Oceano Dunes State Vehicular Recreation Area
Dust Control Program

2020 Annual Report and Work Plan

September 30, 2020

Fourth Draft

State of California

Department of Parks and Recreation

Off-Highway Motor Vehicle Recreation Division

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Oceano Dunes SVRA
Dust Control Program
2020 Annual Report and Work Plan (SECOND DRAFT)

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List of Exhibits

2020 Annual Report and Work Plan Attachments (Separate Documents)

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym / Symbol	Full Phrase or Description
ac	Acre
APCO	Air Pollution Control Officer
ARWP	Annual Report and Work Plan
ASU	Arizona State University
BAM	Beta Attenuation Monitor
BSNE	Big Springs Number Eight
CARB	California Air Resources Board
CDPR	California Department of Parks and Recreation
CFD	Computational Fluid Dynamics
cm	Centimeter
DEM	Digital Elevation Model
DRI	Desert Research Institute
EAF	Environmental Analysis Facility
g	Grams
IC	Ion Chromatography
LIDAR	Light Detection and Ranging
m	Meter
M-O	Monin-Obukhov
MSA	Methanesulfonic Acid
m^3	Cubic Meter
NSF	Normalized Sand Flux
OHMVR	Off-Highway Motor Vehicle Recreation
OHV	Off-highway Vehicle
PI-SWERL®	Portable In-Situ Wind Erosion Laboratory
PMRP	Particulate Matter Reduction Plan
PM	Particulate Matter
PM_{10}	Coarse Particulate Matter
RH	Relative Humidity
SAG	Scientific Advisory Group
SB	Straw Bale
SLOAPCD	San Luis Obispo County Air Pollution Control District
SOA	Stipulated Order of Abatement
SODAR	Sonic Detection and Ranging
STI	Sonoma Technology Incorporated
Std. dev.	Standard Deviation
SVRA	State Vehicular Recreation Area
UAS	Unmanned Aerial System

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym / Symbol	**Full Phrase or Description**
US EPA	United States Environmental Protection Agency
VG	Vegetation
WF	Wind Fence
WSS	WeatherSolve Structures
°	Degrees
µg	Micrograms
$	U.S. Dollar
%	Percent

1 INTRODUCTION

The California Department of Parks and Recreation (CDPR), Off-Highway Motor Vehicle Recreation Division (OHMVR Division), has prepared this 2020 Annual Report and Work Plan for the Oceano Dunes State Vehicular Recreation Area (Oceano Dunes SVRA) Dust Control Program to comply with Condition 4 of the Stipulated Order of Abatement (SOA) approved by the San Luis Obispo County Air Pollution Control District (SLOAPCD) Hearing Board in April 2018 (Case No. 17-01) and amended in November 2019.

SOA Condition 4 requires the OHMVR Division to prepare and submit to the SLOAPCD, and the SOA Scientific Advisory Group (SAG), an Annual Report and Work Plan (ARWP) by August 1 of each year from 2019 to 2022. In general, SOA Condition 4 requires the ARWP to:

- Review dust control activities implemented over the previous 12-month period and, using tracking metrics specified in the Particulate Matter Reduction Plan (PMRP), document progress towards SOA goals.
- Identify dust control activities proposed to be undertaken or completed in the next 12-month period and, using tracking metrics specified in the PMRP, document expected outcomes and potential emission reductions for these activities.
- Using air quality modeling, estimate the downwind benefits and anticipated reductions in PM_{10} concentrations associated with proposed dust control activities.
- Describe the budgetary considerations for development and implementation for proposed dust control activities.
- Provide a detailed implementation schedule with deadlines associated with the physical deployment of proposed dust control actions.

Section 2 of this ARWP ***reports*** on dust control activities implemented the previous year, including progress made towards SOA goals to date.

Section 3 of this ARWP ***proposes*** dust control program activities to be undertaken or completed in the coming year, including model-predicted PM_{10} mass and concentration reductions and continued progress towards meeting SOA goals

Section 4 and Section 5 of this ARWP ***describe*** budget considerations and implementation schedules for the proposed dust control program activities to be undertaken or completed in the coming year.

This report has been prepared under the supervision of Jon O'Brien, Environmental Program Manager, OHVMR Division, whom CDPR has designated as the Project Manager for the Dust Control Program pursuant to Condition 13 of the SOA.

2 ANNUAL REPORT

2.1 Dust Control Activities Implemented Over the Previous Year

From August 1, 2019 to July 31, 2020, the OHMVR Division began development of a 48-acre vegetated foredune, maintained 13.4 acres of existing wind fencing, maintained existing track out activities at the two vehicle entrances/ramps, installed 19.2 acres of backdune straw bale projects (4.2 acre plot specified in the amended SOA and 15 acres of Paw Print converted from wind fence to straw mulch in March 2020), installed 20 acres of backdune vegetation projects, and installed 40 acres of new wind fencing projects. The dust control measures implemented by the OHMVR Division over the past year are listed in Table 2-1, summarized in the sections below, and shown on Exhibit 1, *2019-20 SOA Dust Control Measures*.

Table 2-1. 2020 Annual Report Dust Control Projects Summary(A)

ID	Type	New Acres Controlled	Acres Converted to Vegetation Treatments	Acres of Supplemental Treatments	Net Increase in Acres of Dust Control
2019-VG-01	Vegetation	48.0	48.0	--	48.0
2019-SB-01	Straw Bale	4.2	--	--	4.2
2019-SB-01	Straw Bale	--	--	15.0	--
2019-VG-02	Vegetation	--	20.0	20.0	--
2019-WF-01	Wind Fencing	20.0	--	--	20.0
2019-WF-02	Wind Fencing	20.0	--	--	20.0
Totals		**92.2 Acres**	**68.0 Acres**	**35.0 Acres**	**92.2 Acres**

(A) All acreage values are approximate.

As shown in Table 2-1, there was a net increase of 92.2 acres of dust control at Oceano Dunes SVRA between August 1, 2019 and July 31, 2020. This is in addition to 84.7 acres of dust control implemented pursuant to the SOA in the 2018-19 season. As of July 31, 2020, there were approximately 231 total acres of dust control projects installed at Oceano Dunes SVRA.

2.1.1 Development of a Vegetated Foredune (Project ID: 2019-VG-01)

Pursuant to the SLOAPCD SOA as amended, the OHMVR Division has begun development of a vegetated foredune restoration zone just landward of the upper beach that is approximately 48 acres in size. Exhibit 2, *SAG Foredune Treatment Diagram*, to this report provides a diagram of the foredune development project implemented in the 2019-20 season. Exhibits 3A and 3B, *2019-20 Foredune Planting List* and *2019-2020 Foredune Treatment Summary*, provide a list of the seed, plant stock, and fertilizer used for the project in the 2019-20 season.

The foredune restoration process started by enclosing planting areas with perimeter fencing. The areas closed off are not continuous but have gaps that allow the public to pass from the camping area to the west to the riding areas in the east. In addition, existing infrastructure near the foredune development area (most notably the vault toilet buildings) remain open to service vehicles and the public. Finally, the foredune is set back (northward) from the western snowy plover seasonal nesting exclosure to reduce potential impacts on nesting birds. If possible, paths of travel would follow the prevailing wind pattern to reduce long-term maintenance needs on the protective fencing.

Following installation of the perimeter fencing, development of the approximately 48-acre foredune project was based on a SAG design approach. The fenced plots were sub-divided into 6 different treatment areas (see Exhibit 2), as follows:

- Plot 1 (18.8 acres):
  - Treatment 1a (4 acres): no treatment other than sheep's foot surface texturing to create divots for seeds and create low-level aerodynamic roughness
  - Treatment 1b (5.2 acres): native seed mix with sheep's foot surface texturing
  - Treatment 2 (9.6 acres): sheep's foot to prepare soil with sterile ryegrass and native seed mix
- Plot 2 (18.8 acres):
  - Treatment 3 (9.1 acres): low-density random node planting (spacing derived from natural analogue site near Oso Flaco Lake) with approximately 9 foredune specific plants per node planted within a 12-foot radius zone of straw to protect seedlings.
  - Treatment 4 (9.7 acres): high-density random node planting with the same planting and straw protection strategy.

- Plot 3 (9.9 acres):
  - Treatment 5 (9.9 acres): 'Parks Classic', sheep's foot surface texturing, spread straw over entire area, plant foredune specific species, seed area with native seed (at roughly 5 pounds per acre).

Evaluation Metrics

The reportable metrics for actions necessary to develop a vegetated foredune are included in the Evaluation Metrics 2019-2020 Final Report (see Attachment 1). The metrics measure changes in plant coverage, sand flux (saltation) and volumetric changes, wind shear threshold wind shear velocity, and emissivity. This information will be used to guide future foredune development activities as well as other dust control efforts to be implemented pursuant to the SOA.

2.1.2 4.2-Acre Additional Backdune Treatment (Project ID: 2019-SB-01)

Pursuant to the SLOAPCD SOA as amended, The OHMVR Division has begun development of 4.2 acres of additional backdune dust control treatments (see Exhibit 1). The area to be treated was selected through coordination with the SAG and SLOAPCD. The 4.2-acre area was fenced off to exclude public access in December 2019 and received straw bales/mulch in January 2020. In Section 3 of this ARWP the 4.2-acre area is planned to be planted with native vegetation in 2020-21.

Evaluation Metrics

The reportable metrics for this project are included in the Evaluation Metrics 2019-2020 Final Report (see Attachment 1). The metrics measure changes in plant coverage, sand volume, threshold wind shear velocity, and emissivity. This information will be used to guide future backdune dust control efforts to be implemented pursuant to the SOA.

2.1.3 Wind Fencing Conversion to Vegetation Treatments (Project ID: 2019-VG-02)

Consistent with SOA Condition 1.b., the OHMVR Division converted approximately 20 acres of the 48.6 acres of wind fencing installed in 2018 to vegetation treatments. The project area for the conversion from wind fencing to vegetation is located on the western edge of the approximately 35.2-acre wind fence array located adjacent to the Paw Print vegetation island (see Exhibit 7 and Exhibit 8 from the December 2019 ARWP). Wind fence removal occurred in September 2019 and dune scrub restoration treatment was completed in December 2019.

In September 2019, approximately 15 acres of wind fence on the eastern edge of the Paw Print vegetation island was removed and then covered with straw in March 2020. The fence removal was necessary at this site to facilitate restoration work on the western 20 acres of this treatment area as described above. Rather than replacing the wind fencing on the eastern portion of the project area, CDPR opted to place straw mulch in preparation for native plant planting during the 2020/21 planting season.

Evaluation Metrics

The reportable metrics for this project are included in the Evaluation Metrics 2019-2020 Final Report (see Attachment 1). The metrics measure changes in plant coverage, sand volume, wind shear threshold wind shear velocity, and emissivity. This information will be used to guide future backdune dust control efforts to be implemented pursuant to the SOA.

2.1.4 Seasonal Wind Fencing Projects (Project ID: 2019-WF-01 and 2019-WF-02)

Pursuant to the SLOAPCD SOA as amended, the OHMVR Division have installed approximately 40 acres of seasonal wind fencing in the backdune regions of Oceano Dunes SVRA. The wind fencing is comprised of two, approximately 20-acre projects shown on Exhibit 1. The location of the projects was informed by the SAG and approved by the SLOAPCD. The wind fencing will be maintained until at least September 1, 2021.

Evaluation Metrics

The reportable metrics for this project are included in the Evaluation Metrics 2019-2020 Final Report (Attachment 1). The metrics measure the length of wind fencing installed per day. This information will be used to guide future wind fence dust control efforts to be implemented pursuant to the SOA.

2.1.5 Wind Fencing Maintenance Projects

Consistent with SOA Condition 1.b., the OHMVR Division maintains wind fencing installed in summer 2018 that has not been converted to vegetation by July 31, 2020. Maintenance activities included replacing fence posts, fencing materials, and installing new fence rows to maintain historical design control values for wind fencing arrays (greater than 80% to 90% control in the center of the array). In March 2020, approximately 13.4 acres of wind fencing was maintained in the Eucalyptus and Table Top Vegetation Islands, as shown on Exhibit 1. In Section 3 of this ARWP, these areas are scheduled for planting with native vegetation in 2020-21.

2.1.6 Trackout Control Projects

Pursuant to SOA Condition 1.c, the OHMVR Division was required to install an Air Pollution Control Officer (APCO)-approved trackout control device at the Grand Avenue and Pier Avenue entrances to Oceano Dunes SVRA in the City of Grover Beach and the unincorporated community of Oceano, respectively, by June 30, 2019.

In May 2019, the OHMVR Division installed two temporary trackout mats at the Pier Avenue exit. The mats abate track out onto public streets from vehicles exiting the park. The temporary mats are removed at least once per week and all accumulated sand is removed from the street and disposed at an approved facility.

In addition to the new trackout mats, the OHMVR Division continued its program of street sweeping Grand and Pier Avenues a minimum of five times per week. The OHMVR Division also contracts with a private sweeping firm to cover a portion of Pier Avenue a minimum of two days per week from Air Park Drive to the State Park boundary. This sweeping complements the work that San Luis Obispo County conducts on Pier Avenue.

A permanent Trackout Control Program is currently being developed for the Grand and Pier Avenue entrances. The proposal involves installation V-shaped, grooved concrete panels west of the entrance kiosks at Grand Avenue and Pier Avenue. The design phase of this permanent solution has been completed and the construction phase of this permanent program has been approved for capital outlay funding through the 2020-2021 California State Budget.

2.2 Statement of Progress Achieved

The dust control measures identified in Section 2.1 reduce saltation and dust emissions within the control area and reduce PM_{10} concentrations downwind of the treatment areas. The methodology for assessing progress relies on tracking of evaluation metrics (identified in Attachment 1), outputs from the DRI model on mass emissions and PM_{10} concentrations, and actual changes in PM_{10} concentrations detected at SLOAPCD monitors adjusted for variability of meteorological conditions.

Included as Attachments 1 and 2 to this ARWP are the Evaluation Metrics established through the SOA. Attachment 1 is the final report of the Evaluation Metrics for 2019-20 and Attachment 2 is the initial report of the 2020-21 Evaluation Metrics. Review of the outcomes from these metrics over time will assist in determining progress.

The outputs generated from the DRI model indicate the dust control projects implemented at Oceano Dunes SVRA are reducing PM_{10} mass emissions and downwind PM_{10} concentrations, albeit at levels that currently fall short of SOA goals. The mass emission reduction estimates based on the 2013 PI-SWERL emission grid ($1/r^2$, 5 nearest neighbor interpolation/extrapolation method), and the meteorology of the 10 baseline days are shown in Table 2-2 for the sequence of years from 2013 to 2020. The outputs generated from the DRI model indicate the dust control projects implemented in the 2019-20 season reduced PM_{10} mass emissions from the Oceano Dunes SVRA camping and riding area by 8.7 metric tons per day based on the established baseline using the 10 highest PM_{10} emission days from 2013. This would represent a 4.6% reduction in PM_{10} emissions, based on the established baseline (See Attachment 3 and Section 2.4.1). The total model-estimated reduction in mass emissions for the area in the Oceano Dunes SVRA, defined as the riding area, with all dust controls assumed to be 100% effective (i.e., zero emissions) as of spring 2020 is 27.7 metric tons per day for the baseline scenario. This would represent a 14.7% reduction in PM_{10} emissions, compared to the initial goal of a 50% reduction required by the SOA. This is based on controlling 230.9 acres, which represents 17% of the total riding area (1,350 acres).

Table 2-2. Modeled Estimated Reductions of PM_{10} for the Oceano Dunes SVRA Riding Area

Riding Area Only		10 Highest Emission Days (2013)	
Scenarios	**Cumulative Area Treated (Acres)**	**Metric Tons/Day**	**Reduction %**
2013 Baseline, no controls	0	188.6	-
Controls through 2019	137	169.6	10.1
Foredune Addition[A]	185.6	165.6	12.2
Spring 2020[A]	230.9	160.9	14.7

(A) Combined, the foredune addition and Spring 2020 controls represent the PM_{10} mass emissions reduction progress achieved in the past 12 months.

The DRI model is also used to evaluate potential changes in downwind PM_{10} concentrations at selected receptor sites such as CDF and Mesa2. With no controls in place and using the 2013 PI-SWERL emission grid, the model-predicted value for the 24-hour average PM_{10} concentration the CDF site is 123 µg m^{-3}. With the dust control areas as of spring 2020 in place and at the hypothetical effectiveness of 100% reduction for all controls, the model-predicted value for the CDF site is 57 µg m^{-3}, a reduction of 54%. Using the 2019 PI-SWERL emissions grid the modeled value for the 24-hour average PM_{10} concentration at CDF for the 10 baseline emissions days is 52 µg m^{-3}, a reduction of 58%. For the 2013 and 2019 PI-SWERL emission grids and the 10 baseline days, the DRI model predicts a 5% reduction in the 24-hour average PM_{10} concentration at the Mesa2 site. These model results suggest that the dust controls are effective at reducing the downwind PM_{10} concentrations at the CDF receptor site to a greater degree than is indicated by the reduction in total mass emissions, which the model estimates at 14.7%. Similar improvements at Mesa2 are not observed as the position of the controls do not strongly influence the source areas that affect that location.

In June 2020, the SLOAPCD published a *Frequently Asked Questions* document regarding recent air quality concerns in South San Luis Obispo County. That document is included as Attachment 4 to this ARWP. SLOAPCD reviewed data on actual spring 2020 PM_{10} concentrations being detected at their monitors. The following excerpt was in part the product of that review:

> ***"Q3: What effect have the dust mitigations had on downwind air quality?***
>
> ***A3: The short answer is that we have seen real, significant improvements in air quality, especially at CDF, and especially after taking meteorology (wind) into account."***

2.3 Monitoring Activities Conducted Over the Previous Year

During the 2019-20 season, the OHMVR Division continued monitoring activities and updating the DRI model inputs to reflect new meteorological, air quality, and other data collection efforts described in Chapter 2 of the December 2019 ARWP. The following sections describe the monitoring/modeling activities conducted in the 2019-20 season.

2.3.1 Meteorological, PM and Saltation Monitoring

Beginning in 2018, the OHMVR Division installed 15 meteorological and air quality monitoring stations across Oceano Dunes SVRA (see Figure 2-1) to help assess individual project effectiveness and update the meteorology used in the DRI emissions model (see Exhibit 6 from the December 2019 ARWP). This network of meteorological and air quality instruments was deployed with spatial and temporal resolution equivalent to the 2013 network that helped to define the SOA's baseline time period (May 1, 2013 to August 31, 2013). The air and meteorological monitoring is ongoing. The data collected are integrated into the modeling exercises discussed in Attachment 3.

The instrumentation at each station is placed on a 3 m tripod that sits on a platform above the sand surface (see Figure 2-2). The instrumentation measures wind speed, wind direction, temperature, relative humidity (RH), and air pressure (ClimaVue500). Tipping bucket rain gauges are located at 4 of the stations. Saltation is monitored using Sensits at all stations. MetOne Particle Profilers are deployed at each site to measure particle numbers in 8 size bins every 60 s. These instruments are collocated with a BAM prior to deployment in DRI's dust chamber to develop a calibration relationship between PM_{10} concentration measured with a reference BAM and each MetOne instrument (including 2 spares). This is repeated at the end of the dust season to evaluate how the instruments may be affected by the environmental conditions.

