# Oceano Dunes State Vehicular Recreation Area (ODSVRA) Stipulated Order of Abatement (SOA): Revisiting the target for PM$_{10}$ emissions reductions

Scientific Advisory Group (SAG)
June 17, 2022
Presentation to San Luis Obispo Air Pollution Control District (SLOAPCD) Hearing Board

*SAG members:* **Raleigh L. Martin (Chair of SAG)**, William Nickling, Ian Walker, Carla Scheidlinger, Earl Withycombe, Mike Bush, John A. Gillies

# Stipulated Order of Abatement (SOA) key provisions

- **$PM_{10}$ concentration (2b):** *"The plan shall be designed to achieve state and federal ambient $PM_{10}$ air quality standards."*
  - **State:** 50 µg/m$^3$, **Federal:** 150 µg/m$^3$
  - **Assessment:** Air quality monitoring / modeling at CDF and Mesa2
- **$PM_{10}$ emissions (2c):** *"…the Plan shall begin by establishing an initial target of reducing the maximum 24-hour $PM_{10}$ baseline emissions by fifty percent (50%), based on air quality modeling based on a modeling scenario for the period May 1 through August 31, 2013…"*
  - **Basis:** Designed to achieve a similar frequency of state $PM_{10}$ exceedance events at CDF (disturbed) and at Oso Flaco (undisturbed)
  - **Assessment:** Model $PM_{10}$ emissions for installed dust controls relative to 2013 baseline, using Desert Research Institute (DRI) model

# Modeling PM$_{10}$ emissions



- Use DRI model (Mejia et al., 2019)

- Modeling scenario is top 10 windy days in spring 2013 applied to Riding Area

- PI-SWERL measurements establish baseline (2013) PM$_{10}$ emissions grid

- Modify emissions grid to determine effect of dust control measures

- Apply dispersion model to estimate air quality at downwind receptor sites

J.F. Mejia, J.A. Gillies, V. Etyemezian, R. Glick (2019) "A very-high resolution (20m) measurement-based dust emissions and dispersion modeling approach for the Oceano Dunes, California," *Atmospheric Environment, 218,* 116977
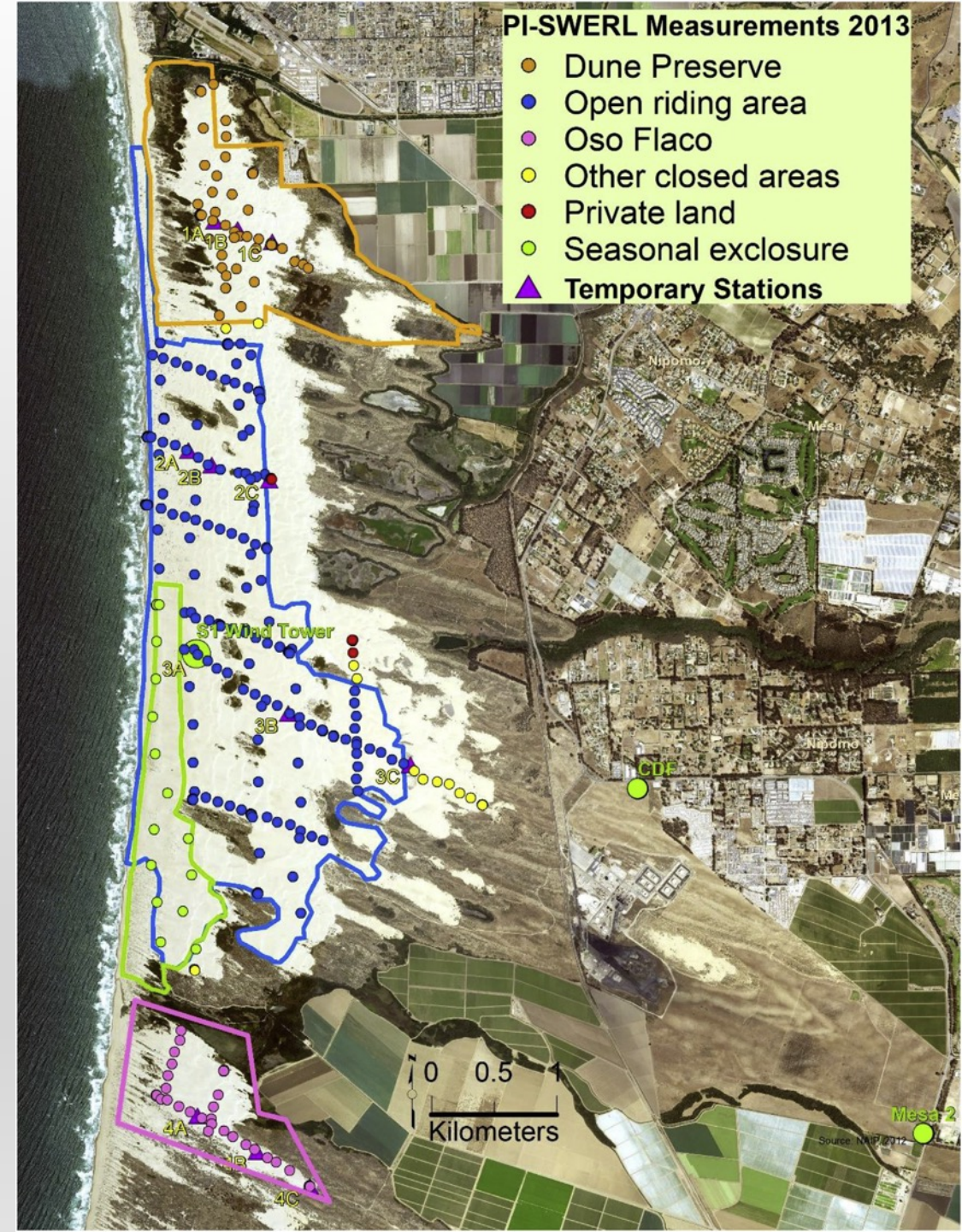
# Modeled progress on PM$_{10}$ emissions
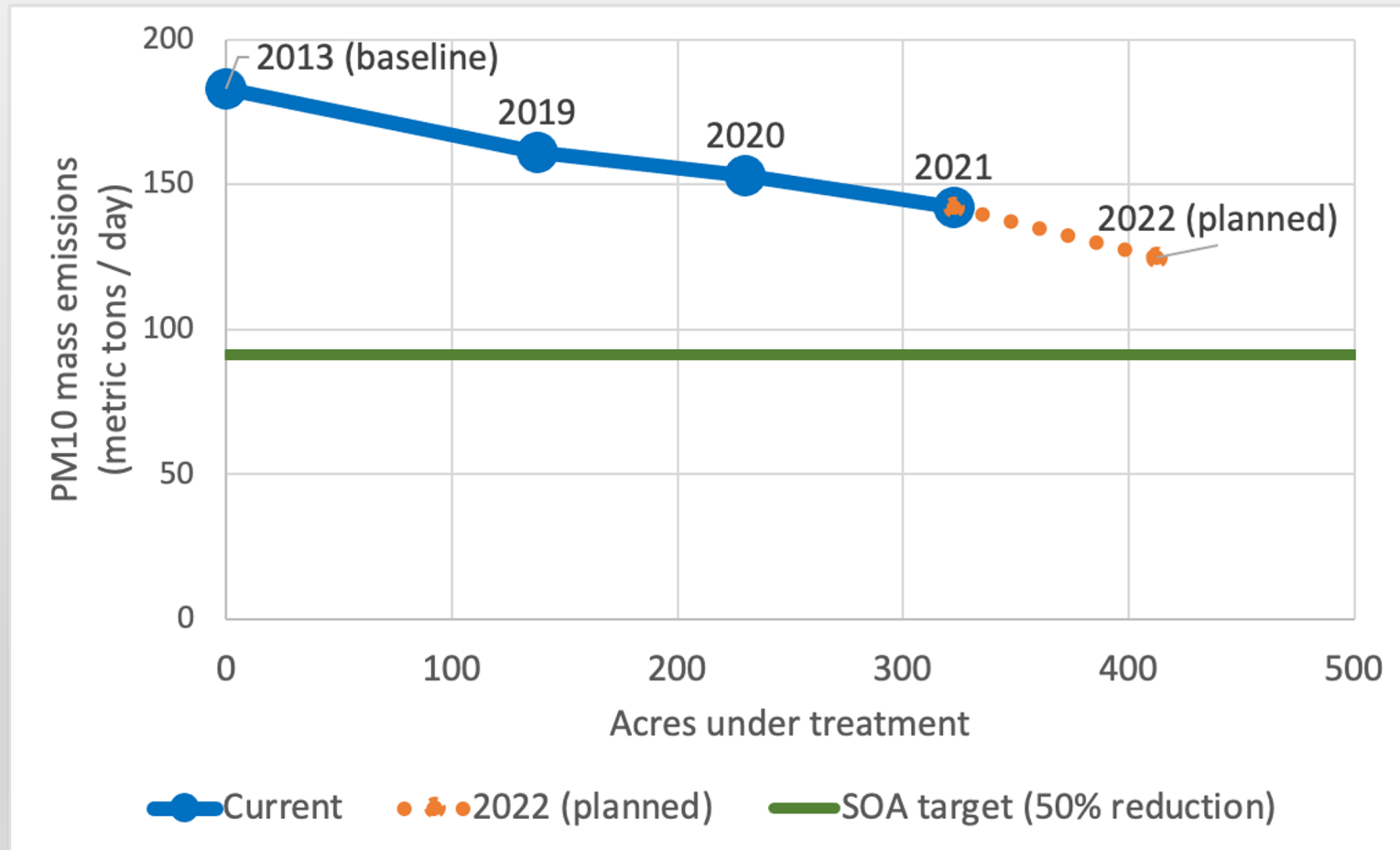


