
**Oceano Dunes State Vehicular Recreation Area
Dust Control Program**

Provisional Final 2026 Annual Report and Work Plan

October 7, 2026



**State of California
Department of Parks and Recreation**

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Oceano Dunes State Vehicular Recreation Area Dust Control Program Provisional Final 2026 Annual Report and Work Plan

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2026 Annual Report and Work Plan Attachments (Separate Documents)

Attachment 01: 2011 to 2026 Dust Control Projects

Attachment 02: 2025/2026 ODSVRA Dust Control Program Vegetation Restoration Projects
(State Parks' ARWP Work Product)

Attachment 03: Report of Findings: ODSVRA Meteorological and PM₁₀ Monitoring Network, 2025

- Report of Findings: ODSVRA Meteorological and PM₁₀ Monitoring Network, 2025 (DRI Document)
- SAG Review of Desert Research Institute (DRI) "Report of Findings: ODSVRA Meteorological and PM₁₀ Monitoring Network, 2025" (SAG Memo)

Attachment 04: ODSVRA PI-SWERL Emissivity Update Report (2025) (SAG Memo)

Attachment 05: UCSB 2025-2026 ODSVRA Foredune Restoration UAS Monitoring Report

- UCSB 2025-2026 ODSVRA Foredune Restoration UAS Monitoring Report
- SAG Review of UCSB Report "2025-2026 ODSVRA Foredune Restoration UAS Monitoring Report" (SAG Memo)

Attachment 06: Summary of Vegetation Monitoring of Restoration Sites at ODSVRA (2025)
(State Parks' ARWP Work Product)

Attachment 07: Increments of Progress Toward Air Quality Objectives, ODSVRA Dust Control 2025 Update

- Increments of Progress Toward Air Quality Objectives, ODSVRA Dust Control 2025 Update (DRI Document)
- SAG Review of DRI Report "Increments of Progress Toward Air Quality Objectives - ODSVRA Dust Controls 2025 Update" (SAG Memo)

Attachment 08: Information Related to Parameterizing Vegetative Grid Cells

- Recommendations for Reconciling DRI Model Assumptions with Ground Evidence in Respect of Vegetated Grid Cells (SAG Memo)
- Incorporating Vegetation Cover into the DRI Model (SAG Memo)
- Contemplating DRI Model Refinements in Anticipation of the 2026 ARWP (SAG Memo)
- Synthetic Power Relations for Vegetation Islands (SAG Memo)
- Restoration Project Maturation Timeline (State Parks Memo)

Attachment 09: Modeling to Determine the Condition of Excess Emissions for 2026 ODSVRA (DRI Document)

Attachment 10: 2026 PMRP Evaluation Metrics

Attachment 11: 2026/2027 ODSVRA Dust Control Program Vegetation Restoration Projects

List of Abbreviations and Acronyms	
Abbreviation or Acronym	Full Phrase or Description
°	degrees
<	less than
>	greater than
≥	greater than or equal to
u^*	shear velocity
$\mu\text{g m}^{-3}$	micrograms per cubic meter
AGL	above ground level
ARWP	Annual Report and Work Plan
ASU	Arizona State University
B	beach area (used in foredune morphological change analysis)
BAM	Beta Attenuation Monitor
CAAQS	California Ambient Air Quality Standard
CARB	California Air Resources Board
CDP	Coastal Development Permit
cm	centimeter(s)
DTM	Digital Terrain Model
DRI	Desert Research Institute
FAQ	Frequently Asked Questions
FD	foredune area (used in foredune morphological change analysis)
FL	foredune lee (used in foredune morphological change analysis)
FRA	Foredune Restoration Area
$\text{g m}^{-2} \text{d}^{-1}$	grams per square meter per day
GSD	ground sampling distance
kg m^{-3}	kilograms per cubic meter
km	kilometer(s)
LD	landward dune (used in foredune morphological change analysis)
m	meter(s)
m s^{-1}	meters per second
$\text{m}^3 \text{m}^{-2}$	cubic meters per square meter
$\text{m}^3 \text{m}^{-2} \text{mo}^{-1}$	cubic meters per square meter per month
$\text{mg m}^{-2} \text{s}^{-1}$	milligrams per square meter per second
n/a	not applicable
NAAQS	National Ambient Air Quality Standard
NDP	Northern Dune Preserve
NDVI	Normalized Difference Vegetation Index

List of Abbreviations and Acronyms	
Abbreviation or Acronym	Full Phrase or Description
NFRA	Northern Foredune (meteorological and PM ₁₀ monitoring site)
NIR	near-infrared
NOF	North Oso Flaco
NRA Central	Non-Riding Area Central Zone
NRA North	Non-Riding Area North Zone
NRA South	Non-Riding Area South Zone
ODSVRA	Oceano Dunes State Vehicular Recreation Area
OHMVR Division	Off-Highway Motor Vehicle Recreation Division
OHV	off-highway vehicle
P66	Phillips 66
Pan	panchromatic
PE	Plover Exclosure
PI-SWERL	Portable In-Situ Wind Erosion Laboratory
PM ₁₀	particulate matter with an aerodynamic diameter of 10 microns or less
PMRP	Particulate Matter Reduction Plan
PST	Pacific Standard Time
QA/QC	quality assurance/quality control
RA-Central North	Riding Area Central-North Sub-Region
RA-Central South	Riding Area Central-South Sub-Region
RE	red edge
RGB	red, green, and blue
RH	relative humidity
RPA	Revegetated Project Areas
RPM	revolutions per minute
SAG	Scientific Advisory Group
SE	Seasonal Exclosure
SLOAPCD	San Luis Obispo County Air Pollution Control District
SOA	Stipulated Order of Abatement
State Parks	California Department of Parks and Recreation
SVRA	State Vehicular Recreation Area
TP	treatment plot
TPM ₁₀	Total Hourly PM ₁₀
TRI	Topographic Roughness Index
TRI m ⁻²	Topographic Roughness Index per square meter

List of Abbreviations and Acronyms	
Abbreviation or Acronym	Full Phrase or Description
TWPD	Total Wind Power Density
UAS	uncrewed aerial system
UCSB	University of California, Santa Barbara
USEPA	United States Environmental Protection Agency
Vis	Vegetation Islands
W m ⁻²	Watts per square meter
WPD	wind power density

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1 INTRODUCTION

The California Department of Parks and Recreation (State Parks) has prepared this 2026 Annual Report and Work Plan (ARWP) for the Oceano Dunes State Vehicular Recreation Area (ODSVRA) Dust Control Program to comply with 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, October 2022, October 2024, and October 2025.¹

State Parks' 2026 ARWP is the eighth document summarizing the status and overall progress of the ODSVRA Dust Control Program in meeting SOA requirements.^{2,3} Each ARWP has applied the best available scientific methods, involving both field data collection and air quality modeling, to prioritize and control emissions of particulate matter with an aerodynamic diameter of 10 microns or less (PM₁₀) from the ODSVRA. Each ARWP has also been prepared in coordination with the SOA Scientific Advisory Group (SAG) and in accordance with SOA requirements; however, the SOA's requirements have changed over time and, accordingly, the contents and information presented in each ARWP have changed over time as well.⁴ Currently, the SOA requires the ODSVRA Dust Control Program to eliminate emissions in excess of naturally occurring emissions from the ODSVRA that contribute to downwind violations of the state and federal PM₁₀ air quality standards. As described in more detail in this 2026 ARWP, State Parks has made substantial progress in reducing PM₁₀ emissions, and modeling conducted in accordance with SOA requirements shows the ODSVRA is not in a condition of excess emissions as of July 31, 2026, and is not predicted to be in a condition of excess emissions on July 31, 2027.

The SOA, as amended, generally requires State Parks' ARWP to include a review of dust control progress made over the previous year, a work plan and estimates of progress anticipated to be made for the coming year, and summary budget and schedule information.⁵ Accordingly, this

¹ The SOA, as amended, is available on the following SLOAPCD website:

<https://www.slocleanair.org/who/board/hearing-board/actions.php>.

² State Parks' 2023 to 2025 ARWP documents are available on the following SLOAPCD website:

<https://www.slocleanair.org/air-quality/oceano-dunes-efforts>.

³ State Parks' 2019 to 2022 ARWP documents are available on the following SLOAPCD website:

<https://www.slocleanair.org/air-quality/oceano-dunes-efforts/oceano-dunes-archive.php>.

⁴ State Parks' 2024 ARWP provides a succinct discussion of how ARWP information has changed over time. The October 2025 amendments, which were made after State Parks' 2025 ARWP was submitted to, and conditionally approved by, the SLOAPCD, did not materially change ARWP content or information requirements, but did add a requirement for State Parks to specifically report on meteorological and PM₁₀ monitoring at the Northern Foredune Restoration Monitor. This reporting is included in Section 2.2.1.1 of this 2026 ARWP.

⁵ The specific content to be included in the ARWP and the SAG and SLOAPCD processes for reviewing and approving the ARWP are described in the original 2018 SOA, specifically, conditions 4 and 5, as modified by the 2019 SOA amendments (modifications 7 and 8); 2022 SOA amendments (modification 6); 2024 SOA amendments (modification 3); and 2025 SOA amendments (modification 4).

2026 ARWP is organized as follows:

- **Chapter 2, Annual Report (August 1, 2025, to July 31, 2026)**, describes Dust Control Program activities implemented in the previous 12 months, including progress made toward SOA goals.
- **Chapter 3, Work Plan (August 1, 2026, to July 31, 2027)**, describes the Dust Control Program activities to be undertaken in the coming 12 months, including activities related to the excess emissions compliance framework established by the SOA.
- **Chapter 4, Budgetary Considerations**, describes the estimated budget to develop and implement the 2026/2027 Work Plan.
- **Chapter 5, Implementation Schedule**, presents schedules for the Dust Control Program activities to be initiated, undertaken, and/or completed in the coming 12 months.
- **Attachments 01 – 11** present, in their entirety, important documents that are summarized and/or referenced in this 2026 ARWP. Some of these documents have undergone the scientific review process agreed upon by State Parks and the SAG and, therefore, the SAG's review of these documents is included with this 2026 ARWP.

This 2026 ARWP has been prepared under the supervision of Ronnie Glick, Senior Environmental Scientist, and Jon O'Brien, District Superintendent, Oceano Dunes District, whom State Parks has designated as the Project Manager for the Dust Control Program pursuant to the SOA, as amended.

2 ANNUAL REPORT (AUGUST 1, 2025, TO JULY 31, 2026)

This chapter reports on Dust Control Program activities undertaken between August 1, 2025, and July 31, 2026, and the corresponding progress made toward achieving air quality objectives during this time.

As a general overview, the ODSVRA Dust Control Program is a comprehensive, multi-year, adaptive management program designed to reduce saltation and dust generation within the ODSVRA and improve air quality downwind of the ODSVRA. State Parks initiated the program in 2011 as a series of studies and pilot projects. Over time, the program has adapted to become an iterative series of dust control-related activities that are evaluated and modified as necessary to meet the evolving requirements of the SOA. Typical annual Dust Control Program activities include the following:

- **Dust control projects** are control measures that reduce or stop saltation and dust generation at the ODSVRA. These measures may be seasonal, temporary, or permanent in nature.⁶ State Parks' report on dust control projects is provided in Section 2.1. Refer to Attachment 01 for maps of dust control projects implemented at the ODSVRA each year since 2011.
 - Seasonal and temporary projects generally include wind fencing, straw bales and broadcast surface straw treatments, and use of other materials that can sometimes, but not always, be recovered and reused in subsequent dust control projects. State Parks has also excluded motor vehicles from areas (vehicle exclusion areas) and has explored, in a very limited manner in 2014, the use of soil stabilizers as a form of seasonal and/or temporary dust control at the ODSVRA.
 - Permanent dust control consists of vegetation plantings, including foredune, backdune, and supplemental planting efforts (i.e., replanting or maintaining vegetation coverage in previously planted projects).

⁶ Seasonal dust control projects are installed for a defined period, usually between approximately March 1 and October 31 of each calendar year. In contrast, temporary projects are installed indefinitely, but not permanently.

- o Two related but independent activities that provide dust control benefits are State Parks' long-term closure of the ODSVRA Western Snowy Plover and California Least Tern nesting enclosure and the seasonal closure of certain beach and transportation corridors.⁷ These closures, which protect nesting shorebirds also prohibit vehicular and non-vehicular recreation from occurring and reduce saltation and dust generation at the ODSVRA. It is noted that State Parks manages the nesting enclosure area for multiple purposes.
- **Field monitoring** collects the data identified by State Parks, the SAG, and the SLOAPCD necessary to support State Parks' adaptive management approach to dust control at the ODSVRA. Field monitoring activities vary by year to meet the specific needs of the Dust Control Program. Not all types of data are collected each year; however, field monitoring generally includes the installation, operation, and/or maintenance of ground and aerial equipment that collects data on one or more of the following: meteorological conditions, PM₁₀ concentrations, surface emissivity characteristics, foredune deposition and erosion rates, and vegetation coverage. The data that are collected are verified, evaluated, and used to improve the effectiveness of dust control projects and the performance of the air quality models used to assess Dust Control Program progress. State Parks' report on field monitoring activities is provided in Section 2.2.
- **Air quality and emissions modeling** is the method stipulated by the SOA, as amended, for evaluating compliance with the SOA's requirement "to eliminate emissions in excess of naturally occurring emissions from the ODSVRA that contribute to downwind violations of the state and federal PM₁₀ air quality standards." Modeling is also used, in part, to demonstrate progress in meeting other evaluation metrics developed by State Parks, the SAG, and the SLOAPCD. State Parks' report on modeling activities is provided in Section 2.3.
- **Track-out control** is a program required by the SOA to prevent track-out of sand onto the Grand Avenue and Pier Avenue entrances to the ODSVRA. State Parks' report on track-out control activities is provided in Section 2.3.

⁷ For the purposes of this ARWP, the terms "Western Snowy Plover and California Least Tern nesting enclosure," "nesting enclosure area," and "Plover Enclosure" or "PE" refer to the same geographic area (see Figure 2-1), with PE also being a specific zone in the excess emissions model (see Section 2.3.2). Similarly, for the purposes of this ARWP, the terms "seasonally closed foredune beach and transportation corridors area," "seasonal foredune beach and transportation corridors area," and "Seasonal Enclosure" or "SE" refer to the same general geographic area (see Figure 2-1), with SE also being a specific zone used in the excess emissions model (see Section 2.3.2).

- **Other Dust Control Program activities** include actions that State Parks, the SAG, and the SLOAPCD may undertake to support and inform the overall adaptive management approach to dust control at the ODSVRA, such as, but not limited to, SAG, SLOAPCD, or other entity preparation and/or review of independent studies. State Parks' report on other activities related to the Dust Control Program is provided in Section 2.4.

State Parks notes that while the SOA requires State Parks to report on activities implemented over the previous year by August 1, 2026, this 2026 ARWP reports on activities that were started more than one year ago (i.e., before August 1, 2025) and completed in the past year (i.e., between August 1, 2025, and July 31, 2026). It also reports on activities started in the past year that State Parks, its contractors, and/or the SAG could not complete in time for reporting in this ARWP cycle. This lag in reporting is due to the seasonal nature of data collection efforts and the time involved in processing, analyzing, interpreting, reviewing, and reporting the data collected for the Dust Control Program.

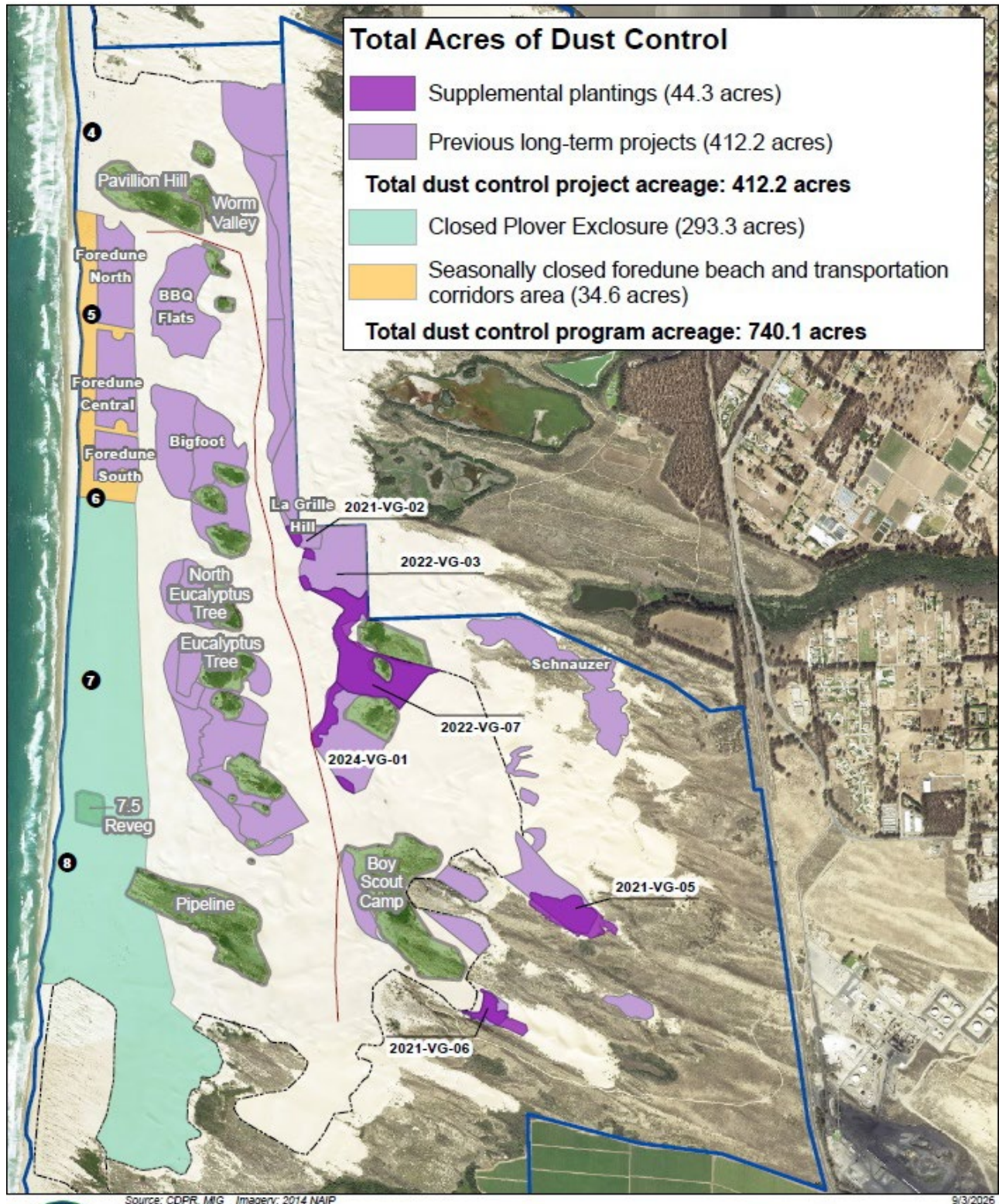
2.1 REPORT ON DUST CONTROL PROJECTS

From August 1, 2025, to July 31, 2026, State Parks completed the following dust control projects:

- **Conducted supplemental vegetation plantings.** Supplemental planting and seeding activities often focus on the west-facing portions of vegetation installations where direct wind and sand activity bury or otherwise compromise treatments. During the 2025-2026 reporting period, State Parks planted approximately 109,660 plants and spread approximately 408 pounds of native dune seed and 1,025 pounds of sterile seed over approximately 44.3 acres of previously treated areas (see Figure 2-1).⁸ One full project (2022-VG-07, 23.6 acres) and two partial project areas (2021-VG-05, 10.3 acres, and 2021-VG-06, 4.4 acres) were retreated with larger quantities of straw, native container plants, native seed, and sterile grain seed because the previous treatment included seed only and not container stock.⁹ Parts of three other project areas received supplemental seeding and plantings only (2021-VG-02, 0.7 acres, 2022-VG-03, 1.0 acres, and 2024-VG-01, 4.2 acres). Refer to Attachment 02 for information on the species list, number of seedlings planted, and pounds of seed applied for each supplemental planting project.

⁸ As recommended by the SAG, the main body of this ARWP and Attachment 01 to this ARWP report the size of dust control projects to the nearest tenth of an acre, with values rounded up (values 0.05 and above) or down (values below 0.05) to the nearest tenth of an acre as necessary.

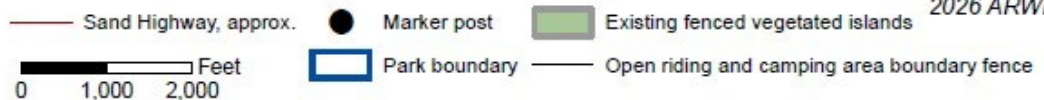
⁹ The "Project ID" shown in Figure 2-1 and Figure 2-2 identifies the year the project was undertaken, the type of project it was, and how many of the same type of project were installed in the dust control year (defined as August 1 of one year to July 31 of the next year). Projects are defined as straw treatment (ST), wind fencing (WF), temporary vehicle exclusion (TV), and vegetation (VG). For example, "2021-VG-06" is the sixth vegetation project from the 2021 dust control year.



Source: CDPH, MIG Imagery: 2014 NAIP

Figure 2-1: 2025 - 2026 Supplemental Planting Projects

2026 ARWP



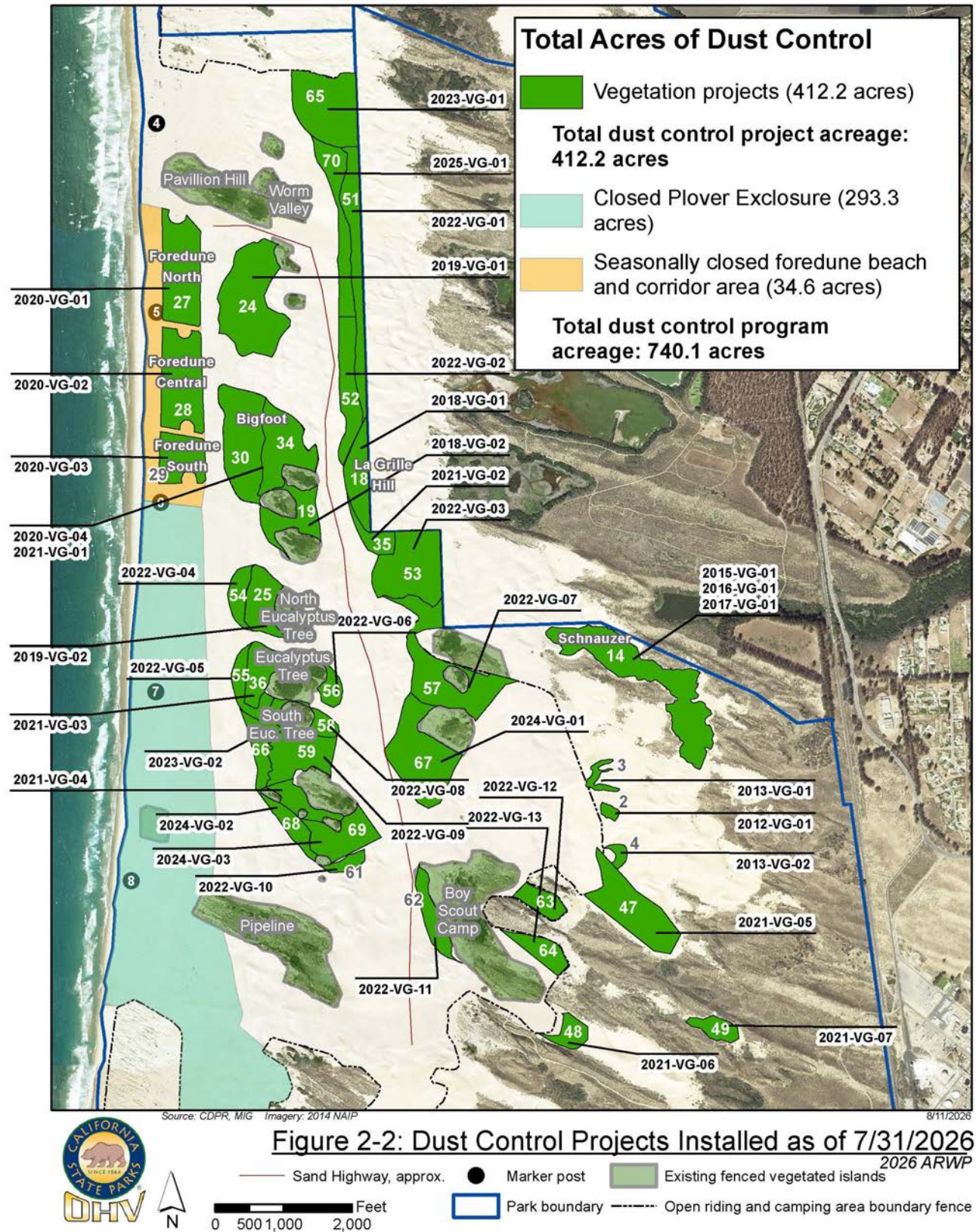
- **Seasonally closed 34.6 acres of foredune beach and transportation corridors area.** State Parks' installation of a 48-acre foredune at the end of 2019 resulted in a narrow beach area to the west of the foredune project and transportation corridors in between different foredune treatment areas, as well as a small corridor to the south of the foredune project, neighboring the Plover Enclosure (see Figure 2-1). These areas are subject to Western Snowy Plover and California Least Tern nesting activity during the breeding season. Consistent with management activities since 2020, State Parks installed seasonal fencing around these areas to protect potential nest sites. In total, State Parks seasonally closed 34.6 acres for approximately seven months from March 1, 2025, to September 30, 2025. The foredune beach and transportation corridors area was again seasonally closed on March 1, 2026, and will reopen on October 1, 2026.
- **Maintained closure of the Plover Enclosure (PE).** In October 2021, State Parks closed the approximately 300-acre PE area to vehicular and non-vehicular recreation (see Figure 2-1).¹⁰ Since then, State Parks has maintained the closed status of this area, installing and maintaining perimeter fencing as necessary.

As of July 31, 2026, State Parks actively manages and maintains 40 different dust control projects.¹¹ In total, these 40 dust control projects, plus the PE and seasonally closed foredune beach and transportation corridors area, occupy 740.1 acres of land at the ODSVRA. The ODSVRA's dust control projects are summarized in Table 2-1 and shown in Figure 2-2.

¹⁰ The decision to close this area was an operational choice that was made independently of Dust Control Program requirements. If State Parks elects to reopen this area, State Parks would, in coordination with the SAG and the SLOAPCD, simultaneously identify and implement dust control projects in other areas sufficient to offset the identified increase in emissions from the PE.

¹¹ While State Parks has implemented 70 different dust control projects over time, only 40 projects are active and in the ground as of July 31, 2026. Refer to footnote 9 for additional details on State Parks' system for identifying dust control projects implemented over time.

Table 2-1. Cumulative Dust Control Projects Installed as of July 31, 2026				
Type of Dust Control Project	Number of Projects ^(A)	Acres Controlled by Dust Control Projects		
		Inside Open Riding and Camping Area	Outside Open Riding and Camping Area	ODSVRA Total
Vegetation				
Foredune	3	48.0	0.0	48.0
Backdune	37	288.3	75.9	364.2
<i>Subtotal</i>	<i>40</i>	<i>336.3</i>	<i>75.9</i>	<i>412.2</i>
Seasonal and/or Temporary Project				
Straw treatment	0	0.0	0.0	0.0
Wind fencing	0	0.0	0.0	0.0
Temporary vehicle enclosure	0	0.0	0.0	0.0
Other ^(B)	0	0.0	0.0	0.0
<i>Subtotal</i>	<i>0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>
Other Operational Activity				
Closed Plover Exclosure	-	293.3 ^(C)	0.0	293.3 ^(C)
Seasonally closed foredune beach and transportation corridors area	-	34.6	0.0	34.6
<i>Subtotal</i>	-	<i>327.9</i>	<i>0.0</i>	<i>327.9</i>
Totals^(D)	40	664.2	75.9	740.1
(A) Value reflects the number of projects, as defined using the Dust Control Program Project ID (see footnotes 9 and 11), in the ground as of July 31, 2026, and does not consider planned activities described in Chapter 3 of this ARWP. Note the FRA was initially planned as three distinct projects and remains identified as such (see footnote 14).				
(B) “Other” refers to porous roughness elements, soil stabilizers, or other types of dust control projects.				
(C) Historically, the size of the Plover Exclosure (PE) fluctuated annually with changes in sand topography and fencing installation. The average annual size of the PE was 294 acres for the 19-year period from 2004 to 2022. For the purposes of the ODSVRA Dust Control Program, the size of the PE is consistently reported as 293.3 acres, which was the size of the PE when the dust control benefit was first credited to this area.				
(D) Without the closed PE and seasonally closed foredune beach and transportation corridors area, there are 336.3 acres of dust control inside the open riding and camping area and 412.2 total acres of dust control at the ODSVRA.				



2.2 REPORT ON FIELD MONITORING

State Parks and the SLOAPCD have collected data on the conditions that lead to dust generation at the ODSVRA for almost two decades, with more recent efforts undertaken in coordination with the SAG. State Parks' field monitoring activities support the scientific investigation and adaptive management of dust control at the ODSVRA, provide context and in-situ observations vital to assessing individual dust control project effectiveness and air quality model performance, and support the evaluation of overall Dust Control Program success. Some monitoring activities, such as data collection at State Parks' S1 meteorological tower, have been occurring near-continuously for more than a decade or are repeated annually to provide a record of the change in conditions at the ODSVRA.¹² Other monitoring activities are seasonal or temporary in nature and may address more specific data needs identified by State Parks, the SAG, and the SLOAPCD. In general, State Parks' field monitoring activities include the following:

- **Meteorological monitoring** to measure wind speed, wind direction, temperature, and humidity throughout the ODSVRA. Meteorological monitoring coupled with PM₁₀ monitoring provides important information on the dispersion characteristics of PM₁₀ through the ODSVRA.
- **PM₁₀ monitoring** to measure PM₁₀ concentrations in the air. State Parks' PM₁₀ monitoring is conducted primarily within the ODSVRA using instruments that go through rigorous installation procedures and data validation processes.¹³ The SLOAPCD also conducts PM₁₀ monitoring downwind of the ODSVRA in accordance with state and federal Clean Air Act requirements. The measurements of actual airborne PM₁₀ concentrations are used to calibrate, verify, and improve confidence in required SOA modeling methodologies. The measurement of changes in PM₁₀ concentrations over time also provides empirical evidence for Dust Control Program progress.
- **Portable In-Situ Wind Erosion Laboratory (PI-SWERL) monitoring** to measure the potential amount of PM₁₀ emissions that can be generated throughout the ODSVRA under different wind shear conditions. This is often referred to as sand surface "emissivity" and is a critical parameter in modeling stipulated by the SOA.

¹² The term meteorological is, in general, shortened to "met" in ARWP figures and tables showing meteorological stations and/or data.

¹³ State Parks' PM₁₀ monitoring is not used to assess attainment of ambient air quality standards, but the Dust Control Program's consistent monitoring methodology allows for trends in PM₁₀ in and downwind of the ODSVRA to be defined across space and through time.

- **Uncrewed aerial system (UAS) or drone surveys** to monitor and quantify changes in dune morphology, sediment erosion and deposition, and vegetation cover within the 48-acre Foredune Restoration Area (FRA) and PE, as well as backdune areas of the ODSVRA.¹⁴ Dune morphology and vegetation change monitoring are used to assess the performance of different vegetation projects at the ODSVRA.
- **Other vegetation change monitoring** conducted by State Parks personnel that complements UAS surveys and assists in assessing the performance of different vegetation projects at the ODSVRA. These include human line-intercept transect sampling and photo point monitoring to document vegetation cover and species composition within dust control project areas.

State Parks' report on field monitoring activities conducted during the reporting period is provided below.

