SALTON SEA ECOSYSTEM RESTORATION PLAN

Unified Executive Summary and Appended Final Air Quality Technical Memoranda Prepared to Support the Salton Sea Ecosystem Restoration Plan Programmatic Environmental Impact Report (PEIR)

February 2005

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UNIFIED EXECUTIVE SUMMARY FOR SALTON SEA AIR QUALITY TASKS

The California Resources Agency is preparing a Salton Sea Ecosystem Restoration Plan (ERP) and accompanying Programmatic Environmental Impact Report (PEIR), on behalf of the Secretary of Resources, and in compliance with legislation enacted in 2003. The study area for the PEIR is the Salton Sea watershed. The United States (U.S.) portion of the Salton Sea watershed is located in several different counties under the jurisdiction of four local air quality agencies, including the Imperial County Air Pollution Control District (ICAPCD), the San Diego Air Pollution Control District (SDAPCD), the South Coast Air Quality Management District (SCAQMD), and the Mojave Desert Air Quality Management District (MDAQMD.

As part of the PEIR, air quality impacts will be evaluated for the no action alternative, a variety of program alternatives (not yet identified), and under cumulative conditions. To evaluate the various alternatives relative one to another, a uniform set of air quality analytical tools will be developed. To evaluate the significance of potential impacts, significance criteria will be established and applied.

This executive summary describes work performed to date in four separate air quality-related tasks under the current air quality task order (DWR Task Order Number SS0405-3575-8). Work performed for the purpose of evaluating air quality impacts included

- collecting and reviewing existing data
- identifying missing data that will be needed to develop the ERP and PEIR
- identifying potential analysis tools
- defining preliminary significance criteria.

A work plan outline was developed in collaboration with the local air quality agencies to identify and gain concurrence on steps to be completed. In addition to the work plan, steps completed to date have been described in three technical memoranda which were circulated among the agencies and stakeholders for review. The work plan outline and the three technical memoranda are summarized in this executive summary.

The complete and finalized work plan and memoranda are attached to this executive summary as appendices. A memorandum to provide responses to comments received on the technical memoranda will be provided as a separate deliverable, but wherever possible, responses to comments were included in the finalized memoranda.

SALTON SEA AIR QUALITY TASK 1 – WORK PLAN OUTLINE

A number of steps were identified to accomplish the goals of 1) agency collaboration, 2) performance of a ecosystem restoration study for the Salton Sea, and 3) development of a programmatic environmental impact report (PEIR) by December 2006. The first step was to develop a comprehensive air quality work plan that established specific work activities to address Salton Sea air quality issues as they pertain to the restoration study and the development of a PEIR.

To meet the goal of agency collaboration, a Salton Sea Air Quality Working Group (SSAQWG) was formed, to include the California Department of Water Resources (DWR), the Salton Sea Science Office (SSSO), the United States Bureau of Reclamation (USBR), the United States Geological Survey (USGS), the California Air Resources Board (ARB), the local air pollution control districts, the Torres Martinez Tribe, and other regulatory agencies and stakeholders. Elements of a draft work plan were discussed and finalized by the newly formed SSAQWG at a workshop held on October 7, 2004. The administrative draft work plan and other work products were also provided to representatives of the United States Environmental Protection Agency (EPA) Region IX and the Desert Research Institute (DRI) following the November SSAQWG and Advisory Committee meetings. A meeting was held with EPA, ARB, and DRI on January 6, 2005, to discuss their reviews and comments.

The planned work activities were designed to build on past activities, information, and experience, and integrate them into the PEIR. Past activities included air quality workshops, sediment studies, correlation of meteorological conditions with PM_{10} levels, and studies related to the prior development of closely related environmental documents.

Steps identified as elements of the work plan (the *Final Salton Sea Air Quality Work Outline*) are listed in Table ES-1, below. Table ES-1 also indicates the relationship of the work plan steps to the current tasks. The Work Plan is provided as Appendix A to this executive summary.

Table ES-1
Air Quality Work Plan Steps and Air Quality Tasks to Date

Air Quality Work Plan Steps	Air Quality Tasks To Date
1. Coordinate with Air Quality Agencies and Other Stakeholders	Task 1 - Develop Work Plan
2. Establish Air Quality Baseline	Prior Contracted Task Order. *Salton Sea Ecosystem Restoration Plan, Initial Draft Report for Existing Baseline Conditions*, dated August 27, 2004.
3. Analyze Impacts of Meteorological Conditions and Other Variables on Air Quality	Task 2 - Identify Data Gaps
4. Determine Data Gaps	
5. Identify Potential Air Quality Sources under Representative Alternatives	Task 3 - Identify Potential Emissions Sources, Significance Criteria, and Analytical Tools and Methods. Task 4 - Soil/Sediment Emissivity Assessment.
6. Identify Applicable Air Quality Significance Criteria	
7. Develop/Identify Emissions Estimation Tools	
8. Develop AQ-Related Screening Criteria for Analysis of Alternatives	Future Tasks
9. Develop Impact Analysis Methodology	
10. Develop/Identify Potential Approaches to Best Meet Air Quality Goals	
11. Estimate/Evaluate Impacts of Screened Alternatives	
12. Develop Mitigation for Significant Impacts and Quantify Benefits	

It was determined that Steps 1 through 7 above could be completed without reference to particular ecosystem restoration plan activities, but that Steps 8 through 12 were directly related to formulating and analyzing alternatives. Therefore, Steps 1 through 7 could be undertaken at an early stage of the project, but Steps 8 through 12 would not be addressed until development of the draft PEIR.

Tasks 1 through 4 of the project address Steps 1 through 7 of the work plan, as indicated in Table ES-1. As indicated previously, Task 1 involved solicitation of representatives of the air quality and other organizations to attend workshops, participate in planning, and review work performed. Under this task, the work plan outline was developed. More detail on air quality tasks 2 through 4 is provided in the following.

SALTON SEA AIR QUALITY TASK 2 – DATA GAPS

The purpose of the Data Gaps assessment was to identify a detailed list of additional data needs to be filled in support of the ERP and the PEIR.

A technical memorandum was prepared that included the following elements (see Appendix B):

1. A summary of available aerometric (meteorological and ambient air monitoring) data, and other air quality references and information.
2. A listing of gaps in the data needed to establish baseline air quality conditions in the Salton Sea watershed.
3. Recommendations on short- and long-term air monitoring in the Salton Sea watershed to support the ERP and PEIR.
4. A data collection plan to obtain additional data required to complete the ERP and PEIR.

The summary of available data was based on information obtained through February 14, 2005, including feedback received from the SSAQWG Workshop held on November 18, 2004, the EPA/ARB/DRI meeting on January 6, 2005, and additional comments received from workshop and meeting attendees.

As part of the PEIR process, data will be needed to further define baseline conditions and to evaluate potential future air quality conditions. Future air quality conditions, including cumulative impacts, will be evaluated for the no-project alternative and a variety of action alternatives.

Existing data will be used to develop the air quality baseline and impacts sections of the Draft PEIR. These sections will be refined as additional data becomes available.

Ambient air monitoring data will be used to establish existing levels and trends of criteria pollutants and toxic air pollutants. These baseline concentrations will be used in the PEIR in the evaluation of the impacts of the alternatives. The meteorological data will be used not only to describe the existing setting, but may also be used in dispersion modeling, to help determine where potential impacts may occur, to evaluate the severity of potential impacts, and to evaluate and compare alternatives.

In addition to identifying existing data and other reasonably available data to fill data gaps, it is important to identify data that might become available during the study time frame. On an ongoing basis, an air quality monitoring and meteorological database, in Microsoft Access, will be maintained for use in refining the air quality baseline assessment, and for eventual inclusion in the Existing Setting section of the Draft PEIR.

The technical memorandum presented a detailed list of available data to be used as a basis for identifying additional data needs, prioritizing data availability issues, and investigating and filling data gaps. Input from the SSAQWG Workshops, held on October 7, and November 18, 2004, and additional comments received since November were also included or responded to in the memorandum.

As described in the October 15, 2004 *Final Salton Sea Air Quality Work Outline*, gaps exist in available data for ambient air quality and meteorological conditions, potential air emission sources, applicable air quality significance criteria, emissions estimation tools, impact analysis methods, and suitable mitigation approaches and effectiveness. Emissions sources, significance criteria, and analytical tools and methods have been addressed in greater depth in technical memoranda prepared for Tasks 3 and 4, as described in following sections of this executive summary, and appended as Appendix C and D. Potential mitigation approaches will be evaluated in future tasks, as project alternatives are identified.

The technical memorandum also contains recommendations for additional meteorological and air quality (aerometric) monitoring stations to meet both short-term requirements of the PEIR and longer term requirements to quantify impacts of alternatives and their corresponding mitigation.

For the PEIR, these recommendations include:

- Install 10-meter meteorological towers at three existing 2-meter CIMIS stations: Salton Sea East, Salton Sea West and Mecca. These new stations will collect wind speed and wind direction data at 10 meters to supplement other meteorological data available for the project area.
- Utilize data from existing PM_{10} and $PM_{2.5}$ monitoring locations to meet the needs of the PEIR.

For long-term impacts, additional aerometric monitoring stations will be needed to track potential future air quality impacts associated with changing conditions in the Salton Sea watershed, and with implementation of projects and controls associated with the ERP. Suitable locations for long-term monitoring stations will be determined in subsequent steps in the process of identifying and analyzing alternatives and controls.

The technical memorandum also contains the preliminary outline of a data collection and management plan. Data collection and management is an ongoing task and will be developed further in future task orders.

SALTON SEA AIR QUALITY TASK 3 – IDENTIFY POTENTIAL EMISSIONS SOURCES, SIGNIFICANCE CRITERIA, AND ANALYTICAL TOOLS AND METHODS

The purpose of Task 3 was to:

- Identify and describe potential air quality emission sources under potential program alternatives;
- Identify applicable air quality significance criteria for the draft PEIR impacts analyses; and
- Identify emission factors, dispersion models, and other tools that can reasonably predict potential future emissions and impacts on air quality.

The recommended tools focused on the development of the PEIR and the study area. Other tools are available, but they may not be appropriate for application in the study area, or they may require data that cannot be obtained in the time frame of the PEIR.

A technical memorandum was prepared that identifies potential sources and pollutants that may result from the no-project or other alternatives to be evaluated in the PEIR, and lists emissions estimation tools and dispersion models for evaluation of each of these potential sources. The potential sources, pollutants, emissions estimation tools, and dispersion models are listed in Table ES-2.

Table ES-2
Potential Sources, Pollutants, Emissions Estimation Tools, and Models

Potential Sources	Pollutants of Concern	Emissions Estimation Tools	Dispersion Models
Area Sources	PM, NO_x, SO_x, CO, ROG and HAPs	URBEMIS, SPECIATE[l]	AERMOD[a] or ISC[f] or CALPUFF[l,mf]
Boats and Personal Water Craft	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model	AERMOD or ISC3 or CALPUFF

Table ES-2
Potential Sources, Pollutants, Emissions Estimation Tools, and Models

Potential Sources	Pollutants of Concern	Emissions Estimation Tools	Dispersion Models
Construction - Equipment	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model and URBEMIS	AERMOD or ISC3 of CALPUFF
Construction – Fugitive Dust	PM	URBEMIS[j]	AERMOD or ISC3 or CALPUFF
Dying or Dead Biota, Volatilization of Compounds - Odors	ROG, HAPs and Odors	Direct Testing	AERMOD or ISC3 or CALPUFF
Farming - Dust	PM	ARB Emission Factors[c]	AERMOD or ISC3 or CALPUFF
Farming - Engines	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model	AERMOD or ISC3 or CALPUFF
Farming - Pesticides	ROG and HAPs	AP-42, Chapter 9[b] and ARB Emission Factors[c]	AERMOD or ISC3 or CALPUFF
Mobile Sources – Exhaust	PM, NO_x, SO_x, CO, ROG and HAPs	EMFAC2002[e]	CAL3QHC[d]
Mobile Sources – Tire Wear	PM	EMFAC2002[e]	CAL3QHC[d]
Mobile Sources – Road Dust	PM	AP-42, Chapter 13[b] and ARB Emission Factors[c]	AERMOD or ISC3 or CALPUFF
Off-road Vehicles - Exhaust	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model[h]	AERMOD or ISC3 or CALPUFF
Wind-blown Fugitive Dust	PM	MacDougall Method[g] and WEPS[k]	AERMOD or ISC3 or CALPUFF

[a] EPA, 1998. "Users Guide for The AMS/EPA Regulatory Model - AERMOD". Office of Air Quality Planning and Standards. Research Triangle Park, NC. November, 1998.
[b] EPA. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources.
[c] 2003 Emission Inventory Methodology Documentation. http://www.arb.ca.gov/ei/documentation.htm
[d] EPA, 1992. User's Guide for CAL3QHC Version 2: A Modeling Methodology for Predicting Pollutant Concentrations near Roadway Intersections. Version 04244.
[e] California Air Resources Board (ARB) On-road vehicle emission model. Version 2.2. August, 2002
[f] EPA, 1995, User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volumes 1 and 2. Version 02035.
[g] Western Regional Air Partnership. http://www.wrapair.org/forums/dejf/fderosion.html
[h] California Air Resources Board (ARB) OFFROAD Emissions Inventory Model. http://www.arb.ca.gov/msei/off-road/off-road.htm
[I] EPA SPECIATE. http://www.epa.gov/ttnchie1/software/speciate/index.html
[j] California Air Resources Board (ARB) Urban Emissions Model. URBEMIS 2002, Version 7.5.0
[k] Hagen, L. J. et al, "Wind Erosion Prediction System (WEPS), BETA Release 95-08, Printed 2 October 1996.
[l] Earth Tech, Inc. A Users Guide for the CALMET Meteorological Model (Version 5.0). Concord, Massachusetts. 2000.
[k] Earth Tech, Inc. A Users Guide for the CALPUFF Dispersion Model (Version 5.0). Concord, Massachusetts. 2000.

Significance criteria are based upon the general conformity requirements established by the federal Clean Air Act Amendments (CAAA) and significance criteria from each of the four local air quality agencies having jurisdiction in the study area: Imperial County Air Pollution Control District (ICAPCD), the San Diego Air Pollution Control District (SDAPCD), the South Coast Air Quality Management District (SCAQMD), and the Mojave Desert Air Quality Management District (MDAQMD). The MDAQMD and SDAPCD have not established specific significance criteria, so the general conformity *de minimis* thresholds and new source review (NSR) thresholds will be used for these areas. In addition to general conformity thresholds, the ICAPCD has established Best Available Control Technology (BACT) thresholds for NO_x, CO, PM_{10}, and Reactive Organic Compounds (ROC). The SCAQMD has established significance criteria for construction activities in addition to operational activities. The construction limits are in terms of pounds/day. The operational criteria include limits on changes in ambient air concentrations, in addition to pounds/day limits.

Significance thresholds for toxic air contaminants or health effects are also defined by some air districts. Emissions of toxic air contaminants would be significant if the emissions exceed acceptable levels or contribute significantly to the areas' excess lifetime cancer risk values, cancer burden, or health hazard indices.

For many of the source categories, there are emission factors and dispersion models that have been approved by the EPA and the California Air Resources Board (ARB). These factors are periodically updated and current factors will be used in the PEIR.

When the total emissions from a source have been determined, a dispersion model can be used to estimate impacts of these emissions on the ambient concentrations and human exposure levels of most of the pollutants of concern. The notable exception is ozone, which requires much more complex regional atmospheric modeling than is possible within the scope of this project. The Industrial Source Complex, Version 3 (ISC3) or the AMS/EPA Regulatory Model (AERMOD) dispersion models can be used for many of the source categories and pollutants.

The ISC3 model has been approved by the EPA, and the approval of AERMOD is pending. These models are commonly used to model downwind concentrations of compounds emitted over a large area. Meteorological data collected at 10 meters above the ground are preferred by the EPA for use with these models.

The required input data for emissions estimation tools and dispersion models are often readily available. In most cases, the identified tool will estimate emissions or concentrations for all criteria pollutants emitted. The emissions for HAPs (air toxics) may be estimated using EPA's SPECIATE model, or from speciation data or emission factors from other ARB- or EPA-approved sources.

A technical memorandum prepared under Task 3 (see Appendix C) provides recommendations of emission factors and models for each source category.

Windblown dust is expected to be a major contributor to emissions in the area, especially if the seabed is exposed during implementation of any of the alternatives. Therefore, a special effort was made to develop tools and models characterize this potential source under Task 4.

SALTON SEA AIR QUALITY TASK 4 – SOIL/SEDIMENT EMISSIVITY ASSESSMENT

The Salton Sea Ecosystem Restoration Plan PEIR will include analysis of several alternatives that may result in future exposure of currently inundated areas within the perimeter of the Sea shoreline. Impacts associated with these alternatives include wind erosion and dust emissions that could affect air quality.

Under existing conditions, the principal sources of windblown fugitive dust in the Salton Sea watershed include farmland, other existing emissive land surfaces (e.g., desert areas), and newly exposed land (e.g., playa once covered by the waters of the Salton Sea). Changes to the PEP (particulate matter emission potential) from newly exposed playa represent the greatest potential for an increase in windblown fugitive dust emissions in the future.

The soil/sediment emissivity assessment focused on identification and development of tools to estimate particulate emissions of potentially exposed Salton Sea playa under varying climate conditions. The assessment of the PEP of current and future exposed soils and sediments was based on such determining factors as land use, climate, and surface conditions, such as soil and sediment types and chemistries, relative humidity, moisture content, surface crust formation, location of sand dunes and sandy soils, and stability of the playa.

The following soil/sediment emissivity-related factors are described and developed in the Task 4 technical memorandum (see Appendix D):

- Mapping of land use patterns on and near the playa
- Mapping of sediments to be exposed on the playa
- Relation of various land uses (including dust control measures) to emissions rates.
- Descriptions of crust properties, climatic dependence, and the resulting calendar of playa surface protection from erosion by crust. Periods when crust does not adequately protect the playa are most likely to contain significant emissions events. Climate-crust-emissions relationships developed for Owens Lake are compared to those developed for the Salton Sea playa. Physical relationships of mineral salts with climatic variables are employed to determine crust transformation patterns and potential influence on emission rates.
- Climatic data records to represent likely future conditions on the playa.

The MacDougall Method and the Wind Erosion Prediction System (WEPS) model were selected to be used together to estimate wind-blown fugitive dust, because employment of these two models appears to be the soundest approach. The MacDougall Method is based upon land use, surface soil properties, and wind tunnel testing. The WEPS computer model simulates documented wind erosion processes. Through combined use, limitations of each approach can be offset by corresponding strengths in the other method. To support the use of both models, DRI has identified and will soon conduct wind tunnel tests at locations identified in the memo. Wind tunnel test locations are proposed near the existing shoreline on soils believed to be representative of playa that may be exposed under potential project alternatives.

The emissions estimation and mapping method used at the Owens playa by the Great Basin Unified APCD is currently impractical for use on the Salton Sea playa, because much of the potentially exposed area is currently under water. The Owens playa method required years for implementation and data analysis, in addition to hundreds of pieces of monitoring equipment. Though impractical for the development of the PEIR, the Owens playa approach may be useful for long-range monitoring under the PEIR.

SALTON SEA ECOSYSTEM RESTORATION PLAN

Final Technical Memorandum
Appendix A: Salton Sea Task 1
Final Salton Sea Air Quality Work Outline
to Support the Salton Sea Ecosystem Restoration Plan
Programmatic Environmental Impact Report (PEIR)

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SALTON SEA TASK 1 – FINAL SALTON SEA AIR QUALITY WORK OUTLINE

WORKSHOP OBJECTIVE

The objective of the October 7, 2004 workshop was to integrate the various air quality work activities by various agencies and their contractors, in concert with regulatory agencies and stakeholders, into a comprehensive air quality work plan. A draft work plan was offered as a “strawman” to facilitate discussion among workshop participants.

INTRODUCTION

The Department of Water Resources (DWR) is tasked with conducting a restoration study of the Salton Sea and developing a programmatic environmental report (PEIR) by December 2006 on behalf of the Resources Agency Secretary.

The following outline identifies work activities to address Salton Sea air quality issues as they pertain to the restoration study and the development of a PEIR. Air quality is a broad and complex topic and is an integral component of any restoration alternatives considered in the PEIR.

The immediate future air quality work activities will build on past activities and integrate them into a PEIR. Past work activities have entailed air quality workshops, sediment studies, correlation of meteorological conditions with PM_{10} levels, and studies related to the prior development of closely related environmental documents.

Resources to Conduct Work Activities

DWR has contracted with the consulting firm of CH2M HILL to conduct the restoration study. The firm has retained Air Sciences, Inc., as a subcontractor, to provide expertise and assist in air quality work activities.

DWR is in the final stages of completing a contract with the Desert Research Institute (DRI), an affiliate of the University of Nevada, to do peer review and carry out various air quality work activities.

United States Bureau of Reclamation (USBR) has entered into a work agreement with the USGS in Flagstaff, AZ to carry out a number of air quality work activities at the Salton Sea; and with Quester Tangent Corporation (QTC) to conduct acoustic surveys of Sea deposits.

Work Plan Steps

Building on prior air quality studies, the following steps are proposed:

Step 1 Coordination with Air Quality Agencies and Other Stakeholders

Step 2 Establish Air Quality Baseline

Step 3 Analyze Impacts of Meteorological Conditions and Other Variables on Air Quality

Step 4 Determine Data Gaps

Step 5 Identify Potential Air Quality Sources under Representative Alternatives

Step 6 Identify Applicable Air Quality Significance Criteria

Step 7 Develop/Identify Emissions Estimation Tools

Step 8 Develop AQ-Related Screening Criteria for Analysis of Alternatives

Step 9 Develop Impact Analysis Methodology

Step 10 Develop/Identify Potential Approaches to Best Meet Air Quality Goals

Step 11 Estimate/Evaluate Impacts of Screened Alternatives

Step 12 Develop Mitigation for Significant Impacts and Quantify Benefits

Steps 1 through 7 can be completed without reference to detailed information regarding restoration alternatives. Steps 8 through 12 are directly related to formulating and analyzing alternatives, and will be scheduled in concert with the development of the draft PEIR.

The following outline is a sequence of steps and associated work activity, identifying each agency's potential role.

Step 1. Coordinate with Air Quality Agencies and Other Stakeholders

DWR[1] will need the active participation and support from the regulatory bodies in all aspects of the air quality (AQ) work, namely: the California Air Resources Board (CARB), the Imperial County Air Pollution Control District (ICAPCD), the South Coast Air Quality Management District (SCAQMD), San Diego County APCD, Mojave Desert AQMD, and the US EPA – Region 9. In addition, DWR is requesting the involvement of comparable air quality regulatory agencies on Tribal Lands and in Mexico.

Work Activity

DWR will contact the air quality agencies for solicitation of members and/or their representatives to participate in air quality workshops. The agencies' role is foreseen as one of input, advisory support, and review of work products. The agencies are to be consulted for planning, coordination, information gathering, and review of work performed, including this work plan.

Step 2. Establish Air Quality Baseline

DWR has prepared a draft air quality baseline assessment in the document titled Salton Sea Ecosystem Restoration Plan, Initial Draft Report for Existing Baseline Conditions, August 27, 2004.

One of the data gaps identified in this draft report was that all air quality monitoring and meteorological stations and California Irrigation Management Information System meteorological stations (CIMIS stations) in the Coachella and Imperial Valleys and surrounding area need to be identified. These will be shown on a regional map, accompanied with a table indicating the type of instrumentation, data collected, data format, frequency of collection, data ownership. The data will be summarized and a location referenced so that the monitoring and meteorological data for each station can be accessed.

Other data gaps identified in the initial draft report will be assessed and addressed in Step 4 and subsequent steps.

Work Activity

The air quality baseline assessment will be refined and supplemented as the steps in this work plan proceed, with the best available information to be included in the Existing Setting section of the draft PEIR.

[1] Throughout the remainder of the document, DWR should be understood to include its consultant team, led by CH2M HILL, including subconsultants such as Air Sciences and SAIC.