| Year | PM$_{10}$ mass emissions (metric tons / day) | % reduction |
|---|---|---|
| **Baseline (2013)** | **182.2** | **0%** |
| 2019 | 160.8 | 12.0% |
| 2020 | 153.1 | 16.2% |
| 2021 | 142.0 | 22.3% |
| *2022 (planned)* | *124.9* | *31.7%* |
| **SOA target** | **91.4** | **50%** |

*Source:* 2021 Annual Report and Work Plan (ARWP) Attachment 02 "Evaluation Metrics." Values modeled for 2013 top 10 wind days using DRI model.

# Modeled progress on $PM_{10}$ concentrations
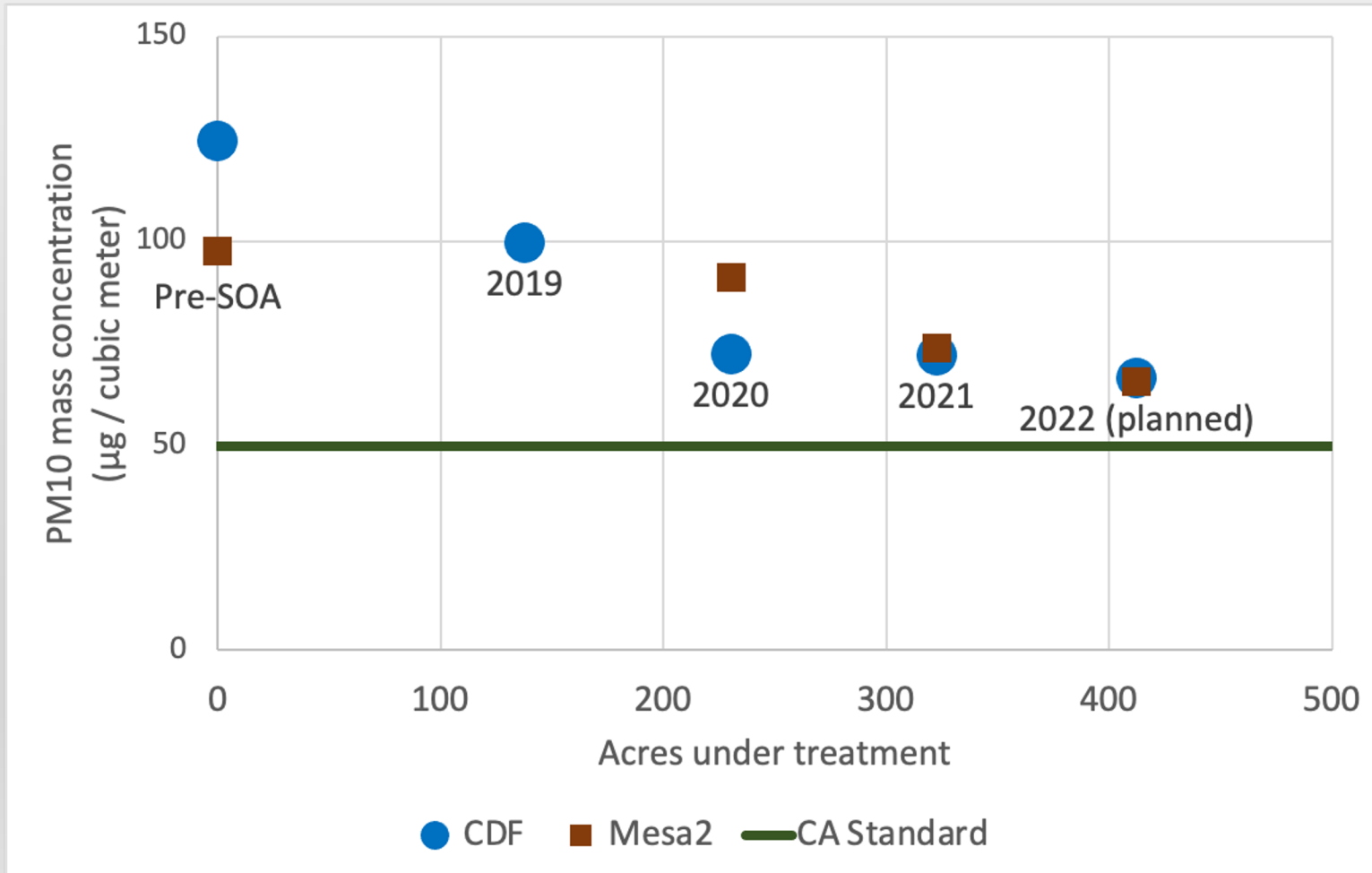


| Year | CDF | Mesa2 |
|---|---|---|
| Pre-SOA | 124.5 | 97.5 |
| 2019 | 99.7 | |
| 2020 | 72.4 | 91.2 |
| 2021 | 72.2 | 73.8 |
| 2022 (planned) | 66.4 | 65.5 |
| CA std | 50 µg / m³ | |