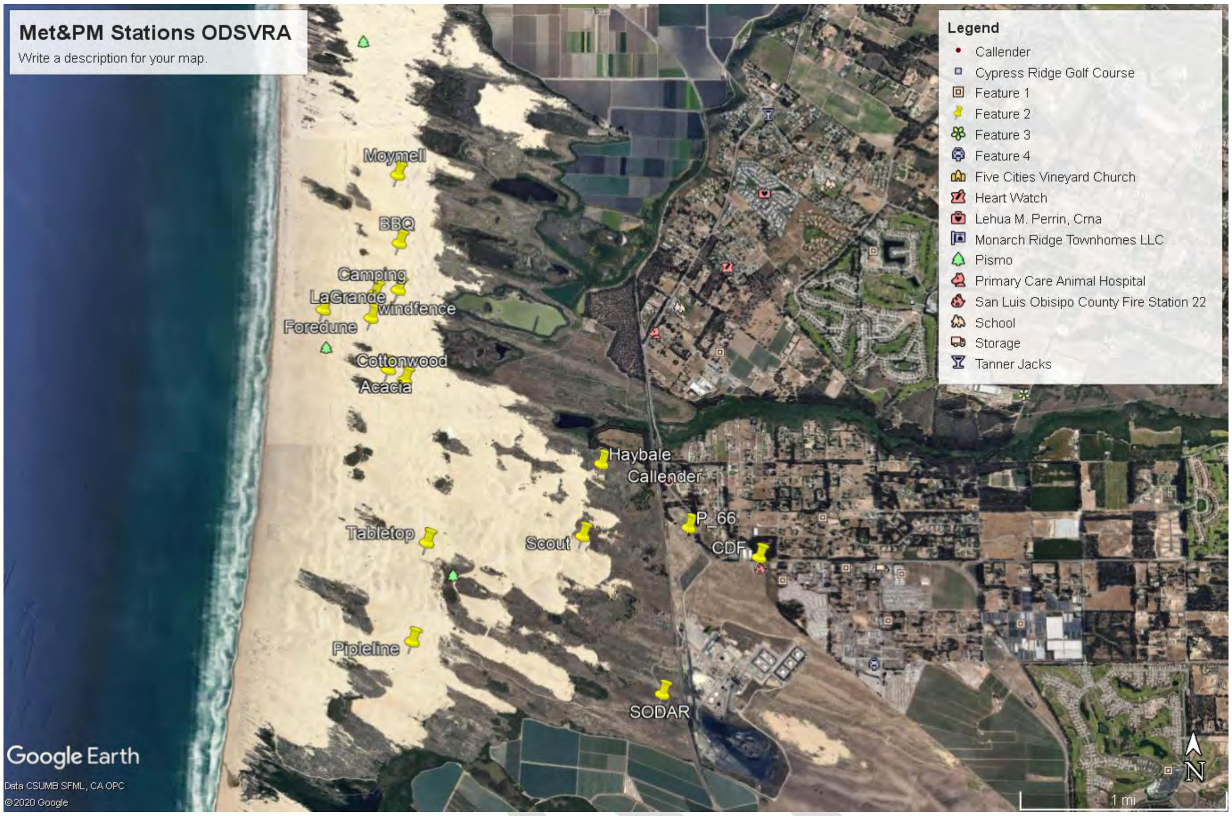


Figure 2-1. The locations of the Oceano Dunes SVRA meteorological and PM monitoring stations (including the SLOAPCD PM_{10} monitoring station designated as CDF).

Figure 2-2. One of the 15 meteorological, saltation, and PM monitoring stations in the Oceano Dunes SVRA.

In 2020 a second calibration between a BAM and the MetOne instruments is being carried out within the Oceano Dunes SVRA to evaluate the effect of dynamic meteorological conditions (i.e., wind speed and RH) on the relationship between the two instruments. The instrument set up is shown in Figure 2-3 and an example of the relationships between the BAM and two MetOne instruments is shown in Figure 2-4. Two MetOne units from the 15 stations are paired with the BAM over a sufficient length of time to expose them to high winds and high PM_{10} concentrations to establish the calibration relationships. Then the next pair is swapped out.

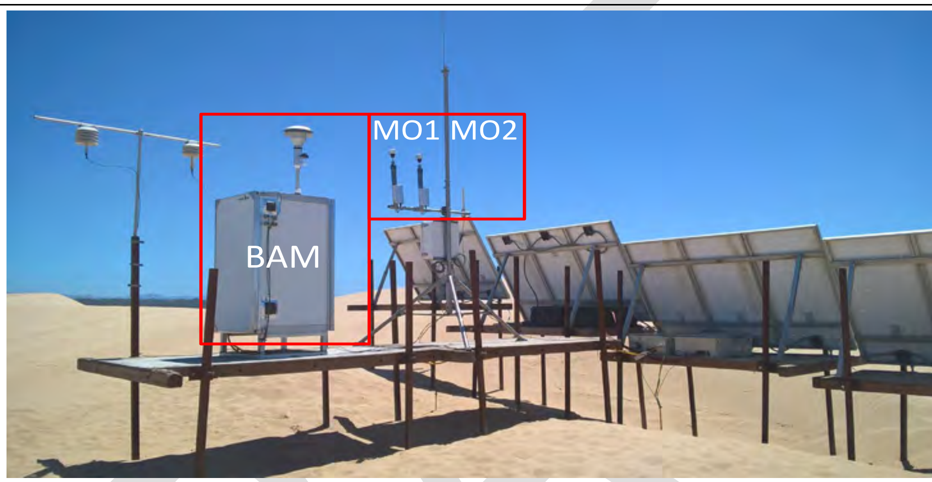


Figure 2-3. The BAM and MetOne (MO1 and MO2) calibration set-up in the Oceano Dunes SVRA near the BBQ monitoring site (see Figure 2-1).

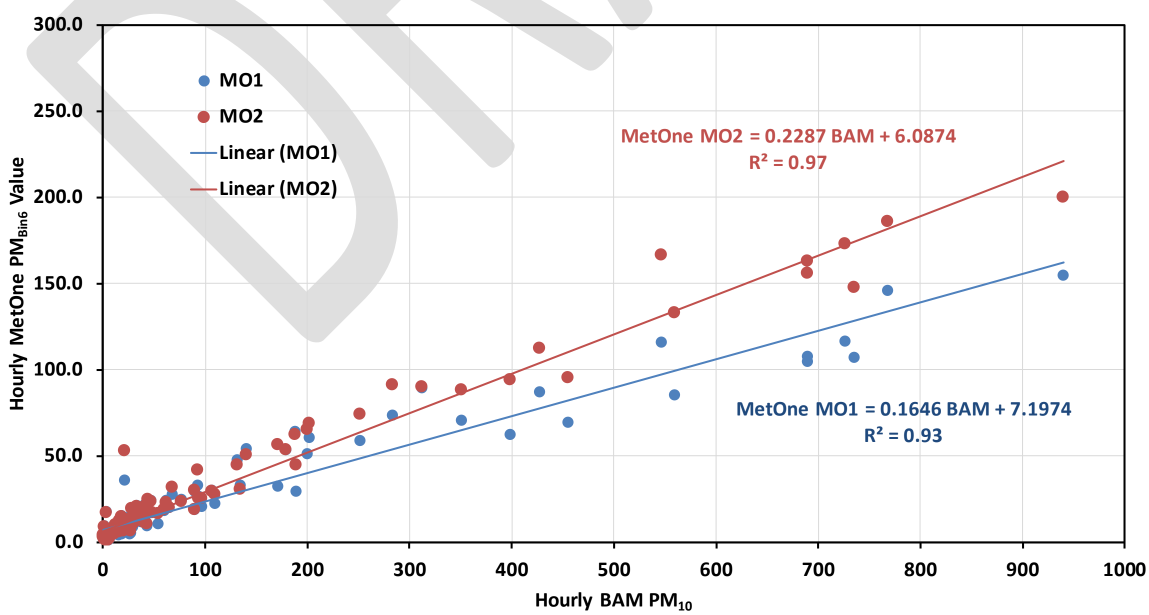


Figure 2-4. In situ calibration of two MetOne instruments with the in-park BAM unit.

The operation of the BSNE sampling network that quantifies sand flux in the dust control areas is carried out by personnel from the Coastal San Luis Resource Conservation District following training received from DRI personnel. The sampling strategy is to have the traps installed, the opening set at 15 cm above the surface, prior to a sand transport event. Following an event (typically the next morning), each BSNE is visited and the collected sand is put into Ziploc bags with the date of collection and the unique identifier for the BSNE. The empty BSNE is returned to its holder and the height set to 15 centimeters (cm) making it ready for the next collection. The sample bags are returned to the RCD office for latter weighing on an electronic balance to a precision of 0.01 grams (g).

Saltation flux measurements were made in the 37.7-acre temporary sand fence array and 7 acre-re-vegetation area in 2019 , and are being made in two temporary sand fence arrays established in spring 2020.[1] In 2019, 32 traps were placed in the fence array area and 20 in the re-vegetation area. In 2020, 12 traps were placed in each of the fence arrays area. In 2019 and 2020, BSNE traps in the array of sand fences were placed between consecutive sand fences at a distance of 6 fence heights from the upwind (western) fence based on the positioning shown in Table 2-3. The locations of the BSNE sand traps in the temporary sand fence arrays in 2020 are shown in Table 2-4.

[1] The 2019 sand flux measurements were collected in Project ID's 2018-WF-01/-02 and 2018-VG-02. As the data collection for the BSNEs and PM sampling stations are still on-going the 2020 data are not yet ready for reporting and will be available by October 31, 2020.

Table 2-3. Sand trap positions in the temporary sand fence array and re-vegetation site, 2019

	37.7 Acre Fence Array		7 Acre Re-Vegetation Site		
Row #	Distance (m)	Normalized Distance (Distance/Fence Height)	Row #	Distance (m)	Normalized Distance (Distance/Total Length of Transect)
0	0.0	0	0-1	0.0	0.00
2-3	15.9	13	1-2	8.5	0.10
3-4	24.4	20	2-3	15.9	0.19
4-5	32.9	27	3-4	24.4	0.29
6-7	50.0	41	4-5	32.9	0.39
8-9	67.1	55	5-6	41.4	0.49
10-11	84.2	69	6-7	50.0	0.59
14-15	118.3	97	7-8	58.5	0.69
18-19	144.0	118	8-9	67.1	0.80
22-23	186.7	153	9-10	75.6	0.90
26-27	220.8	181	10-11	84.2	1.00
30-31	255.0	209			
34-35	289.1	237			
38-39	323.1	272			
42-43	357.5	293			
46-47	391.6	321			
50-51	425.8	349			

Table 2-4. The positions of BSNE sand traps within the two temporary sand fence arrays, 2020

Row #	Distance (m)	D/H	BSNE* (Area 1, 43 rows)	BSNE (Area 2, 36 rows)
0	0	0	X X	X X
2-3	16	13	X X	X X
3-4	24	20		X
4-5	33	27	X X	X X
8-9	67	55	X	X
12-13	101	90	X	X
18-19	144	118	X X	X X
30-31	255	209	X	X
38-39	323	272	X	
*X X indicates 2 BSNEs spaced 2 m apart, N-S				

Control effectiveness of the array to reduce sand flux is defined by the Normalized Sand Flux (*NSF*):

NSF=sand flux internal to the array/sand flux upwind of the array

The overall control effectiveness is based on the change of *NSF* as a function of downwind distance through a dust control area (sand fence array or vegetation).

In the temporary sand fence array 2019, the *NSF* decreased rapidly between the first two sets of traps (upwind and between rows 2 and 3) and the traps through to Rows 4-5 (32.9 meters (m)). The *NSF* then stabilized to a relatively constant value between Rows 6-7 (50 m) to Rows 14-15 (118.3 m). Beginning at Rows 18-19 (144 m) the *NSF* fluctuated between 0.1 and 0.5 through to the end of transect. As in 2018, *NSF* reached a maximum value at 255 m. This corresponds with the maximum elevation of the transect where maximum wind speeds are likely to occur.

The mean *NSF* for all measurement positions for distances >24.4 m was 0.21 (±0.13), indicating a mean percent reduction in sand flux of 79.1% for 94% of the array (see Figure 2-5).

In the 7-acre revegetation area in 2019, at distances >24.4 m from the leading (western) edge the *NSF* values stabilized and ranged between 0.012 and 0.022. For the revegetation site distance is normalized by the total length of the area as there are no fence; this expresses distance as fraction of the total length. In this span of distance, representing 61% of the transect of instruments the mean *NSF* was 0.019 (±0.003), indicating a sand flux reduction of 98.1%. In the distance from 0 to 24.4 m the mean *NSF* was 0.58 (±0.42) across 39% of the transect (see Figure 2-6).

Monitoring of the two temporary sand fence arrays established in Spring 2020 is ongoing.

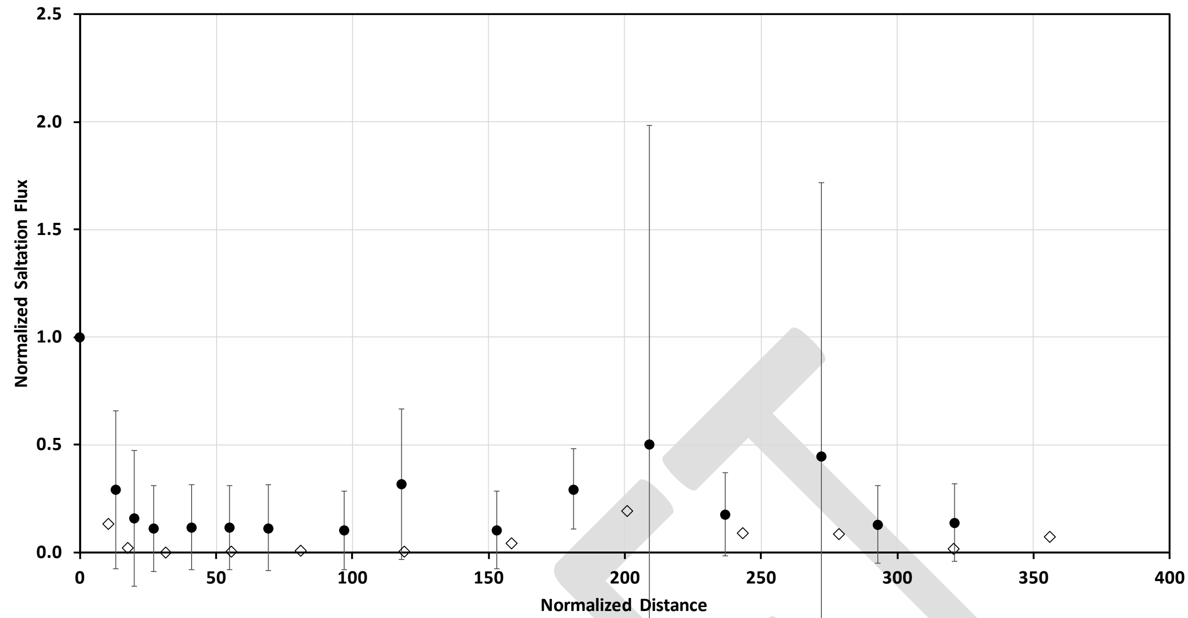


Figure 2-5. Mean normalized sand flux as a function of normalized distance for the 37.7-acre fence array in 2019, represented by the black circles. For comparison, the 2018 data are shown represented by the white diamonds. Error bars represent the standard deviation of the mean *NSF*.

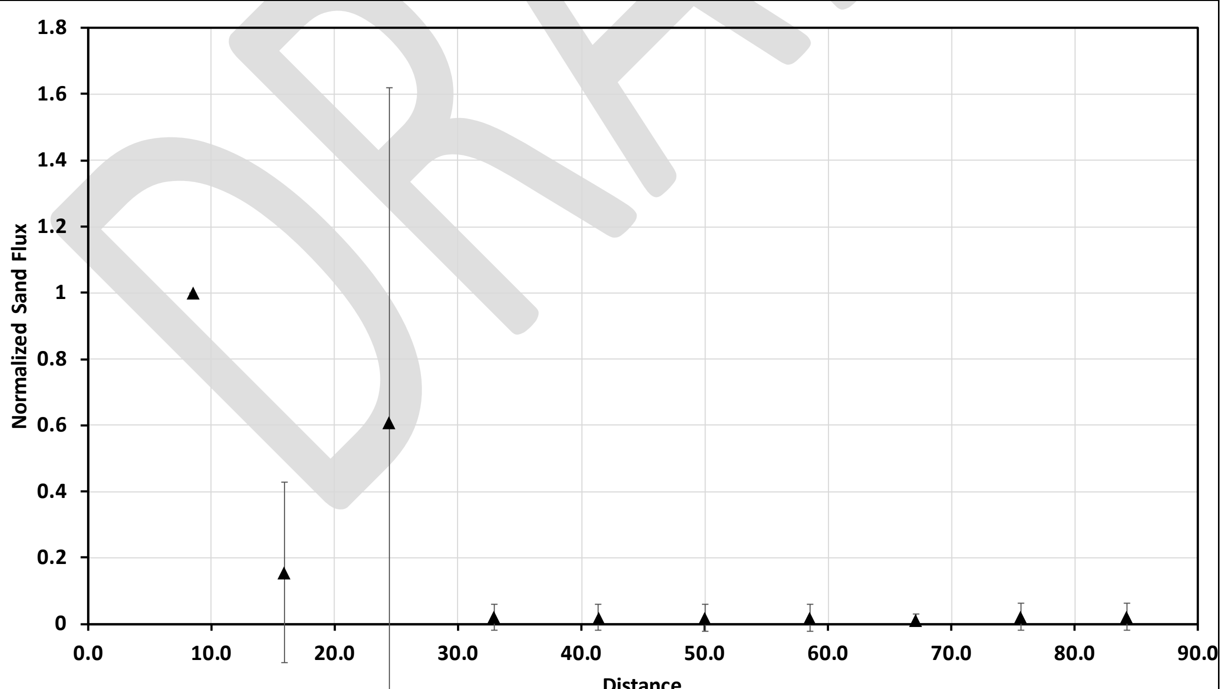


Figure 2-6. The change in normalized sand flux as a function of distance along the measurement transect for the re-vegetation site in 2019. Error bars represent the standard deviation of the mean *NSF*.

Meteorological, PM, and Saltation Monitoring: Foredune Restoration Area

The developing foredune restoration areas will begin to modify the localized meteorological conditions as the vegetation evolves and due to the initial modification to the surface by the treatment type. To characterize the changes in wind and to monitor saltation activity through time, in each test area a suite of instruments on a 3 m tripod on a platform (see Figure 2-7) was deployed near the eastern edge of the areas, approximately 10 m west of the eastern fence line and halfway along the north-south length of an area. A monitoring station has almost the same configuration as those deployed across and exterior to the Oceano Dunes SVRA to measure temperature, RH, wind speed, wind direction, and pressure (ClimaVue500). The restoration area stations do not have PM measurements.