2.2.1 METEOROLOGICAL AND PM₁₀ MONITORING

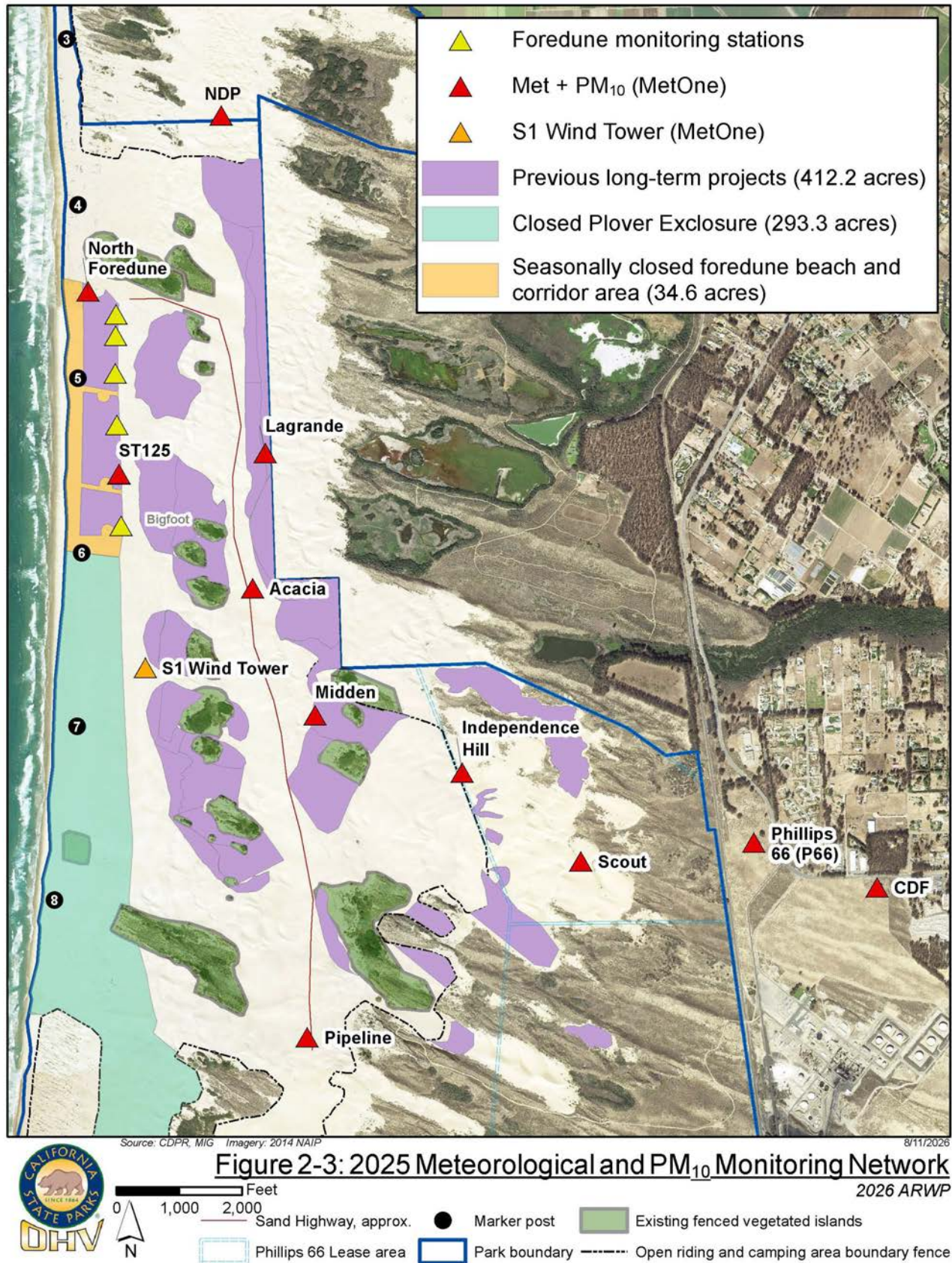
State Parks' meteorological and PM₁₀ monitoring network varies slightly from year to year depending on specific goals, objectives, and dust control measures identified in the annual ARWP cycle. The Desert Research Institute (DRI) has historically prepared a report of key findings related to State Parks' meteorological and PM₁₀ monitoring network. The following information has been summarized from the DRI-prepared and SAG-reviewed "Report of Findings: ODSVRA Meteorological and PM₁₀ Monitoring Network, 2025." The period of record considered by this DRI report is 2021 to 2025. This report, and the SAG's review comments, are provided as Attachment 03 to this 2026 ARWP.

From approximately May 15, 2025, to September 30, 2025, State Parks maintained the meteorological and PM₁₀ monitoring network shown in Figure 2-3.¹⁵ The 2025 monitoring network consisted of 12 total monitoring stations, including 5 new stations: Northern Foredune (NFRA), ST125 (on the eastern side of FRA treatment plot 5 [TP5]), S1 Tower (S1 T), Midden, and Independence Hill.¹⁶

¹⁴ The 48-acre FRA consists of dust control projects 2020-VG-01, 2020-VG-02, and 2020-VG-03 (see Figure 2-14). "Backdune areas" generally refers to the dunes east of the 48-acre FRA. As shown in Figure 2-2 and Table 2-1, all dust control projects except the three projects associated with the FRA are located in backdune areas.

¹⁵ In general, State Parks' meteorological and PM₁₀ monitoring network is typically deployed beginning approximately April 1 of each year. In 2025, equipment delays pushed back the deployment of the monitoring network to mid-May.

¹⁶ Meteorological and PM₁₀ monitoring stations in Figure 2-3 are represented by 11 red triangles and 1 orange triangle (the S1 meteorological tower). The foredune monitoring stations (5 yellow triangles), which are also shown in Figure 2-3, do not have PM₁₀ monitors and are not counted as meteorological and PM₁₀ monitoring stations in DRI's report. The only foredune monitoring station that measures PM₁₀ is the ST125 station. 2025 was the first year in which PM₁₀ was measured at this location.



Each station has a MetSens500 instrument that measures wind speed and wind direction (ultrasonically), ambient temperature, atmospheric pressure, and relative humidity (RH), and a MetOne 212 particle profiler to measure PM₁₀. The MetOne instrument is calibrated against a Beta Attenuation Monitor (BAM) in a dust chamber prior to deployment and after removal from the field in October.¹⁷

The environmental data collected by these stations provide a means to examine spatial trends in PM₁₀ concentrations (in micrograms per cubic meter, or $\mu\text{g m}^{-3}$) across the ODSVRA in relation to wind speed (in meters per second, or m s^{-1}) and wind power density (WPD, in Watts per square meter, or W m^{-2}), and to evaluate if these relations have changed through time.

WPD (in W m^{-2}) is defined as:¹⁸

$$WPD = 0.5 \rho_a u_z^3$$

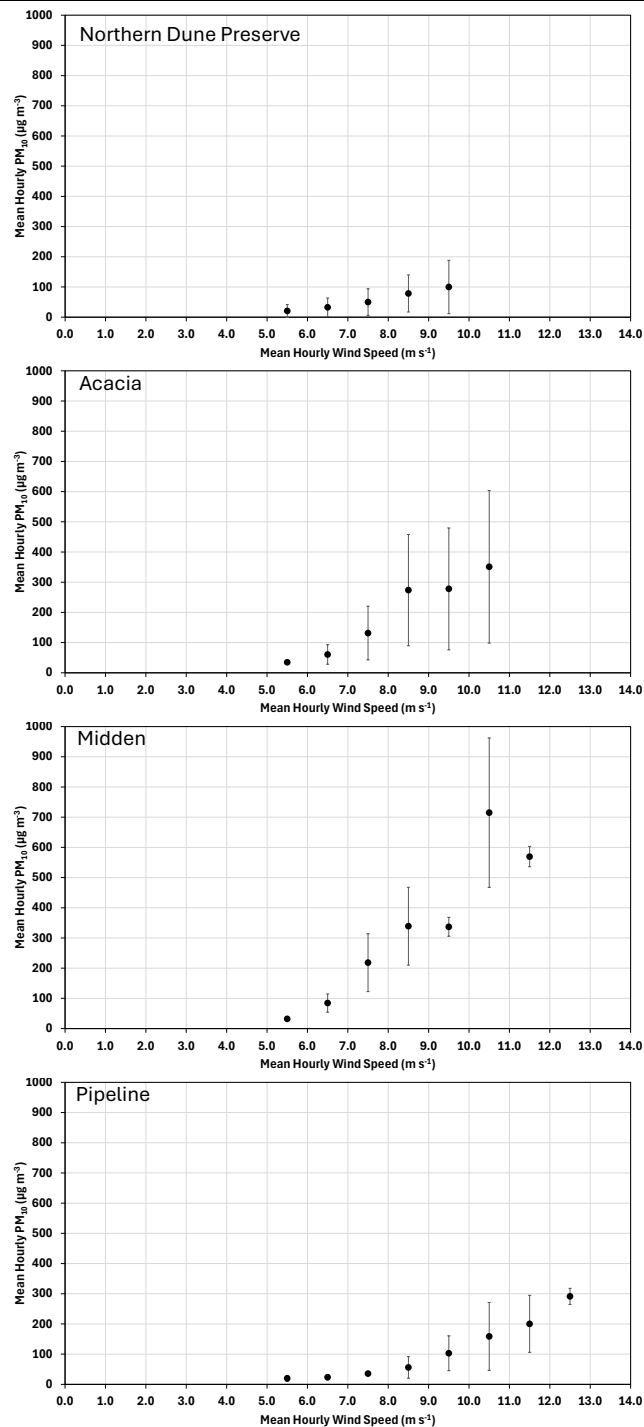
Where:

- ρ_a = Air density at sea level (1.212 kilograms per cubic meter [kg m^{-3}], and assumed constant)
- u_z = Wind speed (m s^{-1}) at measurement height z (in meters [m]) above ground level (AGL)

To compare WPD among different locations and between different years, the height of measurement of wind speed must be the same for each location. Total Wind Power Density (TWPD, W m^{-2}), which is the summation of valid hourly values of WPD (W m^{-2}) for the monitoring period (May through September in 2025), characterizes the total wind energy at a location (see Attachment 03). As the emission of PM₁₀ from the sand is of critical importance for air quality concerns, the mean hourly wind speed that corresponds with the onset of a rapid increase in PM₁₀ at monitoring stations is used to set the lower limit for the summation for calculating TWPD. For the stations on open sand areas of the ODSVRA, this wind speed is 5.5 m s^{-1} measured at 3.5 m AGL. Examples of the relation between mean hourly wind speed and mean hourly PM₁₀ for three of the stations spanning the north-south distance of the monitoring network are shown in Figure 2-4.

¹⁷ Refer to State Parks' 2021 ARWP, Attachment 06, for detailed MetOne particle profiler PM₁₀ calibration procedures.

¹⁸ Kalmikov, A., 2017. Wind power fundamentals. In Wind Power Engineering, ed. T.M. Letcher. Elsevier Science Publishing Co., Incorporated.

Figure 2-4. Relation between PM₁₀ Concentration and Wind Speed

Relation between mean hourly PM₁₀ concentration and mean hourly wind speed for select stations on open sand areas of the ODSVRA (May-September 2025) spanning the network distance from north (Northern Dune Preserve [NDP]) to south (Pipeline). Error bars represent the standard deviation of the mean hourly PM₁₀ for each mean hourly wind speed class.

A wind speed of 5.5 m s^{-1} measured at 3.5 m AGL is indicative of a wind speed of approximately 8.5 m s^{-1} measured at 10 m AGL at S1 Tower. That 10 m AGL wind speed has been used to define a lower limit that indicates a correlation with increasing PM_{10} concentration observed at CDF and Mesa2 (Gillies et al., 2024a, 2024b, 2025).^{19,20,21} Before the summation to calculate TWPD the data are also filtered for the wind direction range of 248 to 326 degrees ($^{\circ}$), as winds in this range will transport the PM_{10} originating in the ODSVRA toward the CDF and Mesa2 air quality monitoring stations.

TWPD, by month, for the period May to September in 2025 for each station on open sand areas of the ODSVRA (NDP, NFRA, Lagrande, ST125, Acacia, S1 T, Midden, Independence Hill, and Pipeline) is shown in Figure 2-5 (top panel). Through this period greater amounts of TWPD are observed in the months of May and June as compared with the months of July, August, and September. Higher wind speeds in the south give rise to greater amounts of TWPD than are observed in the northern stations, which is illustrated by the stations Lagrande, Acacia, Midden, and Pipeline that are roughly in a north-to-south alignment (approximately 353°) as shown in Figure 2-5 (bottom panel).

TWPD, by month, for the period May to September in 2025 for the stations located along an approximately west-to-east alignment from S1 Tower through to CDF (approximately 287°) is shown in Figure 2-6. The same seasonal pattern, i.e., greater TWPD in May and June as compared with July, August, and September, was observed in these stations as occurs for the stations on open sand areas. The TWPD range in this west-to-east direction shows that the TWPD decreases substantially for stations Scout, Phillips 66 (P66), and CDF, compared with the more westerly stations. The wind speed is slowed moving eastward due to the increasing frictional resistance at the surface particularly due to the vegetated surfaces at P66 and around CDF. The CDF station, located farthest inland, has the lowest range of TWPD compared with the other three stations to the west.

¹⁹ Gillies, J.A., G. Nikolich, and E. Furtak-Cole, 2024a. Increments of Progress Towards Air Quality Objectives - ODSVRA Dust Controls, 2023 Update - Revised. Report prepared for State Parks and the SAG. February 15, 2024. This report was included as Attachment 07 to State Parks' 2024 ARWP.

²⁰ Gillies, J.A., and G. Nikolich, 2024b. Report of Findings: ODSVRA Meteorological and PM_{10} Monitoring Network, 2023. Report prepared for State Parks and the SAG. June 20, 2024. This report was included as Attachment 03 to State Parks' 2024 ARWP.

²¹ Gillies, J.A., E. Furtak-Cole, and G. Nikolich, 2025. Increments of Progress Towards Air Quality Objectives - ODSVRA Dust Controls, 2024 Update. Report prepared for State Parks and the SAG. May 14, 2025. This report was included as Attachment 08 to State Parks' 2025 ARWP

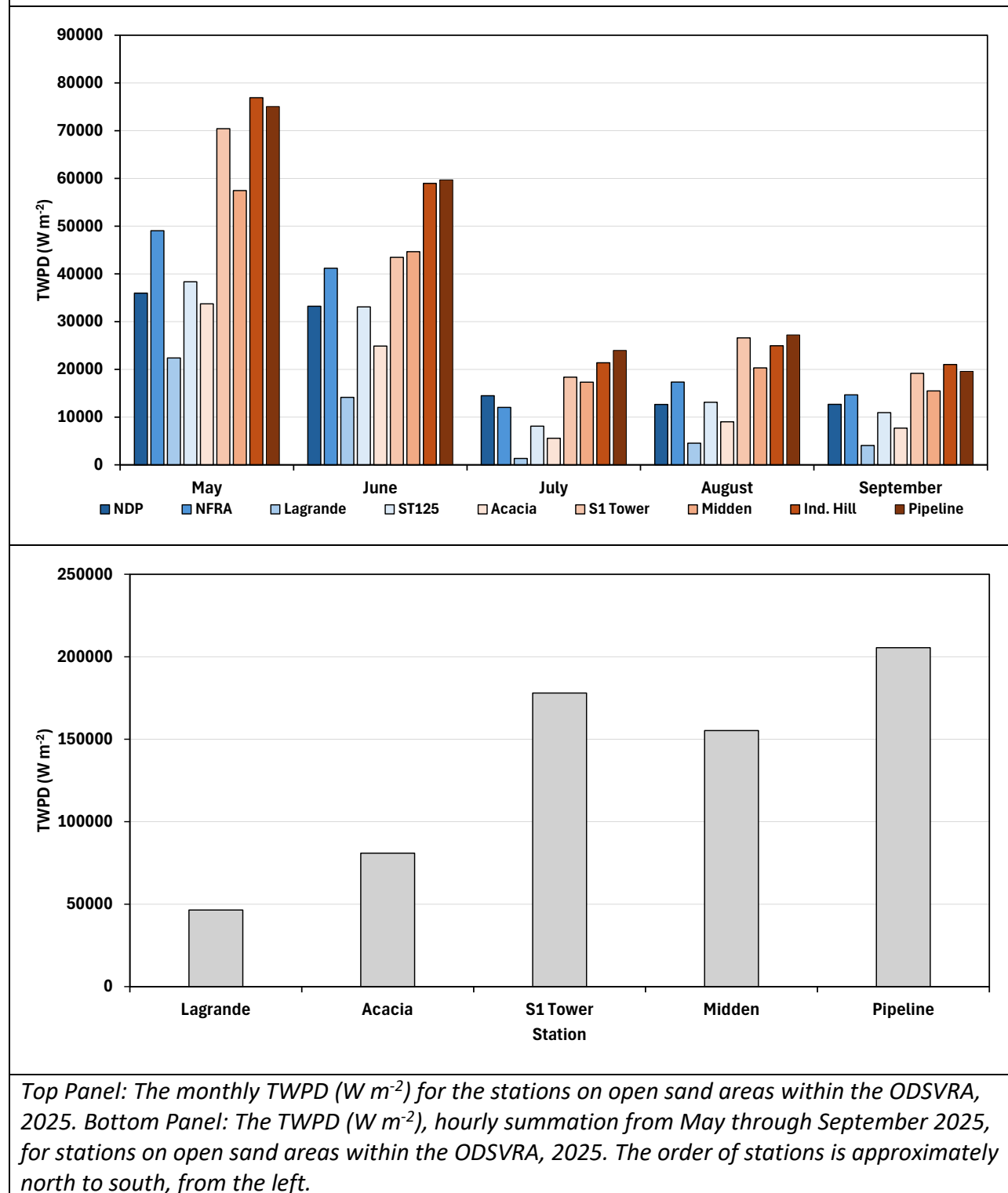
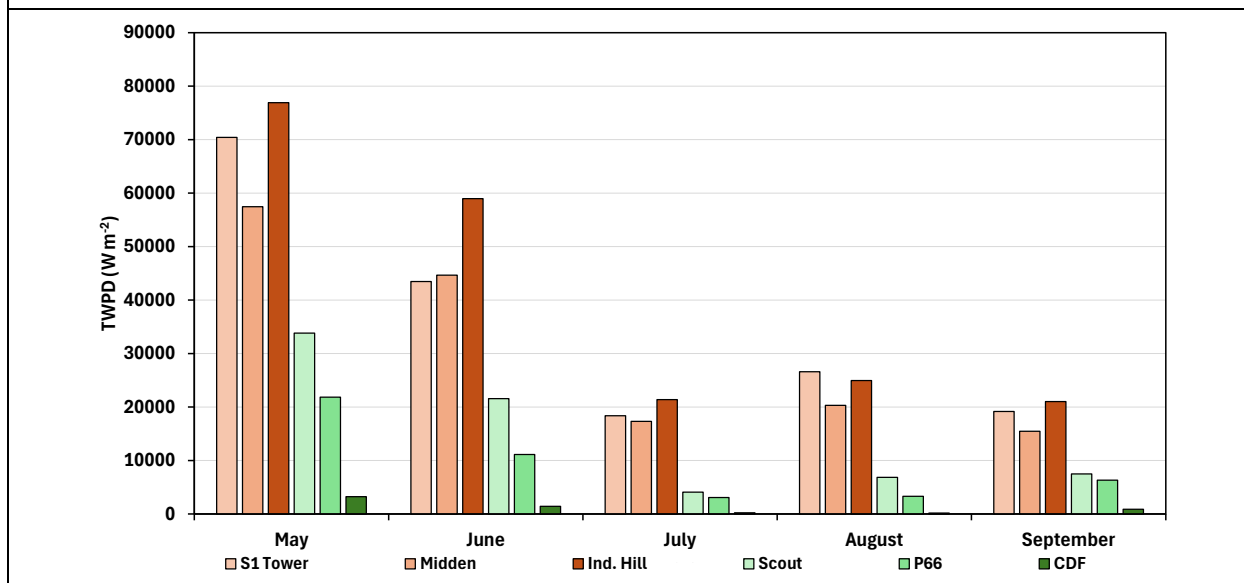
Figure 2-5. Monthly TWPD for May to September 2025 for Stations on Open Sand Areas

Figure 2-6. Monthly TWPDP for May to September 2025 for Stations Along an Approximately West-to-East Alignment from S1 Tower to CDF

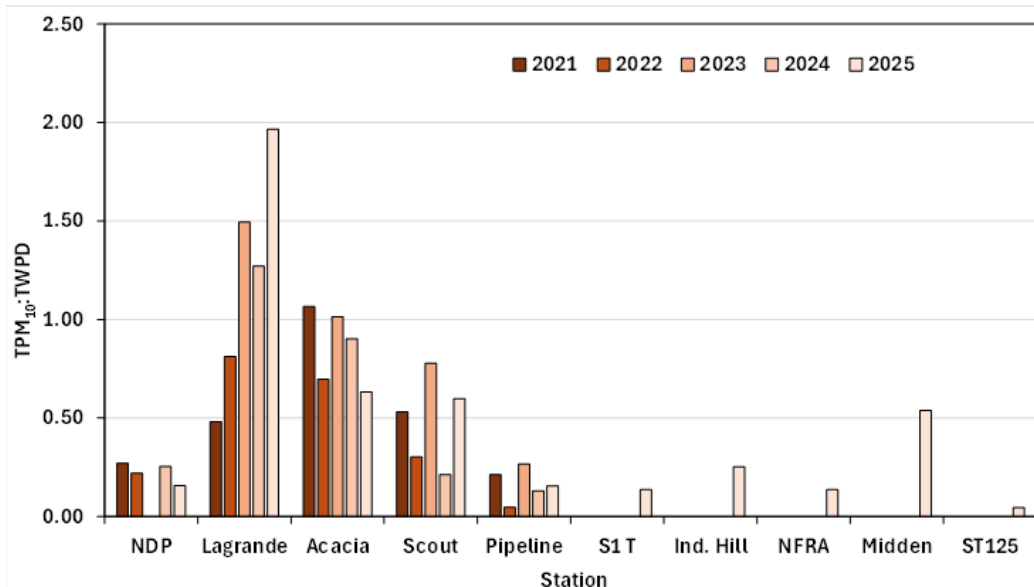


The monthly TWPDP ($W m^{-2}$) for stations along an approximately west-to-east alignment from S1 Tower to P66 and CDF, which are downwind of ODSVRA open sand areas in 2025.

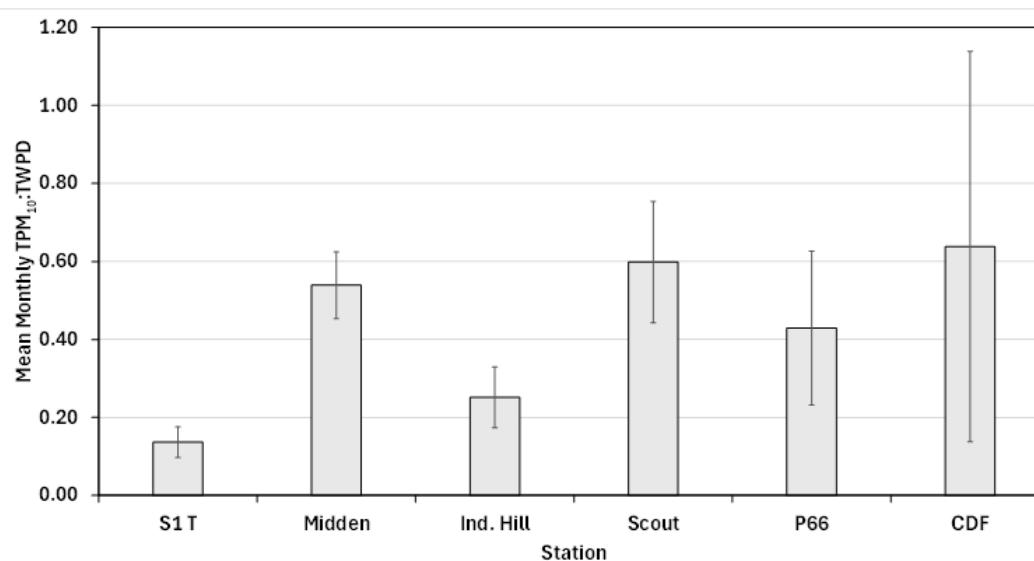
The change in the ratio of Total Hourly PM_{10} (TPM_{10}) to TWPDP ($TPM_{10}:TWPDP$) for stations located on the open sand areas of the ODSVRA (operated in 2025) for available data from April to September 2021 through 2024 and May through September 2025 is shown in Figure 2-7. The $TPM_{10}:TWPDP$ ratio for stations on open sand areas (including NDP) is variable as a function of position. The stations with the greatest $TPM_{10}:TWPDP$ ratio have consistently been the northern stations, and this is still the case in 2025 for the Lagrande and Acacia stations, as well as the Midden station first installed in 2025, which are all on the downwind (eastern) side of the “sand highway” route. The Lagrande and Midden stations have longer upwind fetches of open sand than Acacia. The NDP station in the non-riding area Dune Preserve, which is also in an open sand area, has lower ratio values than the stations in the northern zone of the ODSVRA where off-highway vehicle (OHV) activity is allowed (see Figure 2-7).

The trend in $TPM_{10}:TWPDP$ values along an approximately west-to-east alignment from S1 Tower through to CDF (approximately 287°) for the period May to September in 2025 is shown in Figure 2-8. CDF registered the highest mean monthly $TPM_{10}:TWPDP$ ratio as it has the lowest TWPDP values but elevated PM_{10} concentration levels. It is noted that the $TPM_{10}:TWPDP$ ratio for CDF is not directly comparable to the ratio reported in the Increments of Progress Reporting (see Section 2.3.1) as the measurement instruments, measurement heights, and measurement locations of the wind speed instruments are different.²²

²² These differences are explained in DRI’s report “Increments of Progress Towards Air Quality Objectives - ODSVRA Dust Controls, 2023 Update – Revised.” See footnote 19.

Figure 2-7. TPM_{10} :TWPD Ratio for 2021-2025 for Stations on Open Sand Sheet Areas

The TPM_{10} :TWPD ratio, 2021-2025, based on the summation of mean hourly data for the stations that are located on sand-sheet areas of the ODSVRA (not including the stations that were removed prior to 2025). The values represent the ratio based on a five-month period (2025) or six-month period (2021-2024). Note: The NFRA station did not have a PM_{10} monitor prior to 2025.

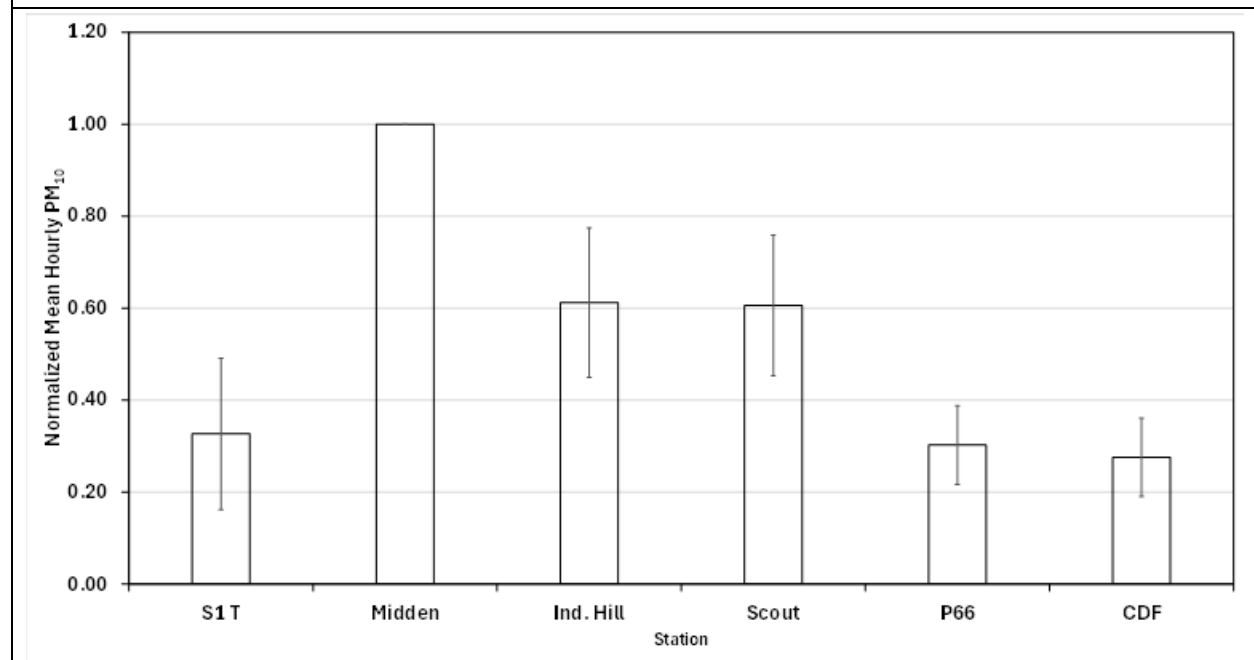
Figure 2-8. TPM_{10} :TWPD Ratio for 2021-2025 for Stations Along an Approximately West-to-East Alignment from S1 Tower to CDF

The TPM_{10} :TWPD for the stations located along an approximately west-to-east alignment from S1 Tower to P66 and CDF, which are downwind of ODSVRA sand-sheet areas. Error bars represent the standard deviation of the mean monthly TPM_{10} :TWPD value (May through September).

A representation of the change in PM_{10} moving from west to east from open sand areas to the monitoring stations downwind of the ODSVRA that better reveals the spatial trend is produced by normalizing the mean hourly PM_{10} concentration data at each location by the hourly mean PM_{10} for the Midden station, which had the consistently highest hourly concentration values in 2025. As shown in Figure 2-9, moving from west to east, the mean hourly PM_{10} concentrations increase from S1 Tower to Midden and then decline as a function of increasing distance east of Midden.

Emissions of PM_{10} from sand areas cease approximately 300 m east of Scout as the wind and the PM_{10} in transport begin to traverse vegetated areas. Following the transition from open sand to vegetation, the PM_{10} particles disperse and deposit as they travel toward P66 and CDF. At CDF, the mean hourly concentration has diminished to 0.28 of the mean hourly value observed at Midden. For the 2024 station data, CDF PM_{10} mean hourly concentration was a third of that observed at the Acacia station, which is relatively consistent with the change in 2025 between Midden and CDF.

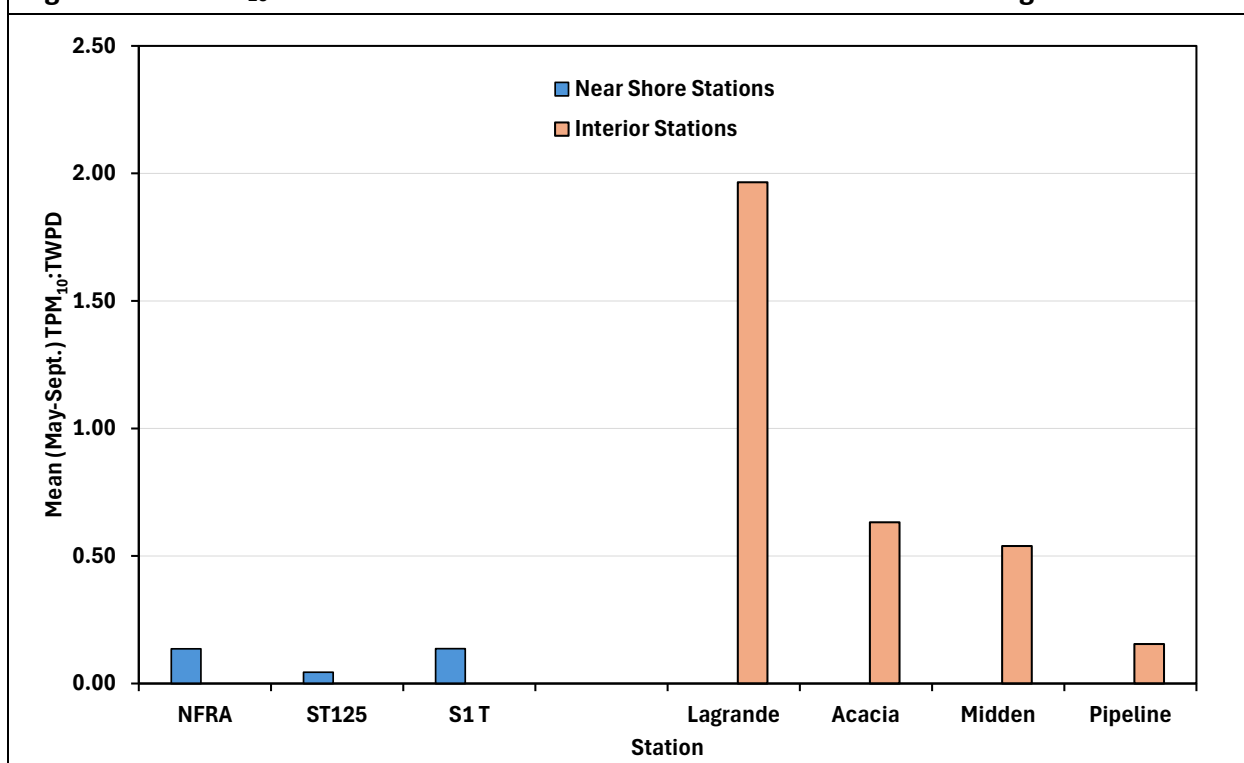
Figure 2-9. Hourly Mean PM_{10} Concentrations Normalized to Midden Station



The hourly mean PM_{10} concentration, normalized to the hourly mean PM_{10} concentration at the Midden station, for the stations located along an approximately west-to-east alignment from S1 Tower to P66 and CDF, which are downwind of ODSVRA open sand areas. Error bars represent the standard deviation of the normalized mean hourly PM_{10} .

A question that has been posed is whether consideration should be given to the potential contribution of oceanic sources to the regional PM₁₀ burden. Several lines of evidence can be used to examine the significance of potential contributions from this source. Wang et al. (2023) quantified the chemical composition of PM₁₀ collected at the CDF site in 2021 and found mineral dust comprised the largest fraction of the particles, which they attributed to wind-driven saltation and dust emission processes within the ODSVRA.²³ In 2025, three monitoring stations measuring PM₁₀—NFRA, ST125, and S1 Tower—were located relatively close to the shoreline. NFRA is located west of the northern limit of FRA TP1. To the west of the NFRA station is a beach area approximately 100 m wide. The beach area is closed to OHV activity for the duration of the Snowy Plover breeding period. West of ST125 is FRA TP5 and a narrow beach zone to the west of the restoration area. West of S1 Tower is a narrow area that has riding activity with the PE farther west of this narrow area. These stations are located downwind of areas of low emissivity, except for the narrow riding area zone to the west of S1 Tower, based on multiple years of PI-SWRL measurements. Comparing the mean (May-September) TPM₁₀:TWPD ratio values from these three stations with Lagrande, Acacia, Midden, and Pipeline, which are located well within the ODSVRA and in open riding areas, the data show that the interior stations produce much higher PM₁₀ values for equivalent WPD, as shown in Figure 2-10. The increase in PM₁₀ produced per unit WPD with increasing distance from the shoreline indicates that the PM₁₀ concentrations cannot be a result of an initial input of high PM₁₀ concentrations from oceanic sources as levels >50 µg m⁻³ were not observed. The near-shore PM₁₀ is likely composed of sea-spray particles and salt and organic particles following the evaporation of the liquid spray particles, as well as some mineral particles during saltation when the beach area is sufficiently dry and exposed to above threshold wind speed. As these near-shore PM₁₀ particles advect, disperse, and deposit downwind, their contribution to the total PM₁₀ burden diminishes, and hence they cannot explain how PM₁₀ concentrations increase at inland monitoring stations.