*Source:* 2021 ARWP Attachment 02 "Evaluation Metrics"

# SAG proposed PM$_{10}$ emissions reduction target

*Scientific Advisory Group (February 7, 2022), "*Scientific Basis for Possible Revision of the Stipulated Order of Abatement (SOA)" (Exhibit 2)

| | |
|---|---|
| *Current SOA approach:* | *SAG proposed new approach:* |

**Current SOA approach:**

- **Target:** 50% reduction in PM$_{10}$ mass emissions relative to 2013 baseline

- ***Basis:*** *Achieving a similar frequency of state PM$_{10}$ exceedance events at CDF (disturbed) and at Oso Flaco (undisturbed)*

**SAG proposed new approach:**

- **Target:** 40.7% reduction in PM$_{10}$ mass emissions relative to 2013 baseline

- ***Basis:*** *Achieving a level of PM$_{10}$ mass emissions comparable to conditions prior to OHV disturbance*

# Approach to revised $PM_{10}$ emissions target

*Motivating question:*

**What was the level of $PM_{10}$ emissions at Oceano Dunes prior to significant OHV disturbance?**
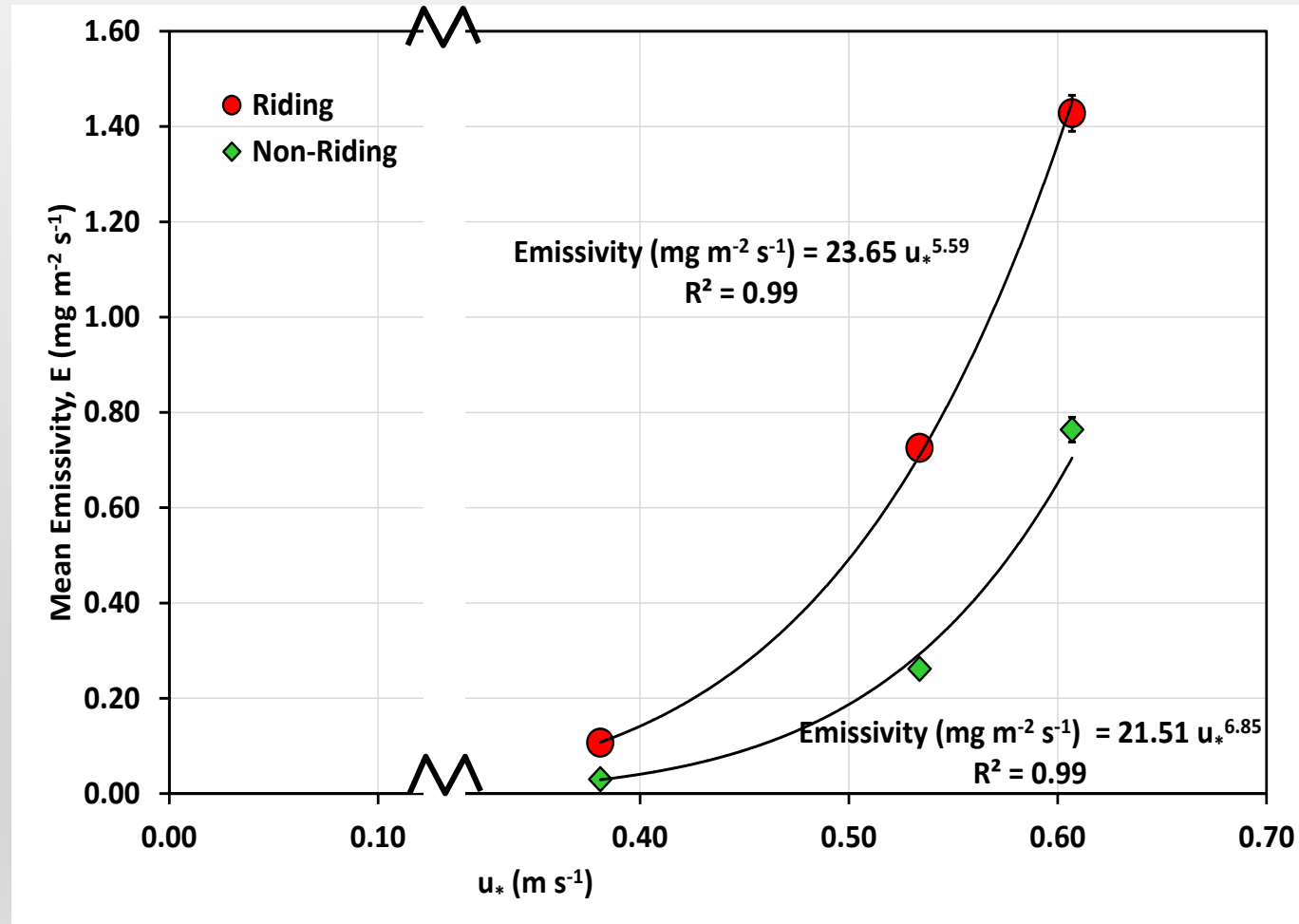
*Key observations:*

**1) $PM_{10}$ emissivity.** OHV-impacted surfaces experience elevated $PM_{10}$ emissions relative to undisturbed surfaces

**2) Vegetation cover.** Vegetation suppresses $PM_{10}$ emissions. Historically, vegetation footprint (within ODSVRA Riding Area) was more expansive.