Step 3. Analyze Impacts of Meteorological Conditions and Other Variables on Air Quality

The impact of meteorological conditions on air quality will be researched by the USGS in ongoing work, to the extent that existing data will allow. Meteorological variables that may affect windblown fugitive dust and air quality impacts include, but are not limited to, wind speed, frequency, direction, and duration; temperature; and humidity. Gust wind speed and wind direction may also prove important. Other variables that may affect air quality, and tools for measuring or monitoring these variables and ambient concentrations of pollutants of concern (POC), will be evaluated.

Work Activity

USBR through the USGS Flagstaff Office is to expand their analyses of the Palm Springs and Indio stations. It is anticipated that the Niland and Westmorland stations will be similarly analyzed. As the screening criteria for alternatives and alternatives are developed, an assessment should be made to determine if this type of analysis may be warranted for other area stations, or if other stations are needed. Additionally, satellite imagery should be utilized if these images can be temporally matched with high wind events and/or dust storms.

USBR/Salton Sea Science Office (SSSO)/USGS to begin visual documentation by photograph, GPS, satellite imagery, written logs, and video of fugitive dust events in the study area. This is a first step in understanding and documenting where the problem areas currently are, and may later be. This may later include future training of local APCD or other Federal employees to become 'plume chasers'.

Step 4. Determine Data Gaps

Data gaps exist in each of the subject areas identified in Steps 5 through 10. More information is needed on potential air emission sources, applicable air quality significance criteria, emissions estimation tools, impact analysis methods, and mitigation approaches. This task will develop more detailed lists of data gaps to be investigated and filled in the following steps, and will provide recommendations for collection of needed information.

DWR is to undertake the determination of data gaps. The information from Steps 2 and 3 and the data gap findings will then be presented in subsequent workshops for input and concurrence. The findings should clearly describe:

- the data that are needed and the reason why they are needed
- The data that are available
- The data that are missing
- The time period over which the data are needed

Data gaps may fall into two types:

1. data gaps specific to development of alternatives, criteria for screening of alternatives, and/or impact analysis
2. data gaps related to adaptive management planning and/or indications that changes in proposed or implemented approaches may need to be evaluated

This task will then involve development and if schedule allows, initial implementation of a data collection plan. The discussions provided in Steps 5 through 10 provide the recommended overall approach to address these areas of data gaps.

One area of data gaps of particular interest involves the adequacy of existing air monitoring data, in particular, PM_{10} and $PM_{2.5}$ monitoring data, in the study area. DWR will review the existing data and determine what additional data are needed to estimate particulate emission rates or particulate emissions potential for the potentially exposed shoreline area, as well for the surrounding desert and agricultural regions.

Specific to air monitoring data gaps, it is anticipated DWR and USBR will coordinate and collaborate on the funding of capital costs of any additional monitoring and/or meteorological stations. The planning of data collection must directly link activities to the purpose and need of this project, and recognize that monitoring may need to be continued indefinitely.

In addition, the group will identify the type(s) and model(s) of instruments and other tools that will be used to collect the data. Careful consideration should be given to the manner of collection because it is anticipated that data quality must meet rigorous standards in order to withstand legal challenges.

Desert Research Institute, under contract with DWR, will provide an independent review of the findings, and will provide input and assistance as needed.

Work Activity

DWR to draft a list of data gaps and a recommended data collection plan. This will include incorporating input from the agencies and from the peer review.

DWR to work collaboratively with the agencies to develop and implement the data collection plan.

Step 5. Identify Potential Air Quality Sources Under Representative Alternatives

This task involves identification of potential air quality emissions sources that may be associated with alternatives analyzed in the Ecosystem Restoration Plan environmental documents. Potential emissions sources and impacts include, but may not be limited to: fugitive dust from exposed seabed, construction, and land fallowing; exhaust emissions from construction equipment and employee commute vehicles, volatilization from evaporating or relocated Sea water, and emissions from recreation-related vehicular traffic and boating. This task will include evaluation of potential sources of both criteria pollutants (NO_x, ROG, PM, CO, and SO_x) and toxic or hazardous air pollutants (HAPs). This task will expand information provided in the draft report on existing baseline conditions.

Work Activity

DWR to develop and/or identify an overview of potential air quality sources and impacts under representative alternatives.

Step 6. Identify Applicable Air Quality Significance Criteria

This task will identify and work to gain consensus on applicable air quality significance criteria for the CEQA analyses of significant impacts. In addition, consensus will be sought on how the significance criteria will be applied and how significance of alternatives will be determined.

Work Activity

DWR to develop and/or identify a list of applicable significance criteria, and provide a plan for application of significance criteria in the determination of significant impacts.

Step 7. Identify Emissions Estimation Tools

The goal is to identify and implement emissions factors, dispersion models, or other tools that can reasonably predict potential future emissions rates and potential impacts on air quality associated with meteorological events, program alternatives, or other variables. The recommendations will focus on tools appropriate for conditions in the areas surrounding the Sea and the Coachella and Imperial Valleys, and tools that are appropriate given the data available in the timeframe of the Programmatic EIR.

Work Activity

DWR to identify existing models and/or analytical tools.

Desert Research Institute, under contract with DWR, will peer review and provide input and assistance as needed.

Step 8. Develop AQ-related Screening Criteria for Analysis of Alternatives

Based on the relative impacts and potential for effective mitigation of possible air emission sources, a screening or "ranking" of different types of sources will be made. Potential sources will be ranked relatively and qualitatively to aid in the screening of project alternatives to be evaluated in PEIR. For example, potential emissions from construction equipment may be ranked high relative to other emissions sources for a given alternative, while emissions from water volatilization may be ranked low.

Work Activity

DWR to develop and/or identify selection criteria for analysis of alternatives, based on information developed in other steps.

Desert Research Institute, under contract with DWR, will peer review and provide input and assistance as needed.

Step 9. Develop Impact Analysis Methodology

Based on the information developed in prior steps regarding data gaps, emission sources, and emissions estimation tools, a methodology for impact analysis will be developed. It is anticipated that this methodology will be uniformly used in future steps to evaluate the screened alternatives, and also will be used to evaluate the benefits of mitigation alternatives.

For example, a method for assessment of the particulate emission potential (PEP) of current or future exposed soils and sediments may be developed by combining the results of the following work activities.

- USBR/QTC will characterize the sediments underlying the Sea to a depth of 25 feet by collecting and analyzing samples and dual frequency acoustic data.
- USBR/USGS to undertake a study using Landsat TM images to predict the vulnerability of currently exposed sediments to wind erosion using the algorithms developed for the Mojave Desert.
- DWR/DRI to conduct wind tunnel tests subsequent a determination of suitable locations
- DWR/CH2M HILL to make a comparison of the PEP of sediments at Owens Lake with those at the Sea, considering parameters such as; exposed sediment type salt types, meteorological conditions, capillary zone, etc.
- DWR/DRI to perform a comparative analysis of other playas
- DWR to draft an approach to assess the PEP of potentially exposed soils and sediments, incorporating the results of the foregoing work activities. For example, meteorological variables that may affect emission rates, and therefore air quality impacts, include wind speed, gust wind speed, wind direction, frequency, and duration; temperature; and humidity. Other variables include soil/sediment types, soil/sediment chemistry, extent of exposed areas, stability of exposed playa, surface crust formation, fetch, land use and land management, and control of public access.

Work Activity

DWR to develop and/or identify impact analysis methodologies.
Desert Research Institute, under contract with DWR, will peer review and provide input and assistance as needed.

Step 10. Develop/Identify Potential Approaches to Best Meet Air Quality Goals

Based on the potential emissions sources and impacts identified in Step 5, potential approaches for mitigation and meeting air quality-related goals will be investigated.

For example, for potential fugitive dust from exposed seabed, construction, and land fallowing, DWR may perform an analysis of the risk of emissivity (or particulate emissions potential) versus mitigation or emission reduction options. Based on the results of this analysis, one or more mitigation or emission reduction approaches may be developed in greater detail, including a description of implementation, time frame, rough-order-of-magnitude costs, long-term performance, maintenance, and applicable locations. The information should be in a form so that the results can be readily used in analyses of alternatives.

DWR/DRI to perform a peer review of the results and their subsequent use in the alternative analyses.

Work Activity

DWR to develop and/or identify potential mitigation approaches, based on emission sources and potential impacts.

Desert Research Institute, under contract with DWR, will peer review and provide input and assistance as needed.

Step 11. Estimate/Evaluate Impacts of Screened Alternatives

DWR will complete the estimation of emissions and potential impacts for each of the screened project alternatives. The evaluation will follow CEQA guidelines and a determination of significance for each impact will be made.

Work Activity

DWR to estimate and evaluate the impacts and potential impacts of the selected alternatives, to support development of the CEQA documentation.

Desert Research Institute, under contract with DWR, will peer review and provide input and assistance as needed.

Step 12. Develop Mitigation for Significant Impacts and Quantify Benefits

After identification of significant impacts, mitigation measures will be identified to reduce impacts. Impact reduction will be identified and benefits will be quantified. Proposed mitigation measures will be reviewed by the agencies and then incorporated into the draft PEIR.

Work Activity

DWR to develop and/or identify mitigation measures for impacts of alternatives deemed to be significant. In addition, DWR will evaluate benefits of the proposed mitigation measures, and quantify these benefits to the extent feasible. Impacts deemed to remain significant or potentially significant after mitigation will be identified.

Desert Research Institute, under contract with DWR, will peer review and provide input and assistance as needed.

SALTON SEA ECOSYSTEM RESTORATION PLAN

Final Technical Memorandum
Appendix B: Salton Sea Task 2
Identification of Data Gaps to Support the Salton Sea Ecosystem Restoration Plan Programmatic Environmental Impact Report (PEIR)

February 2005

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SALTON SEA TASK 2 – IDENTIFICATION OF DATA GAPS

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DATE:	February 25, 2005

EXECUTIVE SUMMARY

The California Resources Agency is preparing a Salton Sea Ecosystem Restoration Plan (ERP) and Programmatic Environmental Impact Report (PEIR). The study area for the PEIR is the Salton Sea watershed. The purpose of this Data Gaps technical memorandum was to provide a detailed list of available data and to identify data gaps to be investigated and filled to support the efforts associated with the ERP and the PEIR. This final technical memorandum integrates responses to comments from the Salton Sea Air Quality Working Group (SSAQWG), and from reviewers at the Desert Research Institute (DRI), the California Air Resources Board (ARB), the United State Environmental Protection Agency (EPA).

This final technical memorandum includes the following elements:

1. A summary of available aerometric (meteorological and ambient air monitoring) data, and other air quality references and information
2. A listing of gaps in the data needed to establish baseline air quality conditions in the Salton Sea watershed
3. Recommendations on short- and long-term air monitoring in the Salton Sea watershed to support the ERP and the PEIR

A data collection plan to obtain additional data required to complete the ERP and the PEIR

The summary of available data was based on information obtained through February 14, 2005, and feedback received from the SSAQWG Workshop held on November 18, 2004, the EPA/ARB/DRI meeting on January 6, 2005, and additional comments received from workshop and meeting attendees.

As part of the ERP and PEIR development process, data will be needed to define baseline conditions and to evaluate potential future air quality conditions. Future air quality conditions, including cumulative impacts, will be evaluated for the no-project alternative and a variety of project alternatives,

Existing data will be used to develop the air quality baseline and impacts sections of the Draft PEIR. These sections will be refined as additional data become available.

Ambient air monitoring data will be used to establish existing levels and trends of criteria and toxic air pollutants. These baseline concentrations will be used in the PEIR in the evaluation of the impacts of the alternatives. The meteorological data will be used to not only describe the existing setting, but may also be used in dispersion modeling, to help determine where potential impacts may occur, to evaluate the severity of potential impacts, and to evaluate alternatives.

In addition to identifying existing data and other reasonably available data to fill data gaps, it is important to identify data that might become available during the study time frame. For example, an air quality monitoring and meteorological database is being developed for use in refining the air quality baseline assessment, and for eventual inclusion in the Existing Setting section of the Draft PEIR.

This technical memorandum presents a detailed list of available data to be used as a basis for identifying additional data needs, prioritizing data availability issues, and investigating and filling data gaps. Input from the SSAQWG Workshops, held on October 7, and November 18, 2004, and additional comments received since November, are also included or responded to in this memorandum. DWR is compiling an ACCESS database to facilitate use of available data for preparation of work products associated with the PEIR.

As described in the Final Salton Sea Air Quality Work Outline[1], gaps exist in available data for ambient air quality and meteorological conditions, potential air emission sources, applicable air quality significance criteria, emissions estimation tools, impact analysis methods, and suitable mitigation approaches and effectiveness. Emissions sources, significance criteria, and analytical tools and methods have been addressed in greater depth in technical memoranda prepared for Tasks 3 and 4 of CH2M HILL's current task order (DWR Task Order Number SS0405-3575-8). Potential mitigation approaches will be evaluated in future tasks, as project alternatives are identified.

DWR has identified data gaps in previous documents, such as the draft air quality baseline assessment, *Salton Sea Ecosystem Restoration Plan, Initial Draft Report for Existing Baseline Conditions (ERP)*, August 27, 2004. In this document, several items were identified that warrant further evaluation to more completely describe the existing baseline conditions, including the following:

- Information on Mexico, including the regulatory framework, attainment status (or the functional equivalent), meteorological data/climate summary, and monitoring data
- Recent information on Imperial County non-attainment status for PM_{10}, emissions inventories, and attainment plans
- Confirmation of available ambient air monitoring data and identification of any pollutant trends in the watershed
- Confirmation of available meteorological and climate information for the Salton Sea watershed
- Development of a map showing locations of existing air monitoring stations and California Irrigation Management Information System (CIMIS) stations
- Development of information on pollutants monitored and a summary of available data for each monitoring station

This technical memorandum also contains recommendations for additional meteorological and air quality (aerometric) monitoring stations to meet both short-term requirements of the PEIR and longer term requirements to quantify impacts of alternatives and their corresponding mitigation.

For the PEIR, these recommendations include:

- Install 10-meter meteorological towers at three existing CIMIS stations; Salton Sea East, Salton Sea

[1] October 15, 2004

West and Mecca. These stations will collect wind speed and wind direction data to supplement other meteorological data available for the project area. The 10-meter data will be used in an attempt to correlate with the historical 2-meter data in the general area, so that the CIMIS data may be used in the PEIR if this correlation can be demonstrated.

- Utilize data from existing PM_{10} and $PM_{2.5}$ monitoring locations to meet the needs of the PEIR.

For long-term impacts, additional aerometric monitoring stations will be needed to track potential future air quality impacts associated with changing conditions in the Salton Sea watershed, and with implementation of projects associated with the PEIR. Suitable locations for long-term monitoring stations will be determined in subsequent steps in the process of identifying and analyzing alternatives and controls.

This memo also contains the preliminary outline of a data collection and management plan. Data collection and management is an ongoing task and will be developed further in future task orders.

BACKGROUND

The goals of this data gaps task included filling data gaps (to the extent possible) with reasonably available data, and identifying other information thought to be available and useful in the study time frame. For example, one eventual product will be an air quality monitoring and meteorological database for use in refining the air quality baseline assessment, and for eventual inclusion in the Existing Setting section of the Draft PEIR.

The California Department of Water Resources (DWR) and U.S. Bureau of Reclamation (Reclamation)/ Salton Sea Science Office (SSSO)/U.S. Geological Survey (USGS) have collaborated on identifying a great deal of existing air quality-related data applicable to the study area. Building on their work, and other studies, the findings from preliminary efforts on this data gaps task were presented at the SSAQWG Workshop held on November 18, 2004. Responses to the comments received during this workshop and additional comments from the DRI, ARB, and EPA have been included in this Administrative Draft technical memorandum.

Input from the first SSAQWG Workshop, held on October 7, 2004, is also included in this memorandum. For example, workshop attendees provided input to help outline additional data needed to characterize meteorological conditions, and to identify additional monitoring, both instrumentation and measurement methods, that might be required. To support evaluation of potential alternatives for the Draft PEIR, additional data are needed to estimate particulate matter emissions rates and to assess the emissions potential of exposed Salton Sea bed and the surrounding desert and agricultural regions.

Other information reviewed under this task includes the comments received on the PEIR Notice of Preparation (NOP) from individual parties, nongovernmental organizations, and local, state, and federal agencies. These comments are primarily related to requests for additional air quality data collection. These comments have also been voiced by stakeholders at the Air Quality Workshops and have been used to develop the data collection plan and recommendations for additional monitoring.

Existing Data

Aerometric Monitoring Data

One area of concern is the adequacy of existing aerometric monitoring data, in particular, meteorological monitoring data in the study area, and ambient air monitoring data for criteria pollutants exceeding National Ambient Air Quality Standards (e.g., ozone, PM_{10}, $PM_{2.5}$). This memorandum presents a list of available data. Figure 1 provides a map with locations and parameters measured at existing monitoring sites. This figure was developed from the existing database of sites and presented at the November 18 Workshop. The figure shows the location of monitoring stations in the nearby area that would provide data for the PEIR and future studies.

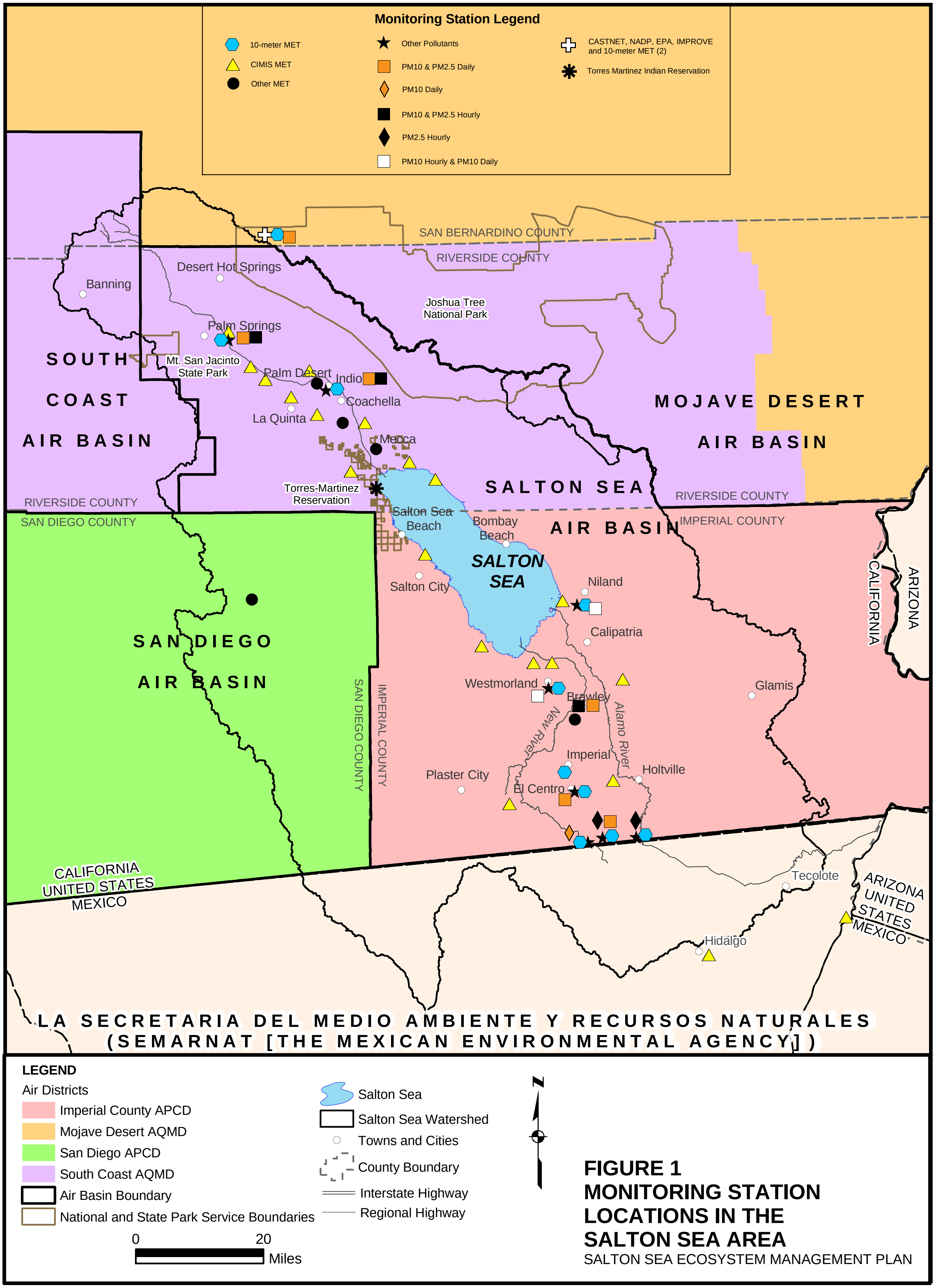

FIGURE 1
MONITORING STATION LOCATIONS IN THE SALTON SEA AREA
SALTON SEA ECOSYSTEM MANAGEMENT PLAN

The existing air quality and meteorological data that are available in the general vicinity of the Salton Sea are described in Table 1, attached to this memorandum. This table includes:

- Site identification number
- Station location, or site name
- Data source
- Parameter
- Measurement height
- Averaging period
- Duration of data
- Availability of data
- Operational status of the monitoring station

Table 2 lists the specific information on the location of each monitoring station. Stations operated by the California Air Resources Board (ARB), Imperial County Air Pollution Control District (ICAPCD), South Coast Air Quality Management District (SCAQMD), and U.S. Environmental Protection Agency (USEPA) are described. Other sources of data presented include the following:

- CIMIS stations in the project area
- the Western Regional Climate Center
- the National Acid Deposition Program (NADP)
- the Clean Air Status & Trends Network (CASTNet)
- the Interagency Monitoring of Protected Visual Environments (IMPROVE) program, which is operated by federal agencies such as the National Park Service, Bureau of Land Management (BLM), and the United States Department of Agriculture Forest Service.

The CASTNet and IMPROVE data include speciated data on toxic metals, elemental and organic carbon, and compounds such as sulfates and nitrates.

One additional and valuable data set is the meteorological and particulate matter data that are being collected by the Torres-Martinez Tribe. Data are being collected on the northwest shoreline of the lake at several locations. The tribe is currently operating a 10-meter meteorological station, a 50-meter meteorological station, and a continuous PM_{10} monitor. The USGS has requested these data. DWR has requested any available aerometric data collected by the Torres-Martinez Tribe from EPA.

Another set of meteorological data that is necessary for dispersion modeling is upper air wind and temperature data. Vertical wind profile data collected from twice daily weather balloon launches is required for input to EPA dispersion models. For the PEIR, if dispersion modeling is required, standard upper air sites will be used and EPA approved models will be used. Upper air sites in the watershed vicinity include:

- Tuscon, AZ. (72274)
- Mercury, NV 72387
- San Diego, CA 72293
- Vandenburg, CA 74606

Data from these sites are available for input into dispersion models. It is possible that long-term meteorological monitoring may also include vertical wind profiler or SoDAR wind data collection to supplement the upper air sites listed above, because these sites are some distance from the project area.

As aerometric data become available, DWR is compiling an ACCESS database to facilitate data use in future tasks. The database currently resides on a CH2M HILL server, and will be available to users from a central location, as yet to be determined. This database has grown to over 300 megabytes (MB) to date.