Sensit saltation sensors are located at each station to provide data on threshold wind speed for sand transport. A webcam is deployed at each station to provide addition information on the frequency and magnitude of sand transport events providing a wider field of view than the point-measurement of the Sensit. Three tipping bucket rain gauges are deployed across the restoration area (north, middle, south).

Sand flux in the 6 foredune restoration treatment areas is measured using BSNE-style sand traps. A linear transect consisting of 5 BSNEs oriented with the major sand transporting wind direction, i.e., 292° at the north-south midpoint of each defined test area was established in April 2020. A BSNE is placed on the western side of a treatment area approximately 2 m from the security fence to receive the incoming sand flux. The next 4 traps in a treatment area are positioned at 4 m (12 feet), 13 m (42 feet), 45 m (148 feet), and 160 m (525 feet) along the 292° transect line. A map of the BSNE locations in the foredune restoration area is shown in Figure 2-8.

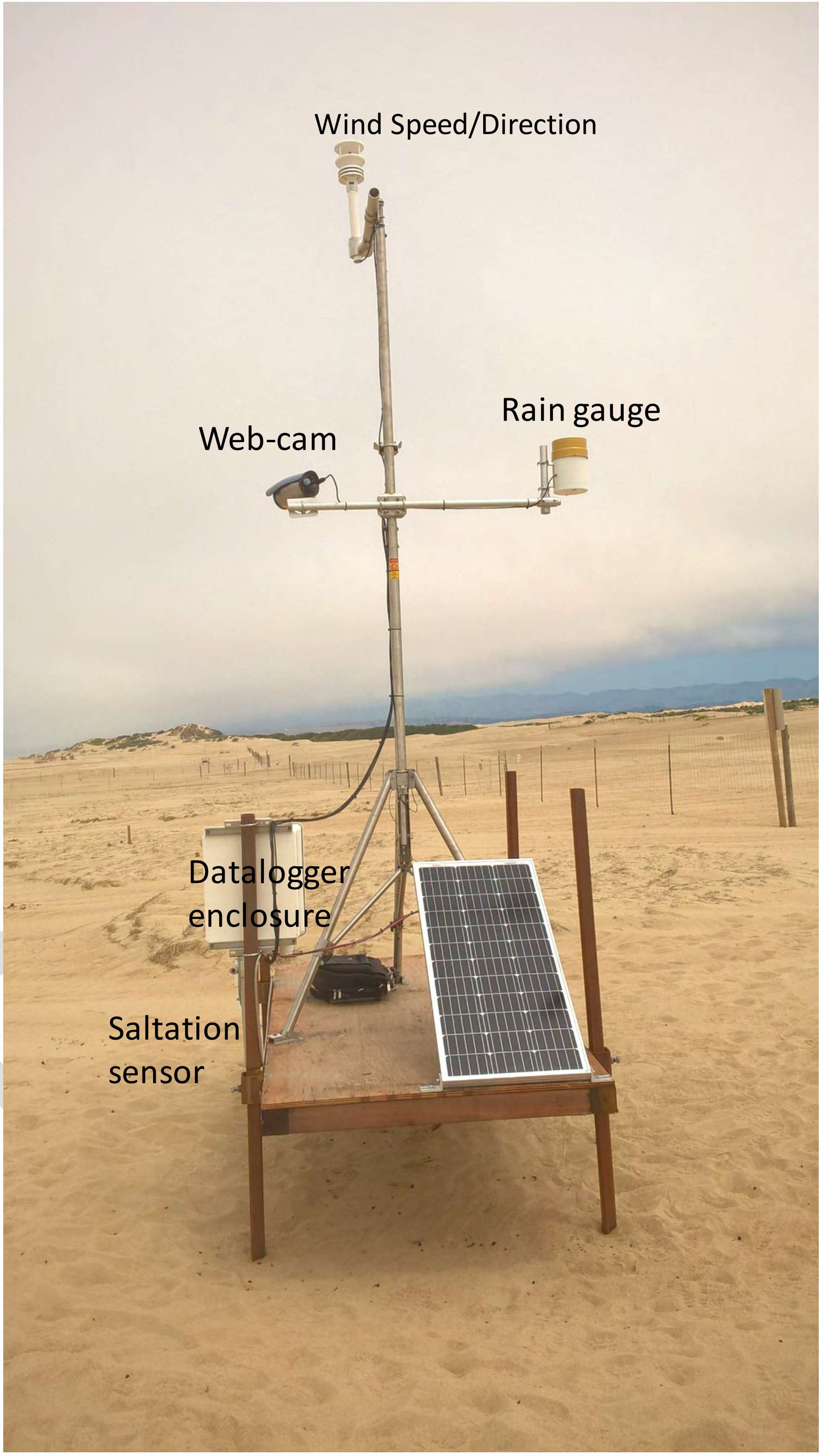
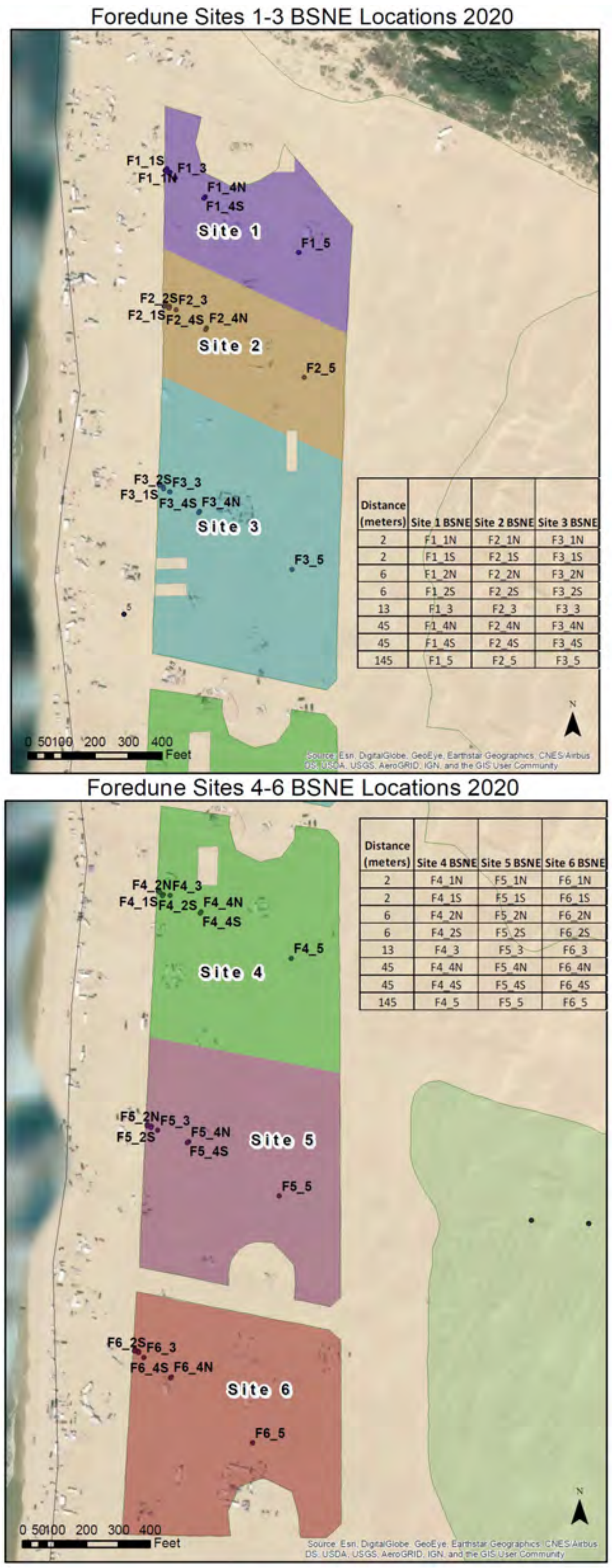


Figure 2-7. A meteorological and saltation monitoring system deployed in the foredune restoration area.



Distance (meters)	Site 1 BSNE	Site 2 BSNE	Site 3 BSNE
2	F1_1N	F2_1N	F3_1N
2	F1_1S	F2_1S	F3_1S
6	F1_2N	F2_2N	F3_2N
6	F1_2S	F2_2S	F3_2S
13	F1_3	F2_3	F3_3
45	F1_4N	F2_4N	F3_4N
45	F1_4S	F2_4S	F3_4S
145	F1_5	F2_5	F3_5

Distance (meters)	Site 4 BSNE	Site 5 BSNE	Site 6 BSNE
2	F4_1N	F5_1N	F6_1N
2	F4_1S	F5_1S	F6_1S
6	F4_2N	F5_2N	F6_2N
6	F4_2S	F5_2S	F6_2S
13	F4_3	F5_3	F6_3
45	F4_4N	F5_4N	F6_4N
45	F4_4S	F5_4S	F6_4S
145	F4_5	F5_5	F6_5

Figure 2-8. Locations of the BSNE samplers in the foredune restoration area.

The information obtained by these stations will provide data on how the developing foredune modifies the boundary-layer flow over the test areas and on the lee side. The station data will also be used to evaluate how the evolving foredune modulates sand transport characteristics (i.e., threshold wind speed and sand flux). These data will also be used to evaluate the effectiveness of each treatment to modulate the sand flux through the test area providing information to inform a decision whether to adopt a specific treatment to apply to the other five areas to enhance foredune restoration.

2.3.2 Digital Elevation Modeling

To assess the impacts of implemented dust control measures and inform future adaptive management decisions, monitoring of landscape-scale changes in beach and dune geomorphology and vegetation cover is required. Aerial light detection and ranging (LIDAR) mapping and unmanned aerial systems (UAS, or drone) platforms have both been used recently within Oceano Dunes SVRA to provide limited assessments of landscape changes. Staff from Arizona State University (ASU) began UAS mapping of the foredune restoration zone in October 2019 and subsequently in February 2020. On the recommendations of SAG, a decision was made to expand the domain of UAS surveys to approximately 1,500 acres to cover a much larger area of emissive surfaces within Oceano Dunes SVRA (see Figure 2-9 and Figure 2-10). This expanded domain will include key reference sites of high OHV activity, protected non-riding areas, high sand transport (saltation activity), and other highly emissive areas.

Figure 2-9. Orthophoto mosaic showing the approximate extent of the expanded UAS DEM mapping domain derived from February 2020 imagery collected by ASU. General area of the foredune restoration zone shown by the yellow polygon. Further details in Attachment 5.

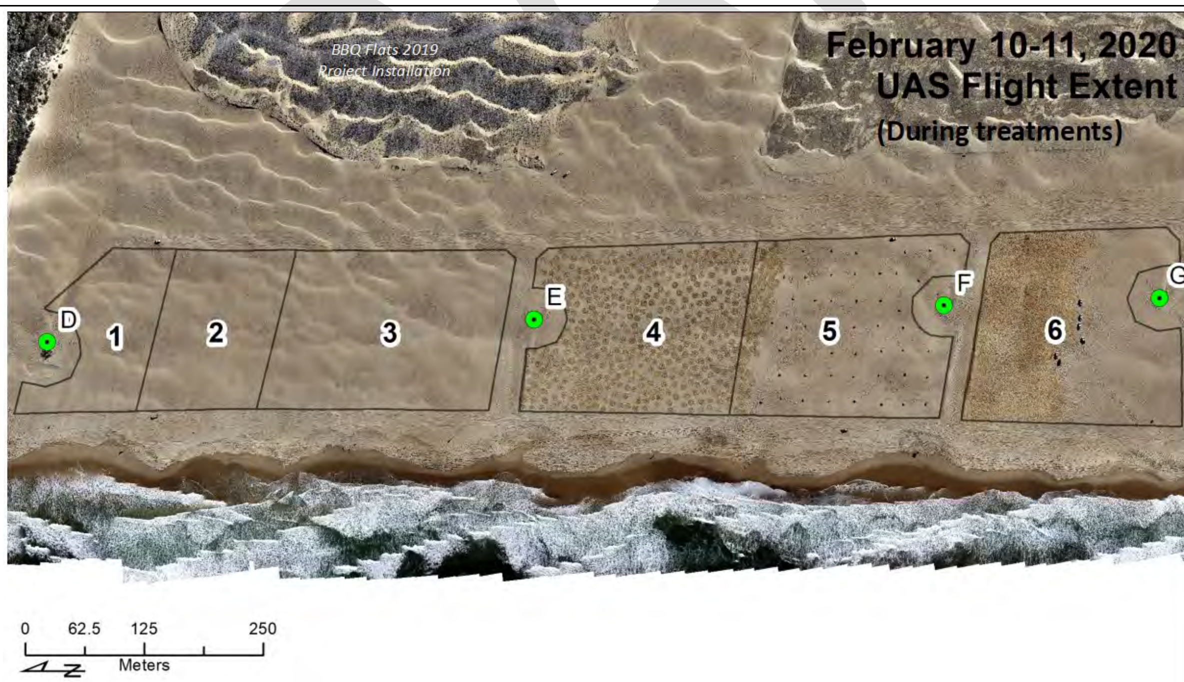


Figure 2-10. Aerial imagery of the foredune restoration zone and related treatments described in Section 2.1.1. derived from February 2020 UAS imagery collected by ASU. Initial installation of the randomly spaced node treatments (treatment areas 4 and 5) and 'parks classic' (treatment area 6) are visible.

2.3.3-DRI Model Verification

Pursuant to Section 2.c of the SOA, modeling "shall be carried out by the California Air Resources Board (CARB), or other modeling groups subject to the review of the Scientific Advisory Group (SAG)." The use of the DRI model was formally approved by SAG, SLOAPCD, and CDPR at the October 2018 SAG meeting.

As part of the ongoing effort to provide confidence that the DRI emission, dispersion and source attribution dust model produces reasonable estimates of the concentration of PM_{10} at selected receptor sites, a verification analysis was undertaken in 2020 using PM_{10} concentration data measured at the CDF and Mesa2 air quality monitoring stations in 2013 as well as for in-Park measurements collected in 2013.

Measurements of PM_{10} made across the spatial domain of the Oceano Dunes SVRA in 2013, as well as external to the Oceano Dunes SVRA, (i.e., at CDF and Mesa2) and model-estimated values at the same locations for the environmental conditions defined by the 10 baseline days were compared to provide an evaluation of the veracity of the DRI dust emission and dispersion model (Mejia et al., 2019) prediction with available measurements. Results of that exercise are discussed in the following sections.

2.3.3.1 2013 BAM 24 Hour PM_{10} versus Modeled 24 Hour PM_{10}, CDF and Mesa2

The comparison of the BAM-measured mean 24-hour PM_{10} and the model-predicted mean 24-hour PM_{10} values for the CDF and Mesa2 locations for the 10 baseline days are shown in Figure 2-11 and Figure 2-12, respectively. For clarity the measured and modeled mean 24-hour PM_{10} values shown in Figure 2-11 and Figure 2-12 are provided in Table 2-5.

The greatest percentage difference between a measured and modeled value is 36.5% (05-19-2013, CDF), with the average considering both sites being 17% (±11%), based on the absolute values of the % difference for each baseline day. The mean value of the observed to model-predicted value ratios for the 10 baseline days are 1.09 (±0.26) and 0.97 (±0.25) for CDF and Mesa2, respectively. The close agreement between the (SLOAPCD quality assured/quality controlled) measured and the DRI model-predicted values verifies that the DRI model is performing at a level much greater than is accepted by the US EPA when using models for predicting the magnitude of scalar quantities (such as PM) (Rhoads, 1981; Hanna, 1993).

DRI recognizes that using just the 10 day baseline for model verification across the spectrum of conditions is restrictive, and notes that model performance for the period May-July 2013, which covers a broad set of conditions, was described in Mejia et al. (2019) as illustrated in Figure 2-13 for CDF and Mesa2. This figure demonstrates that the correlation between modeled and measured PM_{10} concentrations is quite good across a range of conditions. If only extreme values are used, such as the 10 baseline days, then it stands to reason that the correlation between measured and modeled will be low, but the point is reiterated that the fractional difference between measured and modeled for the 10 baseline days demonstrates agreement at a level greater than US EPA guidelines for acceptable model performance.

As the use of the DRI model has been agreed upon by CDPR, SLOAPCD and the SAG, further verification exercises will only be carried out upon request.

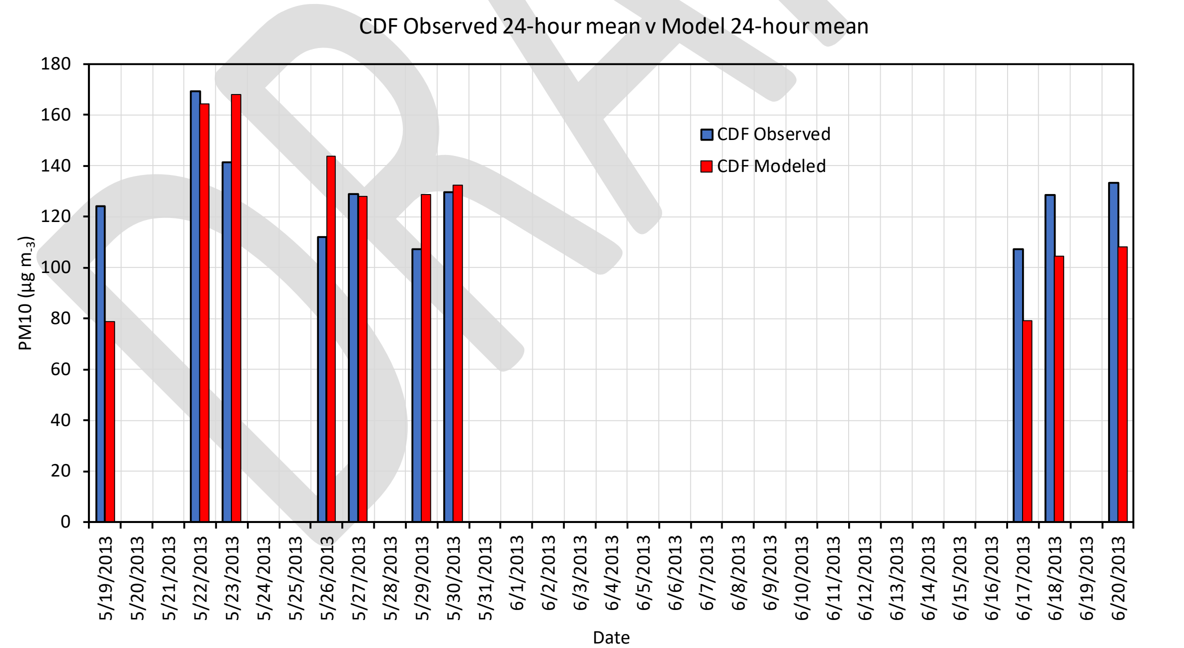


Figure 2-11. Comparison of the mean PM_{10} 24-hour observed value and the mean modeled value for the 10 baseline days at the CDF site based on 2013 winds and 2013 emission grid.