# 1) PM$_{10}$ emissivity

## DRI "Examining Dust Emissions" study

- Results reported in 2021 Annual Report and Work Plan (ARWP) and subsequently published in peer-reviewed journal article.[1]

- Riding Areas have significantly higher PM$_{10}$ emissivity than Non-Riding Areas

[1] Gillies, J. A., Furtak-Cole, E., Nikolich, G., Etyemezian, V. (2022). "The role of off-highway vehicle activity in augmenting dust emissions at the Oceano Dunes State Vehicular Recreation Area, Oceano, CA," *Atmospheric Environment: X, 13*



Emissivity (mg m$^{-2}$ s$^{-1}$) = 23.65 u$_*^{5.59}$
R$^2$ = 0.99

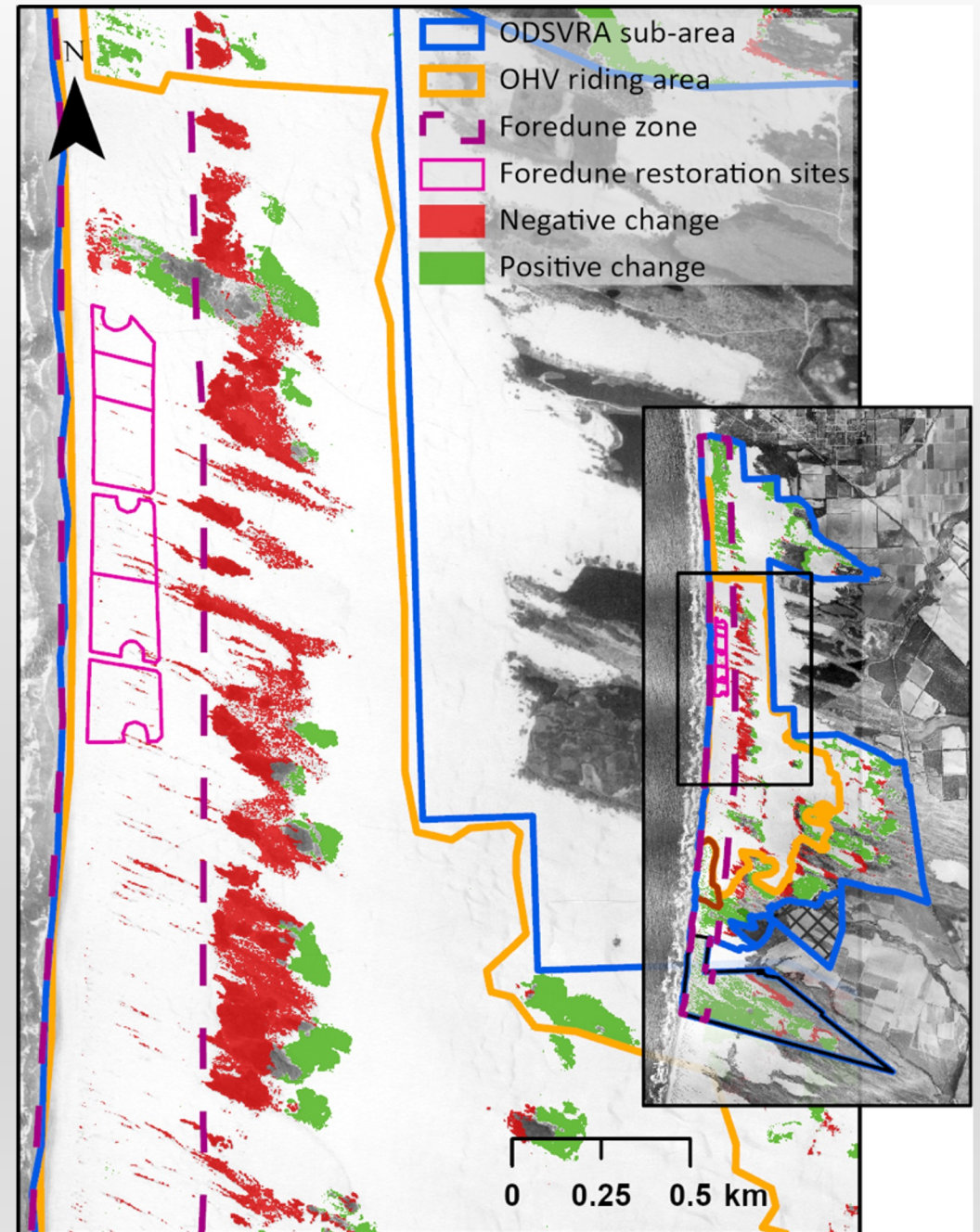Emissivity (mg m$^{-2}$ s$^{-1}$) = 21.51 u$_*^{6.85}$
R$^2$ = 0.99

"Gillies, J. A., Furtak-Cole, E., Nikolich, G., Etyemezian, V. (August 1, 2021). "Examining Dust Emissions and OHV Activity at the ODSVRA"

# 2) Vegetation cover

**UCSB "Historical Vegetation Cover" study**

Detailed study of ODSVRA vegetation change from 1930-2020:

- **Red** = vegetation loss (2012 vs 1939)
- **Green** = vegetation gain (2012 vs 1939)

Swet, N., Hilgendorf, Z., Walker, I. (February 2022). "UCSB Historical Vegetation Cover Change Analysis (1930-2020) within the Oceano Dunes SVRA" [*Attachment 2 of SAG report*]

*Riding Area vegetation change (1939-2012)*



Legend:
- ODSVRA sub-area
- OHV riding area
- Foredune zone
- Foredune restoration sites
- Negative change
- Positive change