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
COOP040983	Borrego Desert Park	NCDC Station Historical Listing for NWS Cooperative Network	Temperature	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP040983	Borrego Desert Park	NCDC Station Historical Listing for NWS Cooperative Network	Precipitation	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP040983	Borrego Desert Park	NCDC Station Historical Listing for NWS Cooperative Network	Total Snow Fall	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP040983	Borrego Desert Park	NCDC Station Historical Listing for NWS Cooperative Network	Snow Depth	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
AIRS0007	Brawley - Main Street #2	Imperial County APCD	PM_{10}	Daily		1/1/04-current	None	Data requested by CH2M HILL	Y
AIRS0007	Brawley - Main Street #2	Imperial County APCD	$PM_{2.5}$	Daily		1/1/04-current	None	Data requested by CH2M HILL	Y
COOP041048	Brawley 2 SW	NCDC Station Historical Listing for NWS Cooperative Network	Temperature	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP041048	Brawley 2 SW	NCDC Station Historical Listing for NWS Cooperative Network	Precipitation	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP041048	Brawley 2 SW	NCDC Station Historical Listing for NWS Cooperative Network	Total Snow Fall	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP041048	Brawley 2 SW	NCDC Station Historical Listing for NWS Cooperative Network	Snow Depth	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
AIRS0006	Calexico - East	ARB	CO	Hourly		4/5/96-current	None	Data requested by USGS	Y
AIRS0006	Calexico - East	ARB	NO_2	Hourly		4/5/96-current	None	Data requested by USGS	Y
AIRS0006	Calexico - East	ARB	O_3	Hourly		4/5/96-current	None	Data requested by USGS	Y
AIRS0006	Calexico - East	ARB	$PM_{2.5}$ (BAM)	Hourly		4/5/96-current	None	Data requested by USGS	Y
AIRS0006	Calexico - East	ARB	Temp	Hourly		4/5/96-current	None	Data requested by USGS	Y
AIRS0006	Calexico - East	ARB	Wind Direction/Speed	Hourly	10 meter	4/5/96-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	CO	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	SO_2	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	NO_2	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	O_3	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	PM_{10}[b]	Daily		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	$PM_{2.5}$[b]	Daily		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	$PM_{2.5}$ (BAM)	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	TSP	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	Toxics	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	Cr6+	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	Temp	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	Relative Humidity	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	Wind Direction/Speed	Hourly	10 meter	3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	Barometric Pressure	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0005	Calexico – Ethel[c]	ARB	Solar Radiation	Hourly		3/1/94-current	None	Data requested by USGS	Y
AIRS0004	Calexico - Grant Street	Imperial County APCD	O3	Hourly		1/1/91-current	None	Data requested by USGS	Y
AIRS0004	Calexico - Grant Street	Imperial County APCD	PM_{10}	Daily		1/1/91-current	None	Data requested by USGS	Y
AIRS0004	Calexico - Grant Street	Imperial County APCD	Temp	Hourly		1/1/91-current	None	Data requested by USGS	Y

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
AIRS0004	Calexico - Grant Street	Imperial County APCD	Relative Humidity	Hourly		1/1/91-current	None	Data requested by USGS	Y
AIRS0004	Calexico - Grant Street	Imperial County APCD	Wind Direction/Speed	Hourly	10 meter	1/1/91-current	None	Data requested by USGS	Y
AIRS0004	Calexico - Grant Street	Imperial County APCD	Barometric Pressure	Hourly		1/1/91-current	None	Data requested by USGS	Y
CIMIS41	Calipatria	CIMIS	Solar Radiation	Hourly		7/17/83-current	None	Data available online: CIMIS	Y
CIMIS41	Calipatria	CIMIS	Temperature	Hourly		7/17/83-current	None	Data available online: CIMIS	Y
CIMIS41	Calipatria	CIMIS	Humidity	Hourly		7/17/83-current	None	Data available online: CIMIS	Y
CIMIS41	Calipatria	CIMIS	Wind Direction/Speed	Hourly	2 meter	7/17/83-current	None	Data available online: CIMIS	Y
CIMIS41	Calipatria	CIMIS	Precipitation	Hourly		7/17/83-current	None	Data available online: CIMIS	Y
CIMIS175	El Centro	CIMIS	Solar Radiation	Hourly		11/15/82-5/27/87	None	Data available online: CIMIS	N
CIMIS175	El Centro	CIMIS	Temperature	Hourly		11/15/82-5/27/87	None	Data available online: CIMIS	N
CIMIS175	El Centro	CIMIS	Humidity	Hourly		11/15/82-5/27/87	None	Data available online: CIMIS	N
CIMIS175	El Centro	CIMIS	Wind Direction/Speed	Hourly	2 meter	11/15/82-5/27/87	None	Data available online: CIMIS	N
CIMIS175	El Centro	CIMIS	Precipitation	Hourly		11/15/82-5/27/87	None	Data available online: CIMIS	N
AIRS1003	El Centro - 9th Street	Imperial County APCD	CO	Hourly		2/1/88-current	None	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	NO_2	Hourly		2/1/88-current	None	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	O_3	Hourly		2/1/88-current	None	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	PM_{10}	Daily		2/1/88-current	None	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	$PM_{2.5}$	Daily		2/1/88-current	None	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	Temp	Hourly		2/1/88-current	None	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	Relative Humidity	Hourly		2/1/88-current	None	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	Wind Direction/Speed	Hourly	10 meter	2/1/88-current	12/01/99-5/18/03	Data requested by USGS	Y
AIRS1003	El Centro - 9th Street	Imperial County APCD	Barometric Pressure	Hourly		2/1/88-current	None	Data requested by USGS	Y
WBAN03144	Imperial County Airport	Western Regional Climate Center	Wind Direction/Speed	Hourly		1948-current	1/1/95-12/31/99	Data available online: wrcc.dri.edu	Y
WBAN03144	Imperial County Airport	Western Regional Climate Center	Temp	Hourly		1948-current	1/1/95-12/31/99	Data available online: wrcc.dri.edu	Y
WBAN03144	Imperial County Airport	Western Regional Climate Center	Stability Class	Hourly		1948-current	1/1/95-12/31/99	Data available online: wrcc.dri.edu	Y
WBAN03144	Imperial County Airport	Western Regional Climate Center	Rural Mixing Height	Hourly		1948-current	1/1/95-12/31/99	Data available online: wrcc.dri.edu	Y
WBAN03144	Imperial County Airport	Western Regional Climate Center	Urban Mixing Height	Hourly		1948-current	1/1/95-12/31/99	Data available online: wrcc.dri.edu	Y
AIRS2002/AIRS4157	Indio - Jackson Street	South Coast AQMD	O_3	Hourly		1/1/83-current	None	Data requested by USGS	Y
AIRS2002/AIRS4157	Indio - Jackson Street	South Coast AQMD	PM_{10}[a]	Daily		1/1/83-current	8/1/89-4/30/03	Data requested by USGS	Y
AIRS2002/AIRS4157	Indio - Jackson Street	South Coast AQMD	PM_{10} (BAM)	Hourly		1/1/83-current	None	Data requested by USGS	Y
AIRS2002/AIRS4157	Indio - Jackson Street	South Coast AQMD	$PM_{2.5}$	Daily		1/1/83-current	None	Data requested by USGS	Y
AIRS2002/AIRS4157	Indio - Jackson Street	South Coast AQMD	$PM_{2.5}$ (BAM)	Hourly		1/1/83-current	None	Data requested by USGS	Y
AIRS2002/AIRS4157	Indio - Jackson Street	South Coast AQMD	Wind Direction/Speed	Hourly	10 meter	1/1/83-current	10/01/88-4/30/03	Data requested by USGS	Y
COOP044259	Indio Fire Station	NCDC Station Historical Listing for NWS Cooperative Network	Temperature	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP044259	Indio Fire Station	NCDC Station Historical Listing for NWS Cooperative Network	Precipitation	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP044259	Indio Fire Station	NCDC Station Historical Listing for NWS Cooperative Network	Total Snow Fall	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
COOP044259	Indio Fire Station	NCDC Station Historical Listing for NWS Cooperative Network	Snow Depth	Hourly		12/1/27 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	EPA AQS	O_3	Hourly		10/1/93-8/31/04	10/1/93-8/31/04		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	EPA AQS	Wind Direction/Speed	Hourly		10/1/93-8/31/04	10/1/93-8/31/04		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	EPA AQS	Temp	Hourly		10/1/93-8/31/04	10/1/93-8/31/04		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	EPA AQS	Dew Point	Hourly		10/1/93-8/31/04	10/1/93-8/31/04		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	EPA AQS	Solar Radiation	Hourly		10/1/93-8/31/04	10/1/93-8/31/04		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	EPA AQS	Rain Melt/Precipitation	Hourly		10/1/93-8/31/04	10/1/93-8/31/04		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Aluminum (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Arsenic (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Bromine (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Calcium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Chloride (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Chlorine (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Chromium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Copper (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (total) (elemental)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (elemental fraction 1)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (elemental fraction 2)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (elemental fraction 3)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Iron (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Hydrogen (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Potassium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	$PM_{2.5}$: mass	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Magnesium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Manganese (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Molybdenum (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	PM_{10}: Mass	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Nitrite (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Sodium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Ammonium ion (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Nickel (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Nitrate (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (total) (organic)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (organic fraction 1)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (organic fraction 2)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (organic fraction 3)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (organic fraction 4)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon (Fine Particulate) (organic fraction pyrolized)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Phosphorus (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Lead (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Rubidium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Sulfur (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Selenium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Silicon (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Sulfate (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Strontium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y

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List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Titanium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Vanadium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Zinc (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Zirconium (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Sulfur Dioxide	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Relative Humidity Factor (Climatological Monthly)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Relative Humidity (Climatological Monthly)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Ammonium Sulfate (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Ammonium Sulfate Extinction (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Aerosol extinction	Hourly		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	$PM_{2.5}$-10: mass	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Coarse Mass Extinction	Hourly		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	deciview	Hourly		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon Extinction (Fine Particulate) (elemental)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Ammonium Nitrate (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Ammonium Nitrate Extinction (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon Extinction (Fine Particulate) (organic)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Reconstructed Fine Mass	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Soil (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Soil Extinction (Fine Particulate)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
IMPROVEJOSH1/IMPROVEJOTR	Joshua Tree National Park	IMPROVE	Carbon Mass (Fine Particulate) (organic)	Daily		9/4/91-12/29/03	9/4/91-12/29/03		Y
COOP045502	Mecca 2 SE	NCDC Station Historical Listing for NWS Cooperative Network	Temperature	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP045502	Mecca 2 SE	NCDC Station Historical Listing for NWS Cooperative Network	Precipitation	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	

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Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
COOP045502	Mecca 2 SE	NCDC Station Historical Listing for NWS Cooperative Network	Total Snow Fall	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP045502	Mecca 2 SE	NCDC Station Historical Listing for NWS Cooperative Network	Snow Depth	Hourly		7/ 1/48 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
CIMIS87	Meloland	CIMIS	Solar Radiation	Hourly		12/12/89-current	None	Data available online: CIMIS	Y
CIMIS87	Meloland	CIMIS	Temperature	Hourly		12/12/89-current	None	Data available online: CIMIS	Y
CIMIS87	Meloland	CIMIS	Humidity	Hourly		12/12/89-current	None	Data available online: CIMIS	Y
CIMIS87	Meloland	CIMIS	Wind Direction/Speed	Hourly	2 meter	12/12/89-current	None	Data available online: CIMIS	Y
CIMIS87	Meloland	CIMIS	Precipitation	Hourly		12/12/89-current	None	Data available online: CIMIS	Y
AIRS4004	Niland-English Road	Imperial County APCD	O3	Hourly		6/1/96-current	None	Data requested by USGS	Y
AIRS4004	Niland-English Road	Imperial County APCD	PM_{10}	Daily		6/1/96-current	None	Data requested by USGS	Y
AIRS4004	Niland-English Road	Imperial County APCD	PM_{10} (BAM)	Hourly		6/1/96-current	None	Data requested by USGS	Y
AIRS4004	Niland-English Road	Imperial County APCD	Temp	Hourly		6/1/96-current	None	Data requested by USGS	Y
AIRS4004	Niland-English Road	Imperial County APCD	Relative Humidity	Hourly		6/1/96-current	None	Data requested by USGS	Y
AIRS4004	Niland-English Road	Imperial County APCD	Wind Direction/Speed	Hourly	10 meter	6/1/96-current	12/01/99-5/18/03	Data requested by USGS	Y
AIRS4004	Niland-English Road	Imperial County APCD	Barometric Pressure	Hourly		6/1/96-current	None	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	CO	Hourly		4/1/71-current	None	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	NO_2	Hourly		4/1/71-current	None	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	O_3	Hourly		4/1/71-current	None	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	PM_{10}[a]	Daily		4/1/71-current	12/1/93-3/31/03	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	PM_{10} (BAM)	Hourly		4/1/71-current	None	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	$PM_{2.5}$	Daily		4/1/71-current	None	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	$PM_{2.5}$ (BAM)	Hourly		4/1/71-current	None	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	Wind Direction	Hourly	10 meter	4/1/71-current	11/27/90-4/30/03	Data requested by USGS	Y
AIRS4137	Palm Springs - Fire Station	South Coast AQMD	Wind Speed	Hourly	10 meter	4/1/71-current	4/03/91-4/30/03	Data requested by USGS	Y
CIMIS72	Palo Verde	CIMIS	Solar Radiation	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS72	Palo Verde	CIMIS	Temperature	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS72	Palo Verde	CIMIS	Humidity	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS72	Palo Verde	CIMIS	Wind Direction/Speed	Hourly	2 meter	1/11/01-current	None	Data available online: CIMIS	Y
CIMIS72	Palo Verde	CIMIS	Precipitation	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS175	Palo Verde II	CIMIS	Solar Radiation	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS175	Palo Verde II	CIMIS	Temperature	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS175	Palo Verde II	CIMIS	Humidity	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS175	Palo Verde II	CIMIS	Wind Direction/Speed	Hourly	2 meter	1/11/01-current	None	Data available online: CIMIS	Y
CIMIS175	Palo Verde II	CIMIS	Precipitation	Hourly		1/11/01-current	None	Data available online: CIMIS	Y
CIMIS128	Salton Sea East	CIMIS	Solar Radiation	Hourly		11/17/94-current	None	Data available online: CIMIS	Y
CIMIS128	Salton Sea East	CIMIS	Temperature	Hourly		11/17/94-current	None	Data available online: CIMIS	Y
CIMIS128	Salton Sea East	CIMIS	Humidity	Hourly		11/17/94-current	None	Data available online: CIMIS	Y
CIMIS128	Salton Sea East	CIMIS	Wind Direction/Speed	Hourly	2 meter	11/17/94-current	None	Data available online: CIMIS	Y
CIMIS128	Salton Sea East	CIMIS	Precipitation	Hourly		11/17/94-current	None	Data available online: CIMIS	Y

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Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
CIMIS127	Salton Sea West	CIMIS	Solar Radiation	Hourly		11/21/94-current	None	Data available online: CIMIS	Y
CIMIS127	Salton Sea West	CIMIS	Temperature	Hourly		11/21/94-current	None	Data available online: CIMIS	Y
CIMIS127	Salton Sea West	CIMIS	Humidity	Hourly		11/21/94-current	None	Data available online: CIMIS	Y
CIMIS127	Salton Sea West	CIMIS	Wind Direction/Speed	Hourly	2 meter	11/21/94-current	None	Data available online: CIMIS	Y
CIMIS127	Salton Sea West	CIMIS	Precipitation	Hourly		11/21/94-current	None	Data available online: CIMIS	Y
CIMIS68	Seeley	CIMIS	Solar Radiation	Hourly		5/29/87-current	None	Data available online: CIMIS	Y
CIMIS68	Seeley	CIMIS	Temperature	Hourly		5/29/87-current	None	Data available online: CIMIS	Y
CIMIS68	Seeley	CIMIS	Humidity	Hourly		5/29/87-current	None	Data available online: CIMIS	Y
CIMIS68	Seeley	CIMIS	Wind Direction/Speed	Hourly	2 meter	5/29/87-current	None	Data available online: CIMIS	Y
CIMIS68	Seeley	CIMIS	Precipitation	Hourly		5/29/87-current	None	Data available online: CIMIS	Y
COOP048892	Thermal FAA Airport	NCDC Station Historical Listing for NWS Cooperative Network	Temperature	Hourly		6/ 1/50 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP048892	Thermal FAA Airport	NCDC Station Historical Listing for NWS Cooperative Network	Precipitation	Hourly		6/ 1/50 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP048892	Thermal FAA Airport	NCDC Station Historical Listing for NWS Cooperative Network	Total Snow Fall	Hourly		6/ 1/50 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
COOP048892	Thermal FAA Airport	NCDC Station Historical Listing for NWS Cooperative Network	Snow Depth	Hourly		6/ 1/50 to 6/30/04	From Website	Data available online: Western Regional Climate Center	
	Torres Martinez Indian Reservation	Torres Martinez Tribe	Unknown	Hourly		Unknown	Unknown	Data requested by USGS	Y
CIMIS185	UC - Mex	CIMIS	Solar Radiation	Hourly		1/18/02-5/31/02	None	Data available online: CIMIS	N
CIMIS185	UC - Mex	CIMIS	Temperature	Hourly		1/18/02-5/31/02	None	Data available online: CIMIS	N
CIMIS185	UC - Mex	CIMIS	Humidity	Hourly		1/18/02-5/31/02	None	Data available online: CIMIS	N
CIMIS185	UC - Mex	CIMIS	Wind Direction/Speed	Hourly	2 meter	1/18/02-5/31/02	None	Data available online: CIMIS	N
CIMIS185	UC - Mex	CIMIS	Precipitation	Hourly		1/18/02-5/31/02	None	Data available online: CIMIS	N
CIMIS186	UC - San Luis	CIMIS	Solar Radiation	Hourly		4/17/02-current	None	Data available online: CIMIS	Y
CIMIS186	UC - San Luis	CIMIS	Temperature	Hourly		4/17/02-current	None	Data available online: CIMIS	Y
CIMIS186	UC - San Luis	CIMIS	Humidity	Hourly		4/17/02-current	None	Data available online: CIMIS	Y
CIMIS186	UC - San Luis	CIMIS	Wind Direction/Speed	Hourly	2 meter	4/17/02-current	None	Data available online: CIMIS	Y
CIMIS186	UC - San Luis	CIMIS	Precipitation	Hourly		4/17/02-current	None	Data available online: CIMIS	Y
AIRS4003	Westmorland	Imperial County APCD	O3	Hourly		4/1/93-current	None	Data requested by USGS	Y
AIRS4003	Westmorland	Imperial County APCD	PM_{10}	Daily		4/1/93-current	None	Data requested by USGS	Y
AIRS4003	Westmorland	Imperial County APCD	PM_{10} (BAM)	Hourly		4/1/93-current	None	Data requested by USGS	Y
AIRS4003	Westmorland	Imperial County APCD	Temp	Hourly		4/1/93-current	None	Data requested by USGS	Y
AIRS4003	Westmorland	Imperial County APCD	Relative Humidity	Hourly		4/1/93-current	None	Data requested by USGS	Y
AIRS4003	Westmorland	Imperial County APCD	Wind Direction/Speed	Hourly	10 meter	4/1/93-current	12/01/99-5/18/03	Data requested by USGS	Y
AIRS4003	Westmorland	Imperial County APCD	Barometric Pressure	Hourly		4/1/93-current	None	Data requested by USGS	Y
AIRS4003	Westmorland	CIMIS	Solar Radiation	Hourly		11/12/82-4/9/86	None	Data available online: CIMIS	N
AIRS4003	Westmorland	CIMIS	Temperature	Hourly		11/12/82-4/9/86	None	Data available online: CIMIS	N
AIRS4003	Westmorland	CIMIS	Humidity	Hourly		11/12/82-4/9/86	None	Data available online: CIMIS	N
AIRS4003	Westmorland	CIMIS	Wind Direction/Speed	Hourly	2 meter	11/12/82-4/9/86	None	Data available online: CIMIS	N

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Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
AIRS4003	Westmorland	CIMIS	Precipitation	Hourly		11/12/82-4/9/86	None	Data available online: CIMIS	N
CIMIS181	Westmorland North	CIMIS	Solar Radiation	Hourly		3/24/04-current	None	Data available online: CIMIS	Y
CIMIS181	Westmorland North	CIMIS	Temperature	Hourly		3/24/04-current	None	Data available online: CIMIS	Y
CIMIS181	Westmorland North	CIMIS	Humidity	Hourly		3/24/04-current	None	Data available online: CIMIS	Y
CIMIS181	Westmorland North	CIMIS	Wind Direction/Speed	Hourly	2 meter	3/24/04-current	None	Data available online: CIMIS	Y
CIMIS181	Westmorland North	CIMIS	Precipitation	Hourly		3/24/04-current	None	Data available online: CIMIS	Y
CIMIS180	Westmorland West	CIMIS	Solar Radiation	Hourly		11/7/01-7/21/03	None	Data available online: CIMIS	N
CIMIS180	Westmorland West	CIMIS	Temperature	Hourly		11/7/01-7/21/03	None	Data available online: CIMIS	N
CIMIS180	Westmorland West	CIMIS	Humidity	Hourly		11/7/01-7/21/03	None	Data available online: CIMIS	N
CIMIS180	Westmorland West	CIMIS	Wind Direction/Speed	Hourly	2 meter	11/7/01-7/21/03	None	Data available online: CIMIS	N
CIMIS180	Westmorland West	CIMIS	Precipitation	Hourly		11/7/01-7/21/03	None	Data available online: CIMIS	N
JOT403	Joshua Tree National Park	CASTNET	Sulfate	Weekly		2/16/95-6/29/04	2/16/95-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Nitrate	Weekly		2/16/95-6/29/04	2/16/95-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Ammonium	Weekly		2/16/95-6/29/04	2/16/95-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Calcium	Weekly		1/05/00-6/29/04	1/05/00-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Magnesium	Weekly		1/05/00-6/29/04	1/05/00-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Sodium	Weekly		1/05/00-6/29/04	1/05/00-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Potassium	Weekly		1/05/00-6/29/04	1/05/00-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Chloride	Weekly		1/05/00-6/29/04	1/05/00-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Nitric acid	Weekly		2/16/95-6/29/04	2/16/95-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Sulfur dioxide	Weekly		2/16/95-6/29/04	2/16/95-6/29/04		Y
JOT403	Joshua Tree National Park	CASTNET	Leaf status	?		?	?		?
JOT403	Joshua Tree National Park	CASTNET	Ozone	Annual		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Sulfur dioxide	Annual		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Nitric acid	Annual		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Particulate	Annual		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Sulfate	Annual		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Nitrate	Annual		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Ammonium	Annual		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Ozone	Quarterly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Sulfur dioxide	Quarterly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Nitric acid	Quarterly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Particulate	Quarterly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Sulfate	Quarterly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Nitrate	Quarterly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Ammonium	Quarterly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Ozone	Weekly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Sulfur dioxide	Weekly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Nitric acid	Weekly		1995-2002	1995-2002		Y

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
JOT403	Joshua Tree National Park	CASTNET	Particulate	Weekly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Sulfate	Weekly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Nitrate	Weekly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Ammonium	Weekly		1995-2002	1995-2002		Y
JOT403	Joshua Tree National Park	CASTNET	Temperature	Hourly		2/1/95-6/30/04	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Relative humidity	Hourly		2/1/95-6/30/04	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Solar radiation	Hourly		2/1/95-6/30/04	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Ozone	Hourly		2/1/95-6/30/04	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Precipitation	Hourly		2/1/95-6/30/04	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Wind Speed/Direction	Hourly		2/1/95-6/30/04	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Wetness	Hourly		2/1/95-6/30/04	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Ozone	Eight hour		2/1/95-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Ozone deposition velocity	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Ozone flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Ozone	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Sulfur Dioxide deposition velocity	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Sulfur Dioxide flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Sulfur Dioxide	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Nitric Acid deposition velocity	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Nitric Acid flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Nitric Acid	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Particulate deposition velocity	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Sulfate flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Sulfate	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Nitrate flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Nitrate	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Ammonium flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Ammonium	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Calcium flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Calcium	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Magnesium flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Magnesium	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Sodium flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Sodium	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Potassium flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Potassium	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Chloride flux	Hourly		02/16/1995-12/31/03	None	Available on website	Y
JOT403	Joshua Tree National Park	CASTNET	Chloride	Hourly		02/16/1995-12/31/03	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Calcium	Weekly		9/19/00-Current	None	Available on website	Y