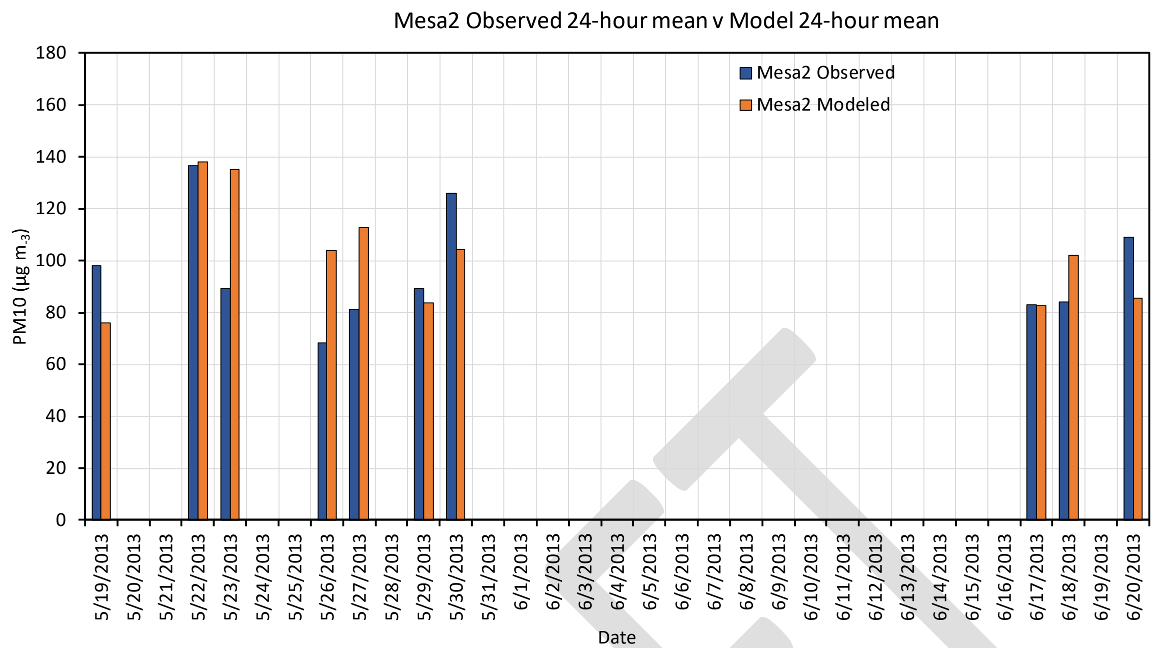


Figure 2-12. Comparison of the mean PM_{10} 24-hour observed value and the mean modeled value for the 10 baseline days at the Mesa2 site based on 2013 winds and 2013 emission grid.

Table 2-5. Measured and modeled mean 24-hour PM_{10} values for the 10 baseline Days

	CDF (µg m^{-3})		Mesa 2 (µg m^{-3})	
Date	**Obs**	**Mod**	**Obs**	**Mod**
5/19/2013	124	79	98	76
5/22/2013	169	164	137	138
5/23/2013	141	168	89	135
5/26/2013	112	144	68	104
5/27/2013	129	128	81	113
5/29/2013	107	129	89	84
5/30/2013	130	133	126	104
6/17/2013	107	79	83	82
6/18/2013	129	104	84	102
6/20/2013	133	108	109	85
Mean	128	124	96	102
Std. Dev	18	31	21	22

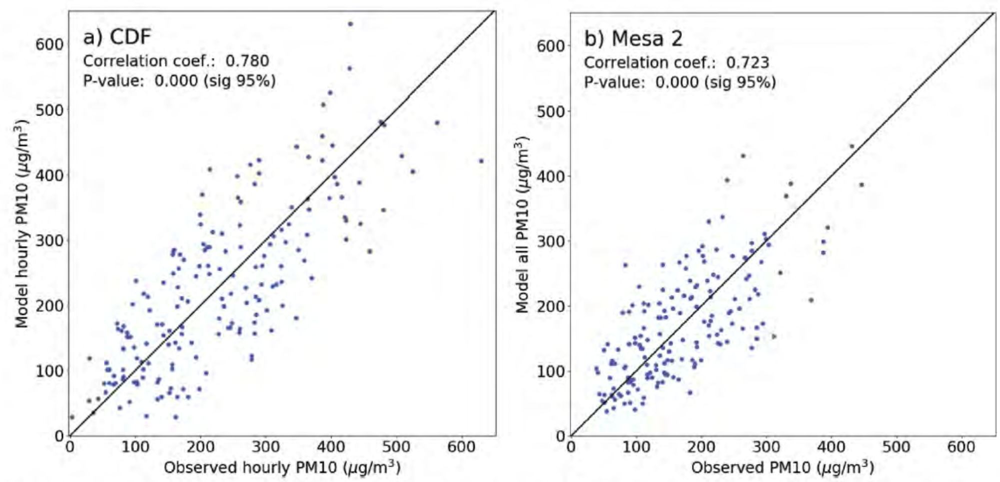


Fig. 13. Scatter plot for observed and model hourly PM_{10} exceeding the observed median for (a) CDF and (b) Mesa 2 sites. Linear correlation coefficients are provided along with their p-value (< 0.025 for 95% significance level).

Figure 2-13. Figure 13 from Mejia et al. (2019) demonstrating the relationship between model-predicted PM_{10} and measured PM_{10} at CDF and Mesa2 for May-July, 2013.

2.3.3.2 2013 In-Park E-BAM 24 Hour PM_{10} versus Modeled 24 Hour PM_{10}

In 2013 E-BAM instruments were placed on instrumented towers within the Oceano Dunes SVRA as part of the initial monitoring of PM_{10} to evaluate its magnitude and spatial variation. The locations (latitude and longitude), distances between transect monitoring positions and their elevation above sea level are listed in Table 2-6. A comparison of the 24 Hour PM_{10} versus modeled 24 Hour PM_{10} for in-park E-BAMs located at positions denoted as T1C, T2C, T3C, and T4B (Figure 2-14) was carried out as part of the model verification procedure as requested by CDPR, for baseline-defined days. The E-BAM data used to derive the 24-hour mean PM_{10} were corrected using colocation correction factors provided by the contractor Sonoma Technology (STI). STI collocated the E-BAMs with a BAM unit to derive the correction factors. Upon review of the observational data the confidence in the measurements at T1C was low for that E-BAM, as the values were considerably lower than the T2C values by a factor of 4, so no comparison was carried out for this site. Due to instrument malfunction not all 10 baseline days are available at each Station. In addition, some of the available baseline days did not have all 24 one-hour data records. Figure 2-15, Figure 2-16, and Figure 2-17 show the observed (E-BAM measured) 24-hour mean values compared with model estimates for the same positions for all available baseline days as measured at the identified locations on the four transects that were operated in 2013.

Figure 2-14. The locations of E-BAM measurements in 2013 identified as T1C, T2C, T3C, and T4B. The SLOAPCD PM_{10} monitoring locations CDF and Mesa2 are also shown.

Table 2-6. The positional data for E-BAMs located at stations T1C, T2C, T3C, and T4B in 2013 (meteorological data were collected at these positions as well)

Transect ID	Latitude	Longitude	Distance from Shoreline (m)	Elevation (m)
T1A	35.088257	-120.6235	700	17.95
T1B	35.087615	-120.6216	893	29.05
T1C	35.086687	-120.6186	1185	21.15
T2A	35.071805	-120.6263	409	13.09
T2B	35.070713	-120.6243	628	19.04
T2C	35.069508	-120.6193	1101	32.35
T3A	35.056977	-120.6261	500	19.64
T3B	35.052712	-120.6181	1365	34.31
T3C	35.048821	-120.6076	2420	24.31
T4A	35.023906	-120.6269	859	18.6
T4B	35.021225	-120.6218	1411	37.28
T4C	35.018632	-120.6173	1913	37.08

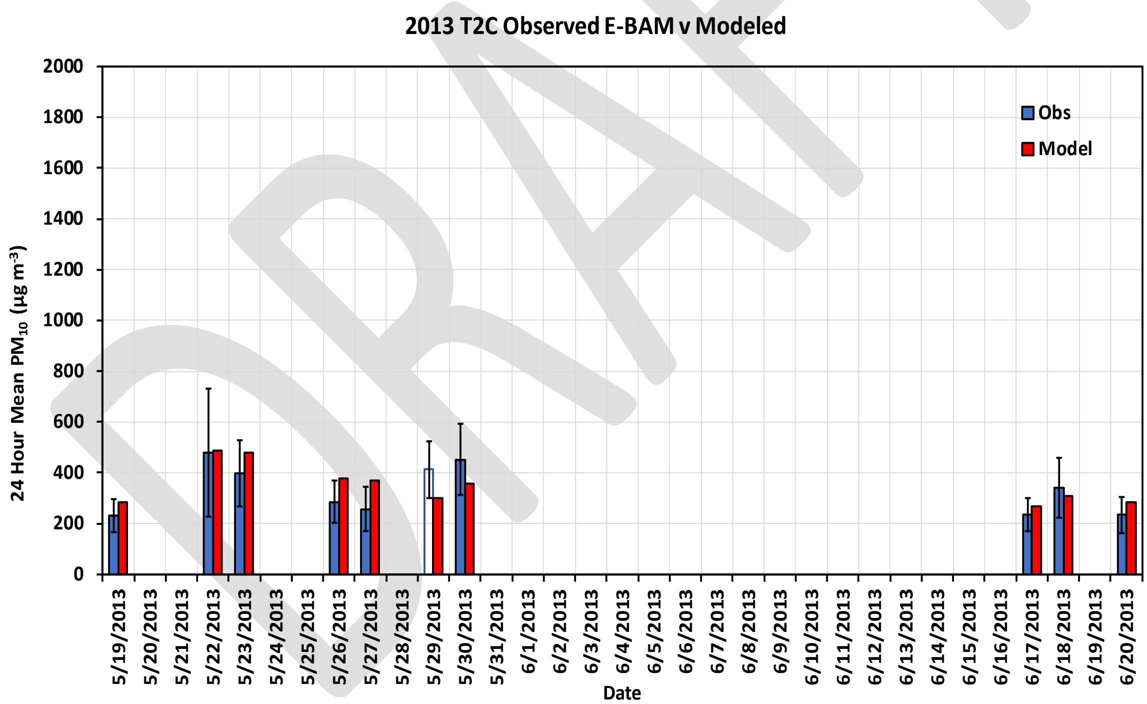


Figure 2-15. Observed 24-hour mean PM_{10} at Station T2C. Error bars show the standard error (i.e., std. dev./[$n^{0.5}$], where n is the number of samples). White bars with blue border indicate missing hours in the observational data record for estimating the mean. Error bars were not calculated for the modeled values.

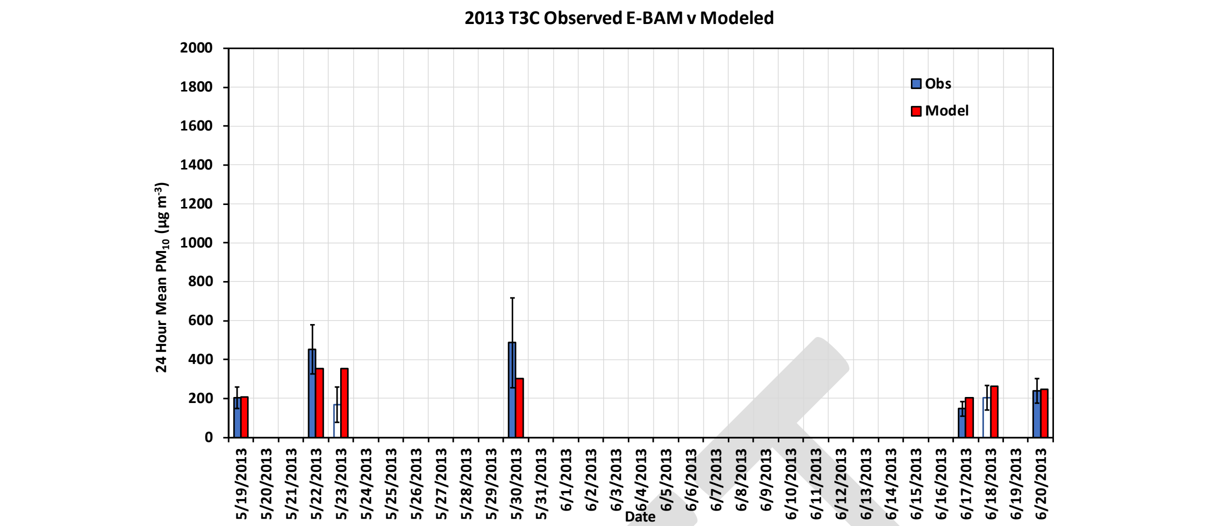


Figure 2-16. Observed 24-hour mean PM_{10} at Station T3C. Error bars show the standard error (i.e., std. dev./[$n^{0.5}$]). Error bars were not calculated for the modeled values. White bars with blue border indicate missing hours in the observational data record for estimating the mean. Error bars were not calculated for the modeled values. Not all 10 baseline days had E-BAM data.

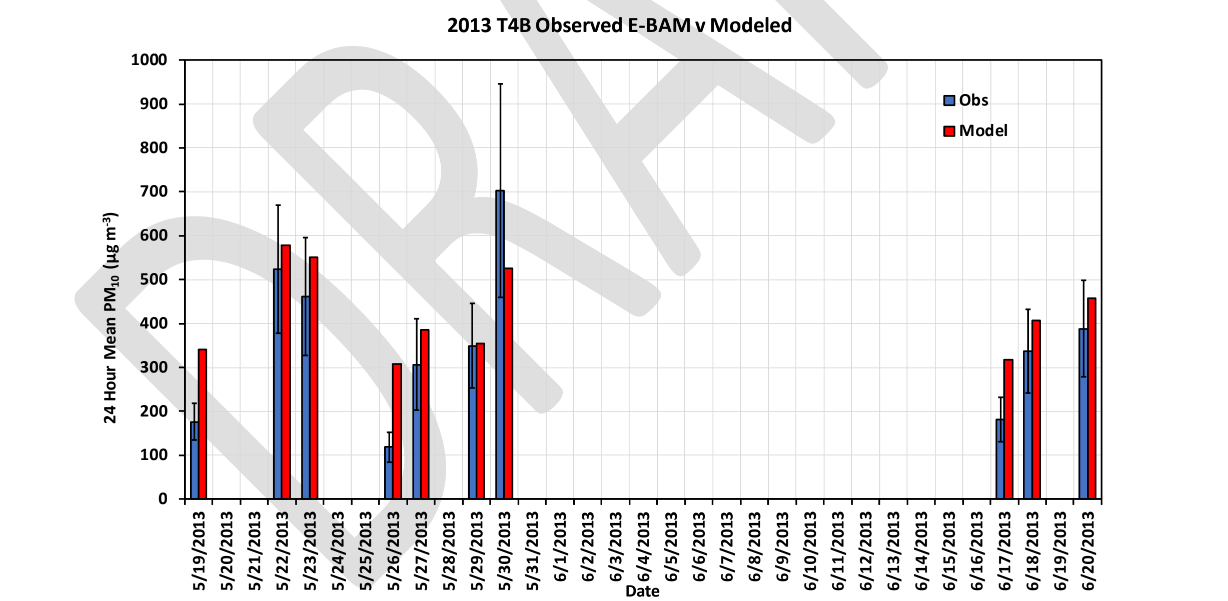


Figure 2-17. Observed 24-hour mean PM_{10} at Station T4B. Error bars show the standard error (i.e., std. dev./[$n^{0.5}$]). Error bars were not calculated for the modeled values.

For the three Stations, T2C, T3C, and T4B, the mean of all available 24-hour PM_{10} concentration values are compared with the mean of the model-predicted 24-hour PM_{10} concentration values in Figure 2-18. The ratio of observed to modeled for the baseline days with valid observations are, respectively, 0.95 (±0.23), 0.97 (±0.38), and 0.80 (±0.27). For all Stations combined the mean value of the observed to modeled ratio is 0.90 (±0.29). The analysis presented here provides confidence that the DRI model is operating in a predictive capacity at a high level of performance. It should also be noted that the in-park monitoring locations are subject to much greater dynamic conditions than those downwind of the park with both emission and dispersion occurring coincidentally. Downwind of the park away from the active sand sheets only dispersion and particle deposition are affecting the mass concentration of PM_{10}.

For the three stations, T2C, T3C, and T4B, the mean of all available 24-hour PM_{10} concentration values are compared with the mean of the model-predicted 24-hour PM_{10} concentration values in Figure 2-15. The ratio of observed to modeled for the baseline days with valid observations are, respectively, 0.95 (±0.23), 0.97 (±0.38), and 0.80 (±0.27). For all stations combined the mean value of the observed to modeled ratio is 0.90 (±0.29). The analysis presented here provides confidence that the DRI model is operating in a predictive capacity at a high level of performance. It should also be noted that the in-park monitoring locations are subject to much greater dynamic conditions than those downwind of the park with both emission and dispersion occurring coincidentally. Downwind of the park away from the active sand sheets only dispersion and particle deposition are affecting the mass concentration of PM_{10}.

PM_{10} data from CDF, Mesa2, and the 15 monitoring stations within the park in 2018, 2019 and 2020 will be used for additional model verification analysis.

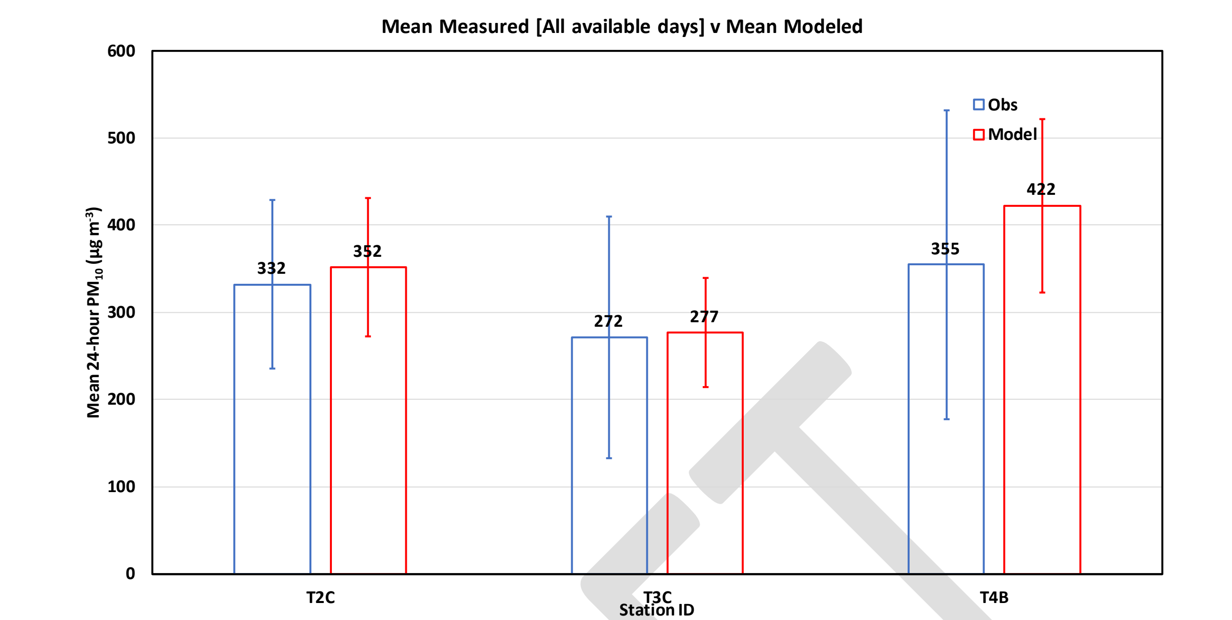


Figure 2-18. Comparison of the mean observed value (E-BAM measured) and the mean modeled value for the available baseline days.

