Appendix A

Technical Studies

SOLANO WIND ENERGY PROJECT

Wind Project Expansion Assessment

B&V PROJECT NO. 194957
B&V FILE NO. 40.0000

PREPARED FOR

SMUD

Sacramento Municipal Utility District (SMUD)

4 JANUARY 2018

NO	Date	Revision Issue
0	01/04/2017	Final Report

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1.0 Executive Summary

Black & Veatch assessed options for repowering and expansion of the Solano Wind projects in the Montezuma Hills in Solano County, California. This effort included preparation of preliminary project layouts, energy production assessments, conceptual civil and electrical plans, capital and operational cost estimates, and a plan for studying vertical wind profiles on site. It was conducted in two revisions; one preliminary ("Revision 1") and one follow on ("Revision 2"). The focus of Revision 1 was to assess the projects of interest prior to turbine vendor recommendations being provided to SMUD. Revision 2 adds analysis of turbine layouts and energy performance, road plans, collections system designs, and capital cost specific to two additional turbine models recommended by Vestas. For both revisions, the expansion is specific to two areas of the existing Solano Wind development area. Phase 1 is a currently operational installation of turbines owned by SMUD. Black & Veatch evaluated the phase for full repowering of turbines along with possible expansion of the phase to the east. Phase 4 is an opportunity for new development to the southwest portion of the project boundary, west of the operating Phase 3 wind project.

At the start of this effort, SMUD had not committed to any turbine make or model for the expansion. To begin Revision 1, Black & Veatch reviewed several possible turbines for site suitability and expected performance. These turbine options were then reviewed with SMUD and a single option was selected as the assumed turbine make and model until Revision 2 began. All turbine options considered as part of this effort are shown in Table 1-1.

Table 1-1 Options for Turbine Implementation Evaluated

Revision	Make	Model	Capacity (MW)	Hub Height	Rotor Diameter
1	GE Energy	GE2.3-116	2.30	80 m	116 m
1	Vestas	V110-2.0	2.00	80 m	110 m
1 & 2	Vestas	V126-3.45	3.45	87 m	126 m
2	Vestas	V136-4.20	4.20	82 m	136 m
2	Vestas	V150-4.20	4.20	105 m	150 m
1	Siemens	SWT2.3-108	2.30	80 m	108 m

After considering the Revision 1 above options, SMUD elected to assume the future installation of Vestas V126-3.45 turbines at both Phase 1 and Phase 4 for the duration of the revision. Revision 2 warranted additional consideration of Vestas V136-4.20 and Vestas V150-4.20 model turbines. Performance results from Revision 2 included additional loss assumptions beyond the wake losses considered in preliminary Revision 1 assessment. The resulting P50 annual energy production values found for each phase are provided in Table 1-2, Table 1-3, and Table 1-4.

Table 1-2 Vestas V126-3.45 P50 Annual Energy and Net Capacity Factor

Phase	Make	Model	#WTGs	Capacity (MW)	Wake Loss	Net Energy (GWh)	Capacity Factor
Phase 1	Vestas	V126-3.45	8	27.6	12.2%	91.9	38.0%
Phase 1 Addn.	Vestas	V126-3.45	4	13.8	9.0%	46.5	38.4%
Phase 4	Vestas	V126-3.45	13	44.9	10.8%	142.5	36.2%
Total			**25**	**86.3**	**11.0%**	**280.8**	**37.1%**

Table 1-3 Vestas V136-4.20 P50 Annual Energy and Net Capacity Factor

Phase	Make	Model	#WTGs	Capacity (MW)	Wake Loss	Net Energy (GWh)	Capacity Factor
Phase 1	Vestas	V136-4.20	6	25.2	11.2%	81.7	37.0%
Phase 1 Addn.	Vestas	V136-4.20	4	16.8	12.1%	52.2	35.5%
Phase 4	Vestas	V136-4.20	12	50.4	9.7%	156.9	35.5%
Total			**22**	**92.4**	**10.6%**	**290.8**	**35.9%**

Table 1-4 Vestas V150-4.20 P50 Annual Energy and Net Capacity Factor

Phase	Make	Model	#WTGs	Capacity (MW)	Wake Loss	Net Energy (GWh)	Capacity Factor
Phase 1	Vestas	V150-4.20	5	21.0	8.0%	79.4	43.2%
Phase 1 Addn.	Vestas	V150-4.20	4	16.8	8.9%	61.7	41.9%
Phase 4	Vestas	V150-4.20	10	42.0	8.1%	151.0	41.0%
Total			**19**	**79.8**	**8.3%**	**292.1**	**41.8%**

With three viable turbine models and layouts for each aspect of the expansion known, Black & Veatch moved to conceptual designs of the major components of civil and electrical works at each phase and for each Revision 2 turbine option. Preliminary access road routes were prepared based on the developed turbine layouts, site terrain, environmental features, and existing infrastructure. Cost considerations were made for both required road distances and complexity of implementation when traversing complex terrain. Existing Phase 1 roads were utilized where practical, though some sections were considered too steep for delivery of large turbines.

Collection system design at Phase 1 focused on two options. The first option was to use the existing 21.6kV overhead line to Russell substation, while the second option was to install a new 34.5kV underground line to Russell 3 substation. Option 2 was determined to be the most feasible implementation and was considered the preferred choice for all Revision 2 designs. Black & Veatch also reviewed the options for the Phase 4 collection system and found that using the underground collection cable and existing feeder plus installing two new circuits to be the most economical option considering electrical limitations of the existing infrastructure.

The substation review revealed that minor work will need to be completed at Russell 3 Substation in order to accommodate the collection system options outlined above. The nature of

this minor work at Russell 3 Substation is detailed in Section 5.3. No additional work is required at Russell Substation for all options.

Following the conceptual design of each phase and for each Revision 2 turbine layout of the Solano Wind expansion, Black & Veatch completed cost estimates of implementation. This estimate excluded turbine procurement costs but did include decommission costs incurred through the repowering of Phase 1. The estimated total costs of engineering, procurement, construction (EPC) are provided below in Table 1-5.

Table 1-5 Estimated Costs of Implementation for Selected Turbine Models

Category	V126-3.45	V136-4.20	V150-4.20
Phase 1 Decommissioning	$1,219,000	$1,219,000	$1,219,000
Substation and Interconnection	$45,000	$45,000	$45,000
BOP	$23,371,833	$23,783,437	$22,930,798
Wind Turbines - NOT INCLUDED	$0	$0	$0
TOTAL PROJECT	**$24,635,833**	**$25,047,437**	**$24,194,798**

These values assume that repower and expansion of Phase 1 will occur concurrently with new construction of Phase 4.

Black & Veatch additionally prepared a 10-year cost estimate of operations and maintenance ("O&M") of the expansion portion of the project. The estimate was informed by existing agreements for Solano Wind 3, provided by SMUD and tailored by Black & Veatch according to industry experience. It was completed prior to the additional consideration of Vestas V136-4.20 and V150-4.20 turbines and focuses solely on the Vestas V126-3.45 turbine option. The primary results of this estimate are provided in Table 1-6 below.

Table 1-6 Operating Cost Estimate of Vestas V126-3.45 Layout

Year	Total Cost	$/kW-yr
1	$1,500,000	$17,390
5	$1,624,000	$18,830
10	$2,977,000	$34,520
Cumulative 10 Year Total	**$22,118,000**	**$25,650**

The project area of Solano Wind is moderately complex with variably arranged ridgelines rising 15 to 30 meters above the site average elevation. It has been SMUD's experience of the duration of operation of Solano Wind that wind patterns tend to be affected by the complexity of the local terrain in ways not easily explained intuitively. It was requested, as a final effort in the Revision 1 scope of work, that assistance be provided in designing a study aimed at measuring these wind patterns. A study design is provided in Section 7.0. It provides recommendations to SMUD for conducting a study of vertical wind speed profiles by use of remote sensing technology at various ridgeline locations across the expansion area. The intention is for unique and identifiable patterns to emerge depending on sensor location and ridgeline orientation.

2.0 Introduction

This report is presented by Black & Veatch as a summary of the recent two-part study of a possible expansion to the existing Solano Wind project, prepared for the Sacramento Municipal Utility District (SMUD). The primary purpose of this study was to prepare conceptual designs and cost estimates for repowering of the existing Phase 1 of Solano Wind and of the new construction of a new Phase 4. This effort required the development of preliminary layouts for each phase and the subsequent evaluation of the potential performance of the project using turbine technologies from several wind turbine suppliers. Three final turbine model options were then selected by SMUD and conceptual designs of site access roads, collection systems, and substation upgrades were completed. The sections to follow detail the Black & Veatch effort to provide SMUD with potential options for repower and expansion turbines, assist SMUD with the selection of the most likely options, and design conceptual EPC plans for implementation.

2.1 KEY ASSUMPTIONS AND STUDY LIMITATIONS

- Black & Veatch reviewed several potential wind turbine models based on current industry models and vendor recommendations as they apply to the specific wind patterns at Solano Wind. Changes to technologies offered by wind turbine suppliers in the future may have an impact on estimated annual energy production values (AEP).
- Performance based results contained herein are based on the assumption of use of Vestas V126-3.45 model turbines with 87 m hub heights, Vestas V136-4.20 model turbines with 82 m hub heights, or Vestas V150-4.20 model turbines with 105 m hub heights at expansion area locations. Changes to the selected model turbines or their locations will invalidate the applicability of performance results presented herein.
- No future development or repowering of surrounding wind projects was considered. If there is wind farm development in the vicinity of the Solano Wind project, then there may be a potential impact on the estimated AEP.
- Black & Veatch has assessed the provided information for accuracy and completeness. However, errors in the supplied information may affect the findings of this assessment.

3.0 Preliminary Performance Assessment

3.1 SITE DETAILS

Solano Wind consists of three project phases located in the Montezuma Hills in Solano County, California. The site is approximately 36 miles southwest of Sacramento, California. Montezuma Hills is a well-known and heavily developed wind area, and the Solano site is adjacent to several existing projects including Shiloh Wind 1 – 4, Montezuma Wind 1 & 2, High Winds Energy, and the EnXco 5 RePower. This study considers a potential repowering and expansion of Phase 1 of Solano Wind, at the eastern end of the project area, and potential development of a new Phase 4 at the southwestern end of the area.

3.2 SITE TOPOGRAPHY

The site consists of moderately sized ridgelines of varying rise and orientation. The elevation within the Solano Wind boundary averages approximately 35 meters, with ridgeline elevations averaging approximately 55 meters. Ridgelines are present within both the Phase 1 and Phase 4 areas. The vegetation consists mostly of grazing land with grass cover, and is largely barren of trees and other structures that might block the wind, with the exception of existing wind turbines. Areas of wetlands and ponds are located south of the project area, but away from the locations anticipated to be useful for turbine siting.

3.3 FACTORS AFFECTING SITE WIND SPEEDS

3.3.1 Surface Roughness

As the wind moves across the ground surface obstacles such as vegetation or structures impede its flow, reducing velocity of the wind through the lowest levels of the surface boundary layer. The surface roughness length is an indirect measure of this frictional effect. While surface roughness is expressed as a dimension of length, it is not a direct measure of the size of the object. Surface roughness length is a scalar value that characterizes the roughness of the ground terrain (including obstacles) which has an effect upon the vertical wind-speed profile. The project site is characterized by mostly short grasses; the corresponding surface roughness length for short grass is generally between 0.01 and 0.04 meters.

3.3.2 Terrain Features

The project is located on rolling terrain, with existing turbines located in higher elevation areas along the ridgelines, which are anticipated to have the greatest local wind resource. The terrain is complex and is typical of this area of California.

3.3.3 Air Density

The mean site elevation across the project area is 35 meters above mean sea-level (AMSL), with a variation of approximately 35 meters across the site. The average site air density was

calculated to be approximately 1.21 kg/m^3, consistent with previous studies in this area of California. The air density calculation is based local area elevation and an assumed air density lapse rate of -0.113 (kg/m^3)/km.

3.4 WIND RESOURCE DATA

Black & Veatch used publicly available wind resource information, along with onsite meteorological (MET) mast data, to prepare the models for estimated wind resource. After review of available MET mast locations as well as existing turbine locations, Black & Veatch determined that greater use could be gained through the use of wind data from the publically available National Renewable Energy Laboratory (NREL) Wind Toolkit as opposed to onsite MET mast data. The basis for this determination was the need to model existing turbines surrounding SMUD phases 1 and 4. Figure 3-1 shows the defined phases of Solano Wind with the locations of existing turbines expected to influence wind flows on new installations.

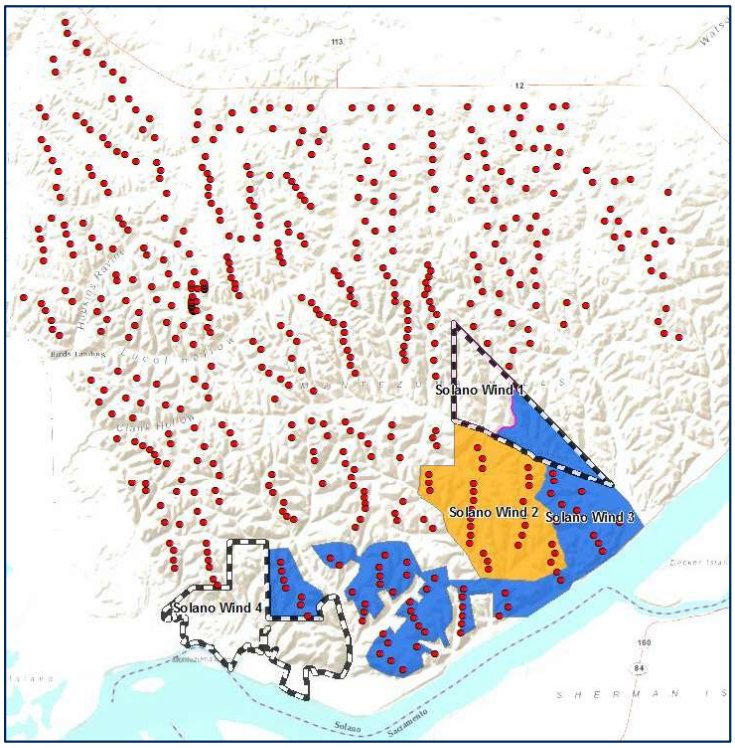

Figure 3-1 Wind turbines External to, but Influencing, Phases 1 and 4

In all, there are 525 turbines standing that may impact future project performance. It can be seen from Figure 3-1 above that the locations of these influencing turbines extend far beyond the boundary of Solano Wind. Use of NREL's Wind Toolkit dataset allows for full and consistent coverage of both the project area as well as all influencing turbine locations. Black & Veatch additionally considers it necessary to begin analysis with wind resource data uninfluenced by existing turbines in order to identify wake implication specific to particular projects and phases.

3.5 ENERGY PRODUCTION ESTIMATES FOR PRELIMINARY TURBINES

Based on the wind resource data collected from the NREL Wind Toolkit datasets, Black & Veatch estimated the potential energy production for Solano Wind Phases 1 and 4 for each of four scenarios. The intent for these scenarios was not to pinpoint or recommend a specific turbine model for implementation but rather to provide options of reasonably applicable turbine models for SMUD to review. The evaluation of these preliminary scenarios was part one (Revision 1) of the two-part study. Turbines from General Electric, Vestas, and Siemens were considered. Specific turbine models evaluated in Revision 1 are provided below in Table 3-1.

Table 3-1 Revision 1 Turbines Considered for Use in Expansion

Make	Model	Capacity (MW)	Hub Height	Rotor Diameter	Rated Wind Speed	IEC Class*
GE Energy	GE2.3-116	2.30	80 m	116 m	10.0	S
Vestas	V110-2.0	2.00	80 m	110 m	12.0	IIIA
Vestas	V126-3.45	3.45	87 m	126 m	12.0	IIA
Siemens	SWT2.3-108	2.30	80 m	108 m	11.5	IIB

Black & Veatch considered the turbines listed above to adequately encompass a spectrum of reasonable offerings to SMUD from turbine suppliers. This section details the Black & Veatch evaluation of turbines and results provided to Client for consideration prior to selecting final Revision 2 turbine models for further evaluations of performance and implementation.

3.5.1 Layout Development

SMUD provided Black & Veatch with land control boundaries and existing turbine locations. Based on this information and the wind resource data developed and reviewed in the section above, Black & Veatch developed project layouts at Phase 1 and Phase 4, for the GE, Vestas, and Siemens turbine options.

In developing the layouts, Black & Veatch first considered physical, environmental, and property line constraints which govern the available locations for wind turbines, collector lines, access roads, transmission lines, and related project facilities. Noteworthy restrictions applied when planning layouts include a physical limitation eliminating placement of wind turbines on terrain with slopes greater than 8.0 percent. Environmental restrictions considered prevented development near publically available wetland locations and FEMA defined 100 Year Floodplains.

Black & Veatch developed site layouts using Openwind®. Turbine spacing was chosen in view of the rotor diameter of the turbine model and wind resource. The minimum crosswind spacing between turbines is 2.0 rotor diameters. The minimum downwind spacing between rows is 8.0 rotor diameters. The primary wind direction was considered to be 270° which is consistent with measured site and long-term MERRA2 data. Layouts were developed with the aid of the Openwind® optimizer to maximize energy production based on changes in wind resource and wake loss across the site.

3.5.2 Site Climatology

Black & Veatch developed a model of each site wind resource utilizing Openwind®, a wind farm design software package developed by AWS Truepower. The Openwind® model develops site specific climatological conditions to estimate generation at the wind plant. Openwind® was used to derive wind resource grids, which provide a model for the varying wind resource across each unique site in the Portfolio. Wind resource grids are derived from representative site specific meteorological mast data. Background surface roughness values, based on observed land cover from the United States Geological Survey National Land Cover Dataset, were applied in the model according to terrain types. OpenWind® was then used to calculate wind resource grids at the respective hub heights of turbines present within and around the Solano Wind Boundary.

3.5.3 Wake Modeling

Black & Veatch also used Openwind® for wake modeling and project performance estimates. A wake model is used to determine the changes to the ambient wind speeds due to the effects of surrounding turbines at each turbine location within a wind farm. There are two available wake models in Openwind®, the Modified PARK model and the Eddy Viscosity model. Unlike the PARK wake model, the Eddy Viscosity model does not assume a linear wake expansion. Instead, it utilizes a two dimensional Computational Fluid Dynamics (CFD) calculation that employs a finite-difference solution of the Navier-Stokes equations for thin shear layers. Consideration of turbine-to-turbine wake losses makes the Eddy Viscosity model more accurate than the Modified PARK model. For this reason, Black & Veatch employed the Eddy Viscosity model to calculate the effective wind speeds and turbulence intensity for each turbine location for the energy production analyses.

3.6 PRELIMINARY ESTIMATE RESULTS

Table 3-2 Performance Results of Preliminary Screening

Phase	Make	Model	#WTGs	Phase Capacity (MW)	Wake Loss	Net Energy (GWh)*	Capacity Factor*
1	Vestas	V110-2.0	13	26.0	8.6%	113.0	50.0%
1	GE	GE2.3-116	13	29.9	9.1%	126.9	48.4%
1	Vestas	V126-3.45	12	41.4	10.0%	158.5	43.7%
1	Siemens	2.3-108	14	32.2	10.5%	130.7	46.3%
4	Vestas	V110-2.0	14	28.0	7.5%	116.8	47.6%
4	GE	GE2.3-116	14	32.2	8.1%	129.4	45.9%
4	Vestas	V126-3.45	13	44.9	9.1%	164.2	41.8%
4	Siemens	2.3-108	17	39.1	10.2%	146.8	42.8%

* Estimation Includes Array Efficiency Losses Only. Additional Losses ≈ 12% are Realistic

4.0 Final Performance Assessment

4.1 SCENARIO SELECTION FROM PRELIMINARY ESTIMATES

After review of the portfolio of options provided above in Table 3-2, SMUD selected the Vestas V126-3.45 model turbine as the option of choice. The selection was predicated on the perceived net benefit of maximizing energy production while minimizing the number of turbines. A Vestas model selection is likely to additionally provide simplicity to SMUD given existing operations and maintenance agreements with the company. The agreed upon layouts for the Vestas V126-3.45 option are provided below in Figure 4-1 and Figure 4-2.

4.2 ADDITIONAL SELECTIONS BY SMUD REQUEST

Toward the completion of Revision 1, it was recommended to SMUD by Vestas that the following options also be considered for implementation at Solano Phases 1 and 4.

Table 4-1 Revision 2 Turbines Considered for Use in Expansion

Make	Model	Capacity (MW)	Hub Height	Rotor Diameter	Rated Wind Speed	IEC Class*
Vestas	V136-4.20	4.20	82 m	136 m	13.5	IIB
Vestas	V150-4.20	4.20	105 m	150 m	12.0	IIIB

Following the same methodologies described in the sections 3.5.1, 3.5.2, and 3.5.3 above, Black & Veatch evaluated the options available to SMUD for locating these turbines within Solano Phase 1 and 4 boundaries. Adherence to required setbacks, dependent upon total turbine height, became a greater challenge during the siting of these turbines. As a result, it was necessary to reduce the number of turbines installed. The greater turbine capacity of 4.20 megawatts largely negates any negative impacts to the reduction in turbine quantities at each phase..

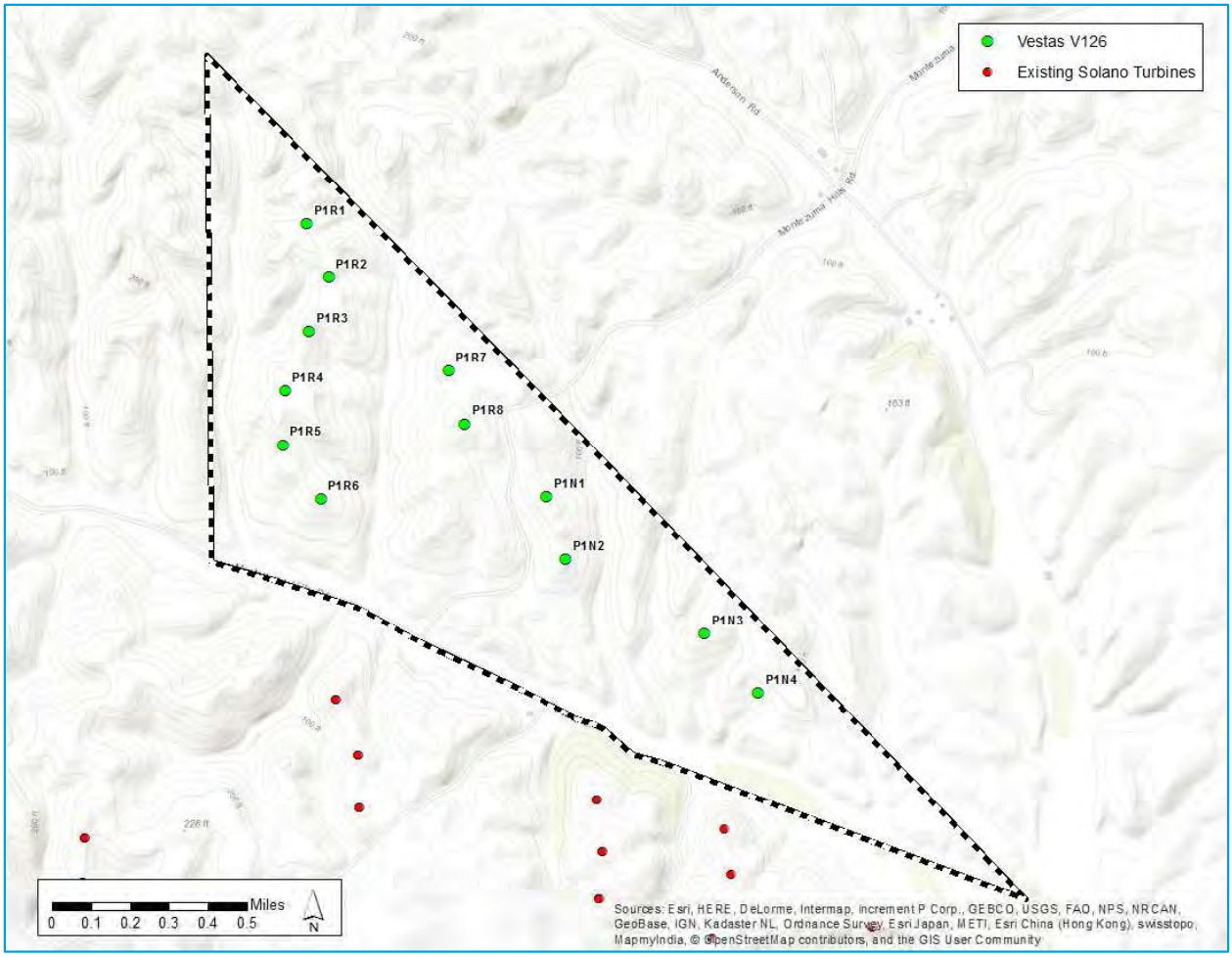

Figure 4-1 Phase 1 Turbine Layout (Vestas V126-3.45)

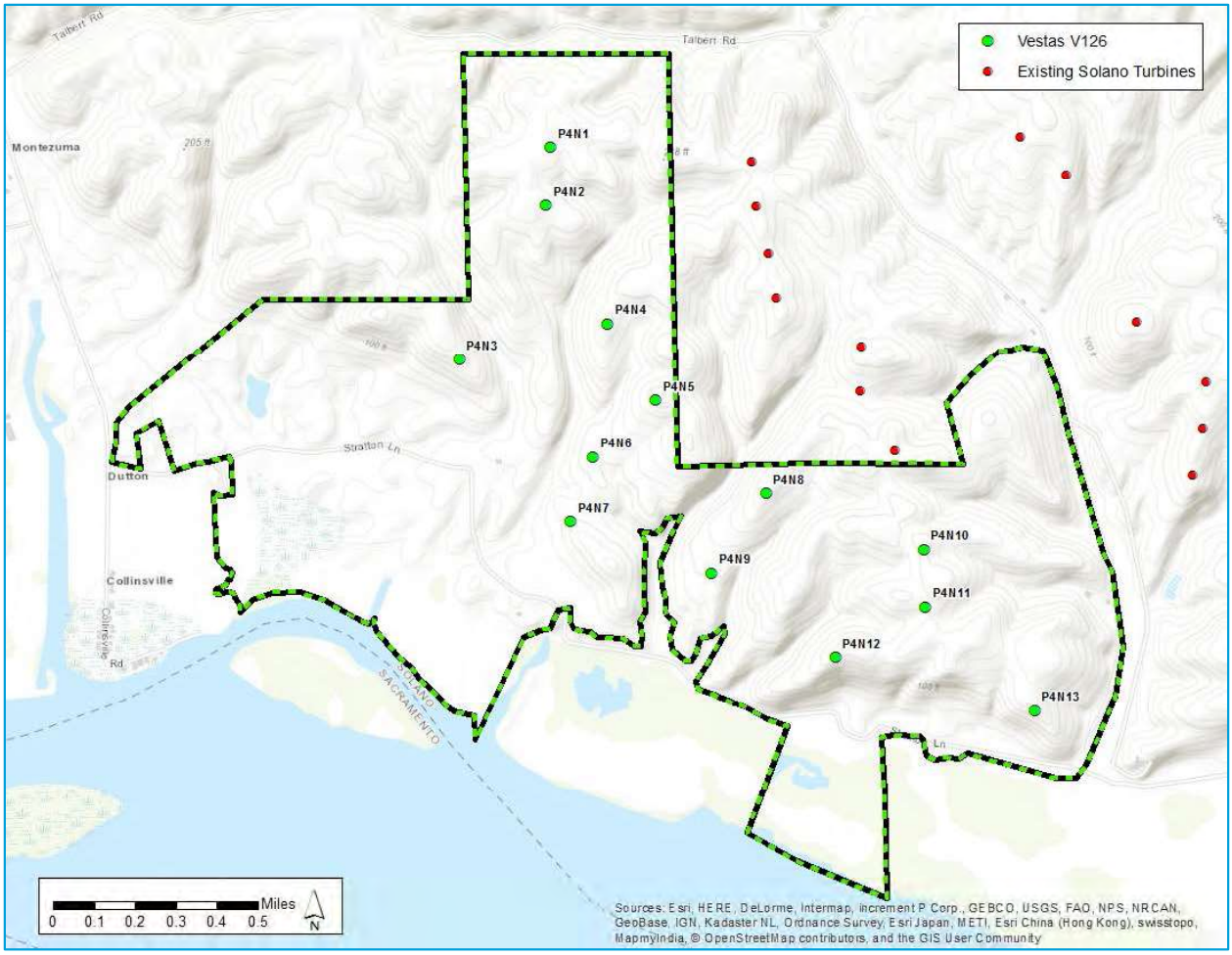

Figure 4-2 Phase 4 Turbine Layout (Vestas V126-3.45)

4.3 ADDITIONAL SELECTIONS BY SMUD REQUEST

Toward the completion of Revision 1, it was recommended to SMUD by Vestas that the following options also be considered for implementation at Solano Phases 1 and 4.

Table 4-1 Revision 2 Turbines Considered for Use in Expansion

Make	Model	Capacity (MW)	Hub Height	Rotor Diameter	Rated Wind Speed	IEC Class*
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Following the same methodologies described in the sections 3.5.1, 3.5.2, and 3.5.3 above, Black & Veatch evaluated the options available to SMUD for locating these turbines within Solano Phase 1 and 4 boundaries. Adherence to required setbacks, dependent upon total turbine height, became a greater challenge during the siting of these turbines. As a result, it was necessary to reduce the number of turbines installed. The greater turbine capacity of 4.20 megawatts largely negates any negative impacts to the reduction in turbine quantities at each phase.

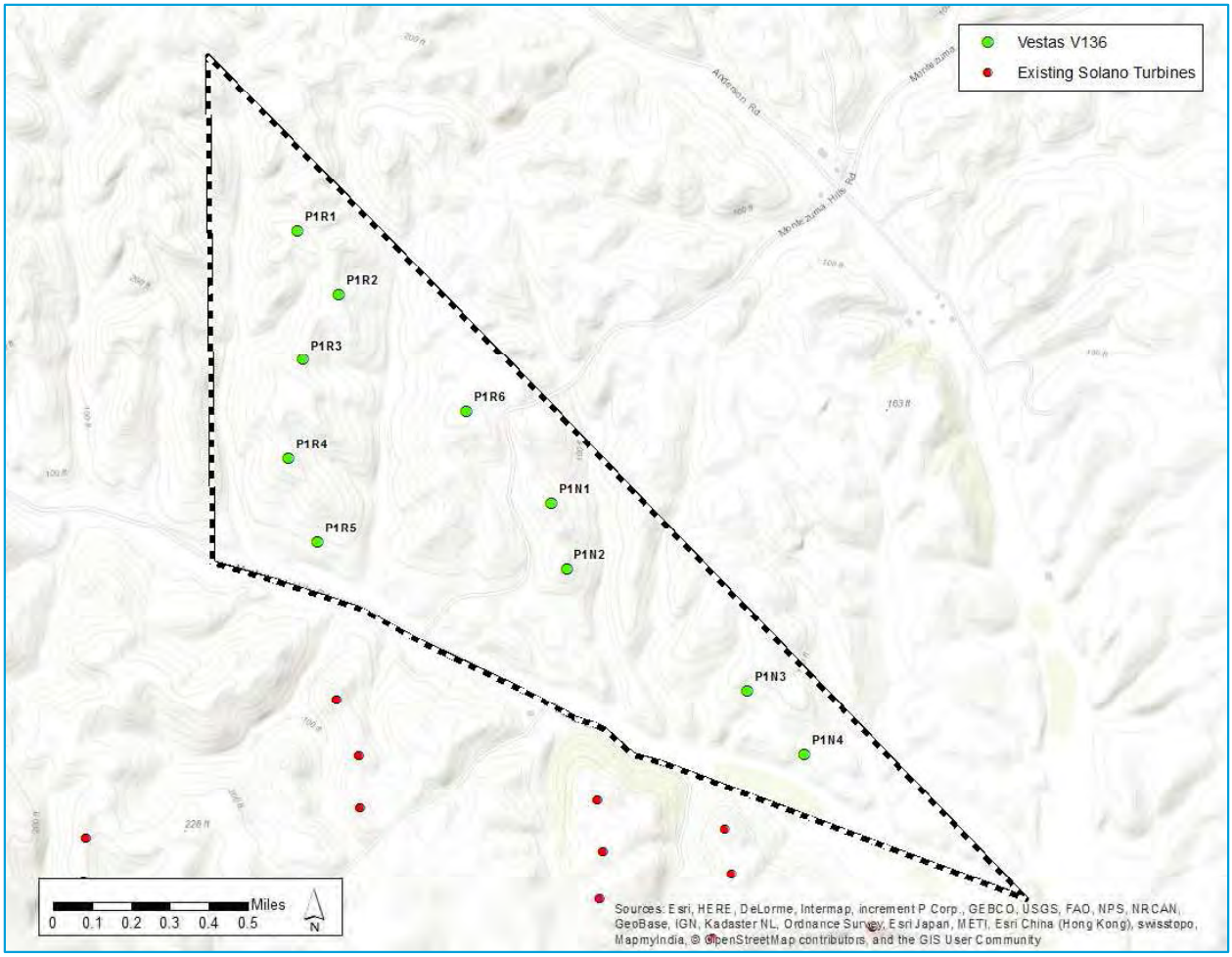

Figure 4-3 Phase 1 Turbine Layout (Vestas V136-4.20)

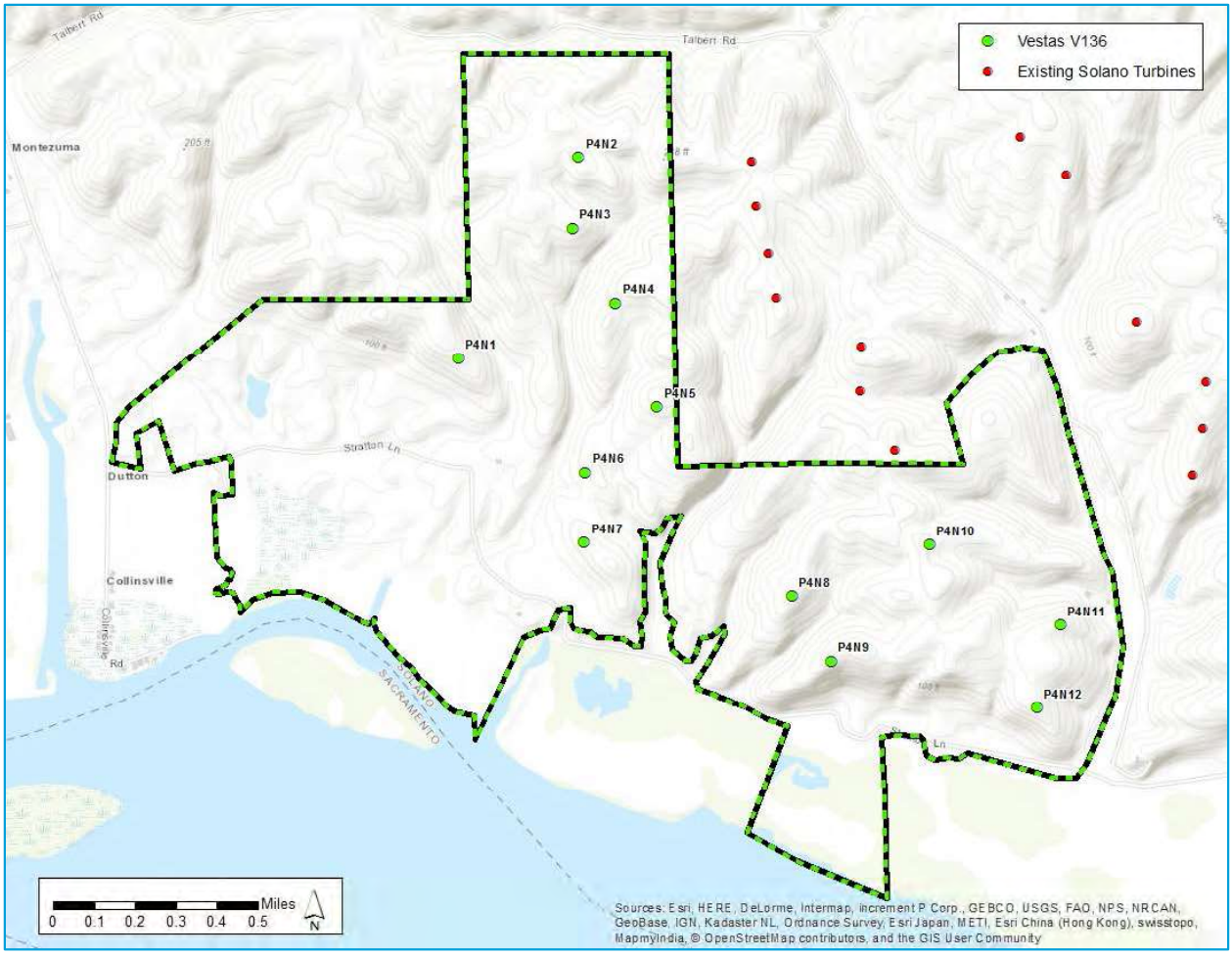

Figure 4-4 Phase 4 Turbine Layout (Vestas V136-4.20)

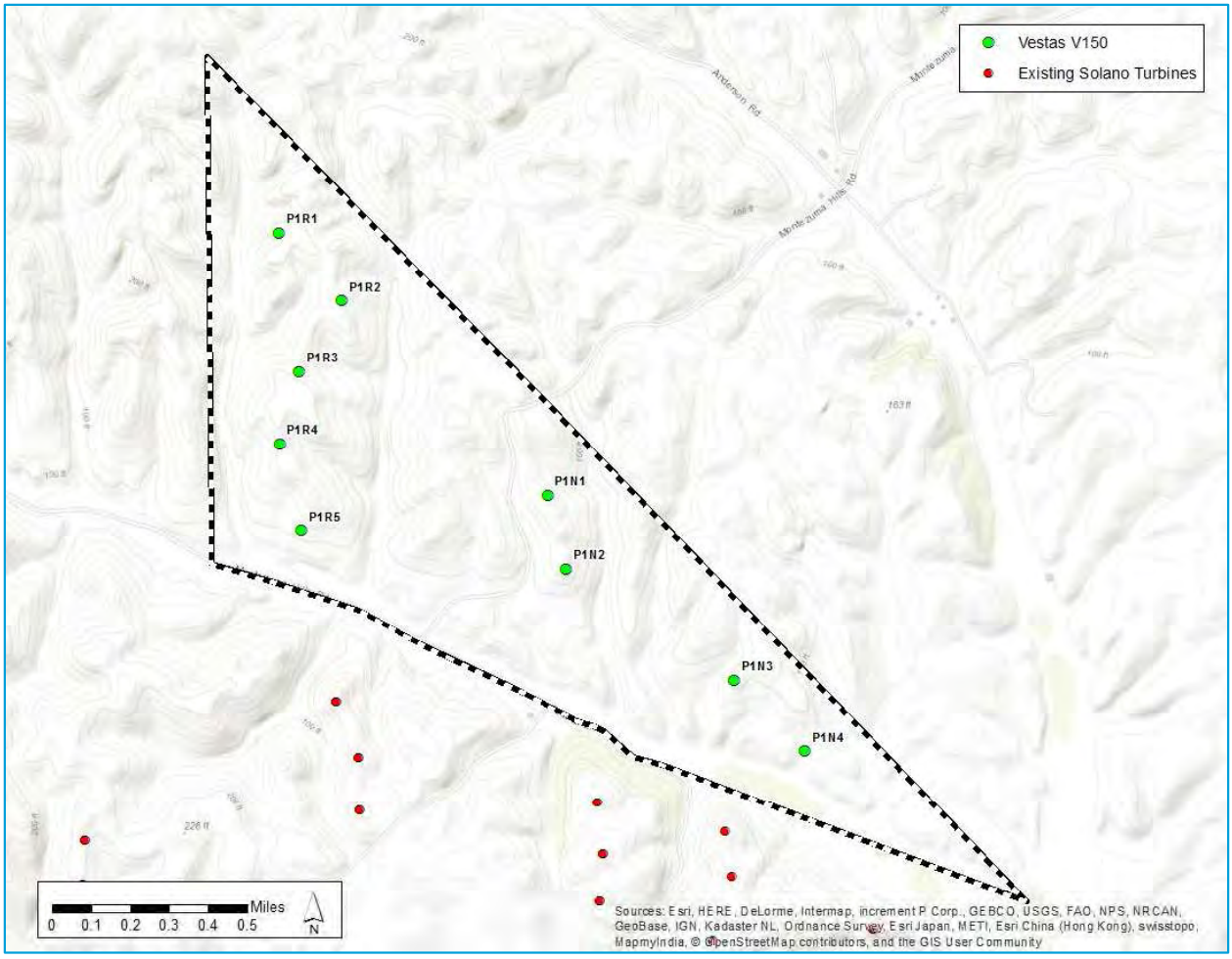

Figure 4-5 Phase 1 Turbine Layout (Vestas V150-4.20)

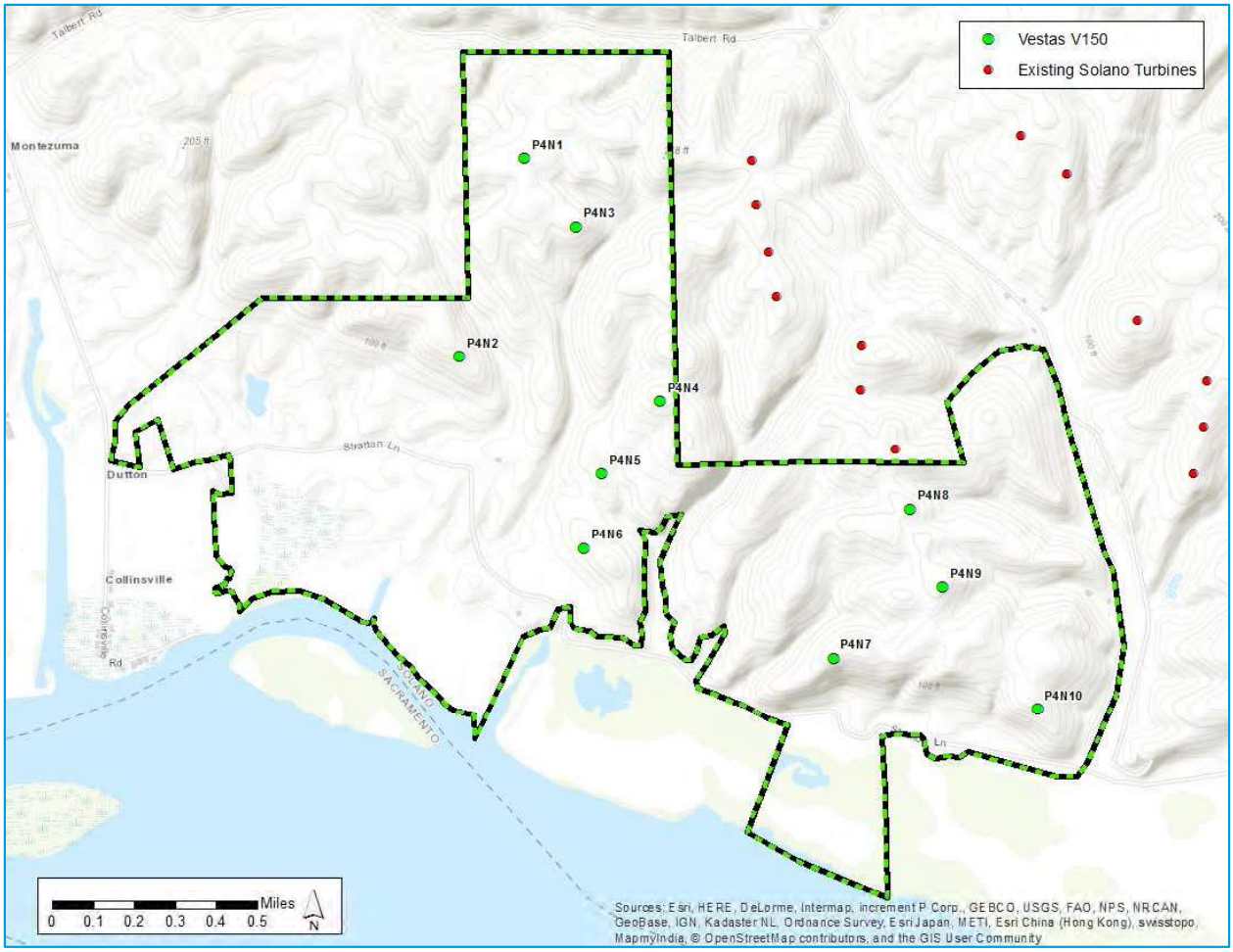

Figure 4-6 Phase 4 Turbine Layout (Vestas V150-4.20)

4.3.1 Additional Losses

Black & Veatch estimated the production losses that could potentially impact wind energy production at the Project site. Losses external to the Project site, including environmental (bird or bat) curtailment, and transmission losses and curtailment beyond the point of delivery were not considered in this analysis. Annual losses are shown in Table 4-2. Black & Veatch considered it reasonable to assume consistent losses, with the exception of Array Efficiency, across all selected turbine models. Losses are discussed in greater detail in Appendix E.

Table 4-2 Annual Energy Efficiency and Losses Applied to Estimates

		Efficiency (%)			Loss (%)		
Parameter	**Project**	**V126**	**V136**	**V150**	**V126**	**V136**	**V150**
Array Efficiency	Phase 1 Repower	87.8	88.8	92.0	12.2	11.2	8.0
	Phase 1 Addition	91.0	87.9	91.1	9.0	12.1	8.9
	Phase 4	89.2	90.3	91.9	10.8	9.7	8.1
Electrical Efficiency	All	97.5			2.5		
Turbine Availability	All	98.0			2		
Environmental	All	98.0			2.0		
Balance of Plant Maintenance	All	99.5			0.5		
Turbine Performance	All	98.0			2.0		
Utility Downtime	All	99.5			0.5		
Power Curve	All	98.0			2.0		
High Wind Hysteresis	All	99.5			0.5		
Wind Sector Management	All	100.0			0.0		
Total	**Phase 1**	**77.8**	**78.7**	**81.5**	**22.2**	**21.3**	**18.5**
Total	**Phase 1 Addn.**	**80.7**	**77.8**	**80.7**	**19.3**	**22.2**	**19.3**
Total	**Phase 4**	**79.0**	**80.0**	**81.4**	**21.0**	**20.0**	**18.6**

4.4 ESTIMATES FOR ANNUAL ENERGY PRODUCTION

The resulting energy and capacity factor estimates for each project site are provided below in Table 4-3, Table 4-4, and Table 4-5. The values were derived from modelling methodology presented in section 3 after the application of additional losses presented in Table 4-2.

Table 4-3 Vestas V126-3.45 P50 Annual Energy and Net Capacity Factor

Phase	Make	Model	#WTGs	Capacity (MW)	Wake Loss	Net Energy (GWh)	Capacity Factor
Phase 1	Vestas	V126-3.45	8	27.6	12.2%	91.9	38.0%
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Total			**25**	**86.3**	**11.0%**	**280.8**	**37.1%**

Table 4-4 Vestas V136-4.20 P50 Annual Energy and Net Capacity Factor

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Phase 4	Vestas	V136-4.20	12	50.4	9.7%	156.9	35.5%
Total			**22**	**92.4**	**10.6%**	**290.8**	**35.9%**

Table 4-5 Vestas V150-4.20 P50 Annual Energy and Net Capacity Factor

Phase	Make	Model	#WTGs	Capacity (MW)	Wake Loss	Net Energy (GWh)	Capacity Factor
Phase 1	Vestas	V150-4.20	5	21.0	8.0%	79.4	43.2%
Phase 1 Addn.	Vestas	V150-4.20	4	16.8	8.9%	61.7	41.9%
Phase 4	Vestas	V150-4.20	10	42.0	8.1%	151.0	41.0%
Total			**19**	**79.8**	**8.3%**	**292.1**	**41.8%**

5.0 Civil and Electrical Design

5.1 SITE ROAD ACCESS

Terrain complexity within the Solano site poses a significant challenge for road routing. These roadways will be utilized for day-to-day project needs but more significantly used for turbine delivery. Roads will need to conform to minimum requirements for turbine delivery, including bearing capacity, width, radius, and incline restrictions. Black & Veatch has prepared preliminary access road routes based on the developed turbine layouts, site terrain, environmental features, and existing infrastructure. Cost considerations were made for both required road distances and complexity of implementation when traversing complex terrain. In order to limit construction costs, existing roads were utilized wherever possible. Road access details for each of the three selected turbine options are detailed below.

Access to Phase 1 was routed from the north via Montezuma Hills Road. Existing Phase 1 roads were utilized where practical, though some sections were considered too steep for delivery of large turbines. Talbert Lane and existing Phase 3 roads were used to access Phase 4. At the direction of SMUD, access to the western edge of the layouts is shown through adjacent property to the north, which is outside of the site boundary provided. Mapped road paths are shown in Figure 5-1 through Figure 5-7.

5.2 COLLECTION SYSTEM – PRELIMINARY ASSESSMENT

Black & Veatch reviewed potential collection system options for the Solano Phase 1 repower and Phase 4 addition. The particular options of interest for Phase 1 were the use of the existing 21.6kV overhead line to Russell substation or to install a new 34.5kV underground line to Russell 3 substation. Black & Veatch also reviewed the options for the Phase 4 collection system and found that using the underground collection cable and existing feeder plus installing two new circuits to be the most economical option while overcoming the electrical limitations. The preliminary collection system assessment was completed under the assumption that Vestas V126-3.45 model turbines are to be installed. Revision 2 collection system recommendations are provided in section 5.3 to follow. The remainder of section 5.2 is dedicated to presenting the Black & Veatch preliminary evaluation of collection system options for Phase 1 and Phase 4, assuming Vestas V126-3.45 model turbines are installed.

5.2.1 Phase 1, Option 1

Option 1 required the installation of new 21.5kV underground circuits with 5 turbines along with the reuse of the existing 21.5kV overhead line to Russell Substation and one new collection circuit with 7 turbines to Russell 3 substation. A map of the option is provided below.

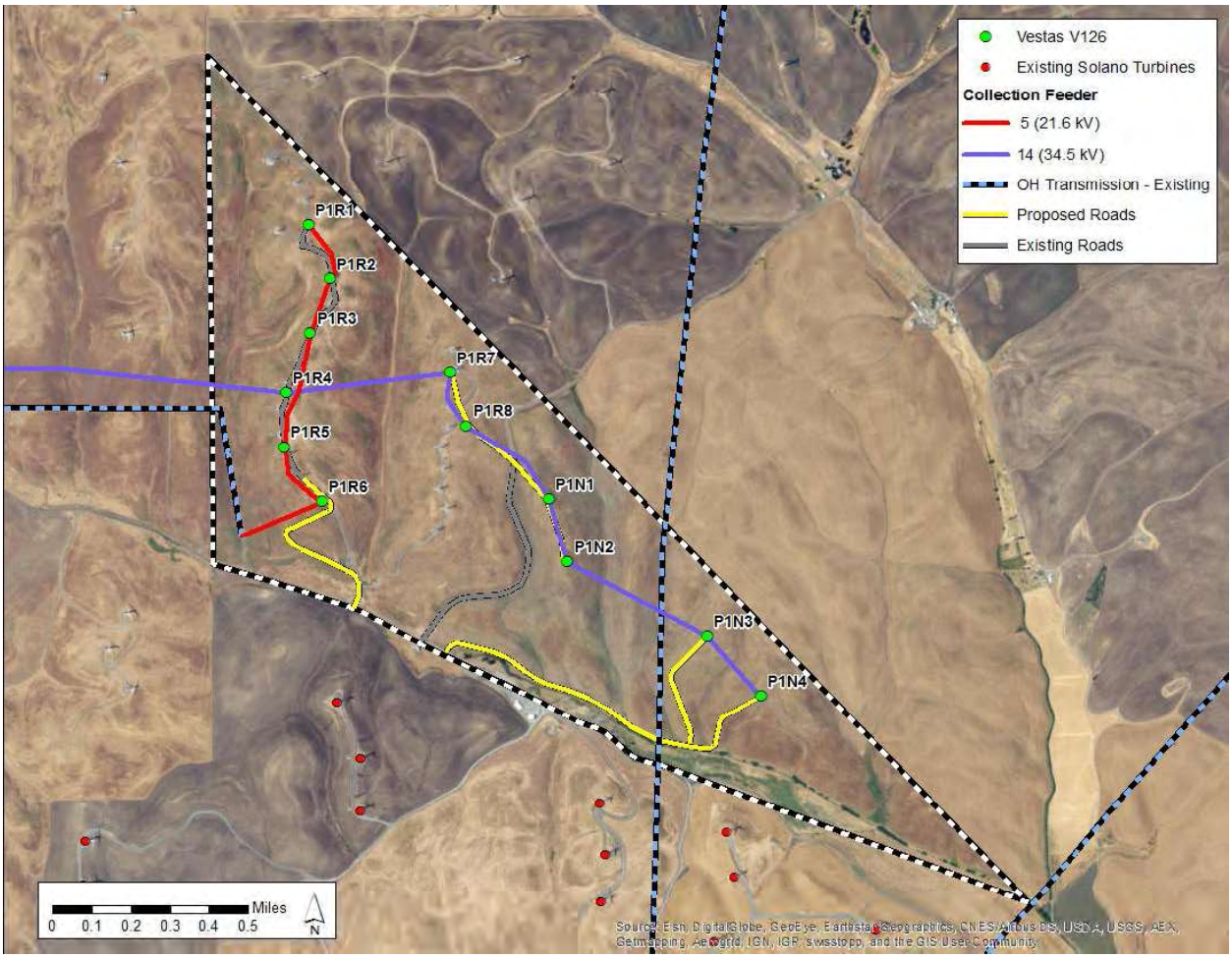

Figure 5-1 Vestas V126-3.45 Phase 1 (Option 1) Road and Collection Routing

5.2.2 Phase 1, Option 2

Option 2 requires that the existing 21.5kV collection system be abandoned and 2 new collection circuits with 6 turbines per circuit be installed with connection to Russell 3 substation. A map of the option is provided below.