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
CA67	Joshua Tree National Park	NADP	Magnesium	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Potassium	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Sodium	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Ammonium	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Nitrate	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Chloride	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Sulfate	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	H?	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	pH	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Precipitation	Weekly		9/19/00-Current	None	Available on website	Y
CA67	Joshua Tree National Park	NADP	Conductivity	Weekly		9/19/00-Current	None	Available on website	Y
CIMIS118	Cathedral City	CIMIS	Solar Radiation	Hourly		12/7/95-Current	None	Data available online: cimis	Y
CIMIS118	Cathedral City	CIMIS	Temperature	Hourly		12/7/95-Current	None	Data available online: cimis	Y
CIMIS118	Cathedral City	CIMIS	Humidity	Hourly		12/7/95-Current	None	Data available online: cimis	Y
CIMIS118	Cathedral City	CIMIS	Wind Direction/Speed	Hourly	2 Meter	12/7/95-Current	None	Data available online: cimis	Y
CIMIS118	Cathedral City	CIMIS	Precipitation	Hourly		12/7/95-Current	None	Data available online: cimis	Y
CIMIS162	Indio	CIMIS	Solar Radiation	Hourly		12/24/99-Current	None	Data available online: cimis	Y
CIMIS162	Indio	CIMIS	Temperature	Hourly		12/24/99-Current	None	Data available online: cimis	Y
CIMIS162	Indio	CIMIS	Humidity	Hourly		12/24/99-Current	None	Data available online: cimis	Y
CIMIS162	Indio	CIMIS	Wind Direction/Speed	Hourly	2 Meter	12/24/99-Current	None	Data available online: cimis	Y
CIMIS162	Indio	CIMIS	Precipitation	Hourly		12/24/99-Current	None	Data available online: cimis	Y
CIMIS176	La Quinta	CIMIS	Solar Radiation	Hourly		11/10/00-Current	None	Data available online: cimis	Y
CIMIS176	La Quinta	CIMIS	Temperature	Hourly		11/10/00-Current	None	Data available online: cimis	Y
CIMIS176	La Quinta	CIMIS	Humidity	Hourly		11/10/00-Current	None	Data available online: cimis	Y
CIMIS176	La Quinta	CIMIS	Wind Direction/Speed	Hourly	2 Meter	11/10/00-Current	None	Data available online: cimis	Y
CIMIS176	La Quinta	CIMIS	Precipitation	Hourly		11/10/00-Current	None	Data available online: cimis	Y
CIMIS136	Oasis	CIMIS	Solar Radiation	Hourly		1/7/97-Current	None	Data available online: cimis	Y
CIMIS136	Oasis	CIMIS	Temperature	Hourly		1/7/97-Current	None	Data available online: cimis	Y
CIMIS136	Oasis	CIMIS	Humidity	Hourly		1/7/97-Current	None	Data available online: cimis	Y
CIMIS136	Oasis	CIMIS	Wind Direction/Speed	Hourly	2 Meter	1/7/97-Current	None	Data available online: cimis	Y
CIMIS136	Oasis	CIMIS	Precipitation	Hourly		1/7/97-Current	None	Data available online: cimis	Y
CIMIS141	Mecca	CIMIS	Solar Radiation	Hourly		5/5/98-Current	None	Data available online: cimis	Y
CIMIS141	Mecca	CIMIS	Temperature	Hourly		5/5/98-Current	None	Data available online: cimis	Y
CIMIS141	Mecca	CIMIS	Humidity	Hourly		5/5/98-Current	None	Data available online: cimis	Y
CIMIS141	Mecca	CIMIS	Wind Direction/Speed	Hourly	2 Meter	5/5/98-Current	None	Data available online: cimis	Y
CIMIS141	Mecca	CIMIS	Precipitation	Hourly		5/5/98-Current	None	Data available online: cimis	Y
CIMIS154	Salton Sea North	CIMIS	Solar Radiation	Hourly		11/15/98-10/29/03	None	Data available online: cimis	N
CIMIS154	Salton Sea North	CIMIS	Temperature	Hourly		11/15/98-10/29/03	None	Data available online: cimis	N
CIMIS154	Salton Sea North	CIMIS	Humidity	Hourly		11/15/98-10/29/03	None	Data available online: cimis	N

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List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
CIMIS154	Salton Sea North	CIMIS	Wind Direction/Speed	Hourly	2 Meter	11/15/98-10/29/03	None	Data available online: cimis	N
CIMIS154	Salton Sea North	CIMIS	Precipitation	Hourly		11/15/98-10/29/03	None	Data available online: cimis	N
CIMIS55	Palm Desert	CIMIS	Solar Radiation	Hourly		5/26/87-4/11/94	None	Data available online: cimis	N
CIMIS55	Palm Desert	CIMIS	Temperature	Hourly		5/26/87-4/11/94	None	Data available online: cimis	N
CIMIS55	Palm Desert	CIMIS	Humidity	Hourly		5/26/87-4/11/94	None	Data available online: cimis	N
CIMIS55	Palm Desert	CIMIS	Wind Direction/Speed	Hourly	2 Meter	5/26/87-4/11/94	None	Data available online: cimis	N
CIMIS55	Palm Desert	CIMIS	Precipitation	Hourly		5/26/87-4/11/94	None	Data available online: cimis	N
CIMIS25	Rancho Mirage	CIMIS	Solar Radiation	Hourly		11/22/82-11/20/85	None	Data available online: cimis	N
CIMIS25	Rancho Mirage	CIMIS	Temperature	Hourly		11/22/82-11/20/85	None	Data available online: cimis	N
CIMIS25	Rancho Mirage	CIMIS	Humidity	Hourly		11/22/82-11/20/85	None	Data available online: cimis	N
CIMIS25	Rancho Mirage	CIMIS	Wind Direction/Speed	Hourly	2 Meter	11/22/82-11/20/85	None	Data available online: cimis	N
CIMIS25	Rancho Mirage	CIMIS	Precipitation	Hourly		11/22/82-11/20/85	None	Data available online: cimis	N
CIMIS24	Thermal	CIMIS	Solar Radiation	Hourly		11/22/82-3/3/86	None	Data available online: cimis	N
CIMIS24	Thermal	CIMIS	Temperature	Hourly		11/22/82-3/3/87	None	Data available online: cimis	N
CIMIS24	Thermal	CIMIS	Humidity	Hourly		11/22/82-3/3/88	None	Data available online: cimis	N
CIMIS24	Thermal	CIMIS	Wind Direction/Speed	Hourly	2 Meter	11/22/82-3/3/89	None	Data available online: cimis	N
CIMIS24	Thermal	CIMIS	Precipitation	Hourly		11/22/82-3/3/90	None	Data available online: cimis	N
CIMIS50	Thermal	CIMIS	Solar Radiation	Hourly		7/22/86-1/11/99	None	Data available online: cimis	N
CIMIS50	Thermal	CIMIS	Temperature	Hourly		7/22/86-1/11/99	None	Data available online: cimis	N
CIMIS50	Thermal	CIMIS	Humidity	Hourly		7/22/86-1/11/99	None	Data available online: cimis	N
CIMIS50	Thermal	CIMIS	Wind Direction/Speed	Hourly	2 Meter	7/22/86-1/11/99	None	Data available online: cimis	N
CIMIS50	Thermal	CIMIS	Precipitation	Hourly		7/22/86-1/11/99	None	Data available online: cimis	N
	Fish Creek Mountain	RAWS	Precipitation	Hourly		3/88-current	None	Data available online with password: wrcc	Y
	Fish Creek Mountain	RAWS	Wind Direction/Speed	Hourly		3/88-current	None	Data available online with password: wrcc	Y
	Fish Creek Mountain	RAWS	Gust Wind Direction/Speed	Hourly		3/88-current	None	Data available online with password: wrcc	Y
	Fish Creek Mountain	RAWS	Temperature	Hourly		3/88-current	None	Data available online with password: wrcc	Y
	Fish Creek Mountain	RAWS	Fuel Temperature	Hourly		3/88-current	None	Data available online with password: wrcc	Y
	Fish Creek Mountain	RAWS	Relative Humidity	Hourly		3/88-current	None	Data available online with password: wrcc	Y
	Fish Creek Mountain	RAWS	Battery Voltage	Hourly		3/88-current	None	Data available online with password: wrcc	Y
	Fish Creek Mountain	RAWS	Solar Radiation	Hourly		3/88-current	None	Data available online with password: wrcc	Y
KIPL	Imperial Airport	ASOS	Wind Direction/Speed	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Gust Wind Direction/Speed	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Cloud Ceiling	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Sky Cover	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Visibility	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
KIPL	Imperial Airport	ASOS	Present Weather	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Past Weather	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Temperature	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Barometric Pressure	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Snow Depth	Hourly		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Precipitation	6 Hour		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Precipitation	12 Hour		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KIPL	Imperial Airport	ASOS	Precipitation	24 Hour		March 1959 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Wind Direction/Speed	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Gust Wind Direction/Speed	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Cloud Ceiling	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Sky Cover	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Visibility	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Present Weather	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Past Weather	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Temperature	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Barometric Pressure	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Snow Depth	Hourly		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Precipitation	6 Hour		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Precipitation	12 Hour		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KPSP	Palm Springs Airport	ASOS	Precipitation	24 Hour		May 1946 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Wind Direction/Speed	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Gust Wind Direction/Speed	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y

Table 1
List of Available Data

Site ID No.	Site Name	Source	Parameter	Averaging Period	Measurement Height	Available Data	Data Received	Comments	Still Operating?
KTRM	Palm Springs Thermal Airport	ASOS	Cloud Ceiling	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Sky Cover	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Visibility	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Present Weather	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Past Weather	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Temperature	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Barometric Pressure	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Snow Depth	Hourly		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Precipitation	6 Hour		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Precipitation	12 Hour		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y
KTRM	Palm Springs Thermal Airport	ASOS	Precipitation	24 Hour		May 1950 - present	None	Available online at www.ncdc.noaa.gov/oa/ncdc.html	Y

Table 2
Data Sites

Site ID No.	Site Name	County	10-Meter Met	2-Meter Met	Other Met	CIMIS	Daily/ Hourly PM_{10}	Daily/ Hourly $PM_{2.5}$	Toxics	Other Pollutants
AIRS0004	Calexico - Grant Street	IMPERIAL	x				D			x
AIRS0005	Calexico - Ethel	IMPERIAL	x				D	D/H	x	x
AIRS0006	Calexico - East	IMPERIAL	x					H		x
AIRS0007	Brawley - Main Street #2	IMPERIAL					D	D		
AIRS1003	El Centro - 9th Street	RIVERSIDE	x				D	D		x
AIRS2002/ AIRS4157	Indio - Jackson Street	RIVERSIDE	x				D/H	D/H		x
AIRS4003	Westmorland	IMPERIAL	x				D/H			x
AIRS4004	Niland-English Road	RIVERSIDE	x				D/H			x
AIRS4137	Palm Springs - Fire Station	RIVERSIDE	x				D/H	D/H		x
AIRS9002	Joshua Tree National Park	SAN BERNARDINO	x							x
CA67	Joshua Tree National Park	SAN BERNARDINO	x							x
CIMIS118	Cathedral City	RIVERSIDE			x	x				
CIMIS127	Salton Sea West	IMPERIAL		x	x	x				
CIMIS128	Salton Sea East	IMPERIAL		x	x	x				
CIMIS136	Oasis	RIVERSIDE			x	x				
CIMIS141	Mecca	RIVERSIDE			x	x				
CIMIS154	Salton Sea North	RIVERSIDE			x	x				
CIMIS162	Indio	RIVERSIDE			x	x				
CIMIS175	El Centro	IMPERIAL		x	x	x				
CIMIS176	La Quinta	RIVERSIDE			x	x				
CIMIS18	Westmorland	IMPERIAL			x	x				
CIMIS180	Westmorland West	IMPERIAL		x	x	x				
CIMIS181	Westmorland North	IMPERIAL		x	x	x				

Table 2
Data Sites

Site ID No.	Site Name	County	10-Meter Met	2-Meter Met	Other Met	CIMIS	Daily/ Hourly PM_{10}	Daily/ Hourly $PM_{2.5}$	Toxics	Other Pollutants
CIMIS185	UC - Mex	IMPERIAL		x	x	x				
CIMIS186	UC - San Luis	IMPERIAL		x	x	x				
CIMIS24	Thermal	RIVERSIDE			x	x				
CIMIS25	Rancho Mirage	RIVERSIDE			x	x				
CIMIS41	Calipatria	IMPERIAL		x	x	x				
CIMIS50	Thermal	RIVERSIDE			x	x				
CIMIS55	Palm Desert	RIVERSIDE			x	x				
CIMIS68	Seeley	IMPERIAL		x	x	x				
CIMIS87	Meloland	IMPERIAL		x	x	x				
COOP040983	Borrego Desert Park	SAN DIEGO			x					
COOP041048	Brawley 2 SW	IMPERIAL			x					
COOP044259	Indio Fire Station	RIVERSIDE			x					
COOP045502	Mecca 2 SE	IMPERIAL			x					
COOP048892	Thermal FAA Airport	IMPERIAL			x					
IMPROVEJOSH1 /IMPROVEJOTR	Joshua Tree National Park	SAN BERNARDINO			x		D	D	x	x
JOT403	Joshua Tree National Park	SAN BERNARDINO	x						x	x
JOT403	Joshua Tree Nat'l Park-CASTNet	SAN BERNARDINO	x		x		x		x	x
CA67	Joshua Tree National Park-NADP	SAN BERNARDINO			x		x		x	x
WBAN03144	Imperial County Airport	IMPERIAL	x							
	Torres Martinez Indian Reservation		x		x		x			
CIMIS118	Cathedral City	RIVERSIDE				x				
CIMIS162	Indio	RIVERSIDE				x				
CIMIS176	La Quinta	RIVERSIDE				x				

Table 2
Data Sites

Site ID No.	Site Name	County	10-Meter Met	2-Meter Met	Other Met	CIMIS	Daily/ Hourly PM_{10}	Daily/ Hourly $PM_{2.5}$	Toxics	Other Pollutants
CIMIS136	Oasis	RIVERSIDE				x				
CIMIS141	Mecca	RIVERSIDE				x				
CIMIS154	Salton Sea North	RIVERSIDE				x				
CIMIS55	Palm Desert	RIVERSIDE				x				
CIMIS25	Rancho Mirage	RIVERSIDE				x				
CIMIS24	Thermal	RIVERSIDE				x				
CIMIS50	Thermal	RIVERSIDE				x				
	Fish Creek Mountain	SAN DIEGO			x					
KIPL	Imperial County Airport	IMPERIAL			x					
KPSP	Palm Springs Airport	RIVERSIDE			x					
KTRM	Thermal Regional Airport	IMPERIAL			x					

D = daily average
H = hourly average

The database must meet the needs of the long-term nature of this project and the need for many stakeholders as well as the public to have access to data. This may require developing a powerful yet functional web-based database to manage the wealth of information from this project. Air information developed throughout the project has been posted to a CH2M HILL ftp web site available to the SSAQWG. That site is located at ftp://ftp.ch2m.com/SaltonAir/.

Available data include meteorological, ambient monitoring, and emissions data. Data are summarized in tabular format according to station location, data source, parameter, duration of data, availability of data, and whether or not a particular monitoring station is still operating. Stations that have ceased operation may be useful in indicating past air quality trends, though this data may not be useful for inclusion in future studies.

DWR will continue to work collaboratively with EPA, ARB, local air quality districts, Tribes, USGS, and other stakeholders to fill in data gaps from other data sources.

Data on Air Toxics or Hazardous Air Pollutants

Data gathering results indicate that data on ambient levels of toxic air contaminants or hazardous air pollutants (air toxics) are collected by ARB at the Calexico-Ethel monitoring station, and by SCAQMD and the CASTNet and IMPROVE programs in Joshua Tree National Park. Data are collected on ambient concentrations of metals, nitrate, and sulfate. The filter-based PM_{10} and $PM_{2.5}$ samples collected at several monitoring stations are analyzed and speciated for concentrations of sulfate and nitrate. These data sets are quite extensive. Tables 3 and 4 list the air toxics species measured at the Calexico-Ethel station. Table 3 lists the air toxics and metals speciated from the samples taken on particulate filters. Table 4 lists the speciated volatile organic compound (VOC) and polynuclear (or polycyclic) aromatic hydrocarbon (PAH) compounds that are monitored at the station. Additional information such as measurement methods and data collected at these and the other stations will be added to the ACCESS database as it becomes available.

Table 3
List of Speciated Air Toxics from PM_{10} and $PM_{2.5}$ Filters
Collected at the Calexico Ethel Station

PM_{10}	$PM_{2.5}$
Nitrates	Nitrates
Sulfates	Sulfates
Chlorides	Sodium Chlorides
Ammonium	Ammonium
Potassium	Potassium
	Organic and Elemental Carbon
	Metals (Al, Si, P, S, Cl, K, Ca, Ti, Vn, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Br, Rb, Sr, Y, Zr, Mo, Sn, Sb, Ba, Hg, Pb and U) (U is not reported to EPA)

Table 4
List of Speciated Air Toxics Measured at Calexico Ethel Station

VOCs	
Acetaldehyde	Ethylene Dibromide
Acetone	Ethylene Dichloride

Table 4
List of Speciated Air Toxics Measured at Calexico Ethel Station

VOCs	
Acetonitrile	Formaldehyde
Acrolein	Methyl Bromide
Acrylonitrile	Methyl Chloroform
Benzene	Methyl Ethyl Ketone
1,3-Butadiene	Methyl Teriary-Butyl Ether
Carbon Disulfide	Methylene Chloride
Carbon Tetrachloride	Perchloroethylene
Chlorobenzene	Styrene
Chloroform	Toluene
meta-Dichlorobenzene	Trichloroethylene
ortho-Dichlorobenzene	meta-Xylene
para-Dichlorobenzene	meta/para-Xylene
cis-1,3-Dichloropropene	ortho-Xylene
trans-1,3-Dichloropropene	para-Xylene
Ethyl Benzene	
PAHs	
Benzo(a)pyrene	Benzo(k)fluoranthene
Benzo(b)fluoranthene	Dibenz(a,h)anthracene
Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene

Land Use

Land use data is needed as part of the evaluation of air quality related issues at the site. Numerous land use maps and GIS information is available for use in this project. These data contain information that may be used as input to air quality dispersion models and is available for other uses related to the evaluation of alternatives. The information which is available on the CH2M HILL GIS network has data from a number of sources and has been summarized in Table 5.

Table 5
IID & Salton Sea Land Use GIS Data

Coverage Name	Description	Source	est. date
CONSRV_FARM	Farm Land Classification (FMMP)	CA Dept. of Conservation	1996
duckclub	duckclubs in the imperial valley	CH developed for Sandy Taylor	NA
FARMLND	Field Boundaries	IID GIS	1996
iid_farm	Farm Land Classification (FMMP)	CA Dept. of Conservation clipped for IID watered area	1996
IMPRMAPC	Farm Bureau Fields	Farm Bureau	NA
salt_wetlands	wetlands	Salton Sea Authority	NA
usbr_iid_ag	LCRAS IID ag field boundaries	USBR	NA
usbr_lcr_ag	Looking like crop report data	USBR	1996-99
r_parks	parks	Salton Sea Authority	NA

Table 5
IID & Salton Sea Land Use GIS Data

Coverage Name	Description	Source	est. date
fmmp_farm	CA Dept Conservation FMMP Riv, Imp, Sdg counties	CA Dept. of Conservation clipped for IID watered area	1996
clipped_scag_lu	SCAG Landuse	SCAG	1993 - 2001
r_lndown	General Landowner data	State of CA?	NA

Data Gaps with Regard to Monitoring Data

Data gaps can best be identified once the specific data analysis tools to be used (e.g., emissions models, dispersion models) have been identified. The needs of the analyses, and of the analytical tools, will lead to an understanding of the gaps. The most apparent gaps appear to be spatial in nature; indicating the need for a map of monitoring station locations by parameter. Figure 1 was developed to meet these needs.

Meteorological Data

Feedback during the October 2004 Workshop emphasized that careful consideration should be given to data quality and the manner of collection. Representatives of both the ARB and the participating air districts emphasized that the meteorological data used for dispersion modeling must meet requirements defined in the USEPA guidance document, *Meteorological Monitoring Program Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, February 2000.* Specifically, wind data must be collected at the 10-meter height above ground, limiting use of available data sets that do not comply with this guidance. Because CIMIS wind data stations collect data at the 2-meter height, at least one 10-meter meteorological monitor would need to be co-located with a 2-meter CIMIS system, to establish the relationship between the two data sets, and allow use of the 2-meter data sets. Several CIMIS stations are located in the project area, where 10-meter data is planned to be collected. Since the DWR operates the existing CIMIS stations, co-location of 10-meter monitors with existing 2-meter systems has been determined to be a cost-effective way to fill data gaps. It was also evident from the map showing locations of existing stations that a 10-meter meteorological station was needed on the eastern side of the project area.

Particulate Data

Potential locations for particulate monitoring stations should be evaluated based on predominant wind patterns and the potential alternatives that may be analyzed in the PEIR. Workshop feedback also stressed that particulate monitoring must be conducted in accordance with USEPA methods that are listed as reference or equivalent measurement methods in the Code of Federal Regulations (CFR). Existing data collected at monitoring sites operated by ARB, the air districts, and the Torres-Martinez tribe should meet these criteria. If non-Reference-Method instruments are used as surrogates, this instrumentation would need to be co-located with USEPA Reference or Equivalent Method monitors to allow correlations to be determined. Surrogate monitors were discussed, because they would be less costly to purchase and operate.

At the November 18, 2004, Workshop, ARB presented an analysis of seasonal and annual wind patterns based on existing data. ARB completed their presentation by recommending installation of at least two additional meteorological and PM_{10} monitoring locations. The first would be at the northern end of the watershed, at Mecca or Oasis, to capture upwind particulate matter data and to help define the winds at the northern end of the Salton Sea. The other would be at the southern end of the watershed, in the vicinity of the Westmoreland CIMIS site. ARB also suggested a potential third site on Torrez-Martinez tribal lands.

From the information discussed at the November 18, 2004 Workshop and follow-on conversations, agreement was reached on recommended locations for additional monitoring. These locations are described in the following section.

RECOMMENDATIONS FOR ADDITIONAL AEROMETRIC MONITORING DATA

At the November 18, 2004, Workshop, ARB and DWR presented recommendations for additional monitoring to fill data gaps for air dispersion modeling to be performed for the PEIR and for longer range projects. After these presentations, further input was gathered from workshop participants. These discussions led to the following recommended additional monitoring locations. These recommendations are divided into two categories: short-term monitoring needs to directly address the requirements of CEQA and the PEIR, and long-term needs to address potential future air quality impacts associated with various scenarios in the Salton Sea watershed.

Based on input from regulatory agencies at the October 2004 Workshop, DWR recommends collecting additional meteorological data at monitors located 10 meters above ground. This can be implemented efficiently by using the existing CIMIS monitoring network, by co-location of 10-meter monitors with existing 2-meter systems. The 10-meter network of stations is designed to provide short-term data for the PEIR at locations along the current shoreline of the Salton Sea.

A total of three stations are recommended. These are located at existing CIMIS stations where 10-meter towers would be added to collect wind speed and direction data. These three stations are:

- Salton Sea East, currently operating CIMIS station # 128, located on the southeastern Salton Sea shoreline
- Salton Sea West, currently operating CIMIS station # 127, located on the western shoreline
- Mecca Beach, currently operating CIMIS station # 141,located on the northern shoreline.

Discussions are continuing between DWR and ARB to determine the suitability of the Salton Sea West site. There is a large tree and a small building located near the CIMIS station. These could act as obstructions to airflow. ARB has recommended that the 10-meter tower at this station be moved several hundred feet further to the east, away from the obstructions so the data are not affected by the turbulence and blocking of the obstructions. Review of the 2-meter data from the Salton Sea West site does show that there is very little wind from the West; the direction where the obstructions are upwind of the station. DWR is committed to locating all stations in accordance with EPA monitoring guidance for meteorological data collection as described in; *Meteorological Monitoring Guidance for Regulatory Modeling Applications (EPA-454/R-99-005).February 2000.*

Monitoring is focused in the south end of the study area, because the Salton Sea is most shallow along its southernmost shoreline and any alternatives resulting in receding water conditions would result in exposed seabed in this area first. However, for short-term monitoring, property is not available to establish a new site or add a 10-meter station at an existing CIMIS site. In addition to the recommendations above, data may be available from existing Torrez-Martinez tribe stations. The tribal data have been requested by USBR.

DWR is proceeding with ordering equipment, so the three monitoring stations can be installed and data collected for a suitable period of time, for use in PEIR air quality analyses. Figure 2 show the locations of these proposed stations and the existing 10-meter meteorological stations.