²³ X. Wang, J.A. Gillies, S. Kohl, E. Furtak-Cole, K. Tupper, and D. Cardiel, 2023. Quantifying the source attribution of PM₁₀ measured downwind of the Oceano Dunes State Vehicular Recreation Area. *Atmosphere* 14, 718, doi: 10.3390/atmos14040718.

Figure 2-10. TPM₁₀:TWPD for Near-Shore Stations and Stations within Riding Area

The TPM₁₀:TWPD for near-shore stations (NFRA, ST125, and S1 Tower [S1 T]) and for stations located within the riding area of the ODSVRA (Lagrande, Acacia, Midden, and Pipeline).

The stations along an approximately 3.8-kilometer (km) west-to-east transect (S1 Tower to CDF) show a consistent peak concentration of PM₁₀ occurring at the Midden station, reflecting the greater emissivity of the sand in this area that is likely influenced by the sand highway to the west of this station. The concentration of PM₁₀ diminished compared to the Midden station by, on average, 70% (±9%) in May-September 2025 for the Phillips 66 station, and 72% (±8%) at CDF, which are east of the open sand areas of the riding and non-riding areas of the ODSVRA. This decrease in normalized concentration reflects the change from an area where emissions of PM₁₀ occur on open sand areas, to one in which dispersion and deposition dominate the transport process. Beginning east of the Scout station (approximately 300 m) and extending to CDF, the surface becomes non-emissive with respect to dust emissions as it is covered by vegetation. Across the distance from Scout to CDF, dispersion and deposition processes will tend to decrease particulate matter concentration with increasing travel distance.

The 2025 wind speed and WPD data, as shown in Figure 2-5, show that, for the north-south distance covered by the network, the wind speed was higher in the south than the north, which corroborates what has previously been reported and indicates that this pattern has persisted since monitoring was initiated. The station TPM₁₀:TWPD data show, as referenced in Figure 2-7, that the northern stations with higher TPM₁₀:TWPD indicate that the emissivity of the sand surfaces upwind

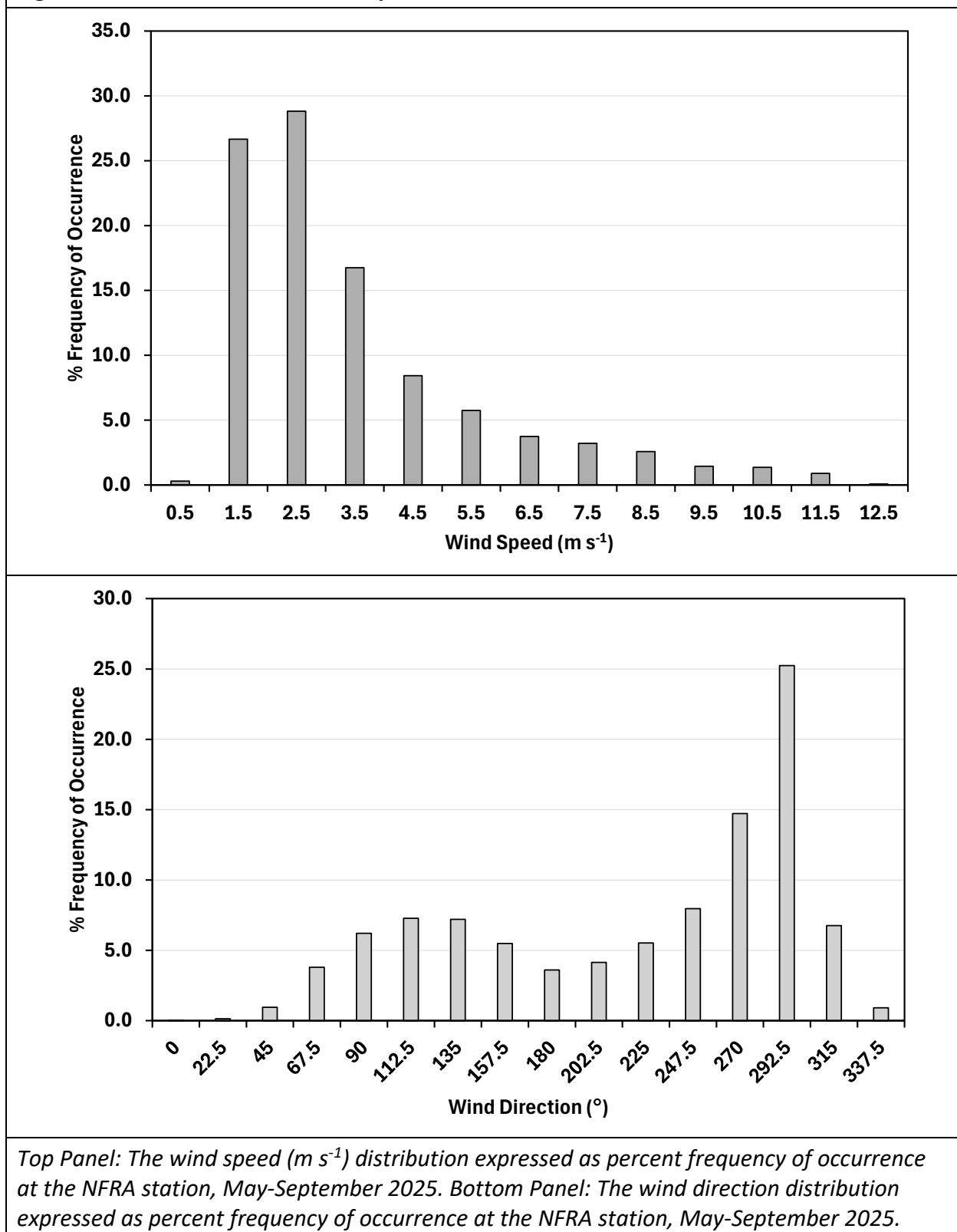
of these stations remains high in relation to the other stations and that these surfaces are still a rich source area for PM₁₀ emissions. The high PM₁₀ concentrations and emissivity in this area may be due to the presence of the sand highway, which remains a high use area for OHVs. The gradient of decreasing emissivity from north to south has also been observed in the PI-SWERL data. The 2025 TPM₁₀:TWPD data, as shown in Figure 2-7, indicate that this pattern has persisted since the monitoring was initiated.

The PM₁₀ data from the monitoring network for its period of operation, 2021-2025, has consistently shown that PM₁₀ concentrations increase from the shore area to the interior of the ODSVRA, and decline moving from the eastern boundary to the two easternmost stations, Phillips 66 and CDF. This argues against the conjecture that high PM₁₀ concentrations downwind of the ODSVRA can be attributed to oceanic sources.

Beginning on April 1, 2026, State Parks re-installed the ODSVRA meteorological and PM₁₀ monitoring network shown in Figure 2-3. As has been done previously by DRI, the MetOne 212 particle profiler instruments were calibrated against a BAM PM₁₀ monitor in DRI's dust chamber prior to deployment in 2025.

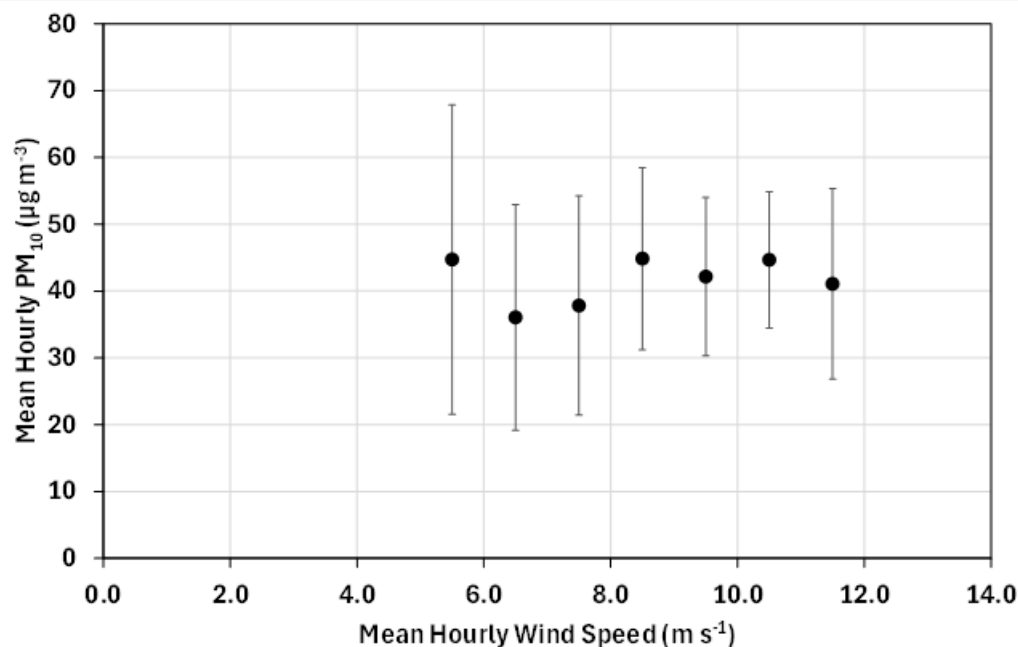
2.2.1.1 NFRA STATION DATA DISCUSSION

The SLOAPCD Hearing Board adopted a modification to the SOA in 2025 that requires reporting on data collected at the NFRA station. This station is closest to the ocean, separated from the water by a flat gently sloping beach approximately 100 m wide that was closed to OHV activity from March 1, 2025, to September 30, 2025, to protect potential Western Snowy Plover and California Least Tern nest sites (see Figure 2-3). The NFRA station was installed in May 2025. The wind speed and wind direction data for the period from May through September 2025 are summarized in Figure 2-11. For the monitoring period, the wind speed range was between 0 and 12.5 m s⁻¹. The percentage of occurrence of winds reaching and exceeding the threshold wind speed for sand transport (i.e., 5.5 m s⁻¹ measured at 3.5 m AGL) was 19%. The wind direction was bi-modal with peaks at 112.5° and 292.5°.

Figure 2-11. Distributions of Wind Speed and Direction for NFRA Station

The wind direction range 248° to 326° is used to define the wind direction condition that has the greatest potential to transport PM_{10} to the SLOAPCD's CDF station when wind exceeds 5.5 m s^{-1} at 3.5 m AGL. Under these two conditions, the other monitoring stations show a correlation between wind speed and PM_{10} (see Figure 2-4). At the NFRA station, the range of PM_{10} concentration was $36 \mu\text{g m}^{-3}$ to $45 \mu\text{g m}^{-3}$, which is much less than the stations farther inland. It was also observed for the 2025 data at NFRA that the PM_{10} was not correlated with wind speed as shown in Figure 2-12. That the concentration of PM_{10} is not correlated with wind speed suggests that, at this location, the PM_{10} measured by the monitor is not or only weakly related to dust emissions from the beach upwind of the monitor. The PM_{10} may also be influenced by liquid sea-spray particles as it is close to the shoreline and the surf zone. Salt (NaCl) and organic matter particles will also be present upon evaporation of the sea-spray particles. As described in Section 2.2.1 and shown in Figure 2-10, the near-shore stations NFRA, ST125, and S1 Tower have lower PM_{10} concentrations for equivalent TWPD conditions, which indicates that high concentrations of PM_{10} were not observed close to the shoreline in May to September 2025.

Figure 2-12. Comparison of PM_{10} Concentration and Wind Speed



The mean hourly PM_{10} concentration compared with the mean hourly wind speed (m s^{-1}) at the NFRA station, May-September 2025. Error bars represent the standard deviation of the mean hourly PM_{10} in each wind speed class.

2.2.2 PI-SWERL/EMISSION MONITORING

Measurements of PM₁₀ surface emissivity at the ODSVRA are made by DRI using the PI-SWERL device, which has been described in previous ARWPs and accompanying documents. DRI applies quality assurance/quality control (QA/QC) protocols to ensure data integrity and to validate operational parameters according to prescribed ranges (e.g., flow and revolutions per minute [RPM] values vary <2% during a test cycle with constant RPM). Once validated for quality, measurements are used to calculate the mean emissivity (milligrams per square meter per second [$\text{mg m}^{-2} \text{s}^{-1}$]) for the periods when the PI-SWERL RPM was constant for each of the rotational speeds (2,000, 3,000, and 3,500 RPM), which correspond to shear velocities (u^*) of 0.381, 0.534, and 0.607 m s^{-1} assuming the roughness of the surface is equivalent to flat sand. The median emissivity values for each test u^* are used to update the emissivity power relations characterizing the current landscape scenario and the 1939 landscape scenario in the DRI simulation model to determine the excess emissions condition, as per the SOA.

DRI has measured PM₁₀ surface emissivity at the ODSVRA using the PI-SWERL device since 2011. The earliest data collection efforts were mainly for information gathering purposes and to help develop sampling methods for later campaigns. Since August 2013, PI-SWERL data have been collected in different parts of the ODSVRA (e.g., riding versus non-riding areas) and at different times of year (e.g., spring versus fall) for operational and regulatory purposes. These data have yielded considerable insight into how surface emissivity varies spatially and temporally across the ODSVRA due to natural processes and human influences. State Parks and the SLOAPCD have, at the recommendation of the SAG, used the PI-SWERL emissivity data to subdivide the ODSVRA into specific geographic units (management zones) that have different emissivity characteristics, and these have been incorporated into the DRI emissions model.²⁴

In total, between August 2013 and September 2025, DRI conducted PI-SWERL emissivity tests at 2,642 locations within the ODSVRA, including 1,323 tests in areas open to OHV recreation year-round, more than 600 tests in areas closed to OHV recreation year-round, and approximately 700 tests in areas that are or were seasonally open to OHV recreation. Each of the locations is sampled at three different speeds (shear velocities [u^*]) within the PI-SWERL chamber, yielding close to 8,000 individual data points.

In September 2025, DRI measured emissivity at 81 locations within the ODSVRA. The sole purpose of this campaign was to characterize the dust emission potential of the PE. A total of 57 measurements were conducted in the PE. As a spatial control on changing surface conditions due to moisture effects, another 24 measurements were conducted in the Non-Riding Area Central Zone (NRA Central) to the east of the PE. These measurements complement those taken in the PE

²⁴ For the SAG's recommendations, refer to State Parks' 2024 ARWP, Attachment 08, for the December 19, 2023, SAG memo "Updated SAG Recommendations for Establishing Emissivity Grids to be used in Modeling Pre-Disturbance Conditions and Future Excess Emissions Reductions."

and other neighboring areas in September 2022 and 2024.²⁵

Figure 2-13 shows the locations of PI-SWERL measurements in September 2025. Despite broader spatial coverage in 2025 than in prior campaigns, the measurements collectively provide similar statistical results (i.e., means, medians, ranges) to those made in 2022 and 2024. Refer to Attachment 04 for the SAG's detailed 2025 PI-SWERL emissivity measurements report, which includes the updated emissivity power relations used in the 2026 DRI model.

Figure 2-13. PI-SWERL Sampling Locations in September 2025



²⁵ For a detailed history of PI-SWERL reporting, refer to State Parks 2025 ARWP, Section 2.2.2, and Attachment 04.

2.2.3 FOREDUNE RESTORATION AREA (FRA) UNCREWED AERIAL SYSTEM (UAS) SURVEYS

State Parks initiated the 48-acre FRA project in late 2019 as a nature-based solution to mitigate dust emissions from a 48-acre site by promoting sand deposition, vegetation growth, and dune development. The FRA consists of 6 treatment plots (TPs) that differ in restoration methods, as follows (from north to south, see Figure 2-14): TP1, a control plot only textured by a sheepsfoot roller; TP2, sheepsfoot texture and broadcast native seeds; TP3, sheepsfoot texture and broadcast native plant and sterile rye grass seeds; TP4, low-density straw planting circles with nodes of juvenile native plants; TP5, high-density straw planting circles with nodes of juvenile native plants; and TP6, complete straw cover with high density of juvenile plants.

Since 2019, a team from the University of California, Santa Barbara (UCSB) (and formerly Arizona State University [ASU]), in collaboration with State Parks, have conducted biannual UAS surveys (in October and February) using a fixed-wing, fully autonomous WingtraOne UAS (or drone) with high resolution visual (red, green, and blue [RGB]) and multispectral cameras to map and quantify geomorphic and vegetation changes across the ODSVRA. State Parks and UCSB use the UAS surveys to quantify and interpret changes in plant cover, geomorphology, and sediment budgets within the FRA. The focus for the analyses of the UAS monitoring has been primarily on the FRA plots and adjoining beach and backdune areas, but also includes most of the ODSVRA's open riding area as well as the PE and the North Oso Flaco foredune reference site (NOF). The typical extent of the UAS mapping domain is shown in Figure 2-15.

To date, 14 UAS mapping campaigns have been conducted, providing results from six years of development to February 2026 (see Table 2-2). Resulting datasets include: georeferenced orthomosaics, plant cover maps, Digital Terrain Models (DTMs), topographic change maps, and sand volumetric change estimates. These datasets are used to examine patterns of sand erosion/deposition, sediment budget responses, dune development, and changes in vegetation across the TPs through time.

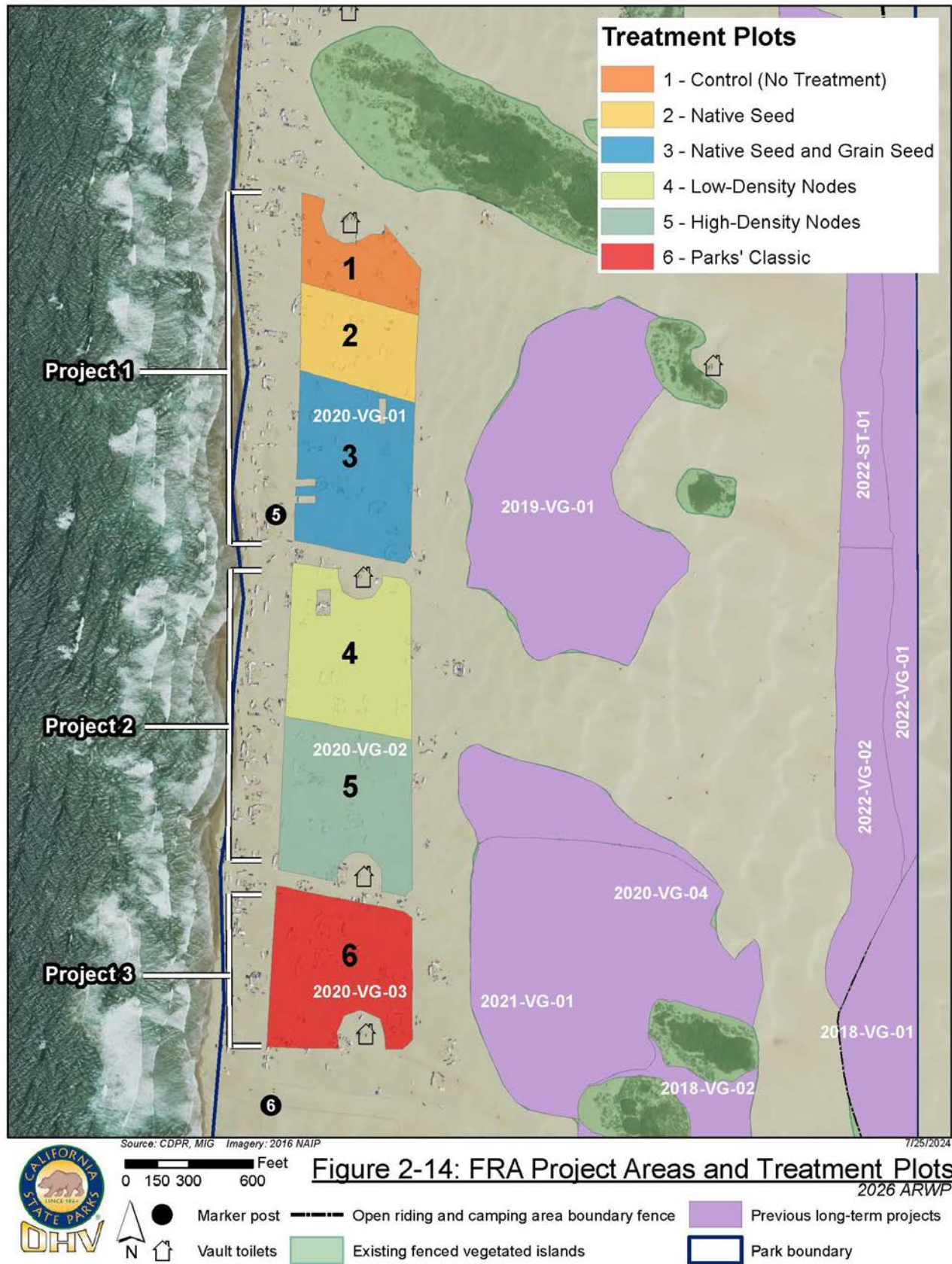


Figure 2-15. UAS Mapping Domain

Map showing the typical extent of the UAS surveys (north oriented to the left). The FRA treatment plots (TP) 1 through 6 and foredune (FD) zone at the NOF are shown with adjoining beach (B), landward dune (LD), and foredune lee (FL, at the NOF only). New analytical sub-zones within the FRA are shown in yellow with the original treatment plot boundaries shown in black. The underlying image is from the National Agricultural Imagery Program (2024).

Table 2-2. UAS Survey Campaign Specifications

UAS Survey Campaign	Survey Date	Sensor Payload	Average Altitude (m)	Ground Sampling Distance (GSD) (cm per pixel)	Total Uncertainty (m)
1. Baseline pre-restoration survey	October 1-2, 2019	Sony RX1RII	114	1.45	0.038
2. Initial treatment installations	February 10-11, 2020	Sony RX1RII	123	1.56	0.033
3. First post-treatment survey and growing season	October 13-15, 2020	Sony RX1RII	121	1.54	0.037
	October 16, 2020	Micasense RedEdge-MX	113	7.53	—
4. End of first year of development	February 17-18, 2021	Sony RX1RII	120	1.52	0.030
	February 18-21, 2021	Micasense RedEdge-MX	118	7.89	—
5. Second growing season	October 4-5, 2021	Sony RX1RII	121	1.54	0.025
	October 5-7, 2021	Micasense RedEdge-MX	119	7.82	—

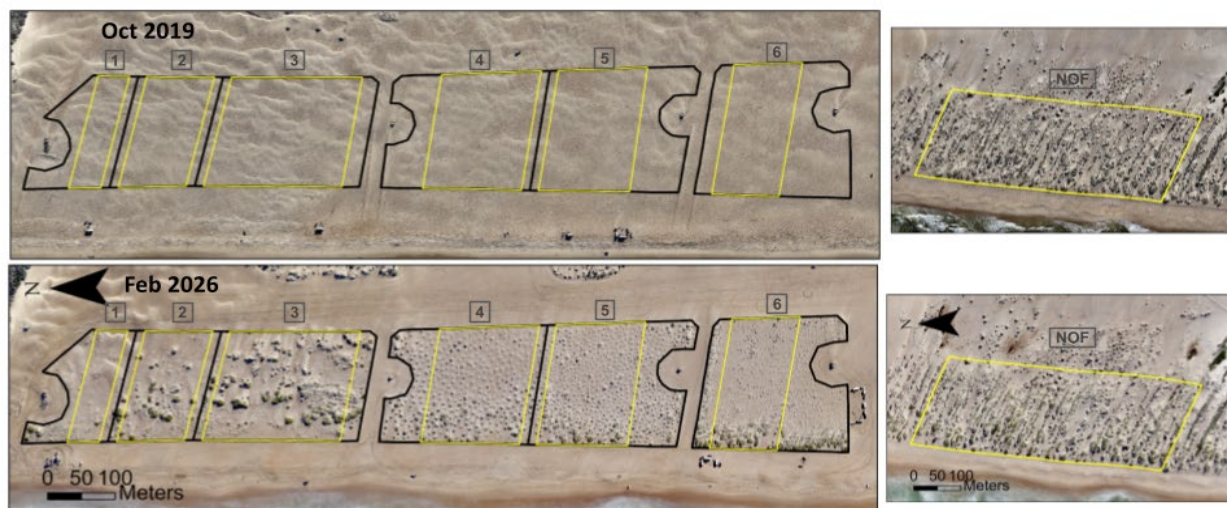
Table 2-2. UAS Survey Campaign Specifications

UAS Survey Campaign	Survey Date	Sensor Payload	Average Altitude (m)	Ground Sampling Distance (GSD) (cm per pixel)	Total Uncertainty (m)
6. End of second year of development	February 23-25, 2022	Sony RX1RII	112	1.42	0.043
	February 25-26, 2022	Micasense RedEdge-MX	116	7.71	—
7. Third growing season	October 17-18, 2022	Sony RX1RII	125	1.66	0.026
	October 19-21, 2022	Micasense RedEdge-P	111	3.67	—
8. End of third year of development	February 23, 2023	Sony RX1RII	121	1.59	0.034
	February 20-21, 2023	Micasense RedEdge-P	120	3.97	0.105
9. Fourth growing season	October 9, 2023	Sony RGB61	108	1.65	0.049
	October 10-13 2023	Micasense RedEdge-P	135	4.42	—
10. End of fourth year of development	February 23, 2024	Sony RGB61	116	1.78	0.071
	February 21-23, 2024	Micasense RedEdge-P	133	4.38	0.071
11. Fifth growing season	October 29-30, 2024	Sony RGB61	107	1.65	0.047
	October 14-18, 2024	Micasense RedEdge-P	121	3.96	—
12. End of fifth year of development	February 20-21, 2025	Sony RGB61	125	1.89	0.030
	February 18-19, 2025	Micasense RedEdge-P	123	4.05	—
13. Sixth growing season	October 14-15, 2025	Sony RGB61	109	1.68	0.055
	October 13-15, 2025	Micasense RedEdge-P	123	4.06	—
14. End of sixth year of development	February 12-13, 2026	Sony RGB61	106	1.64	0.056
	February 9-12, 2026	Micasense RedEdge-P	121	4.00	—

Specifications for the RGB and multispectral UAS campaigns. Multispectral sensors were only used after installation of the vegetation treatments in February 2020. GSD is the distance between the center of adjacent pixels and describes the cell size of each pixel in centimeters (cm) (i.e., pixel resolution). Total Uncertainty values are the calculated vertical uncertainty for datasets used in DTM development and for detecting and quantifying significant volumetric changes. As the multispectral datasets were not used for this purpose, no uncertainty value is shown.

This past year, in consultation with the SAG and State Parks, the analytical approach was modified to include: 1) new analytical sub-areas within the TPs to remove edge effects from fences and structures (see Figure 2-16), 2) observations from the NOF against which data from the TPs are normalized and compared to those of a fully-developed foredune ecosystem in an undisturbed setting, and 3) modification of the performance assessment framework²⁶ to focus only on 3 simpler metrics derived from sediment budget responses, plant cover change, and a new topographic roughness index (TRI) that describes evolving roughness of dunes and plant cover as a more quantitative measure of flow sheltering and dust emissions control potential of the TPs. Accordingly, all results back to installation of the FRA in February 2020 were updated for this year's ARWP and are detailed in Attachment 05. Former methods and results are described in Hilgendorf et al. (2025)²⁷ and earlier reports.

Figure 2-16. UAS Orthophoto Mosaics



Visible (RGB) orthophoto mosaics of the FRA and NOF reference site from the initial baseline survey (October 2019), during installation of restoration treatments in February 2020, and the latest February 2026 UAS survey. Numbers represent the different treatment plots. Notable dune development and plant community re-establishment is observed in all plots, except within the TP1 control plot.

²⁶ Walker, I.J., Z. Hilgendorf, J.A. Gillies, C.M. Turner, E. Furtak-Cole, and G. Nikolich, G. (2023). Assessing performance of a “nature-based” foredune restoration project, Oceano Dunes, California, USA. *Earth Surface Processes and Landforms*, 48(1), 143-162.

²⁷ Hilgendorf, Z, I.J. Walker, and M. Heffentrager, M. (2025). 2023-2024 ODSVRA Foredune Restoration UAS Monitoring Report. Technical Report to the Oceano Dunes Scientific Advisory Group (SAG) and State Parks. 32 p.

The UAS imagery datasets are used to create the following data products (see also Table 2-2):

- Fourteen (14) visual (RGB) georeferenced aerial orthomosaic images of the FRA and NOF at approximately 1.5 centimeter (cm) resolution
- Twelve (12) multispectral (RGB-red edge [RE]-near-infrared [NIR]-panchromatic [Pan]) georeferenced orthomosaic images of the FRA and NOF at approximately 3.0 to 7.5 cm resolution collected concurrently with the RGB datasets since October 2020
- Twelve (12) Normalized Difference Vegetation Index (NDVI) orthomosaics used to assess vegetation cover in the FRA and NOF at approximately 3.0 to 7.5 cm resolution derived from the multispectral orthomosaic datasets
- Twelve (12) georeferenced, orthorectified maps of vegetation cover derived from RGB and NDVI imagery used to track changes in plant cover within the FRA and NOF
- Fourteen (14) three-dimensional point clouds of surface topography within the FRA and NOF at a decimated resolution of 10 cm
- Fourteen (14) three-dimensional DTMs of topography within the FRA and NOF at 10 cm pixel resolution
- Thirteen (13) topographic change maps derived from statistically significant pixels of erosion and deposition between DTM intervals used to assess geomorphic and sediment volume changes

Data collected from the UAS flights allows for high resolution, three-dimensional DTM surfaces to be constructed and compared using geospatial statistics to quantify sand volume changes and dune development over time. Multispectral orthomosaics and DTM surfaces allow for examination of the growth of vegetation and the development of dune forms within the FRA and NOF.

An in-depth report on the data collection, analytical methods, and detailed results from the UAS monitoring flight of the FRA are provided in the UCSB report “2025-2026 ODSVRA Foredune Restoration UAS Monitoring Report.” This UCSB report, and the SAG’s review comments, are included as Attachment 05 to this 2026 ARWP. The following information is excerpted from the UCSB 2025-2026 FRA UAS monitoring report.

2.2.3.1 FOREDUNE MONITORING

Figure 2-16 shows a comparison between the initial (October 2019) RGB UAS orthophoto mosaic of the FRA and the most recent (February 2026) image. Cumulative results of observed changes in vegetation coverage and geomorphic changes, respectively, from the UAS surveys of the FRA through to February 2026 are provided below.

Vegetation Cover Change

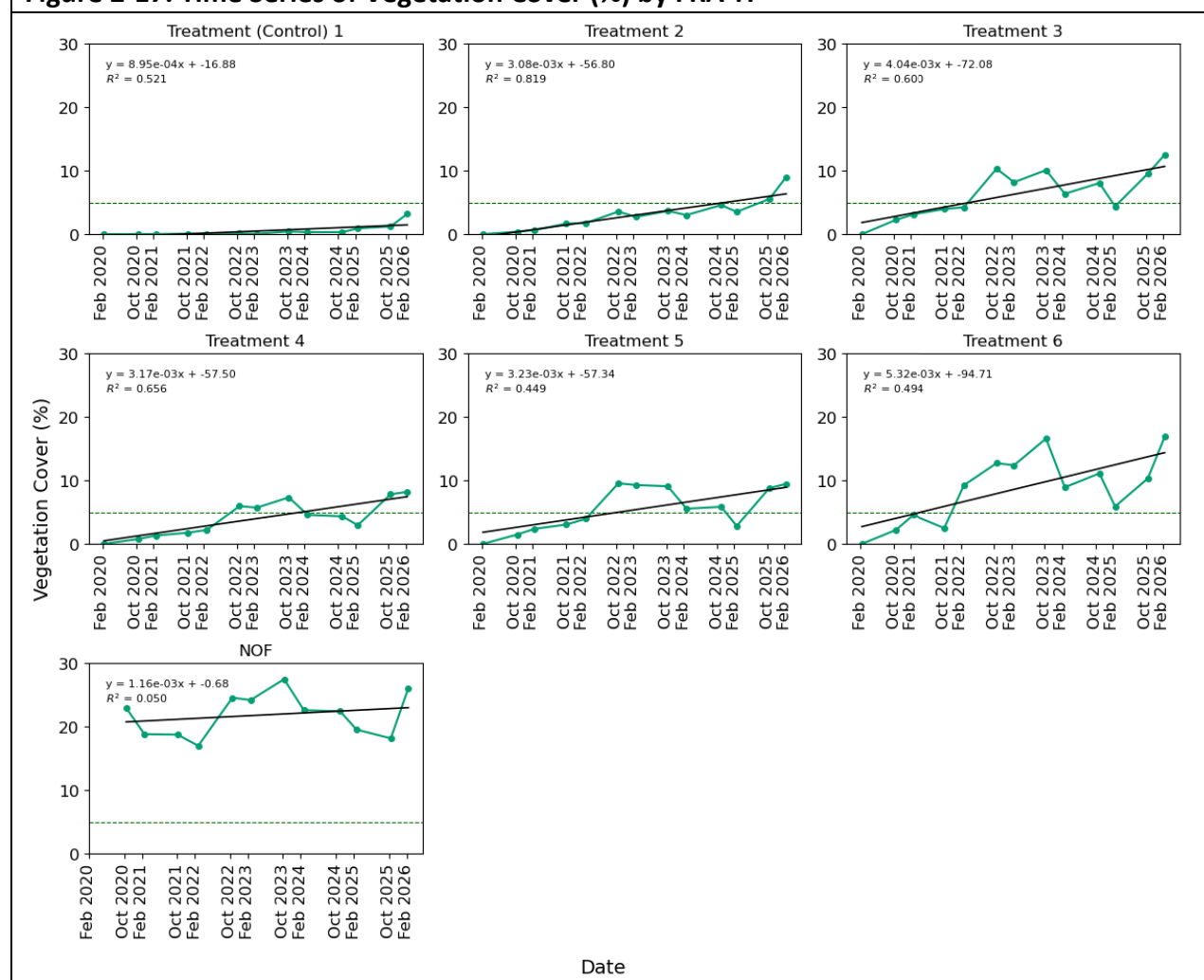
Percent plant cover has generally increased through time in all TPs with some seasonal to interannual variability (see Table 2-3 and Figure 2-17). The NOF reference site maintained a slightly positive trend from October 2020 to February 2026 but generally remains more stable over time given its fully developed state compared to the variability observed in the TPs. By February 2026, TP1 through 4 and TP6 reached their highest plant cover since implementation of the FRA. TP5 still shows increasing plant cover in October 2025 and February 2026, but the highest value was observed in October 2022. Overall, TP6 had the greatest plant cover change (from 2.2% in October 2020 to 16.9% by February 2026), followed by TP3 (2.3% to 12.5%), TP2 (0.4% to 9.0%), TP5 (1.5% to 9.5%), TP4 (0.8% to 8.2%) and TP1 (0.0% to 3.2%). From October 2020 to February 2026, the NOF saw 23.0% to 26.1% cover, respectively, with a total change of 3.1%.