2.3.3.3 PI-SWERL Measurements, May 2020

In May 2020, DRI carried out PI-SWERL sampling of emissivity for a sub-set of the 2019 sampling grid. A bootstrapping analysis was performed on the 2019 data, as it represents the largest and most general sampling available to determine a robust sampling size, which was evaluated to be 100.

DRI expected to carry out PI-SWERL sampling at 100 locations (a subset of the 2020 sampling grid) that covered both riding and non-riding areas in 2020 (Figure 2-19). Unfortunately, due to unfavorable environmental conditions the sampling as of May 2020 was only completed for 86 locations that were only within the riding area.

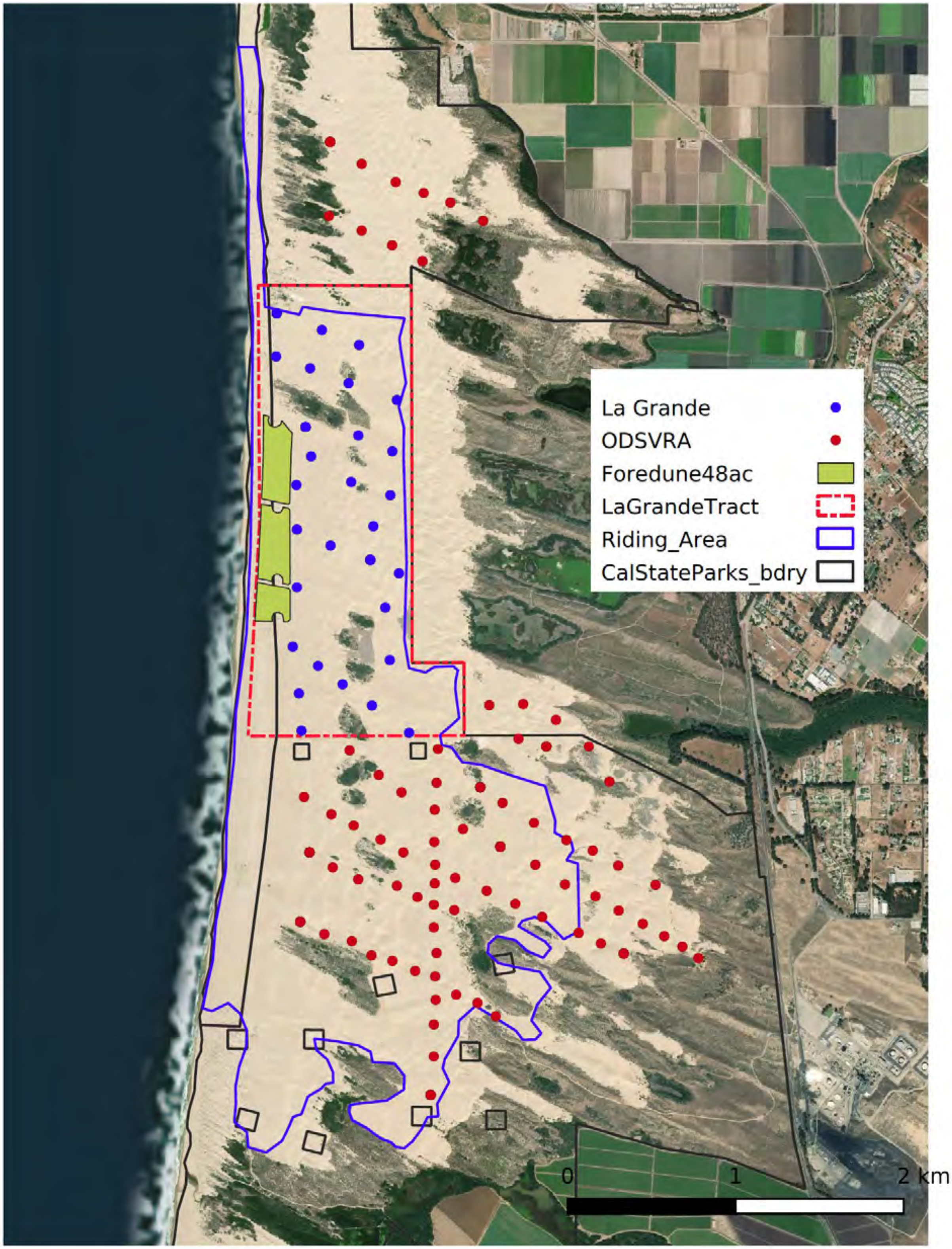


Figure 2-19. The PI-SWERL test locations for 2020.

Due to the same unfavorable environmental conditions and the subsequent hatching/fledging of western Snowy Plovers within the foredune restoration area and areas around the restoration area, PI-SWERL measurements have not yet been made within the foredune restoration area. The locations of the PI-SWERL sampling in the foredune restoration area are shown in Figure 2-20.

Figure 2-20. The locations for PI-SWERL tests in the foredune restoration area.

2.4 Other Relevant Actions

2.4.1 SOA Baseline Update

The SAG was consulted to refine the SOA baseline approach. Attachment 6 to this report describes the SAG review and analysis. Based on this analysis it was determined to use the 10 days in the 2013 monitoring period (April-August) with the highest DRI model-estimated 24-hour mean mass emissions of PM_{10} to define the baseline. The baseline is used for comparison with later years to establish the percent difference in mass emissions in subsequent years.

This new refined baseline approach was updated into the DRI model and reflected in the modeling results discussed in this report.

2.4.2 Analysis of Other Potential PM Sources

Section 7.3 of the PMRP identifies opportunities for studying contributions to PM_{10} on the Nipomo Mesa from potential sources of PM_{10} external to Oceano Dunes SVRA recreational operations. Potential contributing sources include: PM from marine sources, agricultural sources, and combustion sources.

The Scripps Institution of Oceanography (Scripps), in collaboration with the OHMVR Division, continued into year two of its three-year investigation into the constituents that comprise the airborne particulate matter at Oceano Dunes and vicinity. For three weeks, from April 27 to May 16, 2020, air filter samples were collected at the SLOAPCD's CDF location and in the Oceano Dunes SVRA, near shore. Samples were collected on carbon filters and on E-BAM fiberglass tape segments. Analyses conducted and to be conducted include elemental speciation, gravimetric analysis, carbon-source identification using Fourier-transform infrared spectroscopy, and DNA analysis for determining marine and terrestrial biogenic particulate sources. It is anticipated the analytical work will be completed in late August/early September 2020.

The SAG has provided a review of the 2019 Scripps Study, which is included as Attachment 7 to this ARWP.

Based on the required action to identify “other PM_{10}” sources that affect the CDF site, a targeted sampling of PM_{10} and its chemical constituents using the sampling resources of the SLOAPCD was initiated in May 2020. If necessary, it will be extended into 2021.

The samples are being acquired using a Partisol sampler (property of the APCD) located at the CDF monitoring site. This type of sampler meets regulatory (i.e., US EPA Federal Reference Method) monitoring requirements for PM_{10} to collect samples of PM_{10}. Samples are acquired during high winds and dust emission events within the Oceano Dunes SVRA, when the probability for exceeding the 24-hour average State (50 µg m^{-3}) and Federal (150 µg m^{-3}) standards for particulate matter is most likely. Samples are also being taken for lower wind days when PM_{10} will likely be dominated by sources other than wind-generated dust emissions. The Partisol will be loaded with paired 47 mm Teflon-membrane (pre-weighed) and quartz fiber filters supplied by DRI.

These paired filters will be received/installed/run for 24 hours and return-shipped by APCD personnel to DRI for analyses by DRI’s Environmental Analysis Facility (EAF). Analyses include: gravimetry, elemental and organic carbon (using thermal/optical reflectance and transmittance), elements (Na to U, using energy dispersive X-ray florescence), and anion and cation concentrations by ion chromatography (IC), automatic colorimetry, or atomic absorption.

Gravimetric analysis establishes the mass concentration of PM_{10} for a 24-hour sampling period. Carbon analysis provides information on contributions from combustion sources (e.g., gasoline and diesel vehicles, open burning, agricultural burning), elemental analysis identifies mineral sources, and anion and cation analysis identifies agricultural sources (specifically abundance of nitrate). As part of “Other Source” monitoring, DRI will provide quantification of methanesulfonic acid (MSA; CH_3SO_3H) using IC, which can be used as an indicator of contributions to PM by marine phytoplankton sources. MSA is the oxidative product of dimethylsulfide (CH_3SCH_3) that is produced by marine phytoplankton. A number of source apportionment studies have found MSA to be strong indicator for marine biogenic contributions to PM mass (e.g., Calzolai et al., 2015).

2.4.3 COVID Closure Study

The Oceano Dunes SVRA was closed in March 2020 to limit the spread of the COVID19 virus. The SAG produced a statement on the impact of the COVID 19 closure on dust emissions which is included as Attachment 8 to this ARWP.

In response to the closure and the cessation of OHV activity, the DRI implemented two observationally based strategies to evaluate the potential changes to the Oceano Dunes SVRA dust emission system in the absence of OHV activity. The first strategy was the re-establishment of the 15 PM_{10}/saltation/meteorological stations within Oceano Dunes SVRA (see Figure 2-1**)** that have been operated in previous years as soon as was logistically feasible for the personnel required to carry out the installations. This included personnel from T&B Systems, CDPR and DRI. These data will be used to evaluate if the PM_{10} concentrations at these locations has, or has not, changed from 2019, due to the cessation of OHV activity. Comparisons will be made based on the occurrence of similar atmospheric conditions (e.g., wind speed, wind direction, RH, temperature) and climatic conditions (e.g., days between precipitation events) to minimize confounding factors that affect emissivity.

The second strategy was to implement PI-SWERL sampling for a sub-set of locations that were measured in 2019. Since April 2020, PI-SWERL emissivity measurements have been made on a weekly basis (conditions permitting) at the same 29 locations, chiefly within the LaGrande tract area (see Figure 2-21). his sampling has been carried out by personnel from the Coastal San Luis resource Conservation District following training received from DRI personnel. These data will be used to evaluate if the emissivity of these locations has, or has not, changed from 2019, due to the cessation of OHV activity. DRI will also evaluate whether emissivity changed during the period from the initiation of SVRA closure to its eventual re-opening.

During the closure period, CDPR has and will continue to perform routine heavy equipment operation and grading activities throughout Oceano Dunes SVRA. This routine grading is done in support of normal park operations (e.g., maintaining the Pier Avenue sand ramp), is being conducted at the same frequency and interval as historical operations, and is not a substantial or significant increase in equipment operations at Oceano Dunes SVRA. In addition, CDPR conducted two tests of mechanical trash removal equipment. These tests occurred on May 21 (from marker post 2 to marker post 3) and June 3 (from marker post 3 to a point approximately 2,000 feet (0.38 miles) south of marker post 3). The analyses conducted by DRI will consider the effect, if any, CDPR grading activities had on emissivity and dust levels during the closure period.

In addition, pending approvals for UAS flight campaigns and approval of the ASU contract amendment (Attachment 5), the ASU team plans to collect another set of UAS imagery and DEM of Oceano Dunes SVRA in late September 2020. These data can be used to assess the impacts of the covid-19 closure on beach-dune morphodynamics, sediment movements, and the initial efficacy of the foredune restoration treatments in the complete absence of OHV activity. This will provide an invaluable dataset on an additional 'baseline' condition resulting from limited OHV action on landscape dynamics.

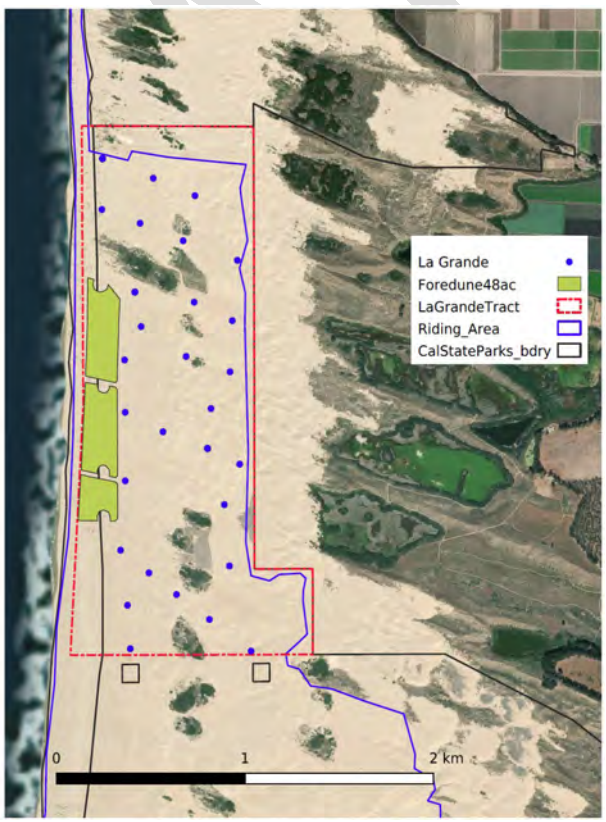


Figure 2-21. The PI-SWERL test locations in the LaGrande tract for repeat testing during the Covid closure period.

3 WORK PLAN

3.1 Dust Control Activities Proposed for the Next Year

For the time period from approximately August 1, 2020 to July 31, 2021, the OHMVR Division is proposing to undertake and/or complete the following dust control activities:

- Supplemental foredune planting to achieve positive net balance of sediment reduction.
- Remaining Initial SOA wind fence - conversion to native dune vegetation:
  - 13.5 acres of wind fence (8 acres at Eucalyptus and 5.5 acres at Table Top).
  - 15 acres of current straw mulch (Paw Print aka Bigfoot).
- SOA amendment 4.2-acre permanent dust treatment – current straw mulch conversion to native dune vegetation.
- Maintenance of 2019-2020 seasonal wind fencing (two 20-acre arrays).
- Install 90 acres of new dust control measures (temporary vehicle exclosures, seasonal wind fencing/straw mulch projects, and/or soil stabilizers) in locations selected in consultation with the SAG by November 16, 2020.
- Continued SAG consultation and evaluation.
- Continued monitoring and modeling activities.

These actions are briefly summarized below. Each summary includes a table that identifies the main implementing actions, whether the action is underway or would be undertaken, and what preliminary evaluation metrics (if applicable) are anticipated to be collected and reported over the coming year. The Evaluation Metrics listed in this chapter are based on the metrics contained in Attachment 2 of this report.

3.1.1 Supplemental Foredune Planting to Achieve Positive Net Balance of Sediment Reduction

The OHMVR Division has begun development of a vegetated foredune just beyond the tidal zone that is approximately 48 acres in size.

The adaptive management strategy on supplemental plantings first requires assessment of the effectiveness of the initial planting treatments (Section 2.3.2, Figure 2-10). To inform this, CDPR staff are collecting plant inspection and viability monitoring and the ASU team are conducting seasonal UAS surveys from which geomorphic, sand volume, and plant cover changes can be detected and quantified. No action on supplemental planting will be taken until these datasets are reviewed by SAG and CDPR. SAG suggests that monitoring data from at least one growth season from both methods is required to assess treatment performance. Currently, the UAS surveys are constrained by the timing of the western snowy plover exclosure (March-September), so it is likely that this assessment might not occur until spring 2021 at the soonest. Table 3-1 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to develop a vegetated foredune.

Table 3-1. Supplemental Foredune Planting Actions, Status, and Metrics

Implementing Action, Task, and/or Requirement	*2020 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Native seed collection and/or native plant cultivation		X				Quantities of seed (W8) Numbers of plants (W9)
Vegetation planting/restoration		X				Acres planted (W1,W2) Increase in area covered by live plants (P4)

Table 3-1. Supplemental Foredune Planting Actions, Status, and Metrics						
	2020 Work Plan Status					
Implementing Action, Task, and/or Requirement	*Already Complete*	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
Monitoring activities		X				Plant inspection/viability monitoring (W3) Change in fraction of plant cover (P4) Change in foredune sand volume/sediment monitoring (P5) Change in hummocks and topographical variability (P8,P9) Increase in silhouette profile (P11) Foredune sand flux (P10) Remote Sensing (W13,W14,W15) PISWERL emissivity (P7) PM_{10} emissions reductions (P1) Meteorological monitoring (P6)

3.1.2 Remaining Initial SOA wind fence - conversion to native dune vegetation

Consistent with SOA Condition 1.b., the OHMVR Division proposes to convert to vegetation approximately 28.5 acres remaining from the 48.6 acres of wind fencing installed in summer 2018 (See Exhibit 4, *2020-21 Wind Fence to Vegetation Areas*).

- 13.5 acres of current wind fence (8 acres at Eucalyptus and 5.5 acres at Table Top)
- 15 acres of current straw mulch (Paw Print)

Following removal of the existing wind fencing as needed, the OHMVR Division will proceed with restoration of the project area. The OHMVR Division's restoration methods are fully described in Chapters 6 and 7 of the June 2019 Draft PMRP. The OHMVR Division will schedule the initial removal of fencing to occur as late as possible given other park operations requirements and the need to ensure sufficient planting time. The OHMVR Division will also perform these restoration efforts in a manner that minimizes the delay between removing the existing wind fencing and initiating planting activities as much as possible given potential constraints (e.g., equipment, staffing, and material availability, other park operations requirements). For restoration work, the fencing must be removed before straw/mulch can be applied. During this time (when wind fencing may be removed but mulch not yet applied), the OHMVR Division will maintain a perimeter fence to prohibit OHV activity and camping in the restoration area.

The OHMVR Division will coordinate with the SAG on preparation of a planting palette with targets for container stock and native seed needed for dust control projects over the next year. It is estimated that a total of approximately 160,000 to 175,000 native dune plants and more than 900 pounds of native dune seed are needed for proposed 2020/21 vegetation planting projects. Table 3-2 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to convert existing wind fencing to vegetation.

Table 3-2. Convert Wind Fencing To Vegetation Actions, Status, and Metrics

Implementing Action, Task, and/or Requirement	*2020 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Native seed collection and/or native plant cultivation		X		X		Quantities of seed (W8) Numbers of plants (W9)
Wind fence removal		X		X		Length of fencing removed (W7)
Vegetation planting/restoration			X			Acres planted (W3)
Monitoring activities		X		X		Acres replanted (W4) Remote Sensing (W13,W14,W15) PM_{10} emissions reductions (P1)

3.1.3 Amended SOA 4.2 Acre Additional Permanent Dust Treatment

Pursuant to the SLOAPCD SOA as amended, CDPR has begun development of 4.2 acres of additional backdune dust control treatments. The area to be treated was selected through coordination with the SAG and SLOAPCD. The 4.2-acre area was fenced off to exclude public access in December 2019 and received straw bales/mulch in January 2020. The area is planned to be planted with native vegetation in 2020-21. Table 3-3 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary for this project.