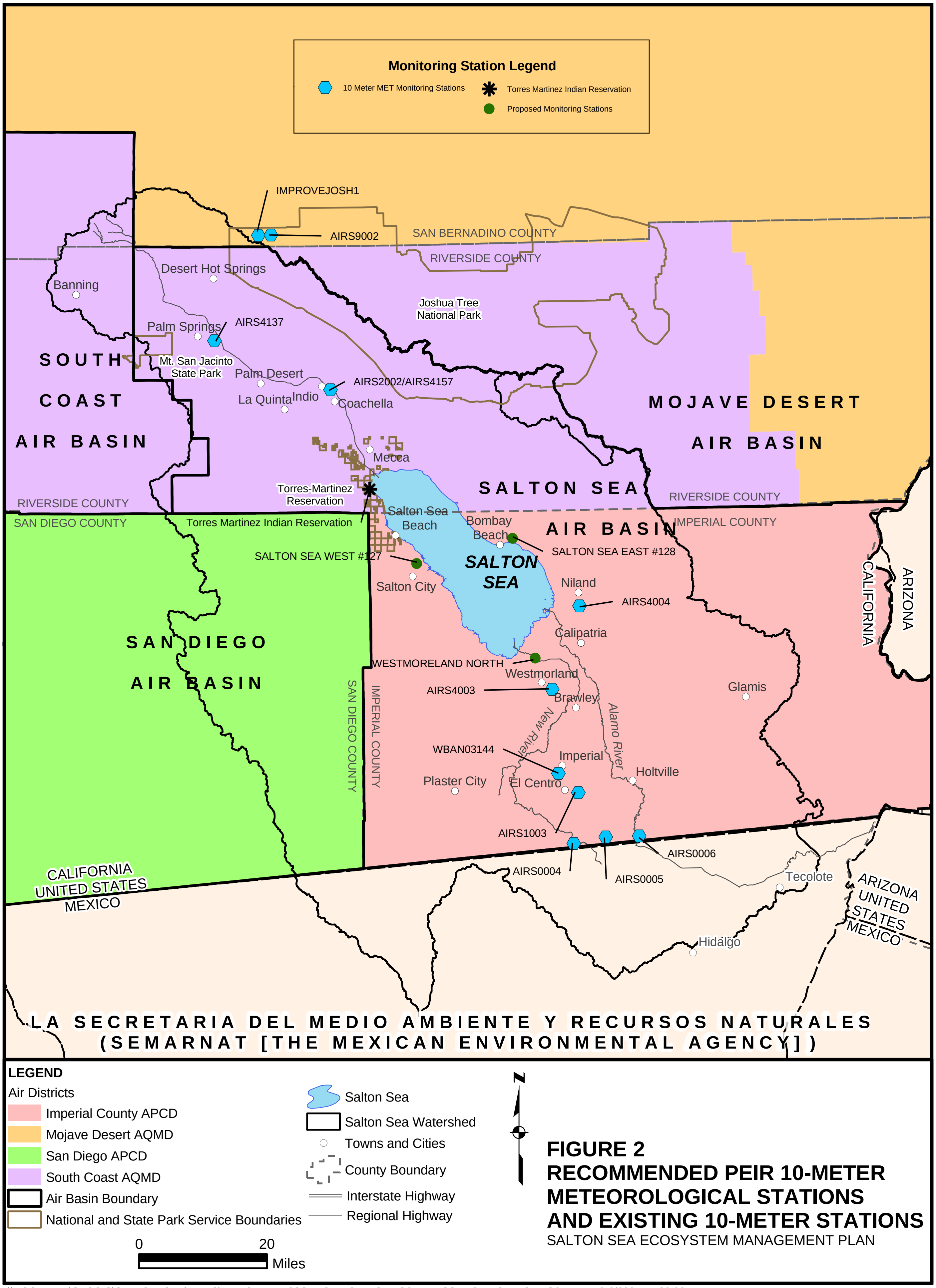

FIGURE 2
RECOMMENDED PEIR 10-METER METEOROLOGICAL STATIONS AND EXISTING 10-METER STATIONS
SALTON SEA ECOSYSTEM MANAGEMENT PLAN

For long-term impact meteorological monitoring, the stations recommended above to meet short-term needs would be supplemented by three additional stations:

- Salton Sea North-currently inactive CIMIS site #154
- Salton Sea Test Site
- Southern shoreline location to be determined

During their November 18, 2004, presentation, ARB recommended adding a monitoring station near the Mecca CIMIS station. Further discussion has led to the recommendation of short-term monitoring at the existing Mecca CIMIS station.

Workshop discussion revealed that the Salton Sea North station, which is currently inactive, is near Mecca and could be a potential long-range monitoring location. Additional long-term meteorological data will likely be needed for the northern, southern and western shorelines. These sites would help determine microscale wind patterns in areas where playa would become exposed under certain project alternatives. By adding these three stations, the meteorological monitoring network would essentially ring the shoreline. This would thereby provide data for use in evaluating numerous project alternatives and mitigation strategies.

For near-term evaluations of airborne particulate matter, PM_{10} was identified as the pollutant of concern since particulate emissions from playa have been shown to be primarily comprised of PM_{10}. $PM_{2.5}$ issues have the potential to become more important as the new NAAQS are implemented. There are two continuous $PM_{2.5}$ monitors operating in the watershed area. There are continuous PM_{10} monitors at four locations and 24-hour samplers at six locations in the watershed area that collect 24-hr samples on an every-sixth-day schedule. The workshop participants agreed that this was a suitable amount of data for preparing the PEIR. For longer term monitoring, additional monitoring will depend on the selected alternatives and mitigation measures. Therefore, long-term particulate monitoring needs cannot yet be determined. However, it is likely that additional PM monitoring will be required to measure control efficiency and to determine attainment status.

EPA Region IX has provided additional input concerning the 10-meter meteorological data collection. These comments are summarized as follows:

Wind data collected at 2 meters instead of 10 meters does not meet EPA guidance for use in a permit or a SIP. However, the PEIR is not required to comply with EPA guidelines. Because the Salton Sea environs are mostly flat, 2- and 10-meter wind speeds and directions would be expected to have reasonable correlation (both heights are substantially above surface roughness elements). Upslope/downslope flows due to complex terrain to the west would likely affect a layer that included both 2-m and 10-m heights.

There will be multiple wind data sets collected over a large area, and the ISCST and AERMOD models can accept only one in a given hour; differences between sites are likely to be much larger than differences between heights at a given site. For these reasons, EPA would not object to use of 2-m wind data "adjusted" to 10-m using co-located data collected over a quarter.

EPA also provided the following caveats:

- Attempts to correlate 2-m and 10-m wind data at Owens Lake, an area similar to Salton Sea in several respects, was not successful, and

- The complex terrain nearby may have unforeseen effects on the winds.

Based on these two points, and because EPA would be reluctant to accept wind data from below 10 meters for use in a permit or SIP, EPA strongly recommends that the 10-meter collection program continue for a full year.

The recommendations for additional aerometric monitoring stations are summarized in Table 6. Agreement has been made regarding the type(s) and model(s) of instruments, so that the 10-meter instruments and datalogger systems are compatible and also meet EPA monitoring guidance. Due to the project schedule, only some of these data may be available for the PEIR analyses. DWR is proceeding with purchasing and installing the three recommended 10-m meteorological stations.

Table 6
Recommended Locations for Additional Monitoring Stations

	Recommended Locations for Monitoring to Support Long-Term Needs*	**Recommended Locations for Monitoring to Support Short-Term Needs (PEIR/CEQA)**
10-meter Meteorological Stations	Salton Sea North -CIMIS inactive	Salton Sea East-CIMIS active
	Salton Sea Test Site –CIMIS inactive	Mecca-CIMIS active
	Southern shoreline location to be determined	Salton Sea West-CIMIS active
PM_{10}	Dependent on PEIR preferred alternatives and mitigation measures	No new stations or data needed

* The long-term monitoring network is recommended to include the stations listed in this column and all sites recommended in the adjacent column of recommended locations to support short-term needs.

EXISTING AIR QUALITY MANAGEMENT PLANS AND REGIONAL EMISSIONS INVENTORIES

Based on the attainment status of the study area for National Ambient Air Quality Standards (NAAQS) and California standards (CAAQS), State Implementation Plans (SIPs) have been or will be developed. These plans will outline steps necessary to reach or maintain attainment status. Current attainment status in the study area is summarized below:

- NAAQS – Imperial, Riverside, and San Bernardino Counties are nonattainment for federal standards for 1-hour and 8-hour ozone and PM_{10}. Portions of Riverside, San Diego, and San Bernardino Counties are nonattainment for federal standards for $PM_{2.5}$.
- NAAQS – San Diego County attains federal standards for 1-hour ozone and PM_{10}, but does not attain federal standards for 8-hour ozone and $PM_{2.5}$.
- CAAQS – Portions of Imperial, Riverside, San Bernardino, and San Diego Counties are nonattainment for 1-hour state standards for ozone, PM_{10}, and all counties except Imperial are nonattainment for $PM_{2.5}$.
- CAAQS – Calexico is nonattainment for CO state standards.

Air quality management and implementation plans developed by the local air quality agencies include the following:

- Riverside County, under the jurisdiction of the South Coast AQMD, has prepared a 2003 Air Quality Management Plan for the Coachella Valley PM_{10} SIP.
- San Bernardino County, under the jurisdiction of the Mojave Desert AQMD, has prepared a 2004 Ozone Attainment Plan and a PM_{10} Attainment Plan.
- San Diego County has prepared a 2002 Ozone Redesignation Request and Maintenance Plan.

In addition, new SIPs for 8-hour ozone and $PM_{2.5}$ will be required for all areas by 2007/2008. Each SIP defines the inventory of emissions sources in the affected area, as well as forecasted emissions, used in attainment planning and demonstration. Some of these emissions data will be needed for modeling and/or impact evaluation for the alternatives considered in the PEIR. Further discussions will continue with the air districts on a routine basis and during future workshops to identify currently available emissions inventory and emissions forecasting information and to define when updated emissions information will become available.

DATA GAPS RELATED TO SOURCES AND EMISSIONS INVENTORIES

Each air agency in the project area is developing SIPs for 8-hour ozone, SDAPCD and MDAPCD are preparing SIPs for $PM_{2.5}$, and Imperial County APCD is preparing a PM_{10} SIP. Although emissions data from air district planning activities will be useful in establishing existing conditions, certain relevant emissions sources may not be included in these inventories. Emissions from these source categories must be estimated. DWR is concurrently preparing information under Task 3 to define data needs for evaluating emissions sources, and tools and methods for estimating emissions. The findings of this task, as of November 18, 2004, are summarized in Table 7. This information will be further detailed in the Task 3 Technical Memorandum.

Data Gaps Related to Dust and Other Emissions from Exposed Salton Sea Playa Areas

Most, if not all, potential ERP alternatives are expected to result in exposure of playa from beneath currently inundated areas of the Salton Sea. Numerous questions have been raised regarding dust and other emissions from these land surfaces and the likely impact of these emissions on air quality. Efforts are currently underway to refine tools to respond to these questions. Data gaps that are being addressed, or that remain to be addressed, include the following:

The nature of sediments underlying the Salton Sea, including the composition of sediments. Discussion is underway regarding pros and cons, practicability, methods, and effectiveness of sampling and analysis of sediments for potential toxic compounds, including inorganic compounds, such as metals, and volatile organic compounds, such as pesticides.

1. Land uses and specific management that will be applied to these exposed areas.
2. The effect of evaporite salts on the stability of crusts that will form at the sediment-atmosphere interface, and how this stability might respond to changes in weather and management.
3. The extent to which these land surfaces or surrounding formations will supply mobile sand onto exposed areas, and the extent to which this sand might play a role in emissions.
4. The nature, extent, and effectiveness of dust mitigation (playa stabilization) options that might be applied at the Salton Sea.
5. A draft of this information was presented at the November 18, 2004, Workshop under Task 4 of the current Task Order. Additional information will be presented in the Task 4 Technical Memorandum.

Table 7
Emissions Tools

Action Item/ Source	Actions	Tools for Estimating Emissions	Information Required for Each Tool	Tools for Estimating Ambient Concentrations
Refine Significance Criteria	Review and update significance criteria from Imperial Irrigation District DEIR/DEIS			
Responses to Comments IID DEIR/DEIS	Provided as information in regards to issues to address			
Mobile Sources-Exhaust		EMFAC2002, or most current version	Number of workers, trips per day, VMT, any changes to local traffic due to construction?	CALINE or CAL3QHC
Mobile Sources-Road Dust		AP-42, Chapter 13	Surface material silt content, mean vehicle weight, surface material moisture content, mean vehicle speed, miles of road traveled, paved or unpaved? VMT	ISCST3/AERMOD
Construction-Equipment		URBEMIS; EPA NONROAD Model	Construction phase schedule, number and type of equipment, hours/day of operation, fuel type	ISCST3/AERMOD
Construction-Fugitive Dust		URBEMIS;	Construction phase schedule, area affected, amount of earth moved, hours of construction, number of trucks and VMT, truck travel distance	ISCST3/AERMOD
Personal Water Craft		EPA NONROAD Model	Watercraft type, engine size, activity level (trips/year, hrs/day), fuel type	NA
Boats		EPA NONROAD Model	Marine vessel types, engine size, fuel type, activity level (hrs/dy, hrs/yr, gals/yr)	NA
Off Road Vehicles-Exhaust		URBEMIS; EPA NONROAD Model	Vehicle types, activity level (trips/year, hrs/day), fuel type	NA
Farming - Dust		ARB EI Documentation (2003)		ISCST3/AERMOD
Farming - Engines		URBEMIS; EPA NONROAD Model	Fuel type, activity level	ISCST3/AERMOD
Farming - Pesticides		AP-42, Chapter 9;	Active ingredient (AI), total quantity applied, method AI was applied, vapor pressure of AI, type of formulation (granules, powder, etc), percentage of inert ingredients, quantity or percent VOC in inerts	ISCST3/AERMOD

Table 7
Emissions Tools

Action Item/ Source	Actions	Tools for Estimating Emissions	Information Required for Each Tool	Tools for Estimating Ambient Concentrations
Wind Blown Fugitive Dust (Including fallow land, broken crust from access and exposed playa)	Review of Owens Lake, Mono Lake WRAP expert panel, and other dust evaluation methods. DWR contract with DRI to support investigations)	Draft framework for analyzing dust emissions impacts WEPS Model Wind tunnel tests and MacDougall Method for emissions inventory Playa crust dynamics model and calendar Historical comparisons with Owens Lake	Framework (includes WEPS, MacDougall Method, and crust dynamics model): Soil/sediment characteristics and maps, climatic data, basic Playa crust-climate relationships, land use unit descriptions and maps of land use associated with each alternative, and dust mitigation methods descriptions Historic comparison: Historic Salton Sea and Owens climatic data, historic Owens emissions data	CALPUFF SCREEN/ISCST3 AERMOD
Volatilization Of Compounds	Additional information required based on volatilization potential and input from Working Group.			
Odor	Quantify odor emission flux rates through direct sampling using an EPA flux chamber. Assess odor impacts at downwind receptor using dispersion modeling.	Odor sample collection using EPA Flux chambers. Sample analysis to be performed by an odor lab in accordance with methods ASTM 679-91 and CEN 13725.	Prediction of downwind odor concentrations using an EPA-approved air quality dispersion model (screening or refined).	SCREEN/ISCST3 AERMOD

Data Gaps Related to Odor Emissions

Data on odor emissions from the Salton Sea appear to be very limited. To fill this gap, odor emissions from shallow areas of the Salton Sea basin may be characterized by direct measurement. Direct measurement involves the use of a surface isolation emission flux chamber. Flux chamber measurements should be conducted in accordance with USEPA Guidance documents (USEPA 1989). The flux chamber may be used to sample gaseous emissions from land or liquid surfaces.

The flux chamber design parameters and odor panel testing result can be used to define the odor flux rate of the area source, whether it is a shallow pool or moist soil surface. This odor emission rate may then be entered into an air quality dispersion model to predict odor concentrations and frequencies of exceedance of odor threshold levels.

DATA COLLECTION PLAN

Task 2 also involves outlining a data collection plan. This plan is outlined below, where the requirements of the data collection plan are identified, followed by a status update:

- The data collection plan must identify the data that are available. These are summarized in Tables 3-6 of this memorandum.
- The plan must identify the data that are missing. These are also summarized in Tables 3-6. Table 3 lists inclusive dates when data have been collected and how to obtain these data.
- The plan must identify the data that are needed, and the reason why they are needed. This memorandum identifies the aerometric data that are needed. Concurrent memoranda for Tasks 3 and 4 will further discuss data needs and rationales.
- The plan must identify the time period over which the data are needed. This memorandum also identifies the aerometric data that are needed for the PEIR. Concurrent memoranda for Tasks 3 and 4 will further discuss data needs, and schedules for obtaining needed data.

DWR is compiling an ACCESS database to facilitate use of available data and preparation of work products under future tasks and PEIR development. As data are provided by USGS, they are also loaded into the database. The database currently resides on a CH2M HILL server, and will be available to users from a central location, as yet to be determined.

Tables 3 through 6 in this administrative technical memorandum were generated from the database. By using a relational database like ACCESS, data can be queried in many ways to suit the needs of the PEIR and future studies. Currently, only meteorological and ambient monitoring data are in the database. Emissions data will be added as they become available.

Not all of the data identified to date will be used for the PEIR. However, the unused data may prove useful for longer term planning and project alternatives. For this reason, data in the database will be related to the two types of data needs:

1. Near-term data needs specific to development of alternatives, criteria for screening of alternatives, and/or impact analysis for inclusion in the PEIR.
2. Longer-term data needs related to adaptive management planning and/or indications that changes in proposed or implemented approaches based on various alternatives and mitigation strategies.

Once this outline for the data collection plan is finalized, a data management plan will further detail specific procedures for accessing and uploading data to the database. Procedures will be developed to enter data into the database. These procedures will ensure that the data are imported electronically to eliminate data transposition errors. The input procedure will include a series of checks to confirm that data are entered correctly and completely.

DWR will continue to work collaboratively with EPA, ARB, local air quality districts, Tribes, USGS, and other stakeholders to routinely search for additional data. One example is the recent finding of a multiyear, 10-meter meteorological monitoring database collected by an industrial source near Westmoreland. Similarly, routine discussions will continue with USGS regarding their data mining project. These data mining efforts will continue during development of the preferred project alternatives. It is estimated that this effort will be completed in the spring of 2005. At this time, the database will become the principal resource for aerometric data to support the PEIR air quality analysis.

SALTON SEA ECOSYSTEM RESTORATION PLAN

Final Technical Memorandum
Appendix C: Salton Sea Task 3
Identify Potential Emissions Sources, Significance Criteria, and Analytical Tools and Methods to Support the Salton Sea Ecosystem Restoration Plan Programmatic Environmental Impact Report (PEIR)

February 2005

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SALTON SEA TASK 3 – IDENTIFY POTENTIAL EMISSIONS SOURCES, SIGNIFICANCE CRITERIA AND ANALYTICAL TOOLS & METHODS

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EXECUTIVE SUMMARY

The California Resources Agency is preparing a Salton Sea Ecosystem Restoration Plan and accompanying Programmatic Environmental Impact Report. The study area for the PEIR is the Salton Sea watershed. The purpose of this technical memorandum is to:

- identify and describe potential air emission sources;
- identify applicable air quality significance criteria for the draft PEIR impact analyses; and
- identify emissions factors, dispersion models, and other tools that can reasonably predict potential future impacts on air quality.

The recommended tools in this memorandum are focused on the development of the PEIR and are appropriate for the study area. Other estimates and tools are available, but they may not be appropriate for application in the study area, or they may require data that cannot be obtained in the time frame of the PEIR.

This memorandum identifies potential sources and pollutants that may result from the no-project or other alternatives to be evaluated in the PEIR, and lists emissions and dispersion models for evaluation of each of these potential sources. The potential sources, pollutants, and associated models are listed in Table ES-1.

Table ES-1
Potential Sources, Pollutants, and Models

Potential Sources	Pollutants of Concern	Emissions Estimation Tools	Dispersion Models
Area Sources	PM, NO_x, SO_x, CO, ROG and HAPs	URBEMIS	AERMOD, ISC3, or CALPUFF
Boats and Personal Water Craft	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model	AERMOD, ISC3, or CALPUFF
Construction – Equipment	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model and URBEMIS	AERMOD, ISC3, or CALPUFF

Table ES-1
Potential Sources, Pollutants, and Models

Potential Sources	Pollutants of Concern	Emissions Estimation Tools	Dispersion Models
Construction – Fugitive Dust	PM	URBEMIS	AERMOD, ISC3, or CALPUFF
Dying or Dead Biota, Volatilization of Compounds – Odors	ROG, HAPs and Odors	Direct Testing	AERMOD, ISC3, or CALPUFF
Farming – Dust	PM	ARB Emission Factors	AERMOD, ISC3, or CALPUFF
Farming – Engines	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model	AERMOD, ISC3, or CALPUFF
Farming – Pesticides	ROG and HAPs	AP-42, Chapter 9 and ARB Emission Factors	AERMOD, ISC3, or CALPUFF
Mobile Sources – Exhaust	PM, NO_x, SO_x, CO, ROG and HAPs	EMFAC2002	CAL3QHC
Mobile Sources – Tire Wear	PM	EMFAC2002	CAL3QHC
Mobile Sources – Road Dust	PM	AP-42, Chapter 13 and ARB Emission Factors	AERMOD, ISC3, or CALPUFF
Off-road Vehicles – Exhaust	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model	AERMOD, ISC3, or CALPUFF
Wind-blown Fugitive Dust	PM	MacDougall Method and WEPS	AERMOD, ISC3, or CALPUFF

The MacDougall Method and the Wind Erosion Prediction System (WEPS) model were selected to be used together to estimate wind-blown fugitive dust, because employment of these two models appears to be the soundest approach. The MacDougall Method is based upon wind tunnel testing, while WEPS is a computer model that simulates documented wind erosion processes. In this manner, limitations of each approach can be offset by corresponding strengths in the other method. The method used at the Owens Playa by the Great Basin Unified APCD is currently impractical for use on the Salton Sea Playa, because much of the potentially exposed area is currently under water. The Owens Playa method required years for implementation and data analysis, in addition to hundreds of pieces of monitoring equipment. Though impractical for the development of the PEIR, the Owens Playa approach may be useful for long-range monitoring beyond the PEIR time frame.

Significance criteria are based upon the general conformity requirements established by the federal Clean Air Act Amendments (CAAA) and significance criteria from each of the four local air quality agencies having jurisdiction in the study area: Imperial County Air Pollution Control District (ICAPCD), the San Diego Air Pollution Control District (SDAPCD), the South Coast Air Quality Management District (SCAQMD), and the Mojave Desert Air Quality Management District (MDAQMD). The MDAQMD has not established specific significance criteria, so the general conformity *de minimis* thresholds will be used for projects in this area. In addition to general conformity thresholds, the ICAPCD has established Best Available Control Technology (BACT) thresholds for NO_x, CO, PM_{10}, and Reactive Organic Compounds (ROC). The SCAQMD has established significance criteria for construction activities in addition to operational activities. The construction limits are in terms of pounds/day. The operational criteria include limits on changes in ambient air concentrations, in addition to pounds/day limits. Significance thresholds for toxic air contaminants or health effects are also defined by some air districts. For example, in SDAPCD and SCAQMD, emissions of toxic air contaminants would be significant if the emissions exceed acceptable levels or contribute significantly to the areas' excess lifetime cancer risk values, cancer burden, or health hazard indices.

BACKGROUND

The California Resources Agency is preparing a Salton Sea Ecosystem Restoration Plan and accompanying Programmatic Environmental Impact Report, on behalf of the Secretary of Resources, and in compliance with legislation enacted in 2003. The study area for the PEIR is the Salton Sea watershed. The United States (U.S.) portion of the Salton Sea watershed is located in several different counties under the jurisdiction of four local air quality agencies, including the Imperial County Air Pollution Control District (ICAPCD), the San Diego Air Pollution Control District (SDAPCD), the South Coast Air Quality Management District (SCAQMD), and the Mojave Desert Air Quality Management District (MDAQMD.

As part of the PEIR, air quality impacts will be evaluated for the no action alternative, a variety of action alternatives (not yet identified), and under cumulative conditions. To evaluate the various alternatives relative one to another, a uniform set of analysis tools will be developed. To evaluate the significance of potential impacts, significance criteria will be established and applied. The purpose of this technical memorandum is to:

- identify and describe potential air quality emission sources;
- identify applicable air quality significance criteria for the draft PEIR analyses of significant impacts; and
- identify emissions factors, dispersion models, and other tools that can reasonably predict potential future impacts on air quality.