The range in observed plant cover change at the NOF (10.5%) indicates that significant interannual variations in vegetation are not uncommon within foredune ecosystems in the region. Most TPs and the NOF reference site showed a notable decline in cover in recent monitoring intervals (October 2023 to February 2025), while TP1 and TP2 saw subtle increases over this time. Since October 2025 or February 2026, depending on the treatment site, all sites have shown increasing plant cover (see Table 2-3 and Figure 2-17).

For historical context, plant cover observed in aerial imagery back to 1939 within the ODSVRA averaged about 25% in 1939, with a peak at 37% in 2012 followed by a slight decline to 35% by 2020 prior to implementation of the FRA.²⁸ Within the foredune zone of the OHV riding area, plant cover was low (2.6 %) in 1939, rose to a peak of 5.3% in 1966, then declined steadily to ~1% from 1985 to 1998. These lower values reflect the influence of decades of vehicular recreation and camping activities in the dunes. Within the FRA specifically, plant cover declined to a negligible amount by 1985 until after installation of the treatments in 2020. At the NOF reference site, plant cover was <1% in the 1930s, but increased notably after 1985 to over 24% by 2012 in response to restoration efforts. Following restoration in the FRA, plant cover has increased to an average of 9.8% across all TPs by February 2026, which exceeded the historic maximum cover in all TPs, except the TP1 control plot, which remained at 3.2% as of February 2026.

²⁸ Swet, N, Hilgendorf, Z, Walker, IJ (2022). UCSB Historical Vegetation Cover Change Analysis (1930-2020) within the Oceano Dunes SVRA. Technical report to the Oceano Dunes Scientific Advisory Group (SAG) and the State of California Parks and Recreation Department Off-Highway Vehicle Division. February 2022.

Table 2-3. Vegetation Cover Change (%) in Each FRA TP							
Survey Date	TP1	TP2	TP3	TP4	TP5	TP6	NOF
February 10-11, 2020*	n/a	n/a	n/a	n/a	n/a	n/a	n/a
October 16, 2020	0.01	0.38	2.25	0.76	1.46	2.19	22.96
February 18-21, 2021	0.02	0.64	3.11	1.30	2.36	4.56	18.83
October 5-7, 2021	0.06	1.64	3.95	1.74	3.03	2.49	18.76
February 25-26, 2022	0.02	1.74	4.23	2.19	3.94	9.26	16.99
October 19-21, 2022	0.12	3.55	10.32	5.94	9.55	12.73	24.58
February 20-21, 2023	0.06	2.71	8.18	5.71	9.28	12.40	24.21
October 10-13, 2023	0.42	3.65	10.09	7.32	9.08	16.61	27.50
February 21-23, 2024	0.32	3.00	6.37	4.57	5.54	8.93	22.61
October 14-18, 2024	0.32	4.57	8.06	4.34	5.84	11.13	22.44
February 18-19, 2025	0.91	3.51	4.38	2.93	2.82	5.90	19.56
October 13-15, 2025	1.21	5.55	9.55	7.81	8.80	10.34	18.17
February 9-12, 2026	3.18	9.00	12.52	8.19	9.46	16.90	26.05
Vegetation cover (%) in each treatment plot and in the NOF as shown in Figure 2-17. Note: A multi-spectral sensor was not available (n/a) for the February 2020 campaign. Multispectral-derived NDVI calculations began in October 2020.							

Figure 2-17. Time Series of Vegetation Cover (%) by FRA TP

Time series of percent vegetation cover by treatment plot derived from the UAS surveys from February 2020 for the FRA treatment plots and October 2020 for the NOF reference site. Dashed line is the peak historic vegetation cover in 1966 (5.3%) within the foredune zone of the broader OHV riding area.²⁹ Corresponding values are shown in Table 2-3.

Sediment Budget Responses and Geomorphic Changes

For dunes to establish and be maintained following erosive events, they require net positive sediment budgets. The topographic difference maps (Figure 2-18 to Figure 2-24) show areas and quantities of significant elevation change that are used to calculate volumes of sediment erosion (red areas) or deposition (blue areas) between surveys. Values are normalized by area and over time (cubic meters per square meter per month [$\text{m}^3 \text{m}^{-2} \text{month}^{-1}$]), which effectively provides an average depth of change (m) over the entire surface averaged over the observation periods (see Table 2-4). Locations of statistically insignificant change are not shown in the change detection maps and are not used to calculate sediment volumes.

²⁹ IBID.

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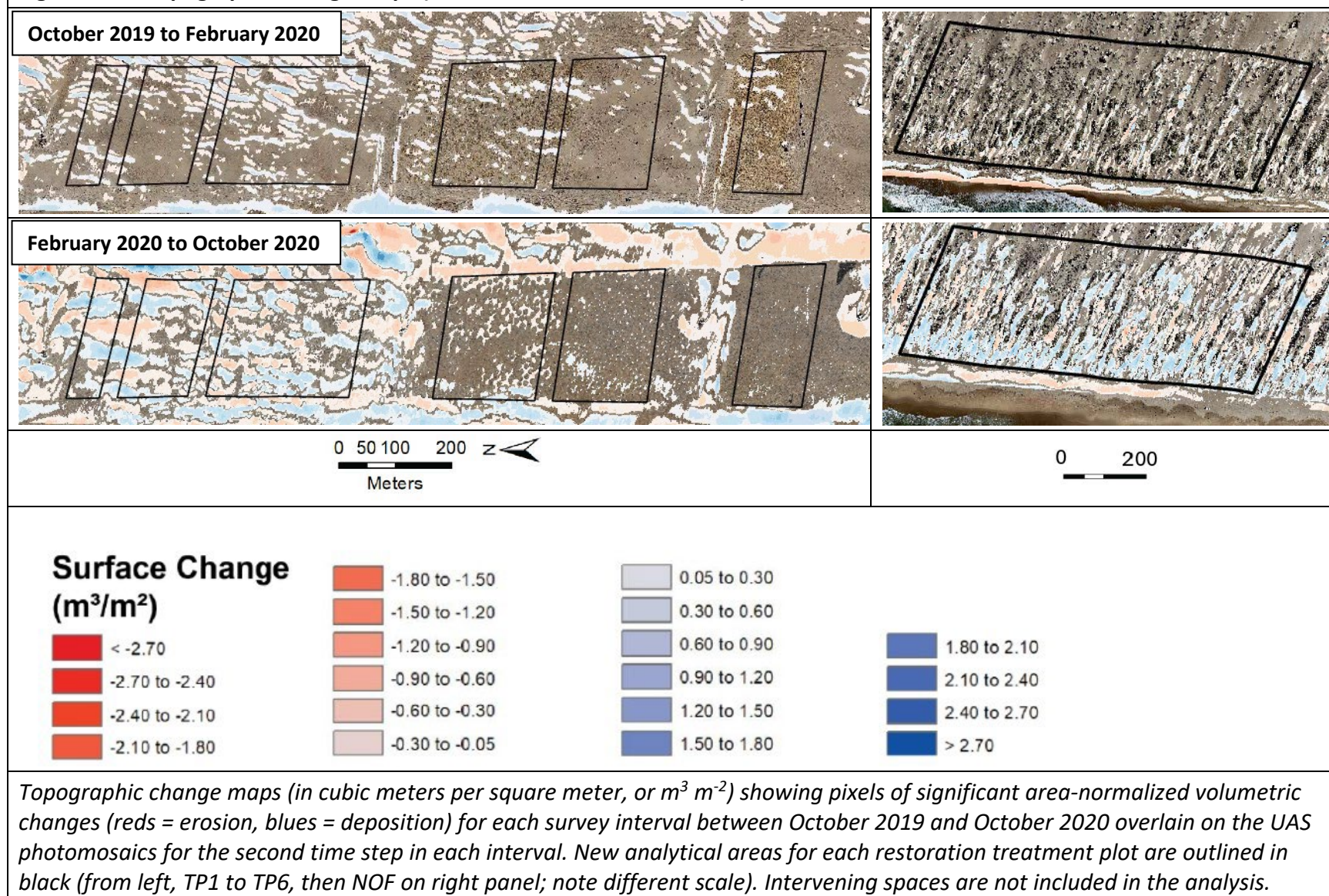
Figure 2-18. Topographic Change Maps (October 2019 to October 2020)

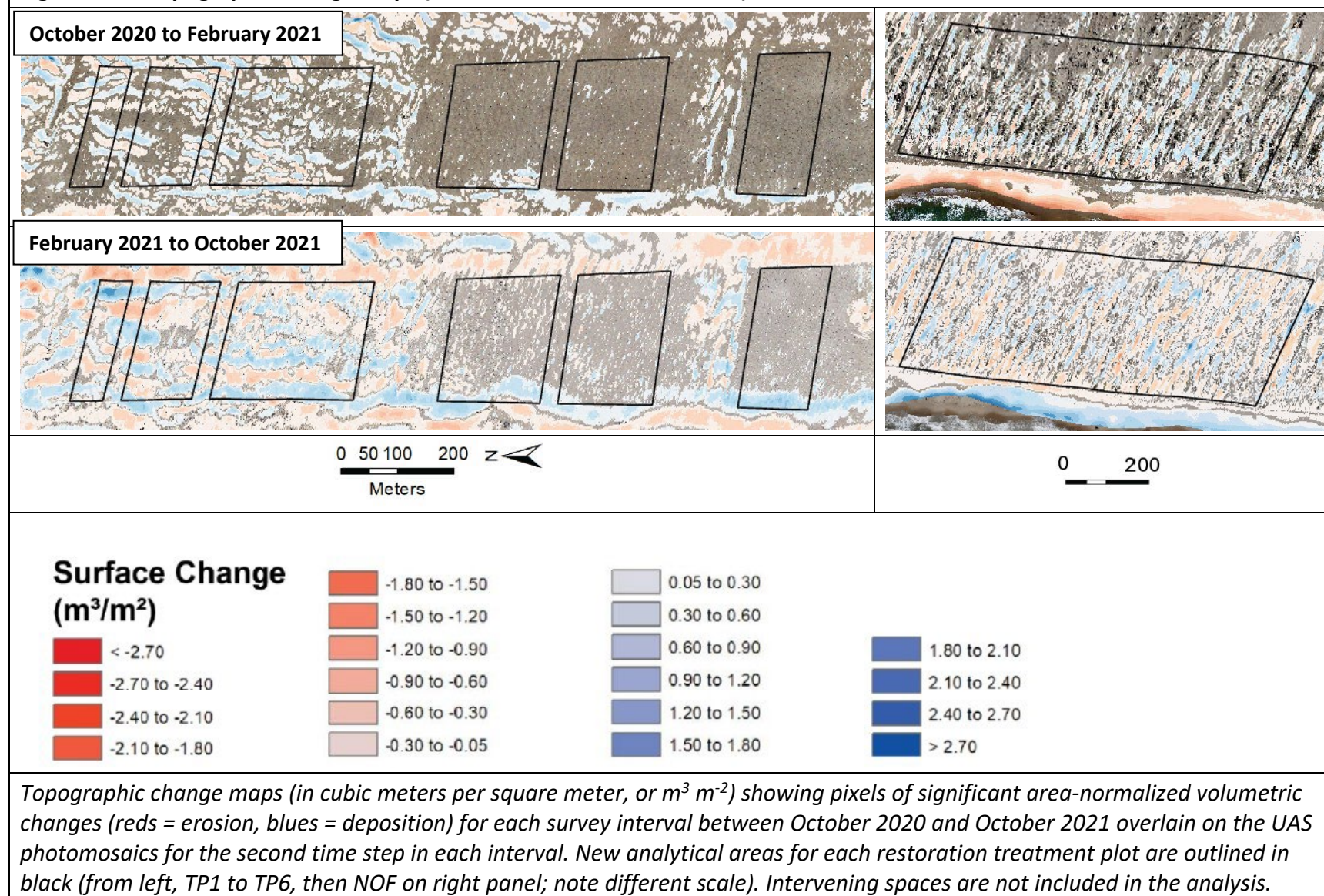
Figure 2-19. Topographic Change Maps (October 2020 to October 2021)

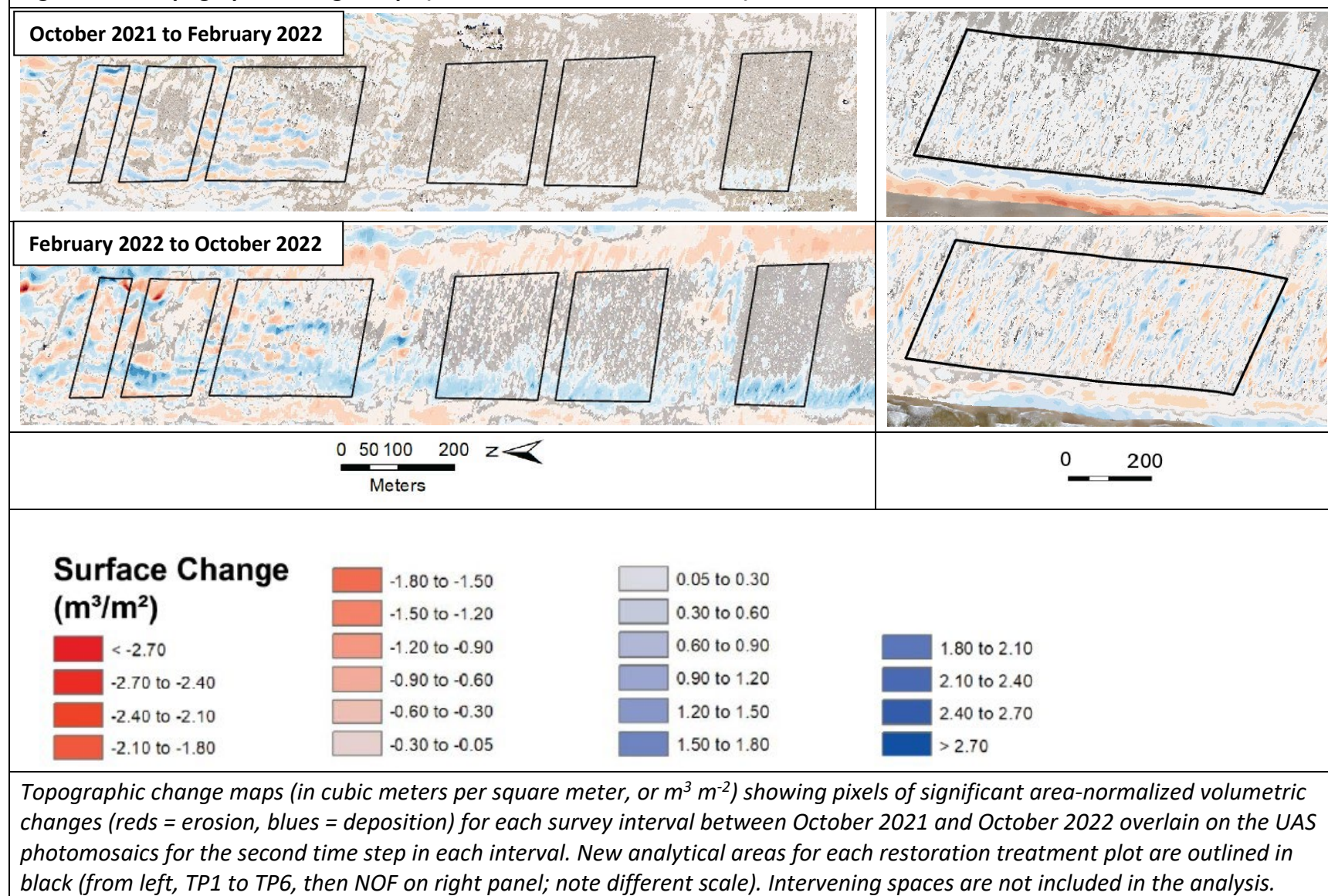
Figure 2-20. Topographic Change Maps (October 2021 to October 2022)

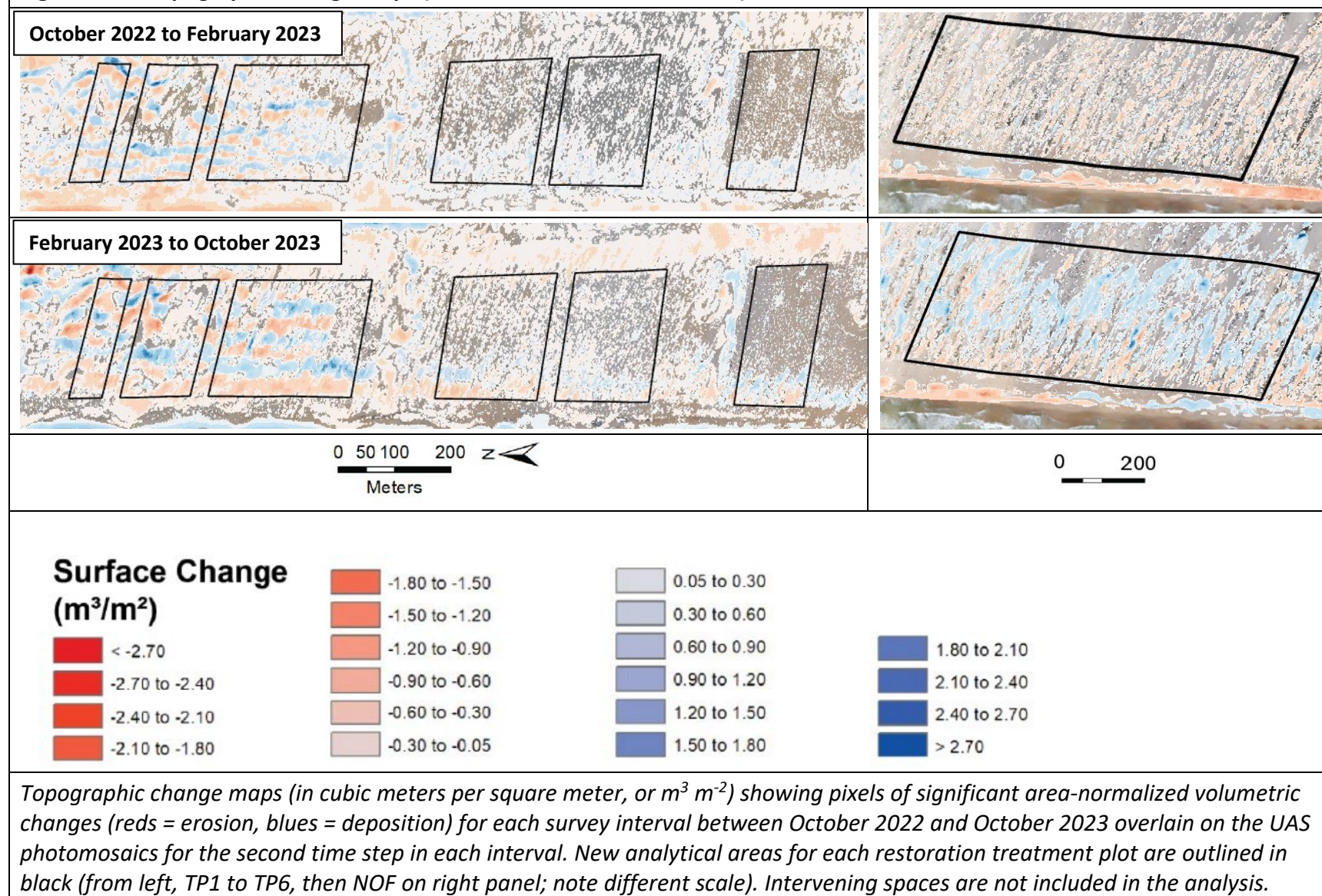
Figure 2-21. Topographic Change Maps (October 2022 to October 2023)

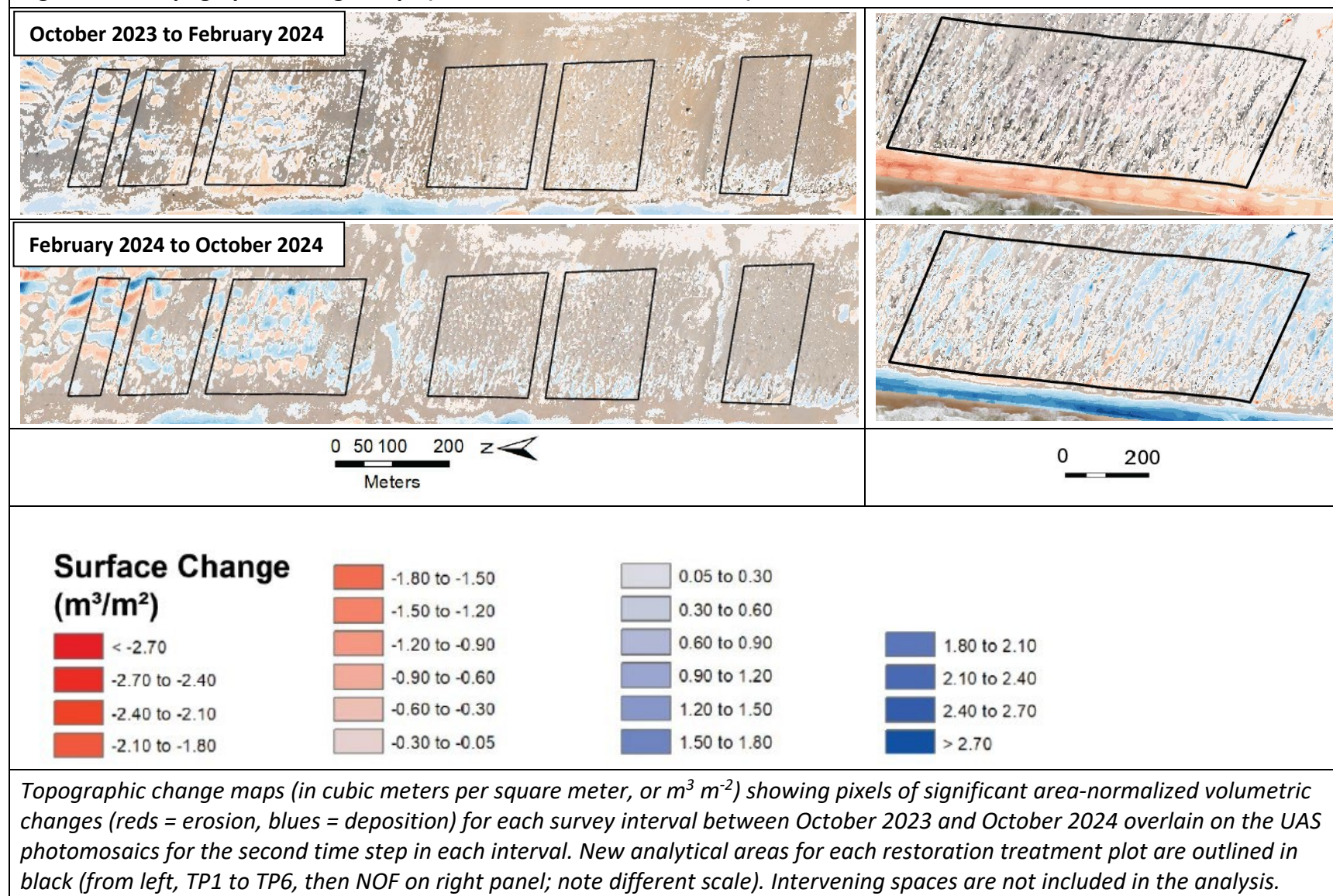
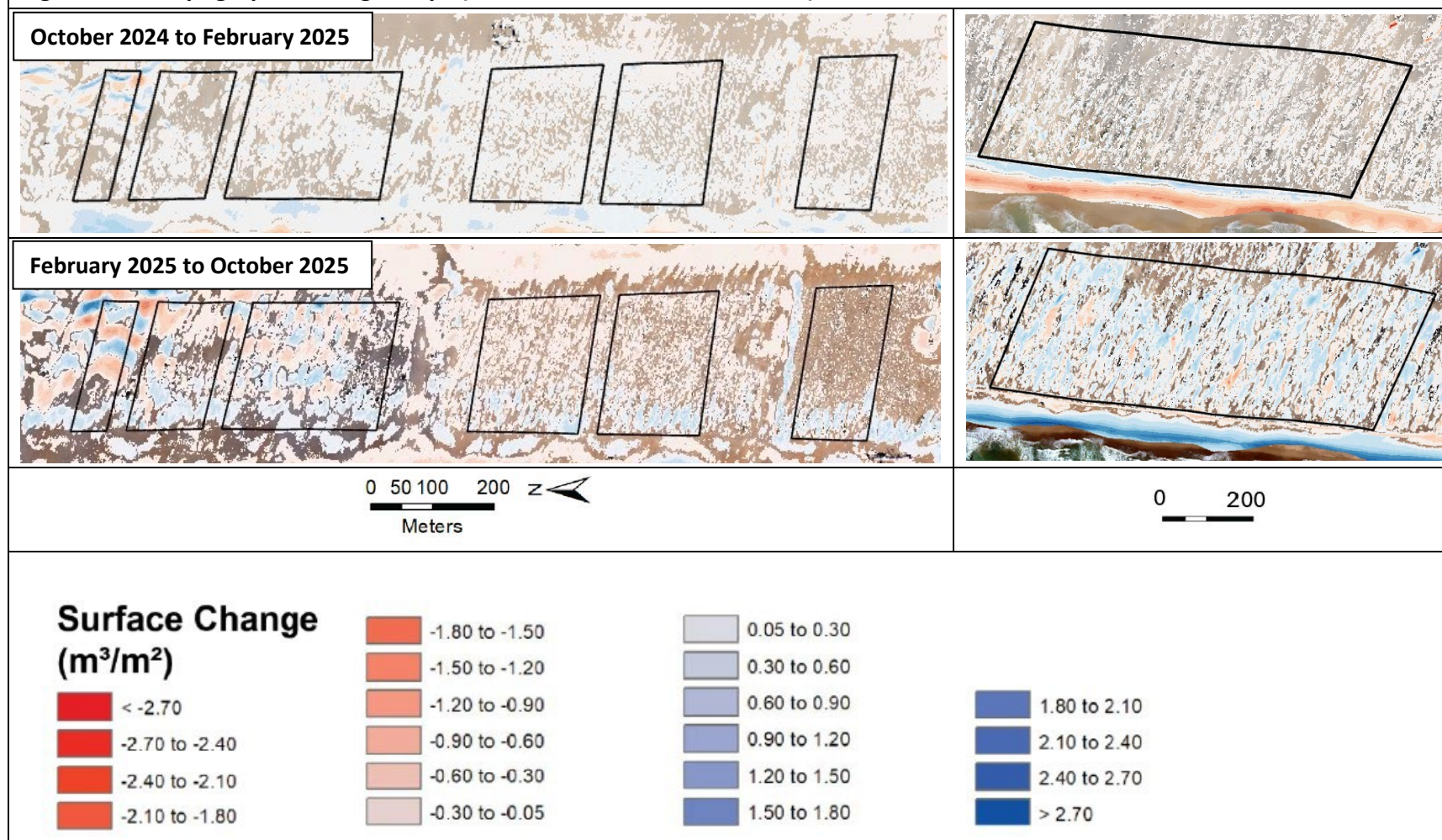
Figure 2-22. Topographic Change Maps (October 2023 to October 2024)

Figure 2-23. Topographic Change Maps (October 2024 to October 2025)

Topographic change maps (in cubic meters per square meter, or $\text{m}^3 \text{m}^{-2}$) showing pixels of significant area-normalized volumetric changes (reds = erosion, blues = deposition) for each survey interval between October 2024 and October 2025 overlain on the UAS photomosaics for the second time step in each interval. New analytical areas for each restoration treatment plot are outlined in black (from left, TP1 to TP6, then NOF on right panel; note different scale). Intervening spaces are not included in the analysis.

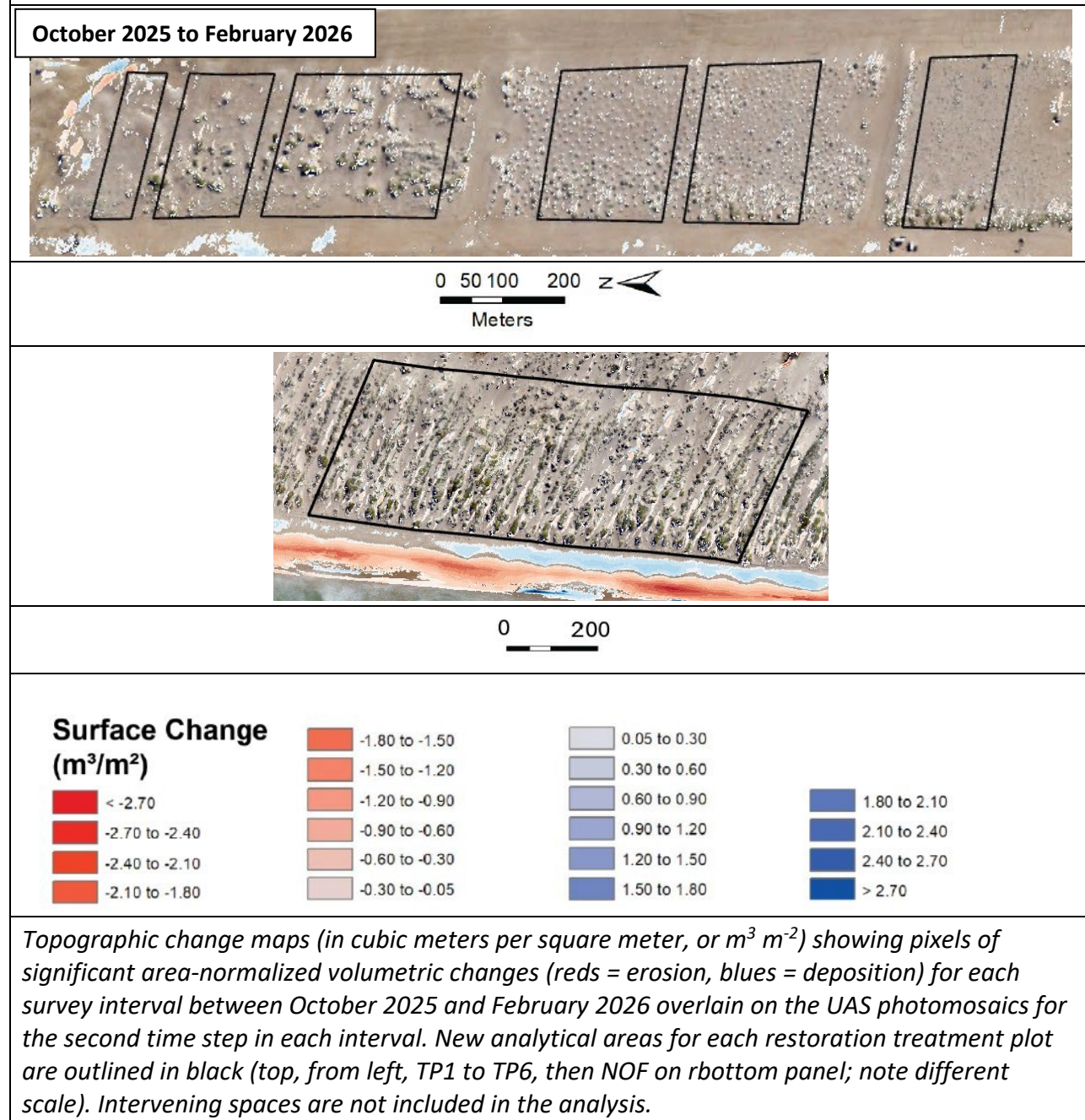
Figure 2-24. Topographic Change Maps (October 2025 to February 2026)

Figure 2-25 shows a time series of normalized volumetric changes within the treatment plots and their adjoining geomorphic units from October 2019 and February 2026 (values provided in Table 2-4). The first interval (October 2019 to February 2020) provides baseline reference conditions prior to implementation of the restoration treatments. Geomorphic units include each of the foredune treatment areas (FD), an adjoining beach area (B), and landward backdune areas (LD) (Figure 2-15). Within the NOF reference site, an additional foredune lee zone (FL) was identified that is a non-riding area with limited dune development that backs the established foredune and

connects to the backdune riding area. For simplicity, and because the FRA TP units lack a comparable zone, volumetric change data for this FL zone are not included in the analysis.