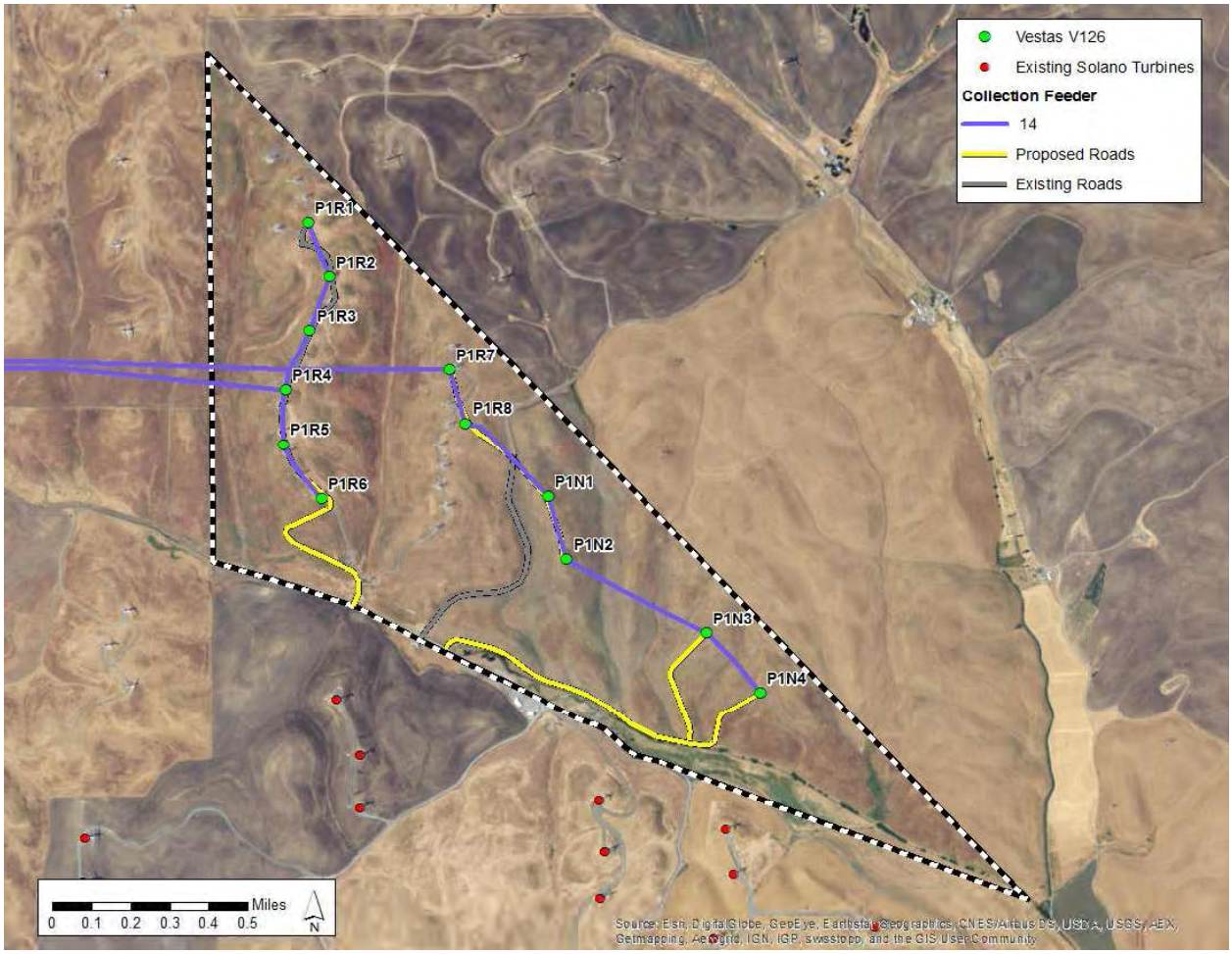

Figure 5-2 Vestas V126-3.45 Phase 1 (Option 2) Road and Collection Routing

5.2.3 Phase 4

Black & Veatch recommends installation of 2 new 34.5kV underground circuits with 4 turbines per circuit to Russell 3 substation for Phase 4. A map of the recommendation is provided below.

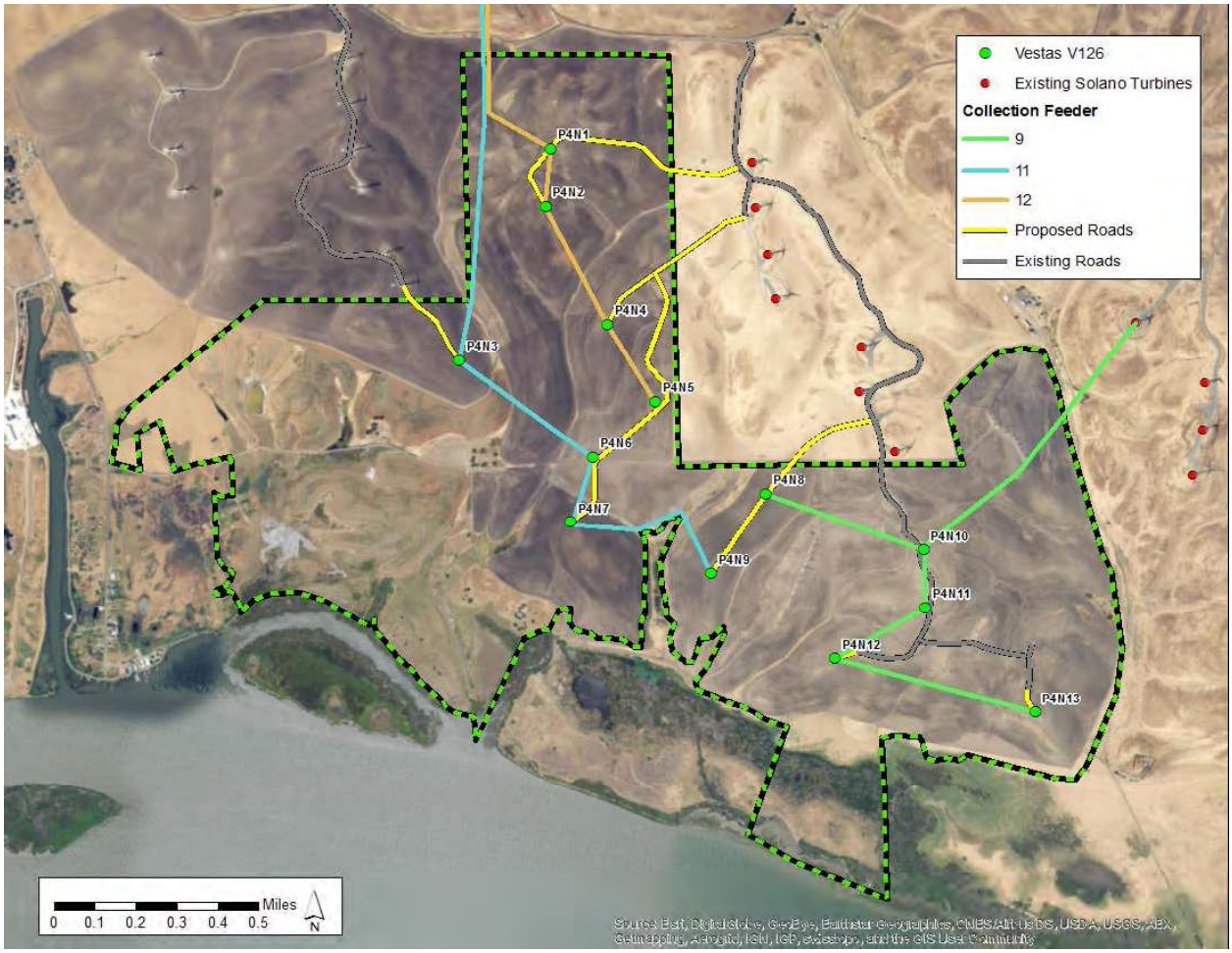

Figure 5-3 Vestas V126-3.45 Phase 4 Road and Collection Routing

Table 5-1 and Table 5-2, in section 5.4, show the electrical capabilities of these potential collection system options.

5.3 COLLECTION SYSTEM – FINAL ASSESSMENT

The addition of the Vestas V136-4.20 and V150-4.20 model options to the selected turbines group for Revision 2 warranted revised collection system assessment for each turbine model. Recommendations for each of the two additional turbine models and for each phase of implementation are detailed below in sections 5.3.1 and 5.3.2

5.3.1 Vestas V136 – 4.20

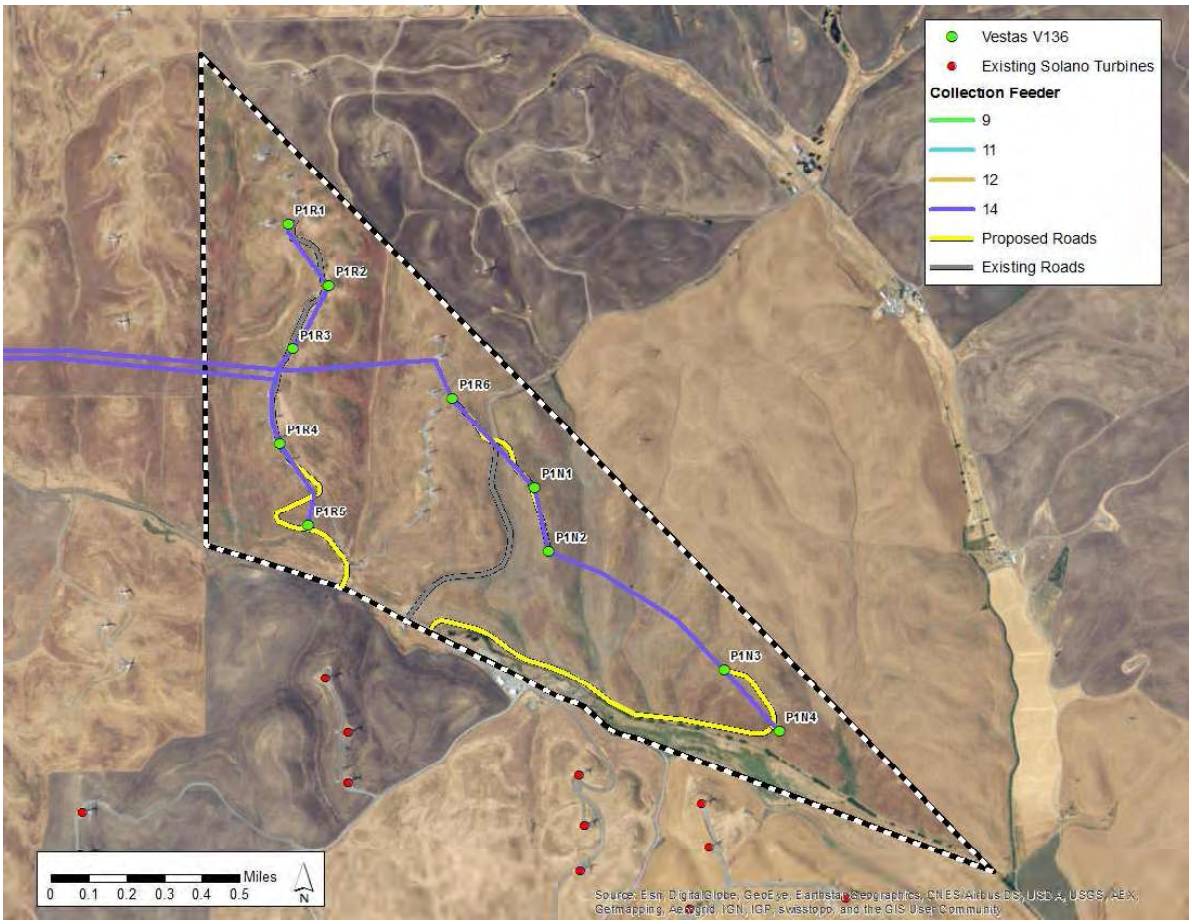

Figure 5-4 Vestas V136-4.20 Phase 1 Road and Collection Routing

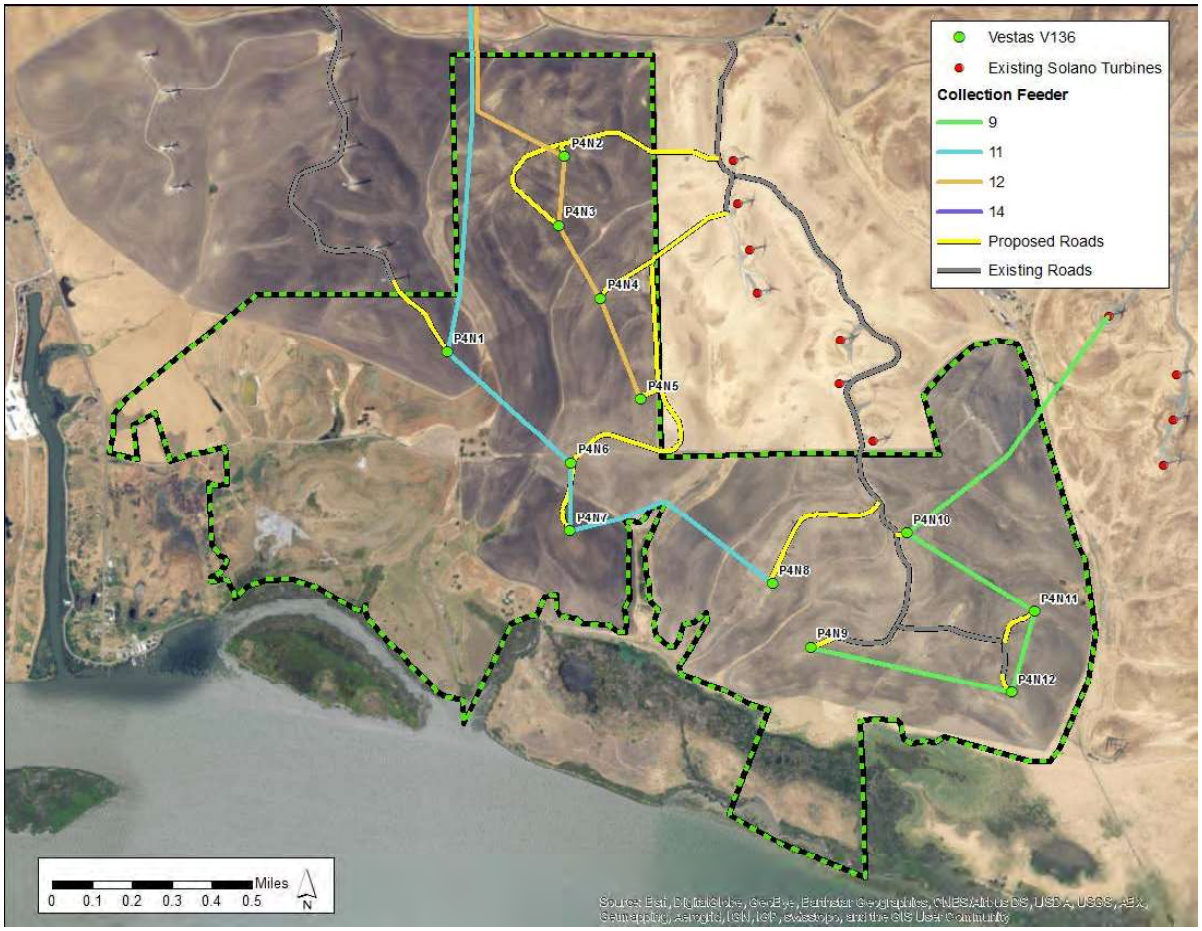

Figure 5-5 Vestas V136-4.20 Phase 4 Road and Collection Routing

5.3.2 Vestas V150 – 4.20

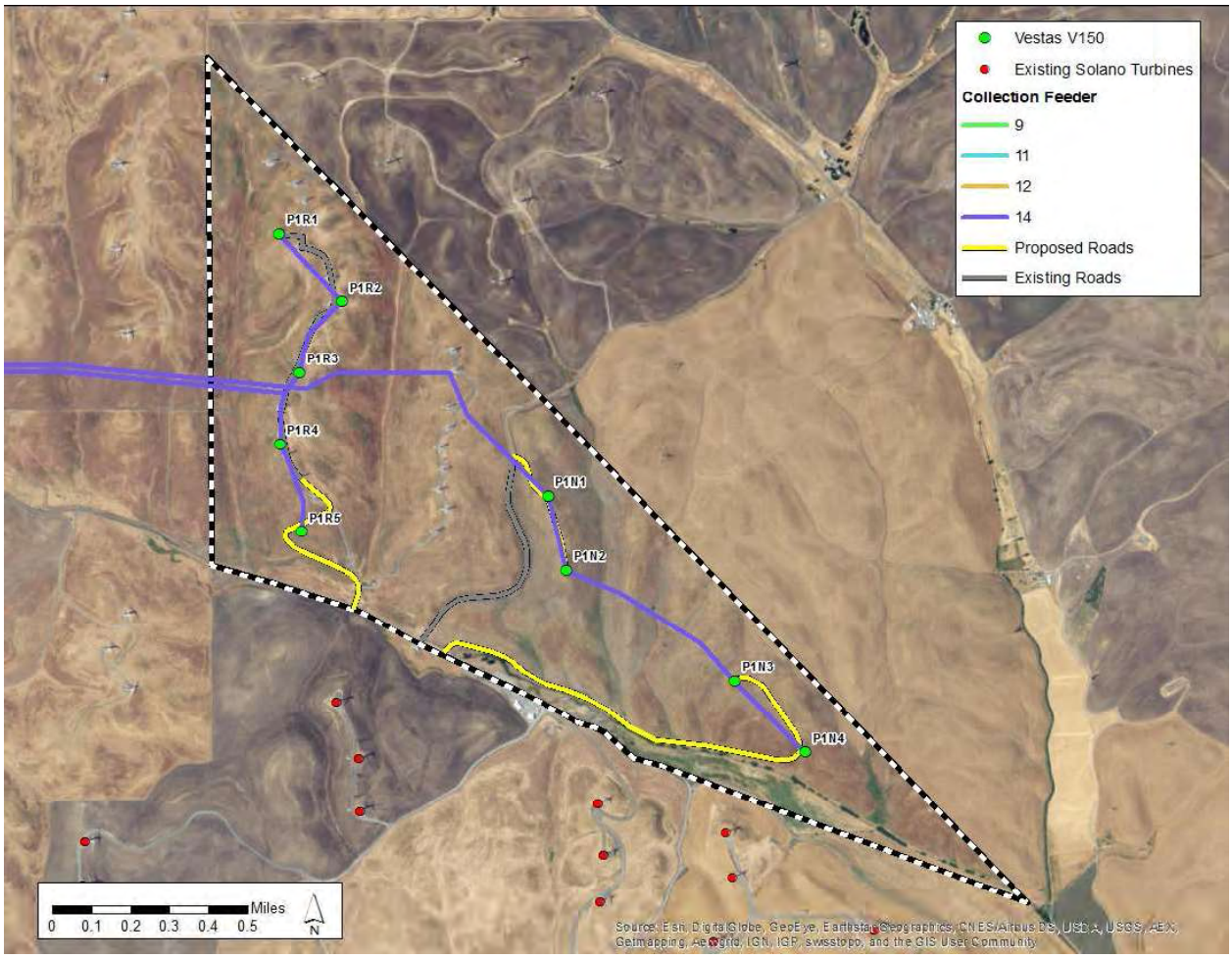

Figure 5-6 Vestas V150-4.20 Phase 1 Road and Collection Routing

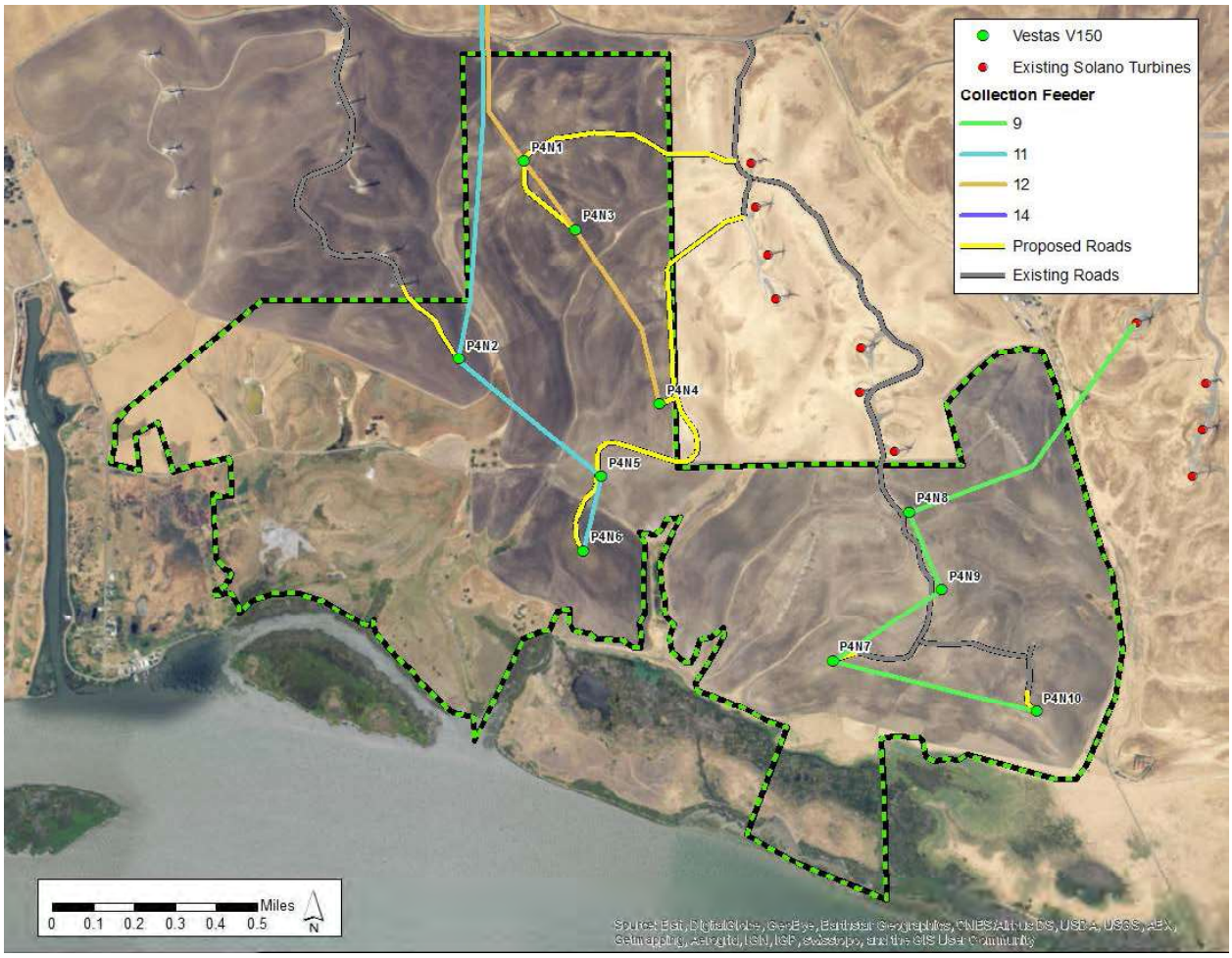

Figure 5-7 Vestas V150-4.20 Phase 4 Road and Collection Routing

Table 5-3 in section 5.4.2 and Table 5-4 in section 5.4.3, show the electrical capabilities of the Vestas V136 and V150 options respectively.

5.4 SUBSTATION

Several factors influenced the collection system conceptual designs including but not limited to substation transformer T2 and T3 ratings and switch ratings. The considerations and results of the three designs are discussed below.

5.4.1 Vestas V126-3.45 Design

The results of Table 5-1 show that transformer T2 shall be sufficient to support a net generation of approximately 104 MW while transformer T3 shall support approximately 197 MW allowing capacity for additional generation. Alternatively, the results of Table 5-2 show that transformer T2 shall support approximately 87 MW allowing capacity for additional generation while transformer T3 shall be sufficient to support a net generation of approximately 214 MW from Phase 1 and Phase 4. Further studies such as reactive power and collection system losses should be

considered during detailed design to more accurately determine the electrical properties of the collection system.

In order to accommodate the collection system options outlined above, minor work will need to be completed at Russell 3 Substation. No additional work is required at Russell Substation for all options. For Phase 1 Repower (Option 1) and Phase 4 Addition, new disconnect switches will need to be installed on the existing riser structure at Feeders 11B and 12B for a total of 6 hook-stick disconnects switches. For Phase 1 Repower (Option 2) and Phase 4 Addition, a new disconnect switch will need to be installed on the existing riser structure at Feeders 11B and 12B as well as an additional disconnect switch at Feeder14B for a total of 9 hook-stick disconnect switches. Option 2 is the presumed option of choice for the remainder of this Report. Refer to Appendix F Collection System and Substations One Line Diagram for further details.

Table 5-1 Vestas V126-3.45 Phase 1 Repower (Option 1) and Phase 4 Addition

SUBSTATION	TRANSFORMER	VOLTAGE (KV)	PHASE	FEEDER	WTG QTY.	WTG MW	ADDITIONAL MW	TOTAL MW
Russell	T2	21.6	1	5	23	0.66	-15.18	104.3
			1	5A	5	3.45	17.25	
Russell 3	T3	34.5	1	14	7	3.45	24.15	196.8
			4	9B	5	3.45	17.25	
			4	11B	4	3.45	13.8	
			4	12B	4	3.45	13.8	

Table 5-2 Vestas V126-3.45 Phase 1 Repower (Option 2) and Phase 4 Addition

SUBSTATION	TRANSFORMER	VOLTAGE (KV)	PHASE	FEEDER	WTGS QTY.	WTG MW	ADDITIONAL MW	TOTAL MW
Russell	T2	21.6	1	5	23	0.66	-15.18	87.0
Russell 3	T3	34.5	1	14A	6	3.45	20.7	214.1
			1	14B	6	3.45	20.7	
			4	9B	5	3.45	17.25	
			4	11B	4	3.45	13.8	
			4	12B	4	3.45	13.8	

5.4.2 Vestas V136-4.20 Design

The results in Table 5-3 show that transformer T2 will have a loading of only 87 MW after removing the existing 660 kW WTG's, leaving additional capacity for future use. T3 will likely have enough capacity to support additional generation from 22 Vestas V136-4.20 WTG's. The net loading on T3 would be approximately 220 MW. Further studies such as reactive power and collection system losses should be considered during detailed design to more accurately determine the electrical properties of the collection system.

In order to accommodate the collection system options outlined above minor work will need to be completed at Russell 3 Substation. No additional work is required at Russell Substation. New disconnect switches will need to be installed on the existing riser structure at Feeders 11B, 12B, and 14B for a total of 9 hook-stick disconnects switches. Refer to Appendix F for further details.

Table 5-3 Vestas V136-4.20 Phase 1 Repower and Phase 4 Addition

SUBSTATION	TRANSFORMER	VOLTAGE (KV)	PHASE	FEEDER	WTGS QTY.	WTG MW	ADDITIONAL MW	TOTAL MW
Russell	T2	21.6	1	5	23	0.66	-15.18	87.0
Russell 3	T3	34.5	4	9B	4	4.20	16.8	220.2
			4	11B	4	4.20	16.8	
			4	12B	4	4.20	16.8	
			1	14A	5	4.20	21	
			1	14B	5	4.20	21	

5.4.3 Vestas V150-4.20 Design

The results in Table 5-4 show that transformer T2 will have a loading of only 87 MW after removing the existing 660 kW WTG's, leaving additional capacity for future use. T3 should have enough capacity to support additional generation from 19 Vestas V136-4.20 WTG's. The net loading on T3 would be approximately 208 MW. Further studies such as reactive power and collection system losses should be considered during detailed design to more accurately determine the electrical properties of the collection system.

In order to accommodate the collection system options outlined above minor work will need to be completed at Russell 3 Substation. No additional work is required at Russell Substation. New disconnect switches will need to be installed on the existing riser structure at Feeders 11B, 12B, and 14B for a total of 9 hook-stick disconnects switches. Refer to Appendix F for further details.

Table 5-4 Vestas V150-4.20 Phase 1 Repower and Phase 4 Addition

SUBSTATION	TRANSFORMER	VOLTAGE (KV)	PHASE	FEEDER	WTGS QTY.	WTG MW	ADDITIONAL MW	TOTAL MW
Russell	T2	21.6	1	5	23	0.66	-15.18	87.0
Russell 3	T3	34.5	4	9B	4	4.20	16.8	207.6
			4	11B	3	4.20	12.6	
			4	12B	3	4.20	12.6	
			1	14A	4	4.20	16.8	
			1	14B	5	4.20	21	

6.0 Capital and O&M Costs

Black & Veatch has estimated the capital cost required for Phase 1 decommissioning and construction of Phases 1 and 4 for each of the three turbine models selected. The high-level cost estimates include the following items:

- Phase 1 Decommissioning
- Civil and Structural Works
- Electrical Works
- Project Indirects
- Substation Upgrades

The baseline cost estimates are assumed to be for the Northern California region, with a strong union work force and high labor rates. Turbines are not included in the cost estimates, nor are owner's costs such as permitting, legal fees, owner's engineering, and various other internal expenses. Additional assumptions include:

- A permanent met tower is not required
- No existing laydown/storage facilities are available
- A Patrick & Henderson foundation will be used
- Upgrades including road and curve widening and resurfacing will be required for existing access roads used for Phase 1 & Phase 4
- Each collection circuit is conservatively assumed to consist of 50% 1250 kcmil, 25% 750 kcmil, and 25% 4/0 cables
- Decommissioned Vestas V47 turbines will have no resale value, only salvage value
- Phase 1 decommissioning and Phase 1 and Phase 4 construction will be concurrent, so that single mobilization and demobilization is required

Appendix B provides itemized cost estimates for Phase 1 decommissioning, expansion balance of plant costs, and expansion substation and interconnection costs for each selected turbine model. These cost estimates are high level, with an accuracy of approximately +/- 30 percent. Accuracy estimations are further detailed in Appendix C. The summations of the estimated costs for option 1 of Phase 1 and Phase 4, for each selected turbine model, are provided by Table 6-1 below.

Table 6-1 Estimated Costs of Implementation for Selected Turbine Models

Category	Total Cost		
	V126-3.45	V136-4.20	V150-4.20
Phase 1 Decommissioning	$1,219,000	$1,219,000	$1,219,000
Substation and Interconnection	$45,000	$45,000	$45,000
BOP	$23,371,833	$23,783,437	$22,930,798
Wind Turbines - NOT INCLUDED	$0	$0	$0
Total Project	**$24,635,833**	**$25,047,437**	**$24,194,798**

6.1 COST ESTIMATION OF OPERATIONS AND MAINTENANCE (O&M)

Black & Veatch also prepared an operating cost estimate for the expansion. Black & Veatch assumed that turbine (WTG) and balance of plant (BOP) O&M services would be covered by a similar contract with Vestas as is currently used for Solano Wind 3. SMUD provided Black & Veatch with summary level details of the current Solano Wind 3 contract. The interpretation of that contract's scope is that it is limited to WTG scheduled & unscheduled maintenance for 15 years, plus BOP service.

The estimate provided below is based on the assumption of similar full scope O&M (excluding BOP) for Phase 1 and Phase 4 using Vestas V126-3.45 turbines. Typical service costs are estimated on a per-machine basis based on known industry average costs, but escalation and BOP service fees incorporate the existing Solano 3 O&M contract information as well. The resulting baseline values are shown in Table 6-2 below.

Table 6-2 Estimated Components Contributing to Annual Operating Cost

Parameter	Value	Unit
10 YEAR SERVICE & MAINTENANCE CONTRACT (WTG Vendor FOR 25 UNITS)		
Years 1-5	$60,000	wtg/year
Years 6-10	$110,000	wtg/year

* BOP maintenance included
** Estimate excludes certain SMUD internal costs such as utilities, insurance, and environmental monitoring

From the above values, Black & Veatch compiled a 10 year running estimate of annual operating costs. This estimate is show below in Table 6-3.

Table 6-3 Projected Annual Operating Cost of Expansion (Years 1 - 10)

Year	Total Cost	$/MW-yr
1	$1,500,000	$17,390
2	$1,530,000	$17,740
3	$1,561,000	$18,100
4	$1,592,000	$18,460
5	$1,624,000	$18,830
6	$2,750,000	$31,880
7	$2,805,000	$32,520
8	$2,861,000	$33,170
9	$2,918,000	$33,830
10	$2,977,000	$34,520
Total	**$22,118,000**	**$25,650**

Black & Veatch considers the values presented above for the Vestas V126-3.45 in Table 6-2 and Table 6-3 to be the most costly of all turbine models considered as part of Revision 2. Although

O&M costs were not estimated for Vestas V136-4.20 and V150-4.20 turbine layouts, the reduction in turbine quantities relative to those of the V126-3.45 turbine layouts could reasonably be assumed to reduce the O&M costs presented herein.

7.0 Study Recommendation for Vertical Wind Profile

In an effort to better understand the effects of terrain complexity on the vertical wind patterns across the project site, SMUD requested that Black & Veatch assist with designing a study. The objective of this study is to characterize the effect of local terrain on the resulting measurements recorded. This information is of significance to SMUD because it will inform turbine siting tendencies with respect to this region of Solano County in the future as well as reduce uncertainty with respect to extrapolation of MET wind speeds to turbine hub heights.

7.1 RECOMMENDED TECHNOLOGY AND SETUP

This study was conceived with the assumption that a single measurement device will be utilized and moved every three months. It would be ideal for all measurements to be recorded during summer months (April – September); given that analysis shows that these will be the most energetic months. Black & Veatch recommends that measurements are taken through remote sensing technology for the purposes of this campaign. This may be accomplished either using LiDAR technology or SoDAR technology. Both LiDAR and SoDAR technology will allow for this along with dynamic flexibility in selecting measurement heights. Black & Veatch recommends that measurements are recorded across the final turbine selection's rotor at heights of (hub height - blade length), (hub height - blade length/2), hub height, (hub height + blade length/2), and (hub height + blade length).

7.2 RECOMMENDED LOCATIONS AND DURATION

Black & Veatch's review of modelled wind flows across the site indicated that the grade and orientation of terrain features will impact realized wind shear effects. Black & Veatch recommends that SMUD attempt to assess six total locations over a two year period. These locations are provided in Table 7-1 below. Mapped study locations are provided in Appendix D.

Table 7-1 Recommended Locations for Study of Vertical Wind Speed Profiles

Location Number	Longitude	Latitude
1	-121.830674	38.090738
2	-121.822121	38.079207
3	-121.812810	38.078961
4	-121.774548	38.127130
5	-121.766950	38.124418
6	-121.755712	38.116431

It is Black & Veatch's opinion that the sites provided above will adequately provide coverage of both project sites while also accounting for some of the complexity of ridgeline orientation. Review of Phase 1 terrain shows ridges featuring proposed turbines running predominately north and south. Phase 4 feature ridgelines of varying orientations and currently has proposed turbine locations on both ridges running north-south and east-west.

Appendix A. Coordinates of Selected Turbine Options

Appendix A1. Vestas V126-3.45

Table A-1 Vestas V126-3.45 Phase 1 Repower Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P1R1	V126-3.45	87 m	4221170	607441	38.131956	-121.774082	59.51
P1R2	V126-3.45	87 m	4220950	607532	38.129958	-121.773083	58.21
P1R3	V126-3.45	87 m	4220720	607449	38.127963	-121.774063	58.27
P1R4	V126-3.45	87 m	4220480	607351	38.125749	-121.775218	63.24
P1R5	V126-3.45	87 m	4220250	607341	38.123728	-121.775360	57.13
P1R6	V126-3.45	87 m	4220030	607499	38.121684	-121.773595	54.89
P1R7	V126-3.45	87 m	4220560	608028	38.126416	-121.767485	59.33
P1R8	V126-3.45	87 m	4220340	608094	38.124420	-121.766765	61.84

Table A-2 Vestas V126-3.45 Phase 1 Addition Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P1N1	V126-3.45	87 m	4220040	608434	38.121653	-121.762923	51.47
P1N2	V126-3.45	87 m	4219770	608510	38.119295	-121.762095	48.09
P1N3	V126-3.45	87 m	4219470	609087	38.116481	-121.755562	42.92
P1N4	V126-3.45	87 m	4219220	609309	38.114234	-121.753072	26.53

Table A-3 Vestas V126-3.45 Phase 4 Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P4N1	V126-3.45	87 m	4216787	602585	38.093061	-121.830113	71.07
P4N2	V126-3.45	87 m	4216558	602565	38.091008	-121.830374	71.03
P4N3	V126-3.45	87 m	4215954	602226	38.085599	-121.834327	52.33
P4N4	V126-3.45	87 m	4216093	602810	38.086789	-121.827645	61.84
P4N5	V126-3.45	87 m	4215792	602998	38.084056	-121.825549	63.35
P4N6	V126-3.45	87 m	4215572	602751	38.082093	-121.828387	33.55
P4N7	V126-3.45	87 m	4215317	602664	38.079807	-121.829418	28.03
P4N8	V126-3.45	87 m	4215429	603431	38.080728	-121.820661	60.11
P4N9	V126-3.45	87 m	4215114	603217	38.077916	-121.823148	31.42
P4N10	V126-3.45	87 m	4215206	604053	38.078647	-121.813600	62.33
P4N11	V126-3.45	87 m	4214981	604058	38.076624	-121.813574	55.88
P4N12	V126-3.45	87 m	4214780	603705	38.074852	-121.817634	55.24
P4N13	V126-3.45	87 m	4214571	604491	38.072876	-121.808706	45.19

Appendix A2. Vestas V136-4.20

Table A-4 Vestas V136-4.20 Phase 1 Repower Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P1R1	V136-4.20	82 m	4221140	607399	38.131740	-121.774565	62.63
P1R2	V136-4.20	82 m	4220880	607573	38.129339	-121.772626	56.84
P1R3	V136-4.20	82 m	4220610	607422	38.126931	-121.774385	57.76
P1R4	V136-4.20	82 m	4220200	607363	38.123272	-121.775114	59.57
P1R5	V136-4.20	82 m	4219850	607483	38.120118	-121.773797	31.94
P1R6	V136-4.20	82 m	4220390	608101	38.124925	-121.766670	60.15

Table A-5 Vestas V136-4.20 Phase 1 Addition Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P1N1	V136-4.20	82 m	4220010	608452	38.121453	-121.762721	50.48
P1N2	V136-4.20	82 m	4219740	608514	38.118993	-121.762061	47.41
P1N3	V136-4.20	82 m	4219240	609264	38.114350	-121.753589	27.77
P1N4	V136-4.20	82 m	4218970	609499	38.111947	-121.750938	13.94

Table A-6 Vestas V136-4.20 Phase 4 Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P4N1	V136-4.20	82 m	4215960	602221	38.085641	-121.834375	52.64
P4N2	V136-4.20	82 m	4216750	602695	38.092688	-121.828856	70.47
P4N3	V136-4.20	82 m	4216470	602670	38.090181	-121.829187	65.52
P4N4	V136-4.20	82 m	4216170	602840	38.087507	-121.827289	59.38
P4N5	V136-4.20	82 m	4215770	603002	38.083826	-121.825503	62.02
P4N6	V136-4.20	82 m	4215510	602720	38.081526	-121.828756	31.10
P4N7	V136-4.20	82 m	4215230	602716	38.079048	-121.828842	38.16
P4N8	V136-4.20	82 m	4215020	603532	38.077053	-121.819569	58.22
P4N9	V136-4.20	82 m	4214760	603686	38.074714	-121.817854	53.76
P4N10	V136-4.20	82 m	4215230	604076	38.078825	-121.813340	61.29
P4N11	V136-4.20	82 m	4214910	604588	38.075915	-121.807550	48.35
P4N12	V136-4.20	82 m	4214580	604499	38.072979	-121.808606	44.82

Appendix A3. Vestas V150-4.20

Table A-7 Vestas V150-4.20 Phase 1 Repower Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P1R1	V150-4.20	105 m	4221140	607325	38.131710	-121.775408	61.51
P1R2	V150-4.20	105 m	4220860	607586	38.129139	-121.772471	54.92
P1R3	V150-4.20	105 m	4220560	607410	38.126525	-121.774525	56.86
P1R4	V150-4.20	105 m	4220260	607327	38.123845	-121.775516	55.36
P1R5	V150-4.20	105 m	4219900	607418	38.120594	-121.774541	35.25

Table A-8 Vestas V150-4.20 Phase 1 Addition Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P1N1	V150-4.20	105 m	4220050	608436	38.121802	-121.762906	48.67
P1N2	V150-4.20	105 m	4219750	608513	38.119030	-121.762066	47.59
P1N3	V150-4.20	105 m	4219290	609207	38.114823	-121.754220	34.07
P1N4	V150-4.20	105 m	4218990	609499	38.112136	-121.750943	14.81

Table A-9 Vestas V150-4.20 Phase 4 Turbine Coordinates

WTG #	Model	Height	Northing	Easting	Latitude	Longitude	Elev (m)
P4N1	V150-4.20	105 m	4216740	602484	38.092646	-121.831268	73.51
P4N2	V150-4.20	105 m	4215960	602226	38.085651	-121.834317	52.70
P4N3	V150-4.20	105 m	4216470	602685	38.090189	-121.829013	63.36
P4N4	V150-4.20	105 m	4215780	603013	38.083970	-121.825369	30.78
P4N5	V150-4.20	105 m	4215500	602787	38.081430	-121.827991	64.32
P4N6	V150-4.20	105 m	4215200	602717	38.078793	-121.828832	64.86
P4N7	V150-4.20	105 m	4214770	603695	38.074802	-121.817743	54.80
P4N8	V150-4.20	105 m	4215360	603997	38.080033	-121.814218	44.85
P4N9	V150-4.20	105 m	4215050	604122	38.077278	-121.812832	35.24
P4N10	V150-4.20	105 m	4214570	604499	38.072901	-121.808609	65.06

Appendix B. Cost Estimate Details

Appendix B1. Vestas V126-3.45

Table B-2 Vestas V126-3.45 Estimation of Phase 1 Decommissioning Costs

Cost Breakdown	Total Cost	Base Cost	Per	Quantity
DECOMMISSIONING PHASE 1				
Turbines	$1,610,000	$70,000	WTG	23
Foundations	$207,000	$9,000	WTG	23
Roads and crane pads	$161,000	$7,000	WTG	23
Electrical	$138,000	$6,000	WTG	23
Mobilization/ Indirects	$0	$0	Project	0
Salvage Value (no resale)	($897,000)	$40,000	WTG	23
Total Decommissioning	**$1,219,000**			

Table B-3 Vestas V126-3.45 Estimation of Substation and Interconnection Costs

Category	Total Cost	Base Cost	Per	Quantity
SUBSTATION AND INTERCONNECTION				
Phase 1 - Option 2				
Feeder 14 - 1200A Switch	$15,000	$15,000	Each	1
Phase 4				
Feeder 11 - 1200A Switch	$15,000	$15,000	Each	1
Feeder 12 - 1200A Switch	$15,000	$15,000	Each	1
Total Substation/Interconnection	**$45,000**			

Table B-4 Vestas V126-3.45 Estimation of Balance of Plant Costs

Cost Breakdown	Total Cost	Base Cost	Per	Quantity
Balance of Plant - Phase 1				
Civil & Structural Works				
Access Roads - New	$875,991	$67	LF	13,055
Access Roads - Improvements	$102,480	$24	LF	4,200
Public Road Restoration	$250,000	$250,000	Project	1
WTG Site Prep	$541,680	$45,140	WTG	12
Crane Pads	$181,536	$15,128	WTG	12
WTG Foundations	$2,100,000	$175,000	WTG	12
O&M Building	$0	$0	Project	0
Wind Turbine Erection	$1,683,600	$140,300	WTG	12
Met Tower	$0	$0	Project	0
Electrical Works – Option 2				
Cable, junction box, ground, etc.	$2,504,205	$55	LF	45,351
Misc. Cable, Connectors, Etc.	$45,000	$45,000	LS	1
Testing & Commissioning	$145,991	$145,991	LS	1
Balance of Plant - Phase 4				
Civil & Structural Works				
Access Roads - New	$973,621	$67	LF	14,510
Access Roads - Improvements	$446,520	$24	LF	18,300
Public Road Restoration	$250,000	$250,000	Project	1
WTG Site Prep	$586,820	$45,140	WTG	13
Crane Pads	$196,664	$15,128	WTG	13
WTG Foundations	$2,275,000	$175,000	WTG	13
O&M Building	$0	$0	Project	0
Wind Turbine Erection	$1,823,900	$140,300	WTG	13
Met Tower	$0	$0	Project	0
Electrical Works				
Cable, junction box, ground, etc.	$2,481,545	$55	LF	45,119
Testing & Commissioning	$172,428	$162,428	LS	1
Project Indirects				
Misc. Construction Indirects				
Temp. Construction Facilities	$732,000	$732,000	Project	1
Site Mob/Demobilization	$630,852	$630,852	Project	1
Project Indirects				
BOP Engineering & Studies	$1,200,000	$1,200,000	Project	1
Construction Management	$2,440,000	$2,440,000	Project	1
Primary Laydown Area	$732,000	$732,000	Project	1
Total Balance of Plant	**$23,371,833**			

Appendix B2. Vestas V136-4.20

Table B-5 Vestas V136-4.20 Estimation of Phase 1 Decommissioning Costs

Cost Breakdown	Total Cost	Base Cost	Per	Quantity
DECOMMISSIONING PHASE 1				
Turbines	$1,610,000	$70,000	WTG	23
Foundations	$207,000	$9,000	WTG	23
Roads and crane pads	$161,000	$7,000	WTG	23
Electrical	$138,000	$6,000	WTG	23
Mobilization/ Indirects	$0	$0	Project	0
Salvage Value (no resale)	($897,000)	$40,000	WTG	23
Total Decommissioning	**$1,219,000**			

Table B-6 Vestas V136-4.20 Estimation of Substation and Interconnection Costs

Category	Total Cost	Base Cost	Per	Quantity
SUBSTATION AND INTERCONNECTION				
Phase 1				
Feeder 14 - 1200A Switch	$15,000	$15,000	Each	1
Phase 4				
Feeder 11 - 1200A Switch	$15,000	$15,000	Each	1
Feeder 12 - 1200A Switch	$15,000	$15,000	Each	1
Total Substation/Interconnection	**$45,000**			

Table B-7 Vestas V136-4.20 Estimation of Balance of Plant Costs

Cost Breakdown	Total Cost	Base Cost	Per	Quantity
Balance of Plant - Phase 1				
Civil & Structural Works				
Access Roads - New	$813,118	$67	LF	12,118
Access Roads - Improvements	$122,000	$24	LF	5,000
Public Road - Improvements Temp.	$300,000	$300,000	Project	1
Public Road Restoration	$250,000	$250,000	Project	1
WTG Site Prep	$400,000	$40,000	WTG	10
Crane Pads	$120,000	$12,000	WTG	10
WTG Foundations	$1,800,000	$180,000	WTG	10
O&M Building	$0	$0	Project	0
Wind Turbine Erection	$1,850,000	$185,000	WTG	10
Met Tower	$0	$0	Project	0
Electrical Works				
Cable, junction box, ground, etc.	$2,585,825	$55	LF	47,015
Misc. Cable, Connectors, Etc.	$45,000	$45,000	LS	1
Testing & Commissioning	$205,254	$205,254	LS	1
Balance of Plant - Phase 4				
Civil & Structural Works				
Access Roads - New	$1,084,202	$67	LF	16,158
Access Roads - Improvements	$244,000	$24	LF	10,000
Public Road Temporary	$300,000	$300,000	Project	1
Public Road Restoration	$250,000	$250,000	Project	1
WTG Site Prep	$480,000	$40,000	WTG	12
Crane Pads	$144,000	$12,000	WTG	12
WTG Foundations	$2,160,000	$180,000	WTG	12
O&M Building	$0	$0	Project	0
Wind Turbine Erection	$2,220,000	$185,000	WTG	12
Met Tower	$0	$0	Project	0
Electrical Works				
Cable, junction box, ground, etc.	$2,501,455	$55	LF	45,481
Testing & Commissioning	$173,732	$163,732	LS	1
Project Indirects				
Misc. Construction Indirects				
Temp. Construction Facilities	$732,000	$732,000	Project	1
Site Mob/Demobilization	$630,852	$630,852	Project	1
Project Indirects				
BOP Engineering & Studies	$1,200,000	$1,200,000	Project	1
Construction Management	$2,440,000	$2,440,000	Project	1
Primary Laydown Area	$732,000	$732,000	Project	1
Total Balance of Plant	**$23,783,437**			

Appendix B3. Vestas V150-4.20

Table B-8 Vestas V150-4.20 Estimation of Phase 1 Decommissioning Costs

Cost Breakdown	Total Cost	Base Cost	Per	Quantity
DECOMMISSIONING PHASE 1				
Turbines	$1,610,000	$70,000	WTG	23
Foundations	$207,000	$9,000	WTG	23
Roads and crane pads	$161,000	$7,000	WTG	23
Electrical	$138,000	$6,000	WTG	23
Mobilization/ Indirects	$0	$0	Project	0
Salvage Value (no resale)	($897,000)	$40,000	WTG	23
Total Decommissioning	**$1,219,000**			

Table B-9 Vestas V150-4.20 Estimation of Substation and Interconnection Costs

Category	Total Cost	Base Cost	Per	Quantity
SUBSTATION AND INTERCONNECTION				
Phase 1				
Feeder 14 - 1200A Switch	$15,000	$15,000	Each	1
Phase 4				
Feeder 11 - 1200A Switch	$15,000	$15,000	Each	1
Feeder 12 - 1200A Switch	$15,000	$15,000	Each	1
Total Substation/Interconnection	**$45,000**			

Table B-10 Vestas V150-4.20 Estimation of Balance of Plant Costs

Cost Breakdown	Total Cost	Base Cost	Per	Quantity
Balance of Plant - Phase 1				
Civil & Structural Works				
Access Roads - New	$763,330	$67	LF	11,376
Access Roads - Improvements	$122,000	$24	LF	5,000
Public Road - Improvements Temp.	$300,000	$300,000	Project	1
Public Road Restoration	$250,000	$250,000	Project	1
WTG Site Prep	$360,000	$40,000	WTG	9
Crane Pads	$108,000	$12,000	WTG	9
WTG Foundations	$1,755,000	$195,000	WTG	9
O&M Building	$0	$0	Project	0
Wind Turbine Erection	$1,935,000	$215,000	WTG	9
Met Tower	$0	$0	Project	0
Electrical Works				
Cable, junction box, ground, etc.	$2,581,645	$55	LF	46,939
Misc. Cable, Connectors, Etc.	$45,000	$45,000	LS	1
Testing & Commissioning	$204,980	$204,980	LS	1
Balance of Plant - Phase 4				
Civil & Structural Works				
Access Roads - New	$848,345	$67	LF	12,643
Access Roads - Improvements	$244,000	$24	LF	10,000
Public Road Temporary	$300,000	$300,000	Project	1
Public Road Restoration	$250,000	$250,000	Project	1
WTG Site Prep	$400,000	$40,000	WTG	10
Crane Pads	$120,000	$12,000	WTG	10
WTG Foundations	$1,950,000	$195,000	WTG	10
O&M Building	$0	$0	Project	0
Wind Turbine Erection	$2,150,000	$215,000	WTG	10
Met Tower	$0	$0	Project	0
Electrical Works				
Cable, junction box, ground, etc.	$2,345,145	$55	LF	42,639
Testing & Commissioning	$163,500	$153,500	LS	1
Project Indirects				
Misc. Construction Indirects				
Temp. Construction Facilities	$732,000	$732,000	Project	1
Site Mob/Demobilization	$630,852	$630,852	Project	1
Project Indirects				
BOP Engineering & Studies	$1,200,000	$1,200,000	Project	1
Construction Management	$2,440,000	$2,440,000	Project	1
Primary Laydown Area	$732,000	$732,000	Project	1
Total Balance of Plant	**$22,930,798**			

Appendix C. Accuracy Bands of Cost Estimate

Table C-1 Vestas V126-3.45 Bounding Accuracy of Capital Cost Estimate

ESTIMATE ACCURACY	Accuracy Range (-/+)		Low	Base	High
Decommissioning	-30%	30%	$853,300	$1,219,000	$1,584,700
Project Substation	-30%	30%	$31,500	$45,000	$58,500
Balance of Plant	-30%	30%	$16,360,283	$23,371,833	$30,383,382
TOTAL PROJECT	**-34%**	**23%**	**$16,259,650**	**$24,635,833**	**$30,302,075**

Table C-11 Vestas V136-4.20 Bounding Accuracy of Capital Cost Estimate

ESTIMATE ACCURACY	Accuracy Range (-/+)		Low	Base	High
Decommissioning	-30%	30%	$853,300	$1,219,000	$1,584,700
Project Substation	-30%	30%	$31,500	$45,000	$58,500
Balance of Plant	-30%	30%	$16,648,406	$23,783,437	$30,918,469
TOTAL PROJECT	**-34%**	**23%**	**$16,679,906**	**$25,047,437**	**$30,976,969**

Table C-3 Vestas V150-4.20 Bounding Accuracy of Capital Cost Estimate

ESTIMATE ACCURACY	Accuracy Range (-/+)		Low	Base	High
Decommissioning	-30%	30%	$853,300	$1,219,000	$1,584,700
Project Substation	-30%	30%	$31,500	$45,000	$58,500
Balance of Plant	-30%	30%	$16,051,559	$22,930,798	$29,810,037
TOTAL PROJECT	**-34%**	**23%**	**$16,083,059**	**24,194,798**	**$29,868,537**

Appendix D. Recommended Vertical Wind Profile Study Sites

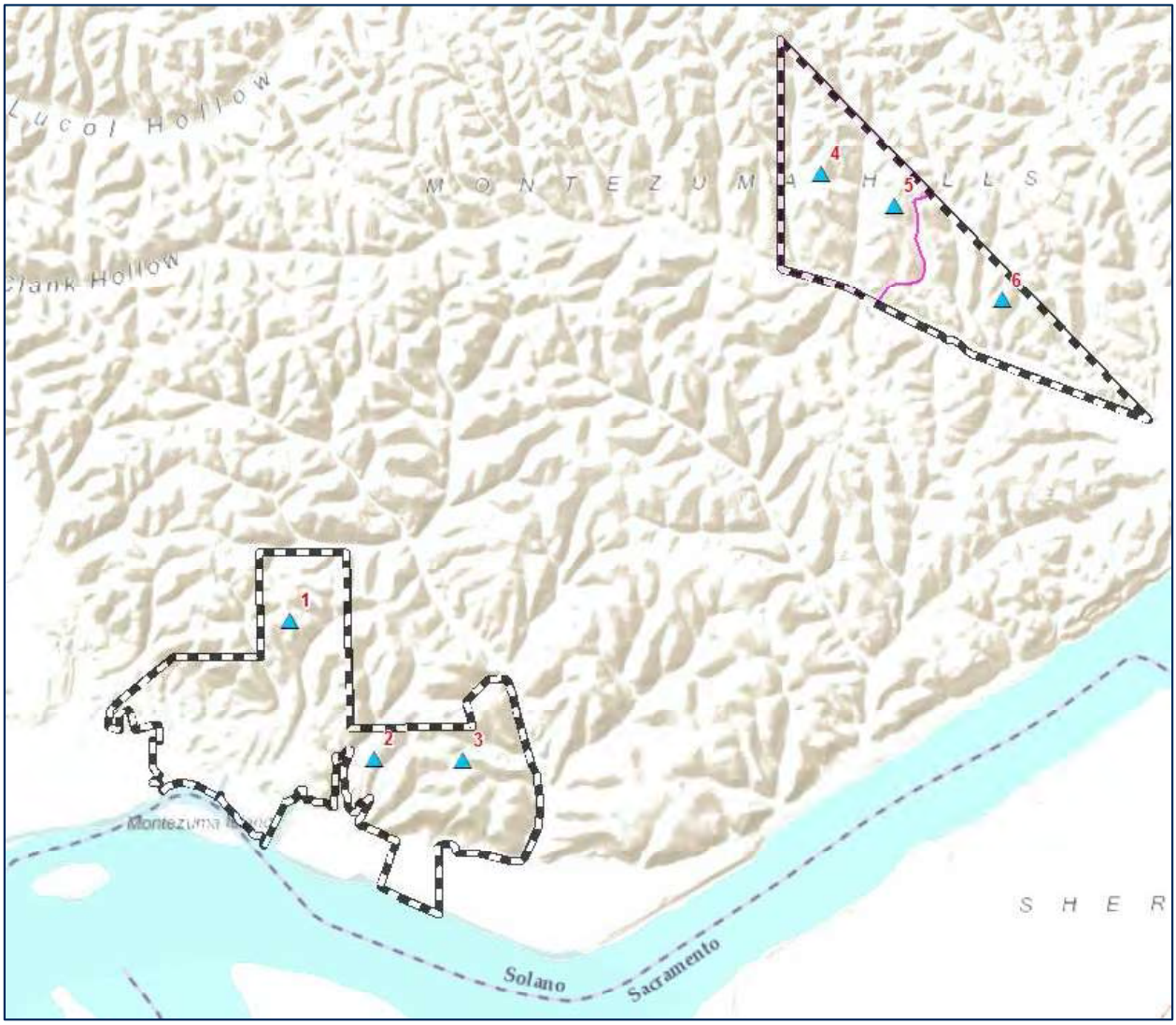

Figure D-1 Recommended Vertical Wind Profile Study Sites

Appendix E. Energy Production Loss Factors

Array Efficiency: This is a calculated value, and part of the output of the wake and energy production model. It represents the ratio of the net to gross energy yield, which only considers calculation of wake losses.

Electrical Efficiency: Losses in the electric collection system and substation prior to the plant's revenue meters are covered by this factor. Points of significant electrical losses in a wind energy project usually include electric collection system lines connecting the turbines to the project substation, the turbine step-up transformers, and the substation's main power transformer.

Turbine Availability: Turbine availability accounts for machine downtime that is either a scheduled or unscheduled outage. This value is typically estimated at 3 to 5 percent. Assumptions for turbine availability are often driven by historical turbine model track record.

Environmental: Wind turbine performance is sensitive to the cleanliness and surface condition of the turbine's blades. The site can contain airborne particulates that may contribute to blade soiling. Blade soiling and blade surface degradation, as well as inclement weather and vegetation growth are considered for this loss.