Table 3-3. Amended SOA 4.2 Acre Additional Permanent Dust Treatment						
Implementing Action, Task, and/or Requirement	*2020 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Native seed collection and/or native plant cultivation		X		X		Quantities of seed (W8) Numbers of plants (W9)
Vegetation planting/restoration		X	X			Acres planted (W3)
Monitoring activities		X		X		Acres replanted (W4) Remote Sensing (W13,W14,W15) PM_{10} emissions reductions (P1)

3.1.4 Maintenance of 2019-2020 seasonal wind fencing

CDPR will maintain the two seasonal wind fencing projects (two 20-acre arrays) installed in 2019 and shown on Exhibit 1. These dust control treatments, which were described in Section 3.1.5 of the 2019 ARWP, were planned to be seasonal in nature and targeted for removal in Fall 2020. The OHMVR Division will instead leave this fencing in place and maintain the arrays through at least September 1, 2021. Table 3-4 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary for this project.

Table 3-4. Maintenance of 2019-2020 seasonal wind fencing						
	2020 Work Plan Status					
Implementing Action, Task, and/or Requirement	*Already Complete*	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
Replace posts, fencing materials, and fence rows as needed			X			Length of fencing installed and fence spacing (W7) Area stabilized by fencing (W6)

3.1.5 Install 90 Acres of New Dust Control Measures

The OHMVR Division proposes to implement 90 acres of new dust control measures consisting of temporary vehicle exclosures, seasonal wind fencing/straw bale projects, and/or soil stabilizers. These new dust control measures would be above and beyond the supplemental foredune plantings (see Section 3.1.1), initial SOA wind fence conversion (see Section 3.1.2), 4.2-acre SOA permanent dust control project (see Section 3.1.3), and existing wind fencing maintenance activities (see Section 3.1.4) described above. The OHMVR Division and the SAG have not yet selected the final location for the 90 acres of dust control measures; however, the new dust control measures would be intended to reduce PM_{10} within the zone downwind of the SVRA that is characterized by the Mesa2 monitor. The exact locations of the new dust control measured will be determined through SAG consultation and modeling of potential control measure effectiveness, but are anticipated to be consistent with the 80 acres of dust control measures identified by the SAG in its August 31, 2020 review of the Draft 2020 ARWP. CDPR will also take into consideration operational issues and public safety when selecting areas for dust control. Regarding the use of chemical soil stabilizers, there are many types of stabilizers, including water, water-absorbing materials, clay additives, organic petroleum products, organic non-petroleum products, and synthetic polymer products. Organic petroleum and non-petroleum products and synthetic polymer products suppress dust by binding or adhering surface particles together. Usually a proprietary chemical formula, the stabilizing compound(s) is mixed with water to provide the desired level of stabilization and then sprayed onto the receiving surface. The mixture is typically a milky white but dries clear or leaves the ground surface appearing wet. Although surface particles are adhered, the stabilized surface remains permeable to water. A US EPA Environmental Technology Verification Report for one particular dust suppression product, EnviroKleen, found the product to have dust control effectiveness between 70 to 90 percent. In addition, the US EPA determined, after testing for acute and chronic toxicity, that this particular product has very low aquatic toxicity and is not considered an aquatic pollutant (US EPA 2005). The OHMVR Division's review of existing, commercially available soil stabilizer products indicates most stabilizer products are non-toxic, but that synthetic polymer products may be the least toxic type of stabilizer. If a suitable non-toxic, environmentally friendly soil stabilization product can be obtained and demonstrated to be viable for use at Oceano Dunes SVRA, the OHMVR Division would apply the product via a tanker truck and spray hose. The stabilizer product could be used in lieu of wind fencing and straw bales, or within the interior of fencing and straw bale arrays (to provide additional dust control).

Since the exact locations of the new dust control measures are not final, the effect of these measures cannot be determined at this time. The locations of the 90 acres of dust control measures will be selected in consultation with the SAG and modeled to determine their effectiveness by November 16, 2020.

Table 3-5 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary for this project.

Table 3-5. Install 90 Acres of New Dust Control Measures						
Implementing Action, Task, and/or Requirement	*2020 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
SAG consultation on exclosure location(s)		X		X		NA
Complete model predictions of dust control measure effectiveness			X	X		NA
California Coastal Commission Permitting			X	X		NA
Install perimeter fencing around treatment area (as necessary)			X			NA
Install fencing materials, straw bales/mulch, and soil stabilizers as needed			X	X		Length of wind fencing installed and fence spacing (I12) Area stabilized by fencing (I10)
Monitoring activities		X				Remote Sensing (W13,W14,W15) PM_{10} emissions reductions (P1)

3.1.6 Continued SAG Consultation and Evaluation

Pursuant to the SLOAPCD SOA as amended, CDPR will continue to utilize the SAG for consultation and evaluation.

OHMVR Division will consult with the SAG on the development of a Public Outreach and Education Campaign. This effort will focus on topics such as:

- Progress of Oceano Dunes dust control treatments
- Purpose of foredune restoration project
- Role of the DRI model
- Health issues associated with respiration of fine particulate matter

Table 3-6 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to continue SAG consultation and evaluation.

Table 3-6. Continued SAG Consultation and Evaluation

Implementing Action, Task, and/or Requirement	*2020 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Quarterly Meetings with SAG		X				NA
Public Outreach Campaign Development			X			NA

3.1.7 Additional Actions to Address Reducible Uncertainty and Gaps in Information

The OHMVR Division will continue to work with the SAG and the SLOAPCD to take action to address reducible uncertainty associated with the DRI model as well as fill in other gaps in information necessary to best meet SOA objectives. These include:

Computational Fluid Dynamics Modeling of the Foredune

In addition to reduced dust emissivity within its footprint (i.e. areal dimensions), the foredune and other dust treatment areas may further reduce sand flux and wind shear stress downwind, thus contributing to additional dust emission reductions that are currently not accounted for in the DRI model. The secondary effects on emissions and air quality from the foredune restoration project are expected to be significant based on scientific arguments made by the SAG, including roughness modification of the boundary layer, but quantification of the added benefits to air quality needs to be carried out.

The current mass emission/dispersion modeling being undertaken to estimate the effect of implementing dust controls to lower mass emissions and improve air quality is not sufficiently sophisticated to take into account the changes in flow that will result from changes in the surface as the foredune develops.

DRI will undertake a measurement and modeling effort to develop a Computational Fluid Dynamics (CFD) model that can be used to evaluate how the evolving foredune will modulate the boundary-layer flow (wind speed, direction, and surface shear velocity) over the foredune area, in the lee of the foredune area, and with the re-vegetation areas that lies east of the foredune restoration area. The use of CFD modeling to understand the flow patterns around aeolian landforms and their potential to modulate boundary-layer flow are not without precedent (e.g., Smyth, 2019; Smyth et al., 2019). There is also published work specifically related to foredunes (Hesp and Smyth, 2016; Hesp et al. 2013), erosional blowouts (Smyth et al., 2019), and nebkhas (Hesp and Smyth, 2017) that can aid in guiding development of a CFD model for the developing Oceano foredunes.

The methodological approach will be to use the open-source finite volume toolbox openFOAM as the basis for developing the flow model. The goal will be to use the model to evaluate how the flow is changed by the developing foredune and subsequently use this information to inform CALMET in terms of wind speed, wind direction, and surface shear over and in the lee of the foredune. The changes in flow will subsequently affect the mass emissions (modify wind shear by an established fractional change for the affected grid cells) and provide a more realistic wind field for the particles that are being dispersed by the wind.

Development of the modeling inputs will also require some measurements be made in the established foredune areas of the SVRA to parameterize boundary conditions (e.g., vertical wind speed profiles, horizontal flow gradients in the lee of select dunes). The DEMs from ASU's UAS land survey program will be required to (digitally) construct the topography of the evolving foredune as well as a DEM of the mature Oso Flaco foredune that has been used as a model for the fully evolved foredune that is being restored.

Benefits that can arise from this work are: 1) a means to provide more realistic estimates of the aerodynamic roughness lengths (z_0) for different areas of the ODSVRA. This parameter plays a critical role in CALMET in the estimation of wind shear (which drives dust emissions), and at present its representation in CALMET remains simplistic; 2) better estimates of shear velocity based on topographic position on the dunes and in their lee, which will also provide better estimates of emissions.

DRI Emission-Dispersion-Source Attribution Model

DRI will develop wind and turbulence fields for scenarios based on 2019 and 2020 conditions using the approach described in Mejia et al. (2019) using the in-Park surface meteorological station data, buoy observations available in the domain, and the SODAR measurements of upper-air wind vectors to be provided by ASU (available as of 7-24-2020). These local measurements will provide better representation of the upper air flow compared to those from Vandenberg Air Force Base, which were used previously.

A weakness of the CALMET meteorological model is the way it estimates friction velocity and the vertical distribution of wind speed and direction at the surface and throughout the boundary layer. For the 2013 CALMET simulations, DRI assumed that Vandenberg AFB operational sounding, available only once a day (12h Coordinated Universal Time, equivalent to 4h Pacific Standard Time) and 35 kilometers due south from Oceano Dunes SVRA, provided a reasonable vertical wind and instability profile. DRI expects that the ASU SODAR measurements will help constrain, within the domain, the vertical winds while filling the gaps between the source and sink sites in the horizontal plane. Adding these measurements can have significant impacts in the particle trajectories and in the turbulent diffusion of dust.

CALMET parameterizes the surface friction effect and flow regime considerations using Monin–Obukhov (M-O) similarity theory (Foken, 2006). The M-O parameterization scheme relies on prescribed values of aerodynamic roughness length, which affects the estimates of the friction velocity and directly impacts dust emissions (dust emissions scales as a power function of friction velocity). There is a need to reconcile this parameter and assess the uncertainties involved in its selection. DRI's development of the CFD model of the foredune will hopefully provide additional insight into the proper parameterization of aerodynamic roughness within CALMET for the topography of the Oceano Dunes SVRA.

The current version of the DRI model assumes that dust deposition is negligible. DRI recognizes that deposition of PM_{10} does occur and that it becomes increasingly important to account for this process with increasing distance from source areas. To improve model estimates DRI is evaluating deposition velocity schemes to incorporate into the component dispersion model in an effort to relax the zero deposition assumptions and provide a more realistic treatment of the process with the expectation being that this will improve model performance. This is important for both CDF and Mesa2, but more important for Mesa2 which is further east than CDF and has almost double the distance from the Park boundary.

DRI Other Sources Study

Following receipt of the 10 pairs of filters collected by the SLOAPCD from the 2020 sampling days, the chemical analyses of the filters will be carried out by the Environmental Analysis Facility of the Desert Research. Once completed the chemically-speciated data of PM_{10} component mass concentrations and the associated uncertainties will be delivered to SLOAPCD (K. Tupper) and CARB (E. Withycombe) to carry out source apportionment analysis. The method of source apportionment will be selected by SLOAPCD and CARB.

Analysis of results from the DRI Other Sources study will include consideration of the ongoing results being produced by the Scripps study.

OHV Closure Study

The PI-SWERL data collected from repeated surveys in the LaGrande tract will be used to evaluate if the emissivity of these locations has, or has not, changed from 2019, due to the cessation of OHV activity.

DRI will also evaluate whether emissivity changed during the period from the initiation of Park closure to its eventual re-opening.

The meteorological, PM, and Sensit measurements from the 15 stations will provide an important data source to interrogate how the range and distribution of PM concentrations may have changed as a result of the Park closure between 2018, 2019 and 2020. It will also offer the opportunity to evaluate how the PM concentrations may have changed as a function of time during the closure period.

Table 3-7 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to address reducible uncertainty and gaps in information.

Table 3-7. Address Reducible Uncertainty Actions, Status, and Metrics

Implementing Action, Task, and/or Requirement	*2020 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Computational Fluid Dynamic Modeling		X		X		NA
DRI Other Sources /COVID Closure Study		X		X		NA

3.1.8 Other Possible Dust Control Measures

WeatherSolve Structures (WSS), a private company, submitted a proposal for installation of industrial style wind fencing at Oceano Dunes SVRA to address the elevated PM_{10} issues. The SAG reviewed and rejected this proposal as described in Attachment 9 to this ARWP.

The SAG determined that beyond the various logistical considerations for installing such a fence in a dynamic beach-dune environment, the wind fence would be ineffective. As described in the WSS proposal, the wind fence would be installed on the downwind edge of the Oceano Dunes SVRA. Thus, the vast majority of emissive surfaces within Oceano Dunes SVRA would experience no change in surface wind speed or shearing stress and, thus, no change in particulate dust emissions. Table 3-8 summarizes the main implementing actions related to evaluating other possible dust control measures.

Table 3-8. Other Possible Dust Control Measures

Implementing Action, Task, and/or Requirement	*2020 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2021 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
WeatherSolve Fence					X	NA

3.2 Expected Outcomes, Effectiveness, and Potential Emissions Reductions

The proposed dust control measures identified in Section 3.1 are intended to reduce dust emissions downwind of Oceano Dunes SVRA. The estimated emission reductions and effectiveness of the dust control measures on downwind PM_{10} concentrations, based on air quality modeling conducted by DRI, are discussed in greater detail in this section.

It is important to note the information below is based on the DRI model results as presented in the May 2020 Oceano Dunes, Emission, Dispersion, an Attribution Model Results and Treatment Assessment (Attachment 3).

3.2.1 Installation of a Vegetated Foredune

The DRI model estimates the installation of the approximately 48-acre foredune would equate to reductions of approximately 4.0 metric tons per day for the baseline 10 highest modeled emission days. This is compared to the estimated reduction of 9.2 metric tons for the foredune described in the 2019 ARWP. The projected reduction of 4.0 metric tons equates to a 2% reduction in PM_{10} mass emissions.

Although this modeled outcome is small, the SAG stresses that, as with any modelling approach, there are notable simplifications particularly related to the parameterization of aerodynamic roughness, incorporation of local upper air data, and estimation of shear stress within and downwind of the foredune zone that generate appreciable uncertainty in the mass emission estimates. The CFD modelling discussed in Section 3.1.7 and planned field measurements in Section 3.2.3 are designed to improve our understanding and modelling of mass emissions related to the foredune restoration treatment.

3.2.2 Preliminary Estimate of Progress to be Gained

As described in Section 3.1.5, since the exact locations of the new dust control measures are not final, it is premature to estimate the outcomes, progress to be achieved, and potential emissions reductions associated with 2020 work plan activities. The locations of the 90 acres of dust control measures will be selected in consultation with the SAG and modeled to determine their effectiveness by November 16, 2020.

Although complete emission reduction estimates cannot be provided at this time, DRI has preliminarily prepared a model-predicted estimate of the potential emissions reductions that may be achieved from a 40-acre dust control project located upwind of Mesa2 and east of Sand Highway.

The source attribution map for Mesa2 using the 2013 PI-SWERL data ($1/r^2$, 5 nearest neighbor extrapolation method), meteorology of the 2013 10 baseline days, and the DRI model is shown in Figure 3-1. Using this information, a 40-acre rectangular-shaped dust control area was evaluated for its potential to affect modeled PM_{10} concentration at Mesa2, assuming zero emissions (i.e., 100% control effectiveness) within the 40-acre dust control treatment area, which was placed in area considered be a high source attribution for Mesa2 (see Figure 3-2). The effect of the dust controls in place as of spring 2020 (assuming 100% effectiveness) and the addition of the 40 acres shown in Figure 3-2 on the modeled PM_{10} concentration for Mesa2 for the 10 baseline days is shown in Table 3-9. Based on the model results, these 40 acres would reduce the PM_{10} at Mesa2 under the conditions described above (2013 PI-SWERL data and 2013 10 baseline days) by 10%.

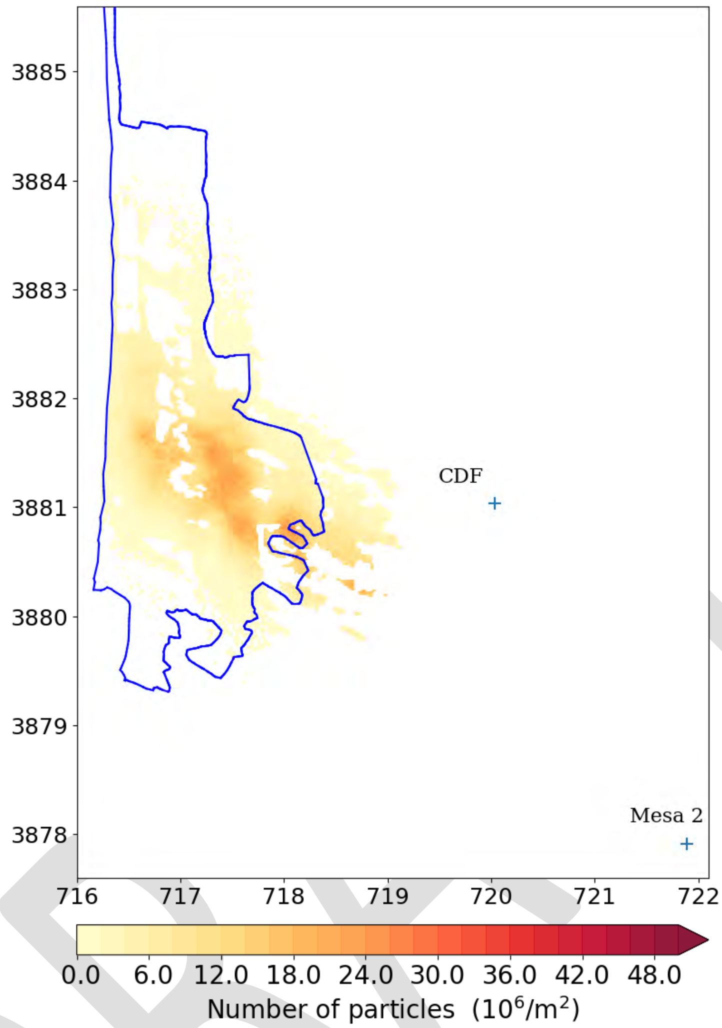


Figure 3-1. Source attribution map for Mesa2 based on the 2013 PI-SWERL data ($1/r^2$, 5 nearest neighbor extrapolation method), meteorology of the 2013 10 baseline days, and the DRI model.