Figure 2-25. Normalized Volumetric Change by Month for FRA TPs

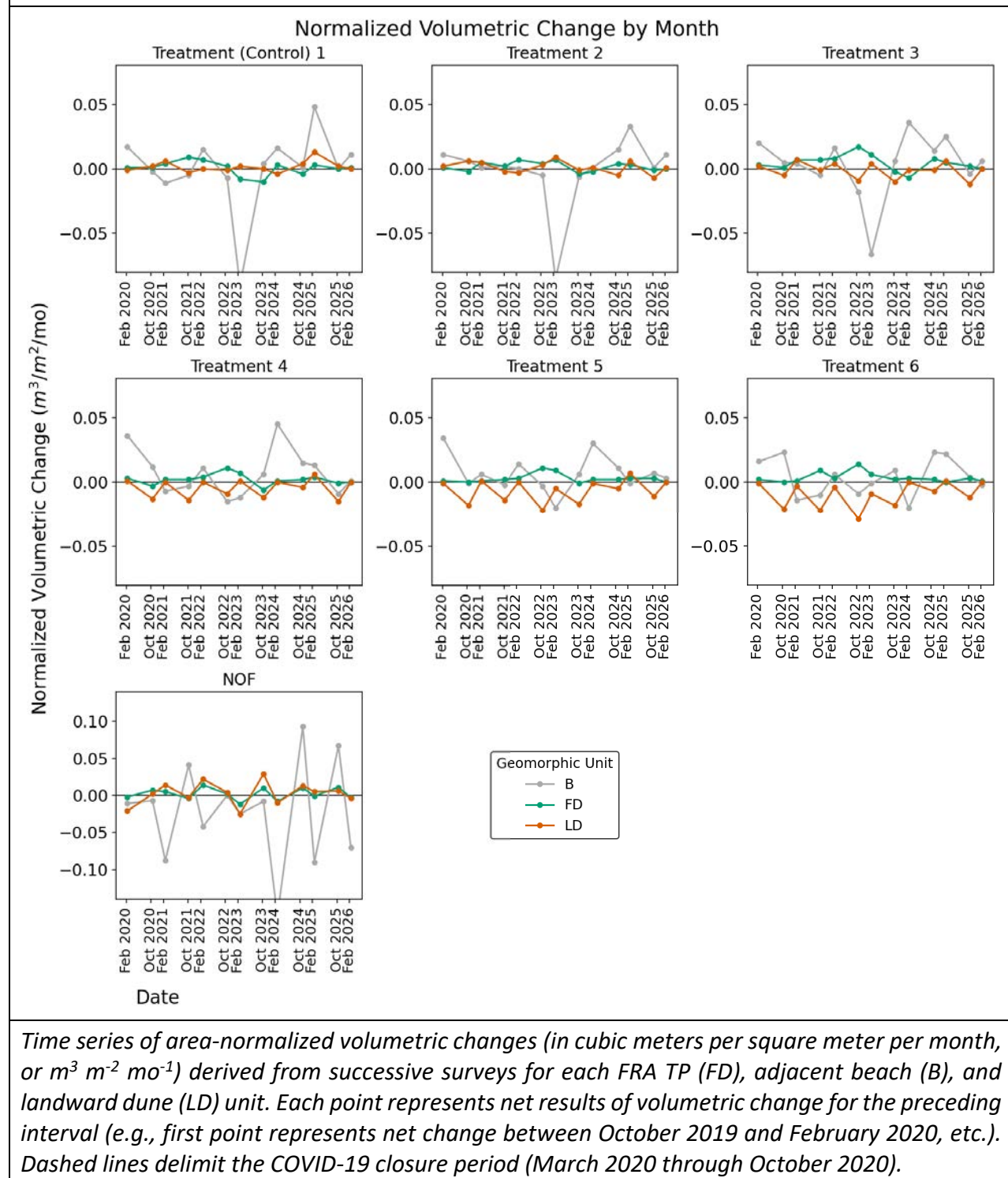


Table 2-4. Area-Normalized Volumetric Changes ($\text{m}^3 \text{m}^{-2} \text{mo}^{-1}$) x 1000

Treatment Plot	Landscape Unit	Oct 2019 to Feb 2020	Feb 2020 to Oct 2020	Oct 2020 to Feb 2021	Feb 2021 to Oct 2021	Oct 2021 to Feb 2022	Feb 2022 to Oct 2022	Oct 2022 to Feb 2023	Feb 2023 to Oct 2023	Oct 2023 to Feb 2024	Feb 2024 to Oct 2024	Oct 2024 to Feb 2025	Feb 2025 to Oct 2025	Oct 2025 to Feb 2026	Cumulative Change	Cumul change/Cumul change (NOF)
TP 1	B	17.24	-1.60	-10.89	-4.92	15.01	-6.51	-89.71	3.67	16.23	0.94	47.87	-0.22	10.68	-1.40	0.35
	FD	1.23	1.19	4.18	8.61	7.15	1.61	-7.56	-9.54	3.35	-3.85	3.18	-0.32	0.74	9.97	
	LD	-1.02	2.41	5.77	-3.37	0.44	-1.35	1.68	-0.30	-3.56	3.50	12.60	1.75	-0.20	1.80	
TP 2	B	11.37	6.42	1.16	2.19	-0.17	-5.08	-85.05	-6.07	0.63	15.27	33.12	1.14	10.92	-2.70	0.82
	FD	1.08	-2.02	5.22	1.70	7.31	3.99	6.76	-3.60	-2.23	4.23	2.70	-1.38	-0.03	23.73	
	LD	1.85	6.14	4.83	-2.20	-2.65	3.26	9.13	-0.56	0.69	-5.13	5.89	-6.75	0.76	2.10	
TP 3	B	20.19	5.25	4.04	-4.85	16.09	-17.68	-65.80	5.85	35.82	14.38	25.50	-3.71	5.60	3.70	2.02
	FD	2.98	1.18	6.53	7.24	7.86	17.07	10.50	-2.45	-7.37	7.86	4.95	1.69	0.35	58.39	
	LD	2.33	-4.84	7.01	-1.31	3.69	-8.87	4.23	-10.13	-1.27	-1.38	5.85	-11.98	0.25	-0.40	
TP 4	B	35.54	11.78	-6.95	-3.30	11.31	-15.19	-12.09	5.86	45.09	15.16	13.27	-8.57	1.49	10.10	0.93
	FD	3.47	-2.86	2.28	2.31	3.83	10.54	7.36	-5.98	0.65	1.80	3.83	-0.59	0.32	26.96	
	LD	0.90	-12.80	-0.40	-13.66	0.07	-8.90	1.01	-11.82	-0.24	-3.65	6.19	-15.03	0.20	-4.40	
TP 5	B	34.01	-0.93	6.28	-2.32	14.16	-2.64	-19.58	5.91	29.60	10.59	-1.23	6.73	2.58	7.40	1.26
	FD	1.30	0.26	0.98	1.61	3.18	11.01	8.65	-1.45	2.32	2.41	2.90	2.75	0.34	36.26	
	LD	-1.12	-18.12	1.26	-13.89	0.01	-21.58	-5.19	-16.76	-0.53	-5.31	6.94	-11.33	0.18	-7.50	
TP 6	B	15.54	23.18	-13.86	-9.52	6.39	-8.96	-0.52	8.98	-20.00	22.66	21.84	4.43	-2.27	4.50	1.64
	FD	2.38	0.29	0.80	9.06	3.47	14.28	6.20	1.95	3.26	2.01	-0.12	3.12	0.50	47.20	
	LD	-0.59	-21.21	-3.23	-22.36	-4.19	-28.57	-8.84	-17.52	-0.36	-6.57	0.74	-11.99	-0.16	-11.30	
NOF	B	-11.15	-6.64	-88.13	41.33	-42.37	-0.14	-25.36	-8.32	-163.30	93.28	-89.85	66.61	-70.12	-304.16	1.00
	FD	-1.68	6.73	5.28	-4.11	13.67	1.97	-11.55	9.68	-7.55	9.85	-1.31	10.86	-2.99	28.85	
	LD	-20.99	1.89	13.59	-2.70	21.62	4.24	-25.03	28.94	-10.28	12.98	4.84	6.20	-3.78	31.52	

Normalized surface volumetric changes for the beach (B), foredune treatment plots (FD) in bold, and landward dune (LD) zones for all the treatment plots and the NOF, using the new polygons. Blue text indicates sand accumulation, red text indicates erosion. The last column indicates the treatment plot foredune area-normalized net volumetric change and the green value is the one closest to the NOF (i.e, closer to one). Uncertainty values are provided in Table 2-2 in Section 2.2.3.

Sediment flux to the beach units is a key control on the sediment budgets and geomorphic responses of landward dunes. The beach units fronting the FRA treatment plots show variable trends of positive (depositional) and negative (erosional) volumetric change (Figure 2-25) that relate to seasonal variations (e.g., winter storm erosion signals) and migration of rip current embayments. Generally, most of the beach units showed declining trends in volume from initial positive values in the October 2019 to February 2020 baseline interval to distinctly negative values by February 2023. Since 2024, most beach units have shown positive trends (Table 2-4), except for slight erosion at TP3 to TP6 in 2025. The northern two plots (TP1-2) have experienced more pronounced erosive intervals compared to the southern four plots (TP3 through TP6) suggesting a general trend of minor erosion in the northern beach units, transitioning towards a more depositional state in the southern units. Farther south at the NOF site, the beach unit shows significantly greater volumes of erosion and deposition with a net (erosional) change of $-304.16 \times 10^{-3} \text{ m}^3 \text{ m}^{-2} \text{ mo}^{-1}$, which is roughly triple the magnitude of the highest net sediment change at TP4 (Table 2-4). This response is due partly to the persistence of large rip cell embayments and a generally narrower beach at this location.

The FRA treatment plots continue to experience net positive gains in sediment volumes (see Figure 2-25 and Table 2-4), albeit with distinct erosional periods (e.g., February to October 2023). The TP1 control site and TP2 continue to show the lowest rates of accumulation, reflecting significant beach erosion and sediment bypassing due to lower plant cover and limited nebkha dune development. TP4 and TP5 experienced the fourth and third highest accumulation, respectively, with relatively low accumulation rates since February 2024. TP6 is the only plot to have experienced minimal erosion (except in February 2025) and now has the second highest net deposition. As reported in the 2025 ARWP, TP6 had the highest accumulation, but this was biased by deposits along a sand fence on the northern side of the plot, which has since been removed from analysis, in consultation with SAG and State Parks. As a result, TP3 is now the treatment plot with the greatest net sand accumulation and has developed extensive nebkha that have coalesced to form appreciable discontinuous ridges >2 m high, which are the tallest dunes in the FRA. Since February 2024, all treatment plots have shown neutral to slightly positive trends in normalized sediment volumes.

In contrast to the largely positive sediment volumes observed in most intervals in the FRA, the foredune at the NOF reference site has shown intermittent periods of erosion and deposition (see Figure 2-25 and Table 2-4). Periods of erosion tend to occur in winter while depositional intervals often occur in summer. In terms of net sediment budgets, TP3, 6, and 5, in decreasing order, have had larger net amounts than the NOF site by factors of 2.02, 1.64, and 1.26, respectively (Table 2-4). Normalized net sediment volume values >1 suggest that these treatments are accumulating at faster rates than the NOF reference site, which is expected for developing dunes. Values < 1 suggest that these sites (TP1, TP2, TP4) are under performing in sediment accumulation rates. Generally, NOF has a much larger magnitude of change in the beach unit compared to the beach unit at the FRA, with a net (erosional) change of $-304.16 \times 10^{-3} \text{ m}^3 \text{ m}^{-2} \text{ mo}^{-1}$, which is more than triple the net

sediment change of the FRA beach unit. As mentioned above, this is potentially due to the presence of large rip-cell embayments and the typically narrower beach width at NOF.

Changes in Topographic Roughness and Dust Control Potential

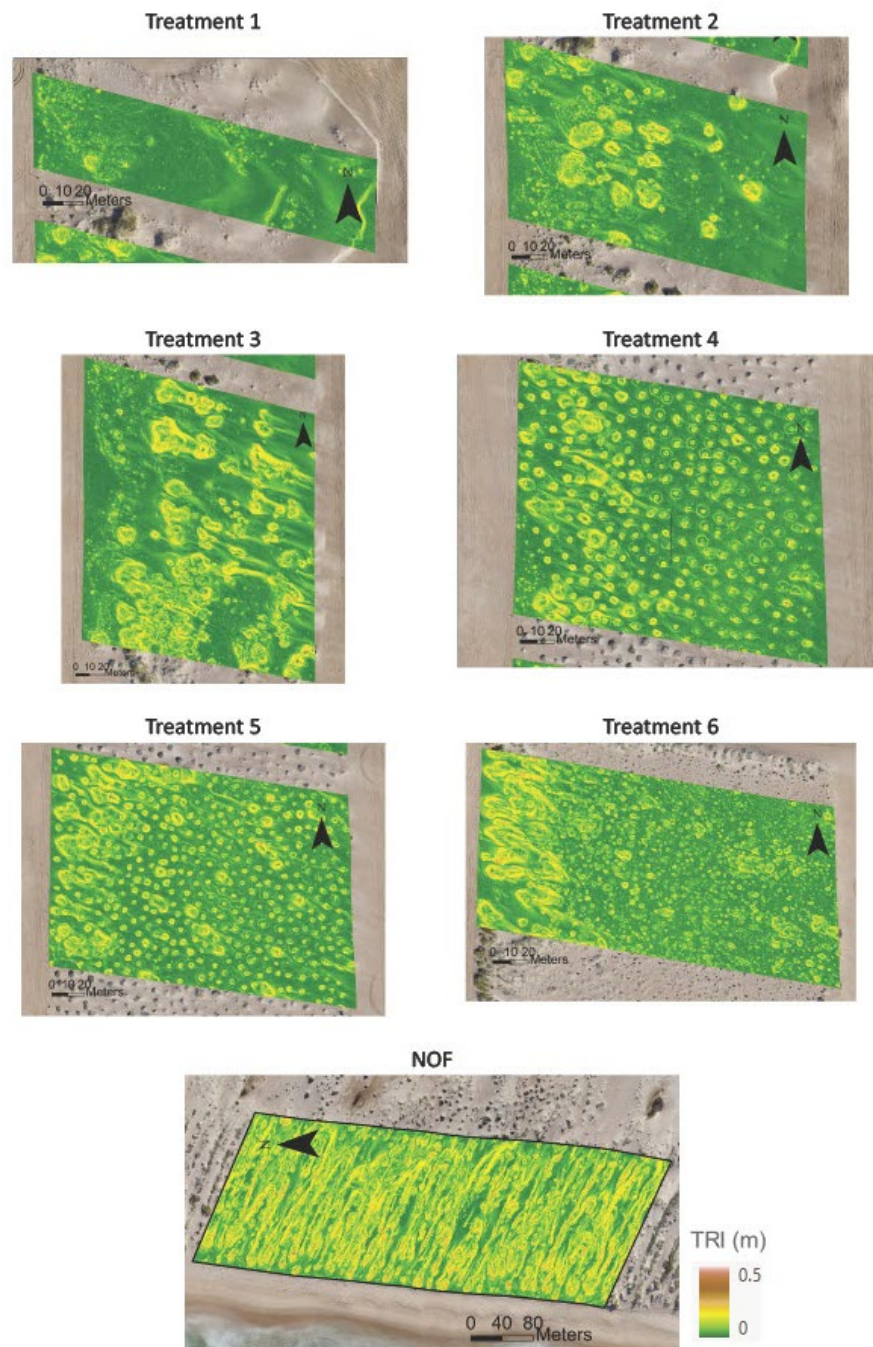
To provide a more quantitative metric to characterize the dust control potential of the evolving dunes and plant cover in the treatment plots, a new TRI, in meter, was used to quantify the topographic complexity and aerodynamic roughness of the treatments based on the spatial variability in elevation derived from their DTMs. This metric has been used in other aeolian studies^{30,31} and an existing method³² was applied that computes TRI using the differences between a given pixel's elevation and that of its neighboring cells using ArcGIS. Full details of the equation used and general methodology are provided in Attachment 05. Besides roughness, TRI values also depend on the pixel size and the neighborhood over which TRI is calculated. For this study, TRI values range from 0 (low roughness) to 1.5 m (high roughness), although values exceeding 0.5 m are rare, with the vast majority concentrated between 0 and 0.5 m. The mean TRI value was determined for each treatment plot (Table 2-5). Figure 2-26 shows examples of TRI-derived roughness maps from the most recent February 2026 DTMs.

Table 2-5. Mean TRI values (x100, in meters) for FRA TPs and NOF														
Area	Oct. 2019	Feb. 2020	Oct 2020	Feb. 2021	Oct. 2021	Feb. 2022	Oct. 2022	Feb. 2023	Oct. 2023	Feb. 2024	Oct. 2024	Feb. 2025	Oct. 2025	Feb. 2026
TP 1	1.92	2.25	2.07	2	2.75	2.31	3.76	3.08	4.37	3.1	2.75	3.31	2.87	2.69
TP 2	1.8	2.07	2.07	2.1	3.01	2.65	3.94	3.51	4.95	3.46	3.52	3.92	3.83	3.65
TP 3	1.93	2.08	2.31	2.73	3.94	3.72	4.75	4.54	5.79	4.63	4.75	5.11	5.25	4.86
TP 4	1.78	2.09	2.19	2.54	3.21	3.02	3.04	3.95	5.51	4.49	4.55	4.7	4.75	4.41
TP 5	1.73	1.85	1.95	2.57	3.62	3.22	4.06	4.52	5.86	4.73	4.75	5.17	5.35	4.98
TP 6	1.76	2.12	1.94	2.83	3.53	3.65	4.05	4.48	5.15	4.87	4.75	5.12	5.09	4.81
NOF	8.03	7.84	8.04	8.1	8.66	8.48	8.61	8.82	8.92	8.4	9.01	8.9	8.69	8.63
Mean TRI values (m) for each foredune restoration treatment plot (TP1 to TP6) and the NOF reference site in bold. Note that values are multiplied by 100 for presentation. The three highest mean TRI values observed are shown in red, while the three highest values in the latest survey are in blue.														

³⁰ Nield, J.M., G.F.S. Wiggs, and R.S., Squirrell, 2011. Aeolian sand strip mobility and protodune development on a drying beach: examining surface moisture and surface roughness patterns measured by terrestrial laser scanning. *Earth Surface Processes and Landforms*, 36(4), 513-522.

³¹ Sankey, J.B., J.U. Eitel, N.F. Glenn, M.J. Germino, and L.A. Vierling, 2011. Quantifying relationships of burning, roughness, and potential dust emission with laser altimetry of soil surfaces at submeter scales. *Geomorphology*, 135(1-2), 181-190.

³² Riley, S., S.D. DeGloria, and R. Elliot, 1999. A terrain ruggedness index that quantifies topographic heterogeneity. *Intermountain Journal of Sciences*, 5(1-4), 23-27.

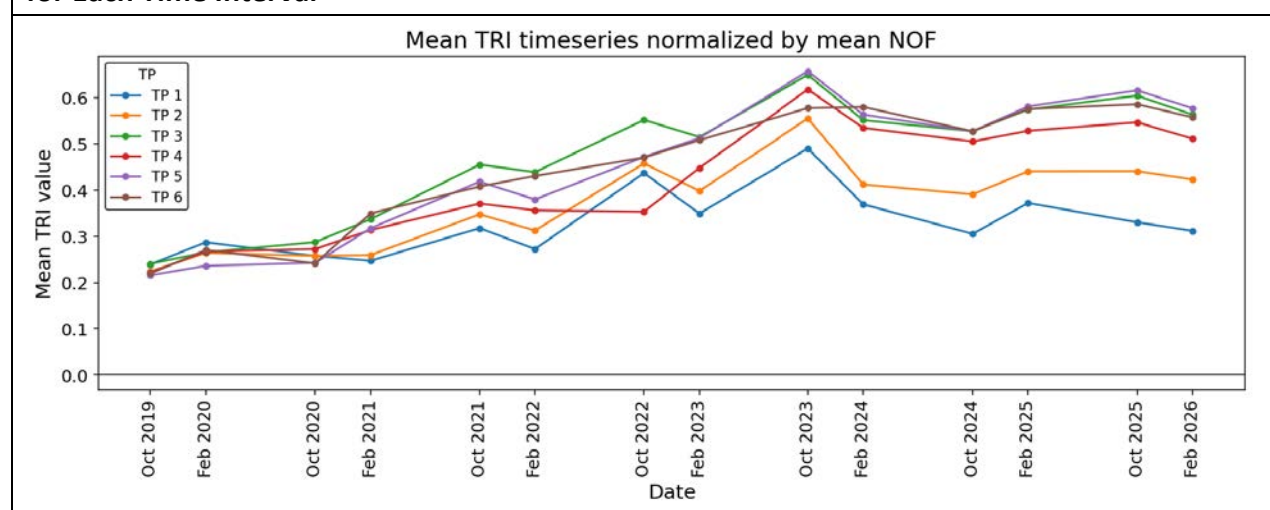
Figure 2-26. Changes in Topographic Roughness and Dust Control Potential

Map of TRI (in m) for each restoration treatment plot and for the NOF foredune reference site, computed using the February 2026 DTM. Generally, greener colors represent smoother surfaces (e.g., interdune corridors, blowouts) and warmer colors are rougher terrain (e.g., dune ridges, vegetated nebkha). All maps are scaled similarly for comparison. Mean values ($\times 100$ for presentation) are presented in Table 2-5.

To date, all treatment plots have shown a progressive increase in roughness (i.e., a positive trend in TRI values) until October 2023, then a decline through October 2024, followed by slight increases in most sites, except TP1 and TP2 (Table 2-5). Roughness increases to October 2023 ranged from ~127% of initial TRI values at the TP1 control site to 239% for TP5. This interval was followed by a widespread decline in roughness from October 2023 to October 2024, ranging from -25% (TP5) to -30% (TP1), which could reflect corresponding declines in plant cover³³. By February 2026, the sites with the highest roughness were, in decreasing order, TP5, TP3, and TP6, followed by TP4, TP2 and TP1. As expected, the NOF reference site has the highest normalized TRI values, given its fully developed dunes, yet it also showed a slight decrease (-6%) from October 2023 to February 2024, but remains mostly stable with slight increases (up to 12%) otherwise.

To assess how the FRA treatment plots are progressing toward the roughness and dust control potential of fully-developed dunes at the NOF reference site, Figure 2-27 shows normalized treatment plot roughness values as a proportion of those at the NOF for each interval. A normalized TRI value here represents unity with roughness conditions at the NOF. TP3, TP5, and TP6 have consistently shown the highest normalized roughness since February 2022, with TP3 and TP5 often leading, while TP6 remained very close and slightly less variable over this time. Since early stages of development in October 2020, the FRA treatment plots have generally increased from 20 to 30% of the roughness at the NOF to over 60% during peak observations in October 2023. Currently, the treatments range from 43% (TP2) to 58% (TP5) of the NOF roughness with the TP1 control site at 31%.

Figure 2-27. TRI Time Series of TRI for Each FRA TP Normalized by Area and by the NOF Value for Each Time Interval



Time series of TRI for each foredune restoration treatment plot (TP1 to TP6) normalized by area and by the NOF TRI value. Because the TRI values of the TPs are normalized by the values of NOF,

³³ Note: DTMs used for roughness parameterization include both plant cover and dune forms. See Daudon et al. (2026) for full details on the TRI methodology.

it is dimensionless (has no units).

Performance Assessment of Restoration Treatments

The FRA was designed as a ‘nature-based’ approach to reduce dust emissions by re-establishing a foredune ecosystem using an assortment of treatment types of increasing levels of intervention. To inform potential adaptive management by State Parks, it is important to recurrently evaluate the relative performance of the treatments. In previous ARWPs, performance assessment was based on a cumulative score derived from six indicators whereby lower values indicated higher overall performance. This approach was refined and simplified, in consultation with the SAG and SLOAPCD, to focus only on three indicators (metrics): 1) plant cover (% cover), 2) sediment budgets (area-normalized volumetric change), and 3) topographic roughness (TRI). Metrics are derived from within smaller analytical areas to reduce bias from edge effects and with comparison to the NOF reference site. Summaries for each of the assessment indicators are as follows:

1. **Net positive plant cover trends persist for all FRA treatment plots** since installation, with some variability, and despite a concerning declining trend at most sites, including the NOF reference site, that began in October 2023. Declines were most pronounced in TP6 and less so within TP3 through TP5. This trend has since reversed with the most recent surveys in October 2025 and February 2026 showing increases in plant cover in all treatment plots and at the NOF. These corresponding declines, followed by increases in vegetation within the FRA and NOF, suggests a regional trend that is likely driven by variability in regional climate, sediment transport, vegetation burial, plant health, and/or plant community dynamics. Currently, **the three top performers for plant cover are TP6 (16.9%), TP3 (12.5%), and TP5 (9.5%) with TP1 through TP4 reaching their highest cover values to date.** With the exception of the TP1 control site, all plots have surpassed the peak historical observed plant cover in the foredune zone (5.3% in 1966). However, vegetation cover within the FRA has not yet reached the target cover state at the NOF reference site (26.1%). At NOF, vegetation trends have been relatively stable, yet fluctuate by as much as 9%, which could be typical of fully-developed dune ecosystems in the region. Observations of trends in plant cover in the FRA and NOF reinforce that more time is required for the treatments to re-establish and sustain dune plant communities, which has important implications for maintaining dune development and growth and, in turn, dust emissions control potential (see also #3 below).
2. **Net positive sediment budgets continue within all FRA treatment plots** (Table 2-4) and the last two monitoring intervals saw mostly positive budgets that exceed those of the TP1 control plot. For comparison to observed changes at the NOF, there were two distinct intervals where most treatment plots exceeded accumulation amounts at the NOF (October 2022, February 2025), which indicate rapid phases of dune growth. For instance, in October 2022, accumulation rates in the treatment plots were 2 to 8 times higher than NOF and roughly 2 to 4 times greater in February 2025. Over time, treatment plot values alternate above and below those at the NOF,

which is not unexpected given variations in beach sediment supply across sites and because the treatment areas should be accumulating sediment at faster rates as the dunes continue to develop. Comparison of overall (net) volumetric gains of each treatment plot against those of the NOF indicates that TP4 has the closest net sediment budget (~11% lower) to that of the NOF; however, as it is expected that the FRA should have higher rates of accumulation than the NOF as the treatment plots continue to develop, **the three top performers with respect to exceeding NOF net accumulation values are TP3 (+106%), TP6 (+60%), and TP5 (+25%).**

3. **Dust control potential for all FRA treatment plots continues to increase.** The new TRI provides a proxy measure of the aerodynamic roughness and surface sheltering effects of the evolving FRA plots, such that higher TRI values and positive TRI trends indicate enhanced dust control potential. Since installation, all treatment plots, as well as the TP1 control site, have shown net positive trends in roughness (Table 2-5), albeit with some variability. Coincident with observed declines in plant cover, a period of declining roughness occurred across all sites from October 2023 to October 2024, and which persisted through February 2025. **As of February 2026, the three top performers for dust control potential based on TRI scores are, in decreasing order, TP5 (57.7%), TP3 (56.3%), and TP6 (55.7%).** Despite continued net positive roughness trends since installation, none of the treatment plots have reached the scale of roughness at the NOF, which has remained largely stable during the six year monitoring period. As with vegetation cover, this reinforces that more time is required for the FRA treatments to continue their morphological development and maximize their dust emissions control potential.

Based on these three indicators and their metrics, TP6 maintains top performance for plant cover (at roughly 65% of the NOF), TP3 for sediment accumulation (at rates exceeding NOF), and TP5 for dust control potential (at about 58% of the NOF). **Overall, as TP3 also placed second for vegetation cover and dust control potential, it narrowly outperformed TP6 and TP5 as the most effective treatment to date** toward developing established foredunes with a self-sustaining plant community while offering enhanced dust control potential.

2.2.4 OTHER VEGETATION MONITORING

In addition to UAS surveys, State Parks monitors changes in vegetation in dust control projects using line-intercept transect sampling and photo point monitoring. Refer to Attachment 06 for detailed information on State Parks' line-intercept sampling and photo point methodology and results.

2.2.4.1 FOREDUNE LINE-INTERCEPT TRANSECT SAMPLING

The line-intercept method is used to evaluate species richness within the 48-acre foredune project and one reference site that had been closed to vehicular activity for at least 20 years and not subject to restoration plantings in the past.³⁴ In 2025, State Parks sampled the following foredune areas:

- The 48-acre foredune project (2020-VG-01, 2020-VG-02, and 2020-VG-03, planted in February 2020). This area was surveyed in 2020 to 2024, and the same transect lines were surveyed in 2025.
- The NOF foredune reference site, which was surveyed in 2021, 2023, 2024, and 2025 to account for potential changes caused by storm surges or other environmental changes.³⁵

The results of State Parks' 2025 line-intercept transect sampling are summarized as follows and in Table 2-6:

- The treatment type with the highest native and total species richness was TP6, which had 10 native species and 12 total species present, matching the total species richness of the NOF reference site, followed by TP5, which had 10 native species and 11 total species present.
- Each of the six treatment types showed an increase in total species richness compared to 2024 results: TP1 (from 4 to 5 species), TP2 (from 3 to 4 species), TP3 (from 5 to 8 species), TP4 (from 9 to 10 species), TP5 (from 10 to 11 species), and TP6 (from 10 to 12 species).

³⁴ Prior to 2025, State Parks' line-intercept transect sampling surveys were also used to evaluate percent cover of species, with the results of the line-intercept transect sampling compared to the UAS survey results to assess total vegetative cover within the FRA. State Parks, in consultation with the SAG, ceased the evaluation of percent cover during line-intercept transect sampling because it was determined to be redundant with the UAS surveys.

³⁵ Although the NOF foredune reference site is in the same geographical location as the reference site described in Section 2.2.3 and shown in Figure 2-15, it was determined independently of the methodology presented in the UAS survey report (see Attachment 5).

Table 2-6. Summary of Foredune Line-Intercept Sampling Results		
Survey Site^(A)	Native Species Richness	Total Species Richness
2023^{(B),(C)}		
Foredune TP1 – Control	6	8
Foredune TP2 – Native Seed	4	5
Foredune TP3 – Native Seed and Grain Seed	6	7
Foredune TP4 – Low-Density Nodes	9	10
Foredune TP5 – High-Density Nodes	8	9
Foredune TP6 – Parks’ Classic	9	10
Reference Site – North Oso Flaco Foredune	9	11
2024^(B)		
Foredune TP1 – Control	3	4
Foredune TP2 – Native Seed	2	3
Foredune TP3 – Native Seed and Grain Seed	4	5
Foredune TP4 – Low-Density Nodes	8	9
Foredune TP5 – High-Density Nodes	9	10
Foredune TP6 – Parks’ Classic	9	10
Reference Site – North Oso Flaco Foredune	10	12
2025		
Foredune TP1 – Control	4	5
Foredune TP2 – Native Seed	3	4
Foredune TP3 – Native Seed and Grain Seed	7	8
Foredune TP4 – Low-Density Nodes	9	10
Foredune TP5 – High-Density Nodes	10	11
Foredune TP6 – Parks’ Classic	10	12
Reference Site – North Oso Flaco Foredune	10	12
(A) The foredune was planted in 2020. All foredune treatment areas were approximately 5.5 years old at the time of the 2025 line-intercept sampling. State Parks typically conducts this survey once in September or October, when the survey will not disturb nesting Western Snowy Plover and California Least Tern. (B) Refer to State Parks’ 2025 ARWP, Section 2.2.4.1, Table 2-6. (C) In 2023, there were four native wetland species that were only present in the storm surge wrack on the western side of the 48-acre foredune. These species, which included marsh jaumea (<i>Jaumea carnosa</i>), saltgrass (<i>Distichlis spicata</i>), dune rush (<i>Juncus lescurii</i>), and California bulrush (<i>Schoenoplectus californicus</i>), were not expected to persist and were not observed in 2024 or 2025.		

The species present within FRA TPs and NOF during the October 2025 sampling are summarized in Table 2-7.