0   0.25   0.5 km

# Approach to refining SOA target: "pre-disturbance scenario" modeling

**Motivating question:** What was the level of $PM_{10}$ emissions at Oceano Dunes prior to significant OHV disturbance?
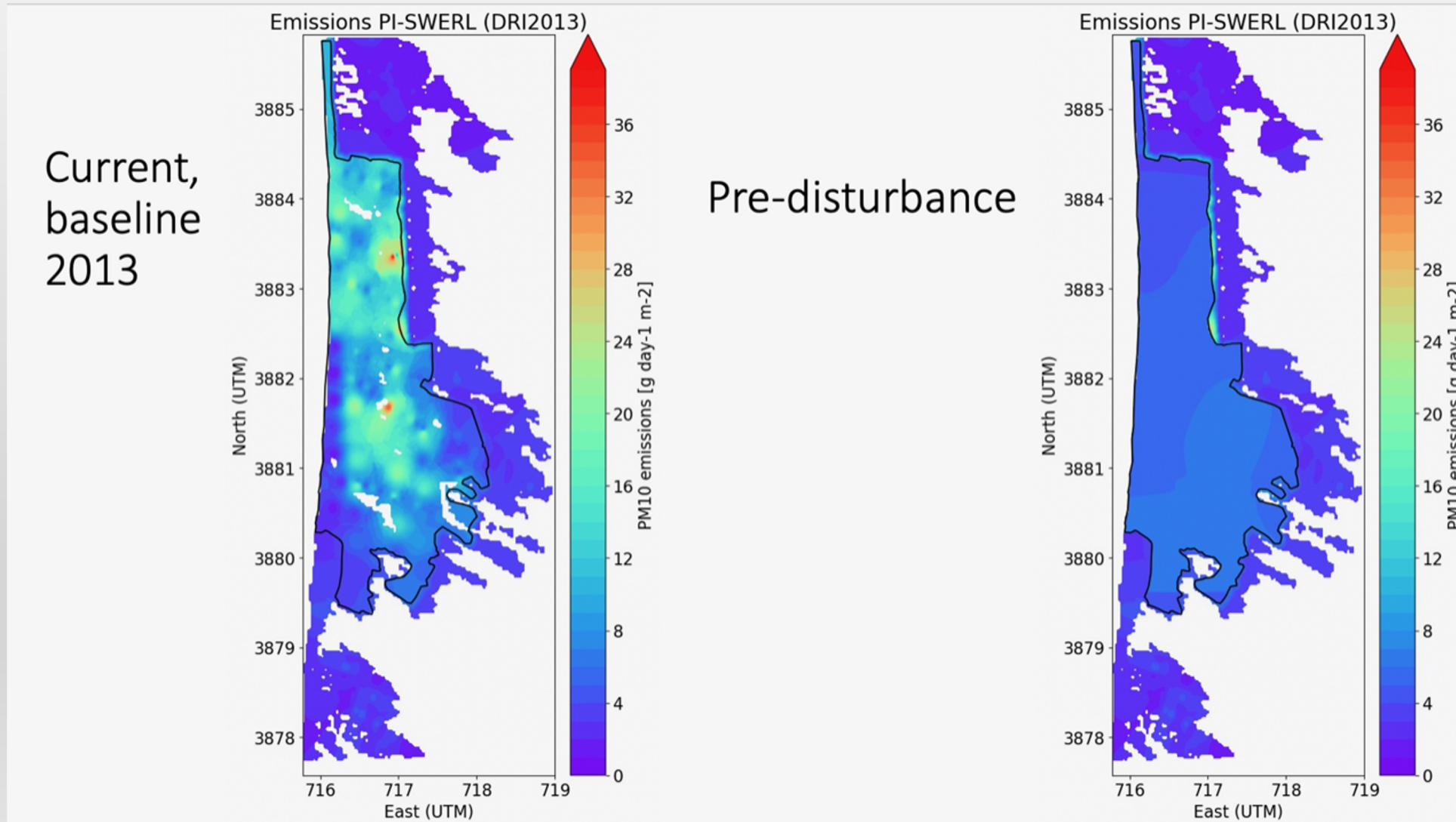
**"Pre-disturbance scenario"** (using DRI model)

**1) $PM_{10}$ emissivity.** Assume $PM_{10}$ emissions across ODSVRA equivalent to current Non-Riding areas.

**2) Vegetation cover.** Assume vegetation cover as per historical (peak vegetation) scenarios.

**Refined SOA target:** Relative to 2013, what % reduction in $PM_{10}$ emissions is required to achieve pre-disturbance scenario emissions?
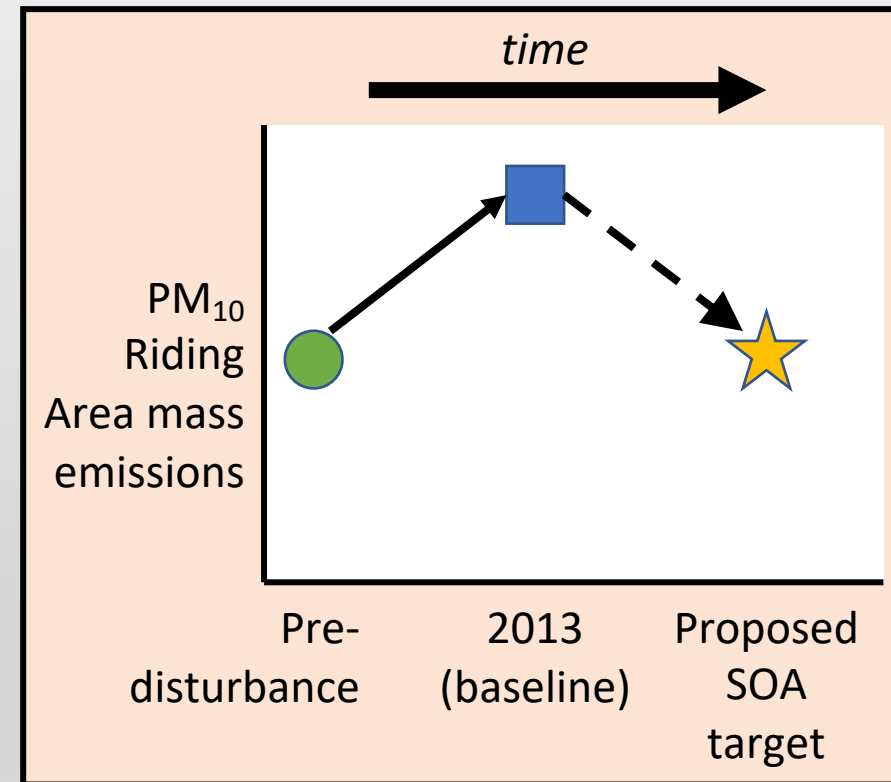
# 1) Emissions grid for DRI model:
## *2013 baseline vs. pre-disturbance*