Balance of Plant (BoP) Maintenance: Substation maintenance requiring the shutdown of the project is assumed to be infrequent, averaging approximately one day out of each year.

Turbine Performance: Turbine performance losses account for sub-optimal performance experienced by turbines, including instrumentation calibration, pitch and yaw errors, and similar sub-optimal operations.

Utility Downtime: Utility downtime accounts for events that require downtime on the part of the utility. These are generally assumed to be infrequent.

Power Curve: The wind turbine manufacturer will warranty a performance level for the turbine at a percentage of the power curve values. Industry experience shows that while wind turbines historically meet power curve warranties when including measurement uncertainty, they often operate slightly under published power curves.

High Wind Hysteresis: When wind speeds exceed the operational range of a wind turbine, the turbine shuts down to protect itself. The turbine then waits to restart until wind speeds fall below a lower restart speed.

Wind Sector Management: Wind sector management is a means of protecting turbines when winds are blowing along the turbine layout direction in which turbines have been given reduced along-wind.

Solano Phase 1 & Phase 4

Westslope - SMUD

Solano County, California

Obstruction Evaluation & Airspace Analysis

July 25, 2018

Capitol Airspace Group

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Summary

Capitol Airspace conducted an obstruction evaluation and airspace analysis for the Solano Phase 1 and Phase 4 wind projects in Solano County, California. The purpose for this analysis was to identify obstacle clearance surfaces established by the Federal Aviation Administration (FAA) that could limit increasing wind turbine heights to 493 feet above ground level (AGL) (black points, ***Figure 1***) and 591 feet AGL (blue points, ***Figure 1***). This analysis assessed height constraints overlying 19 Phase 1 and 22 Phase 4 wind turbine locations as well as an approximately 30 square mile study area (red outline, ***Figure 1***) to determine the likelihood of the FAA issuing favorable determinations of no hazard to 493 and 591 foot AGL wind turbines.

14 CFR Part 77.9 requires that that all structures exceeding 200 feet AGL be submitted to the FAA so that an aeronautical study can be conducted. The FAA's objective in conducting aeronautical studies is to ensure that proposed structures do not have an effect on the safety of air navigation and the efficient utilization of navigable airspace by aircraft. The end result of an aeronautical study is the issuance of a determination of 'hazard' or 'no hazard' that can be used by the proponent to obtain necessary local construction permits. It should be noted that the FAA has no control over land use in the United States and cannot enforce the findings of its studies.

Height constraints overlying the Solano Phase 1 and Phase 4 wind projects are a constant 749 feet above mean sea level (AMSL) and are associated with Northern California (NCT) Terminal Radar Approach Control (TRACON) minimum vectoring altitude sectors. Proposed structures that exceed these surfaces would require an increase to minimum vectoring altitudes. If the FAA determines that this impact would affect a significant volume of operations (as few as one per week), it could result in determinations of hazard.

United States Geological Survey (USGS) elevation data indicates that these surfaces could limit 493 foot AGL wind turbines on higher terrain in the northwestern and central sections of the study area. These surfaces could limit 591 foot AGL wind turbines throughout the study area including five Phase 1 wind turbines (*P1R1:4, P1N1*) and seven Phase 4 turbines (*P4N1:4, P4N7:9*).

This study did not consider electromagnetic interference on communications, navigation, or radar surveillance systems. However, a navigational aid screening surface overlies the northwestern corner of the study area. USGS elevation data indicates that 493 and 591 foot AGL wind turbines proposed in this area will exceed the screening surface. If the FAA determines that the impact on the associated navigational aid would constitute a substantial adverse effect it could result in determinations of hazard regardless of the lack of impact on the other surfaces described in this report.

Methodology

Capitol Airspace studied the proposed projects based upon location information provided by Westslope Consulting. Using this information, Capitol Airspace generated graphical overlays to determine proximity to airports (***Figure 1***), published instrument procedures, enroute airways, FAA minimum vectoring altitude and minimum instrument flight rules (IFR) altitude charts, as well as military airspace and training routes.

Capitol Airspace evaluated all 14 CFR Part 77 imaginary surfaces, published instrument approach and departure procedures, visual flight rules operations, FAA minimum vectoring altitudes, minimum IFR altitudes, and enroute operations. All formulas, headings, altitudes, bearings and coordinates used during this study were derived from the following documents and data sources:

- 14 CFR Part 77 Safe, Efficient Use, and Preservation of the Navigable Airspace
- FAA Order 7400.2L Procedures for Handling Airspace Matters
- FAA Order 8260.3D United States Standard for Terminal Instrument Procedures
- FAA Order 8260.58A United States Standard for Performance Based Navigational (PBN) Instrument Procedure Design
- United States Government Flight Information Publication, US Terminal Procedures
- National Airspace System Resource Aeronautical Data

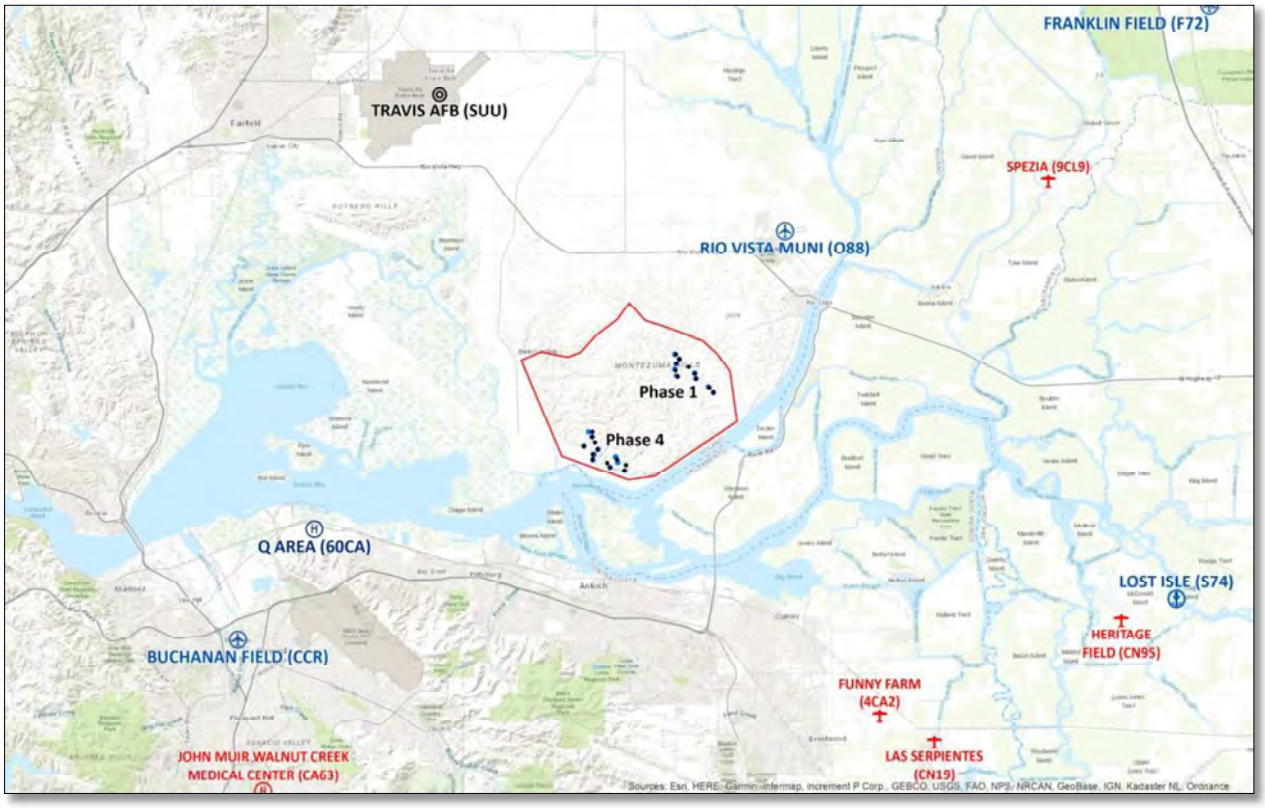


Figure 1: Public-use (blue), private-use (red), and military (navy blue and black) airports and heliports in proximity to the Solano Phase 1 and Phase 4 wind projects

Study Findings

14 CFR Part 77 Imaginary Surfaces

The FAA uses level and sloping imaginary surfaces to determine if a proposed structure is an obstruction to air navigation. Structures that are identified as obstructions are then subject to a full aeronautical study and increased scrutiny. However, exceeding a Part 77 imaginary surface does not automatically result in the issuance of a determination of hazard. Proposed structures must have airspace impacts that constitute a substantial adverse effect in order to warrant the issuance of determinations of hazard.

14 CFR Part 77 imaginary surfaces (***Figure 2***) overlying the Solano Phase 1 and Phase 4 wind projects:

Rio Vista Municipal (O88)
77.17(a)(2): 378 to 785 feet AMSL

At 493 feet AGL (orange area, ***Figure 2***) and 591 feet AGL (orange and yellow areas, ***Figure 2***), wind turbines in the northeastern section of the study area, including all of the Phase 1 wind turbines, will exceed the Rio Vista Municipal Airport (O88) 77.17(a)(2) imaginary surface and will be identified as obstructions. Additionally, at 591 feet AGL, proposed wind turbines will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions regardless of location.

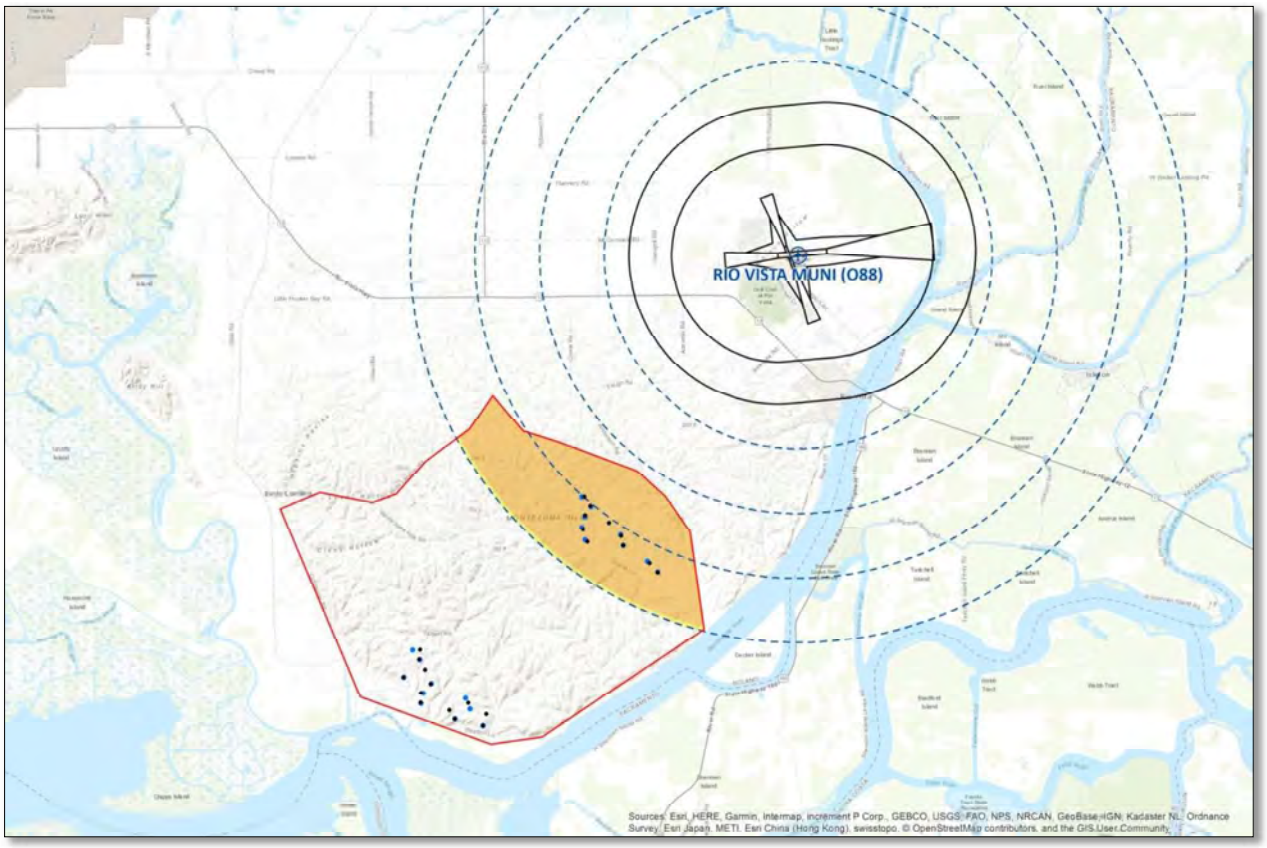


Figure 2: 77.17(a)(2) (dashed blue) and 77.19 (black) imaginary surfaces in proximity to the Solano Phase 1 and Phase 4 wind projects

Visual Flight Rules (VFR) Traffic Pattern Airspace

VFR traffic pattern airspace is used by pilots operating during visual meteorological conditions. The airspace dimensions are based upon the category of aircraft which, in turn, is based upon the approach speed of the aircraft. 14 CFR Part 77.17(a)(2) and 77.19 (as applied to a *visual* runway) imaginary surfaces establish the obstacle clearance surface heights within VFR traffic pattern airspace.

VFR traffic pattern airspace does not overlie the Solano Phase 1 and Phase 4 wind projects and should not limit 493 or 591 foot AGL wind turbines within the defined study area (***Figure 3***).

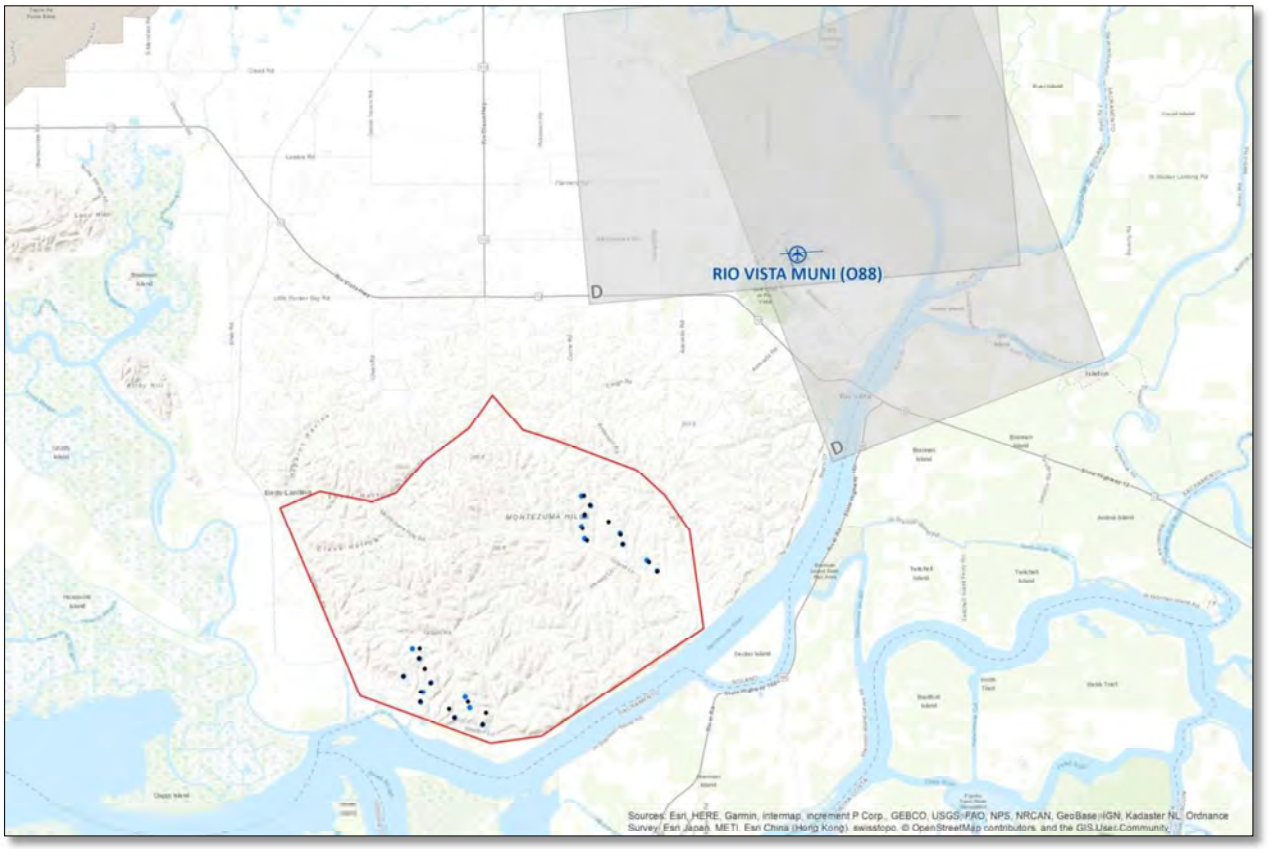


Figure 3: VFR traffic pattern airspace in proximity to the Solano Phase 1 and Phase 4 wind projects

Visual Flight Rules (VFR) Routes

During periods of marginal Visual Meteorological Conditions (VMC) – low cloud ceilings and one statute mile visibility – pilots often operate below the floor of controlled airspace. Operating under these weather conditions requires pilots to remain within one statute mile of recognizable land marks such as roads, rivers, and railroad tracks. The FAA protects for known and regularly used VFR routes by limiting structure heights within two statute miles of these routes to no greater than 14 CFR Part 77.17(a)(1) – a height of 499 feet AGL at the site of the object.

The Solano Phase 1 and Phase 4 wind projects are located in proximity to railroads, highways, and transmission lines that may be used as VFR routes (***Figure 4***). However, operational data describing the usage of these potential routes is not available. If the FAA determines that these potential VFR routes are flown regularly, it could limit wind development in excess of 499 feet AGL and within two statute miles of these landmarks (hatched orange, ***Figure 4***).

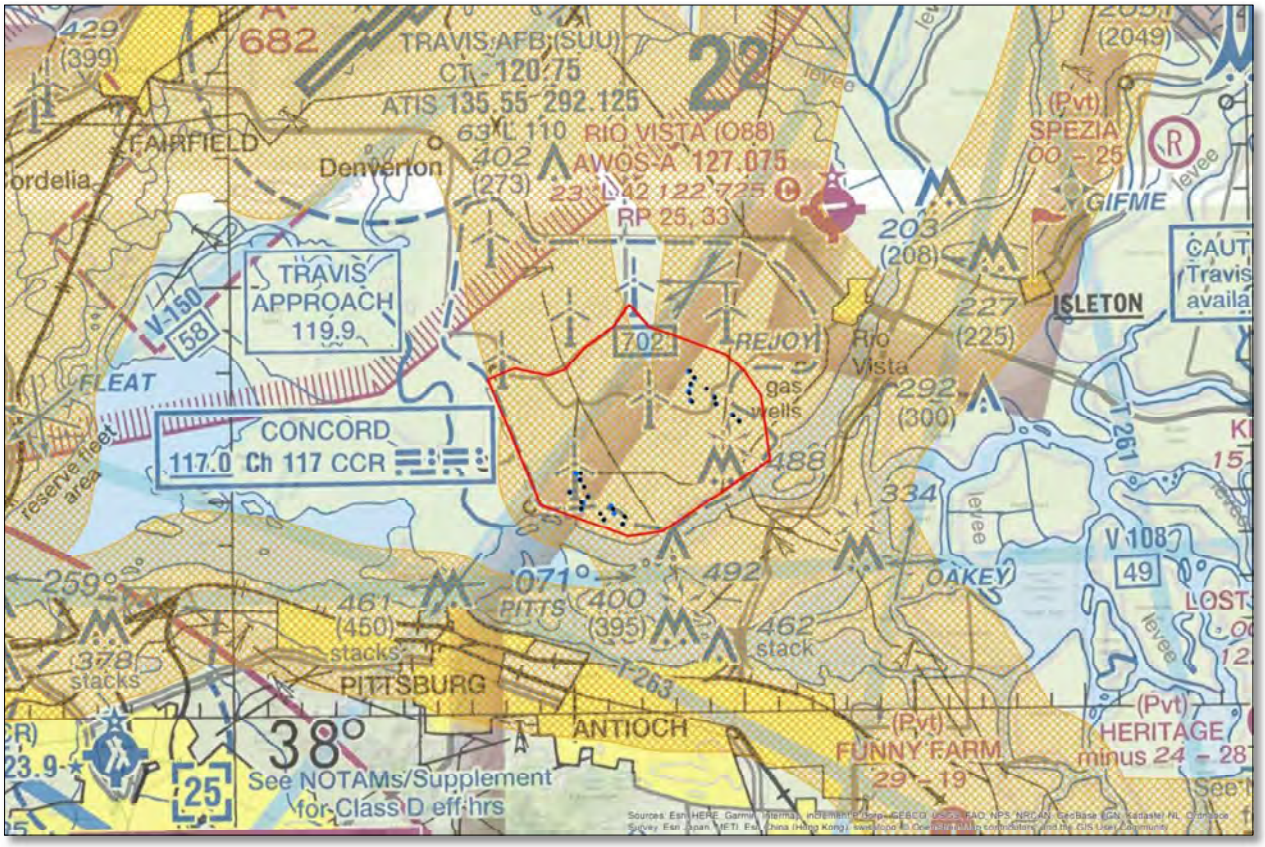


Figure 4: Potential VFR routes in proximity to the Solano Phase 1 and Phase 4 wind projects

Instrument Departures

In order to ensure that aircraft departing during marginal weather conditions do not fly into terrain or obstacles, the FAA publishes instrument departure procedures that provide obstacle clearance to pilots as they transition between the terminal and enroute environments. These procedures contain specific routing and minimum climb gradients to ensure clearance from terrain and obstacles.

Proposed structures that exceed instrument departure procedure obstacle clearance surfaces would require an increase to instrument departure procedure minimum climb gradients. If the FAA determines that this impact would constitute a substantial adverse effect, it could be used as the basis for determinations of hazard.

Instrument departure procedure obstacle clearance surfaces (e.g., ***Figure 5***) are in excess of other lower surfaces and should not 493 or 591 foot AGL wind turbines within the defined study area.

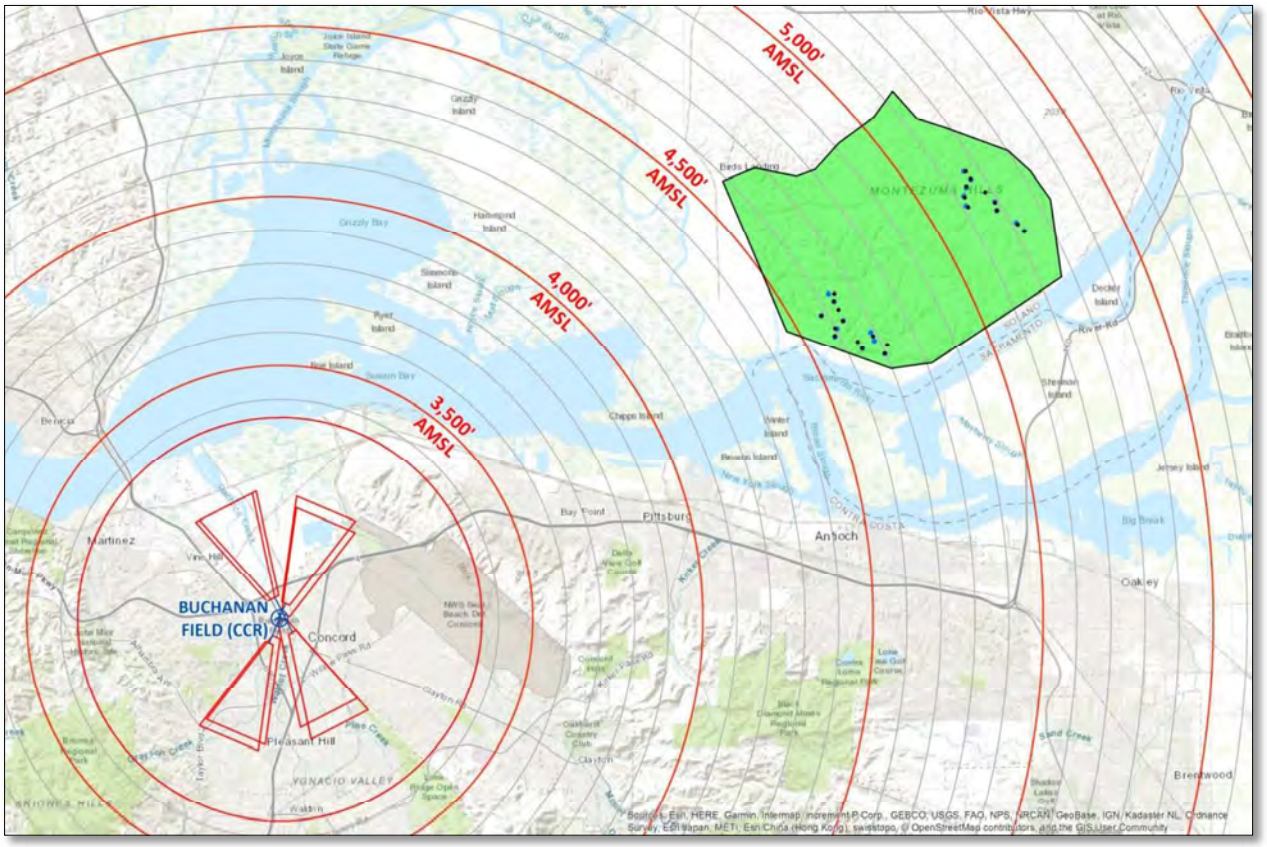


Figure 5: Buchanan Field Airport (CCR) visual climb over airport (VCOA) departure procedure assessment

Instrument Approaches

Pilots operating during periods of reduced visibility and low cloud ceilings rely on terrestrial and satellite based navigational aids (NAVAIDS) in order to navigate from one point to another and to locate runways. The FAA publishes instrument approach procedures that provide course guidance to on-board avionics that aid the pilot in locating the runway. Capitol Airspace assessed a total of 28 published instrument approach procedures at eight public-use airports and one military airport in proximity to the Solano Phase 1 and Phase 4 wind projects.

Proposed wind turbines that exceed instrument approach procedure obstacle clearance surfaces would require an increase to their minimum altitudes. Increases to these altitudes, especially critical *decision altitudes (DA)* and *minimum descent altitudes (MDA)*, can directly impact the efficiency of instrument approach procedures. If the FAA determines this impact to constitute a substantial adverse effect it could be used as the basis for determinations of hazard.

Instrument approach procedure obstacle clearance surfaces (e.g., ***Figure 6***) are in excess of other lower surfaces and should not limit 493 or 591 foot AGL wind turbines within the defined study area.

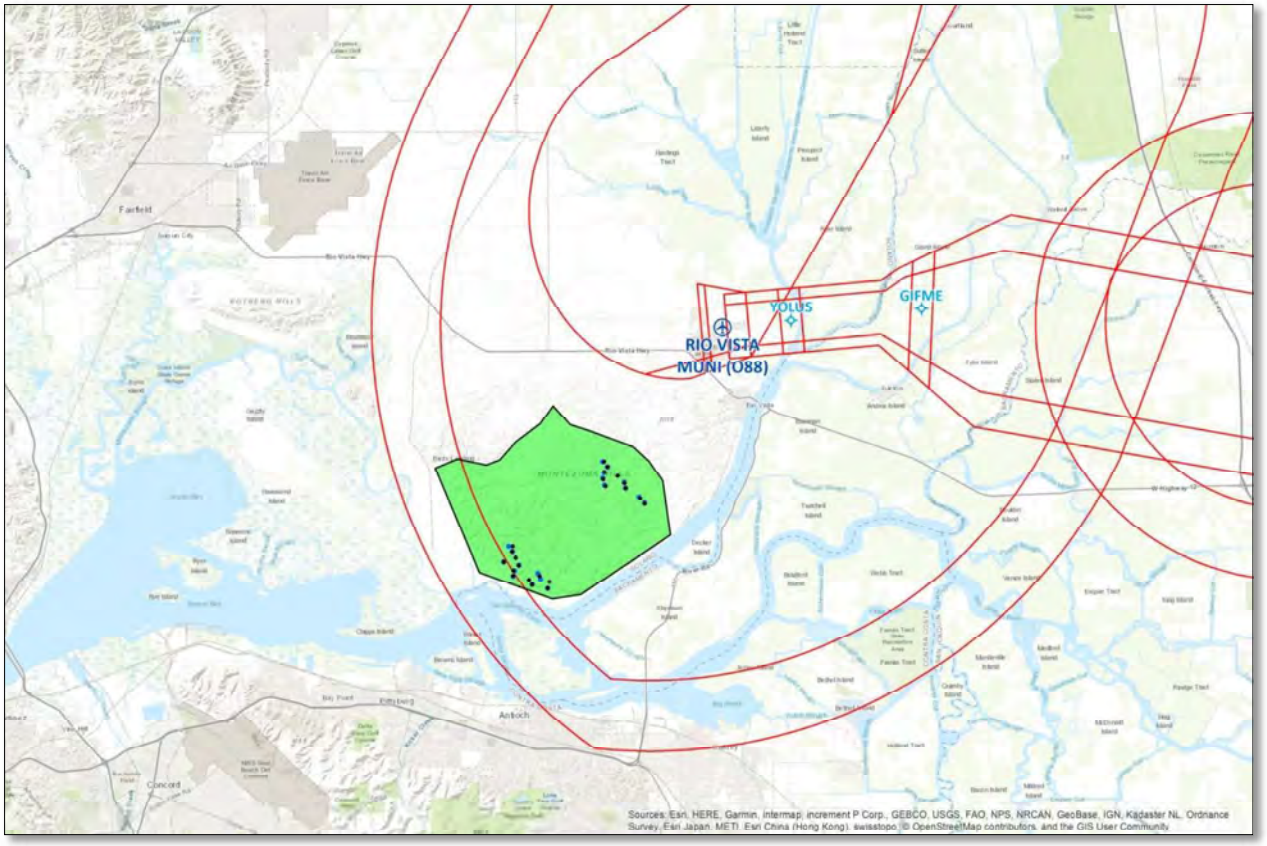


Figure 6: Rio Vista Municipal Airport (O88) RNAV (GPS) Approach to Runway 25

Instrument approach procedures assessed:

Travis Air Force Base (SUU)
ILS or Localizer Approach to Runway 03L
ILS or Localizer Approach to Runway 21L
ILS Approach to Runway 21L (CAT II)
RNAV (GPS) Approach to Runway 03L
RNAV (GPS) Approach to Runway 21L
RNAV (GPS) Approach to Runway 21R
TACAN Approach to Runway 03L
TACAN Approach to Runway 21L
TACAN Approach to Runway 21R

Livermore Municipal (LVK)
ILS Approach to Runway 25R
RNAV (GPS) Approach to Runway 25R
Localizer Approach to Runway 25R

Lodi (1O3)
RNAV (GPS)-B Circling Approach
VOR-A Circling Approach

Rio Vista Municipal (O88)
RNAV (GPS) Approach to Runway 25
VOR/DME-A Circling Approach

Buchanan Field (CCR)
RNAV (GPS) Y Approach to Runway 19R
LDA Approach to Runway 19R
VOR Approach to Runway 19R

Napa County (APC)
ILS or Localizer Approach to Runway 36L
RNAV (GPS) Approach to Runway 06
RNAV (GPS) Y Approach to Runway 36L
RNAV (GPS) Z Approach to Runway 36L
VOR Approach to Runway 06

Byron (C83)
RNAV (GPS) Approach to Runway 30

University (EDU)
RNAV (GPS) Approach to Runway 17

Nut Tree (VCB)
RNAV (GPS) Approach to Runway 20
VOR-A Circling Approach

Enroute Airways

Enroute airways provide pilots a means of navigation when flying from airport to airport and are defined by radials between VHF omni-directional ranges (VORs). The FAA publishes minimum altitudes for airways to ensure clearance from obstacles and terrain. The FAA requires that each airway have a minimum of 1,000 feet of obstacle clearance in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed enroute airway obstacle clearance surfaces would require an increase to their minimum obstruction clearance altitudes (MOCA) and/or minimum enroute altitudes (MEA). If the FAA determines that this impact would affect a significant volume of operations it could be used as the basis for determination of hazard.

Enroute airway obstacle clearance surfaces (e.g., ***Figure 7***) are in excess of other lower surfaces and should not limit increasing the wind turbine rotor diameter to 493 or 591 feet AGL at any of the proposed locations.

Figure 7: Low altitude enroute chart L-02 with V6 obstacle evaluation areas (purple)

Minimum Vectoring/IFR Altitudes

The FAA publishes minimum vectoring altitude (MVA) and minimum instrument flight rules (IFR) altitude charts that define sectors with the lowest altitudes at which air traffic controllers can issue radar vectors to aircraft based on obstacle clearance. The FAA requires that sectors have a minimum of 1,000 feet of obstacle clearance in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed minimum vectoring/IFR altitude sector obstacle clearance surfaces would require an increase to the altitudes usable by air traffic control for vectoring aircraft. If the FAA determines that this impact would affect a significant volume of operations (*as few as one per week*), it could result in determinations of hazard.[1]

Northern California (NCT) Terminal Radar Approach Control (TRACON)

NCT_BAB_MVA: Sector BAB_D

The MVA is 1,700 feet AMSL. The associated obstacle clearance surface is 749 feet AMSL and is the lowest height constraint in the northeastern section of the study area. USGS elevation data indicates that this surface could limit 493 and 591 foot AGL wind turbines in the northern and northeastern sections of the study area, including five of the 591 foot AGL Phase 1 turbines (*P1R1:4, P1N1*).

NCT_MCC_MVA: Sector BAB_D

The MVA is 1,700 feet AMSL. The associated obstacle clearance surface (hatched blue, ***Figure 8***) is 749 feet AMSL and is the lowest height constraint in the northeastern section of the study area. USGS elevation data indicates that this surface could limit 493 foot AGL (red areas, ***Figure 8***) and 591 foot AGL (red and orange areas, ***Figure 8***) wind turbines in the northern and northeastern sections of the study area, including five of the 591 foot AGL Phase 1 turbines (*P1R1:4, P1N1*).

NCT_903S_MVA: 1,700 foot AMSL Sector

The MVA is 1,700 feet AMSL (***Figure 9***). The associated obstacle clearance surface is 749 feet AMSL and is the lowest height constraint overlying the entire study area. USGS elevation data indicates that this surface could limit 493 foot AGL (red areas, ***Figure 9***) in the northwestern and central sections of the study area. However, none of the proposed wind turbines are located in this area. This surface could limit 591 foot AGL (red and orange areas, ***Figure 9***) wind turbines throughout the study area including five Phase 1 turbines (*P1R1:4, P1N1*) and seven Phase 4 turbines (*P4N1:4, P4N7:9*).

[1] Capitol Airspace analyzed the Travis Air Force Base (AFB) minimum vectoring altitude chart provided through CRADA in 2011. It was determined that the associated obstacle clearance surfaces are in excess of other lower surfaces and should not limit up to 591 foot AGL wind turbines within the defined study area.

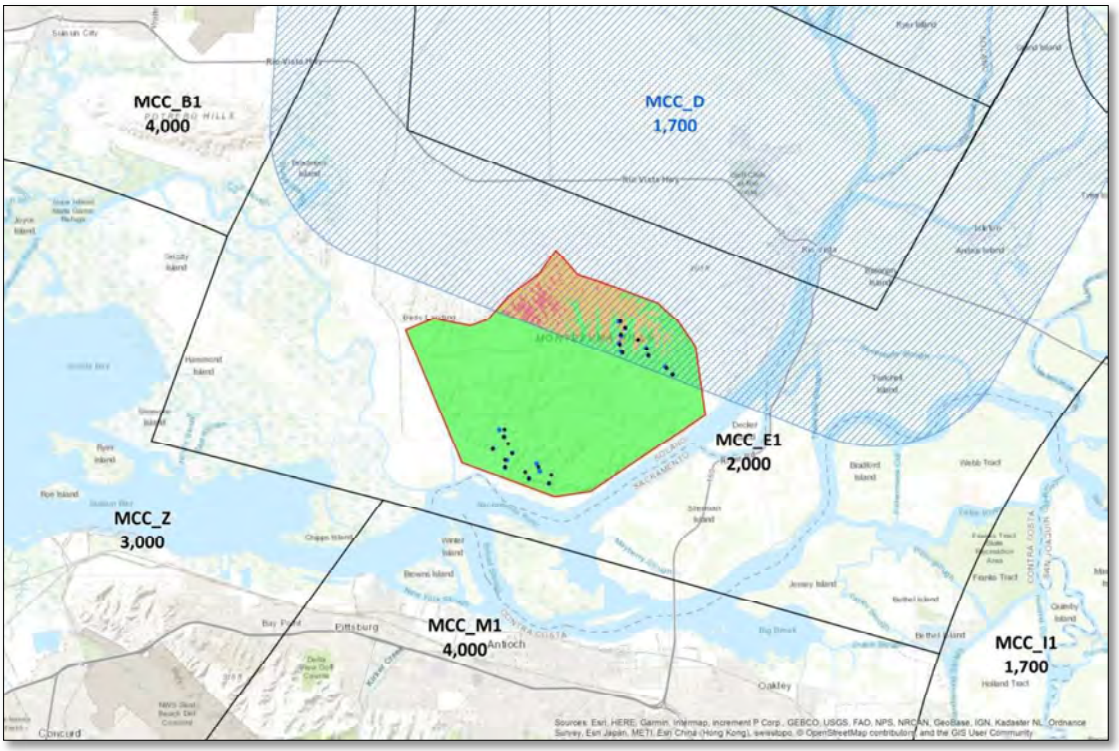


Figure 8: Northern California (NCT) TRACON "NCT_MCC_MVA" MVA sectors (black) with Sector MCC_D obstacle evaluation area (hatched blue)

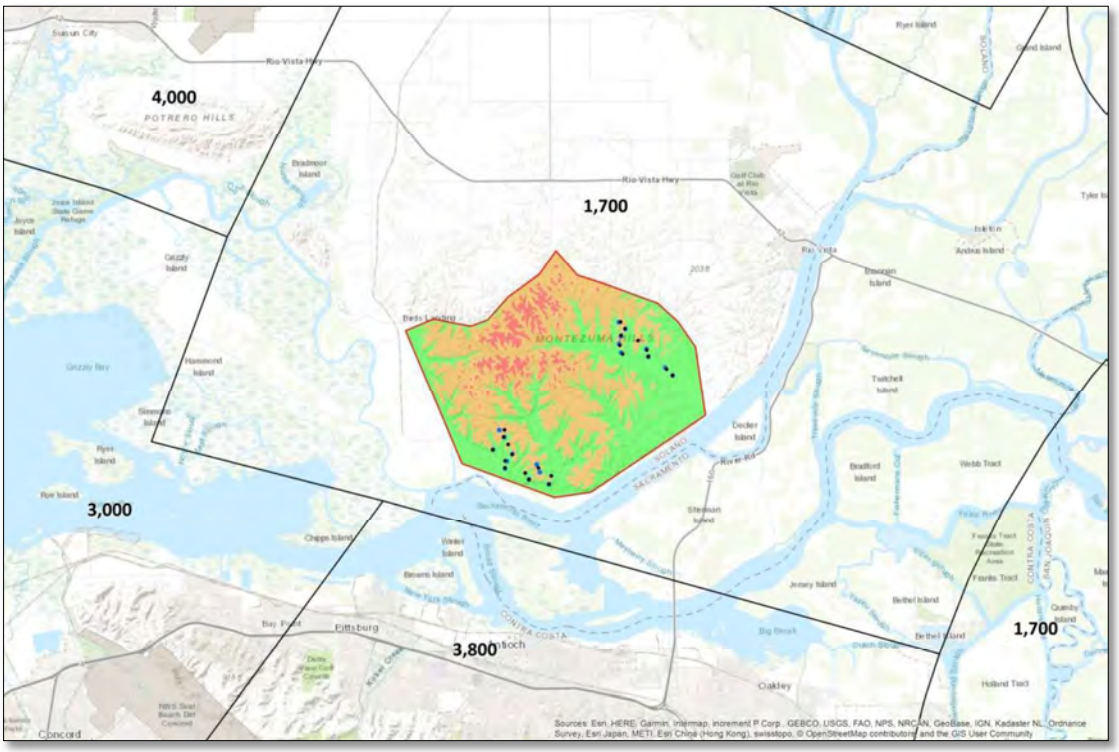


Figure 9: Northern California (NCT) TRACON "NCT_903S_MVA" MVA sectors (black) with Sector MCC_D obstacle evaluation area (hatched blue)

Very High Frequency (VHF) Omni-Directional Range (VOR)

The FAA has established 0.60° (Conventional VOR) and 0.75° (Doppler VOR) screening angles in order to identify proposed structures that may have a negative impact on VORs. This surface extends upward and outward from the VOR to a distance of up to 8 nautical miles. Proposed wind turbines that exceed this surface may interfere with the services provided by the VOR. If the FAA determines this impact to be significant it can be used as the basis for determinations of hazard.

Travis (SUU) TACAN

The 0.60° screening surface, typically applied for Conventional VORs, overlies the Solano Phase 1 and Phase 4 wind projects (***Figure 10***). The height of this surface ranges from 522 to 540 feet AMSL where it overlies the study area. USGS elevation data indicates that 493 and 591 foot AGL (orange area, ***Figure 10***) wind turbines would exceed this surface. However, none of the proposed wind turbines are located in this area.

If line of sight exists between the Travis (SUU) TACAN and wind turbines proposed in this area, FAA Technical Operations may perform further review. If further review determines that proposed wind turbines would have a substantial adverse effect on navigational aids, it could result in determinations of hazard.

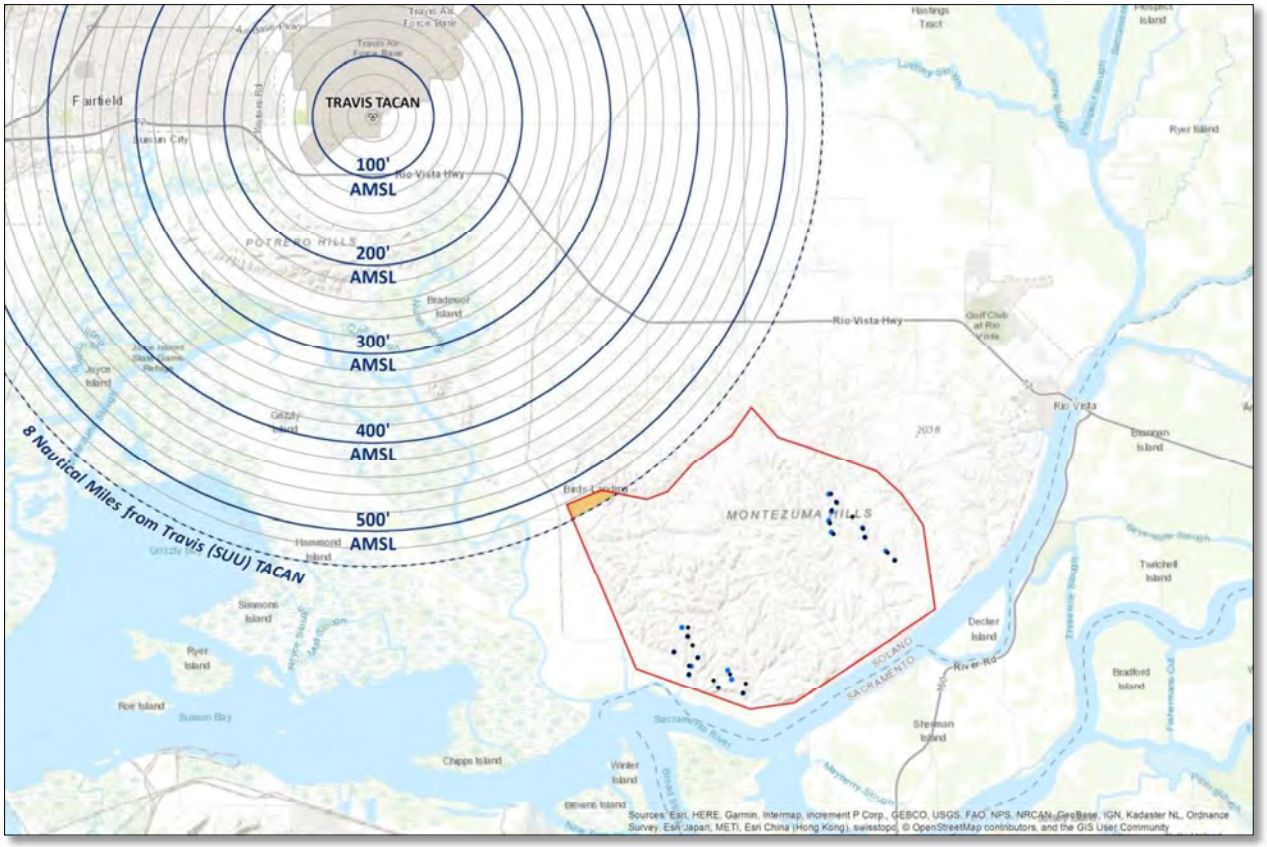


Figure 10: Travis (SUU) TACAN 0.60° screening surface

Military Airspace and Training Routes

Since the FAA does not protect for military airspace or training routes, impact on their operations cannot result in a determination of hazard. However, the FAA will notify the military of proposed wind turbines located within these segments of airspace. If the planned development area is located on federal land, impact on military airspace or training routes may result in the denial of permits by the Bureau of Land Management.

Military airspace and training routes do not overlie the Solano Phase 1 and Phase 4 wind projects (***Figure 11***). As a result, proximity to these segments of airspace should not result in military objections to proposed wind turbines.

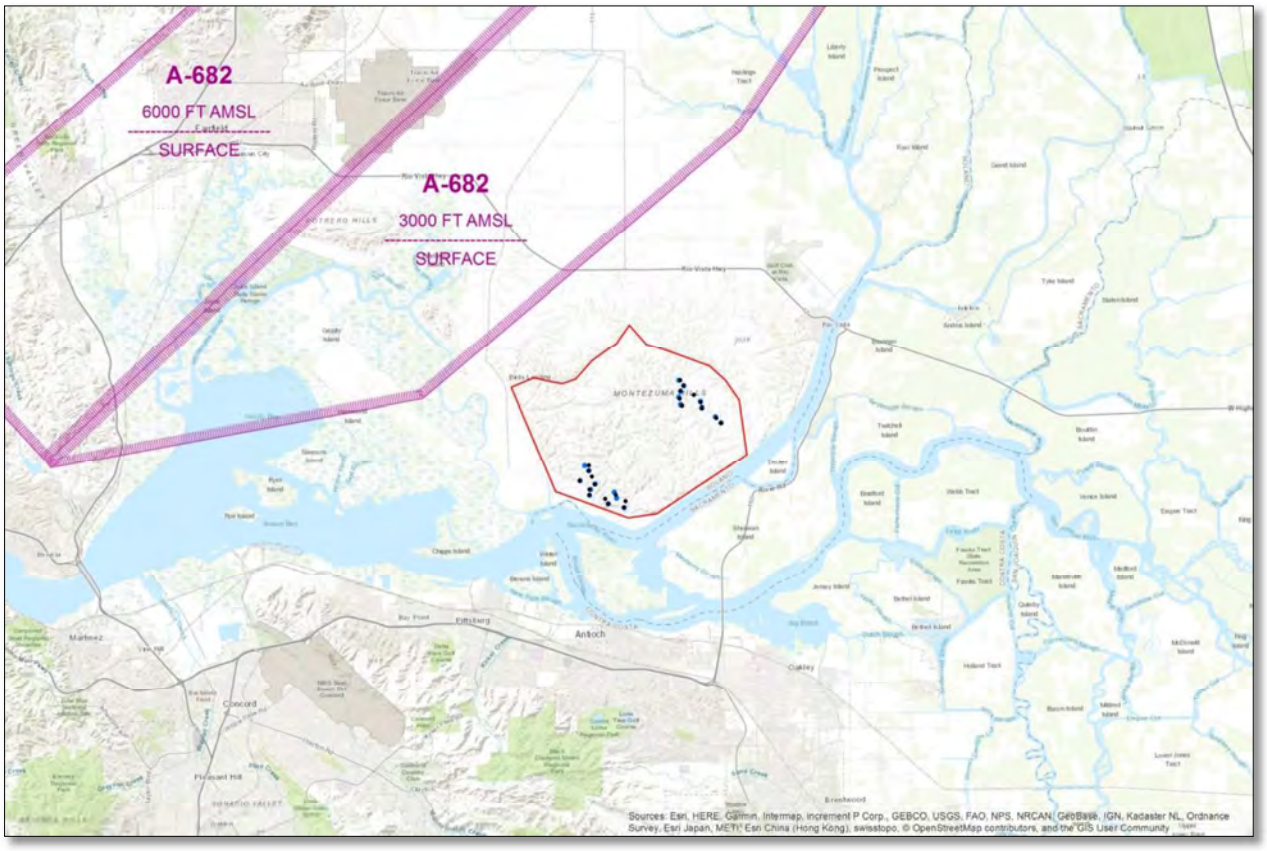


Figure 11: Alert areas in proximity to the Solano Phase 1 and Phase 4 wind projects

Conclusion

At 493 and 591 feet AGL, all of the Phase 1 wind turbines will exceed the Rio Vista Municipal Airport 14 CFR Part 77.17(a)(2) imaginary surface (***Figure 2***) and will be identified as obstructions. Additionally, at 591 feet AGL, proposed wind turbines will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions regardless of location. However, heights in excess of these surfaces are feasible provided proposed wind turbines do not exceed FAA obstacle clearance surfaces.

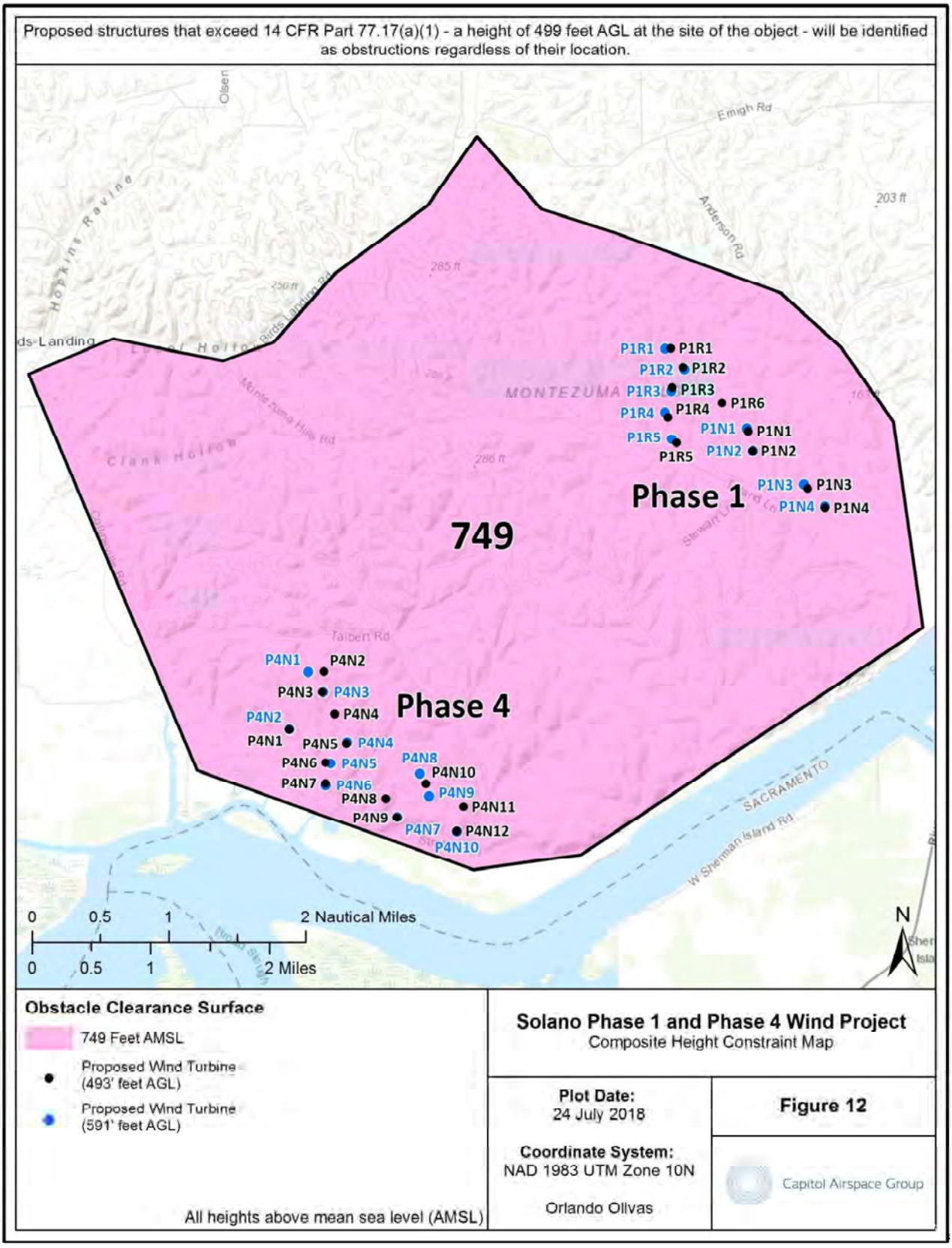
Obstacle clearance surfaces overlying the Solano Phase 1 and Phase 4 wind projects are a constant 749 feet AMSL (***Figure 12***) and are associated with Northern California (NCT) TRACON minimum vectoring altitude sectors (***Figure 8*** & ***Figure 9***). Proposed structures that exceed these surfaces would require an increase to minimum vectoring altitudes. If the FAA determines that this impact would affect a significant volume of operations (*as few as one per week*), it could result in determinations of hazard.

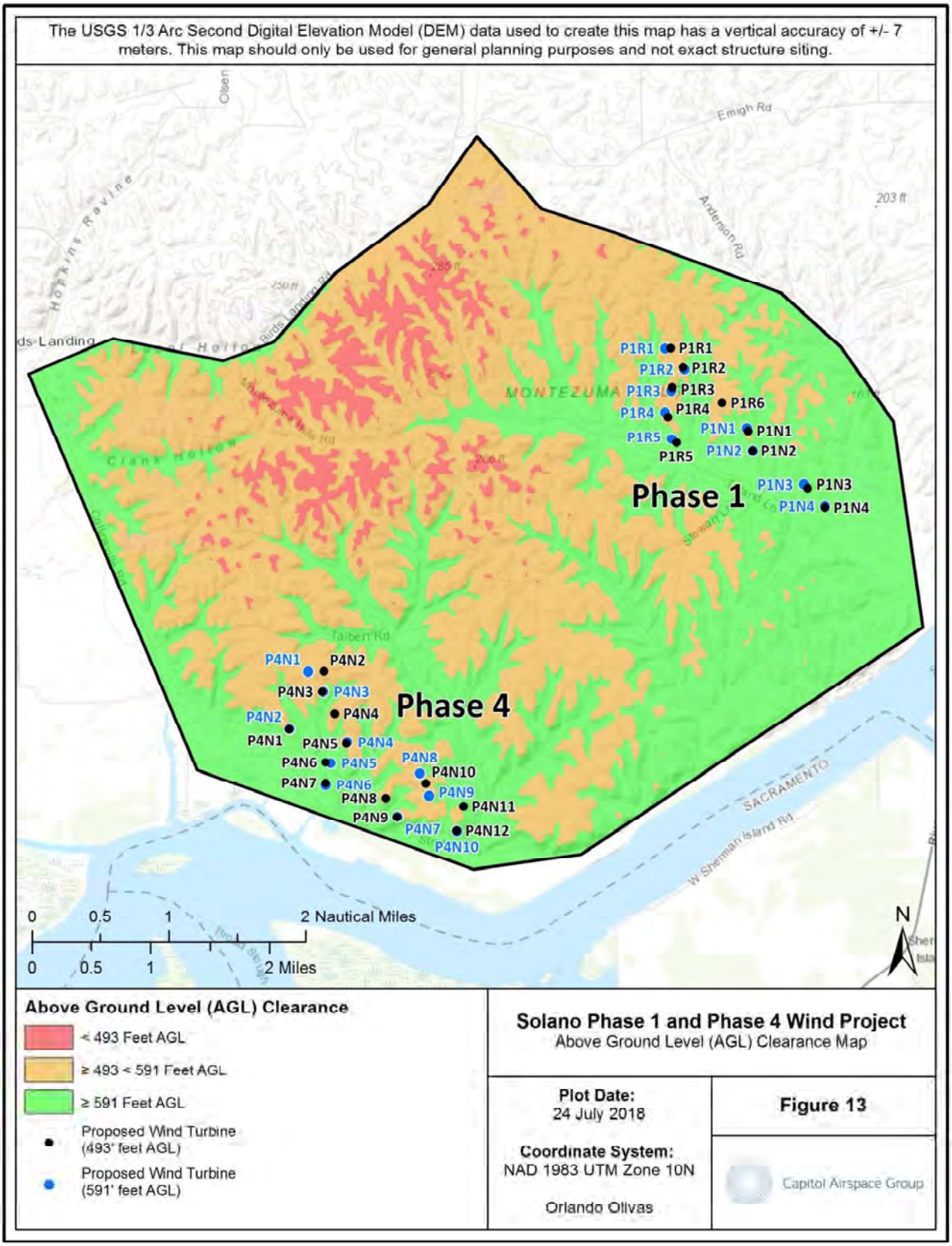
USGS elevation data indicates that these surfaces could limit 493 foot AGL wind turbines on higher terrain in the northwestern and central sections of the study area (red areas, ***Figure 13***). However, none of the proposed wind turbines are located in these areas. These surfaces could limit 591 foot AGL wind turbines throughout the study area (red and orange areas, ***Figure 13***), including five Phase 1 turbines (*P1R1:4, P1N1*) and seven Phase 4 turbines (*P4N1:4, P4N:9*) (red and orange areas, ***Figure 13***).