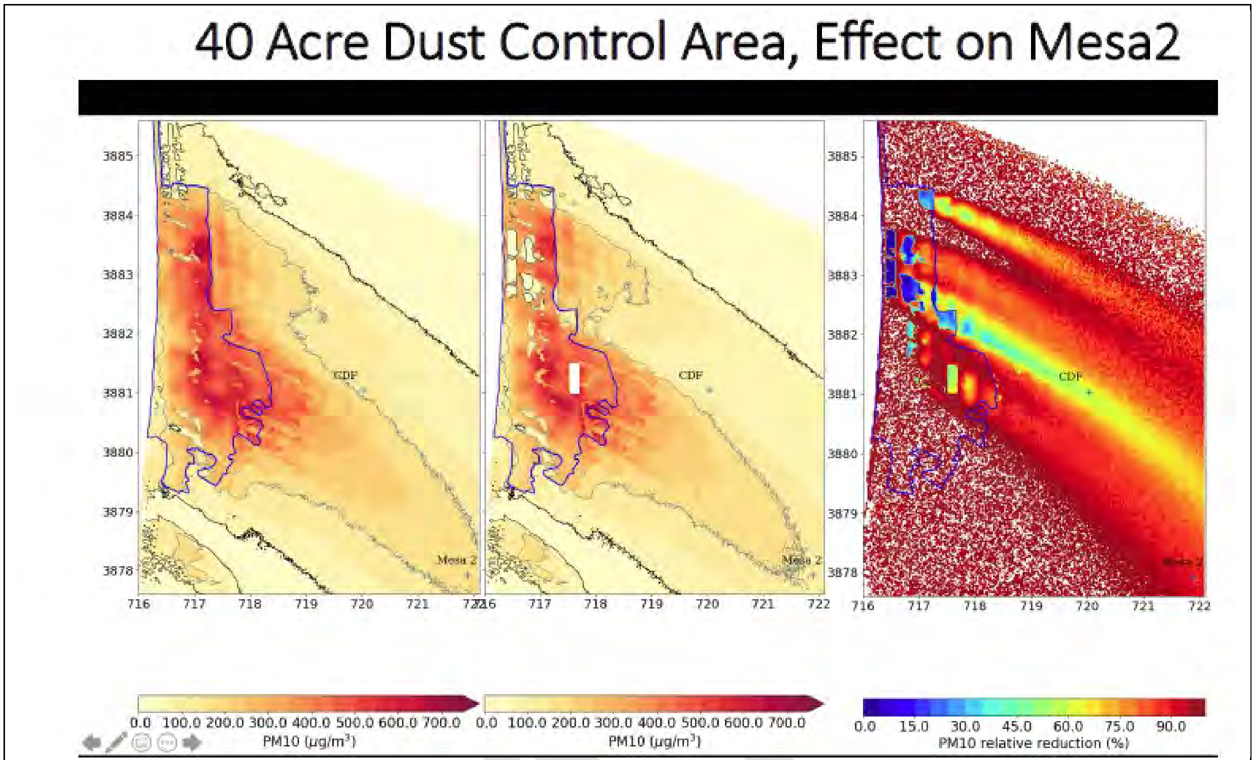


Figure 3-2. The proposed 40 acres of dust control (white rectangle in middle panel) and the downwind effect of reduction on PM_{10} concentration at Mesa2 (right panel) expressed as a percent change.

Table 3-9. Effect on the modeled PM_{10} concentration for Mesa2 with spring 2020 dust controls in place (assuming 100% effectiveness), and with the addition of the 40 acres shown in Figure 3-2

10 Highest Emission Days	PM_{10} (µg m^{-3})	% Remaining After Controls Emplaced
Observations	95	100
Modeled	157	100
Spring 2020 controls in place, 100% effective	149	95
Additional 40 acres added, 100% effective	141	90

The location of the additional 50 acres of new dust control measures described in this 2020 ARWP will be determined using the source attribution model data (see Figure 3-1), the modeled effect of the placements on downwind PM_{10} using the same methods as described for the 40 acre plot (see Figure 3-2), and consideration of Oceano Dunes SVRA operational issues and public safety.

3.2.3 Planned Field Measurements

Digital Elevation Modeling

Digital elevation models (DEMs), or three-dimensional topographic maps, will be constructed from UAS imagery of the site using 'Structure-from-Motion' processing by the ASU team. UAS flights will occur at least twice a year bracketing the nesting season of endangered bird species. Repeat imagery and DEMs will then be used to detect significant changes in surface elevation (sand volume), sand transport pathways, beach and dune geomorphology, and vegetation cover. Spatial-temporal statistics can then be used to detect and quantify areas (and volumes) of statistically significant change, as shown in Figure 3-3. These maps and related imagery, coupled with data from the on-ground meteorological and sand transport stations, will be used to: i) detect and quantify sand volumetric and dune morphology changes, ii) assess the relations between OHV activity, sand transport, morphological changes, and dust emissions, iii) monitor vegetation re-establishment, and, iv) quantify the effectiveness of the foredune restoration treatments.

Further details on the rationale and specifics of the ASU UAS-based DEM modeling is provided in Attachment 5.

As done previously, CDPR, DRI, and SAG will evaluate the effectiveness of proposed dust control measures in the field through a combination of PI-SWIRL, sand flux, and PM_{10} monitoring equipment and associated measurements.

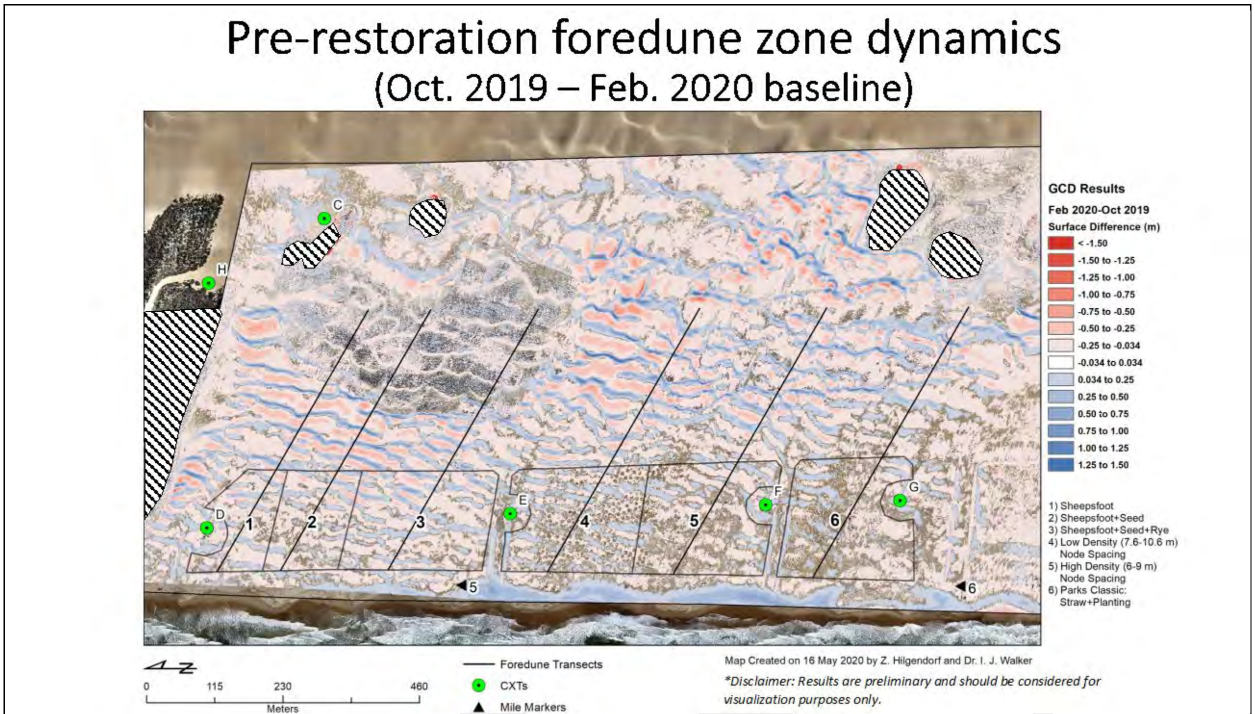


Figure 3-3. Geomorphic change detection map derived using spatial-temporal statistics to detect significant areas of sediment erosion (red) and deposition (blue) in the proximity of the foredune restoration site. This map is derived from UAS-based DEMs captured prior to restoration treatments (October 2019, February 2020) and, thus, provides baseline conditions of sediment transport and dune dynamics before foredune re-establishment.

Sand Flux and PM_{10} Measurements

In 2020-21, the OHMVR Division will continue to plan and evaluate the effectiveness of dust control measures in the field through a combination of sand flux (BSNEs) and PM_{10} monitoring equipment (Ambient Particulate Profilers, E-BAMs, and BAMs). The OHMVR Division anticipates the amount, location, and duration of this monitoring will be similar to the monitoring conducted for the 2019-20 ARWP (see Exhibit 6 in the 2019-20 ARWP), but adjusted to capture the 90 acres of dust control measures proposed in this 2020-21 ARWP. The OHMVR Division will coordinate and consult with the SAG on the final type, amount, location, and duration of monitoring necessary to support this 2020-21 ARWP.

PM_{10} Emissivity Measurements – PI-SWERL

In 2020, PI-SWERL (Etyemezian et al., 2007, 2014) has been used to measure surface emissivity (mg m^{-2} s^{-1}) of PM_{10} within the riding area in May 2020 to provide data to evaluate changes in emissivity across the Oceano Dunes SVRA for riding and non-riding areas and through time. Due to unsuitable environmental conditions and constraints on access due to Plover breeding activities, the measurements were curtailed and stopped in May 2020. DRI plans to complete the PI-SWERL measurements for the Oceano Dunes SVRA and the foredune restoration area when conditions are suitable. Unfortunately, this will be outside of the time period (May) that represents the windy season when dust emissions are expected. This will affect the continuity of measurements making comparisons between years more uncertain due to the different time frames of measurement.

DRI is also planning to carry out PI-SWERL measurements in 2021. This will be either a repeat of the complete 2019 sampling grid or another sampling of a sub-set of the 2019 grid.

3.3 Sensitivity Analysis / Projection of Additional Controls Necessary to Achieve a 50% Reduction in Maximum Baseline Emissions

During 2019 and the first half of 2020, several significant data collection campaigns were undertaken to update the DRI model. DRI developed an updated emission grid based on the recently collected data. DRI also developed an interpolation scheme different from the 2018-CARB method and expanded measurement and input parameters of meteorological data from CALMET. As a result of these modeling updates, different outcomes relative to progress toward SOA goals were produced as compared to those results previously reported throughout this SOA process. A report on this process is included as Attachment 3 to this report. Refer also to Attachment 10 for information on potential sources of discrepancy between the modeling conducted by DRI for the ARWP and previous modeling conducted by CARB using the 2013 emissivity conditions.

Utilizing the newly updated modeling tool, DRI evaluated the effectiveness of dust treatments implemented thus far under the SOA and examined effectiveness of possible future treatments. Following are excerpts from the DRI report on this subject:

- *DRI's emission modeling suggests that reduction in emissions is a linear relation between area under control and emission reductions, i.e., a 1% reduction in emissive area under control lowers mass emission by 1%.*

- *The expected benefit of targeting "hot spots" as identified initially in the CARB modeling has not resulted in "extra" emission reduction, because that "map" over-emphasized the presence of high emission areas.*
- *Either modeling method indicates that the scale of control required to meet the 50% mass emission reduction of the SOA is considerable, and a challenge both from an engineering and Park operations perspective, as well as an ecological/dune dynamics perspective.*
- *This emissions "accounting" method does not take into account any secondary effects that the control measures (e.g., foredune) may have on erosion, emissions, and transport.*

Discussions between the SAG, DRI staff and CDPR staff on this topic included discussions around possible alternatives to the existing SOA goals that appear unachievable. All parties will continue coordination on possible SOA Goal Alternatives, noting that the foremost goal is to achieve reductions in PM_{10} concentrations toward attaining state and federal air quality standards while minimizing impacts to public recreation opportunities.

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4 BUDGETARY CONSIDERATIONS

The OHMVR Division's estimated budget to develop and implement the 2020/2021 dust control actions described in Chapter 3 is $2,642,230. A detailed breakdown of this estimated budget is provided in Table 4-1. This budget roughly covers all activities from July 1, 2020 through June 30, 2021 including existing contracts with SAG members.

Table 4-1. Estimated 2020 Work Plan Budget

Dust Control Activity	**3rd Party Contract Costs**	**Other Costs**	**Total Costs**
Vegetation Plantings (Conversion of Wind Fencing, Foredune, and Supplemental Plantings)			
Support Services	$343,000	$0	$343,000
Labor	$257,000	$104,000	$361,000
Materials	$0	$95,000	$95,000
Equipment	$97,000	$125,000	$222,000
Greenhouse Facilities	$150,000	$0	$150,000
Subtotals	*$847,000*	*$324,000*	*$1,171,000*
Maintenance and Installation of Wind Fencing			
Labor	$156,000	$18,000	$174,000
Materials	$0	$50,000	$50,000
Equipment	$100,000	$0	$100,000
Subtotals	*$256,000*	*$68,000*	*$324,000*
Monitoring (Sand Flux, Air Quality, Meteorological, and Other Monitoring) &Modeling			
Instrument Operations	$229,000	$29,000	$258,000
Data Analysis	$300,000	$0	$300,000
Subtotals	*$529,000*	*$29,000*	*$558,000*
Dust Control Project Design and Technical Assistance			
Scientific Expertise	$368,000	$0	$368,000
Subtotals	*$368,000*	*$0*	*$368,000*
Other Items of Expense			
Miscellaneous	$221,230	$0	$221,230
Subtotals	*$221,230*	*$0*	*$221,230*
TOTAL COSTS	**$2,221,230**	**$421,000**	**$2,642,230**

Note: Cost estimate does not include permanent CDPR staff positions assigned to these duties but does include seasonal staff time and overtime for permanent staff.

The approximately $2.64 million budget shown in Table 4-1 is similar to the costs the OHMVR Division incurred from summer 2019 to July 31, 2020.

5 IMPLEMENTATION SCHEDULE

The tables below present schedules for implementing the dust control activities identified in Chapter 3 over the August 1, 2020 to July 31, 2021 time period.

Table 5-1. Supplemental Foredune Planting

Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2020/2021 Implementation Schedule*											
			Aug ‘ 20	*Sep ‘ 20*	*Oct ‘ 20*	*Nov’ 20*	*Dec ‘ 20*	*Jan ‘ 21*	*Feb ‘ 21*	*Mar’ 21*	*Apr ‘ 21*	*May’ 21*	*Jun ‘ 21*	*Jul ‘ 21*
Native seed collection and native plant cultivation/procurement	May ‘20	Oct ‘20	[in progress]	[in progress]	[in progress]	[complete]								
Monitoring activities	May ’20	Dec ‘23	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]
UAS campaign (DEM)	Oct ‘20	May ‘21			[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]	[in progress]		

Table Key:

[start]	Action start.
[in progress]	Action in progress.
[complete]	Action complete.

Table 5-2. Remaining Initial SOA Wind Fence Areas - Conversion to Native Dune Vegetation

Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2020/2021 Implementation Schedule*											
			Aug ‘ 20	*Sep ‘ 20*	*Oct ‘ 20*	*Nov’ 20*	*Dec ‘ 20*	*Jan ‘ 21*	*Feb ‘ 21*	*Mar’ 21*	*Apr ‘ 21*	*May’ 21*	*Jun ‘ 21*	*Jul ‘ 21*
Native seed collection and native plant cultivation/procurement	May ‘20	Oct ‘20	[in progress]	[in progress]	[in progress]	[complete]								
Wind fence removal	Sep’ 20	Sep’ 20			[complete]									
Straw bales/mulch	Oct ‘20	Nov ‘20			[start]	[in progress]	[complete]							
Vegetation planting	Dec ‘20	Jan ‘21					[start]	[complete]						

Table Key:

[start]	Action start.
[in progress]	Action in progress.
[complete]	Action complete.

Table 5-3. Amended SOA 4.2-acre Permanent Dust Treatment – Planting Vegetation														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2020/2021 Implementation Schedule*											
			Aug ' 20	*Sep ' 20*	*Oct ' 20*	*Nov' 20*	*Dec ' 20*	*Jan ' 21*	*Feb ' 21*	*Mar' 21*	*Apr ' 21*	*May' 21*	*Jun ' 21*	*Jul ' 21*
Native seed collection and native plant cultivation/procurement	May '20	Oct '20												
Vegetation planting	Dec '20	Jan '21												

Table Key:	
	Action start.
	Action in progress.
	Action complete.

Table 5-4. Maintenance of Seasonal Wind Fencing														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2020/2021 Implementation Schedule*											
			Aug ' 20	*Sep ' 20*	*Oct ' 20*	*Nov' 20*	*Dec ' 20*	*Jan ' 21*	*Feb ' 21*	*Mar' 21*	*Apr ' 21*	*May' 21*	*Jun ' 21*	*Jul ' 21*
Replace posts, fencing materials, and fence rows as needed	Feb '21	Mar '21												

Table Key:	
	Action start.
	Action in progress.
	Action complete.

Table 5-5. Install 90 Acres of New Dust Control Measures

Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2020/2021 Implementation Schedule*											
			Aug ‘20	*Sep ‘20*	*Oct ‘20*	*Nov’20*	*Dec ‘20*	*Jan ‘21*	*Feb ‘21*	*Mar’21*	*Apr ‘21*	*May’21*	*Jun ‘21*	*Jul ‘21*
SAG consultation to determine locations	Aug ‘20	Oct ‘20	Start	In progress	In progress	Complete								
California Coastal Commission approval	Nov ‘20	Dec ‘20				Start	In progress	In progress	Complete					
Perimeter fence install	Mar ‘21	Mar ‘21							Start	Complete				
Temporary vehicle exclosure	Mar ‘21	Apr‘21								Start	Complete			
Wind fence installation	Mar ‘21	Apr ‘21								Start	Complete			
Straw bales/mulch	Mar ‘21	Apr ‘21								Start	Complete			

Table Key:

(green)	Action start.
(blue)	Action in progress.
(pink)	Action complete.

Table 5-6. SAG Consultation and Evaluation

Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2020/2021 Implementation Schedule*											
			Aug ‘20	*Sep ‘20*	*Oct ‘20*	*Nov’20*	*Dec ‘20*	*Jan ‘21*	*Feb ‘21*	*Mar’21*	*Apr ‘21*	*May’21*	*Jun ‘21*	*Jul ‘21*
Monthly SAG phone meetings as needed	May ‘20	Jul ‘21	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress
SAG full-day meetings	May ‘20	Jul ‘21	In progress			In progress			In progress			In progress		
Prepare an outline 2021 Work Plan	Mar ‘21	May ‘21								Start	In progress	Complete		
SAG feedback on outline 2021 Work Plan	Jun ‘21	Jun ‘21											Complete	
Prepare full 2021 Work Plan	Jun ‘21	Jul ‘21											In progress	Complete
Consult on Public Education Campaign	Sep `21	Jul `21		Start	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress	In progress

Table Key:

(green)	Action start.
(blue)	Action in progress.
(pink)	Action complete.

Table 5-7. 2020/2021 Continued monitoring and modeling activities

Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2020/2021 Implementation Schedule*											
			Aug' 20	*Sep ' 20*	*Oct ' 20*	*Nov' 20*	*Dec ' 20*	*Jan ' 21*	*Feb ' 21*	*Mar' 21*	*Apr ' 21*	*May, 21*	*Jun ' 21*	*Jul ' 21*
Meteorological and PM data acquisition	Aug-20	Dec-23												
PI-SWERL measurements	May-19	Jun-23												
PI-SWERL analyses	Jul-19	Oct-23												
Updated modeling	Dec-19	Mar-23												
Compare model predictions with PM data measurements	Dec-19	Mar-23												
Improve DRI model performance	Jun-19	Dec-23												

Table Key:

	Action start.
	Action in progress.
	Action complete.