Mejia, J., Gillies, J. A. (January 10, 2022). "Model-Derived Estimates of Mass Emissions of PM10 for Pre-OHV Disturbance and Past Vegetation Scenarios" *[Attachment 1 of SAG report]*
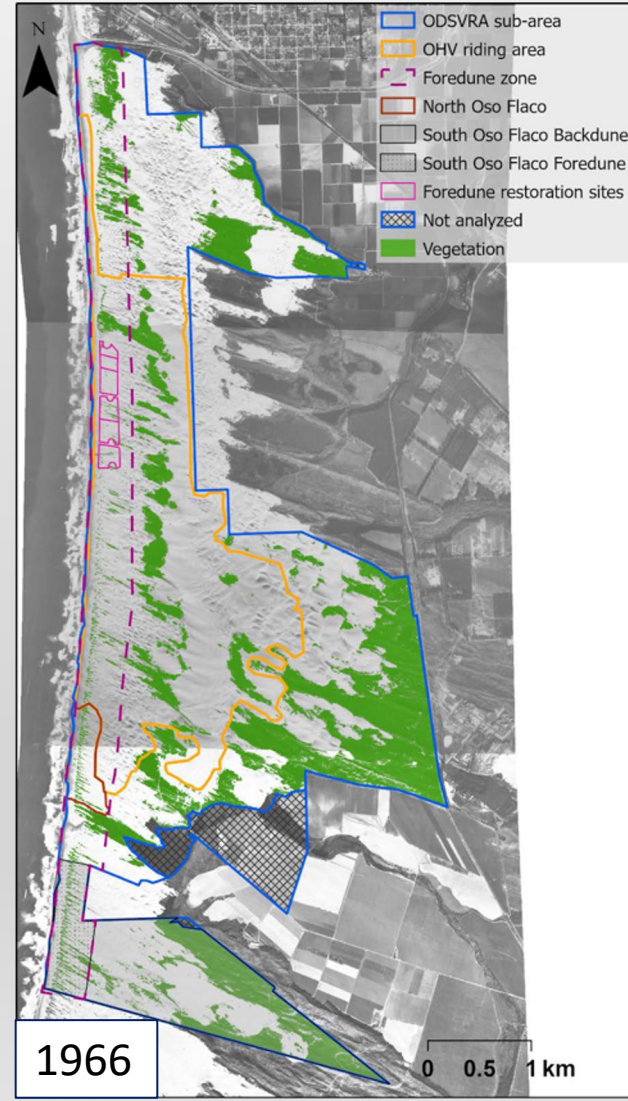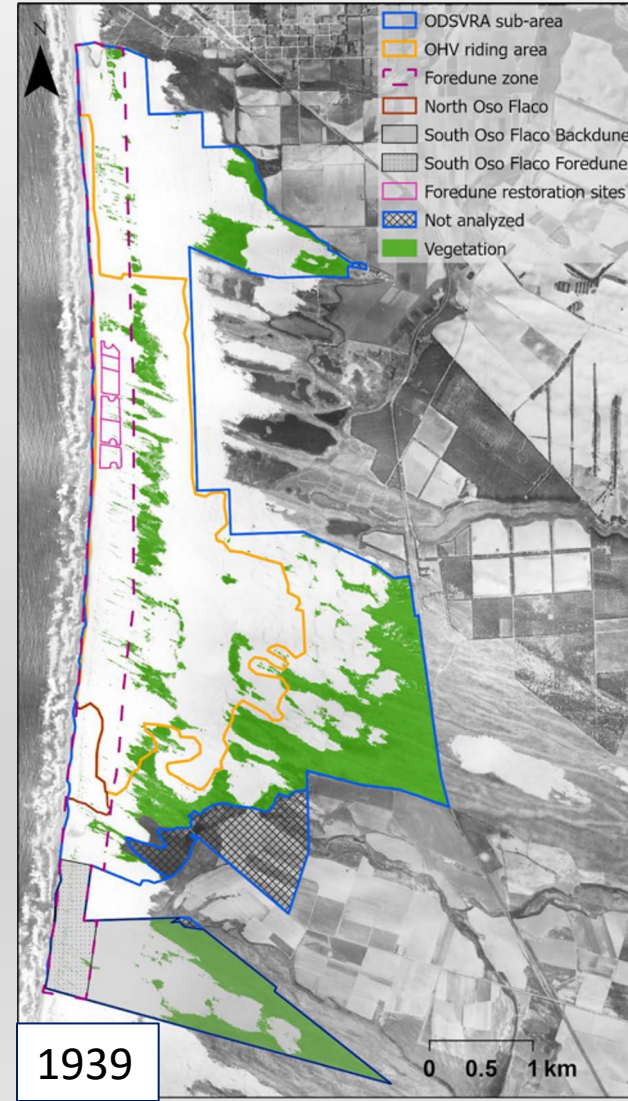
# 2) Vegetation cover for DRI model: 2013 baseline vs. pre-disturbance

2013 baseline

Pre-disturbance

# DRI pre-disturbance scenario modeling results → proposed new SOA target

|  | 2013 Baseline Scenario | Pre-disturbance Scenario 1 (1939) | Pre-disturbance Scenario 2 (1966) |
|---|---|---|---|
| PM$_{10}$ mass emissions (metric tons per day) | 182.8 | 108.4 | 108.9 |
| Percentage reduction from baseline | N/A | **40.7%** | 40.4% |

**Use this as % reduction target for SOA.** Of the 2 scenarios, this is the more conservative (i.e., lower PM$_{10}$ emissions)