At 493 and 591 feet AGL, wind turbines proposed in the northwestern section of the study area would exceed the Travis (SUU) TACAN 0.60° screening surface (***Figure 10***). If further review determines that wind turbines proposed in this area would have a substantial adverse effect on navigational aids, it could result in determinations of hazard. However, none of the proposed wind turbines are located in this area.

The AGL Clearance Map (***Figure 13***) is based on USGS National Elevation Dataset (NED) 1/3 Arc Second data which has a vertical accuracy of generally +/- 7 meters. Therefore, the AGL Clearance Map should only be used for general planning purposes and not exact structure siting. In order to avoid the likelihood of determinations of hazard, proposed structure heights must adhere to the height constraints depicted in the Composite Map (***Figure 12***).

If you have any questions regarding the findings of this study, please contact ***Joe Anderson*** or ***Orlando Olivas*** at (703) 256-2485.


Proposed structures that exceed 14 CFR Part 77.17(a)(1) - a height of 499 feet AGL at the site of the object - will be identified as obstructions regardless of their location.
749
Phase 1
Phase 4
P1R1
P1R2
P1R3
P1R4
P1R5
P1R6
P1N1
P1N2
P1N3
P1N4
P4N1
P4N2
P4N3
P4N4
P4N5
P4N6
P4N7
P4N8
P4N9
P4N10
P4N11
P4N12
MONTEZUMA
Emigh Rd
Anderson Rd
Hopkins Ravine
Clark Hollow
Talbert Rd
SACRAMENTO
W Sherman Island Rd
0 0.5 1 2 Nautical Miles
0 0.5 1 2 Miles
N
Obstacle Clearance Surface
749 Feet AMSL
Proposed Wind Turbine (493' feet AGL)
Proposed Wind Turbine (591' feet AGL)
All heights above mean sea level (AMSL)
Solano Phase 1 and Phase 4 Wind Project
Composite Height Constraint Map
Plot Date:
24 July 2018
Figure 12
Coordinate System:
NAD 1983 UTM Zone 10N
Orlando Olivas
Capitol Airspace Group


The USGS 1/3 Arc Second Digital Elevation Model (DEM) data used to create this map has a vertical accuracy of +/- 7 meters. This map should only be used for general planning purposes and not exact structure siting.
Phase 1
Phase 4
P1R1
P1R2
P1R3
P1R4
P1R5
P1R6
P1N1
P1N2
P1N3
P1N4
P4N1
P4N2
P4N3
P4N4
P4N5
P4N6
P4N7
P4N8
P4N9
P4N10
P4N11
P4N12
MONTEZUMA
SACRAMENTO
Emigh Rd
Anderson Rd
Talbert Rd
W Sherman Island Rd
0 0.5 1 2 Nautical Miles
0 0.5 1 2 Miles
N
Above Ground Level (AGL) Clearance
< 493 Feet AGL
≥ 493 < 591 Feet AGL
≥ 591 Feet AGL
Proposed Wind Turbine (493' feet AGL)
Proposed Wind Turbine (591' feet AGL)
Solano Phase 1 and Phase 4 Wind Project
Above Ground Level (AGL) Clearance Map
Plot Date:
24 July 2018
Figure 13
Coordinate System:
NAD 1983 UTM Zone 10N
Orlando Olivas
Capitol Airspace Group

WESTSLOPE CONSULTING

SMUD Solano 4

Cumulative Impact Study and Mitigation Solution Results
for
2018 Vestas V136 and V150 Wind Turbine Layouts

6 September 2018

Background

- **During the Windfarm RePower Group meeting on April 21, 2016, Westslope presented the results of an RLOS analysis and cumulative impact study for the Solano 4 wind project:**
  - **"RLOS analysis and qualitative review of radar data shows that existing 59 Kenetech wind turbines do not interfere with the Travis AFB radar**
  - **RLOS analysis and cumulative impact study indicates that Solano 4 will interfere with the Travis AFB radar**
    - **Incremental drop in primary Pd over the WRA predicted at 0.3% below 4,000 feet MSL and 0.4% below 10,000 feet MSL**
    - **Cumulative impact of other existing wind projects and Solano 4 predicted to decrease the primary Pd on the AT controllers' displays by 4.8 percent below 4,000 feet MSL and 4.4 percent below 10,000 feet MSL**
    - **Within the 5% Pd tolerance set forth under the CRADA in 2010**
    - **One occasional false primary track on the AT controllers' display**
  - **Effects not expected to be significant and should be manageable for a small 17 turbine project**
  - **No impacts to the secondary radar co-located with Travis AFB DASR"**

Change in Wind Turbine Technology

- **Solano 4 wind project in 2016 consisted of 17 Vestas V117 wind turbines at a blade-tip height of 488 feet AGL**
  - **Located on the SMUD Roberts and Collinsville properties**
- **2018 Solano 4 wind project consists of either 22 Vestas V136 wind turbines at a blade-tip height of 493 feet AGL or 19 Vestas V150 wind turbines at a blade-tip height of 591 feet AGL**
  - **New version of Solano 4 proposes wind turbines located on the SMUD Roberts and Collinsville properties (Solano 4 West) and at the Solano 1 repower site (Solano 4 East)**
- **Same as the 2016 V117 wind turbines, the 2018 V136 and V150 wind turbines will be within radar line-of-sight of and will interfere with the Travis AFB DASR**
- **Westslope updated the 2016 cumulative impact study to account for the Solano 4 V136 and V150 layouts using the same method used under CRADA No. 10-002**

Solano 4 West: Roberts and Collinsville Properties

[redacted]

wind

[redacted]

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Solano 4 West: Roberts and Collinsville Properties 2018 Cumulative Impact Study Results

- **Results show that the primary Pd out of the Travis AFB DASR over the WRA will decrease by 0.3 percent for the V136 layout and by 0.2 percent for the V150 layout below 4,000 feet MSL and 10,000 feet MSL**
  - **Less than predicted for the 2016 Solano 4 V117 wind turbines**

- **Similar trend is expected for the primary Pd on the AT controllers' display based on the findings of CRADA No. 10-002's Radar Working Group**

- **Cumulative impact of existing wind projects and 2018 Solano 4 West wind project predicted to be within the 5% primary Pd tolerance set forth under the aforementioned CRADA**

Project	No. of Wind Turbines	Below 4,000 feet MSL		Below 10,000 feet MSL	
		Pd Drop	Cumulative Pd Drop	Pd Drop	Cumulative Pd Drop
Shiloh III	52	-1.3%	-1.3%	-1.2%	-1.2%
Montezuma I	16	-0.2%	-1.5%	-0.2%	-1.4%
Solano Phase 3	55	-1.3%	-2.8%	-1.3%	-2.7%
Montezuma II	37	-0.6%	-3.4%	-0.5%	-3.2%
Shiloh IV	50	-0.4%	-3.8%	-0.6%	-3.8%
Solano 4 (2016)	16	-0.3%	-4.1%	-0.4%	-4.2%
vs.					
Solano 4 (V136)	12	-0.3%	-4.1%	-0.3%	-4.1%
and					
Solano 4 (V150)	10	-0.2%	-4.0%	-0.2%	-4.0%

Pd drop out of the ASR-11 over the WRA

Description	Below 4,000 feet MSL	Below 10,000 feet MSL
Pd tolerance set forth by CRADA's Operations Working Group	5%	5%
Cumulative Pd drop		
Solano 4 West (2016)	-4.1%	-4.2%
vs.		
Solano 4 West (V136)	-4.1%	-4.1%
and		
Solano 4 West (V150)	-4.0%	-4.0%
Difference in Pd out of the ASR-11 and on the AT controllers' displays	-0.6%	-0.3%
Remaining Pd margin		
Solano 4 West (2016)	0.3%	0.5%
vs.		
Solano 4 West (V136)	0.3%	0.6%
and		
Solano 4 West (V150)	0.4%	0.7%

Remaining Pd margin over the WRA

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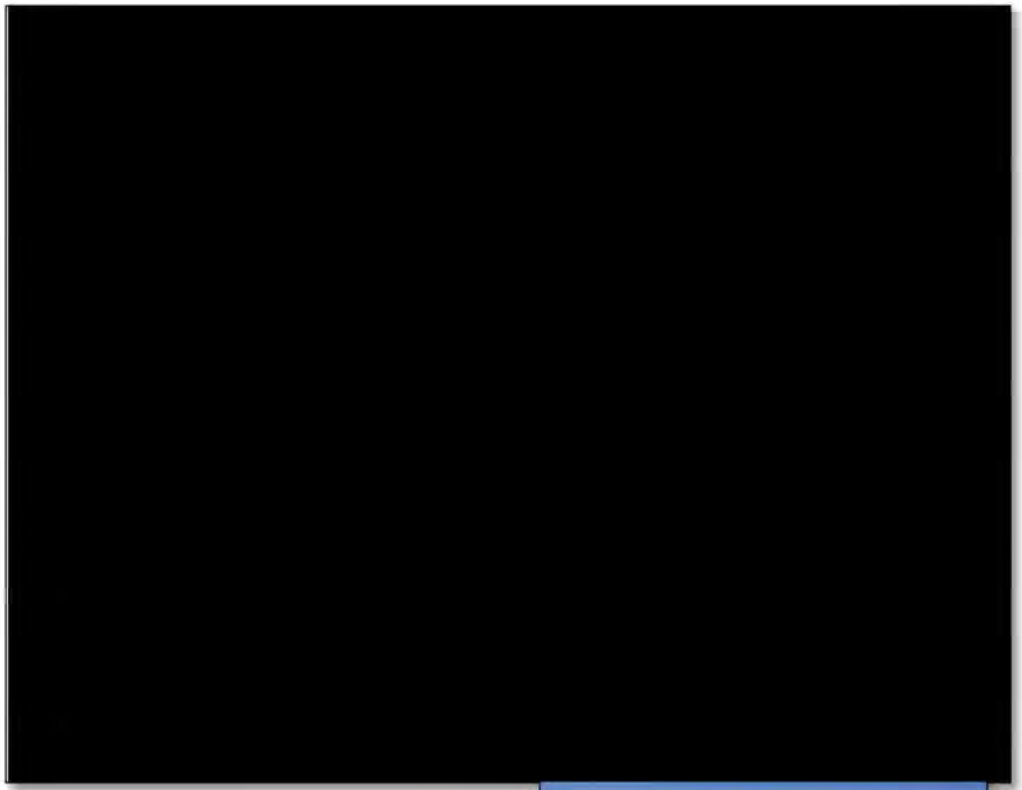
Mitigation Solution

- Existing Solano Phase 1 wind project consists of 23 Vestas V47 wind turbines
  - 16 wind turbines at a blade-tip height of 242 feet AGL and 7 wind turbines at a blade-tip height of 291 feet AGL
- RLOS analysis conducted by Westslope shows that the Solano Phase 1 wind turbines are within RLOS and currently interfering with the Travis AFB DASR
- Reducing the number of wind turbines within radar line-of-sight of the Travis AFB DASR should reduce the cumulative impact on primary Pd
- 2018 Solano 4 East repower consists of either 10 Vestas V136 wind turbines at a blade-tip height of 493 feet AGL or 9 Vestas V150 wind turbines at a blade-tip height of 591 feet AGL

589 wind turbines in operation in the Montezuma Hills



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Solano Phase 1 Repower

Solano 4 East: Repower of Phase 1
2018 Cumulative Impact Study Results

- **Westslope conducted a Monte Carlo simulation to determine whether the Solano 4 East repower V136 wind turbines or V150 wind turbines would negate the predicted primary Pd drop as a result of the Solano 4 West V136 wind turbines or V150 wind turbines**

- **Same assumptions used to predict the drop in Pd as the simulation method used under CRADA No. 10-002**

- **Results show that the primary Pd out of the Travis AFB DASR over the WRA will increase by 0.2 percent**

Project	No. of Wind Turbines	Below 4,000 feet MSL	Below 10,000 feet MSL
		Pd Drop	
Solano 4 West (2016)	16	-0.3%	-0.4%
vs.			
Solano 4 West (V136)	12	-0.3%	-0.3%
and			
Solano 4 West (V150)	10	-0.2%	-0.2%
From previous slide for comparison purposes			
Solano 4 East (2016)	8	+0.3%	+0.3%
vs.			
Solano 4 East (V136)	10	+0.2%	+0.2%
and			
Solano 4 East (V150)	9	+0.2%	+0.2%

Pd drop out of the ASR-11 over the WRA

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Combined
2018 Cumulative Impact Study Results

- **Westslope's simulations show the following:**
  - **For Solano 4 West, the primary Pd out of the Travis AFB DASR over the WRA will decrease by 0.3 percent for the V136 layout and by 0.2 percent for the V150 layout**
  - **For Solano 4 East, the primary Pd out of the Travis AFB DASR over the WRA will increase by 0.2 percent for both the V136 layout and the V150 layout**

- **Results show that the V136 layouts for both Solano 4 East and West areas will result in a 0.1 percent overall decrease in the primary Pd over the WRA**

- **Westslope does not expect that a 0.1 percent drop in the primary Pd over the WRA will result in a material difference to Travis AFB radar operations**

- **V150 layout for the Solano 4 East Repower will negate the Pd drop over the WRA as a result of the Solano 4 West V150 layout**

Conclusions

- 2018 Solano 4 East and West projects will replace 23 existing V47 wind turbines that are currently interfering with the Travis AFB DASR with either 22 Vestas V136 wind turbines or 19 Vestas V150 wind turbines
- Results show that the V136 wind turbines for both Solano 4 East and West will result in 0.1 percent decrease in the primary Pd over the WRA
  - Westslope does not expect that a 0.1 percent drop in the primary Pd over the WRA will result in a material difference to Travis AFB radar operations
- V150 wind turbines for the Solano 4 East will negate the Pd drop over the WRA as a result of the Solano 4 West V150 wind turbines
- False targets not expected to be significant and should be manageable for either 10 or 12 Solano 4 wind turbines
- No impacts to the secondary radar co-located with Travis AFB DASR

Recommendations

- File 2018 Solano 4 East and West wind turbines with the FAA to start the federal government OE/AAA process

- Formalize a Mitigation Response Team
  - Further investigate the effects of replacing 23 Solano Phase 1 wind turbines with up to 22 Solano 4 East and West wind turbines
  - Determine whether radar effects will have an operational impact on Travis AFB's mission
  - Identify mitigation options

- Mitigation options:
  - SMUD to enter agreement to provide voluntary contribution to fund for an optimization update to the Travis AFB DASR

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OE/AAA Aeronautical Study Process
July 31st, 2018

The United States Congress has charged the Federal Aviation Administration (FAA) with the responsibility to promote air commerce in the United States. As part of this responsibility, the FAA is tasked with ensuring air safety and preserving the National Airspace System (NAS). It is through these mandates that the FAA draws its authority to conduct aeronautical studies of tall structures including wind turbines.[1] Below is an overview of the typical process and required steps for working through the aeronautical study process. Although the Department of Defense's (DoD) formal review process occurs concurrently with FAA's aeronautical study, the DoD process is described separately.

FAA Step One: Filing

Developers intending to build structures in excess of 200 feet above ground level (AGL), or in excess of established notification standards (lower closer to airports), must submit a notice to the FAA at least 45 days prior to the start of construction.[2] Primarily, this process is conducted via an online submittal process through the FAA's OE/AAA website.[3] Prior to the FAA's establishment of the FAA OE/AAA automation system, notice was provided to the FAA by submitting FAA Form 7460-1, *Notice of Proposed Construction or Alteration*. The FAA and industry continues to refer to these filings as "7460-1" filings.

FAA 7460-1 filings require very basic information about the project to be studied. Specifically, the FAA requires that each wind turbine's location (latitude and longitude in HH:MM:SS.SS format), ground elevation (above mean sea level (AMSL)), and height (AGL) be submitted.

FAA 7460-1 filings must be submitted for each point on a project, with few exceptions. For wind and transmission line projects, individual points must be submitted for each turbine, met tower, and transmission line tower. Once the FAA receives and verifies these filings, an aeronautical study number is issued for each point. This begins the aeronautical study process.

FAA Step Two: Initial Review

Each project is assigned to a specialist within the FAA Obstruction Evaluation Group (OEG). For most projects, there are ten different government offices that take part in the study process, including: Airports, Instrument Flight Procedures Impact Team, Flight Standards, Technical Operations, Frequency Management, United States Air Force, United States Navy, United States Army, Department of Homeland Security (DHS), and the Department

[1] 14 CFR §77 – *Safe, Efficient Use, and Preservation of the Navigable Airspace*
[2] 14 CFR §77.7 – *Form and time of notice;* and §77.9 – *Construction or alteration requiring notice*
[3] https://oeaaa.faa.gov

of Defense (DoD) Military Aviation and Installation Assurance Siting Clearinghouse (hereafter referred to as the "Clearinghouse").

Technicians in each of these offices will review each point to ensure that the planned structure does not interfere with their areas of responsibility. For example, the Instrument Flight Procedures Impact Team will assess for impact on instrument approach and departure procedures at airports. The DoD will consider impacts to their training operations and defense readiness. Since the DoD review process is evolving, it is discussed separately at the end of the FAA process.

Once each office has assessed the proposed project, they submit a response of either "objection" or "no-objection" via the FAA OE/AAA system. During this preliminary review period, the project is considered to be in "work status" by the FAA. Review by all responding offices typically takes approximately 60 to 90 days. After all offices have responded, the project is moved from "work status" into "evaluation status". It is at this point that the FAA Obstruction Evaluation Specialist, typically a former air traffic controller, will assess all of the responses and determine whether to issue a Notice of Presumed Hazard (NPH) or a favorable Determination of No Hazard (DNH).

If any of the wind turbines exceed a 14 CFR Part 77 imaginary surface, then a NPH is guaranteed (e.g., all turbines taller than 499 feet AGL will exceed an imaginary surface and will be issued a NPH). Additionally, if the wind turbines have any adverse effect on the NAS, then a NPH will be issued. In contrast, if the wind turbines do not exceed an imaginary surface and have no adverse effect, then the FAA would issue favorable Determinations of No Hazard (DNH).

FAA Step Three: Preliminary Results in a Notice of Presumed Hazard (NPH)

A NPH letter is meant to be a means for the FAA to notify the developer that FAA has identified an issue that will require further aeronautical study in order to determine whether or not the structure will pose a hazard to air navigation. Typically, the FAA will also include in this letter any objections received by the various responding offices in the FAA, DoD, and DHS.

FAA Step Four: Responding to a Notice of Presumed Hazard (NPH)

While there are many methods to resolve objections received on a project, nearly all NPH cases must be circularized to the public for comment. Public notices should be distributed to any party that can provide information relevant to FAA's aeronautical study. The distribution list typically includes the following:[4]

[4] As described in FAA Order 7400.2L Paragraph 6-3-17, "Circularization"

- All public-use airports within 13 nautical miles (NM) of the proposed wind turbines
- All private-use airports within 5 NM of the proposed wind turbines
- Any affected airport
- The air traffic facility that provides radar vectoring services in the vicinity of the proposed wind turbines
- FAA Flight Standards
- All known aviation interested persons such as state, city, and local aviation authorities
- Flying clubs and organizations

It is through this 37 day public comment period that the FAA solicits feedback from the flying community. Once the comment period closes, the FAA will discard comments that are not of a valid aeronautical nature. During this time, Capitol Airspace may propose mitigation options that would strike a balance between the needs of the development project and FAA's need to preserve the NAS.

FAA Step Five: Final Determinations

At the end of the further aeronautical study and public comment period, the FAA will make a final decision and issue either a Determination of No Hazard or a Determination of Hazard.

Favorable determinations are valid for 18 months. A one-time extension can be requested. This request is further reviewed by the FAA and may result in the issuance of an extension letter for an additional 18 months.

FAA Step Six: After Construction

Supplemental notice may require notification to the FAA both prior to, and shortly after, construction. This allows the FAA to chart each wind turbine so that pilots are aware of the new, taller structures.

Capitol Airspace anticipates that the project's proximity to Travis Air Force Base will result in DoD objections based on the potential for impact on radar surveillance systems. In the past, this impact would likely result in the formation of a Mitigation Response Team (MRT) which would include representatives from the Air Force Base. Although the DoD review process is continuing to evolve, it is possible that the MRT will be utilized for review of these wind projects. The MRT conducts detailed analyses and negotiates mitigation options with the wind developer. If mitigation options are identified and agreed upon, the Mitigation Oversight Committee will review the solutions. This committee is chaired by the Executive Director of the DoD Clearinghouse. This process could add significant time to the overall review of the proposed project.

On December 12th, 2017, the United States Congress passed the 2018 National Defense Authorization Act (NDAA). This law modified the Clearinghouse and the DoD's review process of mission obstructions. At this time, it is not clear how these changes will be implemented by the

FAA and the DoD. Additionally, the United States Congress is considering revisions which may further change the process. It is therefore recommended to consult early with the DoD Clearinghouse and local military bases for all new wind projects.

Below is an overview of the process described in the 2018 NDAA. This is intended to be updated as the process is amended and evolved.

DoD Step One: Filing

When an aeronautical study is submitted to the FAA, the DoD review process is automatically initiated. The NDAA mandates that the DoD Clearinghouse shall establish procedures so that notification can occur at least one year prior to the start of construction for any project that is within radar line of sight.[5]

DoD Step Two: Initial Review

The DoD Clearinghouse will assess the scope, duration, and level of risk associated with adverse impacts on DoD operations and readiness.

DoD Step Three: Notice of Presumed Risk

If an adverse impact on DoD operations and readiness is identified, the DoD Clearinghouse would issue a "Notice of Presumed Risk." This document outlines concerns identified by the DoD during their preliminary review. Capitol Airspace has yet to see the issuance of a Notice of Presumed Risk by the DoD.

If a Notice of Presumed Risk is issued, the DoD Clearinghouse shall also provide notice to the governor of California. The DoD Clearinghouse must consider any comments received by the governor.

DoD Step Four: Identify Feasible and Affordable Long-Term Mitigation Options

The DoD Clearinghouse should identify "feasible and affordable" mitigation options that can be taken by the DoD and/or the wind developer. Options can include modifications to DoD operations, upgrades or modifications to existing systems, acquiring new systems, or modifying the proposed wind project to include changing size, location, or technology.

DoD Step Five: Finding of Unacceptable Risk

The Secretary of Defense can only object to a project if the adverse impacts would result in an "unacceptable risk to the national security of the United States." Unacceptable risk is defined as a proposed project that would endanger safety in air commerce directly related to DoD operations, would interfere with efficient use of navigable airspace directly related to DoD

[5] 2018 NDAA Section 311 §183(a)(c)(6)

operations, or would significantly impair or degrade the capability of the DoD to conduct training, research, development, testing, or to maintain military readiness.

Within 30 days of making this determination, the Secretary of Defense must submit a report to the United States Congress, including multiple committees. The report should describe the basis for the finding as well as a discussion of why mitigation options were not feasible. Only unclassified reports will be released to the wind developer.

SMUD®

Date: February 9, 2021
Subject: Radar and Airspace Obstruction Evaluation Studies Update

The intent of this memorandum is to clarify the project name, Solano 4 Wind Project (Project), and the Project configuration presented in the following documents:

- Solano 4 Radar Line of Site Studies.pdf
- Solano 4 Obstruction Evaluation Studies.pdf

The Solano 4 Wind Project consists of Solano 4 West and Solano 4 East. Within the documents Solano 4 West is referred to as Solano Phase 4 and Solano 4 East is referred to as Solano Phase 1 Repower.

The Solano 4 Wind Project, as presented in our FAA aeronautical studies filings, consists of only one wind turbine configuration: (19) 591-foot above ground level (AGL) turbines. While considered in the following studies, the (22) 493-foot AGL option for the project was not pursued due to the negative impacts on radar.

SOLANO PHASE 1 REPOWER WIND PROJECT

BASIC RADAR LINE-OF-SIGHT STUDY

APRIL 16, 2018

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Suite 100
Norman, Oklahoma 73072
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INTRODUCTION

The Solano Phase 1 Repower Wind Project (Project) will consist of 10 Vestas V136 (V136) wind turbines at a blade-tip height of 493 feet above ground level (AGL) or nine Vestas V150 (V150) wind turbines at a blade-tip height of 591 feet AGL. [1] Development of this Project will include a repower of the 23 existing Vestas V47 (V47) wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL.

Westslope Consulting, LLC (Westslope) prepared this report to determine whether this repower initiative will have an effect on nearby radar sites. Westslope conducted a radar line-of-sight (RLOS) analysis or Next Generation Radar (NEXRAD) weather radar screening analysis as appropriate for each of the proposed wind turbine heights and included analyses of the existing V47 wind turbines for comparison purposes.

This report provides the results of a Basic Radar Line-of-Sight Study conducted by Westslope, which includes the following:

- An initial analysis using the Department of Defense (DoD) Preliminary Screening Tool (PST);
- Research into other radar sites near the Project;
- A RLOS analysis for each radar site identified by Westslope using wind turbine blade-tip heights of 242 feet AGL, 291 feet AGL, 493 feet AGL, and 591 feet AGL; and
- A NEXRAD weather radar screening analysis using wind turbine blade-tip heights of 242 feet AGL, 291 feet AGL, 493 feet AGL, and 591 feet AGL.

ANALYSIS

Preliminary Screening Tool

Westslope conducted an initial analysis for Long Range Radar (LRR) and NEXRAD weather radar using the PST on the Federal Aviation Administration (FAA) Obstruction Evaluation/Airport Airspace Analysis website.[2] This analysis provides a cursory indication whether wind turbines may be visible, that is, within radar line-of-sight to one or more radar sites, and likely to affect radar performance.

The PST LRR analysis accounts for Air Route Surveillance Radar sites and a few select Airport Surveillance Radar sites used for air defense and homeland security.[3] The PST does not account for all DoD, Department of Homeland Security (DHS), and/or FAA surface-based or tethered aerostat radar sites. Further, the PST NEXRAD analysis accounts for Weather Surveillance Radar model-88D (WSR-88D) radar sites but does not account for FAA Terminal Doppler Weather Radar sites.[4]

[1] SMUD_Phase4_Turbine Location and Height Data 2.20.18.xlsx.
[2] See http://oeaaa.faa.gov.
[3] For LRR, the PST uses a buffered radar line-of-sight analysis at a blade-tip height of 750 feet AGL.
[4] For NEXRAD, the PST uses a blade-tip height of 160 meters AGL (525 feet AGL).

The PST is helpful for identifying potential impacts to LRR and NEXRAD; however, the results are preliminary, as suggested by the title of the PST, and do not provide an official decision as to whether impacts are acceptable to operations.

It should be noted that the PST NEXRAD analysis does not reflect the wind farm impact zone scheme recently updated by the National Oceanic and Atmospheric Administration (NOAA) WSR-88D Radar Operations Center (ROC). The updated scheme expands the red area, or "No Build Zone", from three to four kilometers (km) and to areas where wind turbines penetrate the third elevation angle scanned by a WSR-88D.

Based on the location of the existing V47 wind turbines and the proposed V136 and V150 wind turbine layouts, Westslope created a single point and a polygon for analysis purposes.

The PST analysis results for LRR show that the single point and the polygon fall within yellow areas. Yellow indicates that impacts are likely to air defense and homeland security radar. See Figure 1, where the black rotor represents the single point and the black lines represent the polygon, both created by Westslope, the black dots represent the 23 existing V47 wind turbines, the green dots represent the 10 V136 wind turbines, and the red dots represent the nine V150 wind turbines.

Westslope identified the radar sites in the PST LRR results as the Mill Valley Air Route Surveillance Radar model-4 (ARSR-4), McClellan Airport Surveillance Radar model-9 (ASR-9), and the Stockton Airport Surveillance Radar model-11 (ASR-11). In addition to the DoD and DHS using these radar sites for national defense, the FAA uses these radar sites for air traffic control at multiple facilities including Northern California Terminal Radar Approach Control (TRACON), Oakland Air Route Traffic Control Center, and Travis Air Force Base (AFB) Air Traffic Control Tower (ATCT)/Radar Approach Control (RAPCON).

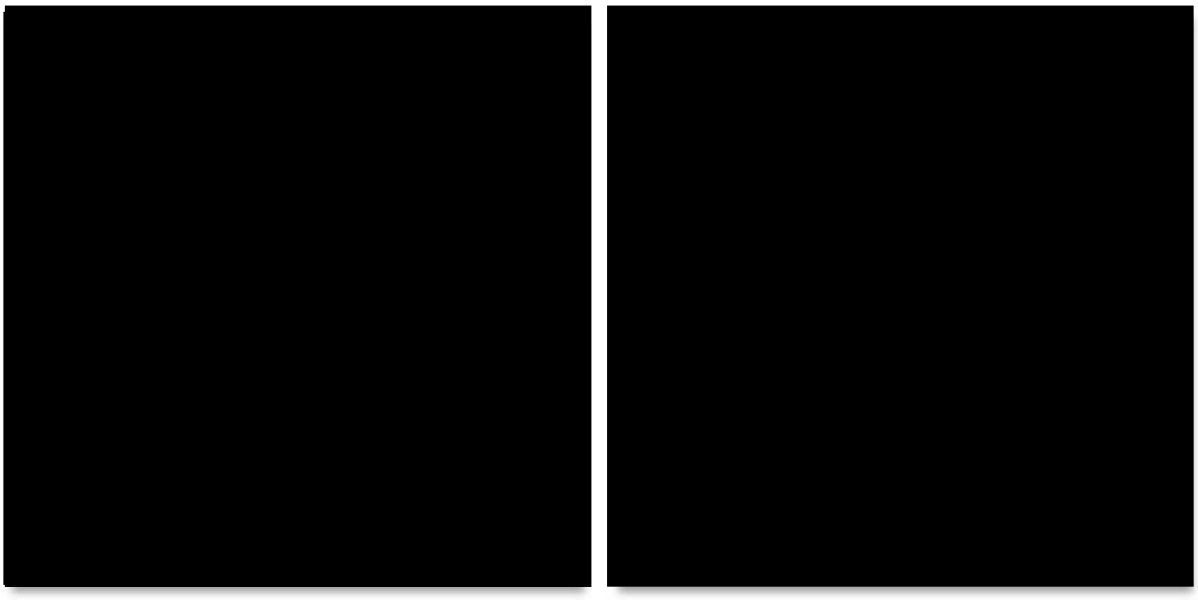

Figure 1 Long Range Radar Results for the Single Point (left) and for the Polygon (right)

For NEXRAD, the PST analysis results show that the single point and the polygon fall within a dark green area, or "Notification Zone", which indicates that some impacts are possible to WSR-88D operations and that consultation with NOAA is optional. See Figure 2. Westslope identified the radar site in the PST NEXRAD analysis as the Sacramento WSR-88D.

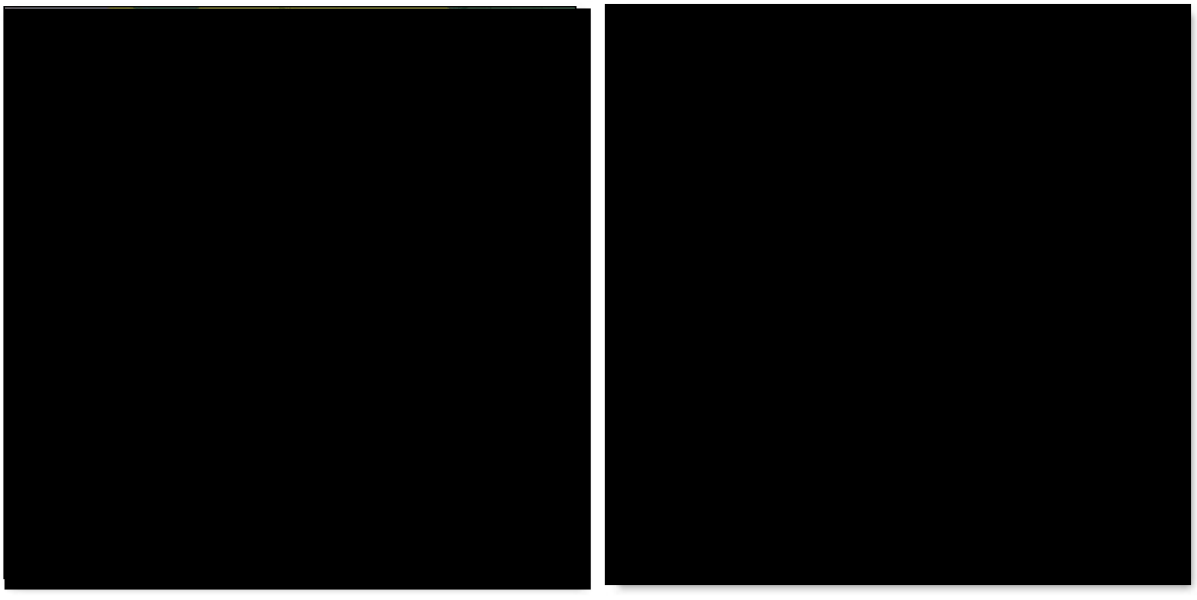

Figure 2 NEXRAD results for the Single Point (left) and for the Polygon (right)

Other Radar Sites

Research performed by Westslope shows four additional radar sites near the Project: the Moffett ASR-9, Oakland ASR-9, Travis AFB Digital Airport Surveillance Radar (DASR), and the San Francisco WSR-88D.

The DoD uses the Travis AFB DASR for air traffic control at Travis AFB ATCT/RAPCON facilities. The FAA uses the Moffett ASR-9 and Oakland ASR-9 for air traffic control at multiple facilities including Oakland TRACON and Northern California TRACON.

Co-Located Secondary Surveillance Radar

A secondary surveillance radar is co-located with each primary surveillance radar. Specifically, an Air Traffic Control Beacon Interrogator model-6 (ATCBI-6) is co-located with the Mill Valley ARSR-4; a Mode S is co-located with the Moffett ASR-9, the Oakland ASR-9, and the McClellan ASR-9; and a Monopulse Secondary Surveillance Radar is co-located with the Stockton ASR-11 and the Travis AFB DASR.

In general, secondary surveillance radar (SSR) are less susceptible to interference from wind turbines than primary surveillance radar.

SSR Only Radar Sites

Westslope also located a SSR only radar site near the Project: the Sacramento ATCBI-6.

Basic RLOS Analysis

Westslope conducted a basic radar line-of-sight analysis using the United States Geological Survey 10-meter National Elevation Dataset (NED). This analysis shows whether the 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL or the nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to one or more radar sites. Westslope also conducted a radar line-of-sight analysis for the existing 23 V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL for comparison purposes.

Westslope performed the radar line-of-sight analysis for the following seven radar sites:

- McClellan ASR-9;
- Mill Valley ARSR-4;
- Moffett ASR-9;
- Oakland ASR-9;
- Sacramento ATCBI-6;
- Stockton ASR-11; and
- Travis AFB DASR.

McClellan ASR-9

The radar line-of-sight analysis results show that 11 of the 23 existing V47 wind turbines at a blade-tip height of 242 feet AGL and 19 of the 23 V47 wind turbines at a blade-tip height of 291 feet AGL are visible to the McClellan ASR-9. See Figure 3. Existing radar effects include unwanted primary radar returns (clutter) resulting in a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the 11 to 19 V47 wind turbines within radar line-of-sight. Other possible radar effects include a partial loss of weather detection and false weather indications over and in the immediate vicinity of the 11 to 19 V47 wind turbines within radar line-of-sight.

Further, the radar line-of-sight analysis results show that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the McClellan ASR-9. See Figure 4.

Based on the fact that between 11 and 19 of the 23 existing V47 wind turbines are visible to and interfering with the McClellan ASR-9 and up to 10 proposed wind turbines will be visible to and will interfere with the McClellan ASR-9, Westslope does not expect that the V136 or V150 wind turbines will result in a material difference to the existing radar effects.

Mill Valley ARSR-4

The radar line-of-sight analysis results show that two of the 23 existing V47 wind turbines are visible to the Mill Valley ARSR-4 at blade-tip heights of 242 feet AGL and 291 feet AGL. See Figure 5. Existing radar effects include an occasional loss of primary radar target detection and an occasional primary radar false target over and in the immediate vicinity of the two V47 wind turbines within radar line-of-sight.

Further, the radar line-of-sight analysis results show that five of the 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and four of the nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Mill Valley ARSR-4. See Figure 6.

Based on the fact that the two of the existing V47 wind turbines are visible to and interfering with the Mill Valley ARSR-4 and up to five of the proposed wind turbines will be visible to and will interfere with the Mill Valley ARSR-4, Westslope does not expect that the V136 or V150 wind turbines will result in a material difference to the existing radar effects.

Moffett ASR-9

The radar line-of-sight analysis results show that wind turbines up to 591 feet AGL will not be visible to the Moffett ASR-9. As a result, Westslope does not expect any radar effects at this height or below.

Oakland ASR-9

The radar line-of-sight analysis results show that wind turbines up to 591 feet AGL will not be visible to the Oakland ASR-9. As a result, Westslope does not expect any radar effects at this height or below.

Sacramento ATCBI-6

The radar line-of-sight analysis results show that all 23 existing V47 wind turbines are visible to the Sacramento ATCBI-6 at blade-tip heights of 242 feet AGL and 291 feet AGL. See Figure 7. The radar line-of-sight analysis results show that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Sacramento ATCBI-6. See Figure 8.

As noted above, secondary surveillance radar, such as the ATCBI-6, are less susceptible to interference from wind turbines. As such, Westslope does not expect any effects from the proposed V136 or V150 wind turbines to the Sacramento ATCBI-6.

Stockton ASR-11

The radar line-of-sight analysis results show that all 23 existing V47 wind turbines are visible to the Stockton ASR-11 at blade-tip heights of 242 feet AGL and 291 feet AGL. See Figure 9. Existing radar

effects include a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the V47 wind turbines. Other possible radar effects include a partial loss of weather detection and false weather indications over and in the immediate vicinity of the existing V47 wind turbines.

Further, the radar line-of-sight analysis results show that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Stockton ASR-11. See Figure 10.

Based on the fact that all 23 existing V47 wind turbines are visible to and interfering with the Stockton ASR-11 and up to 10 proposed wind turbines will be visible to and will interfere with the Stockton ASR-11, Westslope expects a decrease to the existing radar effects with the V136 or V150 wind turbines.

Travis AFB DASR

The radar line-of-sight analysis results show that all 23 existing V47 wind turbines are visible to the Travis AFB DASR at blade-tip heights of 242 feet AGL and 291 feet AGL. See Figure 11. Existing radar effects include a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the V47 wind turbines. Other possible radar effects include a partial loss of weather detection and false weather indications over and in the immediate vicinity of the existing V47 wind turbines.

Further, the radar line-of-sight analysis results show that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Travis AFB DASR. See Figure 12.

Based on the fact that all 23 existing V47 wind turbines are visible to and interfering with the Travis AFB DASR and up to 10 proposed wind turbines will be visible to and will interfere with the Travis AFB DASR, Westslope expects a decrease to the existing radar effects with the V136 or V150 wind turbines.

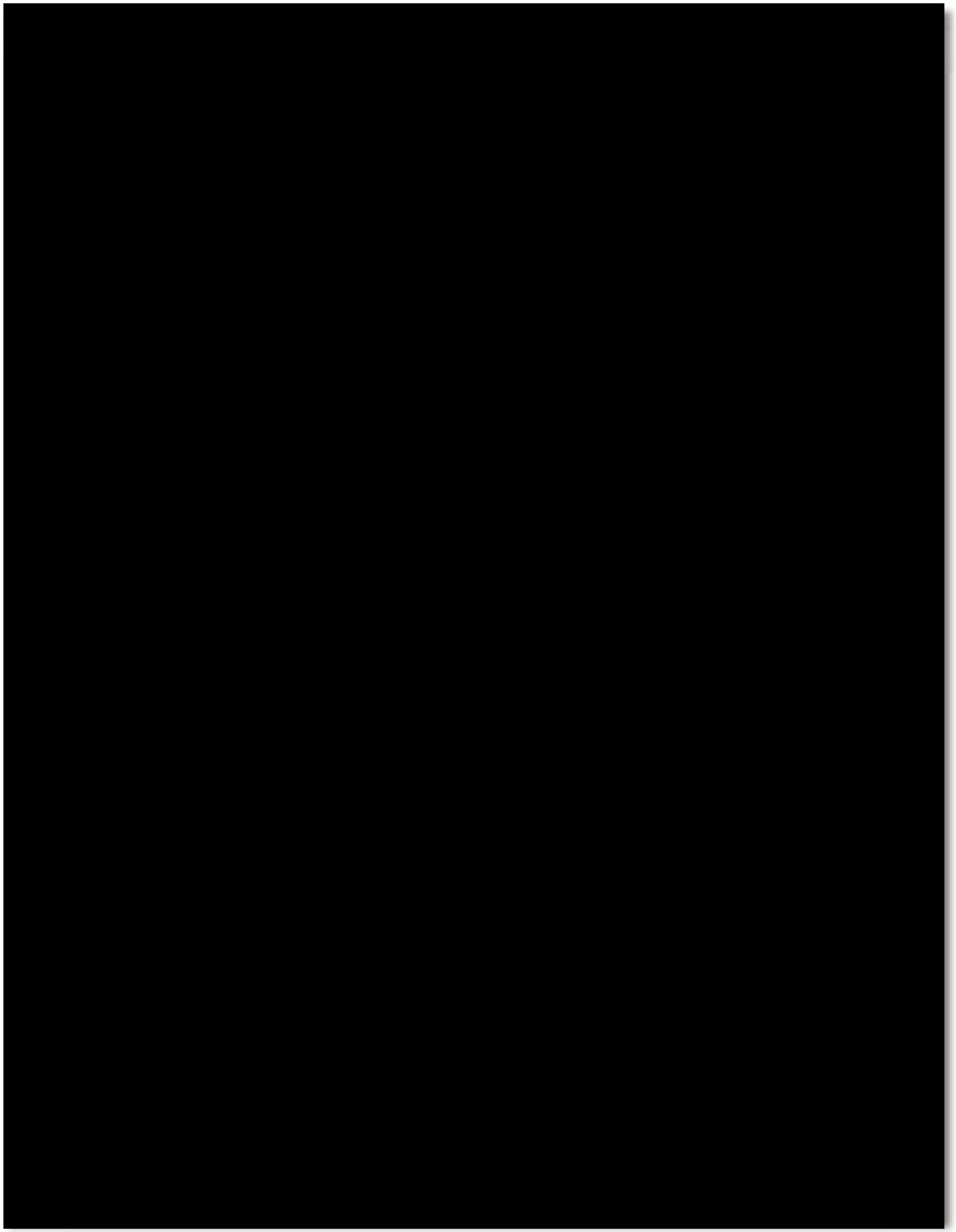

Figure 3 RLOS Analysis Results at 242 feet AGL and 291 feet AGL for the McClellan ASR-9

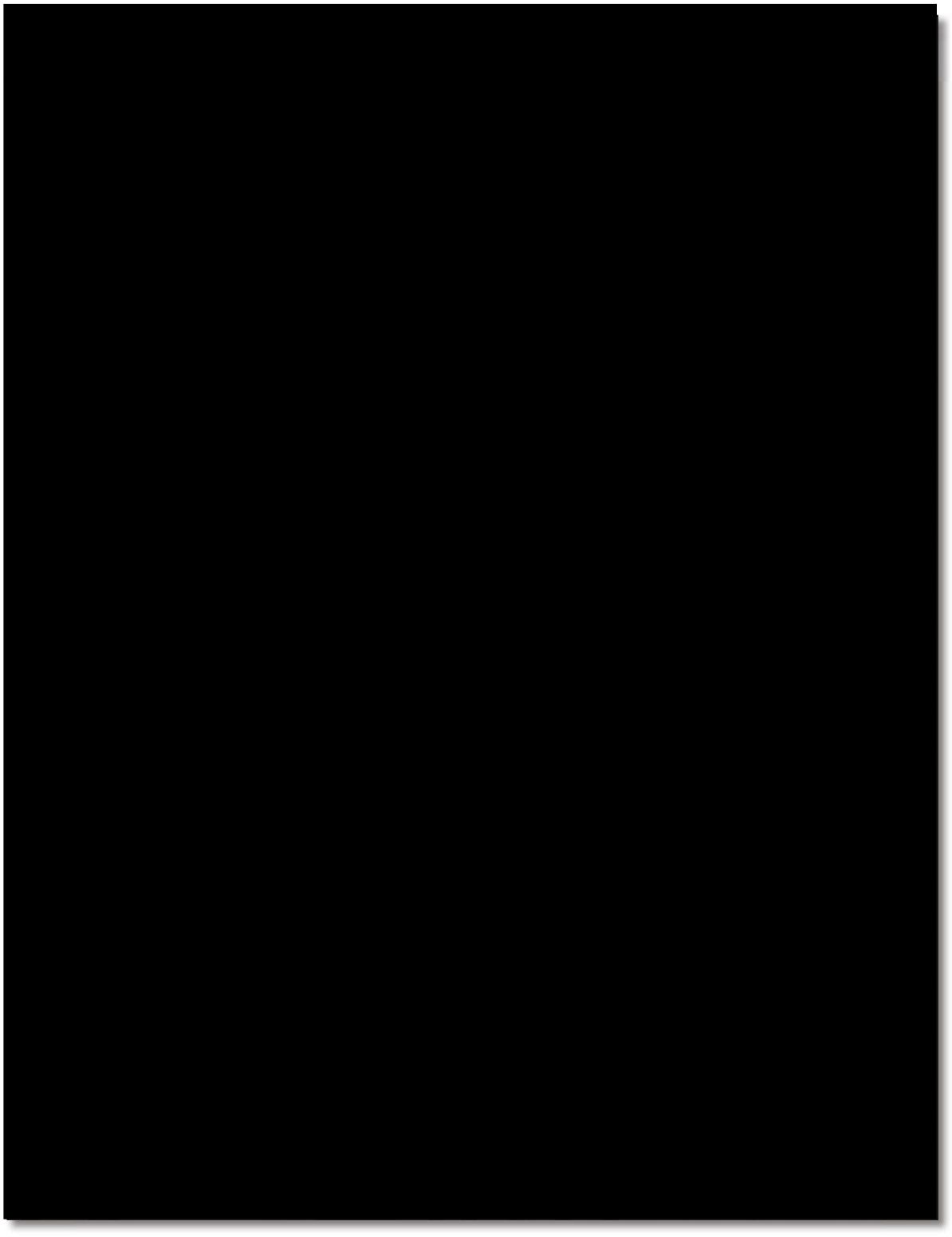

Figure 4 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the McClellan ASR-9

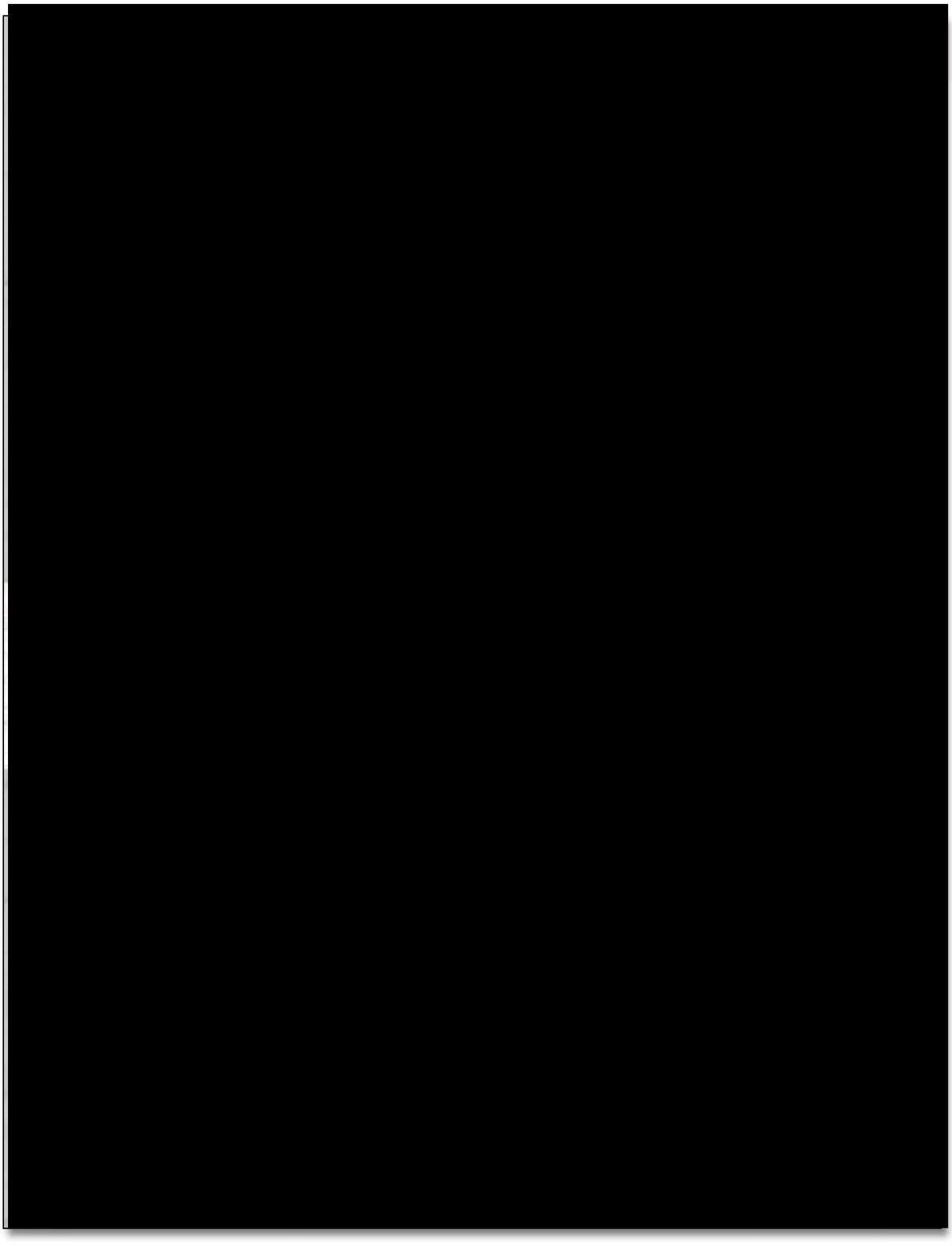

Figure 5 RLOS Analysis Results at 242 feet AGL and 291 feet AGL for the Mill Valley ARSR-4

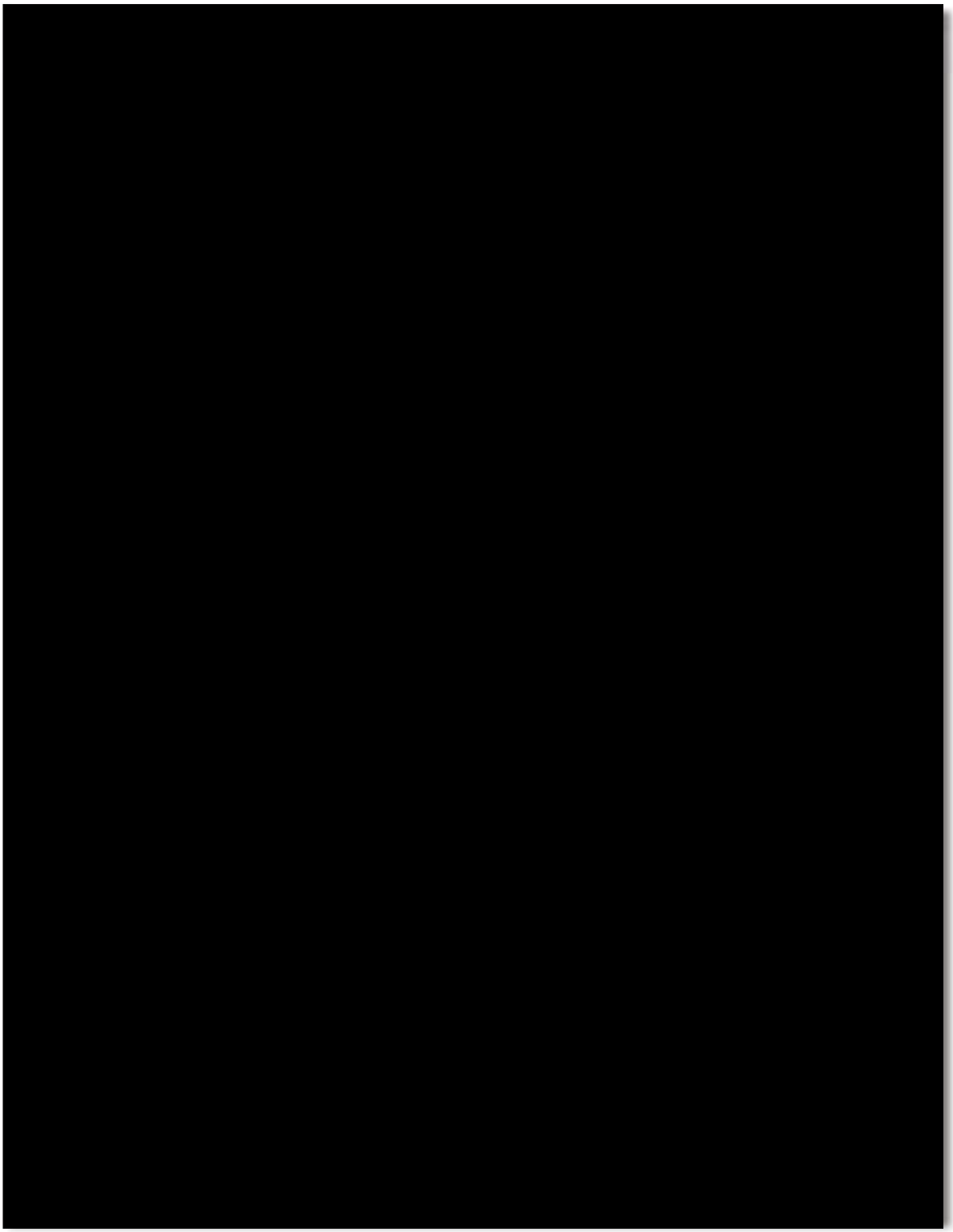

Figure 6 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Mill Valley ARSR-4

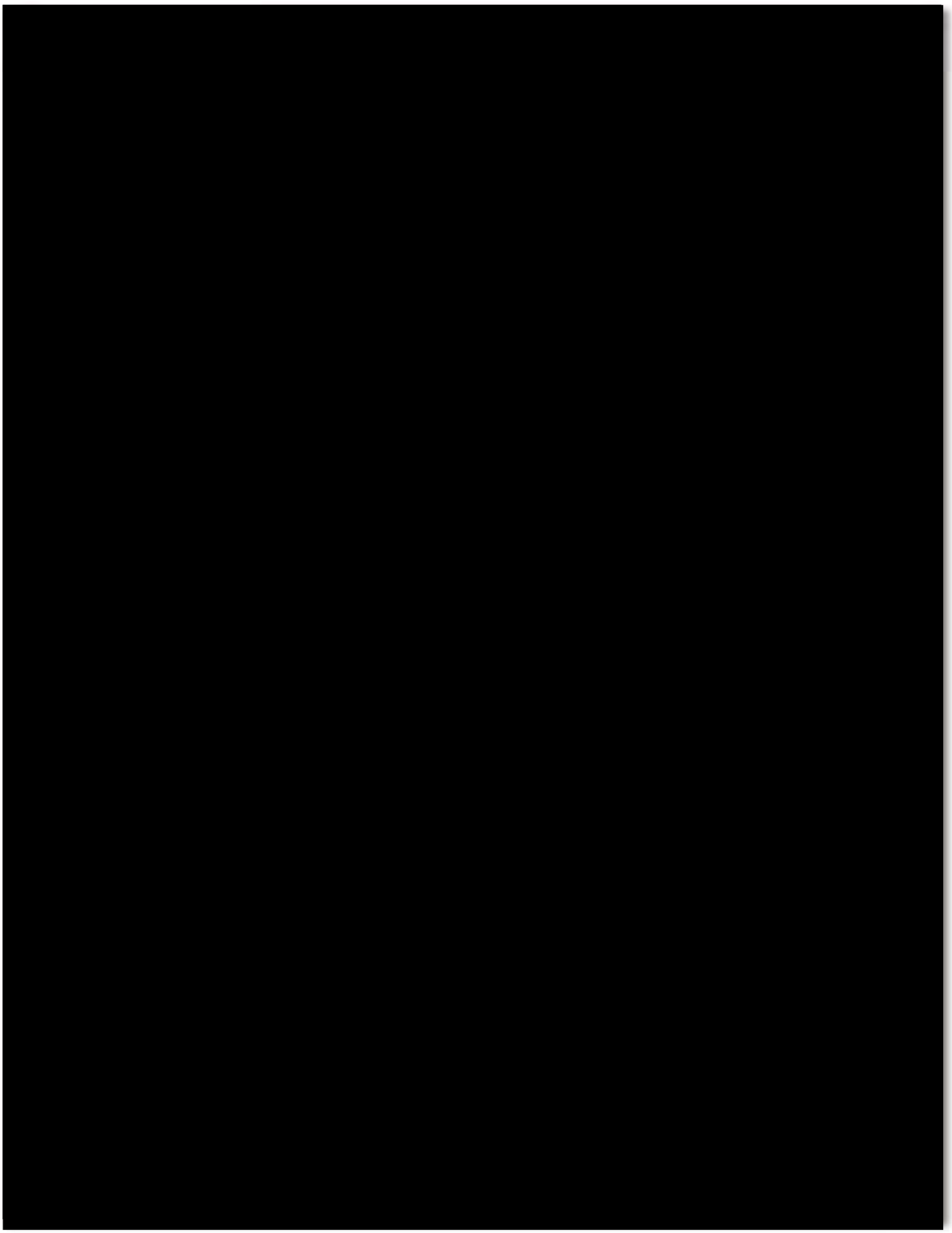

Figure 7 RLOS Analysis Results at 242 feet AGL and 291 feet AGL for the Sacramento ATCBI-6