The focus of this preliminary draft technical memorandum is to provide supporting air quality information relative to the PEIR. The list of potential sources, significance criteria, and tools are not intended to be exhaustive, but rather to provide a basis for completion of the PEIR. The recommended tools are appropriate for conditions in the areas surrounding the Salton Sea, specifically, the Coachella Valley and the Imperial Valley. These tools are also appropriate for the time frame of the PEIR. Other estimates and tools are available, but they may not be appropriate for application in the study area, or they may require data that cannot be obtained in the time frame of the PEIR.

This final technical memorandum includes responses to comments and input from the Salton Sea Air Quality Working Group (SSAQWG), the U.S. Environmental Protection Agency (EPA), and the Desert Research Institute (DRI). In some cases, several different methods or tools for a source were presented to provide a basis for discussion by the SSAQWG, EPA, and DRI. Based on reviewer input, a finalized list of sources, significance criteria, emission factors, dispersion models, and tools has been developed herein, for use in the preparation of the PEIR.

Potential Emission Sources and Pollutants

DWR has identified potential sources and pollutants that may result from the no project alternative or from various alternatives to be evaluated in the PEIR. While the various alternatives to be evaluated have not been identified, the list of sources of air emissions is meant to be as complete as possible, given the types of alternatives that are anticipated.

Pollutants may include particulate matter (PM), both PM_{10} (particles with an aerodynamic diameter of 10 microns or smaller) and $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 microns or smaller); oxides of nitrogen (NO_x); oxides of sulfur (SO_x); carbon monoxide (CO); reactive organic compounds (ROG); and toxic or hazardous air pollutants (HAPs)[1]. Odors may also occur.

[1] In this document the terms reactive organic gases (ROG), reactive organic compounds (ROC), and volatile organic compounds (VOCs) are considered equivalent. Also, the terms toxic air contaminant (TAC) and hazardous air pollutant (HAP) are considered equivalent, without reference to differences in the regulatory meanings of these terms. California uses the term TAC, and has

Presented below are a list of the potential sources, a brief description of each source, and the associated pollutant(s).

- **Area Sources –** Potential alternatives, such as a planned city or large casino, may induce additional population growth within the area. Additional population will result in new area sources. Area sources collectively represent individual sources that are small and numerous. These sources are grouped in such a way that they can be estimated collectively using a consistent methodology. For example, gasoline stations, fuel combustion for heating, and dry cleaning establishments are often treated as area sources. Area sources emit PM, NO_x, SO_x, CO, ROG and HAPs.

- **Boats and Personal Water Craft –** Changes in use of the Salton Sea for recreational purposes may be an indirect impact of project alternatives. Boat and water craft engines burn fossil fuels and emit PM, NO_x, SO_x, CO, ROG and HAPs as exhaust. Boat and water craft also require fuel storage and handling, and emit ROG and HAPs as a result of these processes.

- **Construction – Equipment –** Some alternatives may include the construction of dams, wetlands, water conveyance systems, or other facilities. Construction equipment burns diesel fuel, gasoline, or fuel/oil combinations. Particulate emissions from diesel-fueled engines have been classified as toxic air contaminants by the State of California, with potential for both chronic and carcinogenic health effects in exposed individuals. Potential construction equipment pollutant emissions include PM, NO_x, SO_x, CO, ROG, and HAPs.

- **Construction – Fugitive Dust –** In addition to equipment exhaust emissions, construction activities usually include earthmoving activities and vehicle/equipment travel and movement that create fugitive dust. Fugitive dust includes PM.

- **Dying or Dead Biota –** Alternatives (including the no-project alternative) may result in altered water levels, wetted area, and/or water composition in the Salton Sea. These changes would alter habitat for biota, some of which may perish. The dying or dead biota may cause odors.

- **Farming – Dust –** Some alternatives may change farming activities in the study area, either increasing or decreasing these activities. Farming includes many activities which may produce fugitive dust or PM (notably tillage and harvest operations). In addition to direct changes in farming activity, development of managed vegetation as a dust control measure will involve farm equipment and operations.

- **Farming – Engines –** As with construction equipment, farm engines burn mostly diesel fuel, gasoline, or fuel/oil combinations. Associated emissions include PM, NO_x, SO_x, CO, ROG and HAPs.

- **Farming – Pesticides, Herbicides, and Fertilizers –** Farmers often use pesticides, herbicides, antibiotics, hormonal compounds, and fertilizers when growing commercial crops and raising animals. These substances sometimes include toxic or hazardous compounds. Impacts from changes in chemical use that may be associated with a proposed alternative will be estimated for releases of ROG or HAP emissions.

- **Mobile Sources – Exhaust/Tire Wear –** Many alternatives may include changes in traffic patterns or vehicle miles traveled. Tire wear and vehicle exhaust are estimated based on vehicle miles traveled. Associated emissions include PM, NO_x, SO_x, CO, ROG, and HAPs.

- **Mobile Sources – Road Dust –** On- and off-road vehicles and equipment traveling over paved and unpaved roads and undeveloped areas result in dust releases to the air. Changes in vehicle and vehicle miles traveled in the study area will lead to different amounts of PM emissions and dust in the air.

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identified over 700 substances as TACs. EPA uses the term HAPs, and has identified 189 substances as HAPs. For the most part, the TAC/HAP substances discussed in this document meet the definitions of both California and federal air quality law and regulations. However, diesel exhaust PM is recognized as a carcinogen only by California; the EPA is still studying this issue.

- **Off-road Vehicles – Exhaust –** Changes in use of the Salton Sea area for recreational purposes may be an indirect impact of project alternatives. Off-road vehicles may be diesel- or gasoline-powered, or may use two-stroke engines. Emission controls are not as commonly required for off-road vehicles as they are for on road vehicles. Exhaust emissions include PM, NO_x, SO_x, CO, ROG, and HAPs.

- **Salton Sea – Volatilization of Compounds –** Alternatives (including the no-project alternative) may result in altered water levels, wetted area, and/or water composition in the Salton Sea. Irrigation return-flow hydrography and composition may also change. As waters evaporate or undergo chemical or physical changes, substances that are currently in the water may volatilize or otherwise be emitted. These substances may include pesticides or other potentially hazardous substances. Odors may be associated with volatilization, and with chemical or physical changes in return flow and Salton Sea waters. Impacts of concern may include emissions of ROG, HAPs, and odors.

- **Wind-blown Fugitive Dust –** Alternatives (including the no-project alternative) may result in altered water levels or wetted area of the Salton Sea. For example, the lowering of the level of the water in the Salton Sea would expose seabed, which may result in increased fugitive dust emissions under high winds. The use of off-road vehicles may destroy stable surfaces, making exposed areas more susceptible to wind erosion. Changes in farming practices may lead to additional fallow land, which may alter emissions rates relative to cultivation. Soils disturbed by project related construction could be more susceptible to wind erosion. All of these changes in wind erosion patterns may have PM impacts.

Summarized in Table 1 are the pollutants with associated potential sources.

Table 1
Pollutants of Concern and Potential Sources

Pollutant	Potential Sources
PM	Area Sources Boats and Personal Water Craft Construction – Equipment Construction – Fugitive Dust Farming – Dust Farming – Engines Mobile Sources – Exhaust/Tire Wear Mobile Sources – Road Dust Off-road Vehicles Wind-blown Fugitive Dust
NO_x	Area Sources Boats and Personal Water Craft Construction – Equipment Farming – Engines Mobile Sources – Exhaust/Tire Wear Off-road Vehicles
SO_x	Area Sources Boats and Personal Water Craft Construction – Equipment Farming – Engines Mobile Sources – Exhaust/Tire Wear Off-road Vehicles

Table 1
Pollutants of Concern and Potential Sources

Pollutant	Potential Sources
CO	Area Sources Boats and Personal Water Craft Construction – Equipment Farming – Engines Mobile Sources – Exhaust/Tire Wear Off-road Vehicles
ROG	Area Sources Boats and Personal Water Craft Construction – Equipment Farming – Engines Farming – Pesticides and Other Chemicals Mobile Sources – Exhaust/Tire Wear Off-road Vehicles Salton Sea – Volatilization of Compounds
HAPs	Area Sources Boats and Personal Water Craft Construction – Equipment Farming – Engines Farming – Pesticides and Other Chemicals Mobile Sources – Exhaust/Tire Wear Off-road Vehicles Salton Sea – Volatilization of Compounds
Odors	Salton Sea – Volatilization of Compounds Dying or Dead Biota

Significance Criteria

Significance criteria must be established to determine whether potential air quality impacts identified in the draft PEIR are significant and should be mitigated. The significance of an air quality impact is dependent in part on where the impact occurs. For example, in areas that are not currently meeting the National Ambient Air Quality Standards (NAAQS), relatively small impacts might still be considered significant (Table 2). As mentioned previously, the ICAPCD, the SCAQMD, the SDAPCD, and the MDAQMD have jurisdiction over portions of the U. S. portion of the Salton Sea watershed. Current attainment status in the study area is summarized below:

- NAAQS – Riverside and San Bernardino Counties are non-attainment for 1-hour and 8-hour ozone and PM_{10} federal standards;
- NAAQS -Imperial County is non-attainment for 1-hour and 8-hour ozone, and PM_{10} federal standards.
- NAAQS – San Diego County attains PM_{10}, but does not attain federal standards for 8-hour ozone and $PM_{2.5}$;

- CAAQS – Imperial, Riverside, San Bernardino, and San Diego Counties are non-attainment for 1-hour ozone, PM_{10}, and $PM_{2.5}$ state standards; and
- CAAQS – Calexico is non-attainment for CO state standards.

Table 2
Portions of the Salton Sea Watershed With Air Concentrations that Exceed National and California Ambient Air Quality Standards

County (or Portion of)	Carbon Monoxide	Fine Particulate Matter (PM_{10})	Fine Particulate Matter ($PM_{2.5}$)	Ozone
Imperial	C	N and C		N and C
Riverside/Coachella Valley		N and C		N and C
San Bernardino		N and C	N and C	N and C
San Diego		C	N and C	N (8-hr only) and C

N = Ambient air concentrations exceed the National Ambient Air Quality Standards
C = Ambient air concentrations exceed the California Ambient Air Quality Standards
Source: California Air Resources Board, Area Designations, www.arb.ca.gov

Prior studies, applicable regulations and standards, and CEQA and air quality regulatory guidance documents were reviewed to identify potential significance criteria for use in the draft PEIR. In general, alternatives would have a significant impact on air quality if total direct and indirect emissions from the alternative would:

- Violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- Conflict with or obstruct implementation of an applicable air quality plan;
- Expose sensitive receptors to substantial pollutant concentrations;
- Create objectionable odors affecting a substantial number of people; or
- Result in a cumulatively considerable net increase in any criteria pollutant for which the alternative's region of influence is nonattainment under an applicable federal or state ambient air standard.

Under the conformity provisions of the federal CAAA, no federal agency can approve or undertake a federal action, or "project", unless the project has been demonstrated to conform to the applicable State Implementation Plan (SIP). These conformity provisions were put in place to ensure that federal agencies would contribute to efforts to attain the NAAQS. The EPA has issued two conformity guidelines: transportation conformity rules that apply to transportation plans and projects; and general conformity rules that apply to all other federal actions. A conformity determination[2] is only required for the alternative that is ultimately selected and approved. The general conformity determination is submitted in the form of a written finding, issued after a minimum 30-day public comment period on the draft determination.

Applicable only in areas designed as nonattainment or maintenance for NAAQS, the general conformity rule prohibits any federal action that does not conform to the applicable air quality attainment plan or SIP. General conformity applicability analysis requires quantification of direct and indirect, construction and operation emissions for the project, and comparison of these emission levels to baseline emission levels. If the differences in emissions, i.e., the net emissions associated with the proposed project, exceed the general conformity *de minimis* levels for the peak year or any milestone year for attainment of standards, additional general conformity determination is required.

[2] A conformity determination is a process that demonstrates how an action would conform to the applicable implementation plan. If the emissions cannot be reduced sufficiently, and if air dispersion modeling cannot demonstrate conformity, then either a plan for mitigating or a plan for offsetting the emissions would need to be pursued.

A project is exempt from the conformity rule (presumed to conform) if the total net project related emissions (construction and operation) pass two tests: they are less than the *de minimis* thresholds established by the conformity rule, and they are not regionally significant (emissions are regionally significant if they exceed 10 percent of the total regional emission inventory). A project that produces emissions that exceed conformity thresholds, or that is regionally significant, is required to demonstrate conformity with the SIP through mitigation or other accepted practices, such as dispersion modeling, comparison to SIP requirements, and possibly emission offsetting or revisions to the SIP to accommodate emissions.

The general conformity rule process is intended to demonstrate that the alternative:

- Will not cause or contribute to new violations of federal air quality standards;
- Will not increase the frequency or severity of existing violations of federal air quality standards; or
- Will not delay the timely attainment of federal air quality standards.

General conformity does not apply to areas or pollutants that are nonattainment only for the California ambient standards. The EPA has not yet set general conformity thresholds for the new $PM_{2.5}$ standard, but anticipates setting this threshold within a year.

Significance thresholds for toxic air contaminants or health effects are also defined by some air districts. Emissions of toxic air contaminants would be significant if the emissions exceed acceptable levels or contribute significantly to the areas' excess lifetime cancer risk values, cancer burden, or health hazard indices.

Proposed significance criteria for each area to be used in the draft PEIR are presented below. The proposed significance criteria follow the general guidelines presented above.

SCAQMD

The SCAQMD has established construction related thresholds of significance for the portion of Riverside County that is in the SCAQMD. This portion includes part of the Salton Sea watershed, including Coachella Valley. Construction related emissions in excess of any of the criteria listed in Table 3 are considered significant in this area.

Table 3
Construction Emissions Thresholds of Significance for the Portion of the Salton Sea Watershed within the South Coast AQMD (Riverside County)

Pollutant	Daily Threshold (lbs)
ROC	75
NO_x	100
CO	550
PM_{10}	150
SO_x	150

In addition to the thresholds listed above, the SCAQMD requires that some of the significance criteria established for stationary sources be used to evaluate the potential impacts of construction sites. The significance criteria for the impacts of air toxics released at construction sites are listed in Table 4 below. The significance thresholds for allowable changes in ambient air quality concentrations at construction sites are the same as those listed in the last column of Table 5, except for PM_{10}, where the second number listed is the allowable change in 24-hour PM_{10} concentration for construction sites, i.e., 10.4 μg/m3.

The SCAQMD has also established operational significance criteria for alternatives located in the Riverside County portion of the Salton Sea watershed. There are three types of operational significance criteria; the first two are criteria related to NSR and criteria related to CEQA. Projects with peak operation related emissions or impacts that exceed any of the criteria listed in the NSR and CEQA columns in Table 4 would be considered significant. The third criterion of interest is related to general conformity. Projects with net emissions increases (operations and construction) greater than the de minimis thresholds listed in the General Conformity column in Table 4 would be considered significant and would require a General Conformity demonstration.

Table 4
Operational Significance Criteria for the Riverside County Portion of the Salton Sea Watershed

Pollutant	SCAQMD NSR[a] (Rules 1303 and 1401)	CEQA[b] (lb/day)	General Conformity[c] (tons/yr)
ROC	NA	55	25
NO_x	40 tons/yr	55	25
CO	NA	550	NA
PM_{10}	15 tons/yr	150	70
SO_x	NA	150	NA
Cancer Risk with TBACT without TBACT	 10-5 or 10 in 1 million 10-6 or 1 in 1 million	NA	NA
Cancer Burden	0.5	NA	NA
Acute HHI	1.0	NA	NA
Chronic HHI	1.0	NA	NA

HHI Health Hazard Index
NA Not Applicable
NSR New Source Review (applicable to stationary sources only)
ROC Reactive Organic Compound
TBACT Toxics Best Available Control Technology
[a] SCAQMD Rule 1303, Section (b)5(C)(I); Rule 1401, Section (d)
[b] SCAQMD, CEQA Air Quality Handbook, November 1993
[c] SCAQMD Rule 1901; 40 CFR 51, General Conformity

In addition to the criteria presented in Table 4, the listed allowable changes in pollutant concentrations listed in Table 5 also constitute significance criteria for projects in the Salton Sea watershed.

Table 5
Most Stringent Ambient Air Quality Standard and Allowable Change in Concentration*

Air Contaminant	Averaging Time	Most Stringent Air Quality Standard	Significant Change in Air Quality Concentration
NO_2	1-hour Annual	25 pphm (500 $\mu g/m^3$) 5.3 pphm (100 $\mu g/m^3$)	1 pphm (20 $\mu g/m^3$) 0.05 pphm (1 $\mu g/m^3$)
CO	1-hour 8-hour	20 ppm (23 mg/m^3) 9.0 ppm (10 mg/m^3)	1 ppm (1.1 mg/m^3) 0.45 ppm (0.50 mg/m^3)
PM_{10}	24-hour Annual GM	50 $\mu g/m^3$ 30 $\mu g/m^3$	2.5 $\mu g/m^3$ (10.4 $\mu g/m^3$ for construction sites) 1 $\mu g/m^3$
Sulfate	24-hour	25 $\mu g/m^3$	1 $\mu g/m^3$

Table 5
Most Stringent Ambient Air Quality Standard and Allowable Change in Concentration*

Air Contaminant	Averaging Time	Most Stringent Air Quality Standard	Significant Change in Air Quality Concentration

* SCAQMD Rule 1303

ICAPCD

The study area is located in a federally designated nonattainment area for PM_{10} and ozone. Therefore, the general conformity rule is applicable in the study area for project-related emissions of PM_{10}, and for emissions of ROC (or ROG) and NO_x as precursors to ozone. Table 6 presents *de minimis* thresholds for the Imperial Valley contained in ICAPCD Rule 925, General Conformity. Exceedance of *de minimis* thresholds would require that a general conformity demonstration be performed.

In addition, the ICAPCD follows the requirements set forth by its planning division, which tend to follow the State's CEQA guidelines. For Imperial County, air quality impacts from proposed projects are evaluated on a case-by-case basis. Therefore, there are two types of operational significance criteria in the Imperial Valley: criteria related to New Source Review (NSR), and criteria related to general conformity. The NSR criteria only apply to stationary sources, whereas general conformity criteria apply to both operation and construction emissions for mobile and stationary sources. Both types of significance criteria are listed in Table 6. ICAPCD has not established significance criteria for toxic air contaminant emissions or associated health effects.

Table 6
Significance Criteria for the ICAPCD

Pollutant	BACT Thresholds[a] (lbs/day) (ICAPCD Rule 207)	General Conformity[b] (tons/yr)
ROC	25	100 (VOC)
NO_x	25	100
CO	550	NA
PM_{10}	25	70
SO_x	NA	NA

NA not applicable because Imperial County is in attainment of the NAAQS standard for CO
ROC reactive organic compound
[a] ICAPCD Rule 207, New and Modified Stationary Source Review
[b] ICAPCD Rule 925, General Conformity

MDAQMD

The MDAQMD is designated as a federal moderate nonattainment area for PM_{10} and the 8-hour ozone standard, and is a severe nonattainment area for the 1-hour ozone standard. Portions of the MDAQMD are nonattainment for the $PM_{2.5}$ NAAQS. The general conformity *de minimis* threshold for moderate PM_{10} and ozone nonattainment areas is 100 tons per year, but the *de minimis* threshold for severe ozone nonattainment areas is 25 tons per year for the ozone precursors, NO_x and VOC. Projects in the MDQAMD with net emissions increases of PM_{10}, NO_x, or VOC in excess of these *de minimis* thresholds would be considered significant. MDAQMD has not established significance criteria other than general conformity *de minimis* thresholds. As indicated previously, EPA has not yet established general conformity *de minimis* thresholds for $PM_{2.5}$.

SDAPCD

The SDAPCD does not have general conformity de minimis thresholds established for $PM_{2.5}$, but it might be expected that these thresholds will be similar to those identified in SDAPCD Rule 1501 for PM_{10}. Assuming the general conformity thresholds for the 8-hour ozone standard are the same as those for the 1-hour standard, the general conformity threshold is 100 tons/year for NO_x and VOCs. SDAPCD has not established other CEQA guidelines.

Projects in the SDAPCD with net emissions increases that exceed any of the criteria listed in Table 7 would be considered significant, because they would either exceed the General Conformity de minimis thresholds (SDAPCD Rule 1501) or they would trigger New Source Review requirements (SDAPCD Rule 20.3) or the NSR requirements for toxic air contaminants (TACs) (SDAPCD Rule 1200).

NSR criteria apply to stationary sources only and consist of thresholds for triggering best available control technology (BACT) analysis, an Air Quality Impact Analysis (AQIA), and a TACs analysis. The AQIA thresholds are less stringent than the BACT thresholds, so they are not listed as significance criteria in Table 7.

Table 7
Significance Criteria for the SDAPCD

Pollutant	Stationary Sources		
	BACT[a] (lb/day)	Toxics NSR[b] (SDAPCD Rule 1200)	General Conformity[c] (tons/yr)
ROC	10	NA	100 (VOC)
NO_x	10	NA	100
CO	NA	NA	100
PM_{10}	10	NA	NA
SO_x	10	NA	NA
Cancer Risk with TBACT without TBACT	NA	 10^{-5} or 10 in 1 million 10^{-6} or 1 in 1 million	NA
Cancer Burden	NA	1.0	NA
Acute HHI	NA	1.0	NA
Chronic HHI	NA	1.0	NA

[a] Source: SDAPCD Rule 20.3, New Source Review – Major Stationary Sources and PSD Stationary Sources
[b] Source: SDAPCD Rule 1200, Toxic Air Contaminants – New Source Review
[c] Source: SDAPCD Rule 1501, Conformity of General Federal Actions
AQIA = Air Quality Impact Analysis
HHI = Health Hazard Index
NA = not applicable
NSR = New Source Review
ROC = reactive organic compounds
TBACT = Toxics Best Available Control Technology

ANALYTICAL TOOLS AND METHODS

Introduction

Based upon the proposed significance criteria and the identified potential sources, two types of information may be needed to complete the air quality impact analysis for the PEIR: first, estimates of total project-related pollutant releases in units of mass; and second, estimated impacts of these emissions on concentrations of the pollutants in ambient air or on human exposure levels.

For many of the source categories, there are emission factors and dispersion models that have been approved by the EPA and the California Air Resources Board (ARB). These factors are periodically updated and the most recent factors will be used in the PEIR.

When the total emissions from a source have been determined, a dispersion model can be used to estimate impacts of these emissions on the ambient concentrations and human exposure levels of most of the pollutants of concern. The notable exception is ozone, which requires much more complex regional atmospheric modeling than is possible within the scope of this project. The Industrial Source Complex, Version 3 (ISC3), the AMS/EPA Regulatory Model (AERMOD), or the CALPUFF dispersion models can be used for many of the source categories and pollutants. Whatever model is used, all sources will be evaluated using the same model so relative contributions from each alternative can be directly compared.

The ISC3 model has been approved by the EPA, and the approval of AERMOD is pending. CALPUFF is EPA's approved model for long-range transport (i.e., greater than 50 kilometers) impacts and near-field impacts in complex flow or dispersion situations. These models are commonly used to model downwind concentrations of compounds emitted over a large area. Meteorological data collected at 10 meters above the ground are preferred by the EPA for use with these models.

The required input data for emissions estimation tools and dispersion models are often readily available. In most cases, the identified tool will estimate emissions or concentrations for all criteria pollutants emitted. The emissions for HAPs (air toxics) may be estimated using EPA's SPECIATE model, or from speciation data or emissions factors from other ARB- or EPA-approved sources. Data gaps related to emissions factors or impact estimation tools have been identified in a separate technical memorandum. For some of the sources, emission factors and dispersion models are less developed or may require a great deal of input data. The following text provides recommendations regarding emission factors and models for each source category.

Area Sources

Emission factors for many area sources have been established by ARB. An emissions model, called URBEMIS, has been developed and updated for use in California. The URBEMIS model has been approved by SCAQMD to be used to estimate area source emissions. Once the total mass of emissions have been estimated, the resulting ambient air concentrations for most of the pollutants of concern can be estimated with the appropriate dispersion model. The specific area sources to be evaluated will be determined when the potential alternatives are identified.