# PM$_{10}$ mass emissions and proposed new target
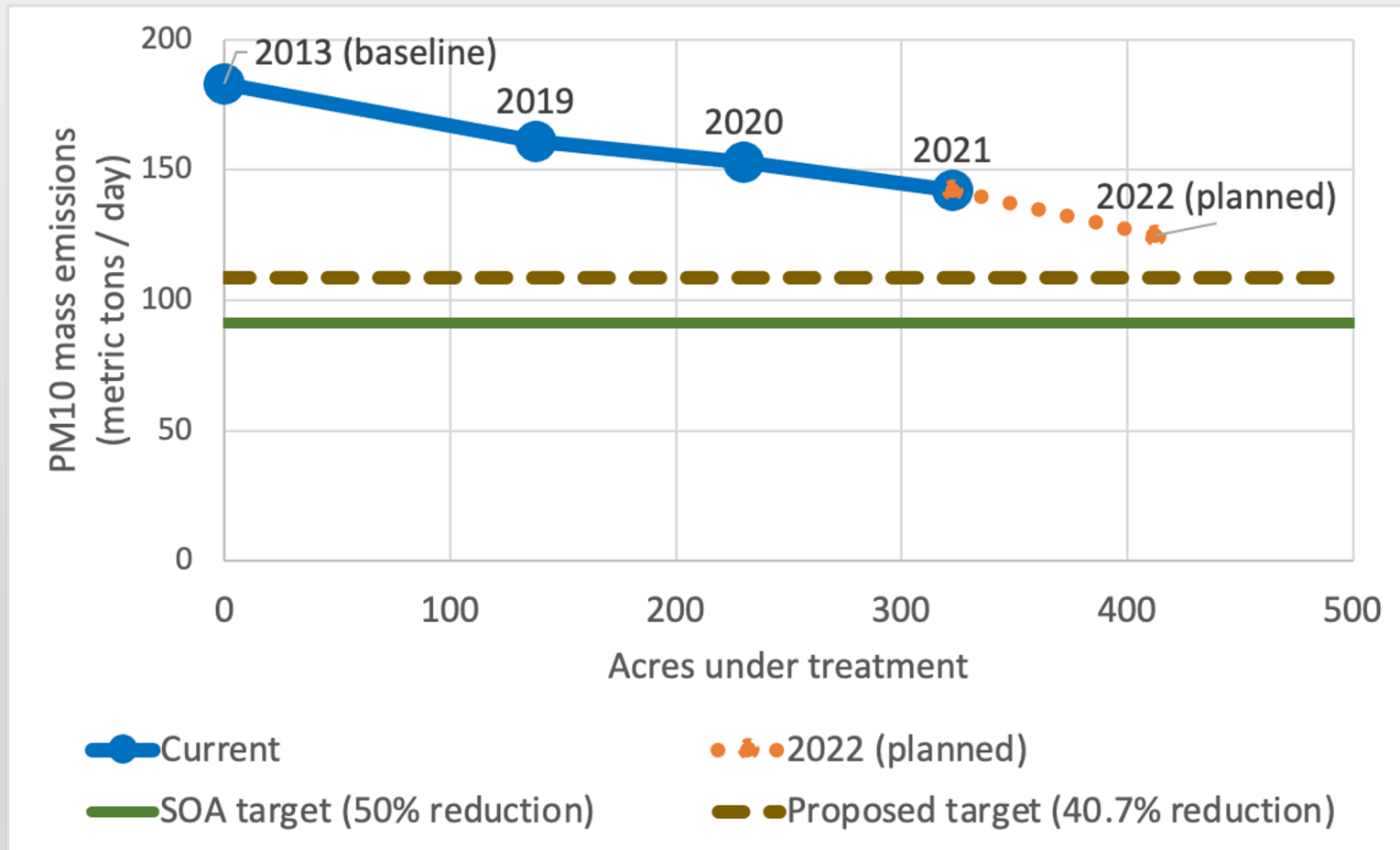


| Year | PM$_{10}$ mass emissions (metric tons / day) | % reduction |
|---|---|---|
| **Baseline (2013)** | **182.2** | **0%** |
| 2019 | 160.8 | 12.0% |
| 2020 | 153.1 | 16.2% |
| 2021 | 142.0 | 22.3% |
| *2022 (planned)* | *124.9* | *31.7%* |
| **Current target** | **91.4** | **50%** |
| *Proposed target* | **108.4** | **40.7%** |

*Source:* 2021 Annual Report and Work Plan (ARWP) Attachment 02 "Evaluation Metrics." Values modeled for 2013 top 10 wind days using DRI model.

# Considerations for SOA target refinement

- SAG proposed SOA target (**40.7% emissions reduction**) assumes management goal to reverse effect of human disturbance (i.e., role of OHVs) on $PM_{10}$ emissions.
- Achieving California $PM_{10}$ air quality standard (**50 µg/m³**) is extremely difficult because dunes are naturally dusty.
  - Eliminating $PM_{10}$ exceedances is very unlikely for current or proposed SOA $PM_{10}$ emissions reduction target.
  - Fully achieving CA standard would require $PM_{10}$ emissions reductions significantly below pre-disturbance conditions.

# SAG proposed model refinements

- Part 2 of SAG report proposes specific refinements to modeling effect of dune restoration on $PM_{10}$ emissions

- Current modeling approach is simple:
  - *Outside control areas:* assume **2013** $PM_{10}$ emissions
  - *Inside control areas:* assume **zero** $PM_{10}$ emissions

- Model refinements to address **actual** effects of dust controls

- Being implemented as part of 2022 ARWP

*Source:* 2021 ARWP



Figure 3-1. 2021/2022 Dust Control Projects

**Total Acres of Dust Control**

- New vegetation (56.2 acres)
- Previous vegetation projects (216.5 acres)
- New straw treatment (26.3 acres)
- Previous straw treatment (27.3 acres)
- Existing wind fence (72.8 acres)
- New test/demonstration stabilizer (7.5 acres)
- Existing vehicle exclusion area (5.9 acres)

Total acreage to be occupied: 412.5 acres

The use of stabilizers is subject to review and coordination with the SAG. Alternative treatments will be applied if stabilizers are not suitable for application.

Figure 3-1: Proposed 2022 Dust Control Treatment Areas

2021 ARWP

- Marker post
- Nesting exclosure from 2020
- Existing fenced vegetated islands
- Open riding and camping area boundary fence
- Park boundary

# SAG proposed modeling refinements

***When modeling PM$_{10}$ emissions for dust control scenarios:***

**1) Open sand areas:** Use updated 2019 PI-SWERL grid (rather than 2013 grid)

**2) Foredunes:** Use computational fluid dynamics (CFD) modeling to estimate PM$_{10}$ emissions within and downwind of foredune

**3) Temporary wind fences:** Model low (but nonzero) PM$_{10}$ emissions, based on sand flux studies (reported in recent ARWPs)

**4) Permanent exclosures:** Estimate emissions based on DRI "Effect of OHV" study of effects of 2020 ODSVRA closure

Continue to assume zero emissions for revegetated areas

***No change to modeling PM$_{10}$ emissions for 2013 baseline***

# Conclusion and key points

1. **Current SOA target is <mark>50%</mark> reduction** in $PM_{10}$ mass emissions reduction relative to 2013.

2. Assuming a management goal for reversing effects of OHV (as modeled for 1939 "pre-disturbance scenario"), **SAG recommends revision of the SOA target to <mark>40.7%</mark>**.

3. Current / revised SOA target is **unlikely to eliminate exceedances** of California $PM_{10}$ air quality standard ($50 \ \mu g/m^3$).

4. SAG also recommends **refinements to modeling** effects of dust mitigation treatments on $PM_{10}$ mass emissions within 2022 ARWP.

# Backup slides

# SOA (Stipulated Order of Abatement) – 2018

- The current SOA (adopted 2018) requires development and implementation of a plan for mitigation of $PM_{10}$ dust from the Oceano Dunes State Vehicular Recreation Area (ODSVRA)

- **$PM_{10}$** = airborne particulate matter with aerodynamic diameter of less than 10 microns

Provisions for the $PM_{10}$ dust mitigation plan include:

- 2a. *"The term of the Plan shall be for four (4) years from the date of approval by the APCO"*

- 2b. *"The plan shall be designed to achieve state and federal ambient $PM_{10}$ air quality standards"*

- 2c. *"…the Plan shall begin by establishing an initial target of reducing the maximum 24-hour $PM_{10}$ baseline emissions by fifty percent (50%), based on air quality modeling based on a modeling scenario for the period May 1 through August 31, 2013…"*