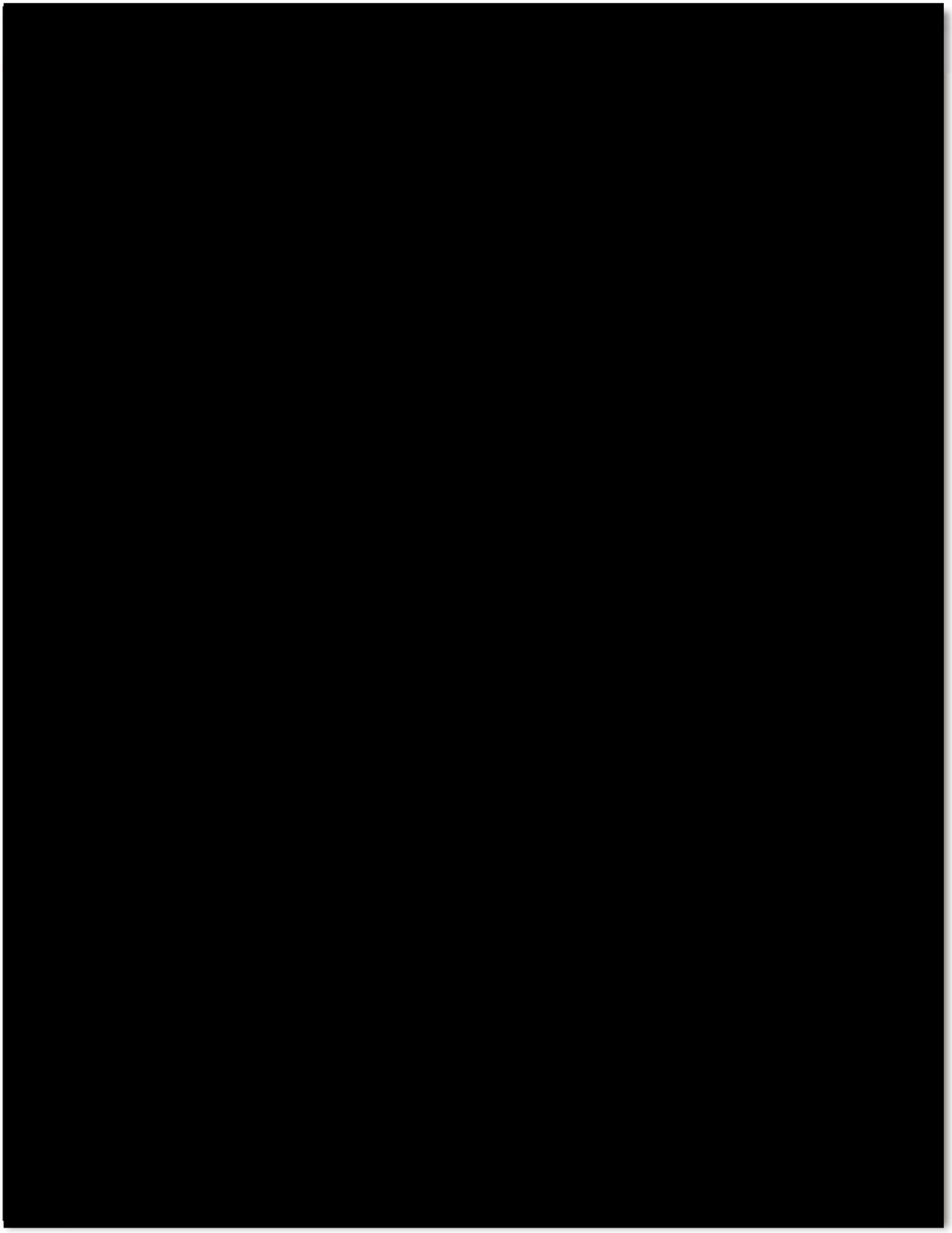

Figure 8 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Sacramento ATCBI-6

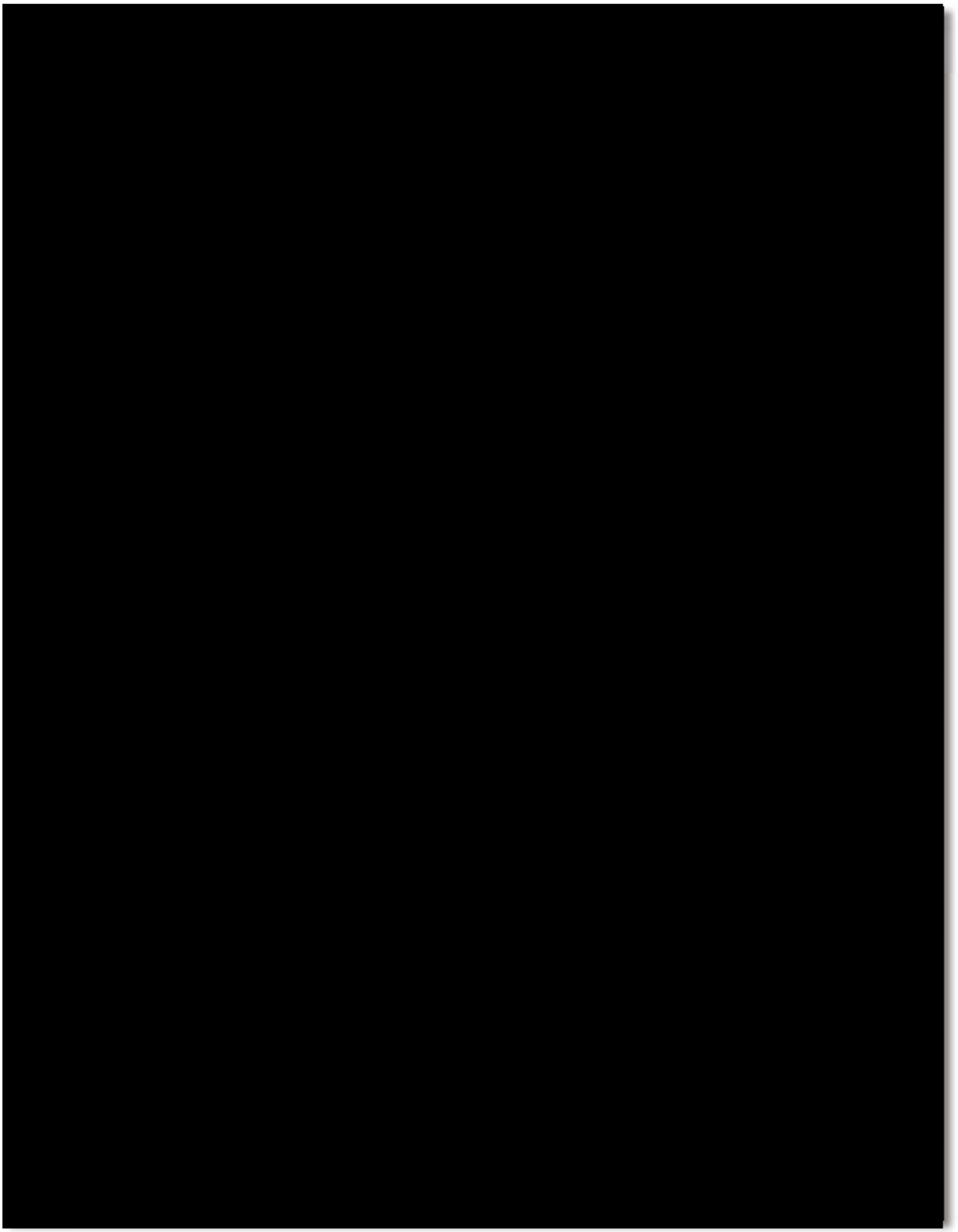

Figure 9 RLOS Analysis Results at 242 feet AGL and 291 feet AGL for the Stockton ASR-11

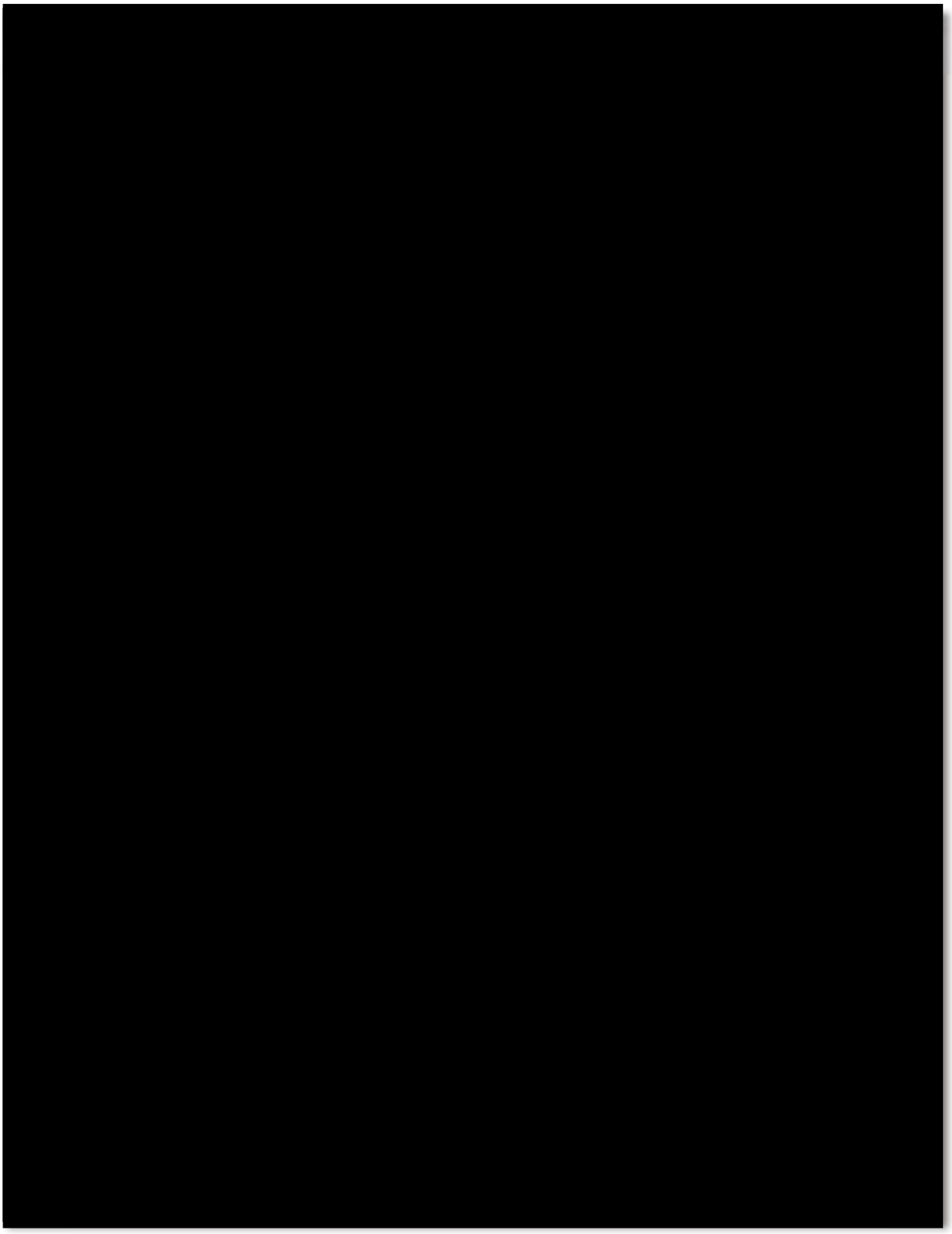

Figure 10 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Stockton ASR-11

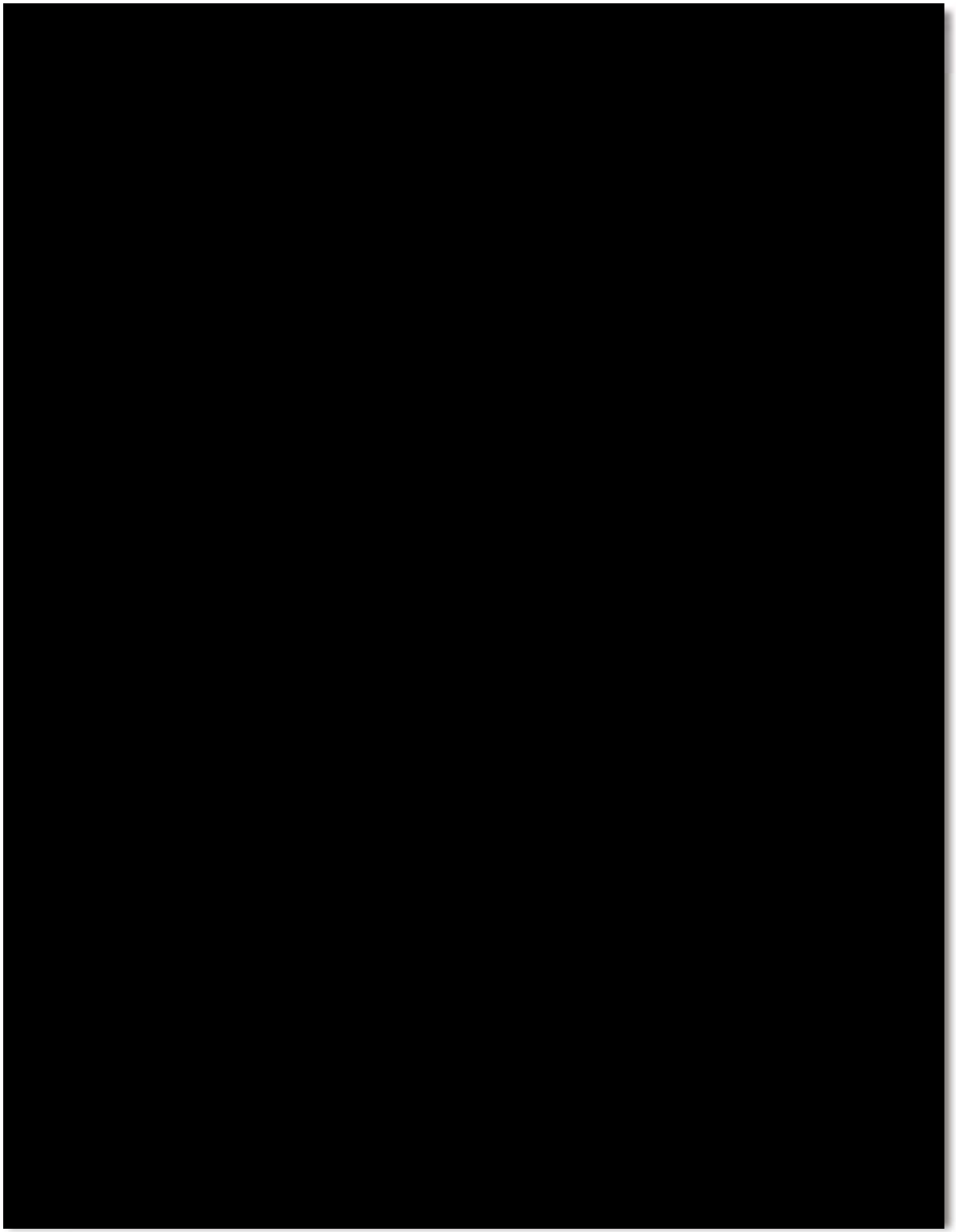

Figure 11 RLOS Analysis Results at 242 feet AGL and 291 feet AGL for the Travis AFB DASR

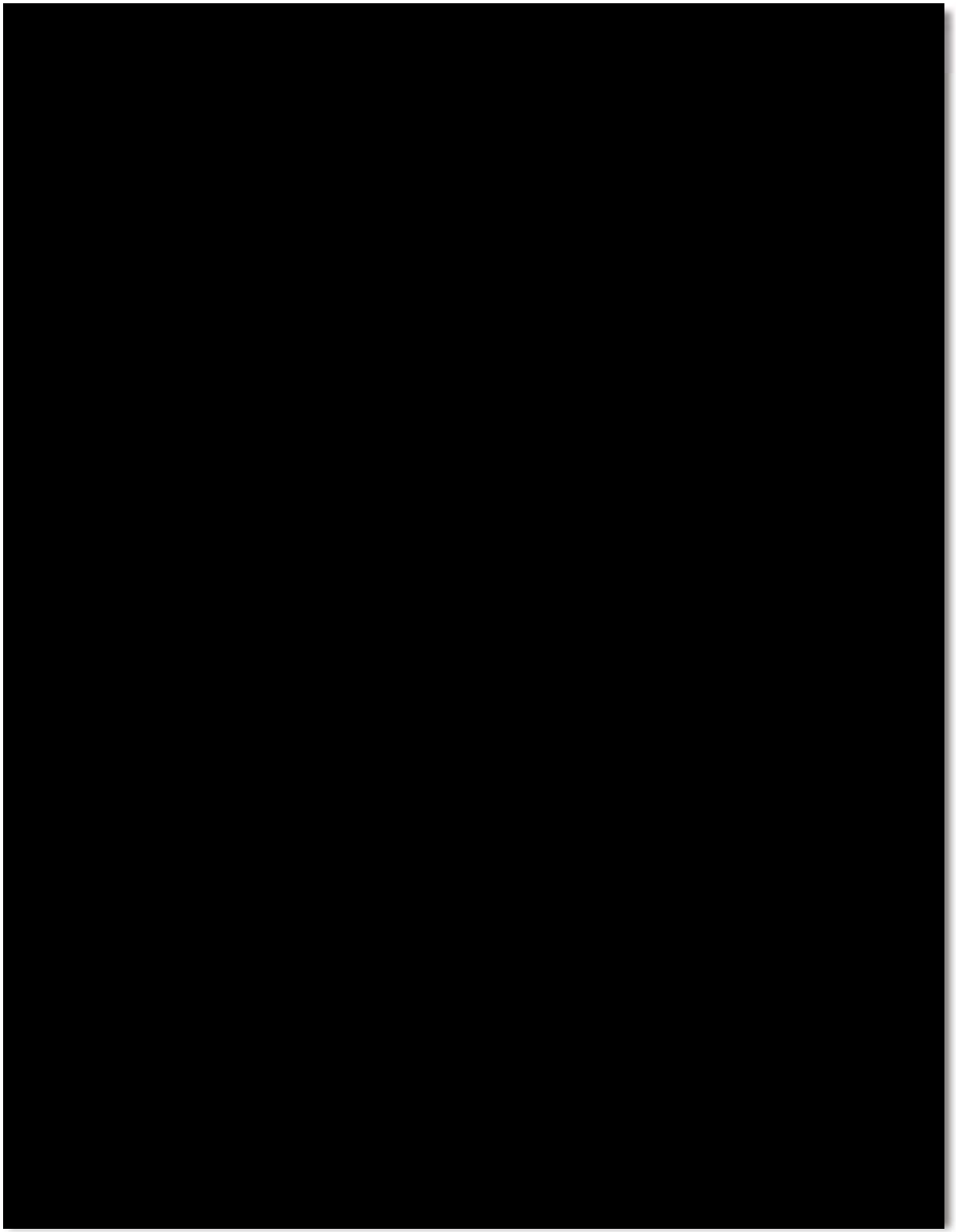

Figure 12 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Travis AFB DASR

NEXRAD Weather Radar Screening Analysis

The PST NEXRAD analysis does not reflect the wind farm impact zone scheme recently updated by the NOAA WSR-88D ROC. The updated scheme expands the red area, or "No Build Zone", from three to four km and to areas where wind turbines penetrate the third elevation angle scanned by a WSR-88D.

Westslope conducted a NEXRAD weather radar screening analysis using the 10-meter NED. This analysis shows whether wind turbines at blade-tip heights of 493 feet AGL and 591 feet AGL will be within radar line-of-sight to one or more WSR-88D radar sites and incorporates the updated wind farm impact zone scheme. Westslope also conducted a NEXRAD weather radar screening analysis for the existing 23 V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL for comparison purposes.

Westslope performed the NEXRAD weather radar screening analysis for the following two radar sites:

- Sacramento WSR-88D; and
- San Francisco WSR-88D.

Sacramento WSR-88D

Westslope's NEXRAD weather radar screening analysis for the Sacramento WSR-88D shows that the 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL are visible to the Sacramento WSR-88D. See Figure 13. Although all 23 V47 wind turbines are within radar line-of-sight, the screening analysis results show that these wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL fall within a green area. A green area, or "No Impact Zone", indicates that impacts are not likely to WSR-88D operations. See Figures 14 and 15.

As such, Westslope assumes there are no existing impacts to Sacramento WSR-88D operations as a result of the existing V47 wind turbines.

The NEXRAD weather radar screening analysis for the Sacramento WSR-88D shows that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Sacramento WSR-88D. See Figure 16. The screening analysis results also show that at a blade-tip height of 493 feet AGL, seven of the 10 proposed V136 wind turbines fall within a dark green area and the remaining three wind turbines fall within a green area. A dark green area, or "Notification Zone", indicates that some impacts are possible to WSR-88D operations and that consultation with NOAA is optional. See Figure 17. Further, at a blade-tip height of 591 feet AGL, all nine proposed V150 wind turbines fall within a dark green area. See Figure 18.

Additional radar effects as a result of the proposed V136 or V150 wind turbines will include Doppler contamination and false weather indications over and in the immediate vicinity of the Project due to clutter; however, based on the screening analysis results, impacts to Sacramento WSR-88D operations

are both possible and not likely depending upon the location and blade-tip height of the proposed wind turbines within the Project.

San Francisco WSR-88D

Westslope's NEXRAD weather radar screening analysis for the San Francisco WSR-88D shows that the 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL or 291 feet AGL are not visible to the San Francisco WSR-88D. The screening analysis results also show that at blade-tip heights of 242 feet AGL and 291 feet AGL, all 23 existing V47 wind turbines fall within a green area. See Figures 19 and 20.

As such, Westslope assumes there are no existing impacts to San Francisco WSR-88D operations as a result of the existing V47 wind turbines.

The NEXRAD weather radar screening analysis for the San Francisco WSR-88D shows that the 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and the nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will not be visible to the San Francisco WSR-88D. Further, the screening analysis results show that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine V150 proposed wind turbines at a blade-tip height of 591 feet AGL fall within a green area. See Figures 21 and 22.

Westslope does not expect impacts to San Francisco WSR-88D operations for the V136 or V150 wind turbines.

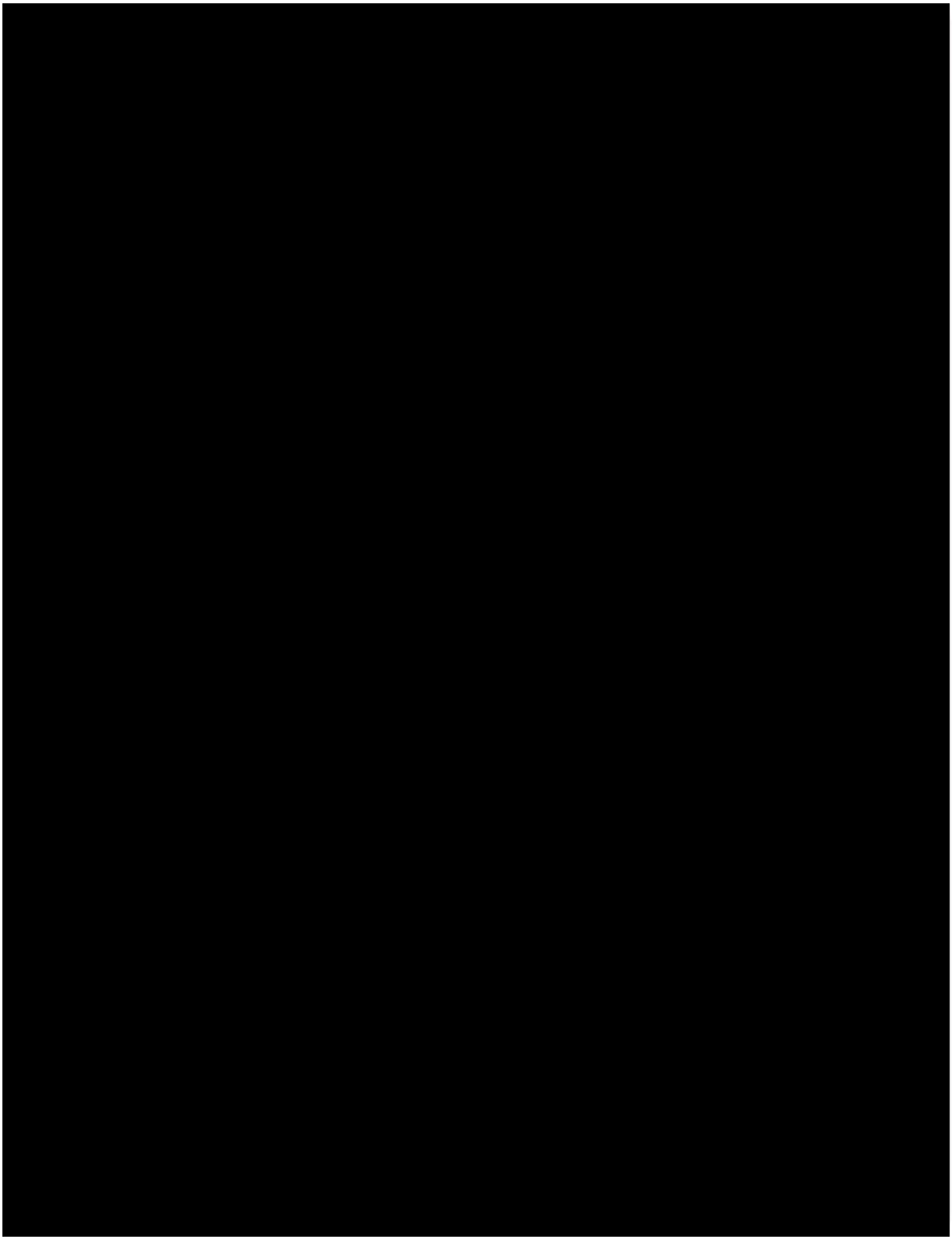

Figure 13 RLOS Analysis Results at 242 feet AGL and 291 feet AGL for the Sacramento WSR-88D

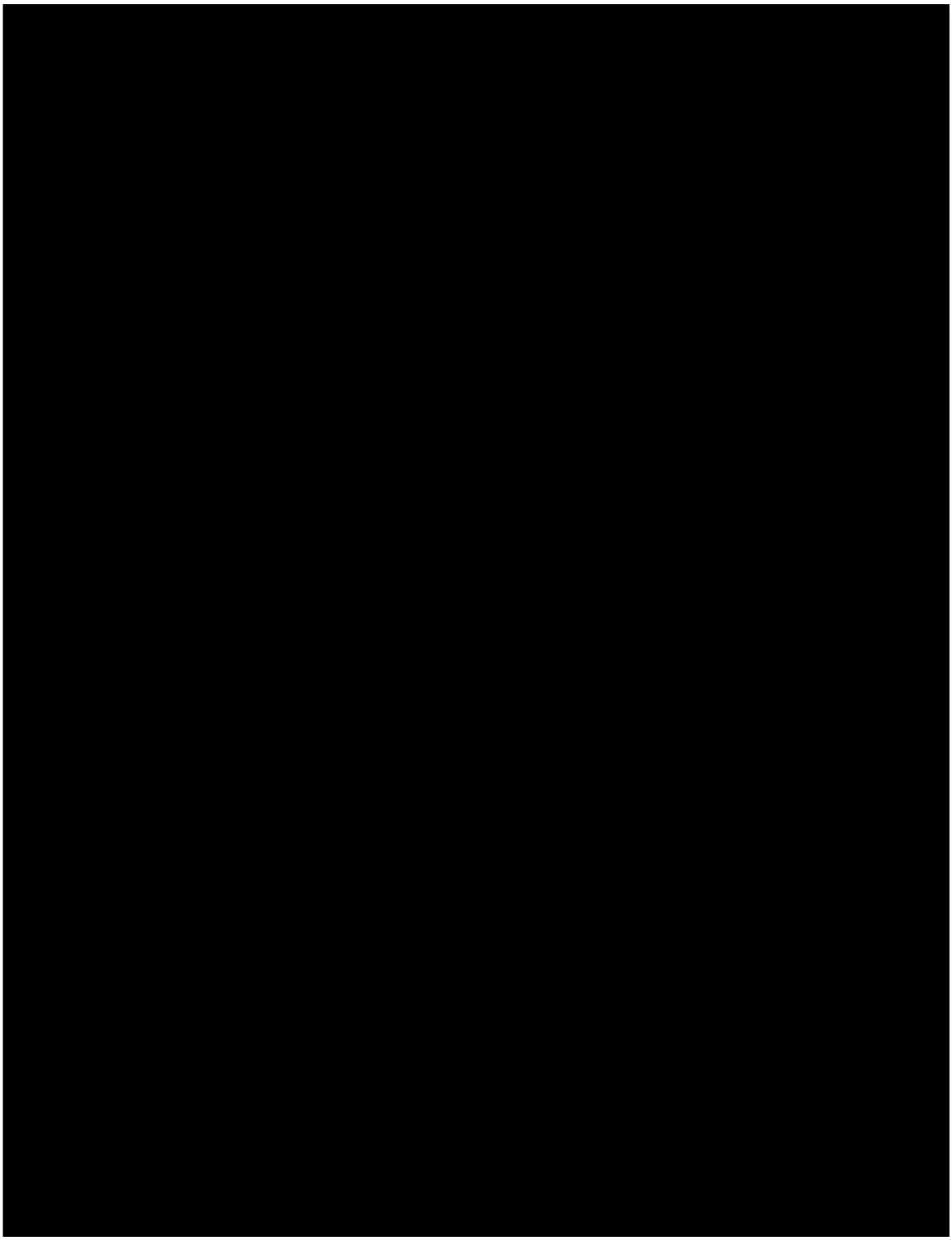

Figure 14 Impact Zone Analysis Results at 242 feet AGL for the Sacramento WSR-88D

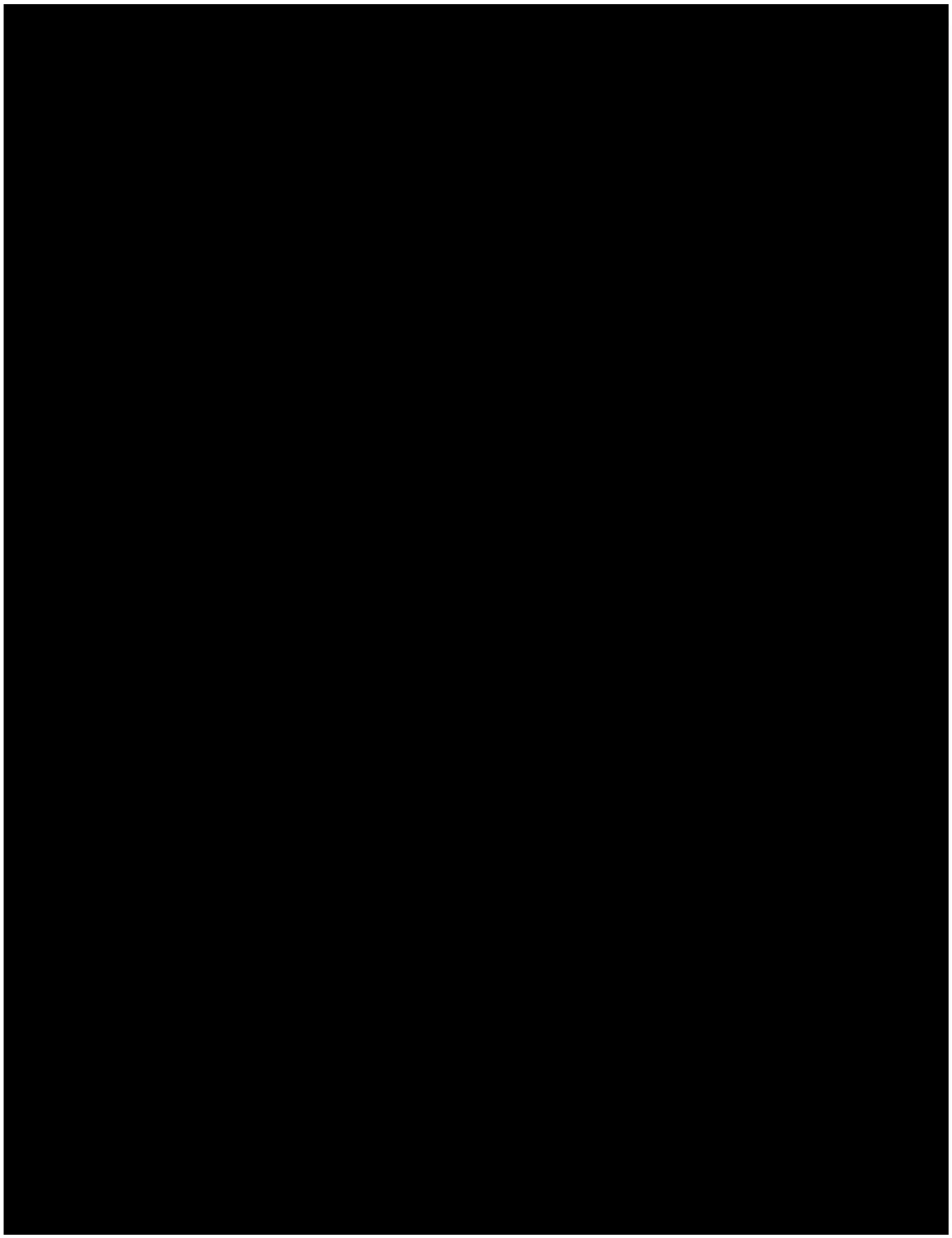

Figure 15 Impact Zone Analysis Results at 291 feet AGL for the Sacramento WSR-88D

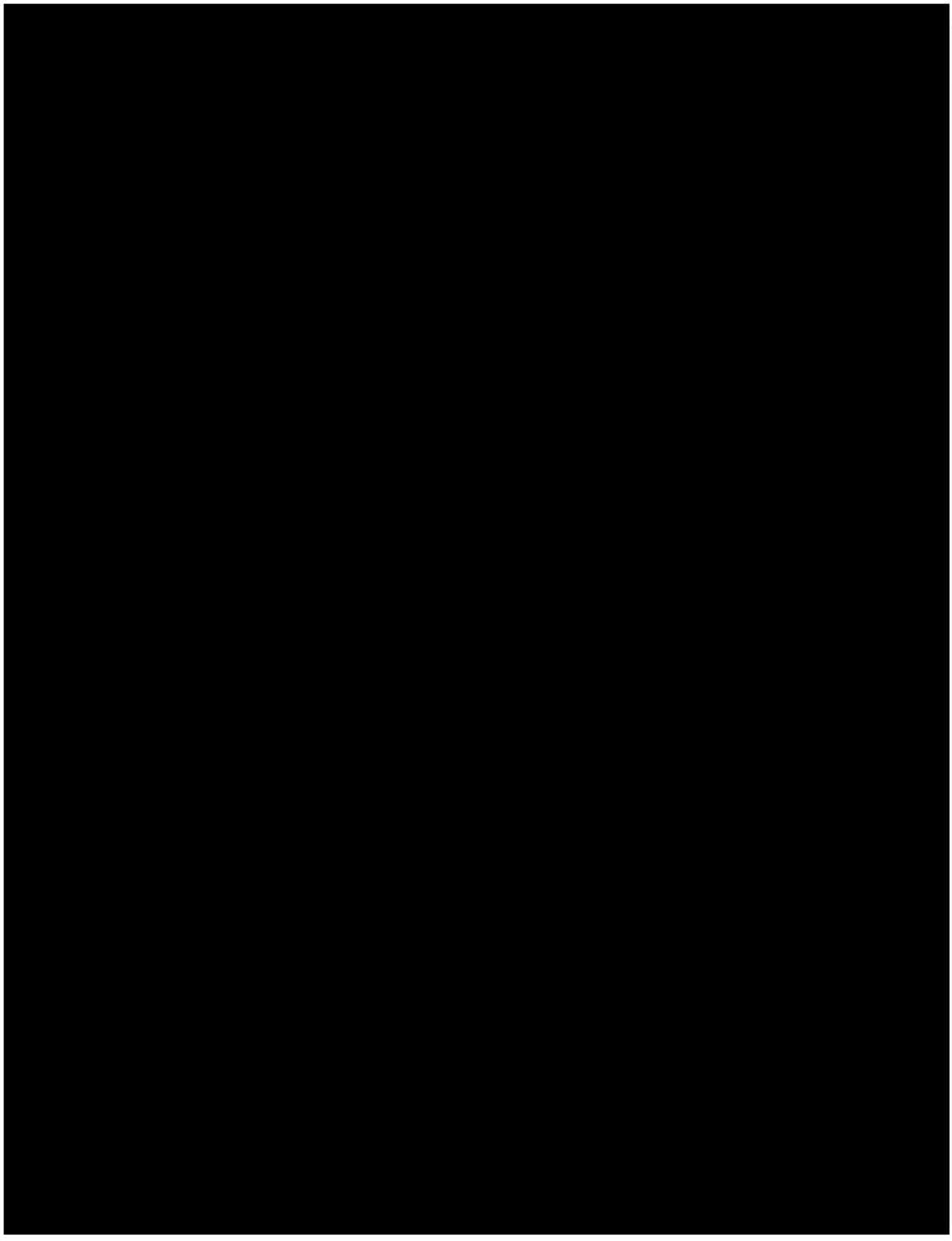

Figure 16 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Sacramento WSR-88D

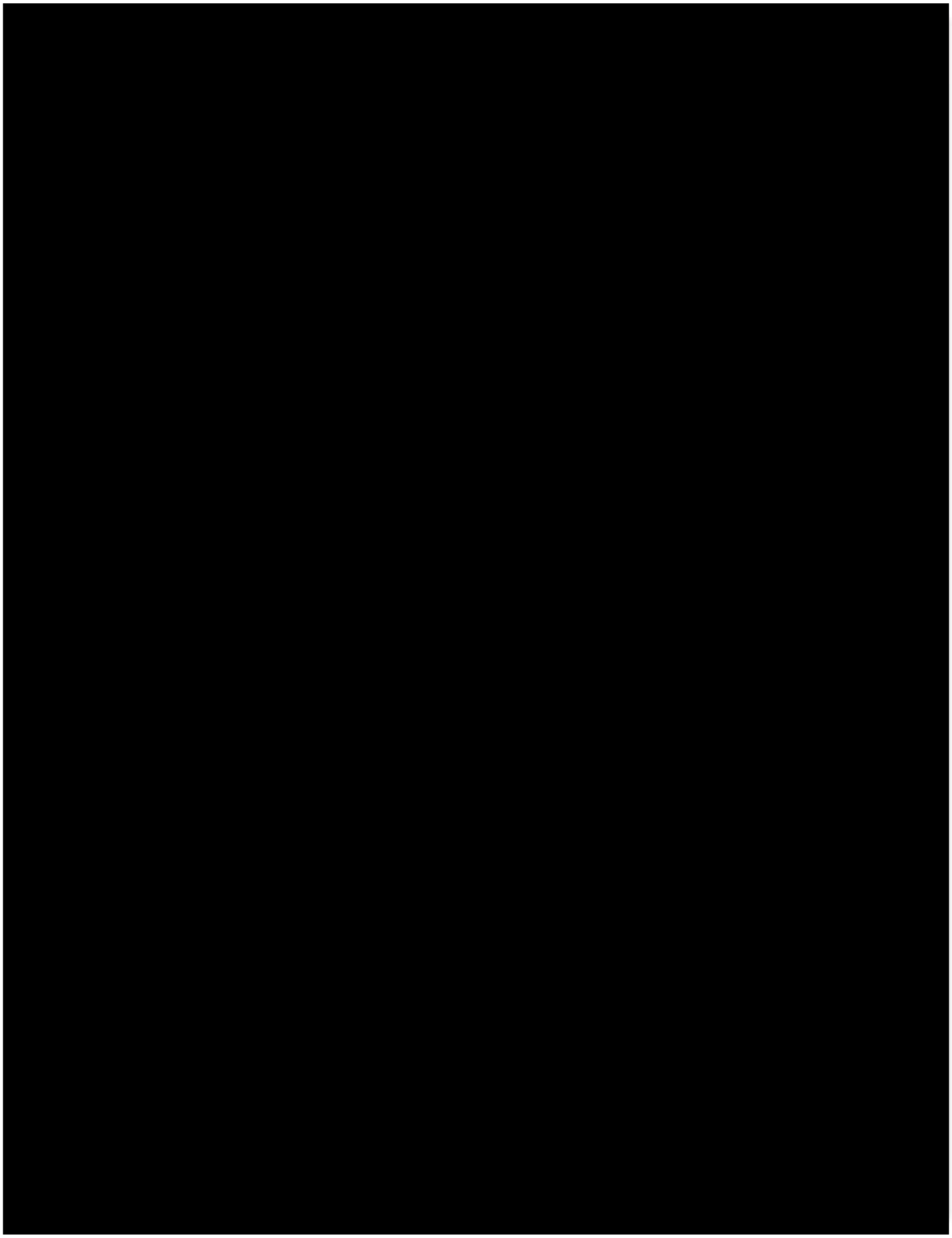

Figure 17 Impact Zone Analysis Results at 493 feet AGL for the Sacramento WSR-88D

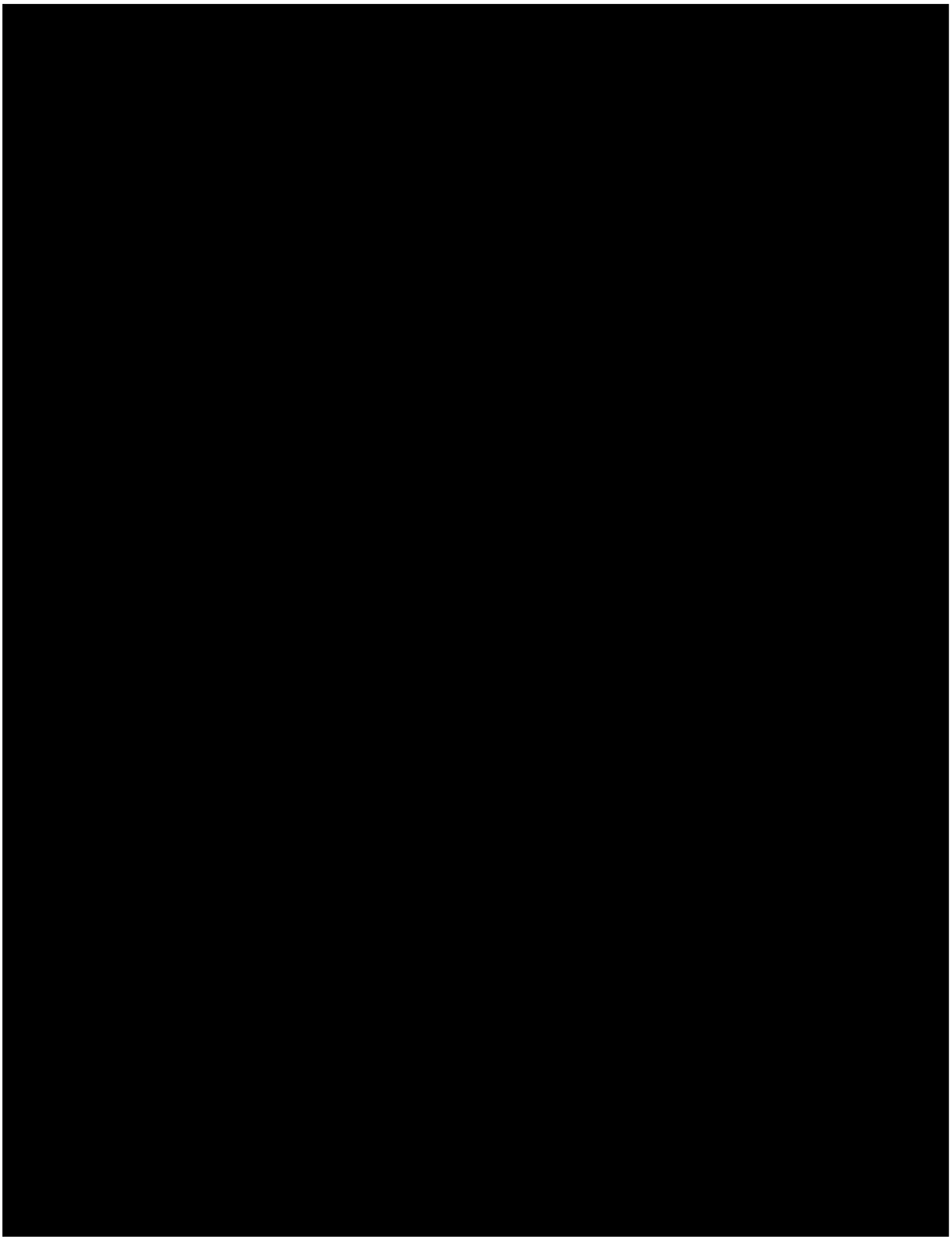

Figure 18 Impact Zone Analysis Results at 591 feet AGL for the Sacramento WSR-88D

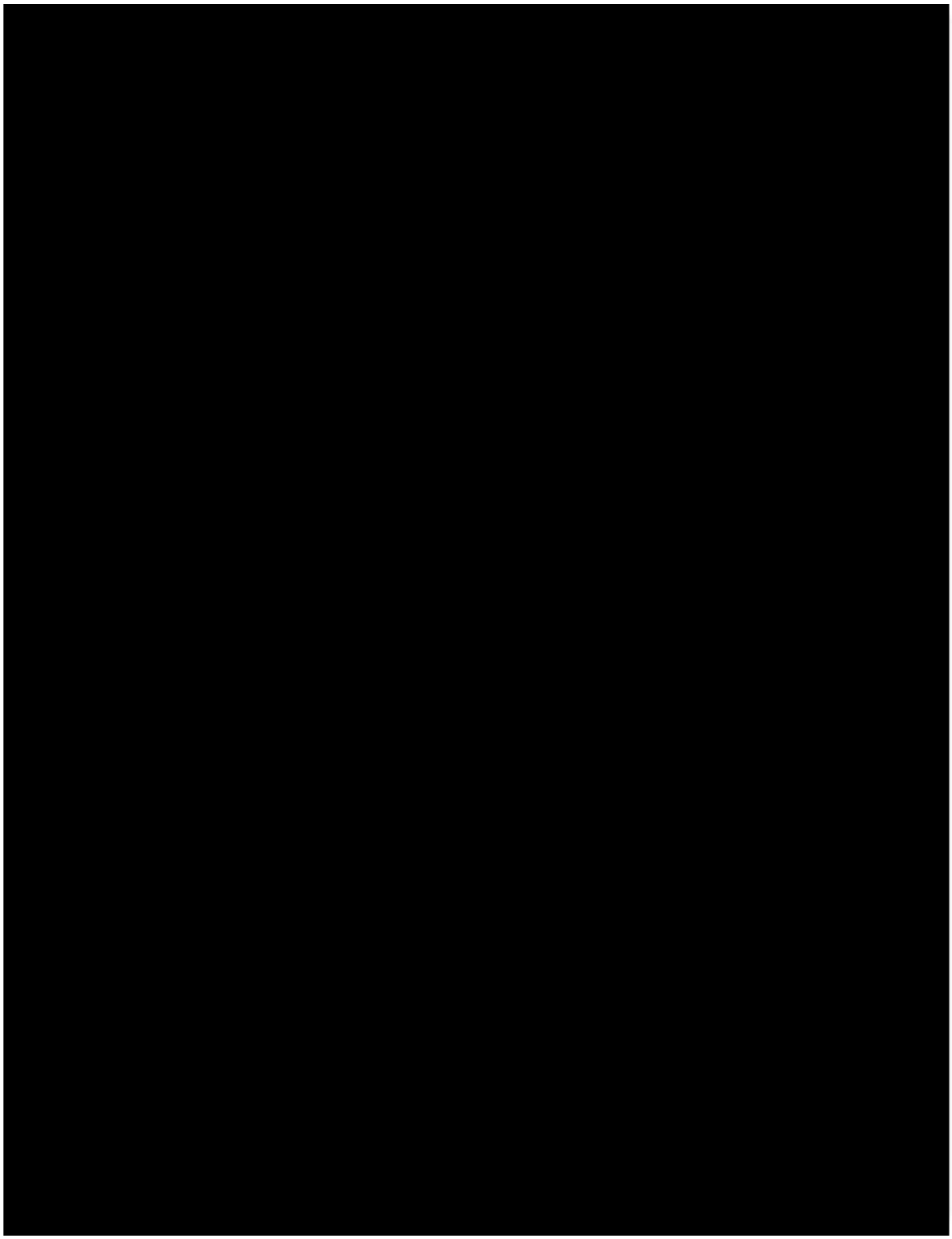

Figure 19 Impact Zone Analysis Results at 242 feet AGL for the San Francisco WSR-88D

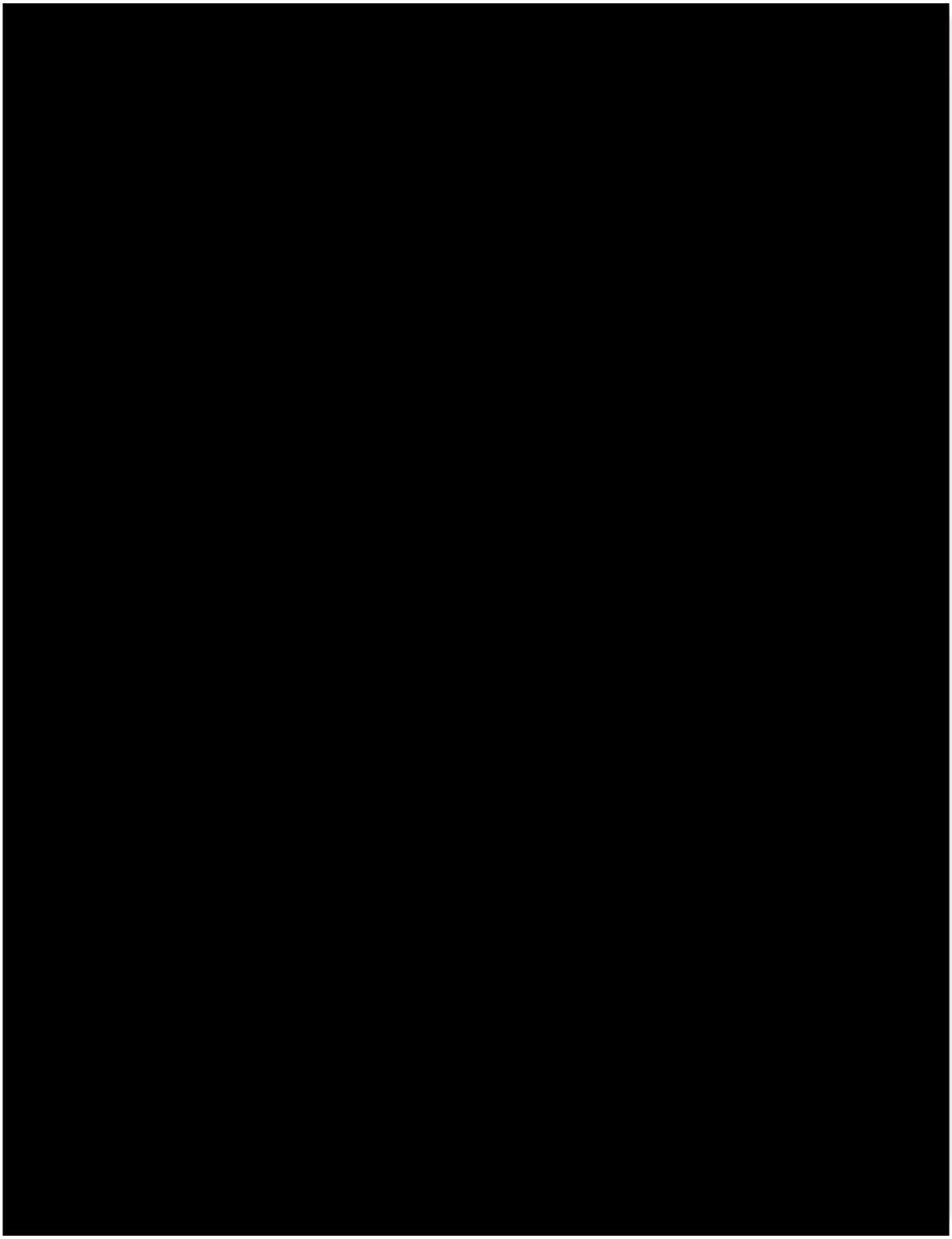

Figure 20 Impact Zone Analysis Results at 291 feet AGL for the San Francisco WSR-88D

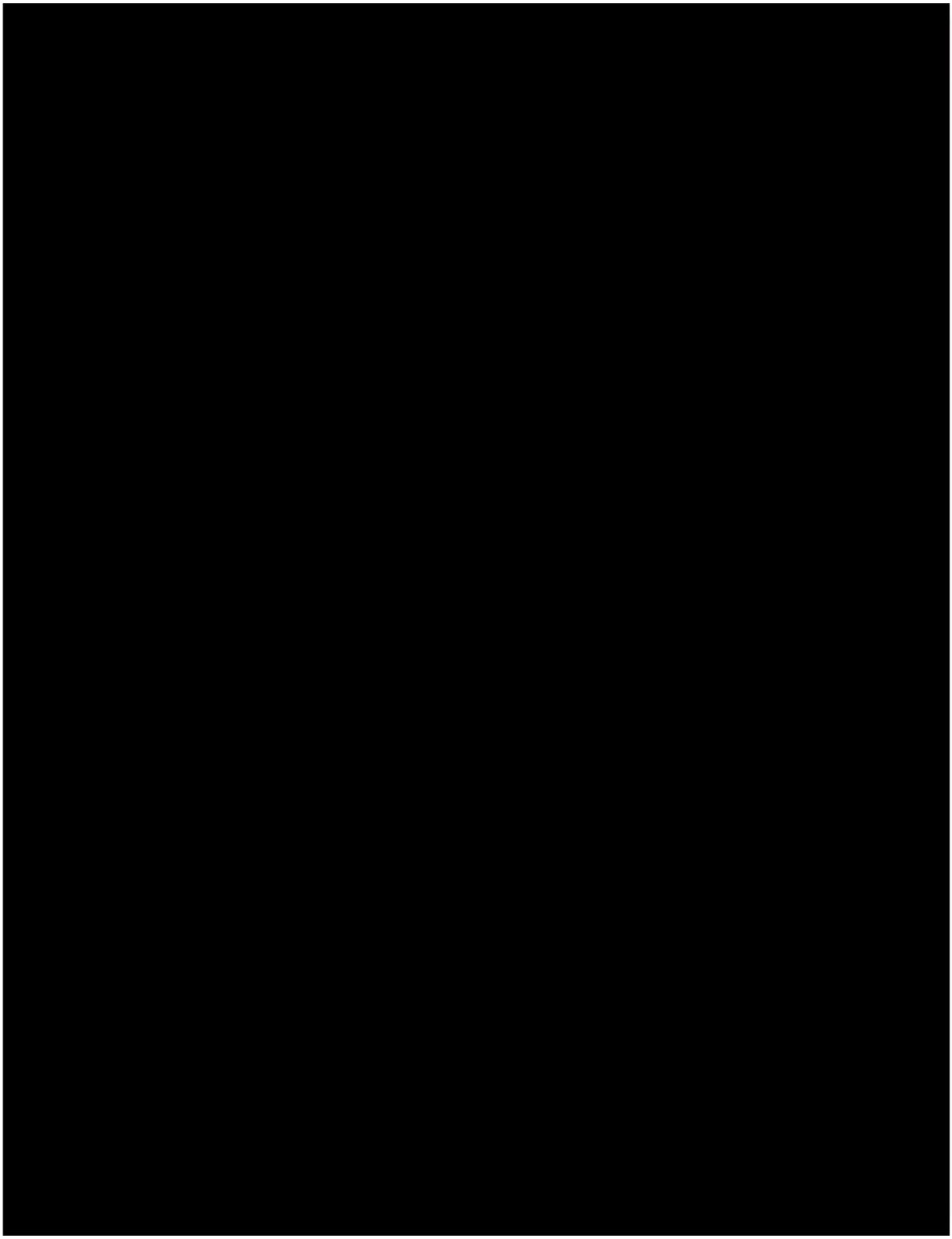

Figure 21 Impact Zone Analysis Results at 493 feet AGL for the San Francisco WSR-88D

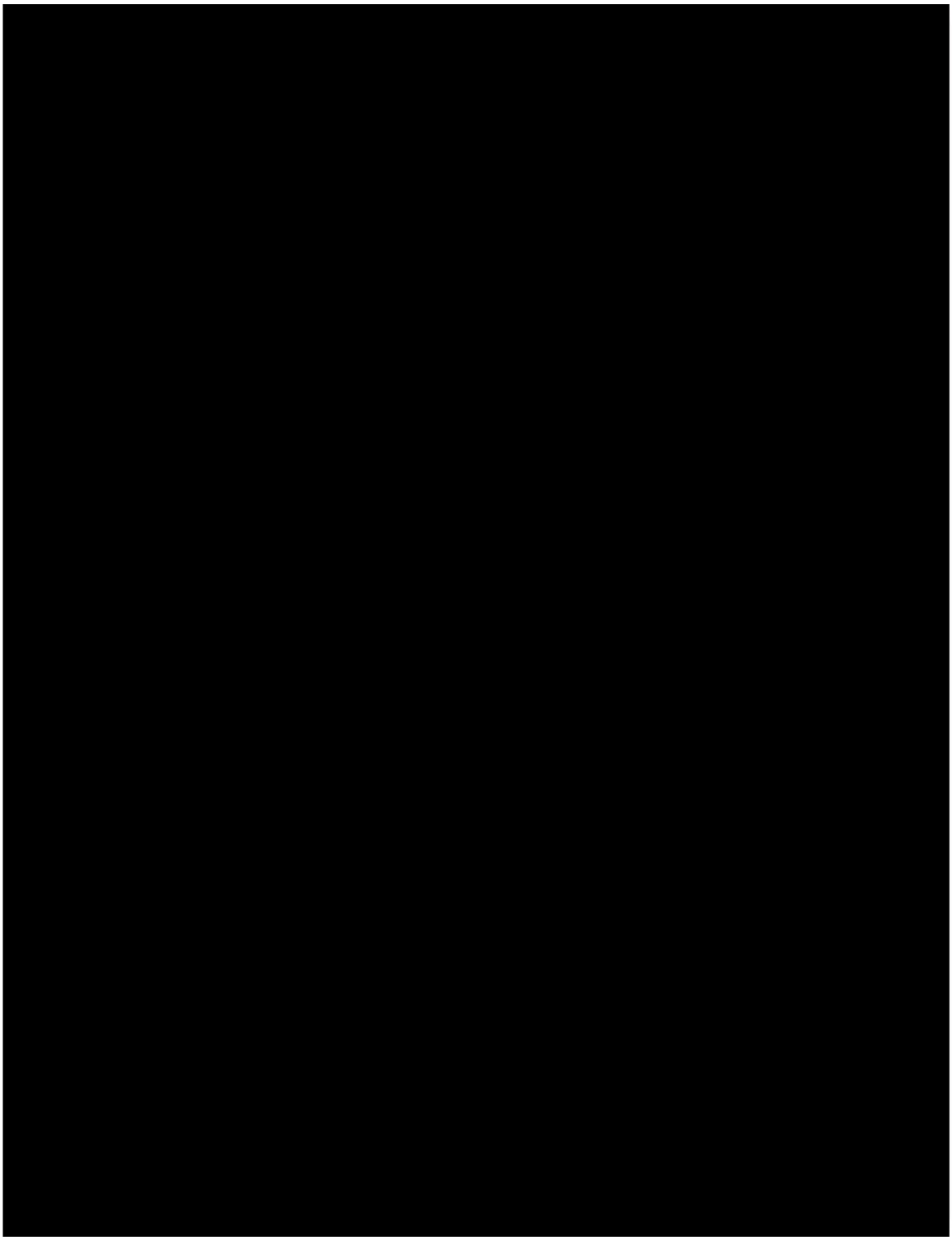

Figure 22 Impact Zone Analysis Results at 591 feet AGL for the San Francisco WSR-88D

CONCLUSIONS

The DoD PST analysis results for the Project indicate the following:

- Impacts to air defense and homeland security radar are likely; and
- Impacts to nearby WSR-88D weather radar are possible.