Boats and Personal Water Craft

Emission factors for fuel combustion in recreational boats and personal water craft have been established by ARB in the California Offroad model. The input information necessary to complete the emission estimates include the number of boats and personal water craft, engine sizes, activity levels, and fuel use. When the total mass of emissions have been estimated, the resulting ambient air concentrations for some of the pollutants of concern can be estimated using the appropriate dispersion model. Emissions of ozone precursors can be estimated, but ozone modeling will not be attempted, as it requires much more complex regional atmospheric modeling than is possible within the scope of this project.

Construction – Equipment

Emission factors for construction equipment have been developed for several types of equipment. The ARB state-wide inventory uses the Offroad model, rather than the URBEMIS model. The emission factors used by ARB will be compared with the factors in the URBEMIS model to ensure the same factors are being used. Data or engineering estimates on the construction phases, schedule, number of pieces of equipment, types of equipment, hours per day of operation, and fuels burned will be needed to use the URBEMIS model. When the total mass of emissions have been estimated, the resulting ambient air concentrations for some of the pollutants of concern, e.g., PM_{10}, can be estimated using the appropriate dispersion model.

Construction – Fugitive Dust

ARB uses different emission factors depending on the type of construction being analyzed. These factors have been approved by the EPA. Emission factors for fugitive dust have also been incorporated into the URBEMIS model. The factors in the URBEMIS model will be compared with the ARB emission factors before the URBEMIS model is used to estimate emissions. Several types of data will need to be known or estimated, including the construction phase, schedule, the area affected, the amount of earth to be moved, hours of construction, number of pieces of equipment, vehicle miles traveled, and travel distances. When the total mass of emissions have been estimated, the resulting ambient air concentrations of particulate matter can be estimated with the appropriate dispersion model.

Farming – Dust

Fugitive dust emission factors from a limited number of farming activities, such as tillage, have been developed by ARB. The number of acres being cultivated, as well as the type of plants per acre, will be estimated. Other types of farming activities may require other approaches for fugitive dust emission estimation, as emissions factors do not yet exist. Once total farming dust emissions have been estimated, the impact on ambient air concentrations of particulate matter can be estimated with EPA-approved dispersion models.

Farming – Engines

The type of fuel burned and the activity levels for the various pieces of farming equipment are needed to develop emission estimates using ARB off-road emission factors. When the total mass of emissions have been estimated, the resulting ambient air concentrations for some of the pollutants of concern, e.g., PM_{10}, can be estimated using the appropriate dispersion model.

Farming – Pesticides, Herbicides, and Fertilizers

The ROG emissions from pesticide use can be estimated using emission factors from AP-42, Chapter 9. The necessary input data include the total quantity applied, the method of application, and the make up of the pesticide. This information can be estimated with the ARB pesticide use report available on the ARB web page, or with data from other agencies such as county agricultural commissioners or the California Department of Pesticide Regulation. Other types of pollutants that might be emitted will require other approaches for estimation. Once emissions are quantified, the resultant ambient air concentrations for pollutants of concern (other than ozone) may be estimated with a dispersion model.

Mobile Sources – Exhaust/Tire Wear

A well developed model for estimation of emissions from vehicle exhaust has been developed for use in California (EMFAC2002). The emission estimates are based upon the emission control requirements in the state of California. Vehicle-mix data have already been incorporated into the model. Input data include average vehicle speeds and total amount of vehicle miles traveled. The corresponding dispersion model, CAL3QHC, allows estimation of resultant ambient air concentrations. Emissions of PM_{10} associated with tire wear can also be estimated using EMFAC2002.

Mobile Sources – Road Dust

Particulate emissions from paved roads can be estimated with the algorithm developed by EPA and published in AP-42, Chapter 13. State-wide silt-loading measurements needed for input into the algorithm are available on the ARB web page. Mean vehicle weights and vehicle miles traveled (VMT) data are also necessary. For unpaved road particulate emission estimates, ARB has developed factors based upon studies conducted in the San Joaquin Valley. Different factors have been developed for unpaved roads associated with farming operations, in comparison with general-use, unpaved roads. Vehicle miles traveled data are needed for general-use roads, while farming emissions are based upon the number of acres cultivated. When the total mass of emissions from unpaved road dust has been estimated, the resulting ambient-air concentrations for particulate matter can be estimated with an appropriate dispersion model.

Odor

As organic matter trapped in shallow pools decays, the potential for adverse odors exists. Odor levels that have the potential to cause a nuisance would be prohibited. An objective significance criterion for odor impacts has not been established. Because this has the potential for generating complaints from the general public, mitigation strategies should be developed.

There are five independent factors that are required for a complete odor assessment.

1. Intensity or pervasiveness – a measure of the perceived strength of the odor compared to concentrations of a standard compound.
2. The character that relates to the mental association made by the subject in sensing the odor.
3. The degree of pleasantness or unpleasantness of an odor sensed by the subject.
4. The detectability or the quantity of the odiferous compound. This can also be related to the number of dilutions required to reduce an odor to its minimum detectable threshold odor concentration.
5. The total mass per unit time or the volume of odorous air produced.

Odor emissions may be estimated from existing lagoons or storage basins in other areas or measured directly from shallow pools that are known to exist along edges of the Salton Sea Basin. Because the character of the odors from existing lagoons and storage basins in other areas may be significantly different from those likely to be observed along the Salton Sea Basin, the direct measurement approach is recommended.

Odor emissions from shallow areas or other areas of interest may be characterized by direct measurement of the emission flux rate and mass of compounds. This method is designed to characterize emissions from large open surfaces and has been widely used to collect odors from liquid surfaces. Direct samples could be analyzed by an odor laboratory with the capability to perform dynamic force choice olfactometry in accordance with methods ASTM 679-91, Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits, and CEN 13725, Air Quality – Determination of Odour Concentration by Dynamic Olfactometry. The odor emission rate may then be entered into an air quality dispersion model to determine ambient odor concentrations and whether the minimum detectable threshold odor concentration will be exceeded.

Off-Road Vehicles – Exhaust

Emission factors for off-road vehicle exhaust have been established by ARB in the California Offroad model. The input information necessary to complete the emission estimates are number of vehicles, types of vehicles, engine sizes, activity levels, and the rate of fuel consumption. When the total mass of emissions have been estimated, the resulting ambient air concentrations for some of the pollutants of concern, e.g., PM_{10}, can be estimated using the appropriate dispersion model.

Salton Sea – Volatilization of Compounds

The partial pressure law and the ideal gas law will be used, in addition to water composition data and flux measurements used to determine odors, to determine the volatilization of compounds from shallow or relocated Salton Sea waters. An air dispersion model can be used to predict downwind ambient air concentrations, if appropriate.

Wind-Blown Fugitive Dust

A state-wide estimate of wind-blown fugitive dust emissions was completed by ARB using a modified form of the wind erosion equation (WEQ) developed by the United States Department of Agriculture (USDA). Emission estimates using the ARB method for Imperial County did not appear realistic. Patrick Gaffney from ARB provided ARB's recommendation for a fugitive dust estimation methodology. Mr. Gaffney did not recommend the method that was used for the state-wide inventory, but rather suggested the MacDougall Method or another newer method should be used. The MacDougall Method predicts hourly emissions of wind blown fugitive dust based upon average hourly wind speeds, maximum wind gusts, land use, and land coverage.

An application of the MacDougall Method is being used by the Western Regional Air Partnership to predict wind-blown fugitive dust emissions for the western states for the regional haze plans. This model was also used by the ICAPCD to estimate emissions. In a final report prepared by Environ for ICAPCD, the MacDougall Method was applied based upon DWR land use and land cover (LULC).

In the mean time, another model, the Wind Erosion Prediction System (WEPS) model, has been developed and is available in a BETA version. The WEPS is intended to replace the WEQ. The WEPS model predicts long-term, average soil loss, but this loss is calculated on a daily basis. The user can specify the number of days for model emissions prediction output.

Both emission models (the MacDougall Method and WEPS) will predict total particulate matter emissions. Based on their output, ambient concentrations then can be calculated with air dispersion models. The WEPS model has been calibrated for the study area as part of the evaluation of the model's performance. It is recommended that the results of the WEPS model be compared to the Imperial County emissions inventory. Based upon the relative results and the amount of input data needed for the two models, a dual-model approach can be developed for the PEIR.

A comparison of the two models was presented at the SSAQWG meeting on November 18, 2004. The input data required for each model is different, with the WEPS model requiring more input data. For either model to be viable, required data must be obtained within the PEIR time frame.

AMBIENT CHEMISTRY MODELING

Emissions of ozone precursors can be estimated, but ozone modeling will not be attempted, as it requires much more complex regional atmospheric modeling than is possible within the scope of this project. Other than compliance with ambient ozone standards, none of the significance criteria established by the agencies with jurisdiction in the study area require ambient chemistry modeling, with the exception of PM_{10}. Particulates can be formed from the emissions of gases in the presence of humidity. Relative humidity in the area is relatively low. Secondary particulate formation was not a significant source of particulate in any of the previous studies completed in the area. In addition, large quantities of these particulate precursors would have to be emitted to have a significant impact. Therefore, unless a potential alternative includes a very large source of particulate matter precursors, it will be assumed secondary particulate formation will not be modeled in the PEIR.

SUMMARY OF ANALYTICAL TOOLS AND METHODS

Many of the potential sources identified for the PEIR use the same emission estimation or dispersion models. Summarized in Table 8 are the emissions estimation tools and dispersion modelsthat may be used to evaluate source emissions and potential impacts.

Table 8
Summary of Emissions Estimation Tools and Dispersion Models

Potential Sources	Pollutants of Concern	Emissions Estimation Tools	Dispersion Models
Area Sources	PM, NO_x, SO_x, CO, ROG and HAPs	URBEMIS, SPECIATE[l]	AERMOD[a] or ISC[f] or CALPUFF[l,mf]
Boats and Personal Water Craft	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model	AERMOD or ISC3 or CALPUFF
Construction - Equipment	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model and URBEMIS	AERMOD or ISC3 of CALPUFF
Construction – Fugitive Dust	PM	URBEMIS[j]	AERMOD or ISC3 or CALPUFF
Dying or Dead Biota, Volatilization of Compounds - Odors	ROG, HAPs and Odors	Direct Testing	AERMOD or ISC3 or CALPUFF
Farming - Dust	PM	ARB Emission Factors[c]	AERMOD or ISC3 or CALPUFF
Farming - Engines	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model	AERMOD or ISC3 or CALPUFF
Farming - Pesticides	ROG and HAPs	AP-42, Chapter 9[b] and ARB Emission Factors[c]	AERMOD or ISC3 or CALPUFF
Mobile Sources – Exhaust	PM, NO_x, SO_x, CO, ROG and HAPs	EMFAC2002[e]	CAL3QHC[d]
Mobile Sources – Tire Wear	PM	EMFAC2002[e]	CAL3QHC[d]
Mobile Sources – Road Dust	PM	AP-42, Chapter 13[b] and ARB Emission Factors[c]	AERMOD or ISC3 or CALPUFF
Off-road Vehicles - Exhaust	PM, NO_x, SO_x, CO, ROG and HAPs	Offroad Model[h]	AERMOD or ISC3 or CALPUFF
Wind-blown Fugitive Dust	PM	MacDougall Method[g] and WEPS[k]	AERMOD or ISC3 or CALPUFF

[a] EPA, 1998. "Users Guide for The AMS/EPA Regulatory Model - AERMOD". Office of Air Quality Planning and Standards. Research Triangle Park, NC. November, 1998.
[b] EPA. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources.
[c] 2003 Emission Inventory Methodology Documentation. http://www.arb.ca.gov/ei/documentation.htm
[d] EPA, 1992. User's Guide for CAL3QHC Version 2: A Modeling Methodology for Predicting Pollutant Concentrations near Roadway Intersections. Version 04244.
[e] California Air Resources Board (ARB) On-road vehicle emission model. Version 2.2. August, 2002
[f] EPA, 1995, User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volumes 1 and 2. Version 02035.
[g] Western Regional Air Partnership. http://www.wrapair.org/forums/dejf/fderosion.html
[h] California Air Resources Board (ARB) OFFROAD Emissions Inventory Model. http://www.arb.ca.gov/msei/off-road/off-road.htm
[I] EPA SPECIATE. http://www.epa.gov/ttnchie1/software/speciate/index.html
[j] California Air Resources Board (ARB) Urban Emissions Model. URBEMIS 2002, Version 7.5.0
[k] Hagen, L. J. et al, "Wind Erosion Prediction System (WEPS), BETA Release 95-08, Printed 2 October 1996.
[l] Earth Tech, Inc. A Users Guide for the CALMET Meteorological Model (Version 5.0). Concord, Massachusetts. 2000.
[k] Earth Tech, Inc. A Users Guide for the CALPUFF Dispersion Model (Version 5.0). Concord, Massachusetts. 2000.

AIR QUALITY WORKSHOP FEEDBACK

The SSAQWG is comprised of representatives from each of the air quality regulatory agencies with jurisdiction over the PEIR study area, DWR, the United States Geologic Survey (USGS), United States Bureau of Reclamation (USBR), the Torres-Martinez Tribe and DWR's consultant, the CH2M HILL team. Each member of the SSAQWG was asked to review the draft technical memorandum for Task 3 and provide feedback and comment. In addition, representatives of EPA Region IX were briefed on the project, asked to join the SSAQWG, and asked to review and comment on this memorandum. Feedback requested from reviewers included:

- Information on any additional sources of air pollutants not included in the memorandum which may be associated with a proposed alternative in the PEIR;
- Information on any additional air pollutants not identified in the memorandum;
- Suggestions regarding alternative significance criteria; and
- Recommendations on air quality impact assessment tools.

The recommendations of this memorandum and the SSAQWG will establish the potential air quality emission sources, air quality significance criteria, air quality emission factors, dispersion models, and appropriate tools to be used for evaluating alternatives for the PEIR. It may be necessary to revise some of these items established for the PEIR in the future due to unforeseen events or circumstances, but the recommendations of the SSAQWG will provide the basis for evaluating the PEIR alternatives.

FUTURE INPUT FROM SSAQWG

After establishing the potential air quality emission sources, significance criteria, and emission factors, appropriate emissions estimation tools and dispersion models will be used to evaluate alternatives for the PEIR. DWR will regularly report back to the SSAQWG on the progress of the development of the draft PEIR. The SSAQWG will be advised of significant changes in approach. The development of the draft PEIR is anticipated to be an open process with the SSAQWG serving as the lead technical advisors for the air quality section of the document. The participation of the SSAQWG is integral to the successful completion of the draft PEIR.

SALTON SEA ECOSYSTEM RESTORATION PLAN

Final Technical Memorandum
Appendix D: Salton Sea Task 4
Soil/Sediment Emissivity Assessment to Support the Salton Sea Ecosystem Restoration Plan
Programmatic Environmental Impact Report (PEIR)

February 2005

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SOIL/SEDIMENT EMISSIVITY ASSESSMENT

EXECUTIVE SUMMARY

The emissivity assessment described in this memorandum is part of an overall work plan to evaluate air quality impacts and develop suitable mitigation measures for alternatives considered in the Salton Sea Ecosystem Restoration Plan Programmatic Environmental Impact Report (PEIR). A framework is developed to carry out this assessment, with a focus on identification and development of tools, and on working in collaboration with a stakeholder work group to estimate particulate emissions of potentially exposed Playa under varying climate conditions.

The following elements, which comprise the framework, are described and developed in the memorandum:

1. **Maps of land use patterns on the Playa under each alternative.**
2. **Maps of sediments to be exposed on the Playa.**
3. **Relation of various land uses (including dust mitigation) to emissions rates.**
4. **Descriptions of crust properties, climatic dependence, and the resulting calendar of Playa surface protection from erosion by crust.** Periods when crust does not adequately protect the Playa are most likely to contain significant emissions events. Climate-crust-emissions relationships developed for Owens Lake are compared to those developed for the Salton Sea Playa. Physical relationships of mineral salts with climatic variables are employed to determine crust transformation patterns and potential influence on emission rates.
5. **Climatic data records that are representative of future conditions on the Playa.**
6. **Basic tools to develop quantitative emissions estimates based on the above data.** Two distinct approaches are identified for concurrent application, each furnishing a somewhat independent check on the other to characterize future emissions patterns on a Playa that has been flooded for the past 100 years:

   – Identification of wind tunnel test locations near the existing shoreline that are representative of Playa that may be exposed under alternatives.

   – The Wind Erosion Prediction System (WEPS) model. This model quantitatively integrates the foregoing elements and relationships developed as part of the framework to determine particulate emissions.

Tools employed on existing dry playas were also considered, but were found not to be applicable for predicting future emissions from a currently flooded Sea floor. However, these tools will have application in emissions monitoring programs for Playa exposed as a result of individual alternatives.

These basic tools have been developed and presented for stakeholder review in this memo. Timely feedback, including additional relevant data and alternative approaches, will be considered during the PEIR analyses.

BACKGROUND AND PURPOSE

The Salton Sea Ecosystem Restoration Plan Programmatic Environmental Impact Report (PEIR) will include analysis of several alternatives that may result in future exposure of currently inundated areas within the perimeter of the Sea shoreline. Impacts associated with these alternatives include wind erosion and dust emissions that could affect air quality. The purpose of this Technical Memorandum is to summarize some of the available data and tools for analyzing these impacts. Specifically, this technical memorandum is intended to fulfill, to the extent practicable within the allotted resources and time, the following scope of work:

1. Assess the particulate matter emission potential (PEP) of current and future exposed soils and sediments in the study area, based on such determining factors as:
   - Land use and management
     - Extent of exposed areas
     - Control of public access
   - Climate (meteorological variables that may affect emission rates)
     - Wind
     - Precipitation
     - Temperature
     - Relative humidity
   - Surface conditions
     - Fetch
     - Soil/sediment types and chemistry
     - Surface crust formation
     - Stability of exposed Salton Sea bed (Playa)
2. Identify suitable locations for wind tunnel tests to be conducted by other agencies and/or contractors based on this assessment of soil/sediment emissivity potential.

Salton Sea Ecosystem Restoration Plan, Air Quality Work Plan: The Context of this Work

This work is one of several steps defined in a work plan that has been reviewed by a number of air quality agencies [e.g., California Air Resources Board (ARB), Imperial County Air Pollution Control District (ICAPCD), and South Coast Air Quality Management District SCAQMD)], then modified according to input received. Building on prior air quality studies, the work plan steps are as follows:

Step 1: Coordination with Air Quality Agencies and Other Stakeholders

Step 2: Establish Air Quality Baseline

Step 3: Analyze Impacts of Meteorological Conditions and Other Variables on Air Quality

Step 4: Determine Data Gaps

Step 5: Identify Potential Air Quality Sources under Representative Alternatives

Step 6: Identify Applicable Air Quality Significance Criteria

Step 7: Develop/Identify Emissions Estimation Tools

Step 8: Develop Impact Analysis Methodology

Step 9: Develop AQ-Related Screening Criteria for Analysis of Alternatives

Step 10: Develop/Identify Potential Approaches to Best Meet Air Quality Goals

Step 11: Estimate/Evaluate Impacts of Screened Alternatives

Step 12: Develop Mitigation for Significant Impacts and Quantify Benefits

Steps 1 through 7 can be completed without reference to detailed information regarding restoration alternatives. Steps 8 through 12 are directly related to formulating and analyzing alternatives, and will be scheduled in concert with the development of the draft PEIR.

This technical memorandum is part of Step 7, *Develop/Identify Emissions Estimation Tools.* Because of the importance of air quality to the overall PEIR, this is one of the first and most intensive tools development efforts yet undertaken. This current work does not address specific alternatives under the PEIR. Rather, it is intended to develop basic tools that will be required to assess the potential air quality impacts, specifically from Playa emissions. The alternatives assessment will occur at a later date when alternatives have been formulated and vetted, based on not only air quality, but also many other considerations and criteria. At that time, air quality will of course only be one among many impacts assessment efforts undertaken to support the PEIR process.

Based on impacts assessment, appropriate mitigation will be developed. The effectiveness of certain mitigation approaches may also benefit from employment of the tools developed here, but again, no discussion of mitigation is presented in this technical memorandum, because no alternatives or associated impacts have as yet been identified.

The tools discussed will eventually need to provide a framework and specific processes or models that, when employed correctly, allow for an accurate assessment of:

- Playa emissions under conditions resulting from implementation of each alternative that is considered during PEIR development, and
- Playa emissions under conditions resulting from mitigation proposed as part of such alternatives.

Significant input from stakeholders and agency partners on work plan steps is being solicited. Proposed tools are being discussed with stakeholders and agency partners, with the request that they review and respond to proposed methods and directions. Based on input received, approaches will be refined, more fully developed, and ultimately reviewed again and finalized. The tools will then be ready for employment on work plan Steps 10 and 11.

Timely feedback on the proposed framework and tools will enable the project to move forward.

Study Area Delineation

The study area for the Ecosystem Restoration PEIR extends throughout the Salton Sea watershed. However, the principal sources of windblown fugitive dust in this area include the following:

1. Farmland
2. Other existing land, such as desert areas
3. Newly exposed land, currently covered by the waters of the Salton Sea (the Playa)

Methods for assessing emissions from these sources were summarized in the Task 3 deliverable. In this technical memorandum, the focus will be on estimating windblown fugitive dust emissions from the exposed Playa, because this is where the greatest potential for changes in the PEP (particulate matter emission potential) exists. Some of the findings of this task may be useful for refining the emissions estimates from farmland or other land, should this prove to be necessary.

APPROACH

This technical memorandum contains an initial discussion of the PEP for soils and sediments in the study area. Available data, methods, and models for this are described. A framework is described for combining these components into a more robust and quantitative tool to evaluate the impacts of alternatives and mitigation.

PARTICULATE MATTER EMISSION POTENTIAL ASSESSMENT

This section includes discussions of the following:

1. Alternative emissions prediction tools
2. Straw man assessment framework
3. Land use factors
4. Climatic factors
5. Predicting emissions

1. Alternative Emissions Prediction Tools

Emissions predictions can be approached by applying site-specific measurements of emissions rates to classes of land surfaces that are of interest. A practical method for doing this is the MacDougall method (MacDougall, 2002), which relies on wind tunnel testing, land use, and soil survey data. This method has been applied successfully for emissions inventories in the arid Western US, and is discussed in greater depth in the Task 3 technical memorandum, "*Salton Sea Task 3 - Identify Potential Emissions Sources, Significance Criteria and Analytical Tools & Methods*". That discussion concluded that the MacDougall method was a reasonable means for extending wind tunnel results to emissions inventories. The method has therefore been accepted as a means of applying wind tunnel results across the Playa.

As noted, emissions predictions for specific sites can be developed with the aid of a wind tunnel. Advantages of wind tunnels (and by extension, the MacDougall method) include the following:

- Provides empirical data on emissions under known conditions; measurements are based on replication of erosion events on actual land surfaces;

- Driving forces for erosion can be "standardized" by replicating consistent wind velocity, sand feed, etc.

- Novel surface conditions that emissions models do not adequately consider can be assessed and compared with surface conditions that are better understood. This can provide an empirical basis for emissions model refinement.

Important disadvantages of wind tunnels include the following:

- Surface conditions on the Playas can change seasonally so that results at one time may differ radically from what would be found at a later date.

- Natural emission processes are not adequately duplicated. For example, wind tunnels employ forced saltation over short fetch distances, are limited to surfaces with little roughness, and do not deal with resuspended particulate matter. The difference in emissions between a 1-meter-long wind tunnel and a 1,000-meter-long field is 3 orders of magnitude (the longer fetch having higher emissions), when all other factors are held equal. At a minimum, studies must be designed and interpreted to account for specific limitations. These steps require significant ancillary data, analysis, and judgement.

- Due to the relatively cumbersome nature of the required apparatus, schedule and budget constraints may limit the number of observations and the ability to adequately characterize a large, diverse, and dynamic landscape. It should be noted that recent innovations include the development of a much smaller device replicating some of the functionality of a wind tunnel for imparting shear stress to soil surfaces, and then measuring emissions. Such apparatus developed at the Desert Research Institute (PI-SWIRL) allows for much more rapid testing of land surfaces than with more cumbersome wind tunnels.