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Oceano Dunes SVRA Dust Control Program

2020 Annual Report and Work Plan

EXHIBITS

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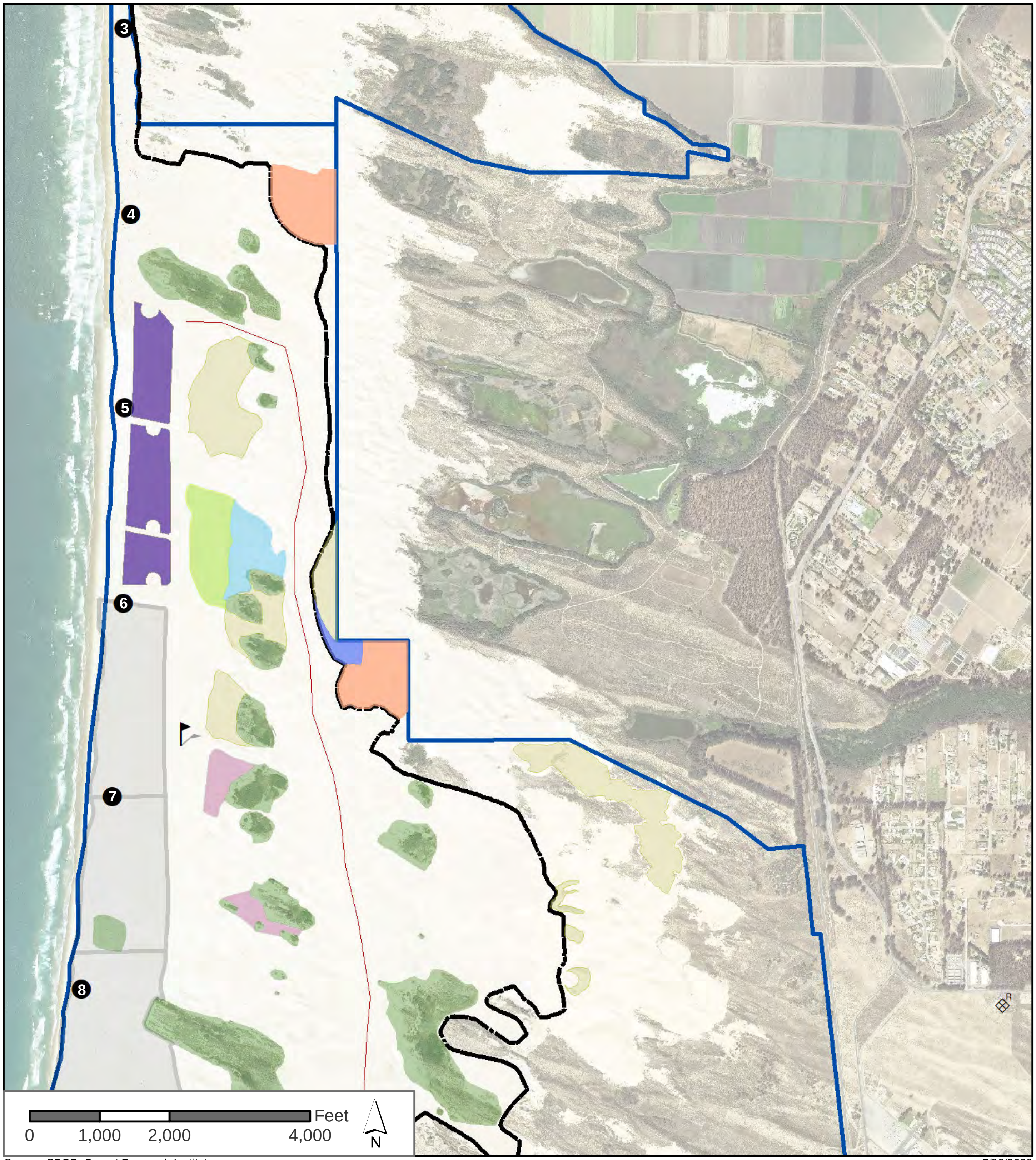
Exhibit 1



Source: CDPR, Desert Research Institute

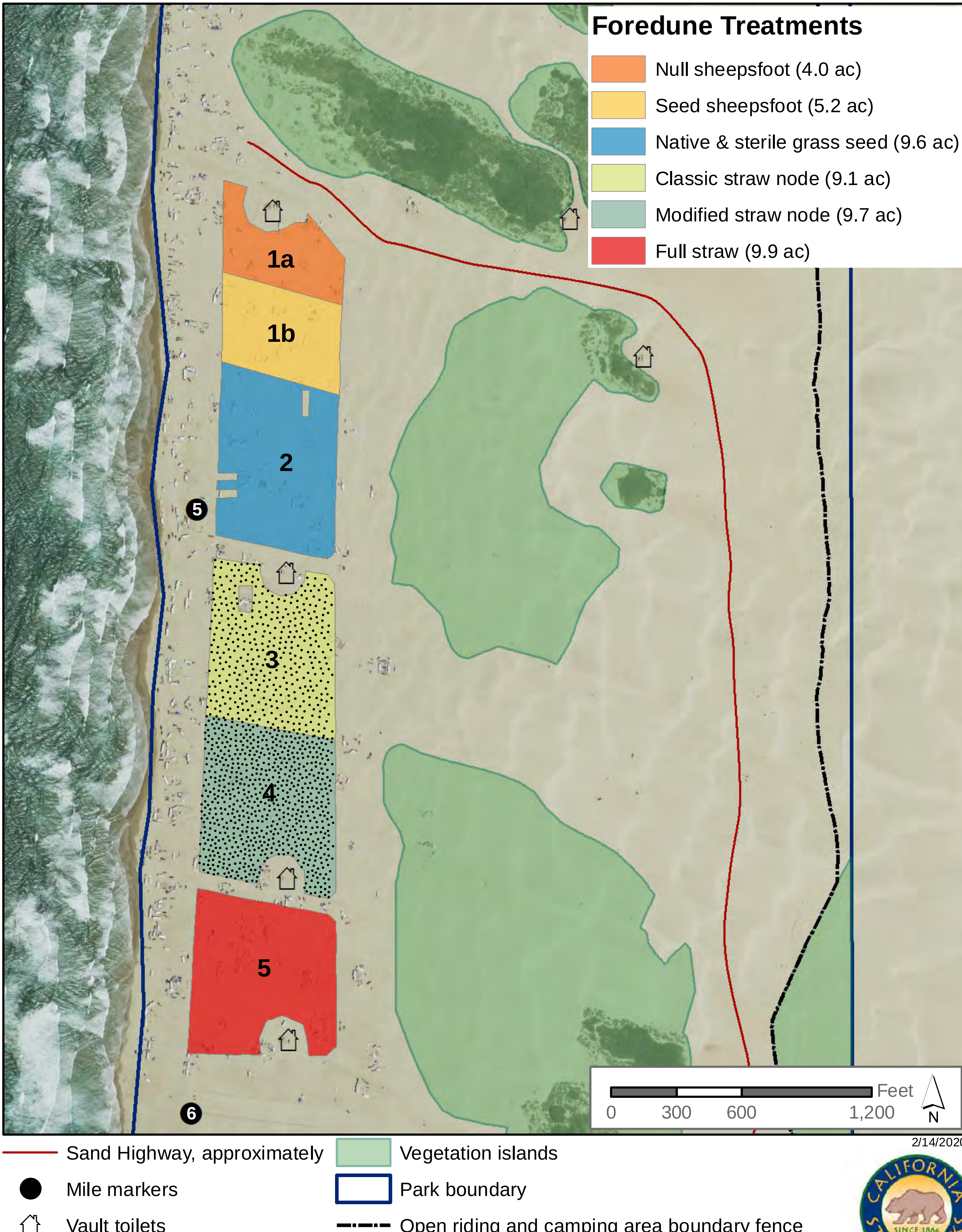
7/23/2020

- Vegetated Foredune (2019-VG-01)
- 4.2 Acre Additional Backdune treatment (2019-SB-01)
- Wind Fencing Conversion to Straw Bales (2019-SB-02)
- Wind Fencing Conversion to Vegetation (2019-VG-02)
- Seasonal Wind Fencing Projects (2019-WF-01 and 2019-WF-02)
- Wind Fencing Maintenance Projects
- Prior Vegetation Projects
- Existing fenced vegetation islands (186 acres)
- Open riding and camping area boundary fence
- Sand Highway, approx.
- Marker post
- Nesting exclosure
- Park boundary
- S1 wind tower

SOA Dust Control Treatment Areas

Oceano Dunes SVRA 2020

Exhibit 2



2020 Dust Control Project

Oceano Dunes SVRA Amended Stipulated Order of Abatement Treatment Area

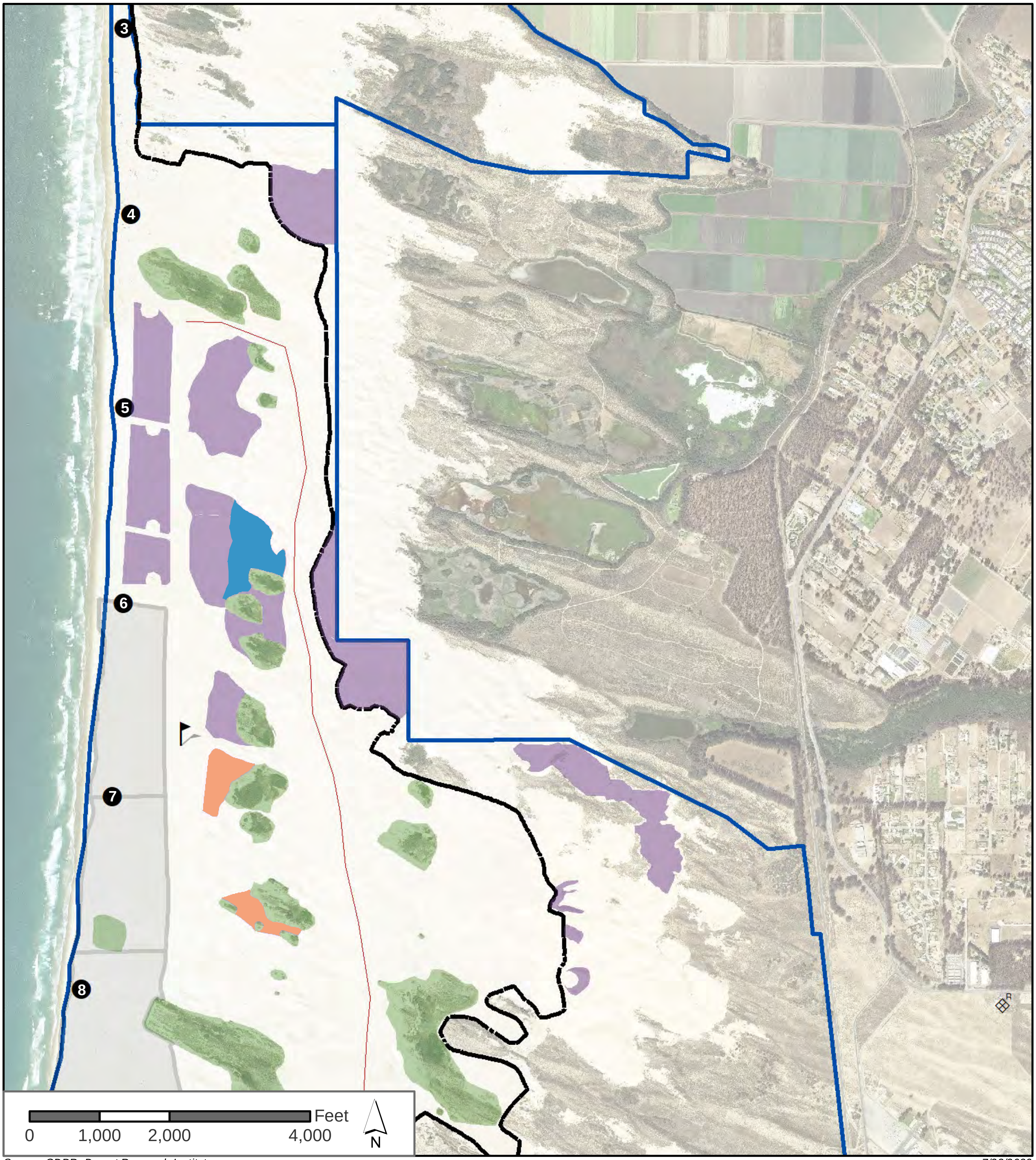
Exhibit 3A: 2019/20 Foredune Restoration Project Plant and Seed Totals

Foredune 48 Acre Project Totals													
Treatment	**Foredune-pioneer species**				**Subtotal**	**Foredune succession species**						**Subtotal**	**Total**
Scientific Name	*Abronia latifolia*	*Abronia maritima*	*Ambrosia chamissonis*	*Atriplex leucophylla*		*Achillea millefolium*	*Camissoniopsis cheiranthifolia*	*Eriogonum parvifolium*	*Eriophyllum staechadifolium*	*Malacothrix incana*	*Fragaria chiloensis*		
Common Name	**Yellow sand verbena**	**Sticky sand verbena**	**Beach bur**	**Sea scale**	**4 Species**	**Common yarrow**	**Beach evening-primrose**	**Coastal buckwheat**	**Seaside golden yarrow**	**Dunedelion**	**Beach strawberry**	**6 Species**	**10 species**
Total Plant Count	114	157	5,964	231	**6,466**	1,978	4,240	686	10,231	4,137	33	**21,305**	**27,771**
Total Seed (lb)	2.41	110.27	155.15	0.57	**268.39**	0.00	0.47	10.70	16.25	0.21	-	**27.63**	**296.03**
1	**Sheepsfoot Only (Control)**												**4.0 acres**
No Plants or Seed	-	-	-	-	-	-	-	-	-	-	-	-	-
2	**Sheepsfoot with Native Seed**												**5.2 acres**
Seed (lb)	0.49	22.39	31.49	0.12	**54.49**	0.00	0.10	2.17	3.30	0.04	-	**5.61**	**60.10**
Seed per Treated Acre	0.09	4.31	6.06	0.02	**10.48**	0.00	0.02	0.42	0.63	0.01	-	**1.08**	**11.56**
3	**Sheepsfoot with Native Seed and Sterile Grain Seed**												**9.6 acres**
Seed (lb)	0.90	41.34	58.14	0.21	**100.59**	0.00	0.18	4.01	6.09	0.08	-	**10.36**	**110.95**
Seed per Treated Acre	0.09	4.31	6.06	0.02	**10.48**	0.00	0.02	0.42	0.63	0.01	-	**1.08**	**11.56**
4	**Nodes - Low Density (46 nodes/acre)** **9 plants and native seed within 1 sq meter of each node. 12 ft radius nodes covered in straw. Total area straw coverage=47%**												**9.1 acres**
Plants per Node	0.05	0.10	2.17	0.17	**2.49**	1.02	1.28	0.17	2.96	1.28	-	**6.71**	**9**
Total Plants	22	43	916	72	**1,053**	432	540	72	1253	540	-	**2,837**	**3,890**
Plants per Acre (9.1 acres)	2.46	4.73	100.66	7.91	**116**	47.47	59.34	7.91	137.69	59.34	-	**312**	**428**
Total Seed (lb)	0.03	1.42	2.04	0.01	**3.50**	0.00	0.01	0.14	0.21	0.00	-	**0.36**	**3.87**
Seed per Treated Acre	0.10	4.38	6.16	0.02	**10.66**	0.00	0.02	0.42	0.65	0.01	-	**1.10**	**11.76**
5	**Nodes - High Density (75 nodes/acre)** **9 plants and native seed within 1 sq meter of each node. 12 ft radius nodes covered in straw. Total area straw coverage=74%**												**9.7 acres**
Plants per node	0.05	0.10	2.15	0.17	**2.47**	1.02	1.27	0.17	2.94	1.27	-	**6.67**	**9**
Total Plants	37	74	1573	124	**1,808**	742	928	124	2152	928	-	**4,874**	**6,682**
Plants per Acre (over 9.7 acres)	3.81	7.63	162.16	12.78	**186**	76.49	95.67	12.78	221.86	95.67	-	**502**	**689**
Total Seed (lb)	0.05	2.49	3.51	0.01	**6.07**	0.00	0.01	0.24	0.37	0.01	-	**0.63**	**6.69**
Seed per Treated acre	0.01	4.38	6.16	0.02	**10.57**	0.00	0.02	0.42	0.65	0.01	-	**1.10**	**11.67**
6	**Park Treatment** **Plants, native seed, sterile grain seed, straw.**												**9.9 acres**
Total Plants	55	40	3,475	35	**3,605**	804	2,772	490	6,826	2,669	33	**13,594**	**17,199**
Plants per Acre (9.9 acres)	5.56	4.04	351.01	3.54	**364**	81.21	280.00	49.49	689.49	269.60	3.33	**1,373**	**1,737**
Total Seed (lb)	0.93	42.63	59.96	0.22	**103.74**	0.00	0.18	4.14	6.28	0.08	-	**10.68**	**114.42**
Seed per Acre	0.09	4.31	6.06	0.02	**10.48**	0.00	0.02	0.42	0.63	0.01	-	**1.08**	**11.56**

Exhibit 3B: 2019/20 Foredune Treatment Summary

Site	Treatment Summary																
	Total Area (acre)	Treated Area Straw (acres)	Treated Area Planting/ Seeding (acres)	Wind Fence Area (Acres)	Total Native Plant Count	Nodes	Plants per acre	Plants per Treated Acre	Native Seed Weight (g)	Native Seed (g) per acre	Native Seed Weight (lb)	Native Seed (lb) per acre	Fertilizer 15-15-15 (lb)	Fertilizer 15-15-15 (lb) per acre	Sterile Triticale (lb)	Sterile Triticale (lb) per acre	Straw Bales (small bale equivalent)
48 Acre Foredune (Area 1a - Control)	4.4	0	0.00		0		0.00	0.00		0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
48 Acre Foredune (Area 1b - Native Seed)	5.2	0	5.20		0		0.00	0.00	25,683	4,939	56.6	10.9	250.0	48.1	0.0	0.0	0.0
48 Acre Foredune (Area 2 - Native Seed & Triticale)	9.1	9.6	9.60		0		0.00	0.00	47,416	4,939	104.5	10.9	500.0	52.1	500.0	52.1	0.0
48 Acre Foredune (Area 3 - LD Nodes)	9.7	4.39	0.33		3,906	434	419	11,909	1,666	179	3.7	0.4	14.0	1.5	0.0	0.0	426.0
48 Acre Foredune (Area 4 - HD Nodes)	9.7	7.15	0.57		6,153	684	637	10,795	2,853	295	6.3	0.7	29.4	3.0	0.0	0.0	581.3
48 Acre Foredune (Area 5 - Parks Classic)	9.9	9.94	9.94		17,199		1,730	1,730	48,710	4,900	107.4	10.8	500.0	50.3	500.0	50.3	992.0

Exhibit 4



Source: CDPR, Desert Research Institute *7/23/2020*

- 15 acres of current straw mulch (Paw Print)
- 13.5 acres of current wind fence (Eucalyptus (8) and Table Top (5.5))
- Dust Control Projects
- Existing fenced vegetation islands (186 acres)
- Open riding and camping area boundary fence
- Sand Highway, approx.
- Marker post
- Nesting exclosure
- Park boundary
- S1 wind tower

CALIFORNIA STATE PARKS SINCE 1864 OHV

28.5/48.6 Acres Remain to be Vegetated of Wind Fence Installed Summer 2018

Oceano Dunes SVRA 2020

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