In total, Westslope identified and conducted a basic radar line-of-sight analysis for the following seven radar sites:

- McClellan ASR-9;
- Mill Valley ARSR-4;
- Moffett ASR-9;
- Oakland ASR-9;
- Sacramento ATCBI-6;
- Stockton ASR-11; and
- Travis AFB DASR.

The basic radar line-of-sight analyses conducted by Westslope show the following:

- For the McClellan ASR-9, between 11 and 19 of the 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL are visible to and interfering with this radar site. All 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to and will interfere with this radar site.
- For the Mill Valley ARSR-4, two of the 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL are visible to and interfering with this radar site. Five of the 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and four of the nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to and will interfere with this radar.
- For the Sacramento ATCBI-6, all 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL are visible to this radar site. All 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to this radar site; however, Westslope does not expect any effects from the proposed V136 or V150 wind turbines.
- For the Stockton ASR-11 and the Travis AFB DASR, all 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL are visible to and interfering with this radar site. All 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to and will interfere with this radar site.

- For the Moffett ASR-9 and Oakland ASR-9, wind turbines up to 591 feet AGL in the Project will not be visible to these radar sites. As a result, Westslope does not expect any radar effects at this height or below.

For the McClellan ASR-9, based on the fact that between 11 and 19 of the 23 existing V47 wind turbines are visible to and interfering with this radar site and up to 10 proposed wind turbines will be visible to and will interfere with this radar site, Westslope does not expect that the V136 or V150 wind turbines will result in a material difference to the existing radar effects.

For the Mill Valley ARSR-4, based on the fact that the two of the existing V47 wind turbines are visible to and interfering with this radar site and up to five of the proposed wind turbines will be visible to and will interfere with this radar site, Westslope does not expect that the V136 or V150 wind turbines will result in a material difference to the existing radar effects.

For the Stockton ASR-11 and the Travis AFB DASR, based on the fact that all 23 existing V47 wind turbines are visible to and interfering with these radar sites and up to 10 proposed wind turbines will be visible to and will interfere with these radar sites, Westslope expects a decrease to the existing radar effects with the V136 or V150 wind turbines.

Because wind turbines will be visible to the McClellan ASR-9, Mill Valley ARSR-4, Stockton ASR-11, and Travis AFB DASR, Westslope expects that the FAA and DoD will initially object to the proposed V136 or V150 wind turbines based on electromagnetic interference to air navigation facilities. As such, Westslope expects that the FAA will issue Notices of Presumed Hazard for the Project. The FAA and DoD will likely require further study to determine whether the radar effects are acceptable to operations or not. The DoD may also setup a Mitigation Response Team to conduct further study. Although possible, Westslope does not expect that the DHS will object to the proposed V136 or V150 wind turbines.

It is important to note that radar effects do not always translate into operational impacts.

Westslope's NEXRAD weather radar screening analysis for the Sacramento WSR-88D shows that the 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL are visible to the Sacramento WSR-88D and that the existing V47 wind turbines fall within a No Impact Zone. As such, Westslope assumes there are no existing impacts to Sacramento WSR-88D operations as a result of the existing V47 wind turbines.

The NEXRAD weather radar screening analysis results also show that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Sacramento WSR-88D. Further, the screening analysis results show that at a blade-tip height of 493 feet AGL, seven of the 10 proposed V136 wind turbines fall within a Notification Zone and the remaining three V136 wind turbines fall within a No Impact Zone. At a blade-tip height of 591 feet AGL, all nine proposed V150 wind turbines fall within a Notification Zone. Additional radar effects as a result of the proposed V136 or V150 wind turbines will include Doppler

contamination and false weather indications over and in the immediate vicinity of the Project due to clutter; however, based on the screening analysis results, impacts to Sacramento WSR-88D operations are both possible and not likely depending upon the location and blade-tip height of the proposed wind turbines within the Project.

Westslope's NEXRAD weather radar screening analysis for the San Francisco WSR-88D shows that the 23 existing V47 wind turbines at blade-tip heights of 242 feet AGL and 291 feet AGL are not visible to the San Francisco WSR-88D and that the existing V47 wind turbines fall within a No Impact Zone. As such, Westslope assumes there are no existing radar effects or impacts to San Francisco WSR-88D operations as a result of the existing V47 wind turbines.

The NEXRAD weather radar screening analysis also shows that the 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and the nine proposed V150 wind turbines will not be visible to the San Francisco WSR-88D. The screening analysis results also show that all 10 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all nine proposed V150 proposed wind turbines at a blade-tip height of 591 feet AGL fall within a No Impact Zone. As such, Westslope does not expect any radar effects or impacts to San Francisco WSR-88D operations for the V136 or V150 wind turbines.

Westslope recommends that the Project details be submitted to the NOAA or the National Telecommunications Information Administration (NTIA) for a detailed review. The NTIA is essentially a clearinghouse for other federal agencies including NOAA.

If you have any questions regarding this analysis, please contact Geoff Blackman at (405) 816-2604 or via email at gnblackman@westslopeconsulting.com.

WESTSLOPE CONSULTING

SOLANO PHASE 4 WIND PROJECT

BASIC RADAR LINE-OF-SIGHT STUDY

APRIL 16, 2018

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INTRODUCTION

The proposed Solano Phase 4 Wind Project (Project) will consist of 12 Vestas V136 (V136) wind turbines at a blade-tip height of 493 feet above ground level (AGL) or 10 Vestas V150 (V150) wind turbines at a blade-tip height of 591 feet AGL.[1] Development of this Project will include the removal of the remaining legacy wind turbines in the Solano Wind Resource Area. Specifically, the 59 existing Kenetech 56/100-kilowatt (Kenetech) wind turbines at a blade-tip height of 107 feet AGL.

Westslope Consulting, LLC (Westslope) prepared this report to determine whether the proposed V136 or V150 wind turbines will have an effect on nearby radar sites. Westslope conducted a radar line-of-sight (RLOS) analysis or Next Generation Radar (NEXRAD) weather radar screening analysis as appropriate for each of the proposed wind turbine heights and included analyses of the existing Kenetech wind turbines for comparison purposes.

This report provides the results of a Basic Radar Line-of-Sight Study conducted by Westslope, which includes the following:

- An initial analysis using the Department of Defense (DoD) Preliminary Screening Tool (PST);
- Research into other radar sites near the Project;
- A RLOS analysis for each radar site identified by Westslope using wind turbine blade-tip heights of 107 feet AGL, 493 feet AGL, and 591 feet AGL; and
- A NEXRAD weather radar screening analysis using wind turbine blade-tip heights of 107 feet AGL, 493 feet AGL, and 591 feet AGL.

ANALYSIS

Preliminary Screening Tool

Westslope conducted an initial analysis for Long Range Radar (LRR) and NEXRAD weather radar using the PST on the Federal Aviation Administration (FAA) Obstruction Evaluation/Airport Airspace Analysis website.[2] This analysis provides a cursory indication whether wind turbines may be visible, that is, within radar line-of-sight to one or more radar sites, and likely to affect radar performance.

The PST LRR analysis accounts for Air Route Surveillance Radar sites and a few select Airport Surveillance Radar sites used for air defense and homeland security.[3] The PST does not account for all DoD, Department of Homeland Security (DHS), and/or FAA surface-based or tethered aerostat radar sites.

[1] SMUD_Phase4_Turbine Location and Height Data 2.20.18.xlsx.
[2] See http://oeaaa.faa.gov.
[3] For LRR, the PST uses a buffered radar line-of-sight analysis at a blade-tip height of 750 feet AGL.

Further, the PST NEXRAD analysis accounts for Weather Surveillance Radar model-88D (WSR-88D) radar sites but does not account for Terminal Doppler Weather Radar sites.[4]

The PST is helpful for identifying potential impacts to LRR and NEXRAD; however, the results are preliminary, as suggested by the title of the PST, and do not provide an official decision as to whether impacts are acceptable to operations.

It should be noted that the PST NEXRAD analysis does not reflect the wind farm impact zone scheme recently updated by the National Oceanic and Atmospheric Administration (NOAA) WSR-88D Radar Operations Center (ROC). The updated scheme expands the red area, or "No Build Zone", from three to four kilometers (km) and to areas where wind turbines penetrate the third elevation angle scanned by a WSR-88D.

Based on the location of the existing Kenetech wind turbines and the proposed V136 and V150 wind turbine layouts, Westslope created a single point and a polygon for analysis purposes.

The PST analysis results for LRR show that the single point and the polygon fall within yellow areas. Yellow indicates that impacts are likely to air defense and homeland security radar. See Figure 1, where the black rotor represents the single point and the black lines represent the polygon, both created by Westslope, the black dots represent the 59 existing Kenetech wind turbines, the green dots represent the 12 V136 wind turbines, and the red dots represent the 10 V150 wind turbines.

Westslope identified the radar sites in the PST LRR results as the Mill Valley Air Route Surveillance Radar model-4 (ARSR-4), McClellan Airport Surveillance Radar model-9 (ASR-9), and the Stockton Airport Surveillance Radar model-11 (ASR-11). In addition to the DoD and DHS using these radar sites for national defense, the FAA uses these radar sites for air traffic control at multiple facilities including Northern California Terminal Radar Approach Control (TRACON), Oakland Air Route Traffic Control Center, and Travis Air Force Base (AFB) Air Traffic Control Tower (ATCT)/Radar Approach Control (RAPCON).

[4] For NEXRAD, the PST uses a blade-tip height of 160 meters AGL (525 feet AGL).

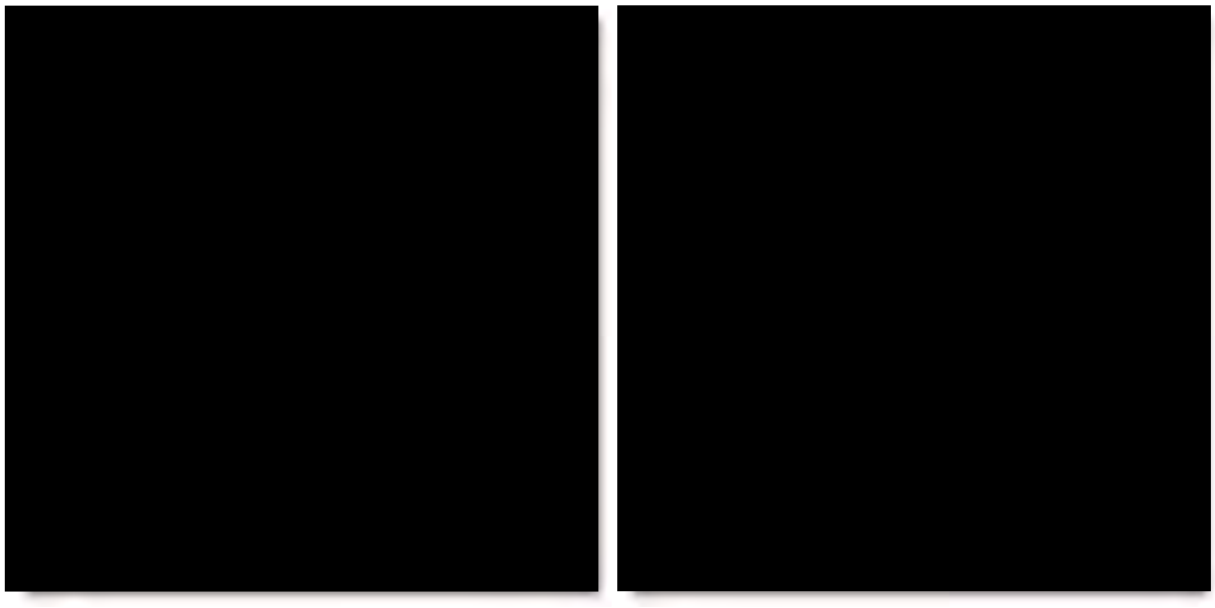

Figure 1 Long Range Radar Results for the Single Point (left) and for the Polygon (right)

For NEXRAD, the PST analysis results show that the single point falls within a dark green area, or "Notification Zone", which indicates that some impacts are possible to WSR-88D operations and that consultation with NOAA is optional. The polygon falls with a dark green area and green areas. A green area, or "No Impact Zone", indicates that impacts are not likely to WSR-88D operations. See Figure 2. Westslope identified the radar site in the PST NEXRAD analysis as the Sacramento WSR-88D.

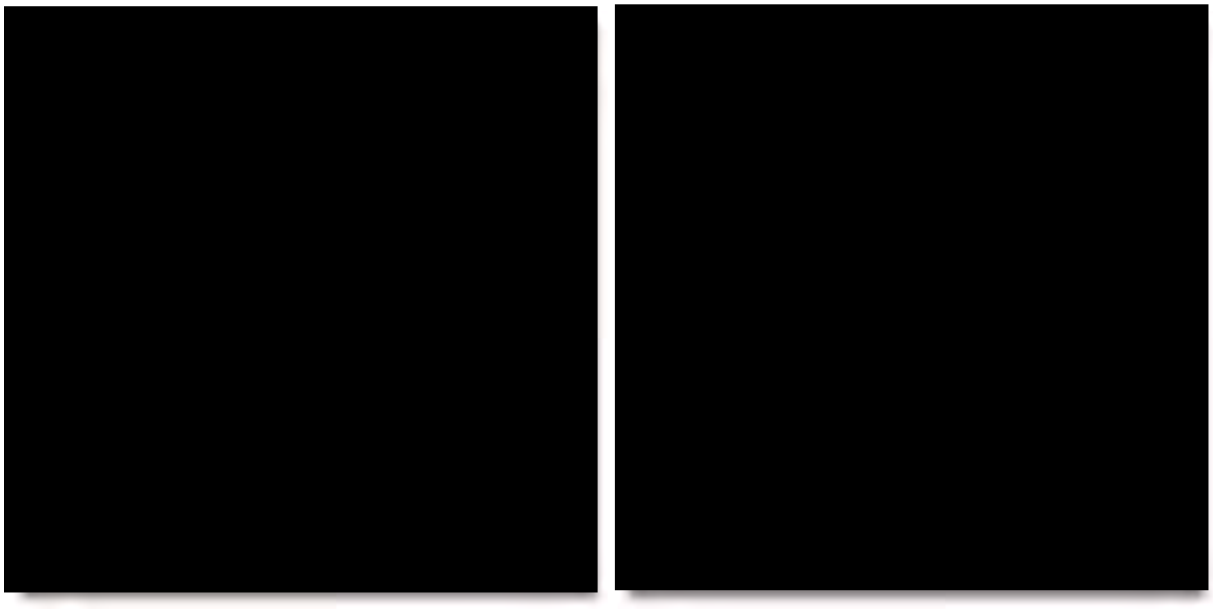

Figure 2 NEXRAD results for the Single Point (left) and for the Polygon (right)

Other Radar Sites

Research performed by Westslope shows four additional radar sites near the Project: the Moffett ASR-9, Oakland ASR-9, Travis AFB Digital Airport Surveillance Radar (DASR), and the San Francisco WSR-88D.

The DoD uses the Travis AFB DASR for air traffic control at Travis AFB ATCT/RAPCON facilities. The FAA uses the Moffett ASR-9 and Oakland ASR-9 for air traffic control at multiple facilities including Oakland TRACON and Northern California TRACON.

Co-Located Secondary Surveillance Radar

A secondary surveillance radar is co-located with each primary surveillance radar. Specifically, an Air Traffic Control Beacon Interrogator model-6 (ATCBI-6) is co-located with Mill Valley ARSR-4; a Mode S is co-located with the Moffett ASR-9, the Oakland ASR-9, and the McClellan ASR-9; and a Monopulse Secondary Surveillance Radar is co-located with the Stockton ASR-11 and the Travis AFB DASR.

In general, secondary surveillance radar (SSR) are less susceptible to interference from wind turbines than primary surveillance radar.

SSR Only Radar Sites

Westslope also located a SSR only radar site near the Project: the Sacramento ATCBI-6.

Basic RLOS Analysis

Westslope conducted a basic radar line-of-sight analysis using the United States Geological Survey 10-meter National Elevation Dataset (NED). This analysis shows whether the 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL or the 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to one or more radar sites. Westslope also conducted a radar line-of-sight analysis for the existing Kenetech wind turbines at a blade-tip height of 107 feet AGL for comparison purposes.

Westslope performed the radar line-of-sight analysis for the following seven radar sites:

- McClellan ASR-9;
- Mill Valley ARSR-4;
- Moffett ASR-9;
- Oakland ASR-9;
- Sacramento ATCBI-6;
- Stockton ASR-11; and
- Travis AFB DASR.

McClellan ASR-9

The radar line-of-sight analysis results show that the 59 existing Kenetech wind turbines are not visible to the McClellan ASR-9 at a blade-tip height of 107 feet AGL. As such, Westslope assumes there are no existing radar effects to the McClellan ASR-9 as a result of these legacy wind turbines.

The radar line-of-sight analysis results also show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the McClellan ASR-9. See Figure 3. Additional radar effects will include unwanted primary radar returns (clutter) resulting in a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the Project. Other possible radar effects include a partial loss of weather detection and false weather indications over and in the immediate vicinity of the Project.

Mill Valley ARSR-4

The radar line-of-sight analysis results show that all 59 existing Kenetech wind turbines are visible to the Mill Valley ARSR-4 at a blade-tip height of 107 feet AGL. See Figure 4. Existing radar effects include a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the existing Kenetech wind turbines due to clutter.

Further, the radar line-of-sight analysis results show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Mill Valley ARSR-4. See Figure 5.

Based on the fact that the existing Kenetech wind turbines are visible to and interfering with the Mill Valley ARSR-4, the proposed V136 or V150 wind turbines will be visible to and will interfere with the Mill Valley ARSR-4, and the development of the Project will include the removal of the existing Kenetech wind turbines, Westslope does not expect that the V136 or V150 wind turbines will result in a material difference to the existing radar effects.

Moffett ASR-9

The radar line-of-sight analysis results show that wind turbines up to 591 feet AGL will not be visible to the Moffett ASR-9. As a result, Westslope does not expect any radar effects at this height or below.

Oakland ASR-9

The radar line-of-sight analysis results show that wind turbines up to 591 feet AGL will not be visible to the Oakland ASR-9. As a result, Westslope does not expect any radar effects at this height or below.

Sacramento ATCBI-6

The radar line-of-sight analysis results show that the 59 existing Kenetech wind turbines are not visible to the Sacramento ATCBI-6 at a blade-tip height of 107 feet AGL. The radar line-of-sight analysis results also show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Sacramento ATCBI-6. See Figure 6.

As noted above, secondary surveillance radar, such as the ATCBI-6, are less susceptible to interference from wind turbines. As such, Westslope does not expect any effects from the proposed V136 or V150 wind turbines to the Sacramento ATCBI-6.

Stockton ASR-11

The radar line-of-sight analysis results show that 51 of the 59 existing Kenetech wind turbines are visible to the Stockton ASR-11 at a blade-tip height of 107 feet AGL. See Figure 7. Existing radar effects include a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the 51 Kenetech wind turbines within radar line-of-sight. Other possible radar effects include a partial loss of weather detection and false weather indications over and in the immediate vicinity of the 51 Kenetech wind turbines within radar line-of-sight.

Further, the radar line-of-sight analysis results show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Stockton ASR-11. See Figure 8.

Based on the fact that 51 of the 59 existing Kenetech wind turbines are visible to and interfering with the Stockton ASR-11, the proposed V136 or V150 wind turbines will be visible to and will interfere with the Stockton ASR-11, and the development of the Project will include the removal of the existing Kenetech wind turbines, Westslope does not expect that the V136 or V150 wind turbines will result in a material difference to the existing radar effects.

Travis AFB DASR

The radar line-of-sight analysis results show that the 59 existing Kenetech wind turbines are not visible to the Travis AFB DASR at a blade-tip height of 107 feet AGL. As such, Westslope assumes there are no existing radar effects to the Travis AFB DASR as a result of these legacy wind turbines. A qualitative review of radar data collected under Cooperative Research and Development Agreement confirms that the 59 Kenetech wind turbines do not interfere with the Travis AFB DASR.[5]

The radar line-of-sight analysis results also show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Travis AFB DASR. See Figure 9. Additional radar effects will include a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the Project due to clutter. Other possible radar effects due to clutter include a partial loss of weather detection and false weather indications over and in the immediate vicinity of the Project.

[5] See Westslope Solano Phase 4 23 February 2017.pptx

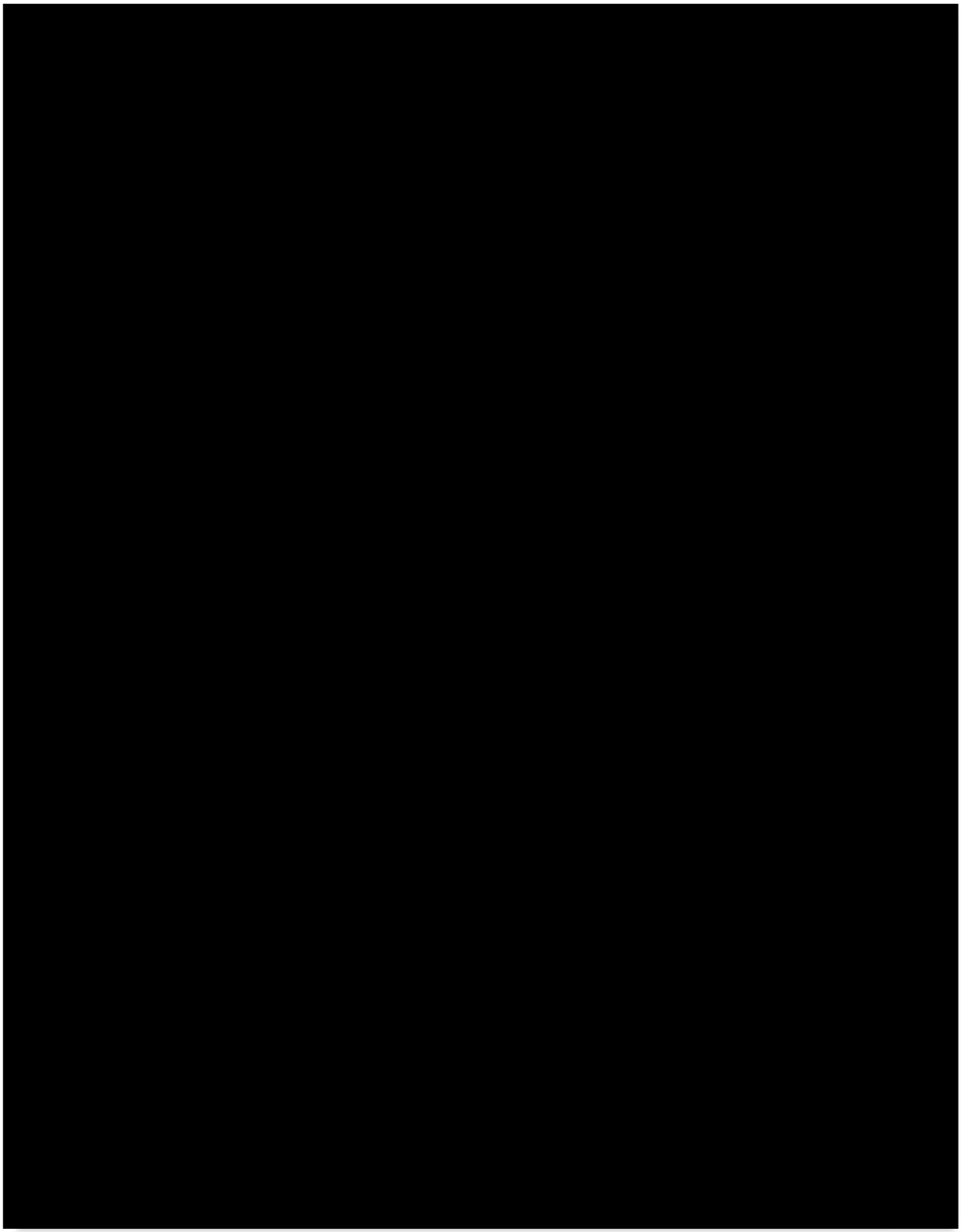

Figure 3 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the McClellan ASR-9

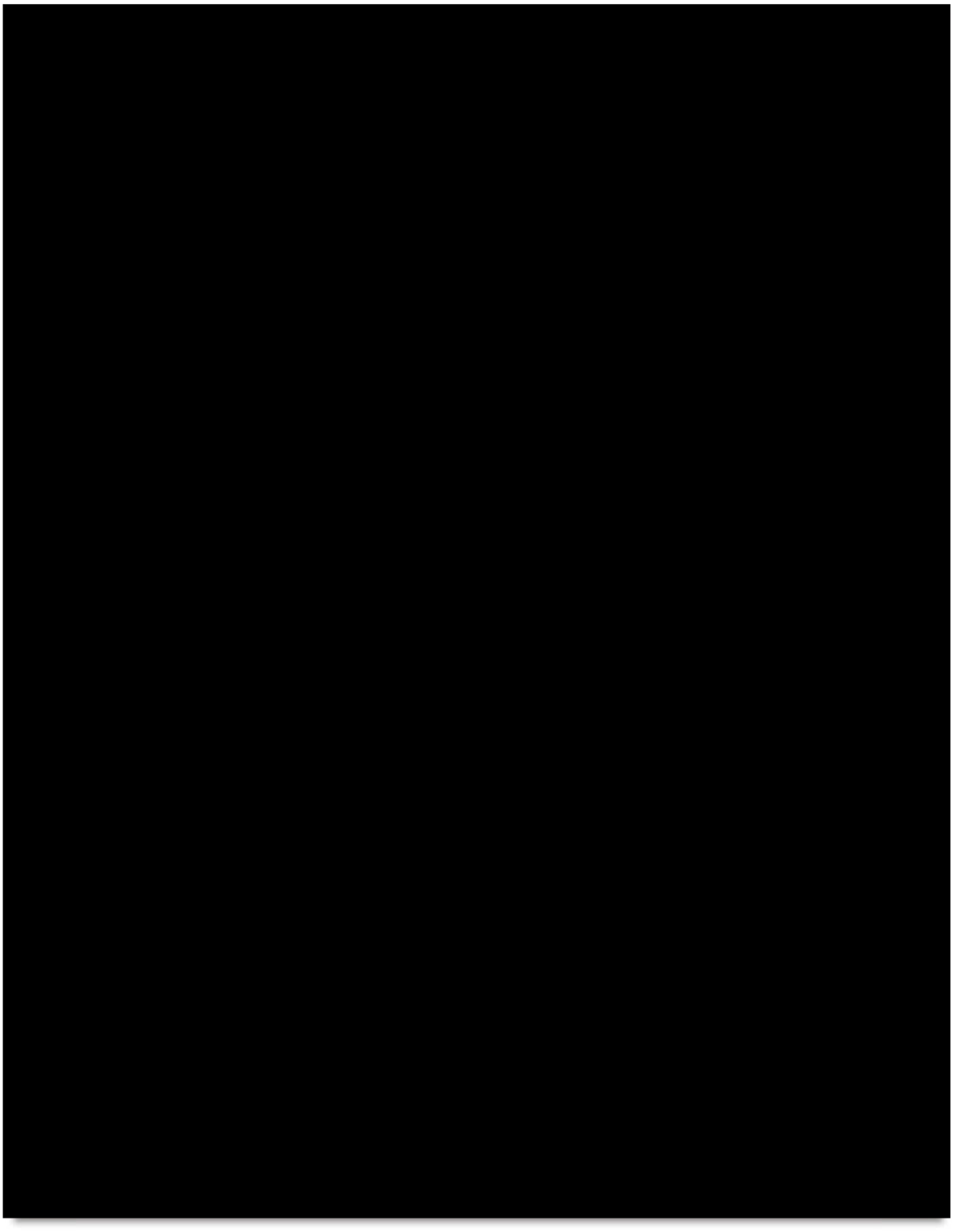

Figure 4 RLOS Analysis Results at 107 feet AGL for the Mill Valley ARSR-4

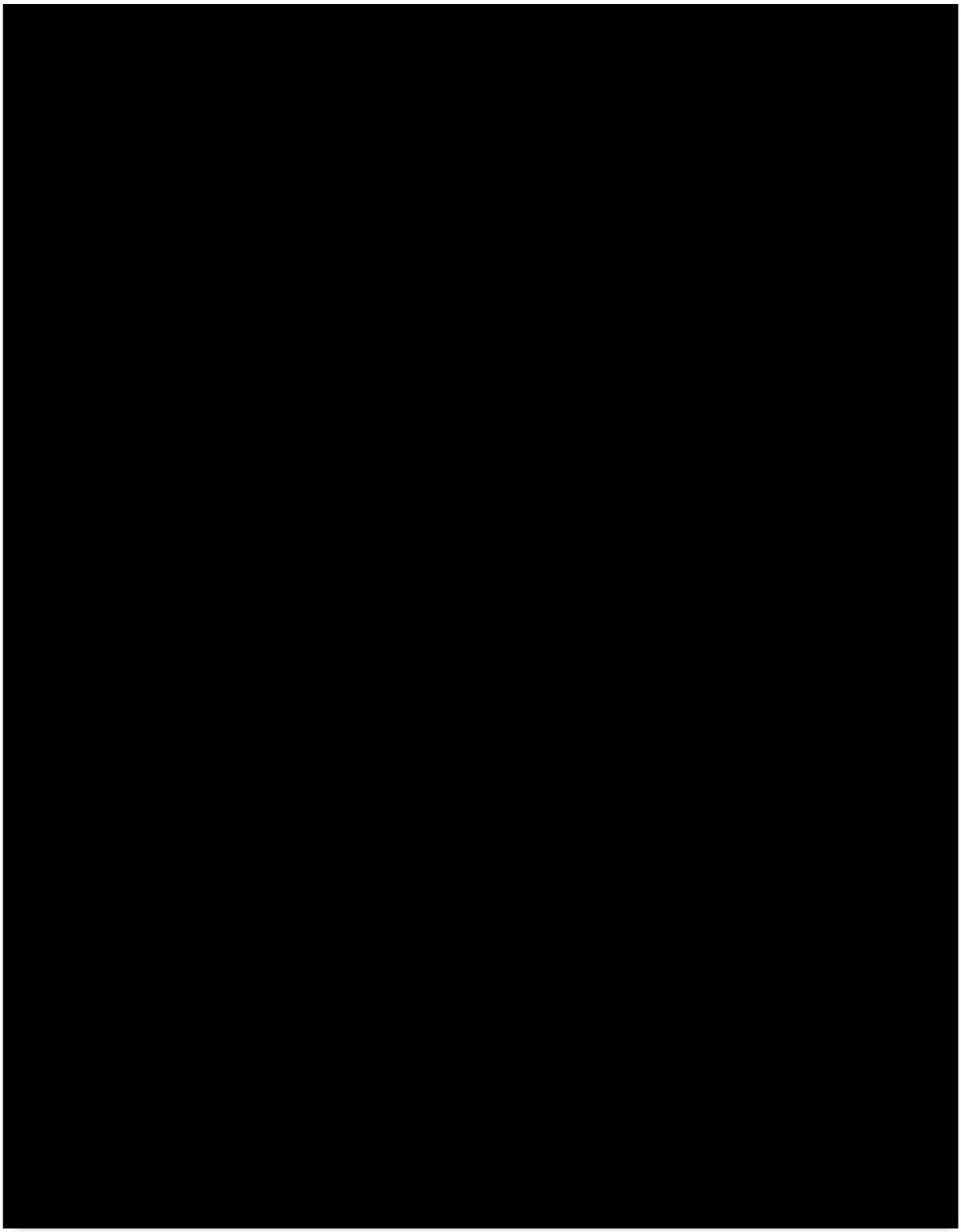

Figure 5 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Mill Valley ARSR-4

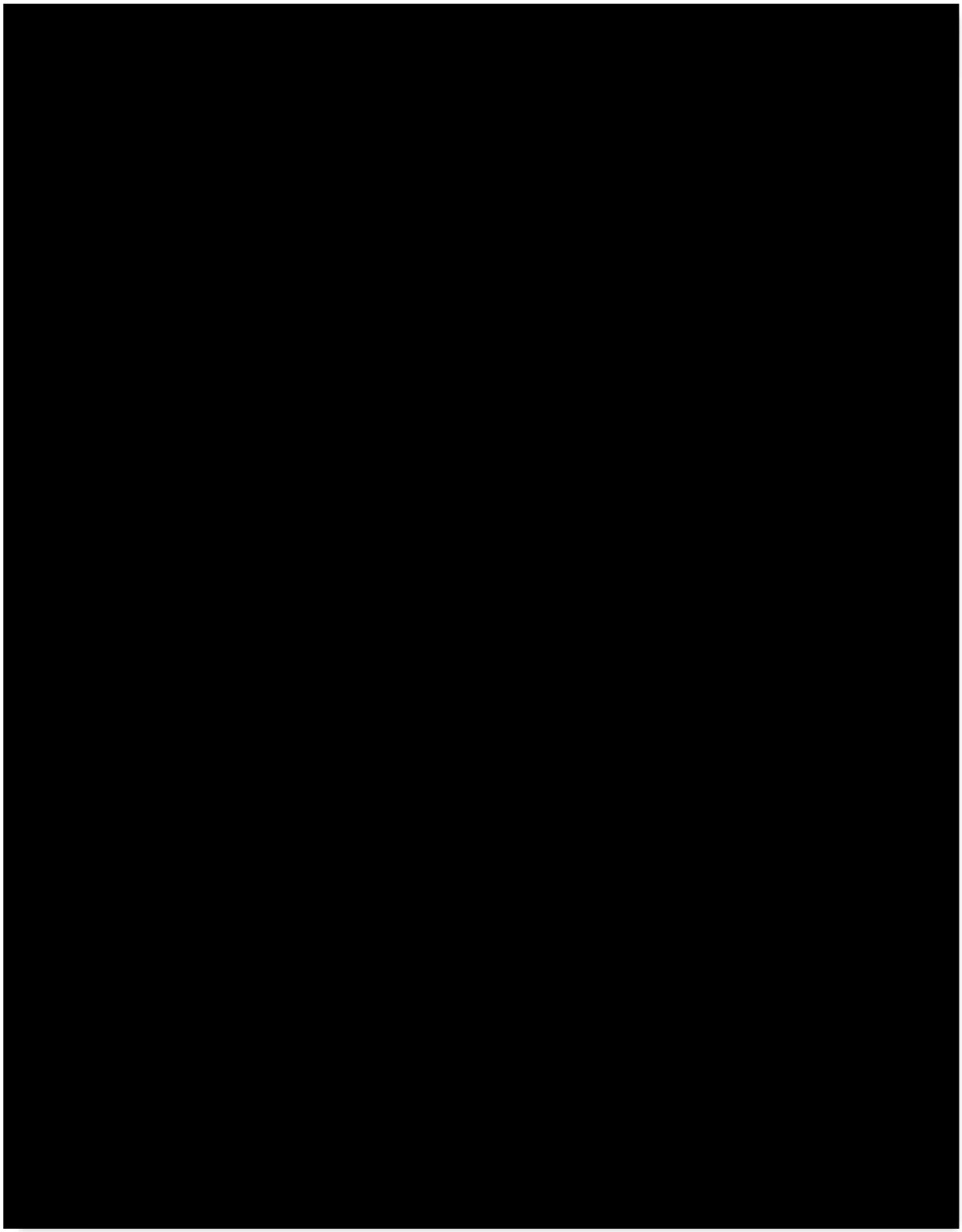

Figure 6 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Sacramento ATCBI-6

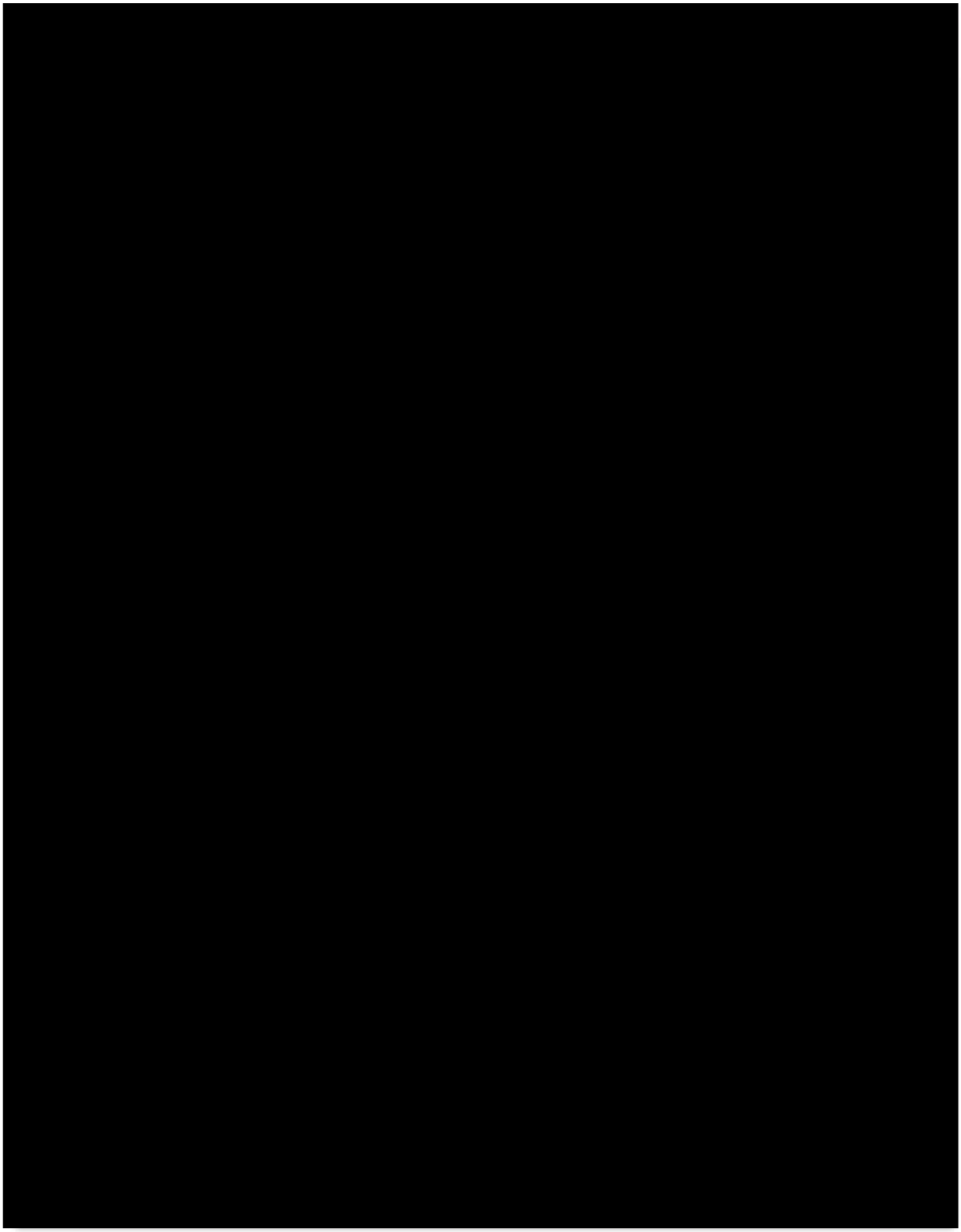

Figure 7 RLOS Analysis Results at 107 feet AGL for the Stockton ASR-11

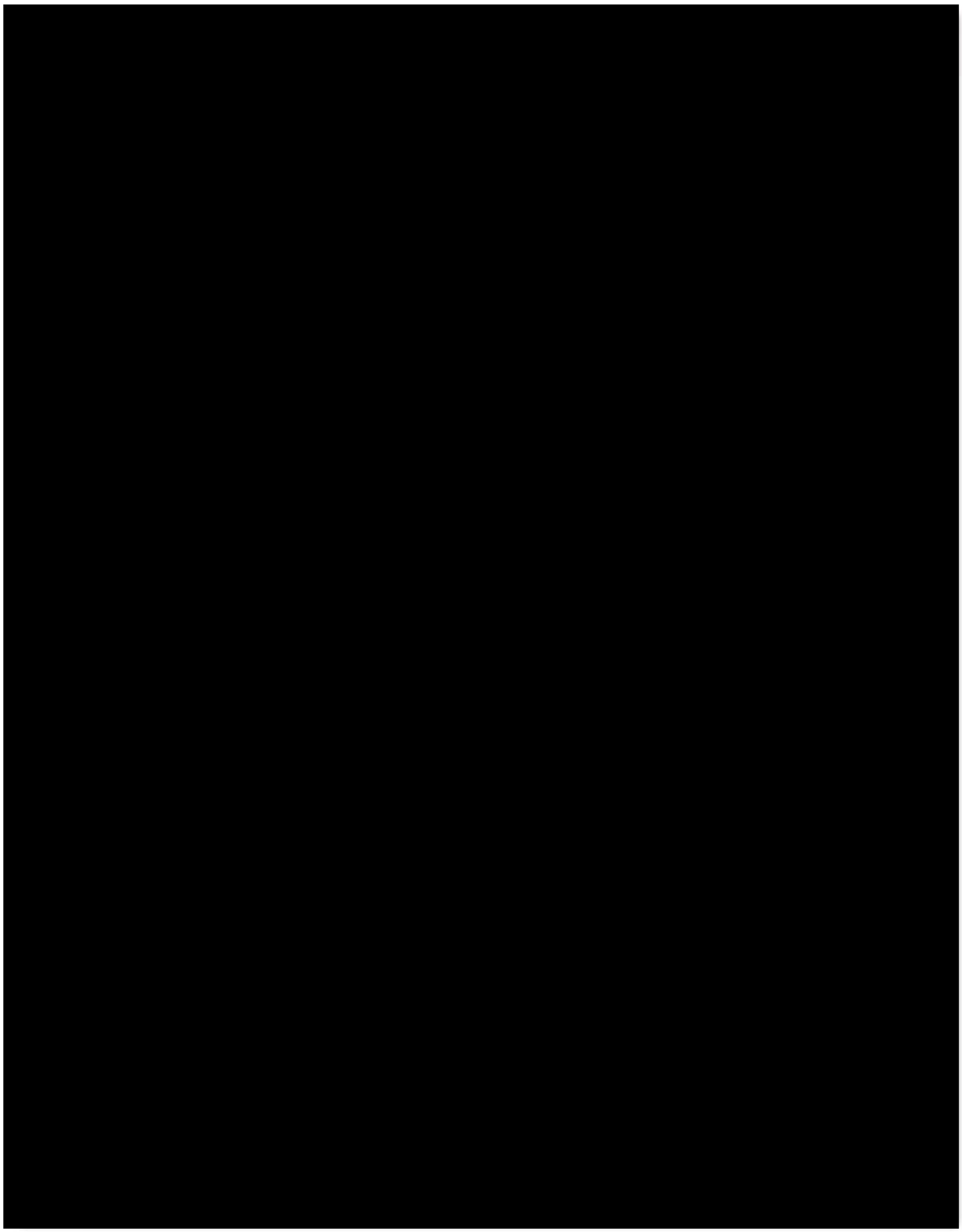

Figure 8 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Stockton ASR-11

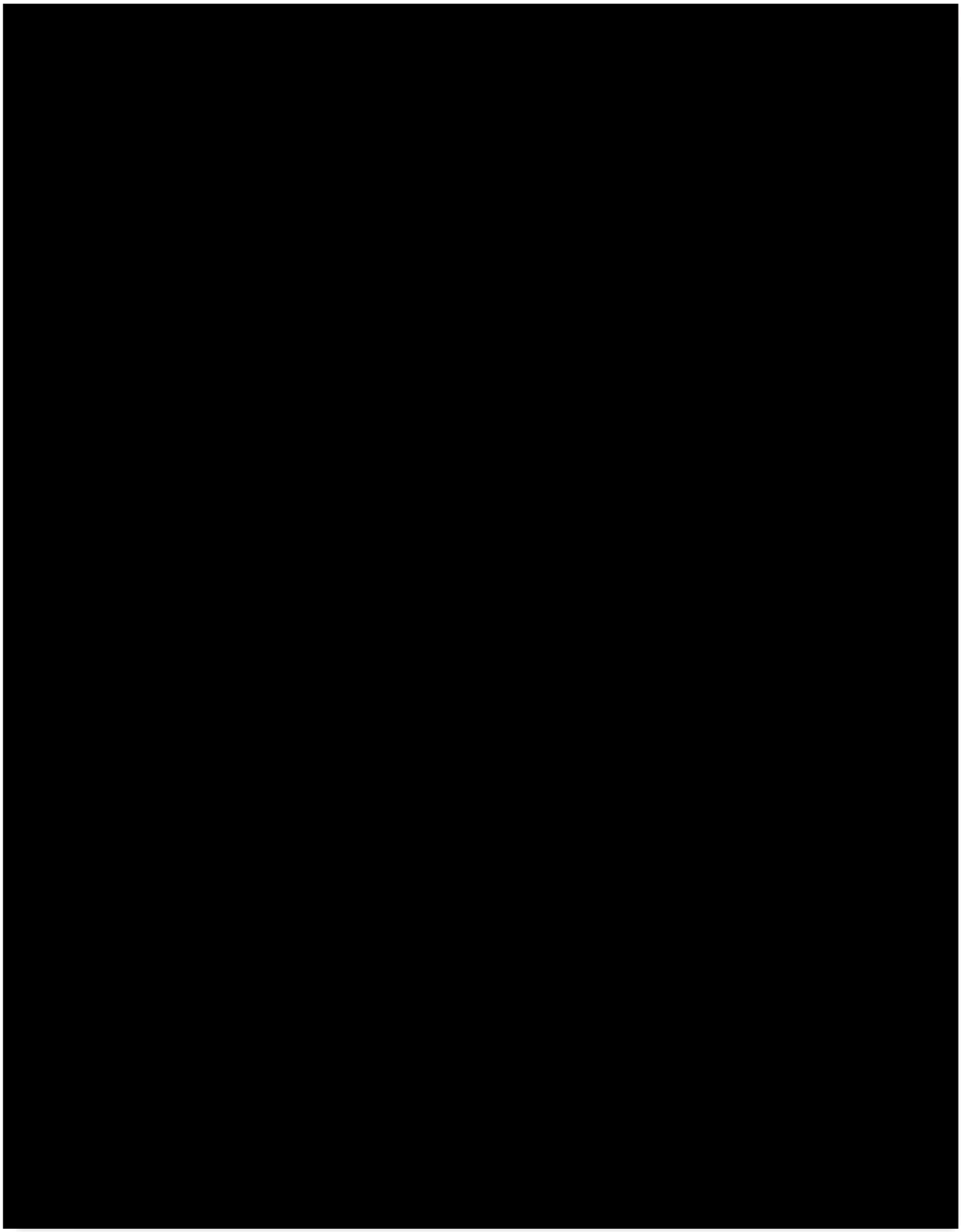

Figure 9 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Travis AFB DASR

NEXRAD Weather Radar Screening Analysis

The PST NEXRAD analysis does not reflect the wind farm impact zone scheme recently updated by the NOAA WSR-88D ROC. The updated scheme expands the red area, or "No Build Zone", from three to four km and to areas where wind turbines penetrate the third elevation angle scanned by a WSR-88D.

Westslope conducted a NEXRAD weather radar screening analysis using the 10-meter NED. This analysis shows whether wind turbines at blade-tip heights of 493 feet AGL and 591 feet AGL will be within radar line-of-sight to one or more WSR-88D radar sites and incorporates the updated wind farm impact zone scheme. Westslope also conducted a NEXRAD weather radar screening analysis for the existing Kenetech wind turbines at a blade-tip height of 107 feet AGL for comparison purposes.

Westslope performed the NEXRAD weather radar screening analysis for the following two radar sites:

- Sacramento WSR-88D; and
- San Francisco WSR-88D.

Sacramento WSR-88D

Westslope's NEXRAD weather radar screening analysis for the Sacramento WSR-88D shows that the 59 existing Kenetech wind turbines at a blade-tip height of 107 feet AGL are visible to the Sacramento WSR-88D. See Figure 10. Although all 59 existing Kenetech wind turbines are within radar line-of-sight, the screening analysis results show that these wind turbines fall within a green area. A green area, or "No Impact Zone", indicates that impacts are not likely to WSR-88D operations. See Figure 11.

As such, Westslope assumes there are no existing impacts to the Sacramento WSR-88D operations as a result of these legacy wind turbines.

The NEXRAD weather radar screening analysis for the Sacramento WSR-88D shows that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Sacramento WSR-88D. See Figure 12. The screening analysis results also show that at a blade-tip height of 493 feet AGL, two of the 12 proposed V136 wind turbines fall within a dark green area and the remaining 10 V136 wind turbines fall within a green area. A dark green area, or "Notification Zone", indicates that some impacts are possible to WSR-88D operations and that consultation with NOAA is optional. See Figure 13. Further, at a blade-tip height of 591 feet AGL, seven of the 10 proposed V150 wind turbines fall within a dark green area and the remaining three V150 wind turbines fall within a green area. See Figure 14.