Table 2-7. Summary of Vegetation Species Present in FRA TPs and NOF During October 2025 Sampling							
Species	TP1^(A)	TP2^(A)	TP3^(A)	TP4^(A)	TP5^(A)	TP6^(A)	NOF^(A)
Scientific Name Common Name							
<i>Abronia latifolia</i> Yellow sand verbena	P	P	P	P	P	P	P
<i>Abronia maritima</i> Sticky sand verbena	P	P	P	P	P	P	P
<i>Achillea millefolium</i> Common yarrow	-	-	-	-	P	-	-
<i>Ambrosia chamissonis</i> Beach bur	P	P	P	P	P	P	P
<i>Atriplex leucopylla</i> Sea scale tream	P	-	-	P	P	P	-
<i>Camissoniopsis cheiranthifolia</i> Beach evening-primrose	-	-	P	P	P	P	P
<i>Eriogonum parvifolium</i> Coastal buckwheat	-	-	-	-	-	P	P
<i>Eriophyllum staechadifolium</i> Seaside golden yarrow	-	-	P	P	P	P	-
<i>Fragaria chiloensis</i> Beach strawberry	-	-	-	-	-	P	-
<i>Malicothrix incana</i> Dunedelion	-	-	-	P	P	-	P
+* <i>Cakile maritima</i> Sea rocket ^{(B),(C)}	P	P	P	P	P	P	P
+ <i>Calestegia soldanella</i> Beach morning glory ^(C)	-	-	-	-	-	-	P
+* <i>Carpobrotus chilensis</i> Sea fig ^{(B),(C)}	-	-	-	-	-	P	P
+ <i>Ericameria ericoides</i> ^(C) Mock heather	-	-	-	-	-	-	P
+ <i>Erigeron blochmaniae</i> Blochman's leafy daisy ^(C)	-	-	-	-	-	P	P
+ <i>Monardella undulata</i> ssp. <i>crispa</i> Crisp monardella ^(C)	-	-	P	P	P	P	-
+ <i>Phacelia ramosissima</i> Branching phacelia ^(C)	-	-	P	P	-	-	-

Table 2-7. Summary of Vegetation Species Present in FRA TPs and NOF During October 2025 Sampling							
Species	TP1^(A)	TP2^(A)	TP3^(A)	TP4^(A)	TP5^(A)	TP6^(A)	NOF^(A)
Scientific Name Common Name							
<i>+Senecio blochmaniae</i> Dune ragwort ^(C)	-	-	-	-	P	-	P
Dead vegetation	P	-	-	-	-	P	-
(A) "P": Present within TP or NOF. (B) Non-native species (C) Species not included in the 2020 seed and plan installation							

2.2.4.2 BACKDUNE LINE-INTERCEPT TRANSECT SAMPLING

In general, State Parks uses the same line-intercept transect methods to monitor changes in foredune and backdune areas; however, within backdune habitats, early successional communities (early seral) and climax communities (late seral) can vary considerably in species composition and percent cover. For this reason, both early seral and late seral reference sites were sampled for comparison. The late seral reference transects were first sampled in 2021 and the early seral reference transects were first sampled in 2022. Follow-up surveys of these original transect lines occurred in 2024. In addition, backdunes are sampled for both percent cover of species and species richness.

In fall 2025, State Parks sampled the following three backdune vegetation projects located east of marker posts 4 and 8 that were originally planted in winter (February) 2023 (see Figure 2-2):

- The Area 1 vegetation project (2023-VG-01, 20.5 acres)
- The Eucalyptus Tree Center vegetation project (2022-VG-09, 14.9 acres)
- The South Orion vegetation project (2022-VG-13, 5.7 acres)

The results of State Parks' 2025 backdune line-intercept transect sampling are summarized in Table 2-8.

Table 2-8. Summary of Backdune Line-Intercept Sampling Results				
Survey Site	Age of Planting (Years)	Total Species Richness	Mean Percent Cover	Range in Percent Cover
Area 1 (2023-VG-01)	2.5	22	31.4%	29.4% - 32.5%
Eucalyptus Tree (2022-VG-09)	2.5	25	24.6%	3.9% - 44.2%
South Orion (2022-VG-13)	2.5	12	24.2%	0.8% - 54.2%
Reference site – early seral ^(A)	-	17	67.2%	54.0% - 87.8%
Reference site – late seral ^(A)	-	16	78.5%	77.2% - 82.4%
(A) Based on October 2024 sampling, refer to Attachment 06 for additional details.				

With regard to backdune vegetation cover, in 2025:

- Each backdune project area showed healthy levels of vegetation cover, with mean vegetation cover ranging from 24.2% to 31.4%. The project with the highest mean vegetation cover (31.4%) was the Area 1 vegetation project (2023-VG-01), while the project with the lowest mean vegetation cover (24.2%) was the South Orion vegetation project (2022-VG-13).
- None of the three backdune projects sampled met or exceeded the 2024 mean vegetation cover of the early seral (67.2%) or late seral (78.5%) reference sites.

With regard to backdune species richness, in 2025:

- The early seral and late seral reference sites combined had 22 native and 23 total species in 2024. In comparison, the three backdune projects sampled in 2025 combined had 23 native and 24 total species.
- The dominant species within the early seral reference site, dune bush lupine (*Lupinus chamissonis*), was also the dominant species observed within all backdune projects.

State Parks anticipates that the backdune areas surveyed in 2025 will continue to grow and approach the vegetation cover of the reference sites in upcoming growing seasons.

2.2.4.3 FOREDUNE AND BACKDUNE PHOTO POINT MONITORING

State Parks has conducted on-the-ground photo point monitoring of the 48-acre foredune project since 2020. Initial photo point monitoring occurred before the installation of the foredune in February 2020. Subsequent monitoring has occurred in May 2020, October 2020, and each subsequent October since 2020. Photo points are located on all four corners of each treatment area. For each photo point, two photos are taken, each with one of the treatment area boundary lines on the outer edge of the photo with the interior of the treatment area centered in the photo. There is also one photo point overlooking the entire 48-acre foredune project area. Select ground photo point monitoring examples are shown in Figure 2-28.

State Parks has also conducted on-the-ground monitoring of backdune planting projects to capture representative photos of the backdune project areas. Backdune ground photo monitoring was initiated in 2018 and is usually conducted in the summer and/or fall of each year. Photo points are positioned to capture changes within the general areas where backdune projects are located. The number of photos for each photo point and the number of photo points vary at each location to sufficiently capture each area. In total, 30 photo points were monitored in 2025. Select backdune ground photo point monitoring examples are shown in Figure 2-29.

In addition to on-the-ground monitoring, State Parks has also conducted drone, or UAS, aerial photo point monitoring of the foredune project. The initial UAS imagery was captured in May 2020, with subsequent UAS imagery captured in December 2020 and every winter until 2024. UAS photo point monitoring was not conducted in 2025 due to staffing availability reasons. State Parks anticipates conducting the UAS photo point monitoring in winter 2026.

Figure 2-28. Example Ground Photo Point Monitoring – Foredune Project

Ground photo point of foredune project TP3 – Native Seed and Sterile Grain Seed facing north prior to planting (top photo taken February 4, 2020) and 5.5 years after treatment (bottom photo taken October 22, 2025).

Figure 2-29. Example Ground Photo Point Monitoring – Backdune Project

Ground photo point of the Eucalyptus Tree backdune project (2021-VG-03 and 2022-VG-05), facing south (top photo taken October 20, 2022) and three years after planting (bottom photo taken November 6, 2025).

2.3 REPORT ON PROGRESS TOWARD AIR QUALITY OBJECTIVES

This 2026 ARWP reports on the improvement in air quality conditions downwind of the ODSVRA and the reduction in mass emissions that has occurred within the ODSVRA pursuant to the SOA's excess emissions methodology. This section provides the following:

- An updated DRI "Increments of Progress" report (Section 2.3.1) that provides the latest information on the relation between wind power, dust control projects, and downwind PM_{10} concentrations
- A description of changes incorporated into the SOA's excess emissions methodology between August 1, 2024, and July 31, 2025, and the results of the latest excess emissions modeling for the current reporting year (Section 2.3.2)
- Updated evaluation metrics for the 2024/2025 period (Section 2.3.3)
- A brief report on track-out control at the ODSVRA (Section 2.3.4)

2.3.1 INCREMENTS OF PROGRESS TOWARD AIR QUALITY OBJECTIVES

As described in Section 2.1, dust control projects such as temporary wind fencing, straw treatments, and vegetation have been used within the ODSVRA to reduce PM_{10} emissions originating from the ODSVRA and to lower the regional PM_{10} burden on the Nipomo Mesa. Since 2013, when there were effectively no dust control projects in place at the ODSVRA, the amount of acreage managed for dust control purposes has increased to 412.2 acres of specific dust control projects and 740.1 acres of total Dust Control Program area (including other operational activities such as the closed PE and the seasonally closed foredune beach and transportation corridors area) as of July 31, 2026 (see Section 2.1 and Figure 2-2). Since 2020, DRI has evaluated, in part, the efficacy of the ODSVRA Dust Control Program by comparing the ratio of TPM_{10} concentrations ($\mu g\ m^{-3}$) and TWPDP ($W\ m^{-2}$) to see if the ODSVRA dust emission system is producing less, more, or the same amount of PM_{10} for the same wind energy conditions. The rationale for this approach, and the methodology for determining the ratio of TPM_{10} :TWPDP, are described in State Parks' 2024 ARWP (Section 2.3.1). In general, DRI's evaluation of 2011 to 2023 TPM_{10} :TWPDP has shown a downward trend in the TPM_{10} :TWPDP ratio at the CDF and Mesa2 monitoring stations with increasing amounts of dust control acreage. DRI has updated the evaluation of TPM_{10} :TWPDP with data from April to September 2025. The following information has been summarized from the DRI-prepared and SAG-reviewed "Increments of Progress Toward Air Quality Objectives, ODSVRA Dust Control 2025 Update." This report, and the SAG's review comments, are provided as Attachment 07 to this 2026 ARWP.

The calculated TWPDP at the S1 meteorological tower for the period from April to September each year from 2011 to 2025 is shown in Figure 2-30. For 2025, the $313,490\ W\ m^{-2}$ is higher by a factor of 1.89 compared with the same period in 2024 ($TWPDP=179,572\ W\ m^{-2}$), and therefore 2025 had

the greater wind power to effect dust emissions within the ODSVRA. The TWPd in 2025 was the second highest in the 15-year record from 2011 to 2025, with 2022 being the highest (325,000 W m^{-2}).

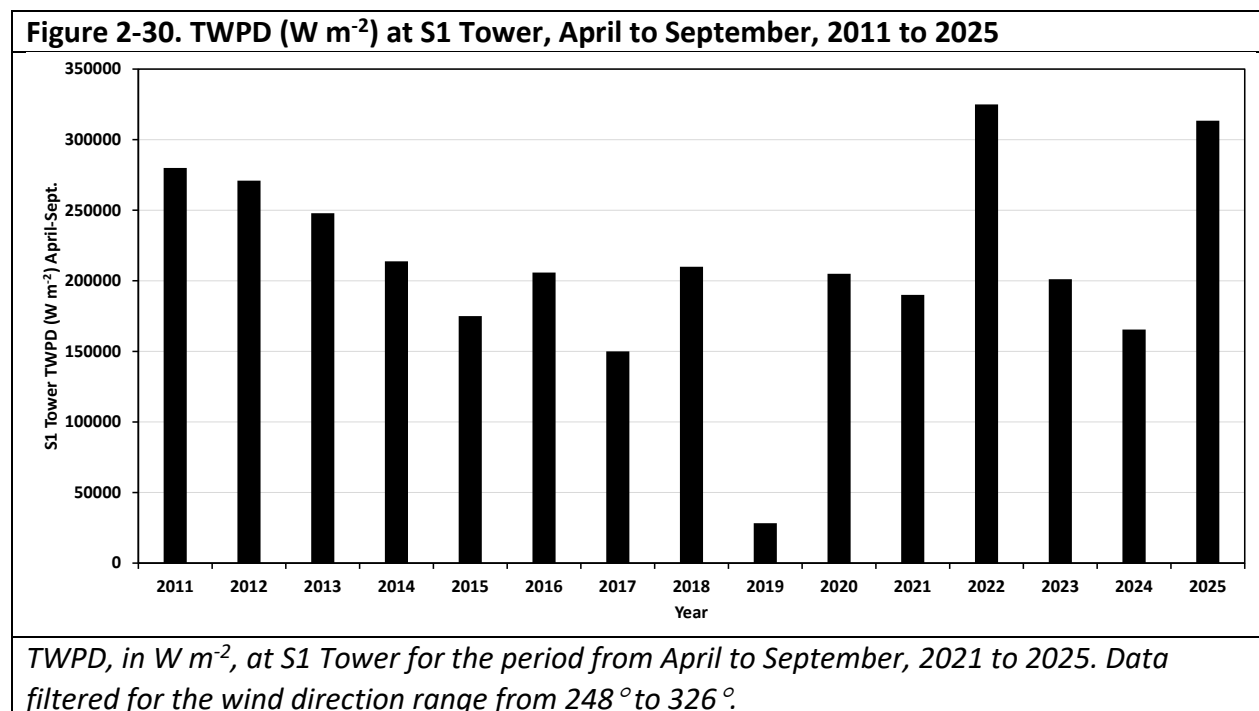


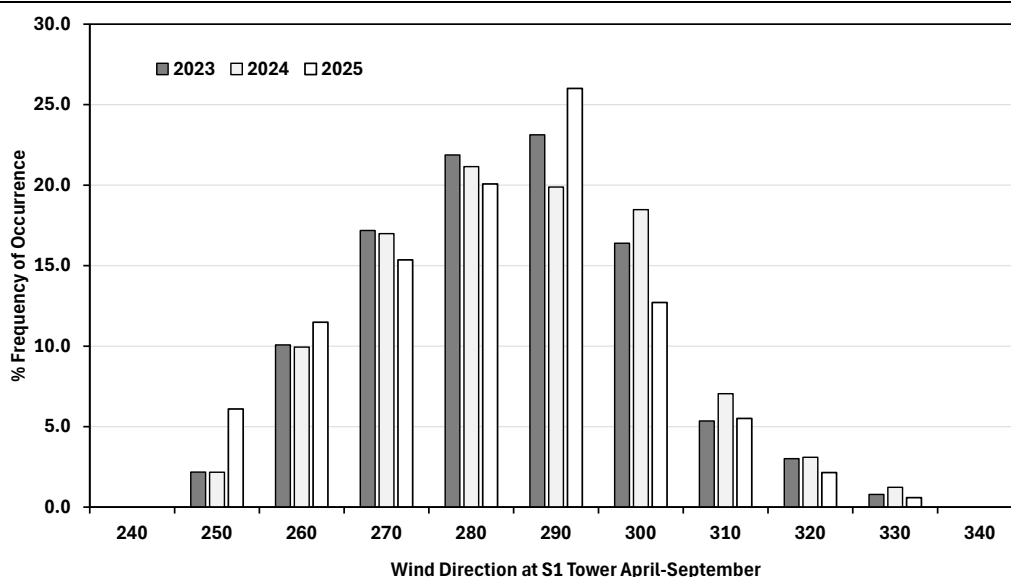
Figure 2-31 shows the distribution of wind direction at S1 Tower for 2023, 2024, and 2025 when applying a directional filter of 248° to 326° , which represents the conditions when it is most likely that the PM_{10} reaching the CDF and Mesa2 monitoring stations originated from saltation within the ODSVRA. The distributions have the same median value of 280° for all three years. As observed previously, TWPd measured at S1 Tower correlates with TPM_{10} at the CDF and Mesa2 monitoring stations.^{36,37,38,39} This relation was also observed for the 2025 data (see Figure 2-32).

³⁶ Gillies, J.A., E. Furtak-Cole, and V. Etyemezian, 2020. Increments of Progress Towards Air Quality Objectives - ODSVRA Dust Controls. Report prepared for California State Parks by DRI, December 2020.

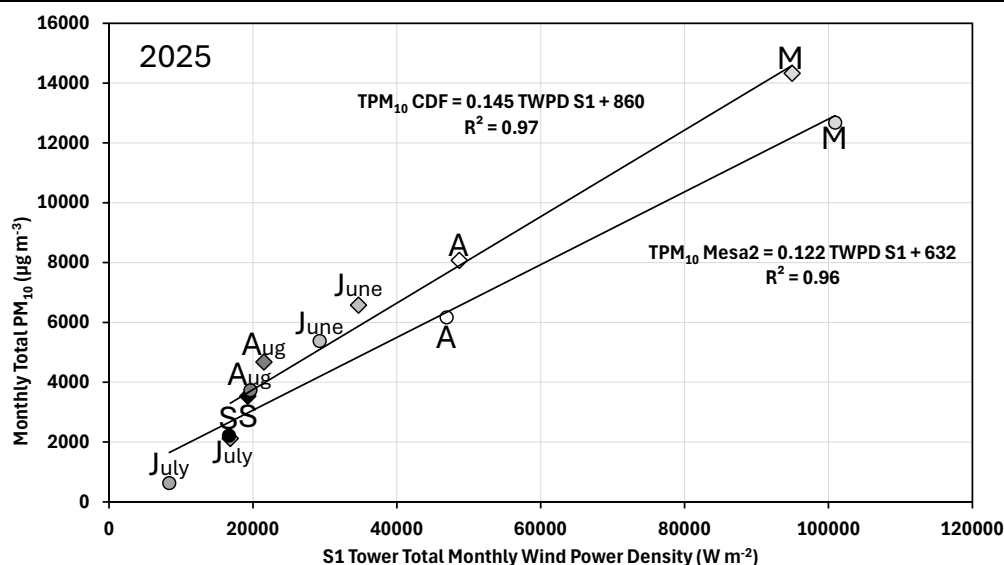
³⁷ Gillies, J.A., E. Furtak-Cole, and V. Etyemezian, 2021. Increments of Progress Towards Air Quality Objectives - ODSVRA Dust Controls. Report prepared for California State Parks by DRI, December 2021.

³⁸ See footnote 19.

³⁹ Gillies, J.A., E. Furtak-Cole, and G. Nikolich, 2023. Increments of Progress Towards Air Quality Objectives - ODSVRA Dust Controls. Report prepared for California State Parks by DRI, December 2023.

Figure 2-31. Wind Direction at S1 Tower, April to September 2023 to 2025

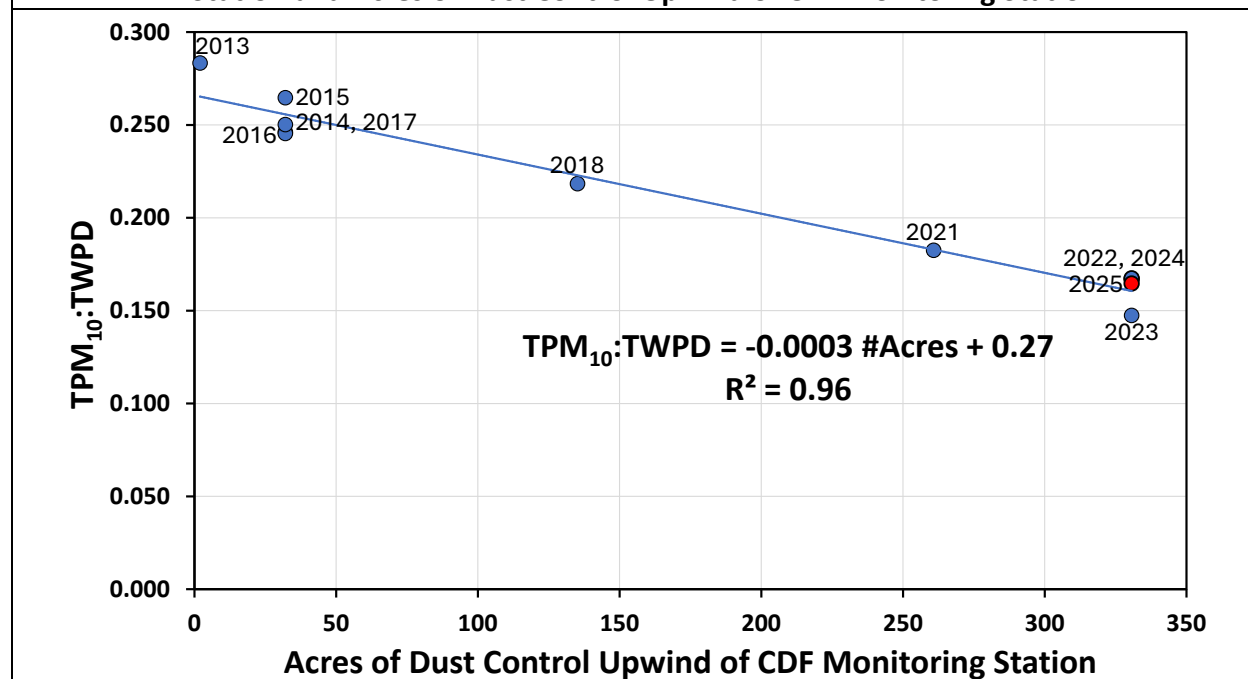
The distribution of wind direction at S1 Tower for the period from April to September, 2023, 2024, and 2025, after applying the filtering criteria (wind between 248° and 326°).

Figure 2-32. Relation Between TPM_{10} ($\mu g\ m^{-3}$) and TWPDP ($W\ m^{-2}$) at SLOAPCD CDF and Mesa2 Monitoring Stations

The relation between monthly TPM_{10} and monthly TWPDP for all hours when the wind direction was from 248° to 326° observed at the CDF station (diamonds) and the Mesa2 station (circles), the wind speeds were greater than or equal to ($\geq$) $3.5\ m\ s^{-1}$ (at the CDF and Mesa2 stations), and hours wherein there were fewer than four days since the last record of precipitation were removed. Monthly values are identified as April (A), May (M), June (June), July (July), August (Aug), and September (S).

Based on the number of acres of dust control that have been established from 2013 (2 acres) through 2024 (330 acres) directly upwind of the CDF station, Figure 2-33 shows that at the CDF station for the period from April through September, a downward trend in the $TPM_{10}:TWP$ ratio with increasing amounts of dust control acreage has been observed.^{40,41}

Figure 2-33. Relation Between $TPM_{10}:TWP$ Ratio Measured at SLOAPCD CDF Monitoring Station and Acres of Dust Control Upwind of CDF Monitoring Station



The $TPM_{10}:TWP$ ratio value measured at the CDF station and the acres of dust control placed upwind of the CDF station from 2013 through 2025. The acres of dust control are accounted for in the directional range 270° to 326° centered on the CDF station. Data from 2019 and 2020 were excluded as discussed in Attachment 07. Note that 2014 and 2017 data and 2022 and 2024 data align on top of each other. 2025 datum is represented by the red circle.

Note that the acres of managed areas upwind of CDF lie within a directional range of 270° to 326° centered on CDF. Areas to the south of 270° will not have much influence on PM_{10} concentrations at CDF as winds less than 270° have a relatively low probability of occurrence of being above the speed needed for saltation and dust emissions. Similarly, winds approaching from greater than 326° do not traverse the ODSVRA to any substantial degree before reaching CDF.

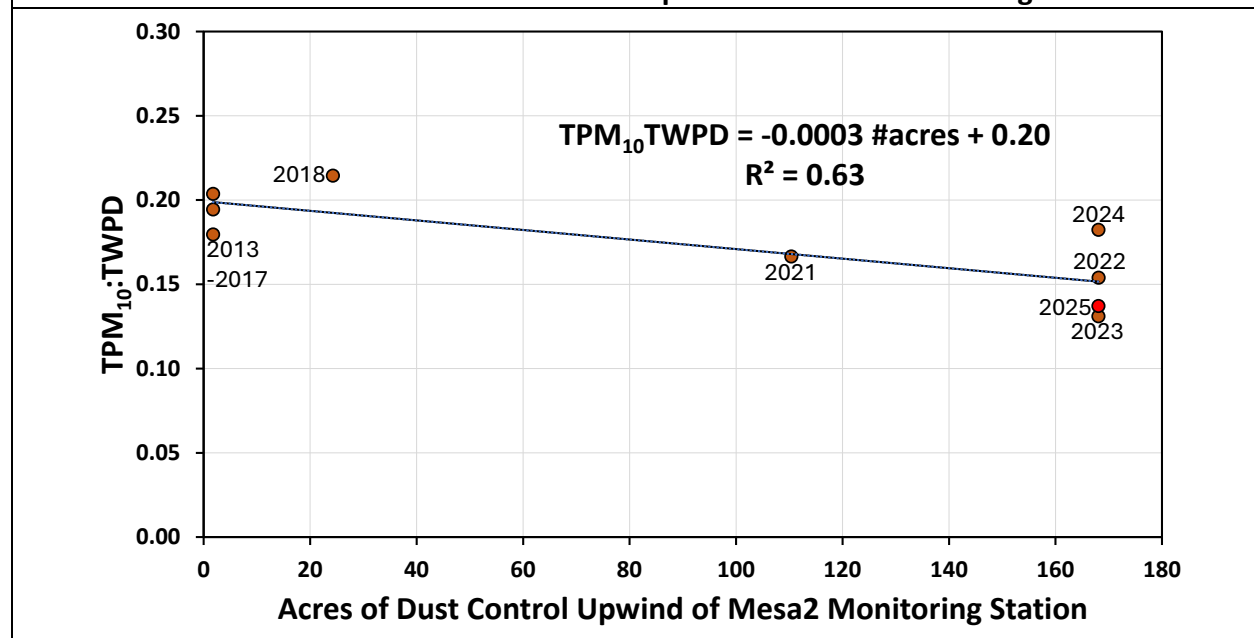
⁴⁰ For the purposes of the $TPM_{10}:TWP$ evaluation, dust control measures are considered upwind of the CDF station if the measure lies within the directional range 270° to 326° , as centered on the CDF station.

⁴¹ As described in Attachment 06, the relation between $TPM_{10}:TWP$ at the CDF station and the acres of dust control upwind of the CDF station excludes data from 2019 (insufficient wind data) and 2020 (OHV activity at the ODSVRA was restricted due to COVID-19).

As shown in Figure 2-33, the TPM_{10} :TWPD ratio has varied between 0.15 (2023) and 0.17 (2024), with 2025 having a ratio value of 0.16. This may indicate that the ratio, representing the area upwind of CDF, has stabilized in the last four years and that the control measures in place have reached a quasi-equilibrium condition.

The ratio of TPM_{10} :TWPD for the Mesa2 station and S1 Tower data for the period from April through September for the years 2013 through 2025 as a function of acres of dust control upwind of the Mesa2 station is shown in Figure 2-34. This figure shows that a downward trend in the TPM_{10} :TWPD ratio is observed with increasing acres of dust control for the period from 2018 (24.3 acres) to 2025 (168 acres).⁴² Prior to 2018, there was no clear trend in the TPM_{10} :TWPD ratio data as there were few acres of dust control upwind of the Mesa2 monitoring station.

Figure 2-34. Relation Between TPM_{10} :TWPD Ratio Measured at SLOAPCD Mesa2 Monitoring Station and Acres of Dust Control Upwind of Mesa2 Monitoring Station

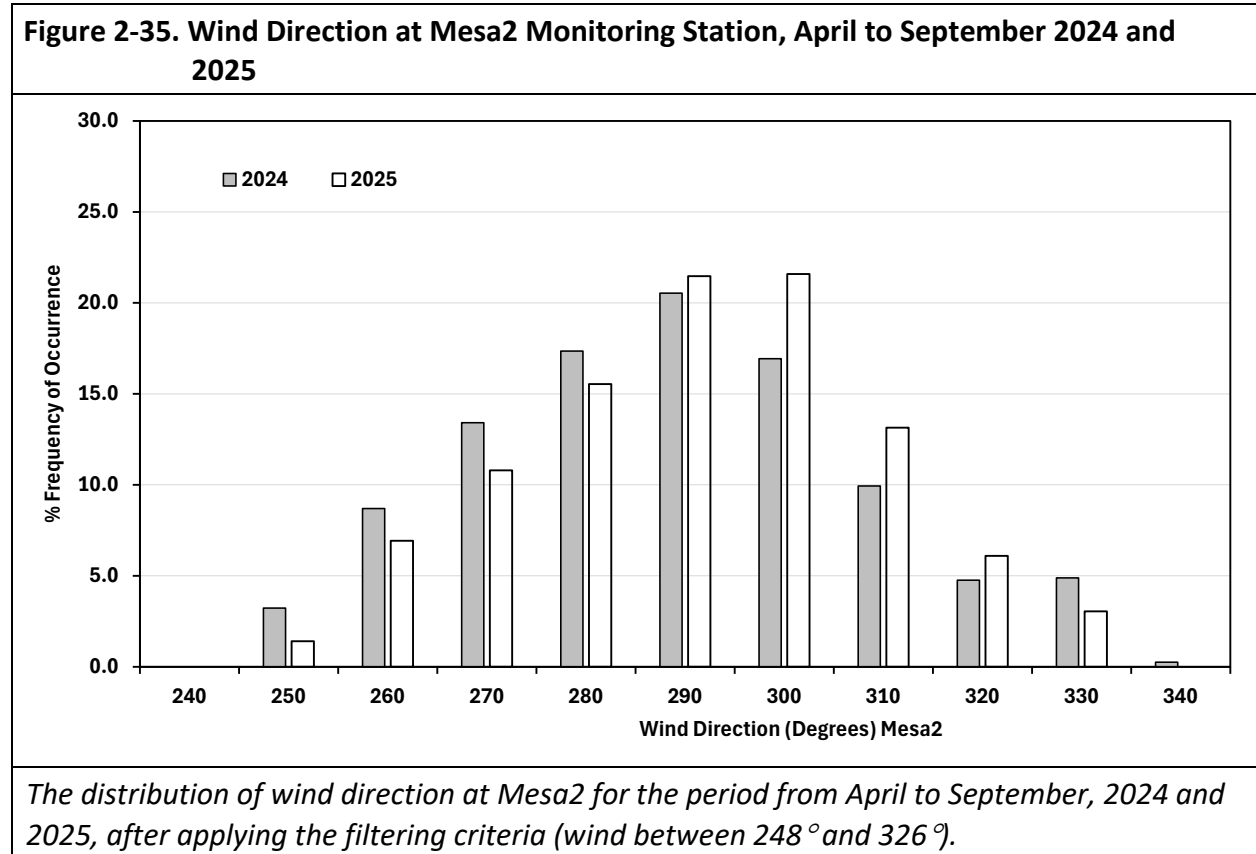


The relation between TPM_{10} :TWPD ratio value measured at the Mesa2 station and the acres of dust control placed upwind of the Mesa2 station from 2013 through 2025. The acres of control are accounted for in the directional range 270° to 305°. Data from 2019 and 2020 were excluded as discussed in Attachment 07. Note that for the 2013-2017 data points some years are aligned on top of one another. 2025 datum is represented by the red circle.

Figure 2-34 indicates that a downward trend in the TPM_{10} :TWPD ratio through time for the Mesa2 station is supported with the inclusion of the 2025 datum, but in general the TPM_{10} :TWPD ratio shows greater variability than the CDF- and S1 Tower-based ratio. The value of 0.14 in 2025, decreasing from 0.18 in 2024, could be indicative of improvement in vegetation cover and

⁴² For the purposes of the TPM_{10} :TPWD evaluation, dust control measures are considered upwind of Mesa2 if the measure lies within the directional range 270° to 305°, as centered on Mesa2.

increasing roughness in some of the dust management areas as the TWPD as measured at S1 Tower increased in 2025 compared to 2024. As shown in Figure 2-35, the wind direction distributions at Mesa2 in 2024 and 2025 were similar. The median wind directions were 284° in 2024, and 287° in 2025 based on the filtered wind direction range of 248° to 326°.



The results of DRI's latest increments of progress analysis continue to demonstrate that TWPD is a robust metric for explaining the relationship between wind-driven saltation and the accompanying emission of PM₁₀ from the ODSVRA as measured at two key receptor sites, CDF and Mesa2. The TWPD and TPM₁₀ measurement-based metric indicates that the PM₁₀ originating from the ODSVRA has been reduced by approximately 43% at CDF using the 4-year (2022 and 2025) mean value of 0.16 (±0.01) for equivalent WPD conditions compared with the baseline year of 2013 (TPM₁₀:TWPD = 0.28) when there few acres of dust control upwind of the CDF station. For Mesa2, the TWPD and TPM₁₀ measurement-based metric indicates that the PM₁₀ originating from the ODSVRA has been reduced by approximately 13% using the four-year (2022 and 2025) mean value of 0.16 (±0.03) for equivalent WPD conditions compared with the baseline year of 2013 (TPM₁₀:TWPD= 0.18) when there were few acres of dust control upwind of the Mesa2 station.

2.3.2 EXCESS EMISSIONS MODELING

State Parks' 2024 ARWP provided detailed information on the SOA's excess emissions requirement and the methodology for modeling whether the ODSVRA is in a condition of excess emissions.⁴³ In general, the methodology for assessing compliance involves comparing the "naturally occurring" emissions from the ODSVRA when it was minimally impacted by OHV recreation, referred to as the "pre-disturbance" scenario, against emissions from the current management landscape of the ODSVRA. An emissions simulation model developed by DRI is used for this purpose, and it uses actual PI-SWERL measurements collected from 2013 onward and a wind model to generate results.

For each of the current and pre-disturbance landscape scenarios, the ODSVRA is sub-divided into management zones or sub-regions, each of which is assigned a different emissivity power relation based on comprehensive PI-SWERL testing completed to date.⁴⁴ For the current (contemporary) landscape, the ODSVRA is divided into eight emissive zones (1 to 8) and two non-emissive zones (9 and 10):

- | | |
|--|-------------------------------------|
| 1. Riding Area Central-North Sub-Region (RA Central North) | 6. Foredune Restoration Area (FRA) |
| 2. Riding Area Central-South Sub-Region (RA Central South) | 7. Plover Exclosure (PE) |
| 3. Non-Riding Area North Zone (NRA North) | 8. Seasonal Exclosure (SE) |
| 4. Non-Riding Area Central Zone (NRA Central) | 9. Vegetation Islands (VIs) |
| 5. Non-Riding Area South Zone (NRA South) | 10. Revegetated Project Areas (RPA) |

For the pre-disturbance scenario, which is based on a 1939 landscape condition (assessed using air photos), the ODSVRA was divided, until recently, into three zones: NRA North, NRA Central, and NRA South. NRA North and NRA South are identical to those used for the current landscape scenario, and they are still used in the pre-disturbance scenario (i.e., identical footprints with identical power relations applied). NRA Central covers a large zone that is bounded to the north by NRA North and to the south by NRA South; in the pre-disturbance landscape, the footprint of NRA Central captures all the remaining management zones (i.e., FRA, PE, SE, VI, RPA, and RA Central North and RA Central South sub regions) assigned to the current landscape. As described in more detail below, the 2026 ARWP divides NRA Central in the pre-disturbance landscape into a new, western, "Beach Foredune" zone and an eastern NRA Central zone that represents the remainder

⁴³ In 2025, refinements were made to the DRI model, including (a) an expanded modeling grid that spanned the entire area of the ODSVRA, and that necessitated a change in the size of grid cells use in the model; (b) the use of updated emission power relations (to include 2024 PI-SWERL data); (c) the use of an updated vegetation cover mask created by UCSB and State Parks based on more recent, publicly available imagery; and (d) incorporation of additional meteorological data to calibrate the CALMET simulation model for wind conditions across the ODSVRA. These refinements were discussed in detail State Parks' 2025 ARWP (Section 2.3.2.1).