FILED

May 4, 2018

Hearing Board
San Luis Obispo County Air
Pollution Control District

BEFORE THE HEARING BOARD OF THE SAN LUIS OBISPO COUNTY

AIR POLLUTION CONTROL DISTRICT
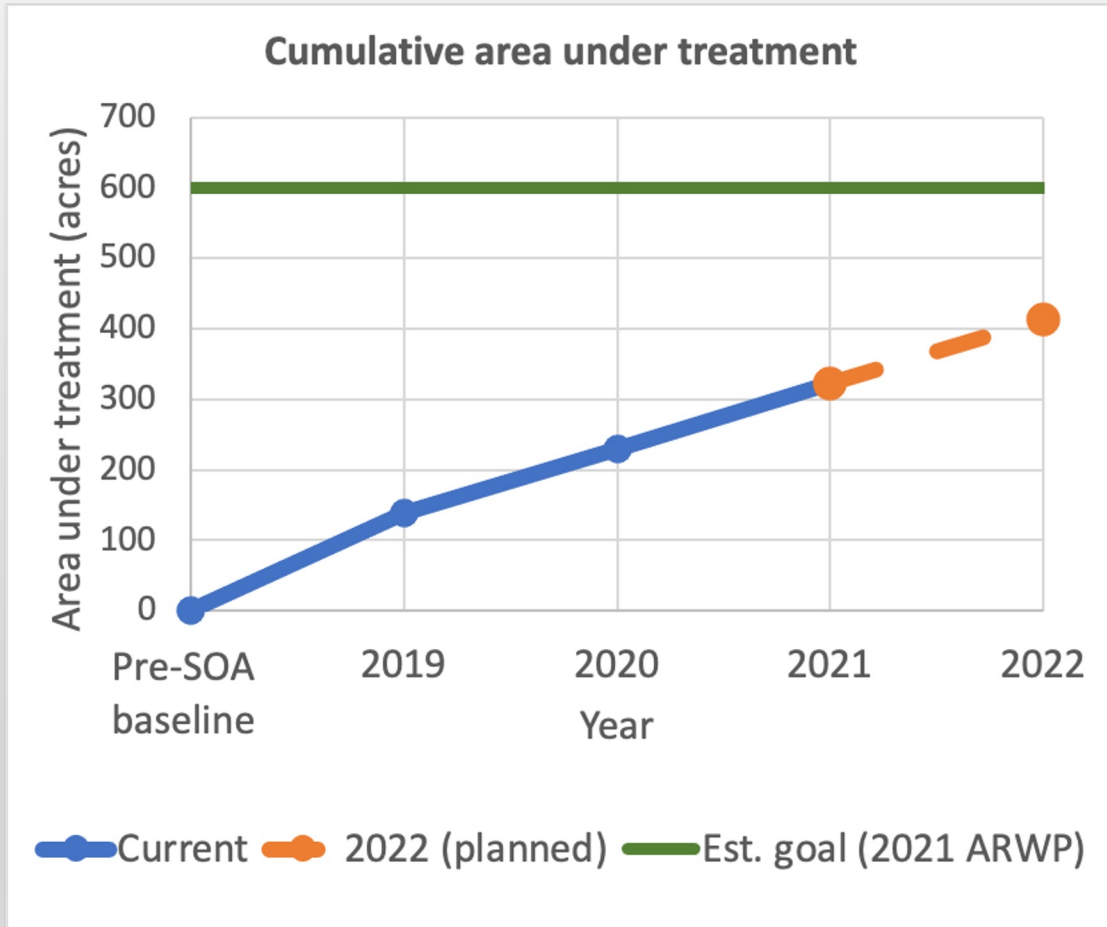
STATE OF CALIFORNIA

In the Matter of

SAN LUIS OBISPO COUNTY AIR POLLUTION CONTROL DISTRICT,

Petitioner,

v.

CALIFORNIA DEPARTMENT OF PARKS AND RECREATION OFF-HIGHWAY MOTOR VEHICLE RECREATION DIVISION,

Respondent.

Case No. 17-01

STIPULATED ORDER OF ABATEMENT

Health & Safety Code §41700 and District Rule 402

Hearing Date: April 30, 2018
Time: 9:00 am
Location: San Luis Obispo County Government Center, Board of Supervisors Chambers, 1055 Monterey Street, California

# PMRP (Particulate Matter Reduction Plan) – 2019

**PMRP (approved June 2019) establishes Parks' approach to achieving goals of SOA:**

a) PMRP sets timeline for $PM_{10}$ mitigation activities: **2019-2023** *(SOA provision 2a)*

b) PMRP establishes use of Desert Research Institute (DRI) emission-dispersion model to estimate effects of mitigation measures on $PM_{10}$ air quality *(SOA 2b)*

- **$PM_{10}$ mass emissions** [input] - *total* mass of $PM_{10}$ generated from dune surface (metric tons of $PM_{10}$ per day)
- **$PM_{10}$ ambient air quality** [output] - airborne concentration of $PM_{10}$ measured at downwind receptor sites (micrograms of $PM_{10}$ per cubic meter)

c) PMRP establishes standard scenario for modeling $PM_{10}$ emissions toward 50% reduction goal based on meteorology for 10 high wind days in 2013 *(SOA 2c)*

- **Baseline emissions (pre-mitigation)** = Average $PM_{10}$ mass emissions per day from OHV Riding Area for 2013 surface conditions
- **Target emissions (post-mitigation)** = 50% reduction in $PM_{10}$ emissions relative to baseline.

# Dune restoration acreage to reduce PM$_{10}$ emissions

**Cumulative area under treatment**



(Chart: Area under treatment (acres) vs Year; y-axis 0–700; x-axis: Pre-SOA baseline, 2019, 2020, 2021, 2022)

Legend: —●— Current   —●— 2022 (planned)   —— Est. goal (2021 ARWP)

| Treatment type | Area under treatment (acres) | |
| --- | --- | --- |
| | Current as of 2021 | *Planned as of 2022* |
| Back dunes (inside riding) | 213.2 | 286.4 (+73.2) |
| Back dunes (outside riding) | 61.3 | 78.1 (+16.8) |
| Foredunes | 48.0 | 48.0 (+0) |
| **TOTAL** | **322.5** | ***412.5 (+90.0)*** |

*Source:* 2021 ARWP Attachment 02 "Evaluation Metrics"

*NOTE: 2019 PMRP estimated ~500 cumulative acres needed to achieve 50% emission reduction. This estimate was modified in 2021 ARWP (Attachment 18) to ~600 cumulative acres, due to differences between expected and actual mitigation treatments.

# Pre-disturbance modeling results: $PM_{10}$ ambient air quality

| | $PM_{10}$ at CDF (µg / m³) | $PM_{10}$ at Mesa2 (µg / m³) |
|---|---|---|
| *2013 Baseline Scenario* | *124* | *98* |
| **Pre-disturbance Scenario 1 (1939)** | 88 | 71 |
| **Pre-disturbance Scenario 2 (1966)** | 87 | 76 |
| **2021** | 72 | 74 |
| **2022 (planned)** | 66 | 66 |
| *CA standard* | *50* | *50* |

*Sources:* 2021 ARWP Attachment 02 "Evaluation Metrics"; Mejia, J., Gillies, J. A. (January 10, 2022). "Model-Derived Estimates of Mass Emissions of PM10 for Pre-OHV Disturbance and Past Vegetation Scenarios"
*[Attachment 1 of SAG report]*

# SAG proposed modeling refinements

| Surface Type | Approach to modeling $PM_{10}$ emissions | | |
|---|---|---|---|
| | **2013 baseline** | **Simplified modeling of $PM_{10}$ emissions reductions (current approach)** | **Refined modeling of $PM_{10}$ emissions reductions (possible new approach)** |
| **Open sand areas** | 2013 PI-SWERL grid | 2013 PI-SWERL grid | Most recent PI-SWERL grid |
| **Foredune shadow zone** | N/A | 2013 PI-SWERL grid | Reduced $PM_{10}$ emissions as determined by CFD modeling applied to most recent PI-SWERL grid |
| **Temporary dust mitigation treatments and developing foredune** | N/A | No emissions | Low (but nonzero) $PM_{10}$ emissions as determined from measured sand flux reductions and CFD study |
| **Permanent exclosures** | N/A | N/A | Reduced $PM_{10}$ emissions as determined by the 2020 ODSVRA closure study |