Additional radar effects as a result of the proposed V136 or V150 wind turbines will include Doppler contamination and false weather indications over and in the immediate vicinity of the Project due to clutter; however, based on the screening analysis results, impacts to Sacramento WSR-88D operations

are both possible and not likely depending upon the location and blade-tip height of the proposed wind turbines within the Project.

San Francisco WSR-88D

Westslope's NEXRAD weather radar screening analysis for the San Francisco WSR-88D shows that the 59 existing Kenetech wind turbines at a blade-tip height of 107 feet AGL are not visible to the San Francisco WSR-88D. The screening analysis results also show that the 59 existing Kenetech wind turbines at a blade-tip height of 107 feet AGL fall within a green area. See Figure 15.

As such, Westslope assumes there are no existing radar effects or impacts to San Francisco WSR-88D operations as a result of these legacy wind turbines.

The NEXRAD weather radar screening analysis for the San Francisco WSR-88D shows that the 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL will not be visible to the San Francisco WSR-88D. At a blade-tip height of 591 feet AGL, two of the 10 proposed V150 wind turbines will be visible to the San Francisco WSR-88D. See Figure 16. The screening analysis results also show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 proposed wind turbines at a blade-tip height of 591 feet AGL fall within a green area. See Figures 17 and 18.

For the V136 wind turbines, Westslope does not expect any radar effects or impacts to San Francisco WSR-88D operations.

For two of the 10 proposed V150 wind turbines, additional radar effects will include Doppler contamination and false weather indications over and in the immediate vicinity of these two V150 wind turbines due to clutter; however, impacts to WSR-88D operations are not likely based on the WSR-88D ROC wind farm impact zone scheme.

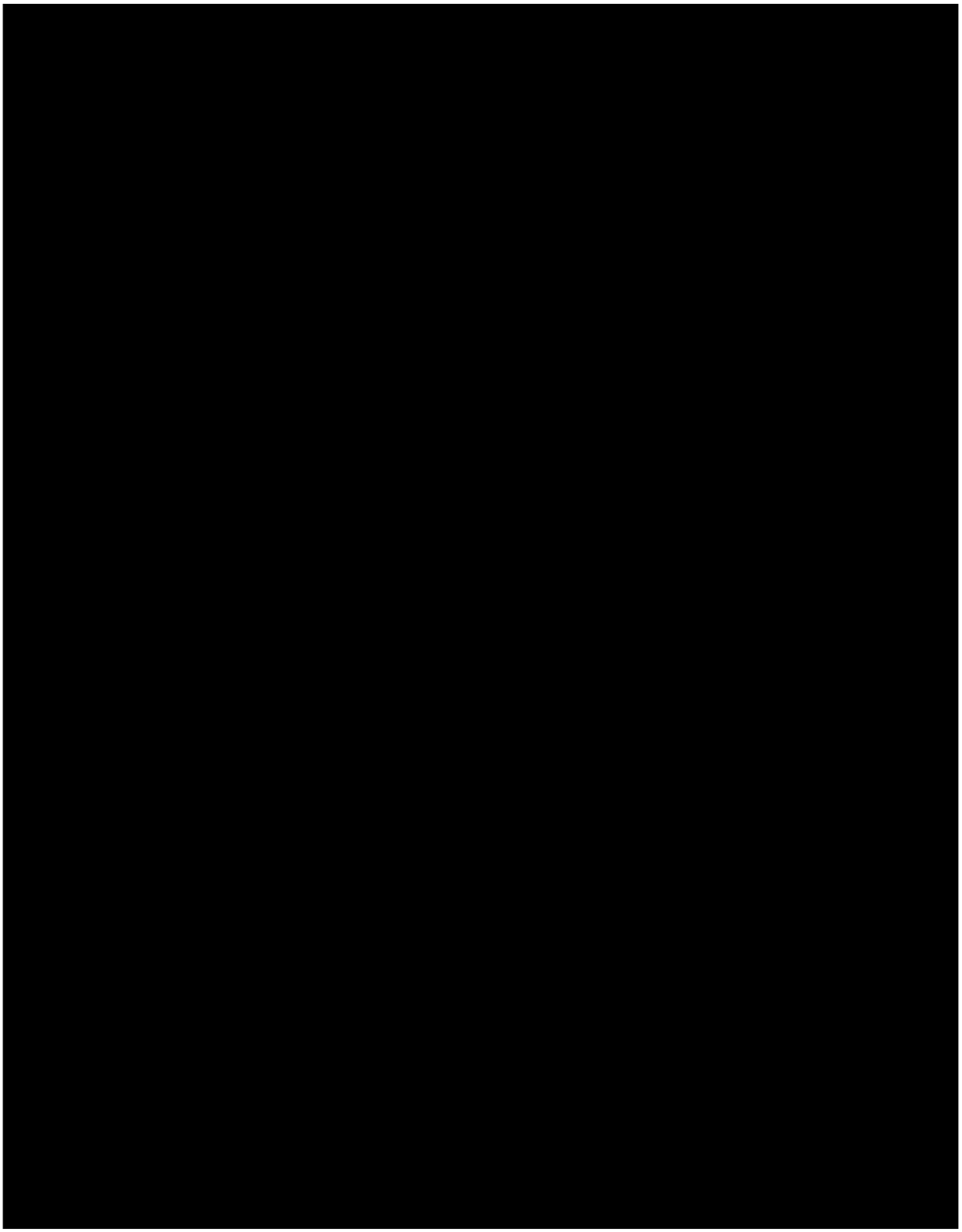

Figure 10 RLOS Analysis Results at 107 feet AGL for the Sacramento WSR-88D

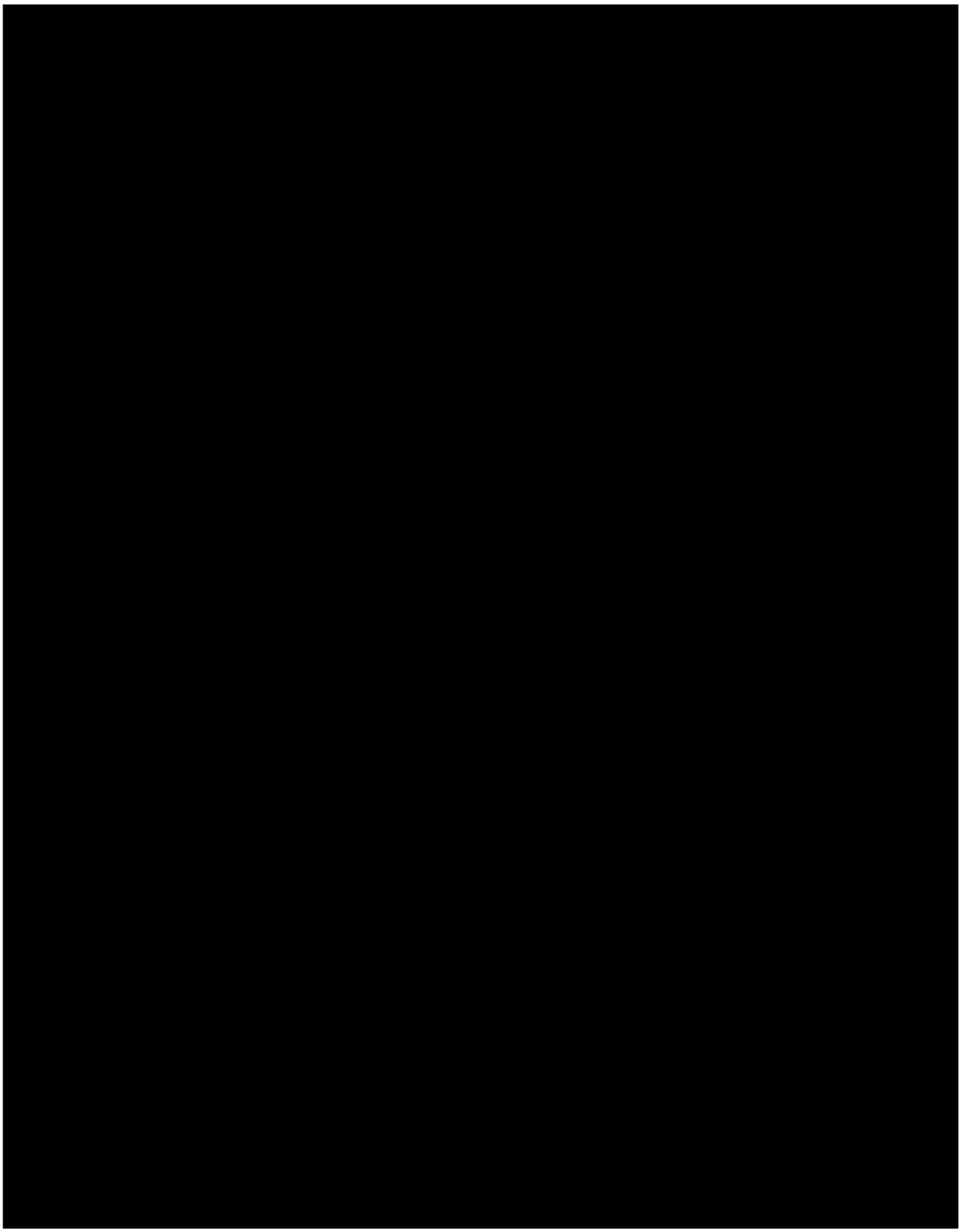

Figure 11 Impact Zone Analysis Results at 107 feet AGL for the Sacramento WSR-88D

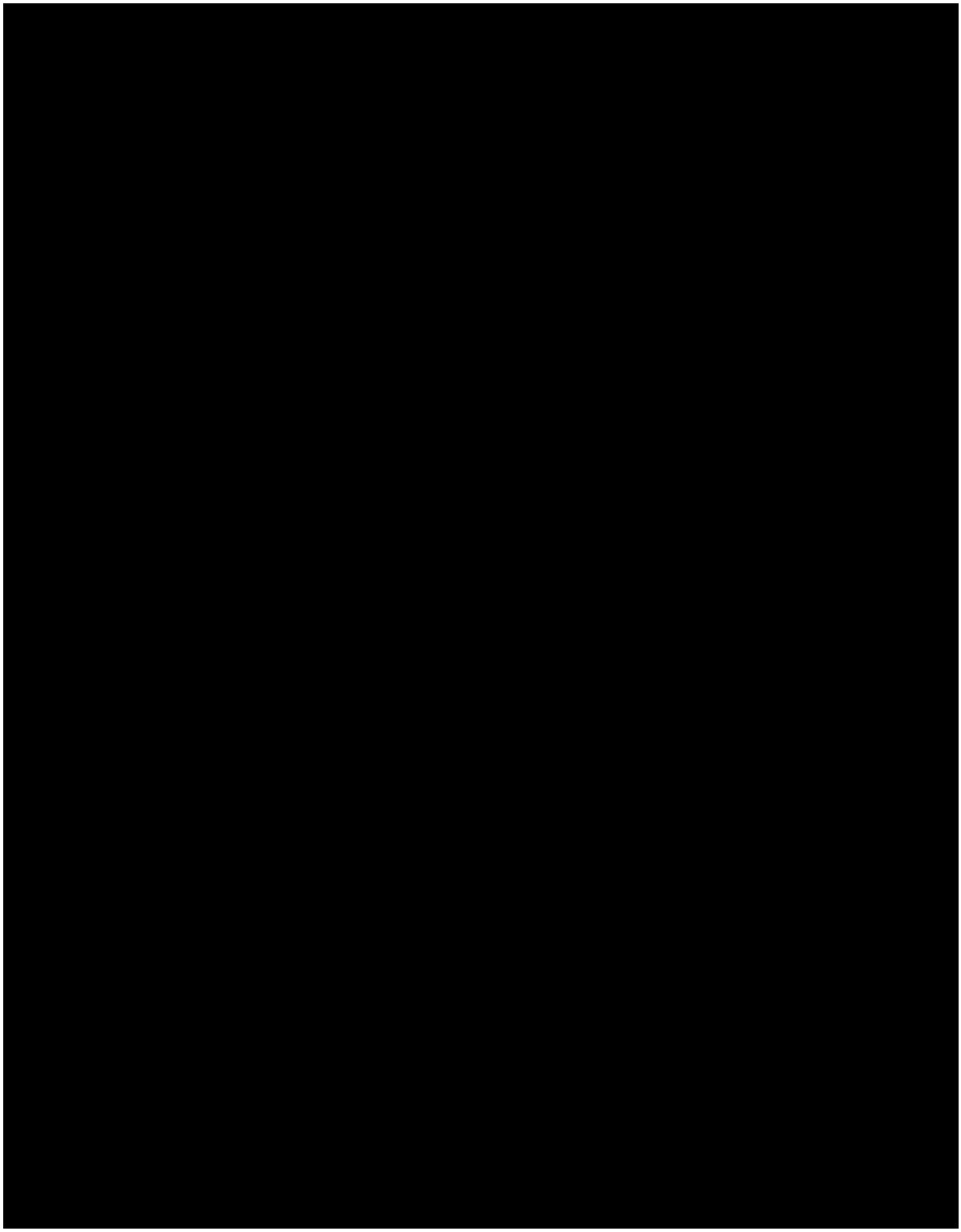

Figure 12 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the Sacramento WSR-88D

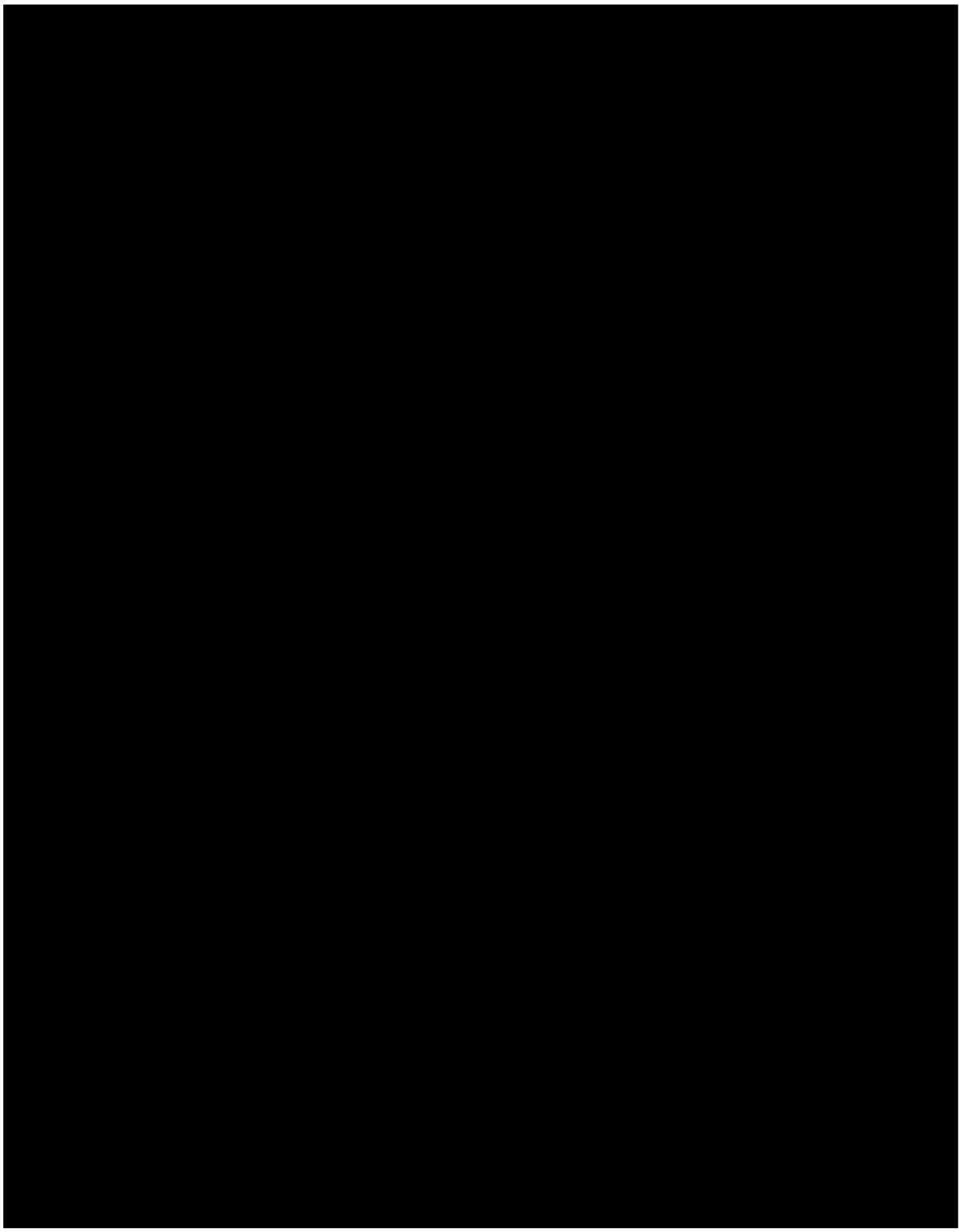

Figure 13 Impact Zone Analysis Results at 493 feet AGL for the Sacramento WSR-88D

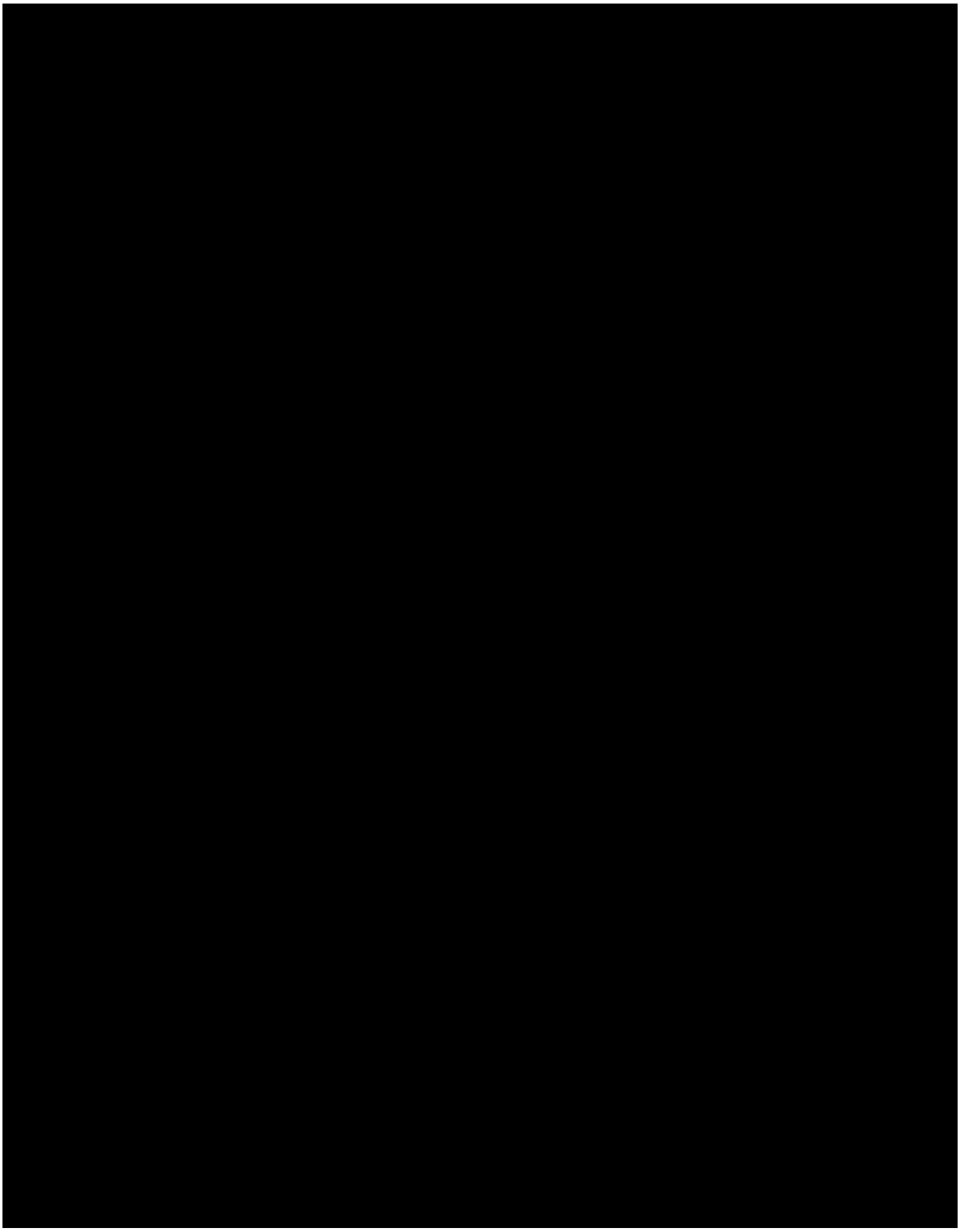

Figure 14 Impact Zone Analysis Results at 591 feet AGL for the Sacramento WSR-88D

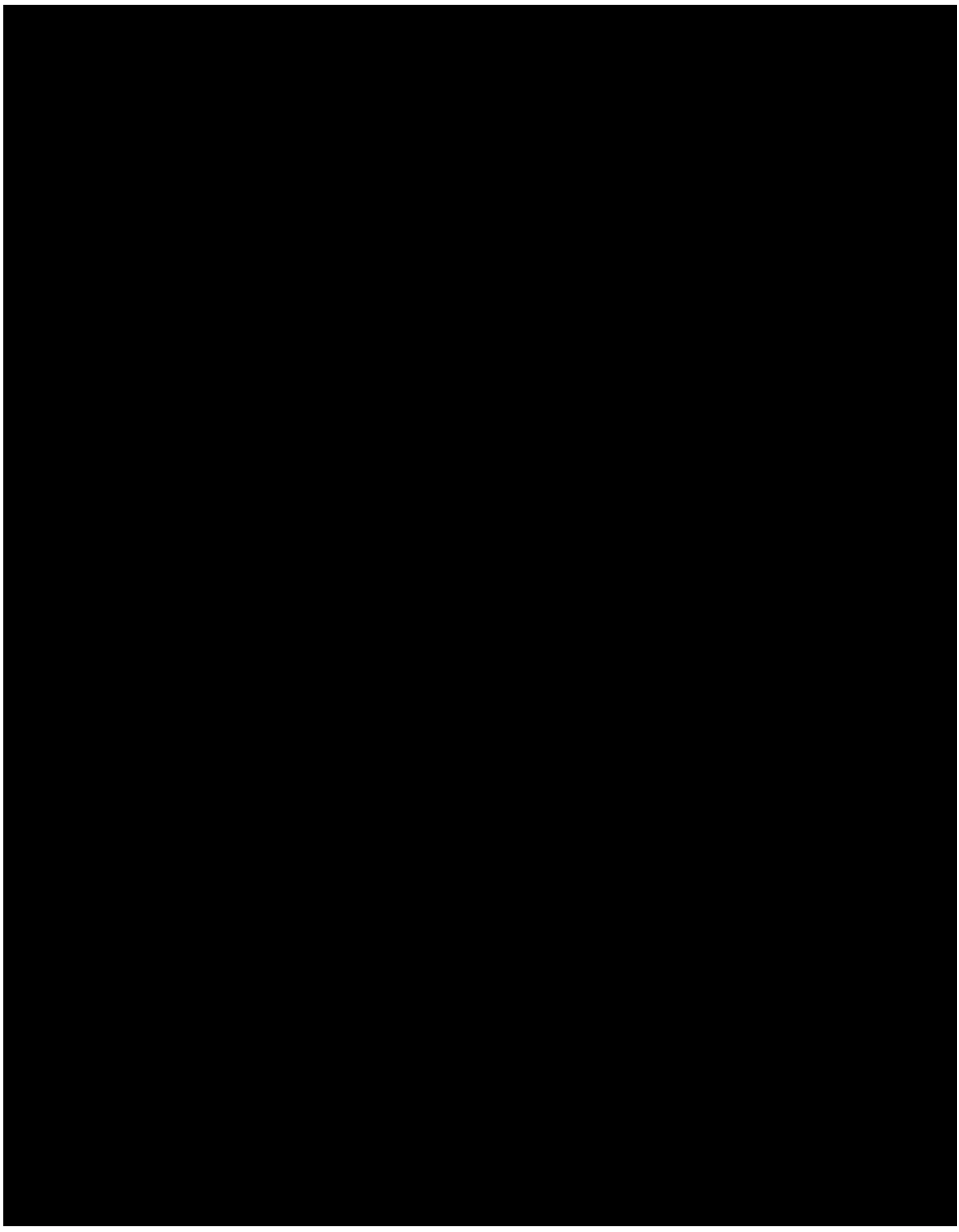

Figure 15 Impact Zone Analysis Results at 107 feet AGL for the San Francisco WSR-88D

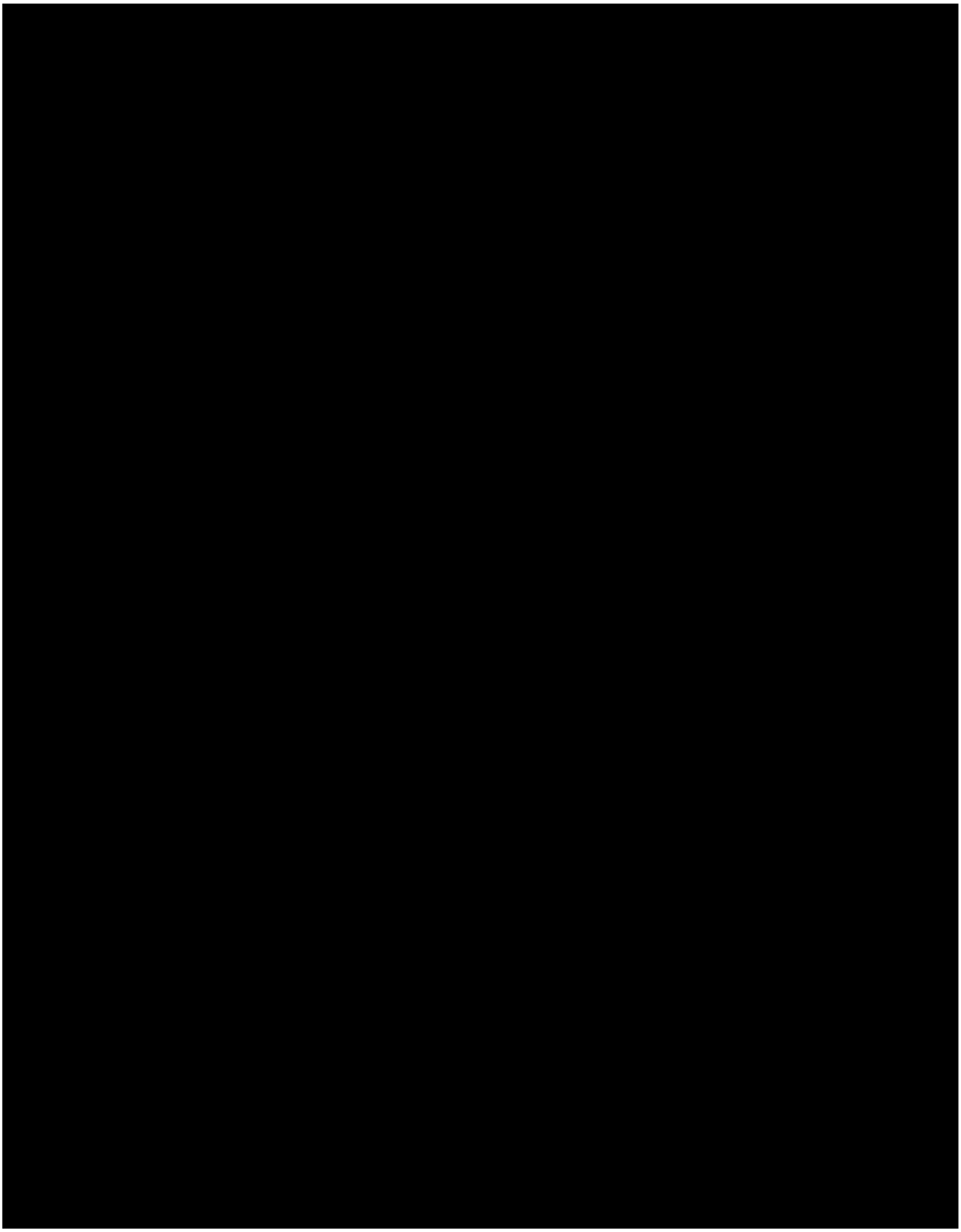

Figure 16 RLOS Analysis Results at 493 feet AGL and 591 feet AGL for the San Francisco WSR-88D

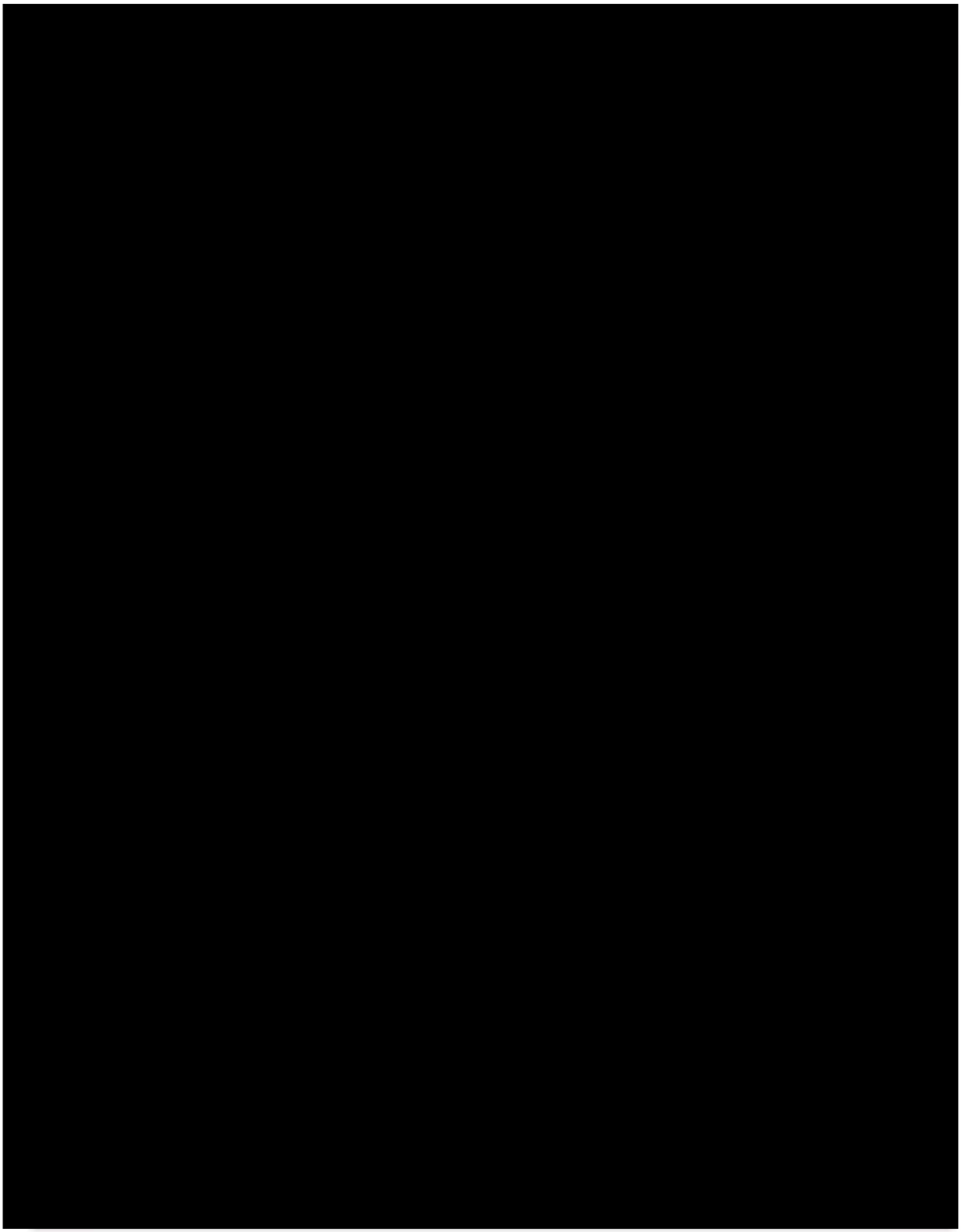

Figure 17 Impact Zone Analysis Results at 493 feet AGL for the San Francisco WSR-88D

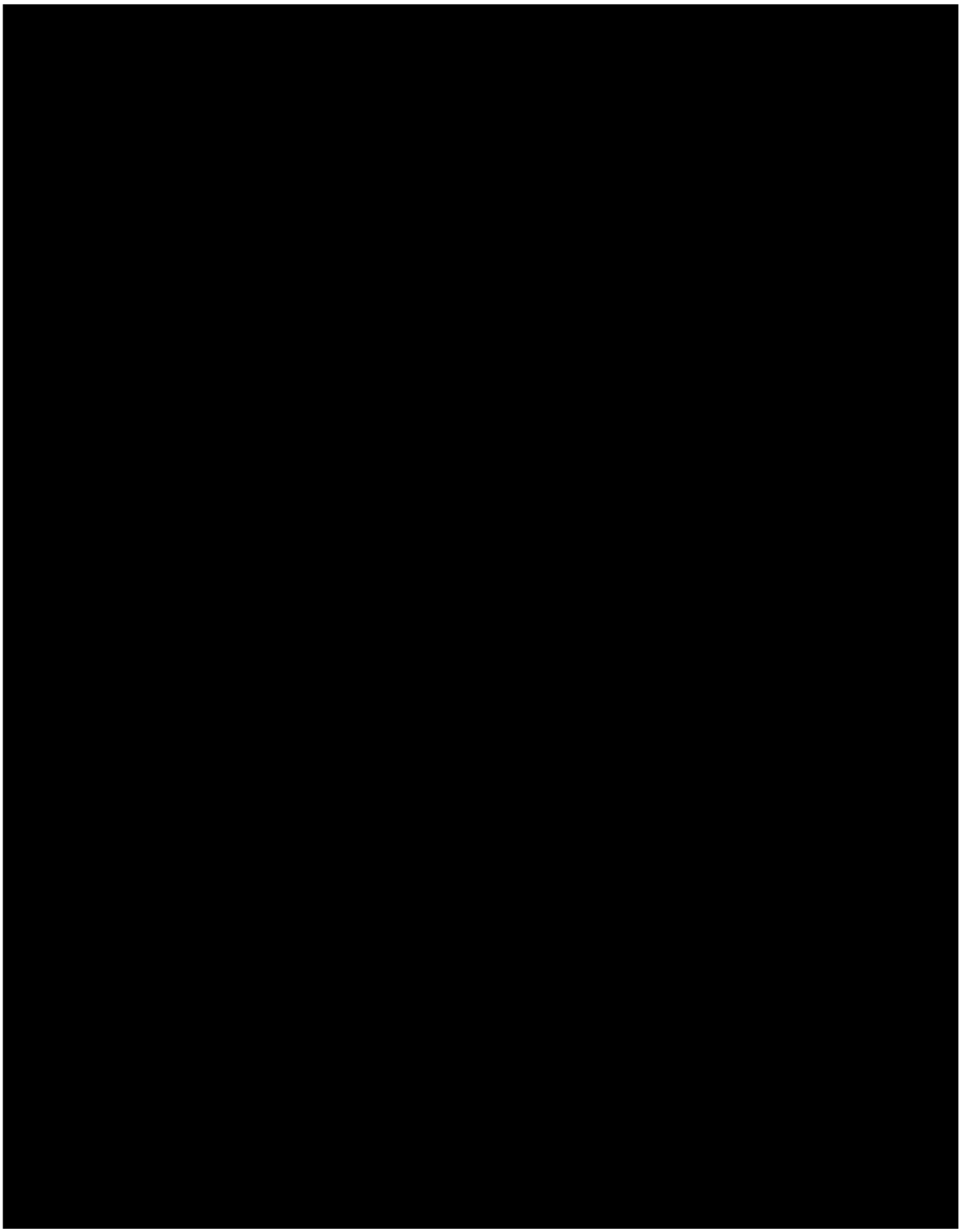

Figure 18 Impact Zone Analysis Results at 591 feet AGL for the San Francisco WSR-88D

CONCLUSIONS

The DoD PST analysis results for the Project indicate the following:

- Impacts to air defense and homeland security radar are likely; and
- Impacts to nearby WSR-88D weather radar are possible.

In total, Westslope identified and conducted a basic radar line-of-sight analysis for the following seven radar sites:

- McClellan ASR-9;
- Mill Valley ARSR-4;
- Moffett ASR-9;
- Oakland ASR-9;
- Sacramento ATCBI-6;
- Stockton ASR-11; and
- Travis AFB DASR.

The basic radar line-of-sight analyses conducted by Westslope show the following:

- For the McClellan ASR-9, the 59 existing Kenetech wind turbines are not visible to and are not interfering with this radar site. All 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to and will interfere with this radar site.
- For the Mill Valley ARSR-4, all 59 existing Kenetech wind turbines are visible to and are interfering with this radar site. All 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to and will interfere with this radar site.
- For the Sacramento ATCBI-6, the 59 existing Kenetech wind turbines are not visible to this radar site. All 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to this radar site; however, Westslope does not expect any effects from the proposed V136 or V150 wind turbines.
- For the Stockton ASR-11, 51 of the 59 existing Kenetech wind turbines are visible to and are interfering with this radar site. All 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to and will interfere with this radar site.
- For the Travis AFB DASR, the 59 existing Kenetech wind turbines are not visible to this radar site. All 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to and will interfere with this radar site.

- For the Moffett ASR-9 and the Oakland ASR-9, the proposed V136 and V150 wind turbines will not be visible to these radar sites. As a result, Westslope does not expect any radar effects to these radar sites.

For the Mill Valley ARSR-4 and the Stockton ASR-11, based on the fact that the existing Kenetech wind turbines are visible to and interfering with these radar sites, the proposed V136 or V150 wind turbines will be visible to and will interfere with these radar sites, and the development of the Project will include the removal of the existing Kenetech wind turbines, Westslope does not expect that the proposed V136 or V150 wind turbines will result in a material difference to the existing radar effects to these radar sites.

For the McClellan ASR-9 and the Travis AFB DASR, without mitigation, additional radar effects as a result of the proposed V136 or V150 wind turbines will include unwanted primary radar returns (clutter) resulting in a partial loss of primary radar target detection and a number of primary radar false targets over and in the immediate vicinity of the Project. Other possible radar effects include a partial loss of weather detection and false weather indications over and in the immediate vicinity of the Project. It is possible that mitigation techniques presently in use for the other 530 existing wind turbines in the Solano Wind Resource Area may be sufficient to address any concerns of the FAA or DoD.

Because wind turbines will be visible to the McClellan ASR-9, Mill Valley ARSR-4, Stockton ASR-11, and Travis AFB DASR, Westslope expects that the FAA and DoD will initially object to the proposed V136 or V150 wind turbines based on electromagnetic interference to air navigation facilities. As such, Westslope expects that the FAA will issue Notices of Presumed Hazard for the Project. The FAA and DoD will likely require further study to determine whether the radar effects are acceptable to operations or not. The DoD may also setup a Mitigation Response Team to conduct further study. Although possible, Westslope does not expect that the DHS will object to the proposed V136 or V150 wind turbines.

It is important to note that radar effects do not always translate into operational impacts.

Westslope's NEXRAD weather radar screening analysis for the Sacramento WSR-88D shows that the 59 existing Kenetech wind turbines at a blade-tip height of 107 feet AGL are visible to the Sacramento WSR-88D and that the existing Kenetech wind turbines fall within a No Impact Zone. As such, Westslope assumes there are no existing impacts to Sacramento WSR-88D operations as a result of these legacy wind turbines.

The NEXRAD weather radar screening analysis results also show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 wind turbines at a blade-tip height of 591 feet AGL will be visible to the Sacramento WSR-88D. Further, the screening analysis results show that at a blade-tip height of 493 feet AGL, two of the 12 proposed V136 wind turbines fall within a Notification Zone and the remaining 10 V136 wind turbines fall within a No Impact Zone. At a blade-tip height of 591 feet AGL, seven of the 10 proposed V150 wind turbines fall within a Notification Zone and the remaining

three V150 wind turbines fall within a No Impact Zone. Additional radar effects as a result of the proposed V136 or V150 wind turbines will include Doppler contamination and false weather indications over and in the immediate vicinity of the Project due to clutter; however, based on the screening analysis results, impacts to Sacramento WSR-88D operations are both possible and not likely depending upon the location and blade-tip height of the proposed wind turbines within the Project.

Westslope's NEXRAD weather radar screening analysis for the San Francisco WSR-88D shows that the 59 existing Kenetech wind turbines at a blade-tip height of 107 feet AGL are not visible to the San Francisco WSR-88D and that the existing Kenetech wind turbines fall within a No Impact Zone. As such, Westslope assumes there are no existing radar effects or impacts to San Francisco WSR-88D operations as a result of these legacy wind turbines.

The NEXRAD weather radar screening analysis also shows that the 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL will not be visible to the San Francisco WSR-88D. At a blade-tip height of 591 feet AGL, two of the 10 proposed V150 wind turbines will be visible to the San Francisco WSR-88D. The screening analysis results also show that all 12 proposed V136 wind turbines at a blade-tip height of 493 feet AGL and all 10 proposed V150 proposed wind turbines at a blade-tip height of 591 feet AGL fall within No Impact Zone. For the V136 wind turbines, Westslope does not expect any radar effects or impacts to San Francisco WSR-88D operations. For two of the 10 proposed V150 wind turbines, additional radar effects will include Doppler contamination and false weather indications over and in the immediate vicinity of these two V150 wind turbines due to clutter; however, impacts to WSR-88D operations are not likely based on the WSR-88D ROC wind farm impact zone scheme.

Westslope recommends that the Project details be submitted to the NOAA or the National Telecommunications Information Administration (NTIA) for a detailed review. The NTIA is essentially a clearinghouse for other federal agencies including NOAA.

If you have any questions regarding this analysis, please contact Geoff Blackman at (405) 816-2604 or via email at gnblackman@westslopeconsulting.com.

Seiden: Thank you, Commissioner Ryan. Could we have a roll call, please?

Senatori: Commissioner Cook

Cook: Here

Senatori: Commissioner DuClair

DuClair: Here

Senatori: Commissioner Randall

Randall: Here

Senatori: Commissioner Ryan

Ryan: Here

Senatori: Commission Sagun

Sagun: Here

Senatori: Commission Sarna

Sarna: Here

Senatori: Commission Vancil

Vancil: Here

Senatori: Chair Seiden

Seiden: Here. Staff members joining us here this evening include, or was here a moment ago, Terry Schmidtbauer and Jim Leland the Principal Planner, and Jennifer is our secretary today, Jennifer Senatori, Planning Commission Clerk. Also, Lori Mazzella, the Deputy County Counsel. May I have a motion please to approve the agenda for this evening.

[unintelligible]

Cook: I'll second it.

Seiden: We have a motion and a second to approve the agenda. Can we have a roll call vote, please?

Senatori: Commissioner Cook

Cook: Yes

Senatori: Commissioner DuClair

DuClair: Yes

Senatori: Commissioner Randall

Randall: Yes

Senatori: Commissioner Ryan

Ryan: Yes

Senatori: Commissioner Sagun

Sagun: Yes

Senatori: Commissioner Sarna

Sarna: Yes

Senatori: Commissioner Vancil

Vancil: Yes

Senatori: Chair Seiden

Seiden: Yes.

Leland: Mr. Chairman if I

Seiden: Mr. Leland

Leland: There is a technical issue. Is this on?

Seiden: Doesn't sound like it.

Leland: There is a technical issue occurring right now with the broadcast, and the way it impacts you is like this - the PowerPoints that the consultants and SMUD want to present cannot be displayed up here in the room. They will go out on Webex, and if the Commissioners want to see them, you will have to call up Webex on each of your monitors. So, I … staff is suggesting that perhaps you take … call a recess at the moment for five or eight minutes or so – tell the public to hang on, and we'll get this resolved shortly.

Seiden: Very well. Without objection, we'll be in temporary recess while we pull up a Webex on our monitors. If we could get the assistance of staff, please. The presentation on our screens here at the dais. There are no minutes as this is a special meeting this evening. Moving on then to reports from commissioners or staff -- any commissioners have any reports they would like to submit or bring to our attention? Hearing none, staff, any reports to bring? Seeing none again we will…

[unintelligible]

Seiden: Yes, please. Commissioner Cook has requested an update, and I'm able to do that on the current status of the letter that we voted in favor of at our last meeting. And,

that letter has been drafted and is ready to be printed on our stationery and will be sent out probably the first of the week.

Cook: So, we're hoping it will do the job.

Seiden: Correct, we are certainly hoping it will help bring …

Cook: Everybody should know the Mayor's selection committee doesn't meet until June 16th, so nothing will happen until then.

Seiden: At this time, I'd like to invite any items from the public but regarding, because it is a special meeting, regarding this evening's agenda item of which there is only one. Hearing none and moving forward then, there is no consent calendar this evening either. So, staff would ask please that you present the information you have regarding this evening's item, which is a AC21-009, Sacramento Metropolitan, pardon me, Municipal Utility District, SMUD, Solano 4 Wind Project, Turbine Project. Jim.

Leland: Yes, thank you, Mr. Chairman, members of the Commission. We only have one item on tonight, and it is, as the Chair said, a public hearing on application ALUC 2103 for a consistency determination on a SMUD project in the Montezuma Hills. And we submitted to the Commission and the public through the agenda process, a staff report that details our recommendation to the Commission. So, with your permission, I'll just summarize it this evening. We did recommend that the Commission find that the project is not consistent with the Travis Plan and is not eligible or does not meet the requirements for an exemption under the Travis Plan in the section called "Other Special Conditions." Briefly, SMUD is proposing to replace 23 existing turbines and 59 turbines they've also already removed with 19 new turbines. The new turbines are taller than any of the old ones. As I mentioned earlier, staff had sent you a staff report analyzing that, and staff has also engaged the services of Environmental Science Associates, the author of the Travis Plan, and they are available to answer questions this evening online. The project is in Compatibility Zones D and E, which generally have no land use parameters like population density or any of those things. But they do have concerns about wildlife hazards and tall objects and wind turbines. And within those compatibility zones, any turbine less than 100 feet can be built anywhere. Once you're over 100 feet, you have to stay out of the line of sight of the Travis radar. If you are a project that is replacing turbines with like kind turbines, the same height the same reflectivity, you can also do that. I think everyone in the room realizes that the project before you does not meet those criteria, and so it's not consistent with the compatibility plan. Within the compatibility plan, though, there is an exception process, and SMUD has asked you to consider their project for an exception and submitted information they believe tells you that they are eligible for and should be granted an exception. So, the exception process -- and this will be the first time we used it as you know -- the exception process generally asks fives questions, I'm summarizing. It asked if there is something extraordinary about the site - the physical site, either due to terrain or some other factor. It then says that if there is, you can consider an exception, and it then goes on to say there are three mandatory things you must determine. You must determine that it's not an obstruction to aircraft in flight or presenting danger to people on the ground. That's one question. You must determine that there's not a noise issue,

and I think the turbines are okay with the sounds of jets flying over, and you must determine there's no impact to military operations at their airport. If you get past those hurdles, you have a final hurdle, and that is to state what the extraordinary factors are that would make a wind turbine project within the line of sight acceptable when it's generally prohibited. And, so, I'll just touch briefly on what staff and ESA in general had to say about all those points. SMUD presented information that there are unusual factors about the site and that had to do with tall structures surrounding their site, and they talked about PG&E towers and other turbine projects. And staff concedes that is unusual and would be a factor if you are considering an exception from the obstruction standard or the part 77 standard. We're not sure that speaks to radar interference, but that's a decision for the Commission. When we concede that the obstruction mandatory finding that you have to make, you can probably make because of those tall structures, and FAA has given a no hazard determination for all their structures. As I mentioned earlier, I don't think the turbines mind sound of jets flying overhead, so there's not a noise impact hurdle for you to overcome. The Base has indicated that there's not impact to military operations by the Project. So, that leaves us with this final consideration that you have to make, which is, what extraordinary factor is there that would make a project that's normally incompatible okay, meaning in the line of sight of the radar. And, to summarize staff's position on that, we know that wind turbines affect radar reception. We know that radar reception has been reduced over the years at Travis due to the ongoing development of wind turbines. More than 10 years ago, we tried to address, the County tried to address that problem with the creative process that released three projects, including a SMUD project. After all of that took place, your Travis Plan was updated in 2015, and the decision was made enough's enough. The radar has been degraded too much in the opinion of the ALUC, and the standard to not be in the line of sight was adopted because over the long term, it would make those wind projects go away once their economic life exhausted them. And you could wait for technology which was promised at the time in the form of stealth blades -- we went through that. We're now going through a technological trial that the Defense Department and the FAA are conducting with gap fill radar to try to solve the radar problem created by wind turbines so we know all of that. We don't believe anything has been presented that definitively tells you there's something unique about this project that either makes zero difference in radar reception or, better yet, improves it. So, that's why we can't support making a finding that there's extraordinary circumstances here that warrant an exception. In essence, that's my summary of the report that we sent, and I am happy to answer any questions at this point if you want. I can do it later if you like, uh SMUD… As I mentioned, our consultants are here to answer questions also and SMUD is here physically, and they're also on the line and their consultant, Westslope is also available to make a presentation, and you can ask them questions also. So, what's your pleasure?

Seiden: Thank you Mr. Leland. I would like to offer an opportunity for SMUD to please come forward and present some additional information which I have been informed that we may not yet be aware of. Please introduce yourself to the Commission.

Cutting: Good evening, Commissioners. Thank you for taking the time out of all of our busy lives to be here a one night you probably didn't plan on this month, so thank you.

Jim, I want to thank you for all your help in getting the application submitted and reviewing it so promptly, thank you. So, at this point I was hoping that we could transfer to our Board member, Rob Kerth, and he was going to give an introductory briefing, and then I'll jump in with my presentation. So, I'm not sure if we can transfer to Rob Kerth.

Seiden: Do you have a person online that you would like to present?

Cutting: I sent him the Webex.

Kerth: There can…

Cutting: I hear you, Rob. Yes.

Kerth: You can hear me? Great. Okay. Well, Commissioners, thank you so much for giving us this chance tonight to meet with you. I'm Rob Kerth, I'm a Board member at SMUD and thank you for giving me a chance to talk about some of the great benefits of this project. First off, the Solano 4 project will produce enough clean power every year to completely supply about 40,000 homes. This is about 10 times the power that the current turbines generate. Next, the Solano 4 construction is expected to contribute $22.5M to the local economy and create 211 construction jobs in Solano County. The operation of Solano 4 is expected to contribute $440,000 every year to the Solano County economy, and, you know, we're pretty proud of being able to do that while at the same time meeting the needs of our customers. I'm sure you heard about the push to decarbonize electric utilities by 2035. The SMUD Board is pushing even harder. Our plans to reach zero carbon by 2030 and to keep any rate increases below the cost of inflation. We would be the first large utility in the nation to meet this challenge. Solano 4 is key to our plan. I was once the chair of the Airport Land Use Commission in Sacramento County, and I understand that things are never quite as simple as they appear, but I know the SMUD staff has worked very hard to create a great project that meets everyone's needs, including the Air Base. I hope very much that you can make an exception for our project tonight so we can make this good thing happen for everyone. So, with that, let me hand the floor back over or to answer any questions that you might have. Thank you.

Seiden: Thank you, Mr. Kerth. Commissioners, question for Mr. Kerth? Seeing none at this time, more to present?

Cutting: Okay, I will tell you guys what slide I'm on so that we stay on the same page. So, moving to slide four, it's just a quick overview of the wind resource area and Travis Air Force Base's orientation. I don't know if some of you guys are graphic, it always helps. Do you guys see it?

Seiden: No, we do not. If we are able in the back to move ourselves forward to slide #4, please. Excellent. Thank you.

Cutting: Okay, so you can see the light blue line is the wind resource area and at the very top left is Travis Air Force Base, and then the white, well it's a triangle and then some odd shape, those are the project areas, and the wind resource area starts at about 5 1/2 miles from Travis and 2 1/2 miles from Rio Vista, and our project is about 12

miles from Travis, at the closest. That's just to kind of get a geographic reference. If we go to Slide 5, and Jim may have already presented this as he discussed the zones, and this is just the overlay of the project with the Compatibility zones and the airport impact area. Does that make sense to everybody? It's hard. I wish I could point, but I can't, but just want to make sure we're all oriented, and you can see we're at the southern edge of incompatibility, as you said earlier, I can barely read – D and E. And, then the next slide, which would be #6 is just a zoom in of the area, so you can see the approximate turbine locations – they're the little green dots. Are there any questions about this or …? This is really just to get you guys kind of oriented. Okay, moving on to Slide 7. So, as Jim brought up earlier, we were a creative signatory in 2010. We were a member of the Renewable Energy and Wind Resource Working Group from basically its inception to its disbanding. We participated in multiple Wittram meetings, we provided him data for the infill radar. I still, probably every six months, talk to the infill radar vendor and we're actively supporting that project. I mean, this is not much you can do, it's on the FAA's timeline, unfortunately, but I still think as discussed, it's a promising technology. We've probably been meeting with Travis for 13 years now. I mean, I've personally met with Gary Gotschall, Colonel Nelson, Colonel Simmons and was introduced to a new deputy commander just now. So, I mean we have really worked to reach out, listen to the Base and understand their concerns. So, as part of the process, we have to go through -- Jim talked about earlier -- the FAA determination. So, we filed with the FAA in 2018. At that point, Travis did not raise objections – it was their option not to, but after the determinations were…not sure what the right word is … determined valid, they did send us a letter, and so we paused our process and worked very closely with the Base, and about that time transitioned from Colonel Nelson to Colonel Simmons, and we had, I think, a meeting every other week and they went through their internal diligence process. And, at the end of that….well, sorry. First they raised concern with the Department of Defense Clearinghouse and then we start some mitigation response team. We participated in that - we worked with them. They did their analysis. They provided their review to the DoD Clearinghouse. The clearinghouse reviewed it – make sure I get everything here. So, at the end we got a mission compatibility letter from the Department of Defense Clearinghouse that said it was no impact to their operations. And then from that we got an extension to our existing FAA determination of no hazard, so the point of all this is, I really feel that SMUD has done its diligence to the agencies that are responsible for the safe operation of airplanes and Travis nationwide, and we have built a project that has no net impact. So, next slide is number 9. The wind project status. So, our..

Harrison: Sir, I'm sorry, I'm struggling to hear you.

Cutting: Oh, really?

Harrison: Can you either get closer to the…

Cutting: Take my mask off? Yeah, sorry about that. Did you want me to go back or …? Okay, I'm happy to take the mask off. You know, if I make it higher, does that work any better? Thank you. So, anyway, our request for our we call it a bid package hit the street on Wednesday, so we're out bidding for it now. The final Environmental Impact Report is planned for release in June of this year. We hope to award a construction

contract by the end of this year, and the project, the exact construction date is not quite known yet. There's a few things still determined, but it's about a year's worth of construction work. So, the next slide number 10, I was going to have Mr. Blackman walk you guys through the presentation – the other one, Jim. So, they probably want it -- I don't know if we want pause and have them pull it up, and I'll go through these bullets briefly.

Leland: Yes.

Cutting: So, we designed the project to not have any increase in radar impact -- in the turbine business, there's many sizes you can buy - there were economic and viable projects with 40 turbines, and we said no. And, we worked closely with Westslope, Geoff Blackman, and said do a study, do a study…oh, look – this one works. It doesn't cause any net increase in radar impact, so there were different viable economic projects, but we chose the one that didn't cause any degradation to radar and we worked with Mr. Blackman. I'm not sure if you guys are familiar, and he'll give a presentation here. Again, we reached out to Travis the whole time, we went through an MRT process, we got cleared by the DoD. We got clear by Travis. We got cleared by the FAA. So, at this point, I'm hopefully going to step back, and you guys can hear from Geoff Blackman, and he'll give you an overview of the modeling, excuse me, of the process that we did. He did for us to quantify the potential for radar impact, or basically how we verified we didn't have any.

Seiden: So, just to clear it up for us, the representative for Westslope, is that right?

Cutting: Yes, yes, sorry. I think it's Westslope Associates. It's Geoff Blackman, he's the principal.