⁴⁴ See footnote 24.

of the historical NRA Central zone.

For the 2026 ARWP, several refinements were made to the DRI model, and the remainder of this section describes updates to the excess emissions modeling methodology implemented since August 1, 2025.

2.3.2.1 EXCESS EMISSIONS MODEL UPDATES

Since August 1, 2025, four substantive refinements to the DRI model have been made for purposes of determining the state of excess emissions. First, the manner in which vegetated grid cells are parameterized has been changed to reflect updated knowledge on the manner in which plant cover influences potential PM₁₀ emissions from sandy surfaces. Second, grid cells within zones that have been treated with plantings within the past five years (i.e., treatment projects) are assigned an emissivity of zero to accommodate the time required after initial planting for vegetation to establish and grow to maturity, thereby providing protection from wind erosion. Third, the large central region in the pre-disturbance landscape (referred to as NRA Central) was divided into two sub-zones. Fourth, updated emissivity power relations were generated and applied in the DRI model.

- **Parameterizing of Vegetated Grid Cells:** For previous ARWPs, any vegetated grid cell with greater than 50% plant cover was considered to be “non-emissive” and assigned an emissivity of zero. For 2026, several changes to the treatment of vegetated grid cells were made. Refer to Attachment 08 for detailed information on the parameterizing of vegetated grid cells in the DRI model.
 - The threshold condition to be considered non-emissive and assigned an emissivity of zero was revised to a minimum 15% plant cover, which more closely reflects the scientific literature on the influence of vegetation on potential dust emissions.
 - An aerodynamic sheltering effect was adopted and applied to the 2026 DRI model. A grid cell is considered to be aerodynamically sheltered (and assigned zero emissivity regardless of actual plant cover) if the immediately adjacent, upwind (to the west) grid cell has greater than 40% plant cover.
 - Any grid cell that does not meet the 15% cover threshold or is not aerodynamically sheltered is considered to be “emissive” and assigned an emissivity power relation based on the management zone it falls within (such as RA-North, NRA Central, FRA, PE, etc.).
- The changes to the non-emissive threshold condition and the use of an aerodynamic sheltering effect were applied to the entire ODSVRA (not only to VIs) for both the pre-disturbance and current landscape scenarios; however, grid cells within VIs are parameterized somewhat differently from grid cells that lie outside VIs. Previously, any

grid cell that fell within the polygon of a VI was considered to be non-emissive automatically. This approach did not accurately reflect the fact that there were significant portions of VIs that were open sand, especially on the leading (upwind) margins of many VIs, that would have the potential to emit PM₁₀. To address this, two new synthetic emissivity power relations were developed, one for emissive grid cells within VIs that include Bigfoot and other VIs to the north, and another for emissive grid cells within VIs that include Eucalyptus Tree and other VIs to the south. For the grid cells that are within a northerly VI, PI-SWERL data from measurements within the FRA from 2022 and 2025 were pooled with the measurements taken since 2013 in the northern half of NRA Central. For the grid cells that are within a southerly VI, PI-SWERL data from measurements within the PE from 2022 to 2025 were pooled with the measurements taken since 2013 in the southern half of NRA Central.

- **Parameterizing of Treatment Project Areas:** State Parks has been actively modifying and treating sand surfaces within the ODSVRA to mitigate the potential for PM₁₀ emissions for more than a decade, with considerable success. Approximately 700 acres have been subject to surface treatments, and efforts are ongoing with supplemental plantings in areas that have not established well. In 2026, State Parks undertook an analysis of how long it takes, on average, for non-foredune Dust Control Program vegetation projects to achieve a state of “maturity,” concluding that it takes approximately five years post-planting for vegetation treatments to achieve a condition where 80% of the grid cell reaches 15% cover (refer to Attachment 08 for this analysis). Based on this finding, State Parks and the SLOAPCD agreed to adopt a five-year time frame for which grid cells within treatment projects are effectively considered to be non-emissive, even if the project has not reached the new, minimum 15% plant cover threshold to be considered non-emissive that is applied elsewhere in the DRI model (see “Parameterizing of Vegetated Grid Cells” above). This change was applied to any grid cell that was treated in the past five years regardless of location. Specifically, it applies to all mapped treatment areas within the ODSVRA, including those contained within the polygons of VIs. For grid cells within treatment areas that are older than five years since initial planting and have not attained at least 15% plant cover (and are not aerodynamically sheltered), an emissivity relation is assigned based on whether the grid cell falls within a VI (northerly or southerly) or elsewhere in the ODSVRA (e.g., NRA Central). Refer to Attachment 08 for information on assumed emissivity relations within VIs.
- **Re-Zoning of NRA Central in the Pre-Disturbance Landscape:** For previous ARWPs, as had been recommended by the SAG, NRA Central was modeled as one large zone and parameterized using all PI-SWERL measurements made in that zone since 2013.⁴⁵ Repeat

⁴⁵ See footnotes 24 and 25.

PI-SWERL measurements from the FRA and PE since 2022 have demonstrated that potential PM₁₀ emissivity close to the beach and foredune is typically smaller than farther inland. This likely reflects a gradient in grain size from west (coarser) to east (finer), aided perhaps by the effects of surface moisture gradients in the inland direction. Based, in part, on these findings and related SAG-recommendations, State Parks coordinated with DRI to divide the pre-disturbance landscape NRA Central zone into two sub-zones in the 2026 DRI model. The new western sub-zone is referred to as the “Beach Foredune” zone while the eastern sub-zone has retained the NRA Central designation.⁴⁶ The emissivity relation for the Beach Foredune zone is based on the average of PI-SWERL measurements taken in the FRA and PE from 2022 to 2025, while the emissivity relation for NRA Central is based on PI-SWERL measurements from NRA Central. Refer to Attachment 08 for background information related to dividing NRA Central into two sub-zones.

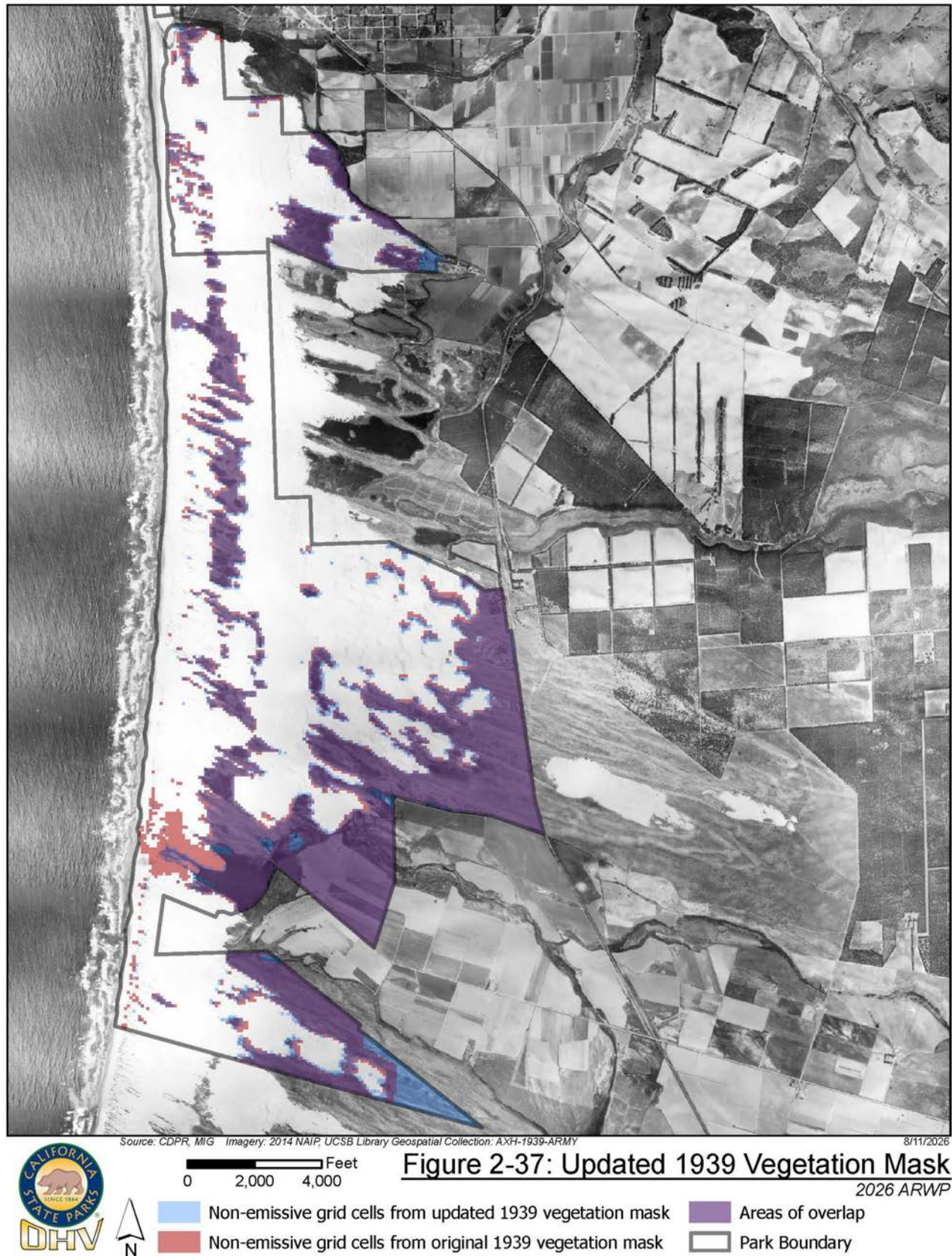
- Table 2-9 and Figure 2-36 summarize and depict the emissive and non-emissive management zones for the pre-disturbance and current landscape scenarios included in the 2026 DRI Model. Refer to Attachment 09 for zonal information in the 2026 DRI Model.
- **Updated Emissivity Relations:** As described in Section 2.2.2, DRI conducted new PI-SWERL monitoring in September 2025 within the PE and NRA Central. These new measurements were used to update the emissivity power relations for the PE and NRA Central. In addition, three new emissivity power relations were developed for purposes of parameterizing the emissive grid cells in the northern and southern VIs (see “Parameterizing of Vegetated Grid Cells” above) and the new Beach Foredune zone. The excess emissions model for the 2026 ARWP incorporated these updated relations.

In addition to the above changes, in reviewing past exercises, it was noted that two areas in the eastern portion of the Dune Preserve and the eastern portion of Oso Flaco had been mapped as bare sand in the 1939 vegetation mask. The pre-disturbance model was updated to reflect changes in vegetation coverage and areas with bare sand. This resulted in approximately 100 grid cells within the DRI model changing from emissive to non-emissive in the pre-disturbance scenario, as highlighted in Figure 2-37.

⁴⁶ As described in Attachment 08, the SAG identified that the new Beach Foredune zone should extend between 200 m and 400 m inland from the shore. The 2026 DRI model is based on a 200-meter-wide Beach Foredune zone.

Table 2-9. Summary of 2026 DRI Model Emissive and Non-Emissive Management Zones					
Modeled Scenario and Emissivity Zone	Emissive Areas ^(A)	Non-Emissive Areas ^(A)			Total Modeled Acres ^(A)
	Unvegetated Acres	Vegetated Acres	Aerodynamically Sheltered Acres	Acres of Projects Less than 5 Years Old	
1939 Pre-disturbance Landscape					
NRA-North	545.3	144.1	6.6	-	726.3
Beach Foredune	260.1	9.7	0.3	-	239.8
NRA-Central	1498.8	759.8	30.3	-	2,288.7
NRA-South	567.0	594.1	9.3	-	1,170.7
Total	2,871.2	1,507.8	46.5	-	4,425.5
Current 2026 Landscape					
NRA-North	368.3	347.0	11.0	0.0	726.3
NRA-Central	185.5	623.6	6.0	3.9	819.0
NRA-South	190.9	971.9	7.4	0.0	1,170.2
Riding Area Central-North	241.4	3.9	5.1	0.0	250.3
Riding Area Central-South	527.7	9.9	9.4	0.3	547.3
Foredune Restoration Area	48.8	0.3	0.0	0.0	49.1
Plover Exclosure	306.4	3.1	0.5	0.0	310.0
Seasonal Exclosure	33.7	0.0	0.0	0.0	33.7
Revegetation Projects	17.5	91.0	4.2	93.4	206.0
Vegetation Islands	24.6	251.0	4.2	33.8	313.5
Total	1,944.7	2,301.6	47.7	131.4	4,425.5
(A) The modeled acres reported in this table may vary slightly from acreages reported in other ARWP sections (e.g., Section 2.1). This is due to fact that the DRI model superimposes 25 m by 25 m grid cells onto ArcGIS polygons that were field mapped and polygonal in nature. The difference in reported acres is not usually more than approximately +/-1 one acre in total size for any individual dust control project or modeled emissive zone feature.					

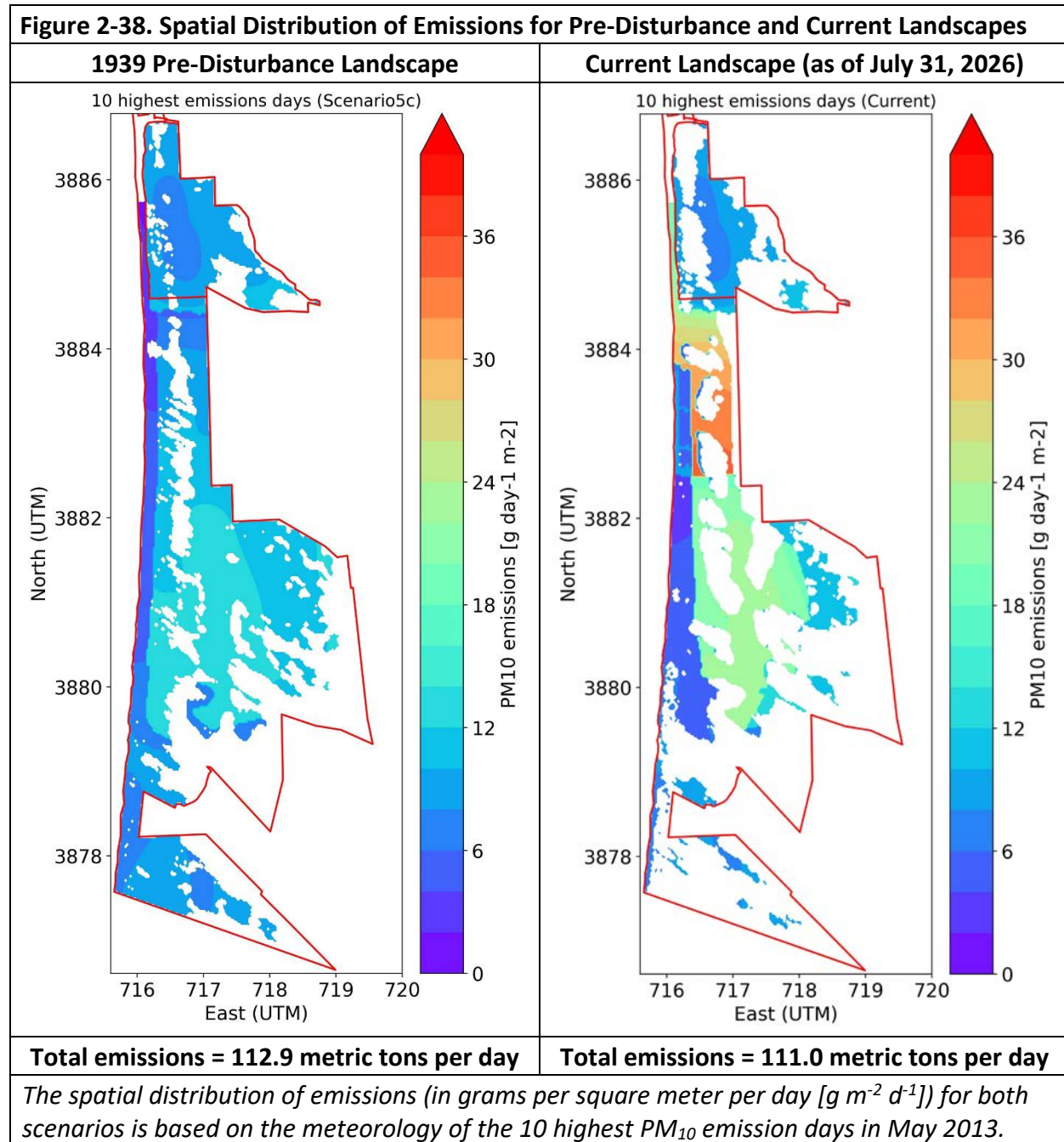




2.3.2.2 EXCESS EMISSIONS MODELING RESULTS

The DRI model was programmed with the model refinements recommended in Section 2.3.2.1, and emissions scenarios were run for the pre-disturbance and current landscape conditions (see Table 2-10 and Attachment 09). Figure 2-38 shows maps of the spatial distribution of emissions for each of the two scenarios. The pre-disturbance emissions map (left panel) indicates relatively uniform emissions with largest values in NRA Central and smallest values in NRA North (Dune Preserve). White areas correspond to zero emissions in association with grid cells that have a minimum 15% vegetation cover or are aerodynamically sheltered. For the current emissions map (right panel), the white zones include grid cells that have a minimum 15% vegetation cover, are aerodynamically sheltered, or are in treatment areas that are less than five years old since their installation (as of July 31, 2026). The current emissions map shows considerable variation in emissions, with large values in the sub-regions where OHV riding is allowed.

Table 2-10. Modeled Pre-Disturbance (1939) and Current (2026) Landscape Mass Emissions		
Modeled Scenario and Emissivity Zone	Modeled Emissions in Metric Tons per Day	
	1939 Pre Disturbance Landscape	Current 2026 Landscape
Non-Riding Area North	20.0	12.9
Non-Riding Area Central	74.2	9.3
<i>Western Beach Foredune</i>	3.9	-
<i>Eastern Dunes</i>	70.3	9.3
Non-Riding Area South	18.7	6.2
Riding Area Central-North	-	28.1
Riding Area Central-South	-	46.4
Foredune Restoration Area	-	0.9
Plover Exclosure	-	5.2
Seasonal Exclosure	-	1.2
Vegetation Islands with Less than 15% Plant Cover	-	0.8
<i>North</i>	-	0.5
<i>South</i>	-	0.3
Total^(A)	112.9	111.0
Source: DRI, 2026 (see Attachment 09)		
(A) Totals may not equal due to rounding.		



As shown in Figure 2-38, when summed across the entire model domain covering the ODSVRA, the total emissions for the 10 highest emissivity days in May 2013 amount to 112.9 metric tons per day for the pre-disturbance scenario, whereas the current landscape scenario emits 111.0 metric tons per day. Therefore, **the modeling indicates that the ODSVRA, as currently configured according to SAG-recommended emissivity management zones and accounting for all treatment projects implemented since 2013, does not emit dust to a level that is in excess of the “naturally occurring” conditions inherent to the pre-disturbance scenario.** In this respect, the ODSVRA is in compliance with the SOA as amended.

2.3.3 EVALUATION METRICS

State Parks' 2021 ARWP incorporated a new set of evaluation metrics intended to provide a streamlined dashboard for reporting Particulate Matter Reduction Plan (PMRP) evaluation metrics, tracking Dust Control Program progress, and informing adaptive management strategies at the ODSVRA. The updated evaluation metrics include "dust mitigation targets" that compile specific, measurable endpoints and "dust mitigation indicators" that document progress in key areas that lack a specific, measurable target or endpoint for various reasons. To provide continuity with past ARWP documents, State Parks' summary report on PMRP evaluation metrics is provided below. Refer to Attachment 10 for a detailed summary of evaluation metrics.

2.3.3.1 DUST MITIGATION TARGETS

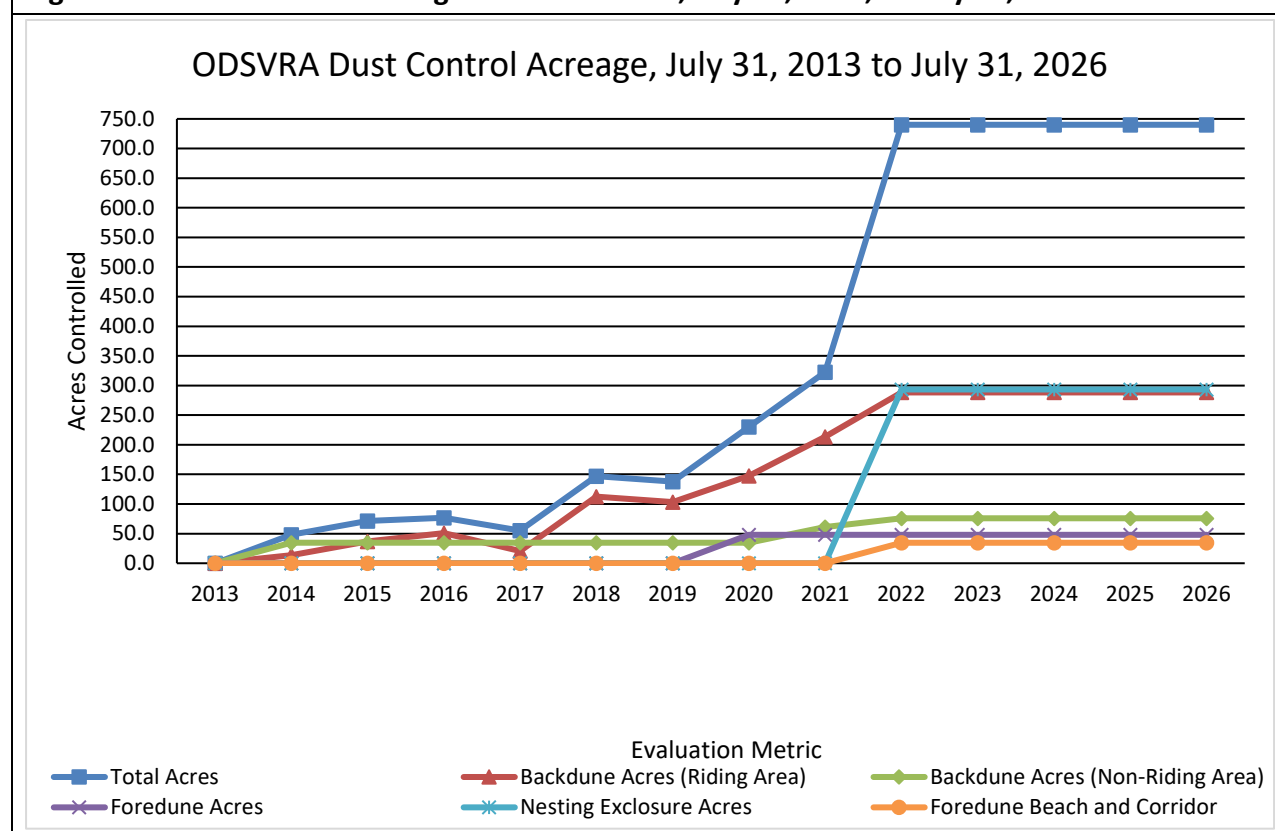
Key dust mitigation targets include the cumulative dust control project acreage at the ODSVRA and the PM₁₀ mass emissions reductions achieved at the ODSVRA (as of July 31 of the ARWP reporting year).

Dust Mitigation Treatments

Compared to 2013 baseline conditions, when there were no long-term dust control projects or a nesting exclosure at the ODSVRA, State Parks now manages 740.1 acres of land for dust control benefits (see Figure 2-39). Nearly 90% of this managed land is located inside the ODSVRA open riding and camping area, as defined by the 2013 open riding and camping area boundary, and approximately 50% of this managed land (i.e., excluding the Plover Exclosure) was converted from open riding and camping area to dust control project acreage in order to address dust management objectives. Refer to Section 2.1 for State Parks' detailed report on dust control projects installed at the ODSVRA as of July 31, 2026.

PM₁₀ Mass Excess Emissions

As of July 31, 2026, current modeled PM₁₀ mass emissions from the ODSVRA (111.0 metric tons per day) are approximately 1.9 metric tons per day less than the modeled pre-disturbance condition mass emissions (112.9 metric tons per day; see Table 2-10). The ODSVRA, therefore, is not in a condition of excess emissions. Refer to Section 2.3.2 for additional information on excess emissions modeling.

Figure 2-39. ODSVRA Dust Mitigation Treatments, July 31, 2013, to July 31, 2026

2.3.3.2 DUST MITIGATION INDICATORS

Key dust mitigation indicators include the number of high wind days and the number of exceedances of the state and federal ambient air quality standards, the status of the 48-acre foredune restoration project, and the amount of backdune stabilization occurring under the Dust Control Program. Dust mitigation indicators are compared against 2013 baseline conditions where appropriate but do not have a specific measurable target or goal to achieve.

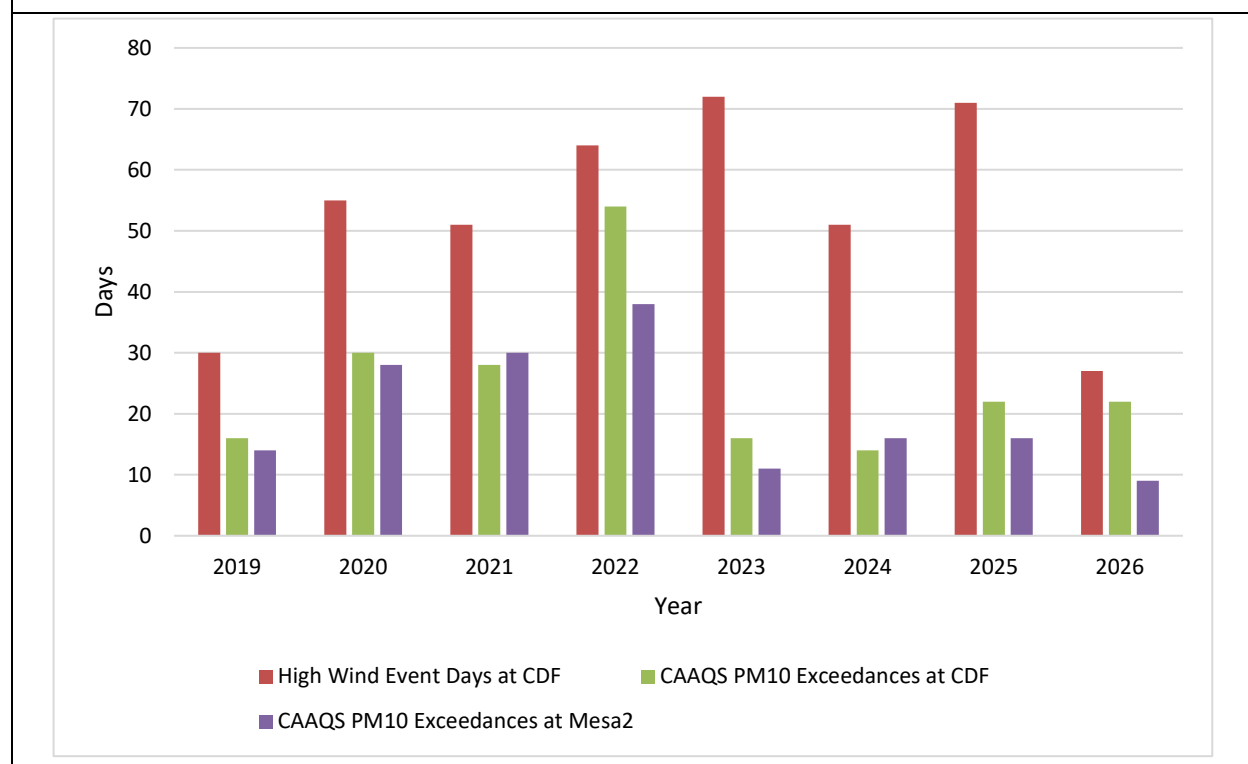
Air Quality Indicators

As shown in Figure 2-40, between January 1, 2026, and July 31, 2026, the number of high wind event days at the SLOAPCD's CDF air quality monitoring station (27 days) was lower than the number of days for approximately the same period in 2019 (30 days), 2020 (55 days), 2021 (51 days), 2022 (64 days), 2023 (72 days), 2024 (51 days), and 2025 (71 days).⁴⁷ However, the number

⁴⁷ Since 2021, State Parks' ARWPs have, in coordination with the SAG, defined "high wind event day" as any day when the 3:00 PM Pacific Standard Time (PST) hourly wind speed at the CDF air quality monitoring station exceeds 8 miles per hour and the 1:00 PM PST hourly wind direction is between 290° and 360°. Resultant wind speed data for the CDF station (United States Environmental Protection Agency [USEPA] Air Quality System ID #060792007) are from the California Air Resources Board (CARB) Air Quality and Meteorological Information System website: https://www.arb.ca.gov/aqmis2/aqmis2.php?_ga=2.46929383.1773760890.1688103838-837133623.1674194586.

of days in which the 24-hour average PM₁₀ California Ambient Air Quality Standard (CAAQS) of 50 $\mu\text{g m}^{-3}$ was exceeded at the SLOAPCD's CDF air quality monitoring station in 2026 (22 days) was higher than in the same comparable period in 2019 (16 days), 2023 (16 days), and 2024 (14 days); lower than in same period in 2020 (30 days), 2021 (28 days), and 2022 (54 days); and the same as in the same period in 2025 (22 days). The number of days in which the 24-hour average PM₁₀ CAAQS of 50 $\mu\text{g m}^{-3}$ was exceeded at the SLOAPCD's Mesa2 air quality monitoring station in 2026 (9 days) was lower than in the same comparable period in 2019 (14 days), 2020 (28 days), 2021 (30 days), 2022 (38 days), 2023 (11 days), 2024 (16 days), and 2025 (16 days).⁴⁸ There were no exceedances of the National Ambient Air Quality Standard (NAAQS) of 150 $\mu\text{g m}^{-3}$ at either the CDF or Mesa2 air quality monitoring stations during the listed period. The last exceedance of the NAAQS occurred at the CDF air quality monitoring station in 2013.

Figure 2-40. High Wind Event Days at CDF Air Quality Monitoring Station and 24-Hour Average PM₁₀ CAAQS Exceedances at CDF and Mesa2 Air Quality Monitoring Stations, Approximately January through July, 2019 to 2026



Data may be preliminary and will be verified by the SLOAPCD. The ARWP high wind event definition may differ from the definition used by the SLOAPCD in SLOAPCD reports and studies.

⁴⁸ The 2025 estimate of the number of days above the CAAQS at the CDF air quality monitoring station is based on standard conditions for daily average PM₁₀ BAM data for the CDF (USEPA Air Quality System ID #060792007) and Mesa2 (USEPA Air Quality System ID #060792004) air quality monitoring stations obtained from CARB's Air Quality and Meteorological Information System website:

https://www.arb.ca.gov/aqmis2/aqmis2.php?_ga=2.46929383.1773760890.1688103838-837133623.1674194586.

Data may be preliminary and will be verified by the SLOAPCD.

Backdune Stabilization

Compared to 2013 baseline conditions, when there were no long-term dust control projects at the ODSVRA, State Parks continues to manage 740.1 acres of land for dust control benefits, including the 293.3-acre PE and 34.6-acre SE. Excluding the PE and SE, because these areas have not been actively planted or otherwise controlled specifically to reduce dust emissions, State Parks has installed 412.2 acres of total dust control projects at the ODSVRA. The total dust control acreage remains unchanged since 2022, though all temporary wind fencing and straw treatments have been converted to vegetation projects. As of July 31, 2026, there are 364.2 total acres of backdune stabilization measures in the ODSVRA, all of which are under vegetation treatment. Refer to Section 2.1 for State Parks' detailed report on dust control projects installed at the ODSVRA.

FRA Development and Dust Control Potential

At the request of the SAG, and given continued development of dunes and plant communities within the FRA, the number of indicators and metrics used to evaluate the performance of the FRA toward reducing dust emissions was reduced to 3 key indicators (and metrics): 1) vegetation cover (% plant cover by area in each TP), 2) sediment budget responses (normalized sand volume changes in $\text{m}^3 \text{m}^{-2} \text{month}^{-1}$), and a new indicator, 3) terrain roughness (Topographic Roughness Index, TRI, in m).

Generally, compared to the fully developed foredune reference site at NOF, all TPs in the FRA continue to show lower vegetation cover and surface roughness, although sediment budgets remain positive and dune development has progressed notably since February 2020.

In terms of sediment budget responses, despite fluctuations in beach sand supply and marked periods of erosion, all TPs have maintained positive sediment budgets and dune growth, with TP3 exhibiting the highest net sand accumulation. TP1, the control site, has remained approximately neutral, while TP2 showed the lowest accumulation, likely due to sediment bypassing and declining beach sand inputs. TP4 also had relatively low accumulation, whereas TP5 and TP6 showed moderate and high rates, respectively.