Blackman: Hi, can everyone hear me?

Cutting: Yes.

Seiden: Yes.

Blackman: Great, perfect. For those on the Commission who don't know me, I've been working out with Travis, working out the radar issues with Travis, since probably 2007. First got involved while still working for the FAA as an advisor to provide impact input on trying to address some of the original concerns that we received with the original radar out of Travis and basically worked with the Base to make improvements to the existing radar and then worked with the Base for about 2-3 years after that to help set up a new radar, a new display system used by the controllers to see if we can find the best configuration to basically get the best performance out the radar for the controllers. And then we ended up getting involved with the original CRADA, the Cooperative Research and Development Agreement, to look at the methods for predicting the impacts of new projects on the Base, and Mr. Leland referenced those at the start of the meeting in his summary. The slides I'm going to go through today, really, I was reading through the staff analysis and in there, it stated in there, that we haven't provided sufficient quantitative analysis in the package. We have gone through and completed quantitative analysis. This was data that was shared with Travis. Every

time we've really updated any of our analysis, we've shared that with Travis over the years to make sure we're transparent and really trying to find a solution that was going to work for everyone. So, these are the slides - I have redacted or deleted some of the images in here given that it contained some graphics with some of the figures of some of the details, the radar that we really don't want out in public for proprietary nature/sensitive nature. I would like to turn to the next slide, please. So, I'll try and go through this very fairly quickly, but if at any time it's unclear, please stop me and ask me to clarify. We first sort of started this process, and I was asked to present to the Repower Group at the County, the first sort of Solano 4 project that had been proposed, which was 16 turbines that were located on what is now the Solano West 4 west area, where the 59 old Kennentech wind turbines were located. And I was looking at what would be the additional impacts of those 16 turbines. The first thing we looked at was line of sight and determined that the old turbines that were there at the time were not within line of sight of Travis, which is an indicator that you know they're not likely to indicate with the radar/interfere with the radar. We also looked at actual radar data to verify that as well, so there was a quantitative assessment as part of that as well... a qualitative assessment as part of that. We then looked at the 16 proposed turbines at the time and those were at the height of 488 feet, and what we ended up finding was that one, they were over in line of sight, and two, because of the interference there based on impact predictions, we were using the same modeling approach that we had used under the original CRADA, we found that based on altitude, there was some additional effect on the radar. So, the slide here it says incremental dropped in primary PD that's probability of detection. In other words, you know, we're seeing some loss, additional loss, in the detection from the radar. Primary refers to the two radars in one here. The primary is the radar that doesn't talk to the transponders onboard the aircraft. So, if aircraft are operating transponders, there's no issue. And, the majority of aircraft in the airspace do use transponders. The primary we did see said there was some small drop of .3% below 4000 feet and .4% below 10,000 feet, which was a concern. Just for reference in here, we did include some of the criteria or methodology that we've used under the original CRADA, which was a 5% tolerance just for reference. You know, from my experience working on this type of radar, the DASR, I was an FAA senior engineer for 10 years, was one of the engineers responsible for conducting the national testing on this radar, and ultimately part of the team that certified it so it could be put in service nationally. I have also authored upgrades and algorithm changes to radar to help out in situations such as wind farms. I mean just based on my experience actually going out, setting radars up, training people on how to set this radar up, you know, these types of effects are manageable within the radar. I'm not opining on whether that's acceptable to Travis at the controller screens or not, just saying that it's manageable. Next slide, please. So, that was really our starting point and in looking at that we realized there was some concerns there. We also have changes in technology as time has rolled on – turbines change year to year - larger turbines were available and then I was basically asked to look at the possibility of using the Vestas V136 at 493 feet. or the Vestas V150 or 591 feet. A move into larger technology allows us to reduce the number of turbines required to get the same amount of power out, so that was sort of the next step really in our analysis. Next slide, please. This is one that I had to remove the figures on, so next one, please. Thank you. And the key thing in here, there's a lot

of numbers here, the key thing really is the top table and the bottom row of the top table where it's Solano 4 2016 versus Solano 4 V136, etc. You know when we originally looked at this set in 2016, we had a drop of negative .3% for below 4000 and then a negative .4% below 10,000. If you look at the numbers on the underneath there for the larger turbines, you end up seeing that as you go further down, the larger the turbine gets, the smaller the drop in the detection was going. Ended up resulting in a smaller drop in the detection. So, the bottom row really there where it says the negative .2, that would be the drop in detection below 4000 and below 10,000. And those two altitudes were sot of altitudes that we focused on a lot during the original CRADA, and below 10 thousands, really below 10,000, you don't have to have a transponder on. Below four was really focused in on lower altitude aircraft. So, that bottom row there is really the key one that larger technology resulted in smaller loss or smaller drop in the radar's detection. And understanding that we still want to get to a point to where there's no difference in the effect on the radar or no increase in the loss of protection. Then we had to look at other mitigation options. Next slide, please. So, one thing we looked at really was where else could we go or what other projects were available where SMUD could go in and reduce the number of turbines that were currently impacting the radar. Solano Phase I, the original project that SMUD installed, that's the oldest one, and it seemed logical to look at maybe prematurely replacing those turbines or repowering those turbines. The 23 of those turbines currently installed that are interfering with the Travis radar today, so as a note, there are 16 at 242 feet and seven at 291 feet, so we actually looked at possible replacements for those at the larger turbine sizes, and I really just focused on the last one, the V150 which would reduce the number of turbines from 23 down to nine with the larger turbine, which goes up to 591 feet. Next slide, please. So, basically, in looking at the larger turbines here, we use basically the same assumptions we used during the CRADA, but we ended up having to use a different model in order to look at this, which was a Monte Carlo model. Monte Carlo basically just means that we are using, in this case, 10, well thousands of random aircraft tracks over the area to look at really the difference between the impact of 23 turbines versus 9, but the reason we use this model is we needed to significantly increase the sample set so statistically we could find reliable numbers are consistent numbers. So, what this ended up showing and if on the table on the right hand side and it's really the top part where it says Solano 4 West V150 -- the numbers there, it says the 10 turbines -- we have this negative .2 which we have already discussed and then the bottom line in there, it says Solano 4 East v150. We did look at the V136, too, to look at whether. going from 23 smaller turbines to 9 larger turbines could end up reducing the current impact on the Travis radar and what we ended up finding was that it would actually increase the detection over that area by .2%. But for both altitudes I mentioned earlier. In other words, it would negate the effect of installing the turbines in Solano 4 West. Next slide, please. So, I mean, I sort of hit the critical part in there in that the intent was to try and negate the impacts we were seeing with Solano 4 West, and through repowering Solano Phase I, we could actually show that that was possible. So, that is the actual project. The next slide, please. Should be one last one, so, you know, after we had presented this to Travis, the Project was filed with the FAA and that's when we worked through, and the FAA issued the determinations of no hazard. And then, with the extensions, that is when Travis raised concerns in accordance with the DoD Siting

Clearinghouse process under the FAA process. We basically established the mitigation response team, these slides were shared with members of the mitigation response team. Both the Airforce Flight Standards Agency and NORAD, North American Aerospace Defense Command, basically went away, conducted their own analysis, and came to the same conclusions that have came to here. And, ultimately that's where we saw the decision coming out of the Base that there wouldn't be any – basically, there wouldn't be any improvement on the radar, but it wouldn't be any further degradation. And, ultimately, that that led to the Department of Defense removing any concerns they had, and it went back over to the FAA process. One thing I would note about the FAA process, when the Department of Defense and one of the services under the Department of Defense raises a concern, the FAA process is put on hold until we address those concerns. So, you know, it's….we have to address all these older requirements and concerns for Airforce. The DoD will then, if they agree, will then issue no objections to the FAA and then the FAA will continue on and do their part of the analysis before issuing the extensions. And, in this case, that's basically what transpired. So, you know, what we've gone through this process, essentially twice now. FAA made the same conclusion twice -- on the second time round, we were able to work through this with Travis, and Travis and its experts basically came to the same conclusions that were drawn, which was a good conclusion overall for everyone. Thanks. I'll take any questions.

Seiden: Pardon me. Commissioner Sagun.

Sagun: Yes, thank you. Thank you for the presentation. I have a couple questions. You mentioned the Wittram Study, and I didn't see any reference in the DEIR about Wittram. Why was that?

Cutting: You want to answer that?

Blackman: I don't know if I'm the right person to respond to it, but I certainly, you know, will mention that. You know, when we go through this process, we try and identify concerns. If there's an unacceptable risk, and we have to identify mitigation, then we could look at other mitigation options. And there wasn't sort of…it basically wasn't warranted in the process we've gone through here.

Cutting: Yeah, our interest in participating in the Wittram Project, process, excuse me, is to be good neighbors. We're very invested in this wind resource area. We've been here since… I think we bought our first piece of property in 1992, and our first project went commercial in 95. We're one of the original wind project developers out here, so that I don't... I didn't see it as part of the environmental process and as Geoff said, we had a project with no net impact, so…. Ammon Rice I think is on the call who is our CEQA lead if you would want to direct question to him, I think we could probably get him on the phone. Does that address your question?

Sagun: Well, the way I'm reading it is that SMUD is required by CEQA to propose possible mitigations if any significant impacts are indicated and your own consultants stated those very words – that there were significant impacts, but yet there was no

mention of the Wittram in the DEIR. Is there going to be a mention of Wittram in the final EIR that's coming out in June?

Cutting: Struggling to see how participating in a group that is to improve the radar is correlated to a project that is quantified to have no net impact. Again, I'm not a CEQA guy, so I would have to ask our CEQA expert to step in.

Sagun: Okay, thank you. And, also, my second question is regarding you said there was a study done that you and your consultants worked on that showed that there was…that the project would have no additional impact and might have an incremental improvement in the radar. And, I'm wondering, where can I find that study because I don't have that in my resource materials. Has that been distributed to the ALUC?

Cutting: You got this yesterday, right? Jim has it. It's documented in the study that was just presented to you. It has been shared with the…

Sagun: Okay, but I don't know – have any of the other Commissioners had access to this? Because the way I understand it is we are called upon here to potentially make a determination tonight, but yet we haven't seen something that's very significant to the process. You also mentioned that the study, if I understood this and it's very complex to me, but it sounded like you did a study on Solano 4 West, and that's where you showed some incremental improvement in the radar reflections, but I didn't hear a mention of Solano East.

Cutting: I should probably let Geoff answer these questions. As yet, we have to be...

Blackman: I think I answer your question, sir, we looked at Solano 4 West, and there was a small increase in the impact on Travis. And then with the change with Solano 4 East, we negated that impact to the point to where it has a net zero impact on the radar.

Sagun: Okay, so if I understand you correctly, sir, you're saying that the Solano 4 West study showed that there was a net increase in impact, but the Solano 4 East study showed there was a decrease, and they basically zeroed each other out. So, is that right?

Blackman: You got it. Yes, sir.

Sagun: Okay, I…

Schofield: This is Joe Schofield. May I add on to something that Geoff just said that draws back to answer your earlier question about CEQA, which is CEQA requires mitigation when there is a significant impact resulting from a project, or a potential significant impact. In this case, since those two phases - East and West of the project together pose no deviation from the baseline of radar interference, CEQA does not call that to be an interference. CEQA measures the environmental impact of a project against the baseline. Since there's no deviation or no meaningful deviation from the baseline, there is no, in CEQA parlance, significant impact.

Sagun: Okay, I come from the airline industry, so if we have a procedure…a group of procedures we are trying to implement, and one of two of them, and one of them shows that it would decrease the probability of a collision, but the other procedure shows it would increase the probability of collision, the two negate each other out -- is that, would that be considered a success and we would go ahead and implement both procedures as a project/as a whole?

Schofield: CEQA requires the lead agency to evaluate the impact of the project as a whole, and if one section of the project has a mild increase and the other one has an offsetting decrease and the result is that you're not resulting in an increase over baseline, yes, they cancel each other out. And in the in the context of radar interference, or if you have two component project aspects that together cumulatively result in no net increase, then there is no impact, such is the way that CEQA is analyzed under the law.

Sagun: Thank you. My next question has to do with the lifespan of the existing wind generators that are planned to be replaced. What is their lifespan and what is the proposed lifespan of the new proposed replacements?

Cutting: In general, they are designed to an international standard for a 20-year fatigue life. You can potentially run them longer. You have to do some inspections, similar to airplanes. The newer turbines are more likely 25 years. Does that answer your question?

Sagun: Pretty much, but I'm wondering, are the existing turbines that are due to be replaced coming up on the 20-year lifespan? What is their specific lifespan or timeframe?

Cutting: My apologies. I did not completely answer your question. We have one that's two years past its lifespan, 15 that have three years to go, and seven that have five years/four years to go. So, they're getting close.

Sagun: Okay, and so, and the new proposed generators have about a 25-year lifespan.

Cutting: Thank you, Commissioner Sagun.

Sagun: Okay, my last question that I noted here was on the FAA's determination of no hazard, hasn't that expired?

Cutting: No. We had an extension because we went through the MRT process, worked with Travis. DoD Clearinghouse gave us a mission compatibility letter, which then gave us the extensions. So, we have valid extensions right now.

Sagun: Okay, thank you.

Cutting: You bet.

Sagun: That's all I have for now.

Seiden: Other Commissioners, please. Commissioner Cook.

Cook: So, this is probably Geoff Blackman that..

Seiden: Take your mask…Thanks.

Cook: I am happy to remove my mask, too. This question is for Geoff. So, I was trying to track everything you're saying about this newer type of, well, trying to address the radar issues because based on everything I read in the report, and I have been to the radar facility at Travis, and the controllers were definitely having problems from the wind turbine returns and the fix, which Jim mentioned in his briefing, is this infill radar. Right? But, one of my questions is are you talking about a different type of system, of radar that's going to be better than what we're being told by the infill? And the infill radar, as I understand, is taking longer than they thought to get it a validation system with the FAA and then get it implemented. So, the original projection was like 2 years and that was over two years ago. Now, there saying it could be 5 to 10 years and when I was speaking to the controllers, they talked about how, you know, when it…one of the the most time consuming things .. they lose because of the radar turbines giving false and then they have to re-establish contact - that's what's the most time consuming part for them. So, I have sort of gone around the hill here, but is this a different type of radar system that you're talking about? And, I see the bullet here that says to enter agreement to provide voluntary contribution for funding it, so that's… that's all very confusing to me.

Blackman: Okay, so the radar we're talking about is the main radar used by Travis Air Force Base, the DASR - the digital airport surveillance radar. That's the one you see over near the wind turbines, basically off of what is Highway 12 - if you look back towards the Base, you'll see the orange antenna turn around.

Cook: I understand the primary and secondary radar and the digital is the secondary. Right?

Blackman: They're actually….the DASR itself is the primary radar, so located with that is the secondary called that MSSR. They're both digital radars now, Ma'am. So, that's the radar we're talking about - this is the one where we've actually looked at the impact of Solano 4 West and was able to show that with Solano 4 East we can negate any of those impacts across the wind resource area.

Cook: But it's not going to remove the current problem that the controllers have. Right? Because the infill radar is what they're saying is the most promising technology to do that.

Blackman: So, we've been able to show that, from a controller's perspective, they won't see any difference, and that's what Travis and its experts ultimately concluded working with all their radar experts, including NORAD, which is our air defense, air defenders for the United States. They looked at this as well and came to the same conclusion that with this project, the way it's designed, it will not have any difference in the effect on what the controllers are currently seeing.

Cook: Agreed, no effect, but they still have a negative effect right now.

Cutting: There's almost

Cook: It's not going to be worsened is what you're saying.

Cutting: Yeah, but.

Cook: It's not going to take it away.

Cutting: Geoff, I can just give the numbers. We're only talking 19 turbines and currently I believe there's 560 installed, so it really doesn't matter what we do. We just worked really hard to make sure we had no net change. Does that make sense? I mean …

Cook: Yeah, I appreciate…

Cutting: If we remove all of our SMUD turbines, it really wouldn't change what they saw on the radar because we're a small fraction of what's out there.

Cook: I didn't say this at the beginning, but I did want to thank SMUD for bringing this presentation to the Commission because I understand that it's… I think it's important to have this public forum to discuss and bring our concerns up, so thank you.

Cutting: Thank you, Commissioner Cook. We're neighbors.

Blackman: The one other thing I would like to bring up or respond to Commissioner Cook's comment about the last bullet on here about voluntary contribution. We're sort of working similar processes like this with wind projects all over the country. There's a standard sort of practice now, especially when we're dealing with Base radar or radars used for defense that we basically put agreements in place to fund for the Air Force engineers to go out and once the projects are built, basically to update the settings in the radars to make sure that they're providing the control with the best performance, so that was what was recommended in here. But when we worked through the process with Travis and ultimately with the DoD, it was determined that that wasn't required, so it was a recommendation, but it wasn't required.

Cook: Okay. Thank you.

Seiden: Any other Commissioners? Steve? Commissioner Vancil.

Vancil: I'd like to echo Commissioner Cook's comments. Thank you very much for appearing with us. You've been meeting with us and discussing with our Commission since before the CRADA, over a decade. So, we've had a long, long, very productive discussion over the years. And you guys were a very big part of helping start and fund the CRADA. There were three major developers in the wind resource area, and you guys are still here, not sure where the other guys are.

Cutting: Thank you.

Vancil: But, I would like to acknowledge that your projects that you have are the ones that are farthest away from the Base, the other two developers had the projects that were the closest to the Base, so as it stands today, as we kind of have discussed, there is some interference -- it's more from the other projects, the ones that are closer to the Base. Mr Leland, from our staff, I think gave a very excellent summary of how we got to the 2015 update of the Travis Airport Land Use Plan. The CRADA process certainly helped, and we appreciate Mr Blackman's work with that, the probability of detection criteria the FAA uses and the filtering certainly did help, but I think we got to the point where it is such a large area with so many turbines, a complex area, that it is more a problem now of false targets than probability of detection. And the filtering has certainly very much helped the radar display, but still there is clutter on the display, and I think that's the problem that Commissioner Cook has referred to. The probability detection wasn't completely working for us as we saw, and there was hope there would be some technology that would advance the filtering and take out so that we could still use the radar, but in 2015, we did some white papers on a whole bunch of research on different potential new technologies that might mitigate, but ultimately came to the conclusion it was at least five and probably 10 years away. And that's why we came up with the line of sight criteria because it was more of a matter of false targets than probability of detection. I think the other problem we had, we realized that the probability methods that Westslope uses is proprietary, so we couldn't necessarily see the homework, or exactly how it came up with the figures, but every time there seemed to be a project, we would get a feedback that it meets the 80% probability detection - kind of like this evening. You can see well there's only a 2.2% degradation or 1% degradation or whatever, but we really didn't have any firm data we could grab our hands on other than that -- that it's still above 80%. So, I think that issue of going by the FAA standard of 80% probability detection we found was, for us, not something good to stand on because when we would go to the scope, and Commissioner Cook is actually a former Air Force Officer and air traffic controller, we would see all of the clutter on the display and the struggle that the controllers were having, especially on high wind days and especially as the turbines got bigger when the wind blades were moving at faster speeds. So, that's why we came up with it, out line of sight criteria. I am very hopeful that we will have some new technology, and I very much appreciate SMUD's staying in the game with us, with the Air Force Base, and with the gap infill radar. Hopefully, we can do something to move that along, because ultimately that's what really solves the problem for not only this SMUD project, but the other two developer projects and potentially other projects that might come up. But, again, I do thank you for appearing before us, but I kind of wanted to give you a little background of how we as a Commission came up with our view of the line of sight criteria.

Cutting: Thank you, Commissioner Vancil.

Seiden: Thank you, Commissioner Vancil. Commissioner DuClair?

DuClair: (unintelligible) radar operator in the military. I know radar…(unintelligible) So, with these new turbines, how (unintelligible) and how much noise are they going to generate to come back to Travis approach control to wipe out those screens for those operators saying, Well, is that an aircraft or is that noise off of a turbine?

Cutting: I would ask Geoff Blackman if he could address this.

Blackman: So, I got about half of that. Buck, would you mind just sort of summarizing the question?

Cutting: Counselor DuClair's question was, will the larger turbines have more noise that is seen by the radar? Is that correct?

DuClair: Yes/

Cutting: Thank you.

Blackman: Larger turbines produce larger returns to the radar, but overall, reducing the number of turbines reduces the overall effect on the radar. And, this is an approach that, you know, we work in projects all over the country where we're looking at repowering a number of, lots of, projects across the country and generally it's considered that when we reduce the number of turbines by going up in height, we're reducing the effects on the radar. So, repowering, it could end up, is basically considered as something that can result in improvement on the radar, even though the returns are greater, the overall effect is considered less.

DuClair: Okay.

Randall: Just a little clarification. You're saying that the false positives are going to be the same.

Cutting: Geoff, did you hear that?

Randall: The false positives are going to be the same?

Cutting: False positives, was the question. Will they change?

Blackman: There'll be no… as far as I'm concerned, there will be no difference. I mean, we're reducing the number of turbines out there, you know. You could argue that it might be a small reduction, but I would say to be conservative that there would be no difference in what they're currently seeing today.

Cutting: Thank you.

Seiden: Thank you, Thomas. Any other Commissioners? Dan? Commissioner Sarna?

Sarna: Does inclement weather have more of an effect in the area of the turbines? Does it have more effect on the screens of the radar operators?

Cutting: Geoff, did you hear that?

Blackman: What will the project have any more effects on the screens for the radar operators? No.

Cutting: During incl...

Blackman: That's what we're saying, the way the project's designed with the current locations of where the turbines have been proposed, that will end up having zero difference to the operators.

Sarna: Yeah, I'm sorry, Geoff. What I meant was during inclement weather over the turbine areas, does that affect the clutter on the screens?

Blackman: Inclement weather. So, I mean – are you talking about seeing the weather indications on the screen?

Sarna: Yeah, yeah. When we have storms over the turbine areas, does that add to the clutter on the screens for the radar operators.

Blackman: No.

Sarna: Hmm. Thank you, that's all I had.

Blackman: You're welcome.

Seiden: Other questions from commissioners?

Vancil: Yes, I kind of had..

Seiden: Commissioner Vancil.

Vancil: I kind of have a simple question to follow up Commissioner Sagun's. We talked about the East and West portions of the Solano 4 - which one is being built first?

Cutting: It's really up to what the contractor proposes. We try not to dictate it at that level. Whatever it works out to be least cost, they would be built within the same year. Does that answer your question?

Vancil: Yeah, it does.

Cutting: Thank you.

Vancil: My consideration was one, apparently it had a little bit of a negative effect, a little bit of a positive effect. I'm trying to see whether we get the negative or positive first.

Cutting: First, we take the 23 down, so it'd get better. Thank you, Commissioner Vancil.

Seiden: Commissioner Sagun.

Sagun: Thank you, Mr. Chairman. I had a question about what other radars did you find that will be affected by the project, other than the Travis radars?

Cutting: Geoff, did you hear that? The question was what other radars other than Travis would be affected by the project?

Blackman: You know, to be quite honest, I would have to go back to double check, but I do believe that there will be some additional.. well, the project would be within line of

sight I think with the Stockton radar, and then the Mill Valley radar – Mill Valley's on top of Mount Tamalpais. But, you know, for both those radars, mitigation is already put in place to address the turbines. In fact, you know I could argue that with the reduction in turbines in there, they could back off on some of that mitigation. You know, if you actually studied that, and the FAA did consider that, and NORAD considered that as well as part of this process, and they really came to the conclusion that would be no difference in the current effects.

Sagun: I think I found a reference in the document. Will the McClellan radar be affected? It looks like it will be if I'm reading this correctly.

Blackman: You're looking in the…? Is that in the determination. Yeah, I mean, the FAA when they looked at this, this well determined that is in line of sight with Stockton, then Travis, Mill Valley, and then McClellan. But overall, from everyone's review of this determination was there was there was no additional effect here that would affect operations.

Sagun: Is that located in the report? Can you point me to it?

Blackman: It's not in this specific… in the presentation that I've provided here. We were focused on looking at the Travis radar, being the radar.. my understanding was the ALUC was most concerned about.

Seiden: Commissioner Randall.

Randall: Yeah, in the spirit of being good neighbors and Travis actually being a good neighbor also of Solano County, the mission… Okay, when those turbines went out there originally, they kind of changed the training for Travis, you know, to put them into a little box. Okay, and after seeing all that went on, everybody was like, "ooh, what happened? We wouldn't have ever done this" because the mission of Travis changed. Okay, so, in my mind, I'm saying to myself, with the assault landing zone out there and Travis always trying to expand their missions, you know, also to get different planes to come in and everything. My concern, which might not be a question to you guys, but as a whole with Travis, will it limit Travis's mission, that Travis's mission can expand or are we just looking at today and saying, today it would be good to put these here but then later, you know, we might have jets come in here to do – that was the primary purpose of this assault landing zone so planes could fly lower and get up and go. Okay, I'm not sure if… I'm looking at where these new turbines are going, and I'm saying to myself, are we limiting Travis again? Are we going to put them in a box again? And, the big picture is the more we limit Travis, the more we come out ahead of BRAC, I'm speaking of the elephant in the room because we don't want to lose Travis. Okay, and I think that's what the tug of war is – we want to be good neighbors, but we don't want to lose our Base. And, I think for myself, limiting…to keep limiting them in their space of training is problematic. So, I don't know if that's a broad question out there or if it's just my question, you know? And, I wish I had Travis to answer that, you know, the best they could, but that's my concern.

Cutting: We don't want to … Commissioner Randall, thank you for expressing that – we don't want to jeopardize anything to do with Travis's operations, and again, we worked really hard not to, and we're very far.. my understanding is the assault landing zone is on the east end of their runway, so we might be 15 miles away and flying low over the SMUD property isn't really possible because of the multiple tall transmission towers. So, our project, now admittedly, some of the turbines are a mile or two away, but I don't know about you guys, but I'm thinking that the planes are doing 180 knots on Base, and that's 20 seconds in my book, and I would stay away from those towers even if they're five miles away. But, so… I think it's a very legitimate concern, and it's hard to see what the future need is going to be, and if you inadvertently block out a future need because you didn't foresee it, you're going to not be happy about it. But, I think this particular project, given its geographic location and the unique situation we happen to have all the major transmission line towers on our property, sort of precludes it from becoming a low altitude route anywhere in the future unless we want to do something different with those transmission lines. Does that..

Randall: Including Rio Vista, though, right? Dan, is it out of you guys's way, too, for the most part?

Sarna: For the most part, yes. **Sagun:** Thank you, Mr. Chairman. So, I was reading the Westslope attachment to the proposal and I noticed this paragraph that says "because wind turbines will be visible to the McClellan ASR 9, Mill Valley is ARSR 4, Stockton ASR11, and Travis Air Force Base DASR, Westslope expects that the FAA and DoD will object to the proposed V136 or V150 Wind turbines, based on electromagnetic interference to air navigation facilities. As such, Westslope expects that the FAA will issue notices of presumed hazard for the project. The FAA and DoD will likely require further study to determine whether the radar effects are acceptable to operations or not. The DoD may also set up a mitigation response team to conduct further study. Although possible, Westslope does not expect that the DHS will object to the proposed V136 or V150 wind turbines." I'm a little bit confused as to the timing letters, but I'm wondering - I did not see a reference to that in the draft EIR. Was it there? Did I miss it? And will this be included in the upcoming EIR?

Cutting: Sorry…

Sagun: to give us a little more background?

Cutting: Yes, Commissioner Sagun. All of these documents are in the consistency determination application that we submitted, and we went through every one of those steps. We got a… I always have to remember…a notice of presumed risk, and the FAA did their analysis and determined no risk. And then we went back to extend and then we went through the mitigation response team and got a clean bill of health from the. DoD clearinghouse so everything that you've discussed that Geoff showed that could potentially happen happened, and we cleared those hurdles. Thank you.

Seiden: Any other Commissioner requests? Commissioner Vancil.

Vancil: I know we've talked about the infill or the gap radar and understand its progress is kind of delayed, but do we have any sense of where it actually stands? I don't know if Westslope Consulting has actually done any recent work with the gap radar, the infill radar.

Cutting: I can provide a very brief update. I have tried to stay abreast of it. You should all be very proud. The East Coast of the United States is pushing very hard for extremely large offshore wind projects, and the group that started the Wittrem in Travis is now dealing with these projects on the East Coast, and I recognize the names, and they are now the offshore wind turbine..what is it, turbine integration…whatever it is. I can't remember the name of the acronym, so they are still active and to my understanding, from what I have been able to determine, the offshore projects on the East Coast have similar issues to the on-shore, and given that they are looking at 10GW, and we are looking at 100 MW, which would make it -- in my brain here, I can't do the math -- like 10,000 times bigger, there will be lots of pressure on the FAA to come up with a solution. So, the good news is the interest and need to develop an infrared radar is increasing, not decreasing. Again, I wish I could offer you more specifics, but that's what I've been able to determine in about the last year.

Vancil: Thanks, I appreciate that very much.

Cutting: Sure.

Vancil: I think for us as the Commission, we know the infill radar is progressing along, but we get very little feedback on how that's coming, so we appreciate the update very much.

Seiden: Other comments or questions, Commissioners? Okay, hearing none, my own comments have to do with careful reading of our analysis from our consultant, which is Environmental Science Associates. And, in that, there are some items that caught my attention. In particular, a letter from Westslope itself, which included with…included rather the application for consistency review states that, "the proposed development will be within line of sight of and will interfere with the Travis Air Force Digital Airport Surveillance Radar, DSR, and as such, it would" be inconsistent or it would "not be consistent" as the wording actually used. As I was reading through this analysis, I find some inconsistencies with what we're hearing tonight, and in particular, that there is.. if I'm hearing your correctly, currently an analysis that there is no increased interference as a result of this project – that's kind of concisely putting it, but that is not what I find in this report. I find minimal, the term is used, indeed that Colonel Simmons himself, for instance, Commander the 60th AMW, in January stated that, "as proposed, the Solano 4 Wind Project would have minimal impact on Travis Air Force Base." That's not the same as no impact. As a Commission, as Commissioner Vancil outlined a little earlier, and I know you're thoroughly aware with, we … and also staff member Leland mentioned it at the onset of this, at some point back in about 2016, we determined that enough is enough, the degradation of the ability of the radar to detect has gone far enough. And, as an.. also an airline background pilot, but also someone with experience in virtually every facet of aviation in this country from cropdusting all the way through military and civilian flight instructing and so on, I don't want to see any

degradation. The idea that we establish 80% as acceptable, to me, is personally unacceptable as a pilot. If we had one target missed, in inclement weather in particular as Dan was referring to, where pilots cannot see one another, and suppose that one aircraft is in effect what we refer to as scud running and another is on an IFR flight plan but the one on scud running may not be detected, those are two aircraft could come into contact with each other, and if it was your grandchildren or your mother or someone on those aircraft, there's no way you could justify that. Hence, my reservations about the idea of the 80% floor. But I understand of course that that is what we currently are accepting, but going below an 80% floor, to me at least, is unacceptable. I don't care if its 1/10 of 1%. We had to set a line some place, hence, the line of site requirement.

Cutting: Thank you, Chair Seiden.

Seiden: In your background slide that was up for our presentation earlier, you mentioned the 59 Kennatech turbines had no impact upon the radar? Is.. are they beyond line of sight? I'm just asking on that.

Cutting: That's my understanding.

Seiden: Okay, So they have none because they are beyond line of sight. Every turbine that is within line of sight has some impact on that radar.

Cutting: Yes.

Seiden: And while I understand that the tradeoff that you are trying to make here is with less turbines, you can bring it down to a point where it would not increase. So, I need clarification from you that, indeed, as is in contradiction to what I'm reading in our consultant's report, which says there is minimal impact, and therefore, that says to me, some increase in the loss of our ability to see aircraft. How can you assure us at this point that what you're giving us tonight is indeed the bottom line fact that there is no decrease in our detectable capability. If the tradeoff of the number of turbines indeed results in none, so putting it … taking it just slightly further, if you took one of those proposed turbines out, clearly, that would drop it down a little bit more in terms of how much interference is generated, and you're trying to go as far as possible not, you know, economically and so forth, not to have that happen. Can you assure us that there is no further degradation of that radar?

Cutting: Um, I ask that we back up a bit and think about the 560 turbines and the 19 we're talking about…really, again, this project can't, um, swing the resource area, but we have worked fastidiously to not jeopardize it. Again, the FAA, which is the lead agency nationwide over air space, found the project acceptable. They cannot find it acceptable unless it goes through the Department of Defense Clearinghouse process, of which the military bases all participated. We have documented, active participation from Travis, so at the… at the air space operation level, the lead agencies nationwide found the project acceptable. I can't say, and again, this is not a reflection on Geoff's competency, he was a design tool we used to create the project. To me, what matters, is what the lead agency says that owns the airspace nationwide, and they say the

project's okay. So, that's the guarantee I can give you, is the FAA is okay with it, DoD is okay with it.

Seiden: I need to find my place here in this report because there is a place, I believe, where the FAA said is "there is no substantial adverse effect on safe and efficient utilization of the navigable airspace by aircraft or on operation of the air navigation facilities." It's not a direct statement regarding the radar. And while, as Commissioner Sarna mentioned with respect to, as an example, the Rio Vista Airport which is perhaps the closest in proximity, they can operate with the knowledge that the turbines are there and stay well clear of them, and so forth. They are, nonetheless, an obstruction, and that's why obstructions are put on all the charts, particularly sectional charts. So, in my reading of that, it suggests to me that there may be no physical obstruction that is increased by this proposal, but it doesn't necessarily satisfy me with regard to radar possibilities.

Cutting: The…I mean, maybe I'm wrong, but my understanding is the radar is, it's not Travis's asset, it's actually the FAA's because the FAA, again, is lead agency on airspace, and the Do…but the way the process was set up, I believe in 1958 by Eisenhower, was that the DoD always coordinated and the FAA doesn't move forward without DoD's concurrence. So, again, the nationwide lead agencies have found this project did not, does not impact the operations at Travis and that includes both radar and air space. I, again… I love Geoff's work, I used it as the design tool -- I have to lean toward the nationwide agencies that have no objection to our project.

Seiden: Thank you. Any further comments from Commissioners? Questions? Commissioner Cook?

Cook: Could I just get clarification from, from Mr. Leland on…so, the staff position is not in support because it does in fact not comply with the line of sight requirement, right?

Cutting: Yeah, sorry.

Leland: I think I can offer some explanation about what's going what…what is in conflict here. It appears the Department of Defense and the FAA have taken the position with respect to the review of wind turbine projects, if they're not making it any worse, it's okay by us. In the meantime, different people at the FAA and the Department of Defense are saying the radar at Travis is unacceptable, and we're going to find a pilot mitigation project to try to fix it. And, they're working to try to fix it. So, you've got different voices coming out of the institutions. What's more important is that the FAA has no jurisdiction over the approval of the wind turbine project. They're advisory only, they did not issue a permit for the wind turbine project. And, they can't approve the wind turbine project -- it's a land use, and that's under the jurisdiction of the state. And, the state has assigned that to you because it's within an airport influence area. And, when you did the Travis plan, you were looking in the rearview mirror at the CRADA work, which was…which the ALUC was not involved in, so the ALUC did not sign on to the 80% standard -- that was the county and the wind developers and the Department of Defense through the CRADA at the time. When 2015 rolled around, and we were

doing the plan, and we had our white paper and our consultants -- the ultimate conclusion was, "that didn't work out so well." Because the standard was met, it was protected by that process, and yet the operators at the screen are telling you, "this is very frustrating - we have trouble with false returns and dropping targets. We have to map out all that clutter from time to time, so we're not looking at anything." So, so that's the difference. They are telling you there's no additional degradation in radar, according to their study, from what's there now, but if they took down what's there now and then didn't build anything, I presume it would get better. And, that was your objective in adopting line of sight. Let's just not put any more of this out there for now until they solve the technological problem, either through the stealth blades, which was the talk back then, or this latest gapfill radar solution. And, so, you are looking at it in your plan differently than FAA is looking at it when they review a individual project. And, as you know, also in obstruction review, the FAA can find a wind turbine tower not to be a physical obstruction to Rio Vista because they're going to change the flight standard to increase the gradient on takeoff. Well, that doesn't sit very well with the airport operator or their pilots, so there's a lot of nuance to all of this, but the fundamental issue, Commissioner Cook is what you identified. This Commission switched to line of sight because the CRADA process that the county initiated, in retrospect, wasn't solving the problem. The problem is broader than just looking only at probability of detection. I don't know if that helps or not, so that's where staff is coming from – is we don't deny that all of the documents that presented, they…they were very thorough in the amount of information they offered up for you guys to review. You know, we're not were not quarreling with any message that came from DoD or the Base, but they are looking at it through a different set of lens than you did when you prepared to plan, so now you have to decide, is this one project - if you grant an exception -- what does that do for you? Does it set a precedent for every other of the 500 wind turbine owners to come in and say, well, I only…I don't degrade it either, but that means you're perpetuating the unacceptable situation into the future. So, it's your decision, not staff's, but that was what was behind our recommendation.

Cook: Thank you.

Seiden: Well, that brought up some hands. Commissioner Vancil?

Vancil: I think the question of the FAA's ruling of determination of no hazard maybe mirrors with the discussion. We had this discussion way back, I think maybe it was pre-CRADA, but the FAA determination of no hazard is primarily an en route navigation determination. And, we saw that specifically with the example at the Rio Vista airport where two turbines received a determination of no hazard, but they immediately caused Rio Vista to have to change its _____ departure procedures. Then because of the height, they had to come up with new restricted climb gradient. So, obviously there was an impact on aviation. So, they…when they do a determination of no hazard, they are primarily looking at hazards to en route navigation, not necessarily terminal… impacts on terminal approaches into and out of airports. So…

Blackman: I'd to just jump in there. That's not accurate, sir.

Vancil: Okay.

Blackman: When the FAA look at this, they look at every aspect of flight. They look at radar interference, they look at interference to navigational ways, they look at interference to approaches and departures and en route – they look at everything. If…if, and this is one thing I think that I think is a little bit of a point confusion because I know one of the other Commissioners said, that you know, in one of my studies, I brought up about being in the line of sight and creating interference, when we go through this, we mirror the FAA, the DoD process. And, if it's in line of sight, we acknowledge there's going to be some interference. But then you have to look at, operationally, is there going to be an impact? And, the FAA will try and work with…one, they've got to figure out if there is some interference, can we mitigate it? Is it going to affect operations? Just like you mentioned Rio Vista airport, and it changed a climb gradient, the FAA would have had to reach out to the airport and discuss with them, is that going to impact…is that going to be a concern with them or not? So, they will coordinate on all of these things. They do make changes on a daily basis across the national airspace system to accommodate growth with towers and buildings and everything else. For this project, there's no change to Rio Vista. There was a change in the altitude on the chart for northern California TRACON. Those are changes that the FAA do daily across the country for many different things. The FAA will look at the impacts at the local level, but they rely, in this particular case, on the DoD and the airports and Travis Air Force Base and all the national radar experts working with Travis Air Force Base to make a determination whether this is workable or not. And, everyone looking at this came to the same conclusion that I did in the analysis that this would not result in any additional effect on the Travis radar, and, therefore, would not result in any additional change to the way Travis conducts their operations. Simply put, they will look at, you know, will Travis be able to do what they can today, tomorrow. And, the answer is yes, and that's where ultimately these decisions get made. The one other thing while I'm talking, and I wanted to talk about 80% that keeps getting thrown around. Someone raise a concern about being uncomfortable about 80%. Eighty percent is a design standard. When we go out and acquire radars, as a minimum for a small target – something less than the size of a Cessna 172 – we want to see it 80% of the time in perfect clear blue sky. Operationally, when we go set the radars up, a larger aircraft flying across the airspace, we may see 95% of the time. But those small targets, we may only see 80%, so it's not like every aircraft is 80%. It varies based on the angle the aircraft is to the radar and the size of the aircraft. So, it's not like over the wind resource area, we're 80% on every aircraft - that's inaccurate. Eighty percent is sort of the bottom number for small targets. And, it's only for targets that are not using a transponder. And, a transponder is equipment onboard an aircraft that's like wearing your seat belt. If you've got your transponder on, air traffic can see you. So, that's why Travis will do outreach, the FAA does outreach to tell pilots to turn their transponders on.

Vancil: Thank you very much for your insight. I appreciate it, Mr Blackman.

Seiden: Commissioner Sarna? I mean… pardon me.

Sarna: Thank you, Mr. Chairman. Will there be any changes required to minimum vectoring altitude?

Blackman: Yes. It will increase one of the sectors for Northern California TRACON - the minimum vectoring now to from 1700 feet up to 1800 feet. And, with the project, the FAA will coordinate and implement that change. That was not deemed to be a significant change, only accepted…they have accepted, and they will move ahead and make that change.

Sarna: Thank you.

Seiden: Any other questions or comments? Commissioners? At this point, then, I'd like to open a public hearing. If there is anybody in the public who happens to be tuned in and would like to speak, please speak up at this time. Public hearing is open.

Cutting: I had a few more slides, sorry.

Seiden: I will retract that statement for the moment.

Cutting: Yeah, so we should be on to Slide 11 on the SMUD PowerPoint. It might take a second to switch over. Thanks for the long night, second one anyway – meeting with us twice this week. Or not.. uh, sorry, having two meetings this month - appreciate all the good thought that's gone into the questions. You guys have slight 11 now? Do you have slight 11? I gotta put the microphone up. Okay,

Leland: Is it up yet?

Cutting: Yes, it starts with, “ESA memorandum reports.”

Seiden: The slide is up.

Cutting: Okay. Jim pretty much said all this already. I just wanted to hit it real quick. Again, one of the SMUD things we really try to be is honest and trustworthy, so we're never denying we’re not in the line of sight. And, so, we know we don't meet the 100-foot line of sight criteria. This is a restatement. We do believe we meet the special condition criteria. So, ESA did an analysis for Solano County, and I don't know if you want me to read it, it's in front of you, but the highlights are…that it.. I gotta read.. I’m trying to find the highlights so I don’t have to read the whole thing to you. Basically, we didn’t cause any impact, which was the overall goal of the Airport Land Use Commission. The aeronautical study indicates the project would have no substantive adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or in the operation of air navigation facilities. The FAA thus determined that the project would not be a hazard air navigation. As Jim stated earlier, there are no noise or safety criteria applicable to people or buildings on the ground in Compatibility Zone D and E. And, their analysis went on to say that our application was persuasive in supporting the position that special conditions apply to the proposed development. So, that's our ask to you. If we go to slide 13, in summary, no net change to Travis Air Force Base radar as confirmed by Travis, Department of Defense, FAA and Westslope. The Solano Wind Project will neither create a safety hazard to the people on the ground or aircraft in flight nor result in excessive noise exposure, for the proposed use nor impact aircraft, excuse me, airport military operations. So, our request to the Commissioners is that you find the SMUD Solano 4 Project consistent with the Travis Land Use Compatibility Plan.

That's all I have tonight. Thank you very much for taking the time again to listen to us and all your thoughtful questions. I'll stay here if there's future questions. Thank you.

Seiden: Okay, seeing none then at this time… Dan, please. Go ahead.

Sagun: Thank you, Mr. Chairman. In another life I was an FAA controller and went on to participate in some rulemaking activities in Washington that dealt with the controllers, and one of the big issues that we always confronted was increased controller workload. That is a huge issue for controllers -- adding one word to the phraseology causes a riot. And I notice that from one of the documents presented by, I believe, one of the consultants to the law firm that reviewed the DEIR states that, "the FAA studies show that the proposals will affect the quality and/or availability of radar signals," etc., and it goes on to talk about this could increase controller workload and resulting pilot workload trying to re-identify the targets. I am wondering, because I didn't see any reference to it anywhere, if the controller workload was addressed in either the EIRs or any of your studies.

Cutting: Joe? I might ask counsel to address that because, again, I'm not an EIR expert and, again, we didn't find any impact from the radar so it would…it's kind of a deep dive for us, but we'll see if someone can come up with a better answer on the SMUD team. Thank you.

Schofield: This is Joe Schofield again from SMUD. CEQA is not concerned with economics or individual agencies' workloads. It's concerned with environmental impacts. So, the environmental document did not look at how many man hours or woman hours that would be necessary to effectuate the workload by that agency.

Sagun: Well, perhaps I mis… I wasn't clear in my question. My question we had to do with increased controller workload, which obviously has in impact on the level of safety, not the man hours involved in running the traffic. Were the human factors, which aren't an environmental issue, considered? And, could you point me to where if so?

Blackman: Hey, Joe, I can talk to this -- I know what the gentleman's talking about here. I actively… well, I routinely get involved in safety risk management panels with the FAA to assess impacts of wind farms on operations, and controller workload is one part of what we consider working through this -- not only controller workload, but also flight crew workload as well. And, I… you know, I think when you were referencing the language as far as affecting the quality of the radar signals, that is standard language that gets added into notices of presumed hazard, which are the interim findings telling the proponent that if they need to do further study. As part of that further study, and as part of the work we've done looking to try and negate any additional effects, ultimately, that led to the decision that the FAA would issue the determinations of no hazard and have actually extended those as well. And, that really came down to the fact that we've worked to negate any incre…any changes in the current situation at Travis. In other words, there will be no additional increase controller workload. Hopefully, that helps.

Sagun: Thank you.

Blackman: You're very welcome.

Seiden: Thank you, Commissioner Sagun. Anyone else? Mr. Leland, please. Staff?

Leland: Mr. Chairman, apparently some callers are not able to call in, but they have made comments on the chat page. And, so we're going to read their comments into the record if that's okay.

Seiden: Please do. I understand there's a Danny Bernardini that is trying to call in.

Leland: That's one of them.

Seiden: Are there other callers that possibly are available through the audio? If not, Terry, can you help us with those calls?

Schmidtbauer: Yeah, they're coming in. Let's see if I can get this up.

Seiden: Just for clarification, this will be part of the public hearing.

Unknown: Callers, if you wish to speak on this topic, please press *6 to come off mute and state your name.

Schmidtbauer: Excuse me, so we have a Doug LeMond. He's with the Laborers Local 324, and he says, I applaud SMUD for the work you have done in all your efforts to work with the DoD and FAA to deem your project acceptable. My name is Doug LeMond with Laborers Union 324, and we stand with and support SMUD for their efforts thus far. We look forward to supporting you in any way possible on Solano 4. I personally have been a working hand on Solano 3 as well as Shiloh 3 and Shiloh 4. Sincerely, Doug Lemond. Rob Keith, I'm sorry, Rob Kerth says, thanks, Doug. Wonderful. And from Jorge Romero – my name is Jorge Romero, with Cement Masons Local 400 and we also, I believe he means stand in support of SMUD. And, Danny Bernardini, he states the code given on the agenda is not valid. We have tried to call in several times, and he says, thanks, Jorge. Whoops, I'm sorry. From Rob Kerth, thanks Jorge. And, let's see if I can get that down. Doug LeMond, well said Geoff Blackman. This…there is no hazard. This project has been deemed acceptable by DoD and FAA. And, Glenn Loveall says yes, I would like to speak. And, Danny Bernardini says the code is invalid, the meeting hasn't started, yes, I would like to speak. So, apparently, some people are having a problem dialing in.

Seiden: Insofar as you know, that's all the public comments?

Schmidtbauer: That's all that's on chat.

Seiden: Thank you. Hearing none other, then, I will conclude the public hearing at this time.

Unknown: We'd like to speak if possible.

Unknown: I see some people that are coming off mute.

Seiden: Yes, would you identify yourself? And go ahead, the first speaker.

Lemond: Sure, sir, my name is Doug Lemond, I'm with Laborers Local 324, and I do want to commend and applaud SMUD for the work that they've done thus far in trying to mitigate all the issues and concerns that they've discussed tonight. I want to speak in support of Solano 4. Like I said in the chat, I've been a part of Solano 3 as well as Shiloh 3 and 4, and I don't feel as though there is anything that they have brought forward thus far or your questions or concerns thus far that can't be mitigated. And, I would be happy to support the project in any way possible. The power generated from the Solano 4 Wind Project is critical to both SMUD and the state's goal to decarbonize our energy grid, and I think we all know what that means. So, I support the project 100%, and I'd ask that you truly understand the effort that has gone into the concerns around radar, CEQA, EIR. They take this stuff serious. I've worked for these folks in the past, and all of it is very, very serious. I've been a part of it, I've stood on Solano 3 for SMUD and put the sweat and time into building that project, and they take this stuff serious. Thank you.

Seiden: Thank you. Are there other speakers that are on?

Loveall: Yes, please.

Seiden: Please identify yourself.

Loveall: Yes, my name is Glenn Loveall, Political Coordinator of the Iron Workers Union Local 378, representing members across Solano County. As a resident, born and raised in Fairfield as well as a resident Benicia – I grew up near to the Base and have family within the Solano wind zone, I'd like to speak strongly in support of this project. First and foremost, the safety and technical considerations were covered by the federal agencies deeming it would not adversely impact Base operations and other safety considerations. And so given the federal agencies FAA and the Department's analysis provided, this would resolve that issue. This leads us to the other two great issues that this project positively addresses, which is our need to convert to a sustainable energy infrastructure and a sustainable society, and the huge impact on decarbonization this projects provides right here in this county along with the much needed economic stimulus as this community, as this nation as a whole, continues to get through the last stages of this pandemic and the direct and quality job generation and economic growth that this project will bring within this community. Thank you very much.

Seiden: Thank you. Any other speakers waiting?

Bernardini: I'd like to speak, please.

Seiden: Please identify yourself.

Bernardini: This is Danny Bernardini, Business Manager of the Napa and Solano County Construction Trade Council. It kind of sounds like you guys are the radar use commission tonight. I've been around Solano County a long time. I used to be a reporter, and I covered the Land Use Commission when the Walmart was going in, and I also covered when Travis Air Force Base fully objected to the _____ Project. And, they actually showed up to the Supervisors' meeting, and you know, voiced their

concerns, and so there was a problem and eventually, you know, a big check was written and radar got fixed and that project went up. And, so we've…we've been down this road before, and anyone who has been around Solano County long enough knows that if Travis does not want a project, they will definitely speak out against it. So, you know, we've seen the documentation from the agencies that, you know, states what's SMUD's doing, and you know, on my side, you know, we're talking about a lot of new green technology and the Building Trades are concerned that, you know, those jobs are very good paying, and you know, benefits.. And so, SMUD's commitment to signing a project labor agreement with the building trades shows that, you know, as they convert these and upgrade them, that they're using Union labor and they're committed to the working men and women of Solano and Napa County. So, I want to commend them on that and urge your approval of the project. I know that we need to, you need to, have a special exception. I think enough evidence has been proved that this makes sense. Thank you for your time and everything you do.

Seiden: Thank you, Mr. Bernardini. Any further people waiting on hold?

Unknown: Chairman, we have 22 people on the line, so additional callers if you wish to speak on this topic, please press *6 to unmute yourself.

Unknown: And, Mr. Chariman, there's a delay, so you have to wait about 45 seconds for them to hear what he just said.

Seiden: Thank you. We will wait. Mr. Leland, does it seem that we have had sufficient time in waiting?

Leland: Chairman, I do not see anybody coming off mute at this time.

Seiden: Thank you. With that, I will close the public hearing. Public hearing is closed. Any further questions or comments from Commissioners prior to us entertaining the possibility of a motion? Yes, Commissioner Sagun.

Sagun: I just wanted to thank SMUD and all their consultants for a great job in presenting the project to us. I am looking at my package here on my tablet, 2162 pages of submittal – that's a lot, and my hat's off to you - very well presented. Thank you.

Seiden: Any others? Hearing none, I would like to add my thanks to SMUD for a well prepared presentation and all that information that you have been able to provide for us. I would entertain, if there is one, a motion to approve ALUC-21-03, the Sacramento Municipal Utility District's Solano 4 Wind Project, turbine project.

Unknown: So moved.

Seiden: As being consistent.

DuClair: I would like to make a motion _____, at this time but put it on our meeting for next time so that Board members can think of everything that has come up and maybe we have some more questions, answers that we can get the answers to …

Mazzella: We're at the deadline. The deadline for action is going to come up before the next meeting.

Seiden: Okay, there… Can you clarify that, please? Lori, what that means to the Commission.

Mazzella: Right, you have to...the Commission has to act on an application within 60 days. If the Commission does not act, it's deemed consistent. Sixty days is prior to the next meeting, so tonight would be the time to act, especially if the Commission wants to deem it not consistent. You know, there is an option not to act, but it would be…it would be a consistency finding.

Seiden: Thank you. Any Commissioners not clear on that guidance? With that having been said, we have a motion, is there a second?

Randall: The motion is to…

Seiden: The motion is to table this, apparently, until the next meeting. Is that correct, Commissioner DuClair?

Sagun: Question?

Seiden: Commissioner Sagun?

Sagun: Just for clarification, if we were to delay it to the next meeting, my understanding is, please correct me if I'm wrong, that that would automatically deem the proposal consistent.

Mazzella: Correct. Yes.

Seiden: Yes, that is correct. So, if we fail to act, we automatically, in effect, give approval.

Randall: Could I..

Seiden: Commissioner Randall.

Randall: Can I make a motion or no?

Seiden: There has not been a second as of yet.

Randall: Oh, okay.

Seiden: Am I hearing a second for that motion?

DuClair: I withdraw the motion.

Seiden: Motion withdrawn. Now, Commissioner Randall, please.

Randall: I'd like to make a motion to…with the staff's recommendation for inconsistency.

Seiden: We have a motion and a second to find this proposal inconsistent with our Commission rules within our bounds.

Mazzella: There are two parts to the recommendation. One is whether it's consistent or not, the second part is whether the special circumstances apply. And, so, staff's recommendation was to find it not consistent and that the special circumstances do not apply. So…

Seiden: Are we needing two separate motions, then?

Mazzella: You could do one motion with two parts.

Randall: Right.

Seiden: Okay.

Mazzella: Right? So, either…yeah…

Seiden: Commissioner Randall, would you like to modify your motion?

Randall: Yes, I'd like to add the inconsistency and not meeting up to what's it called?

Seiden: Special circumstances.

Randall: Special circumstances. Thank you.

Seiden: And, is there a second to that motion? Commissioner Cook is a second. Prior to the vote, any further comments or questions for…

Cook: Yes, I have one, especially for our presenters from SMUD. Again, we appreciate what a benefit in terms of renewable energy and increasing the amount of wind-generated energy; however, the role of the Airport Land Use Commission and Solano County is to protect and airports, and what this appears to be is an incremental encroachment. Because, I mean, I've been here since 2002, when the first wind, Shiloh, went in, and they continued to have more…sorry, more wind projects to replace them. They're taller, bigger – so, it's like we have to make a line in the sand. And, I think that time is…is now, with the understanding that potentially in the future, we'll have a solution to the radar. It's still in the works to give it better than 80% for sure on a consistent basis. So, that's why I would be voting that it's not consistent right now.

Seiden: Thank you, Commissioner Cook. Anyone else? Comments? Questions? I was preparing to say almost exactly what Commissioner Cook just said, and that is that our role as a Commission, and I do respect and appreciate very much the callers who commented about our need to, as a society, move toward green energy, and of course, the economic benefit to the community with more jobs during the construction process -- those things certainly touch each of us, but that is, in fact, not our role. Our role is to make a determination based upon whether it meets the criteria, and so I think we are ready for a roll call vote. Madam Secretary, roll call, please?

Senatori: Commissioner Cook.

Cook: Yes.

Senatori: Commissioner DuClair.

DuClair: Yes.

Senatori: Commissioner Randall.

Randall: Yes.

Senatori: Commissioner Ryan.

Ryan: Yes.

Senatori: Commissioner Sagun.

Sagun: Yes.

Senatori: Commissioner Sarna.

Sarna: Yes.

Senatori: Commissioner Vancil.

Vancil: Yes.

Senatori: Chair Seiden.

Seiden: Yes. So, the application is deemed not to be in compliance with the needs of the County to protect our airports. We thank you for your presentation this evening, and it might…this is only my own thoughts, but it might be that, as I alluded to earlier, if a single turbine was removed from the proposal, it could drop that total effect on the radar down sufficiently as to actually improve detection. It might change the picture, at least that would be my…my thought process. Any other Commissioners before we adjourn? Thank you for your time this evening. The Commission meeting is adjourned.