Plant cover has generally increased since 2020, despite substantial variability and a marked decline following the wet and stormy conditions of 2023. Since February 2025, vegetation cover has resumed increases across all TPs. TP6 showed the greatest net increase (14.71%), followed by TP3 (10.27%), TP2 (8.62%), TP5 (8.00%), and TP4 (7.43%), while TP1 increased slightly to 3.17% and remains the only plot below the historical peak value of 5.3% observed in the foredune one at ODSVRA in 1966. However, all TPs remain well below the NOF reference site, which has average and minimum plant cover of 21.89% and 16.99%, respectively. *Abronia latifolia* has established and expanded rapidly and appears to contribute substantially to dune development.

Topographic roughness offered by dunes and plants, is a proxy for dust-control potential of the FRA and has also increased across all TPs as plant cover and dunes continue to develop. TRI values

increased by factors of 2.3–3.4 between February 2020 and October 2023, followed by a n approximately 1.3-fold decline through October 2024, likely associated with reduced plant cover. Since, TRI has stabilized or increased slightly at most sites, while TP1 continued to decline. TP3, TP5, and TP6 have consistently shown the greatest roughness since 2022, with TP5 highest by February 2026. Nevertheless, TP roughness remained only 30–60% of that at the fully developed NOF dune reference site, indicating that further vegetation and dune development are needed to approach the roughness and dust-control potential of a fully developed foredune ecosystem.

Overall, across these indicators, TP3 continues to perform best toward developing a sustainable dune ecosystem with enhanced dust control potential, with TPs 5 and 6 following.

2.3.4 TRACK-OUT CONTROL

Condition 1.c of the original 2018 SOA required State Parks to install SLOAPCD-approved sand track-out control devices at the Grand Avenue and Pier Avenue entrances to the ODSVRA. This requirement was not modified by any of the subsequent SOA amendments. State Parks completed the construction of the Grand Avenue track-out control project in November 2022.⁴⁹ State Parks has not proceeded with the construction of the Pier Avenue track-out control project due to the uncertain future of this entrance; however, State Parks continues to use temporary rubber track-out mats at this entrance. The temporary mats were originally installed in 2019 and are regularly cleaned when the beach is open to public vehicle activity. State Parks also continues to conduct ongoing street sweeping activities on Pier and Grand Avenues at a minimum of three times per week.

2.4 OTHER DUST CONTROL PROGRAM ACTIVITIES

State Parks, the SAG, and the SLOAPCD may undertake activities to further support and inform the overall adaptive management approach to dust control at the ODSVRA. State Parks' report on other Dust Control Program-related activities is provided below.

2.4.1 SAG REVIEWS OF STUDY REPORTS

Report: Report of Findings: ODSVRA Meteorological and PM₁₀ Monitoring Network, 2025

Author: Desert Research Institute (J. Gillies and G. Nikolich)

Draft Date: February 2026

Date State Parks Requested SAG Review: June 1, 2026

SAG Response Date: June 9, 2026

Final Publication Date: August 10, 2026

Report: Increments of Progress Towards Air Quality Objectives – ODSVRA Dust Controls 2025 Update

Author: Desert Research Institute (J. Gillies, G. Nikolich, and E. Furtak-Cole)

Draft Date: November 06, 2025

⁴⁹ Refer to State Parks' 2021 ARWP, Attachment 05 (Sediment Track-out Prevention Measures), for detailed plans for track-out control at Grand Avenue.

Date State Parks Requested SAG Review: January 6, 2026

SAG Response Date: January 15, 2026

Final Publication Date: August 10, 2026

Report: ODSVRA Dust Control Program – Draft 2025 ARWP

Author: State Parks staff

Draft Date: August 15, 2025

Date State Parks Requested SAG Review: August 15, 2025

SAG Response Date: August 29, 2025

Final Publication Date: September 26, 2025

Report: ODSVRA Dust Control Program – Provisional Final 2025 ARWP

Author: State Parks staff

Draft Date: September 26, 2025

Date State Parks Requested SAG Review: September 26, 2025

SAG Response Date: October 1, 2025

Final Publication Date: September 26, 2025

Report: 2025-2026 ODSVRA Foredune Restoration UAS Monitoring Report

Author: UCSB (Z. Hilgendorf, I. Walker, and M. Heffentrager)

Draft Date: July 2026

Date State Parks Requested SAG Review: July 10, 2026

SAG Response Date: July 16, 2026

Final Publication Date: August 1, 2026

2.4.2 SAG-GENERATED REPORTS AND MEMOS

During the 2026 ARWP reporting period (August 1, 2025, through July 31, 2026), the SAG generated the following reports and memoranda:

- **SAG Memo: Recommendations for Reconciling DRI Model Assumptions with Ground Evidence in Respect of Vegetated Grid Cells**, January 7, 2026. Discussion and suggestions for considering the effects of vegetation on dust emission potential with the DRI model.
- **Classifying Grid Cells Relative to Percent Vegetation Cover – Influence on Dust Emission Potential**, January 16, 2026. Workflow guidelines for classifying “vegetated” grid cells as well as “aerodynamically sheltered” grid cells. Accompanies the January 7, 2026, SAG memo. To be used by State Parks personnel to assess model grid cells in the DRI model.
- **ODSVRA PI-SWERL Emissivity Measurements Update Report (2025)**, February 12, 2026. Summary report from the SAG on the results from the September 2025 PI-SWERL campaign conducted by DRI. New emissivity power relations developed for the PE and NRA Central based on updated information.
- **SAG Memo: Incorporating Vegetation Cover into the DRI Model**, April 9, 2026.

Background summary report and recommendations for improved modeling of vegetation effects on dust emissions within the ODSVRA. Detailed follow-up on the January 7, 2026 SAG memo.

- **SAG Memo: Contemplating DRI Model Refinements in Anticipation of the 2026 ARWP**, May 31, 2026. Background summary report and recommendations for parameterizing the pre-disturbance scenario in the DRI model.
- **SAG Memo: Proposed Updates to Reporting on the Foredune Restoration Area**, June 9, 2026. Recommendations regarding metrics used to evaluate the performance and state of the six treatment types in the FRA. Some old metrics to be eliminated and two new metrics introduced. Size of polygons changed to eliminate edge effects.

2.4.3 SAG PARTICIPATION IN MEETINGS

During the 2026 ARWP reporting period (August 1, 2025, through July 31, 2026), the SAG participated in a number of meetings with State Parks and SLOAPCD personnel, as well as with the SLOAPCD Hearing Board. In addition to those highlighted below, there were numerous regularly scheduled and ad hoc meetings between SAG members and other individuals on topics related to dust emission measurement/modeling and SOA compliance assessment:

- SAG monthly online meetings in July and August—cancelled (no new business)
- ARWP planning meeting, August 5, 2025 (B. Bauer in attendance via Teams)
- ARWP planning meeting, August 28, 2025 (B. Bauer in attendance via Teams)
- Ad hoc meeting with Jon O’Brien regarding DRI modeling assumptions, September 10, 2025
- Ad hoc meeting with Jon O’Brien regarding PE, September 17, 2025
- SAG semi-annual in-person meeting, October 13-14, 2025, Oceano, California (all SAG members present)
- SLOAPCD Hearing Board meeting, October 15, 2025, San Luis Obispo (presentation by SAG Chair B. Bauer; all SAG members present)
- SAG monthly online meeting, November 17, 2025, via Zoom (all SAG members present)
- SAG monthly online meeting, December 15, 2025, via Zoom (all SAG members present)
- SAG monthly online meeting, January 12, 2026, via Zoom (all SAG members present)
- SAG monthly online meeting, March 9, 2026, via Zoom (all SAG members present)
- SAG semi-annual meeting, April 13, 2026, via Zoom (all SAG members present)
- SAG ad hoc meeting, April 20, 2026, via Zoom (all SAG members present)
- SAG monthly online meeting, May 18, 2026, via Zoom (all SAG members present)
- SAG monthly online meeting, June 15, 2026, via Zoom (all SAG members present)

- SAG monthly online meeting, July 13, 2026, via Zoom (all SAG members present)
- Bi-weekly meetings with State Parks OHV Management, August 2025 through July 2026, via Teams (SAG Chair B. Bauer and Program Manager J. O'Brien)
- Bi-weekly meetings with SLOAPCD management, August 2025 through July 2026, via Zoom (SAG Chair B. Bauer and Executive Director K. Tupper)

2.4.4 PUBLIC RELATIONS CAMPAIGN

State Parks' public relations campaign is intended to educate the public on regional air quality issues in southern San Luis Obispo County surrounding the ODSVRA, how they are being addressed, and how the public can be part of the solution.⁵⁰ During the reporting period, the campaign conducted the following activities:

- Continued to host a digital two-page flyer that explains the basics about sand movement in a dune system. This flyer is located on the ODSVRA's Particulate Matter Information website: https://ohv.parks.ca.gov/?page_id=26918
- Continued to host a video that provides a broad overview of the Oceano Dunes Air Quality Management Program. This video is located on the ODSVRA's Particulate Matter Information website: <https://youtu.be/gkbf7kia3-Q>
- Continued to host the Frequently Asked Questions (FAQ) document with specific information about air quality and the dust mitigation activities. This FAQ document is located on the ODSVRA's Particulate Matter Information website: https://ohv.parks.ca.gov/?page_id=26918
- Continued to conduct website maintenance for the ODSVRA's Particulate Matter Information website.
- Created social media posts on the Oceano Dunes Facebook page, focusing on the Dust Control Program and educating the public on the things they can do to help: <https://www.facebook.com/OceanoDunesDistrictPismoBeach/>

2.4.5 COASTAL COMMISSION COORDINATION

The 2025 ARWP only included supplemental planting activities that occurred in project areas that had already been permitted previously by the California Coastal Commission. Accordingly, 2025 Work Plan activities were not subject to a new or amended Coastal Development Permit (CDP), and no coordination with the Coastal Commission was necessary.

⁵⁰ Refer to State Parks 2023 ARWP, Attachment 12, for State Parks' public relations campaign details.

3 WORK PLAN (AUGUST 1, 2026, TO JULY 31, 2027)

This chapter of the ARWP proposes activities that State Parks will undertake to sustain the progress the Dust Control Program has made in reducing current PM₁₀ emissions to a level that is not in excess of the naturally occurring conditions inherent to the modeled 1939 pre-disturbance condition. State Parks' Work Plan emphasizes and focuses on providing supplemental planting to maintain dust control project effectiveness and continued refinement of the excess emissions modeling methodology.

For the period of approximately August 1, 2026, to July 31, 2027, State Parks is proposing the following Dust Control Program activities:

- Install up to approximately 8 acres of new, temporary straw treatment projects outside the open riding and camping area
- Provide supplemental seeding and vegetation planting on approximately 42.2 acres of previous vegetation treatment areas
- Continue Dust Control Program field monitoring and air quality modeling activities
- Continue SAG consultation, including updating the approach to evaluating Dust Control Program progress
- Continue to implement the Dust Control Program public relations campaign
- Coordinate with the California Coastal Commission on 2026 ARWP permitting requirements

In addition, State Parks has begun preliminary planning for the following activities:

- Any new dust control measures that may be required to maintain long-term compliance with the SOA
- Reopening a portion of the PE to seasonal recreation activities⁵¹

Both of these planning process will include coordination with the SAG and other agencies and, once a specific plan is determined, SLOAPCD review and approval. State Parks' description of proposed Dust Control Program activities is provided below.

3.1 DUST CONTROL PROJECTS PROPOSED FOR AUGUST 1, 2026, TO JULY 31, 2027

3.1.1 NEW TEMPORARY DUST CONTROL PROJECT

State Parks proposes to install up to approximately 8 acres of new straw treatments outside the open riding and camping area (2027-ST-01, see Figure 3-1) This project would be located east of

⁵¹ Typically, under a seasonal management regime, the PE would be opened on October 1 of one calendar year and closed on the last day of February in the following calendar year.

Boy Scout Camp, in the southeastern portion of the backdune non-riding area, adjacent to an existing project area (2021-VG-05).

3.1.2 SUPPLEMENTAL PLANTINGS

State Parks proposes to conduct supplemental planting and seeding activities on nine previously installed vegetation projects totaling approximately 42.2 acres, as shown in Figure 3-1. One project area (South Crescent, 2021-VG-05) had previously been treated with seed only and not container stock, while another project area (Eucalyptus Tree Center 2022-VG-09) had previously been treated with container stock, native seed, and sterile grain seed but no straw treatment. Both of these treatments resulted in slow vegetation recruitment and low vegetation cover. To improve vegetation cover, parts of these projects will receive installation of straw, native container plants, native seed, and sterile grain seed. The remaining seven supplemental planting areas (2018-VG-02, 2019-VG-01, 2022-VG-04, 2022-VG-05, 2022-VG-07, 2022-VG-11, and 2023-VG-02) have each had significant sand inundation on their western edges, resulting in burial and loss of vegetation cover. These areas had originally been treated with straw, container plants and native seed, and sterile grain seed. To improve vegetation cover and species diversity, supplemental planting is proposed in these areas including installation of straw, native container plants, native seed, and sterile grain seed.

The proposed supplemental planting projects, particularly the supplemental planting efforts at 2021-VG-05 and 2022-VG-11, should improve downwind air quality concentrations at not only the CDF air quality monitoring station, but also the Mesa2 air quality monitoring station. State Parks will, in coordination and consultation with the SAG, continue to evaluate and monitor backdune vegetation projects and conduct supplemental planting activities in areas where vegetation has not yet become established.

3.1.3 PLANTING PALETTE/ESTIMATE OF PLANTS AND SEED NEEDED FOR DUST CONTROL PROJECTS

As of August 1, 2026, State Parks estimates up to approximately 114,499 plants, 400 pounds of native seed, and 1,050 pounds of sterile grain seed would be required to complete the proposed supplemental planting activities (see Section 3.1.1). Refer to Attachment 11 for estimates of planting and seeding activity associated with State Parks' proposed 2026 Work Plan.

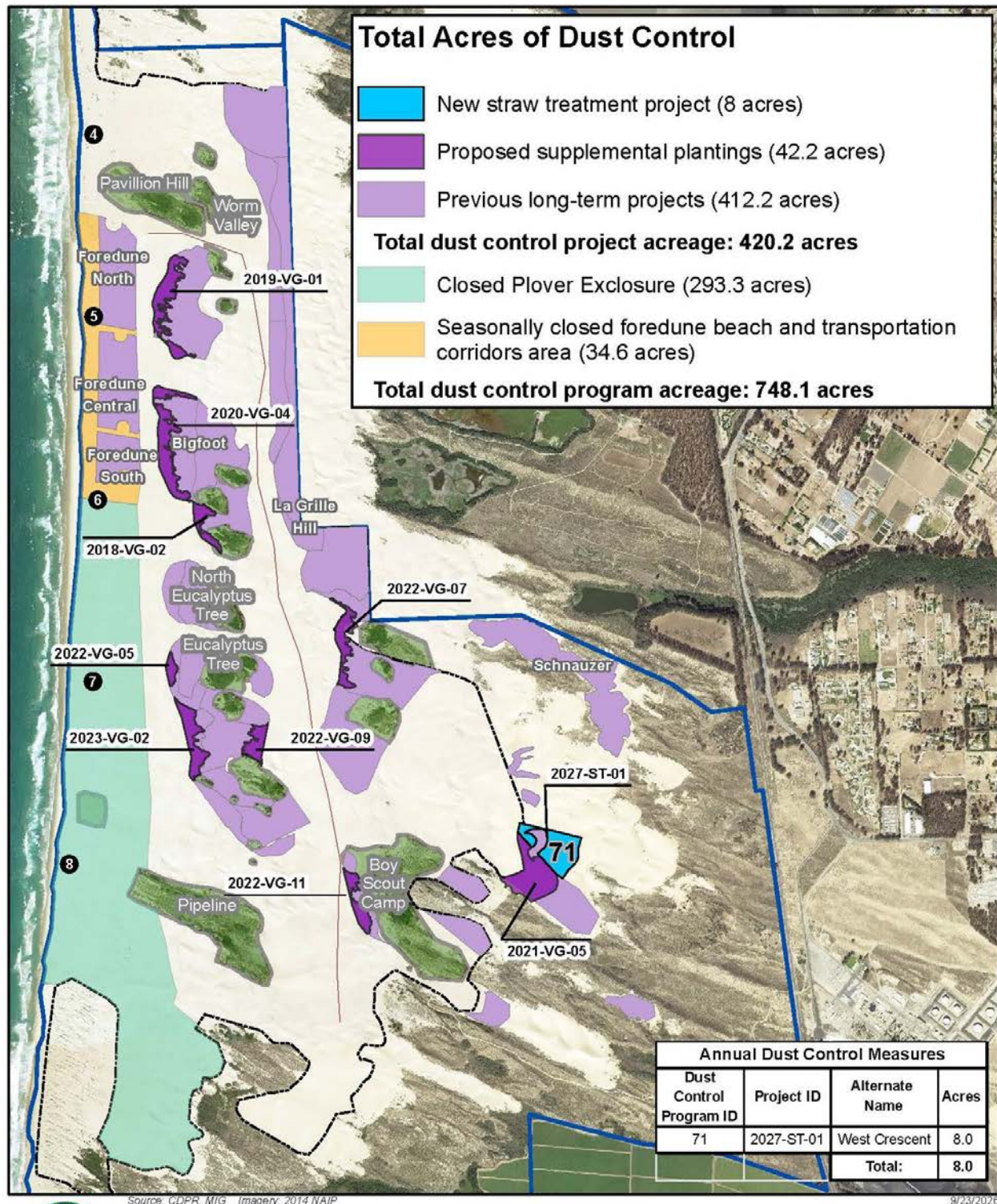


Figure 3-1: 2026-2027 Dust Control Projects



Sand Highway, approx. 0 1,000 2,000 Feet



Existing fenced vegetated islands

3.2 AIR QUALITY MODELING ACTIVITIES

State Parks, in coordination with DRI and the SAG, proposes to conduct the air quality modeling activities described below from August 1, 2026, to July 31, 2027.

3.2.1 PREDICTION OF FUTURE EXCESS EMISSIONS REDUCTIONS

As summarized in Section 2.3.2.2, the results of the excess emissions modeling (as shown in Table 2-10) conducted by DRI indicate that the ODSVRA, as currently configured according to the SAG's recommended emissivity management zones and accounting for all treatment projects implemented since 2013, does not emit PM₁₀ to a level that is in excess of the naturally occurring conditions inherent to the pre-disturbance scenario and therefore is in compliance with the SOA. Accordingly, an estimate of the amount of additional dust control projects needed to comply with the SOA, and predictions of future excess emissions reductions that would occur with new dust control projects, are not necessary at this time. Nonetheless, preliminarily, State Parks estimates that the 8 acres of new straw treatments shown in Figure 3-1 would result in a reduction of approximately 0.3 metric tons of emissions. State Parks will coordinate with DRI to refine the estimate of emissions reductions associated with the final straw treatments installed as part of this Work Plan as part of the ARWP process, and any excess credits could be applied to address future changes in emissivity relations, vegetation cover, or other issues that may arise as part of the 2027 ARWP process.

3.2.2 MODEL REFINEMENTS

As described in Section 2.2.2, State Parks and the SAG have used the PI-SWERL data collected by DRI to establish emissivity grids and parameterize PM₁₀ emissions from the ODSVRA for the purposes of modeling pursuant to the SOA's excess emissions framework. State Parks will coordinate with DRI and the SAG to conduct updated PI-SWERL tests between August 1, 2026, and July 31, 2027, and incorporate this new information into the emissivity power relations used in the excess emissions model. As described in more detail in Section 3.3.2, State Parks anticipates that, at a minimum, PI-SWERL testing will occur in the PE and that emissivity power relations will be updated after the sampling campaign(s) are complete.

3.3 FIELD MONITORING ACTIVITIES

State Parks, in coordination with DRI and the SAG, proposes to conduct the field monitoring activities described below from August 1, 2026, to July 31, 2027. Field monitoring activities would generally continue in a manner similar to previous years' efforts.

3.3.1 METEOROLOGICAL AND PM₁₀ MONITORING

As described in Section 2.2.1, State Parks conducts meteorological and PM₁₀ monitoring, with an emphasis on data collection from April 1 to September 30. This network was re-installed in April 2026 and will be maintained through September 2026. DRI will analyze and use the data

collected by the network to update ODSVRA meteorological and PM₁₀ monitoring network reporting (see Section 2.2.1) in the 2027 ARWP. State Parks anticipates re-installing the network shown in Figure 2-3 in April 2027. As has been done previously by DRI, the MetOne 212 particle profilers will be calibrated against a BAM PM₁₀ monitor in the DRI dust chamber prior to and following deployment.

Additionally, State Parks will continue to maintain its S1 Tower, and will coordinate with DRI to analyze and use the data collected by the tower to update reporting on progress toward air quality objectives (see Section 2.3.1) as part of the 2027 ARWP process.

3.3.2 PI-SWERL SURVEYS

State Parks will coordinate with DRI to undertake additional PI-SWERL sampling in 2026 and 2027. Preliminarily, DRI will measure emissivity within the PE and State Parks will coordinate with DRI and the SAG on the timing of this testing given the potential reopening of this defined emissivity zone. The results of this testing would be used to refine emissivity relations for the PE if necessary.

In consultation with DRI, State Parks will also work with the SAG to determine whether other additional useful PI-SWERL measurement campaigns should be carried out in 2026/2027 (beyond the planned PE campaigns) to further the current understanding of the dust emissions system and inform air quality modeling and management of dust emissions at the ODSVRA. Any new measurements would be incorporated into the global dataset of PI-SWERL measurements used in the excess emissions modeling.

3.3.3 FRA UAS SURVEYS

Consistent with previous years (see Section 2.2.3), UAS surveys for the 2026 ARWP (August 1, 2026, to December 1, 2027) will continue biannually in October 2026, February 2027, and October 2027. UAS surveys will involve both RGB and multispectral bands. The same data products as described in Section 2.2.3 will be produced (georeferenced orthophoto mosaics, DTMs, geomorphic change maps, vegetation maps, TRI roughness maps and quantities) and interpreted to describe changes in the foredune restoration project area with comparisons to the NOF reference site.

3.3.4 OTHER VEGETATION MONITORING

3.3.4.1 FOREDUNE AND BACKDUNE LINE-INTERCEPT TRANSECT SAMPLING

State Parks will conduct foredune and backdune line-intercept transect sampling in winter 2026 (see Section 2.2.4.1 and Section 2.2.4.2); however, beginning in 2026, State Parks plans to modify the location and direction of all of the FRA transect lines to run in the direction of the prevailing wind for the entire width of the FRA within each of the treatment plots. This approach will better capture the change in species composition along the prevailing wind and provide better insight into the interaction of species with environmental factors including, dune

development, deflation surfaces, wind exposure, tidal events and exposure to salt spray.⁵²

3.3.4.2 FOREDUNE AND BACKDUNE PHOTO POINT MONITORING

State Parks will conduct foredune ground and foredune and backdune aerial photo point monitoring using the same methodology described in Section 2.2.4.3.

3.4 OTHER DUST CONTROL PROGRAM ACTIVITIES

3.4.1 SAG ACTIVITIES

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

The SAG will continue to exercise its independent advisory role by preparing scientific reports and reviews that inform the implementation and monitoring of ODSVRA dust mitigation activities. The SAG may consult with State Parks and the SLOAPCD to ensure access to relevant context and information in preparing such reports and reviews. To ensure independence, however, the content and timeline for the final publication of SAG reports and reviews will be at the sole discretion of the SAG, although the SAG will consider timeline considerations from either agency.

The SAG anticipates the following meeting and workshop activities in 2026/2027:

- One annual two-day meeting at the ODSVRA, with the participation of State Parks and SLOAPCD staff, to be held in association with the timing of the Hearing Board meeting in October 2026
- Monthly SAG meetings (via remote link), with the participation of State Parks and SLOAPCD staff as needed
- Regular bi-weekly meetings (via remote link) between the SAG Chair and ODSVRA Superintendent
- Regular bi-weekly meetings (via remote link) between the SAG Chair and SLOAPCD Executive Director
- Additional ad hoc calls among subgroups of the SAG to address specific work tasks with State Parks and SLOAPCD staff as needed
- SAG presentations at public meetings and workshops, as requested by State Parks and the SLOAPCD

⁵² State Parks, in consultation with a member of the SAG (Ian Walker), has determined that modifying the protocols for the line-intercept transect sampling could improve understanding of species distribution with the FRA and provide a better comparison to other sites. Refer to Attachment 06 for further details regarding the updates to protocols.

3.4.2 PUBLIC RELATIONS CAMPAIGN

As described in Section 2.4.4, State Parks has finalized a public relations campaign to educate the public on regional air quality issues in southern San Luis Obispo County surrounding the ODSVRA, how they are being addressed, and how the public can be part of the solution. State Parks will continue to implement aspects of this campaign, including social media posts, in 2026/2027.

3.4.3 COASTAL COMMISSION COORDINATION

Regarding State Parks' proposed Dust Control Program activities for the August 1, 2026, to July 31, 2027, period (e.g., supplemental planting, installing monitoring equipment, etc.), State Parks will coordinate with the California Coastal Commission as needed. If necessary, State Parks will submit a formal CDP application to the California Coastal Commission and coordinate with a representative from the Coastal Commission to track the progress of this application and answer questions or concerns that arise during the review of the application materials.

3.5 ADAPTIVE MANAGEMENT

State Parks' Draft PMRP⁵³ prepared under the original SOA defined "adaptive management" as:

A type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policy, strategies, and practices.

The history of dust mitigation efforts in the ODSVRA has been detailed in prior ARWPs and is summarized in the sections above. The progress made since 2013 is testimony to the successful and effective implementation of adaptive management by State Parks, not only in terms of the many projects that were completed that reduced dust emissions but also with respect to the sophistication of the modeling effort that informs the air quality program and the shift in management approach regarding compliance assessment. A key element of the overall strategy was to use measurements of meteorological conditions and dust concentrations within the ODSVRA and from nearby stations (e.g., CDF, Mesa2, Oso Flaco) collected since 2013 to monitor changing conditions and to drive the DRI emission-dispersion model that was created specifically for the ODSVRA. The model results, in turn, were used to identify hot spots of dust emissions, which were targeted for immediate treatment. Those treatments led to reductions in dust emissions and PM₁₀ concentrations at the CDF and Mesa2 monitoring stations (as documented in prior ARWPs). Subsequent modeling scenarios and treatment projects have led to additional dust

⁵³ State Parks' Draft PMRP is available on the following SLOAPCD website (under "June 11, 2019 Update," "Important Documents," "Particulate Matter Reduction Plan – June 2019"): <https://www.slocleanair.org/air-quality/oceano-dunes-efforts/oceano-dunes-archive.php>.

mitigation benefits, documenting a continually decreasing trend in normalized, cumulative PM₁₀ concentrations (TPM₁₀:TWPD) at CDF (see Figure 2-33) as a function of increasing acreage in dust control treatments immediately upwind of the monitoring station between 2013 and 2023 (see also Section 2.3.1). Between 2013 and 2017, the dust control projects amounted to fewer than 45 acres, but there was a perceptible decline in the TPM₁₀:TWPD ratio. Large areas were treated between 2017 and 2022, leading to significant and steady declines in the TPM₁₀:TWPD ratio (see Figure 2-33 and Figure 2-34). Although no additional acreage was closed to public access in the open riding and camping area between 2022 and 2023, the ratio still declined to its lowest value of about 0.15. In 2026, the ratio generally held steady at 0.16. Additional measurements in 2026 will yield more insight. Despite highly varying wind conditions from year to year (see Figure 2-30), the downward trend in the TPM₁₀:TWPD ratio is consistent with other metrics of dust emission reductions in the ODSVRA. The modeling analyses presented in Mejia et al. (2026) using available meteorology and PM₁₀ data from the CDF and Mesa2 monitoring stations also indicate that the decreasing 24-hour PM₁₀ levels through time are a result of dust management efforts within the ODSVRA and not due to changes in the wind climatology.⁵⁴ For example, the SLOAPCD reports a decreasing trend in violations of Rule 1001, with a maximum of 63 in 2017 to a minimum of 10 in 2024, although violations did increase to 17 in 2025, possibly due to the fact that TWPD in 2025 was the second highest in the 15-year record from 2011 to 2025 (see Section 2.3.1).⁵⁵ Nonetheless, significant progress has been made in mitigating dust emissions from the ODSVRA due to the adaptive management strategy adopted by State Parks.

The mobile sand-dominated landscape of the ODSVRA is a dynamic one that is complex in its geologic history, contemporary geomorphology, evolving biogeography, varying meteorology and climatology, and sensitivity and responsiveness to human influences. Consequently, **long-term monitoring is essential to improve understanding of the key processes at work and, more importantly, to provide critical indicators of the relative success of dust mitigation efforts.** For example, as explained in Section 2.2.3, UCSB, in consultation with the SAG, has implemented the new TRI to quantify the topographic complexity and aerodynamic roughness of FRA treatments and, as explained in Section 2.3.2.1, the 2026 DRI model includes updates to how Dust Control Program vegetation projects are modeled. For 2026 and beyond, there will be continuing field monitoring of relevant meteorological and dust-related parameters and foredune evolution to gauge progress toward the SOA objectives. This will include updating the PI-SWRL emissivity grid and implementing model refinements as appropriate and consistent with the evolving understanding of the dynamics of sand transport and dust emissions within the ODSVRA.

⁵⁴ Mejia, J.F., J.J. Henao, J.A. Gillies, and E. Furtak-Cole, 2026. Seasonal dynamics of fugitive dust emissions from the Oceano Dunes: Linking wind regimes, PM₁₀ exceedances, and intervention effectiveness. *Atmospheric Environment* 375, 122008, doi:/10.1016/j.atmosenv.2026.122008.

⁵⁵ SLOAPCD, 2025. *Report on 2025 Air Quality in San Luis Obispo County*. May 20, 2026.

4 BUDGETARY CONSIDERATIONS

State Parks' estimated budget to develop and implement the 2026/2027 Work Plan described in Chapter 3 is \$2,805,933. A detailed breakdown of this estimated budget is provided in Table 4-1. This budget covers all activities from July 1, 2026, through June 30, 2027, including existing contracts with SAG members. The approximately \$2.81 million budget shown in Table 4-1 is similar to the costs that State Parks identified for proposed activities in the 2025 ARWP (\$2.78 million).

Table 4-1. Estimated 2026/2027 Work Plan Budget							
Entity	Budget Item						
	SAG Costs	Vegetation Propagation and Planting	Monitoring and Modeling	Other Expenses	Materials	Labor	Total
UCSB	\$30,000		\$120,000				\$150,000
DRI			\$400,000	\$67,993			\$467,993
ACE/CCC ^(A)						\$295,000	\$295,000
RCD ^(A)		\$400,000			\$27,818		\$427,818
Cal Poly Foundation		\$230,776					\$230,776
Trinity Consulting			\$96,970				\$96,970
Street Sweeping				\$53,550			\$53,550
SLOAPCD Staff and Fees				\$187,407			\$187,407
Miscellaneous ^(B)				\$245,000	\$255,000	\$266,419	\$766,419
SAG Costs	\$130,000						\$130,000
Total	\$160,000	\$630,776	\$616,970	\$553,950	\$282,818	\$561,419	\$2,805,933
(A) ACE is the American Conservation Experience, CCC is the California Conservation Corps, and RCD is the Coastal San Luis Resource Conservation District.							
(B) Miscellaneous refers to contracts for fence materials, greenhouse maintenance, and other Dust Control Program costs.							

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5 IMPLEMENTATION SCHEDULE

Table 5-1 through Table 5-5 below present schedules for implementing the dust control activities identified in Chapter 3. The tables cover an approximately 14-month period from June 2026 to July 2027.

Table 5-1. Dust Control Measures														
State Parks Task/Activity	2026							2027						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Consult with SAG on project selection		O	→	→	X									
Manage seasonal recreation in PE					O	→	→	→	X					
Collect native seed and plants, cultivate growth, collaborate and grow additional plants from nurseries	→	→	→	→	→	X								
Distribute straw mulch (if necessary)					O	→	X							
Initiate seeding and planting (if necessary)							O	→	→	X				
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-2. Supplemental Planting in Previous Treatment Areas														
State Parks Task/Activity	2026							2027						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Collect native seed and plants, cultivate growth, procure additional plants from nurseries	→	→	→	→	→	X								
Initiate seeding and planting							O	→	→	X				
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-3. Continued Foredune Monitoring and Assessment by State Parks Staff														
State Parks Task/Activity	2026							2027						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Consultation with SAG on monitoring		O	→	X									O	→
Transect sampling				O	→	→	→	→	X					
Photo point monitoring					O X									
Data analysis										O	→	X		
Table Key:	O	Task Start				→	Task In Progress				X	Task Complete		

Table 5-4. Field Monitoring and Air Quality Modeling Activities														
State Parks Task/Activity	2026							2027						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Meteorological and PM ₁₀ data acquisition	→	→	→	→	→	→	→	→	→	→	→	→	→	→
PI-SWERL surveys and data analysis				O	→	→	X			O	→	→	X	
UAS surveys					O X				O X					
Improvement of DRI air quality model performance	→	→	→	→	→	→	→	→	→	→	→	→	→	→
Table Key:	O	Task Start				→	Task In Progress				X	Task Complete		

Table 5-5. Continued SAG Consultation and Evaluation														
State Parks Task/Activity	2026							2027						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Consultation with SAG on 2026 ARWP	O	→	→	→	X									
Refinement of excess emissions modeling	→	→	→	→	→	→	→	→	→	→	→	→	→	→
SAG quarterly meetings			X		X				X			X		
Consultation with SAG on 2027 ARWP											O	→	→	→
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

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