However, wind tunnels can provide a relative measure of the change in emissions following a change in surface properties; for example, soil with and without a chemical binder. When employed with care and in conjunction with other tools, such as models, results provide one indication of the relative emissions potential of various land surfaces and conditions.

At the opposite end of the spectrum are emissions models, such as the WEPS model discussed later in this memo. The advantages of models include the following:

- Analyses may be relatively cost effective and rapid.
- Relationships in the model may be well documented.
- Models can be used to cost-effectively characterize emissions under a broad range of conditions, so that results can be applied to a diverse, dynamic landscape.

Disadvantages may include the following:

- Models may lack sensitivity to important variables.
- Developmental models may lack a finalized version that has undergone quality control (as is the case of WEPS).

A third method has been applied at Owens Playa by Great Basin Unified APCD. The basis of this method is the observation that on the Owens Playa there is a strong relationship between sand motion (which can be measured by installed instruments), and dust emissions rates. Based on back calculation from observed dust concentrations, and on wind tunnel testing, factors ("K factors") have been developed to convert sand motion into dust emission rates for regions of the Owens Playa. Now, with a network of sand motion monitors, emissions from hundreds of specific monitoring locations across the Owens Playa are estimated on a relatively continuous basis. This method has the following advantages:

- Provides specific emissions rates that vary in both space and time.
- With the exception of the application of K factors to locales, the estimates do not rely on mediating and interacting influences of variable soil properties, dynamic crust conditions, land management, or even meteorology.

Disadvantages include the following:

- K factors do not reliably account for mediating and interacting influences of variable soil properties, dynamic crust conditions, land management, or even meteorology.
- Emissions processes that are not primarily driven by saltating sand are not directly considered.
- Such a system requires that the Playa in question (or some analogous land surface) be exposed so that sand motion can be measured.
- Installation and maintenance costs are significantly greater than for even a moderate number of wind tunnel tests, or than for many thousands of emissions model runs.
- Years are required for implementation and data collection before any meaningful analysis of emissions can be undertaken.

After comparing these three general approaches, the K factor approach was eliminated based on the fact that it is currently impractical for use on the Salton Sea Playa. However, this approach may be useful for long-range monitoring, beyond the PEIR timeframe.

Employment of models and wind tunnel testing would appear to be the soundest approach. In this manner, limitations of each approach can be offset by corresponding strengths in the other method. This should result in the most robust overall analysis possible. Where results of the two methods agree, this will provide confidence that an estimate is sound. Where results do not agree, further investigation as to sensitivities and accuracy of the two methods will need to be undertaken to resolve the conflict.

Wind tunnels and models can provide a suite of emissions estimates, each reflecting a specific land condition; these estimates must be distributed across the landscape according to mapping of these conditions. A framework for this step is discussed in the next section.

2. Assessment Framework

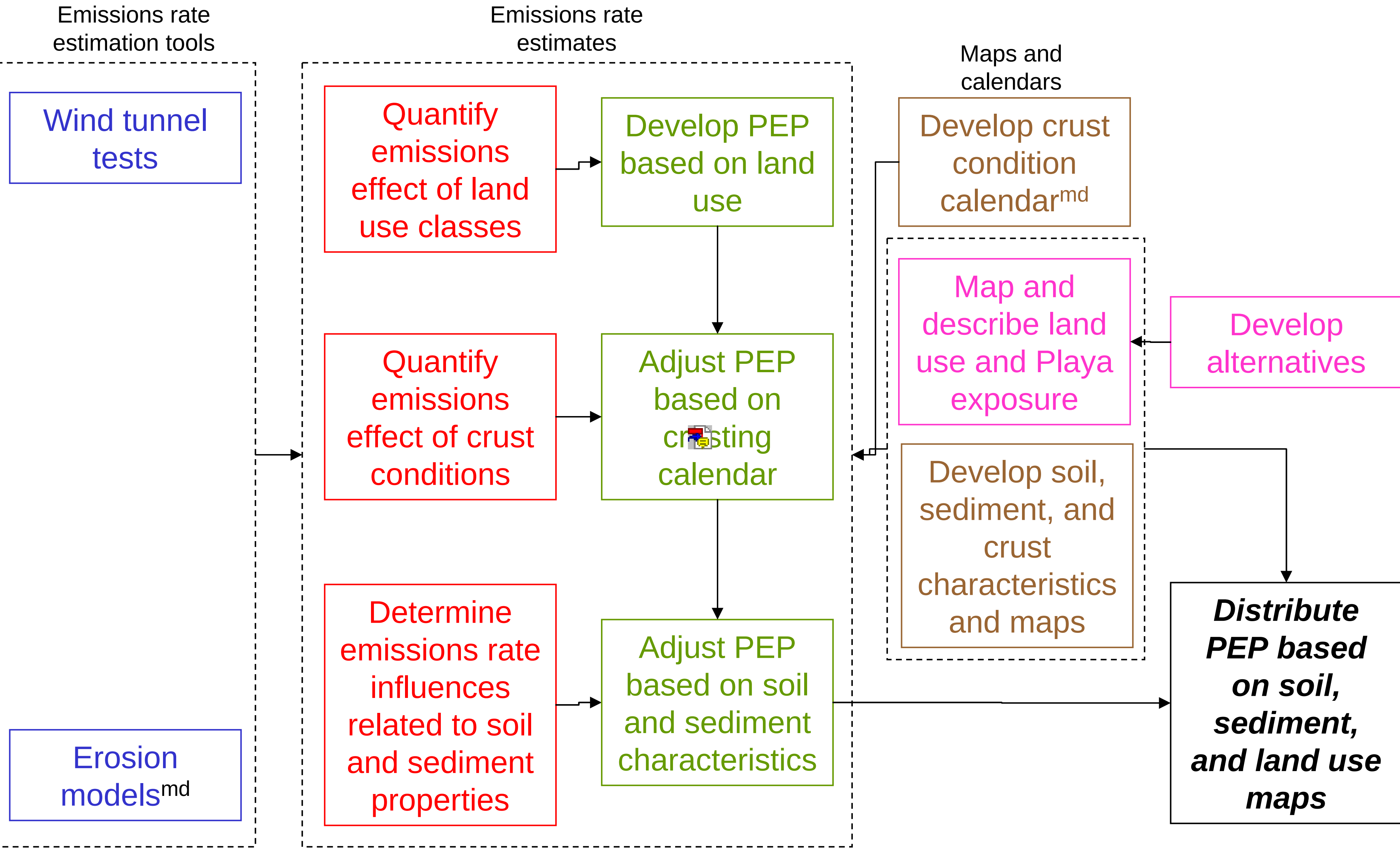
There are various methods of applying unit emissions rate estimates across landscapes to produce an emissions inventory. A method that applies wind tunnel data based on land use and soil survey information has been developed by MacDougall (2002), as discussed in the Task 3 technical memorandum, *Salton Sea Task 3 - Identify Potential Emissions Sources, Significance Criteria and Analytical Tools & Methods.* The framework proposed here combines some of the features of that method with use of models such as WEPS.

The assessment framework (Framework) for the Playa must provide for the prediction of windblown dust emissions from exposed Playa. A schematic of a proposed framework, denoting the potential use of a number of familiar tools, is illustrated in Figure 1. Included in the Framework are tools for estimating emissions rates, as discussed above. Meteorological conditions are incorporated into emissions and crusting models. The schematic works inward from the periphery toward the center, and then out again to a bolded endpoint. Emissions rate estimation tools are employed to develop increasingly refined unit emissions estimates for expected classes of land use and soil surface conditions. Maps of land use and soil surface conditions are assembled for the Playa. Finally, unit emissions rates are distributed on the landscape based on these maps. Each alternative will have a unique land use map so that each will also have a unique emissions inventory. This inventory forms the source field for air pollutant dispersion models to be applied to estimate the impact of predicted emissions on ambient air quality. While such modeling is critical to impacts evaluation, it is outside of the scope of this technical memorandum, and will be taken up at a later date.

Within the emissions rate estimation step, tools are used to define how soil and sediment properties, crusting, and land use affect PEP. The order of consideration stems from the following hypotheses and logic:

1. Land use may in many cases be the dominant determinant of emissions rates. Among land use classes we might see, for example, flooded areas, wildlife refuges, roads, controlled access, etc. Should dust mitigation in the form of specific land management requirements be associated with an alternative, then this would be added to the land use information and would affect emissions results for the alternative.

2. Among the processes and characteristics affecting emissions from playas, soil crusting is most dominant. This is because regardless of soil or sediment characteristics, when surfaces are cemented by stable crust, they emit much less dust. Also, crusts are widespread and potentially quite durable on playas. Therefore, it is critical to consider them (and how they are affected by climate and land use) early in the emissions estimation process.



[md] Meteorological data required

Figure 1: Schematic Framework for Assessment of Particulate Emissions Potential from Exposed Salton Sea Playa

3. Soil and sediment characteristics significantly influence the rate of erosion on land that is not protected from erosion by land use or a stable crust. Emissions rates for representative classes of soils therefore need to be developed.

In summary, to estimate the impacts of emissions from potentially exposed playa on ambient air quality, the following must occur:

1. Factors influencing emissions must be identified, and these influences quantified in a predictive framework. Sections 2 through 4 focus on this step, describing how each factor can be considered in the Framework.

2. The land area must be classified according to factors affecting emissions. Section 5 contains a brief review of available mapping information, some of which was employed to site wind tunnels and to generate input data for the WEPS model.

3. Emissions predictions must be developed for each location on the land surface. Section 6 contains WEPS model pilot test results. Also, land surfaces representing Playa are identified for wind tunnel testing in the final section of the technical memorandum.

3. Land Use Factors

Ecosystem Restoration Plan PEIR alternatives, and associated Playa configuration and land use, have yet to be determined. However, based on what is currently known, provisional land use classes can be inferred. These include some or all of the following:

1. **Wildlife refuge, wetlands habitat, upland habitat.** From an emissions perspective, these areas would benefit from a mixture of management attention, surface wetting, controlled access, and vegetation. Specific habitat types and land management affecting surface conditions can potentially have a dominant effect on emissions. Wet areas, areas with reasonably dense vegetation, and areas protected from traffic, should have relatively low PEP.

2. **Geothermal development.** This activity may not directly affect PEP, but may provide a land management entity to ensure that associated development properties comply with fugitive dust emissions control requirements, as set by the local air district (District).

3. **Dust mitigation.** Where PEP rates are predicted to be high (e.g., areas that are dry, sparsely vegetated, and heavily trafficked), local District rules may require dust mitigation. The regulatory framework requires that dust mitigation measures control PEP so that ambient air quality standards can be met.

4. **Infrastructure** (levees, canals, roads, etc.). Construction, operation, and utilization of new infrastructure will also be subject to District requirements. PEP of roads, for example, can be reduced by gravel cover or paving, or surface treatments such as watering or application of stabilizing agents. This is discussed in greater detail under other Salton Sea air quality tasks.

5. **Brine storage and reuse.** Brine pools form naturally in shrinking, playa lakes. Certain alternatives may result in areas where salinity is elevated enough to preclude use by certain, or even all species. Like the currently flooded areas, there are virtually no emissions from these areas, other than potential odors.

6. **Undeveloped areas.** These areas have the greatest potential PEP. They can be assumed to be very dry and to have limited vegetation, because without some specific land management effort, vegetation would colonize dry, saline playa slowly, if at all.

7. **Control of access.** Disturbance by human activities is a dominant variable affecting PEP on the Playa, and therefore is a key land use feature in the analysis of PEP. The importance of land surface disturbance discussed in a later section (Disturbance).

To be included in the Framework, the following land use information will be needed as part of the alternative descriptions:

- A map showing the approximate location and extent of land use classes on the Playa.
- Description of salient features of each land use class, such as the features discussed earlier in this section for the provisional land use classes.

The effect of each land use on emissions will need to be estimated with the tools outlined previously. Practically, this can be quantified for any land use as a reduction in PEP, relative to undeveloped areas. These reduction figures were not quantitatively developed under this task.

4. Climatic and Physical Factors

Climatic records have been compiled as part of other PEIR air quality tasks, and these data have been employed, and in some cases augmented, to assess PEP. Factors employed here include wind speed, precipitation, temperature, and relative humidity. Their consideration is fundamental to assessment of wind erosion, because wind is the driving force for the process, and because moisture, humidity, and temperature can strongly influence playa stability. These factors will mostly be discussed in the following two sections, where they are applied to assess PEP.

Physical factors controlling emissions rates include fetch (the length of uniform surface over which the wind has blown) and surface roughness. Both depend strongly on land use and mediate the effect of climatic variables. The wind profile and other related properties of turbulent transport vary with fetch. Longer fetch can be associated with greater wind erosion, because particulate movement over long fetch lengths builds the momentum and destructive force of the storm. An obstruction (e.g., sand fence) will have an effect on fetch, but the effect is localized. Roughness increases friction between wind and the land surface, increasing turbulence and reducing velocities near to the surface. Roughness and fetch must be considered together.

Salton Sea bathymetry (Figure 2) indicates that the Playa, while not flat, lacks significant change in surface characteristics that would shorten the fetch. Alternatives, then, will be key determinants of any PEP reductions related to shortening the fetch or increasing surface roughness.

To be included in the Framework, the following information influencing physical characteristics will be needed as part of the alternative descriptions:

- A map showing the approximate location and pattern of obstructions to wind flow across the Playa
- Enough information to allow deduction of salient features of significant obstructions to flow, such as its length and height, orientation, porosity, and rigidity
- Specification and mapping of land surface conditions affecting roughness

Many obstructions are relatively generic and can be described as such. These include the classes of obstructions mentioned previously. Practically, the effect of obstructions can be quantified when considering the location and intensity of sources, or during dispersion modeling.

SALTON SEA BATHYMETRY

LEGEND

- -235 Elevation Contour
- One Foot Bathymetric Contours
- Dike Location

One foot contours interpolated from five foot contour data provided by the Salton Sea Authority

N

1 0 1 Miles

APPROXIMATE SCALE
1 : 63,360

IID Water Conservation and Transfer Project

CH2M Hill RDD ArcView Project File \\rddgis\iid\sea_bathymetric_analysis.apr 9:12 a.m. 05-22-2002

5. Land Surface Conditions

Topics related to the Playa's surface conditions are discussed in the following subsections:

- Available mapping
- Disturbance
- Crust hardness
- Soil properties

The relevance and current knowledge related to each is described. An approach for integrating each into the Framework is proposed.

a. Available Mapping

Application of model or wind tunnel results to the Playa will require mapping of predicted Playa conditions. Following are key themes in this mapping and current status:

- **Playa configuration.** Currently unknown, this will be developed as part of the PEIR alternative descriptions. This may include exposure of currently shallow Salton Sea margins, along with manipulation of such exposure through the use of levees.

- **Land use of Playa.** Currently unknown, this will be developed as part of the alternative descriptions.

- **Playa properties.** Mapping of old playa, contained in soil surveys of Riverside and Imperial Counties, is shown in Figure 3. Each delineation marks the transition between two "mapping units." Mapping units are defined by a set of physical, chemical, and landscape properties that are defined in the soil surveys, and usually occur in patches throughout the soil survey area.

Levine-Fricke sampled sediment at about 70 locations in 1998 and 1999 (Figure 4; Levine-Fricke, 1999). USGS recently completed a survey of shallow sediments characterizing texture and organic matter content. A map produced by this survey is shown in Figure 5. Ongoing USGS activity includes an acoustic survey that will extend sediment characterization in the shallows, and provide information on sediments in deeper regions in the Salton Sea.

Mapping of each of these themes will determine the PEP-linked variables across the area to be analyzed for each alternative. Therefore, mapping is critical to the impact analysis. However, the need for this information can be prioritized. Based on what we know about each of these themes, mapping priorities (with brief justification) are as follows:

1. Playa configuration and land use. These themes are part of the alternatives descriptions, and may justify at least an approximate "layout" description for each. This is the top priority because, where land use affects key factors such as land surface protection, wetness, or disturbance, it is of overriding importance in determining PEP.

2. Soil and sediment characteristics. Where soil is disturbed, or is not protected, wetted, or consolidated, soil and sediment characteristics can be the dominant factor affecting emissions. However, interactions with other factors can mask the effect of soil and sediment properties on emissions rates. For example, it has not been possible to strongly relate Owens Playa emissions to soil properties. Rather, emissions seem to be driven by the presence or absence of dust mitigation (land use), the condition of the playa crust (traffic and climatic conditions), and the presence of mobile sand and wind to drive it. Erosive combinations of these conditions reliably cause soils with a broad range of properties to become emissive, while in their absence, very little dust is emitted from any soil type.

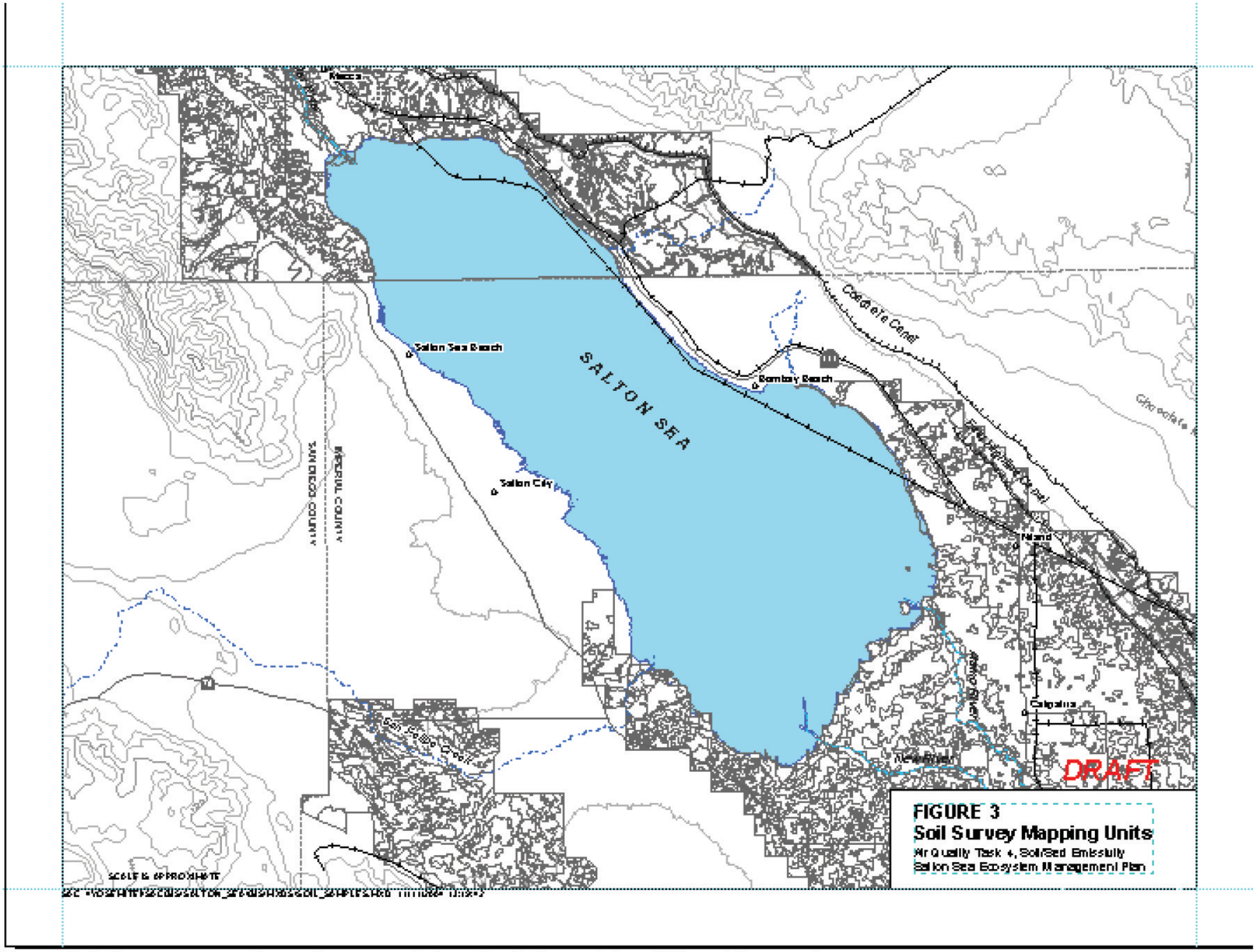


Figure 3. Soil survey mapping units near to Salton Sea in Imperial and Riverside counties.

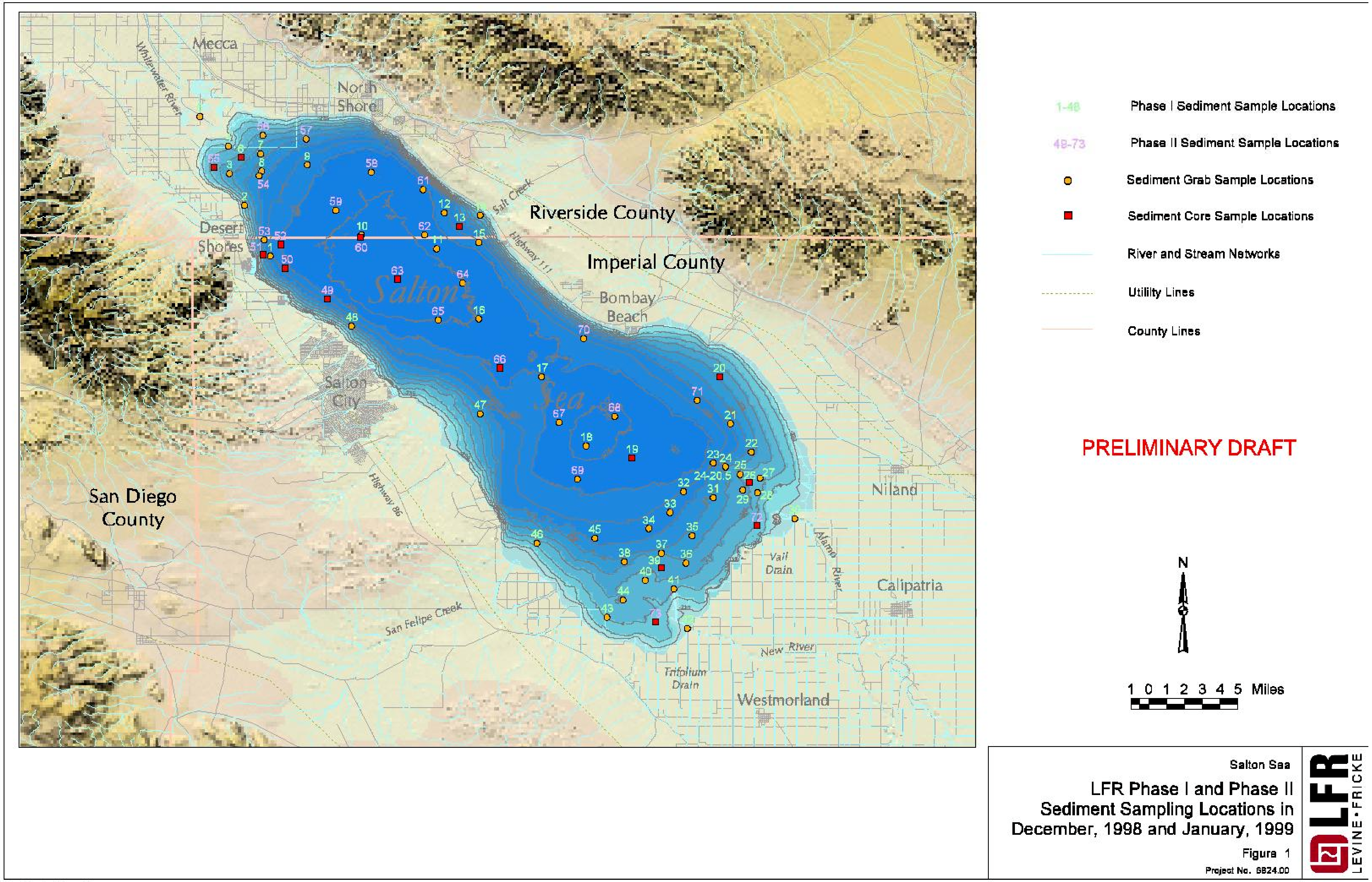


Figure 4. Core sampling locations from Levine-Fricke report.

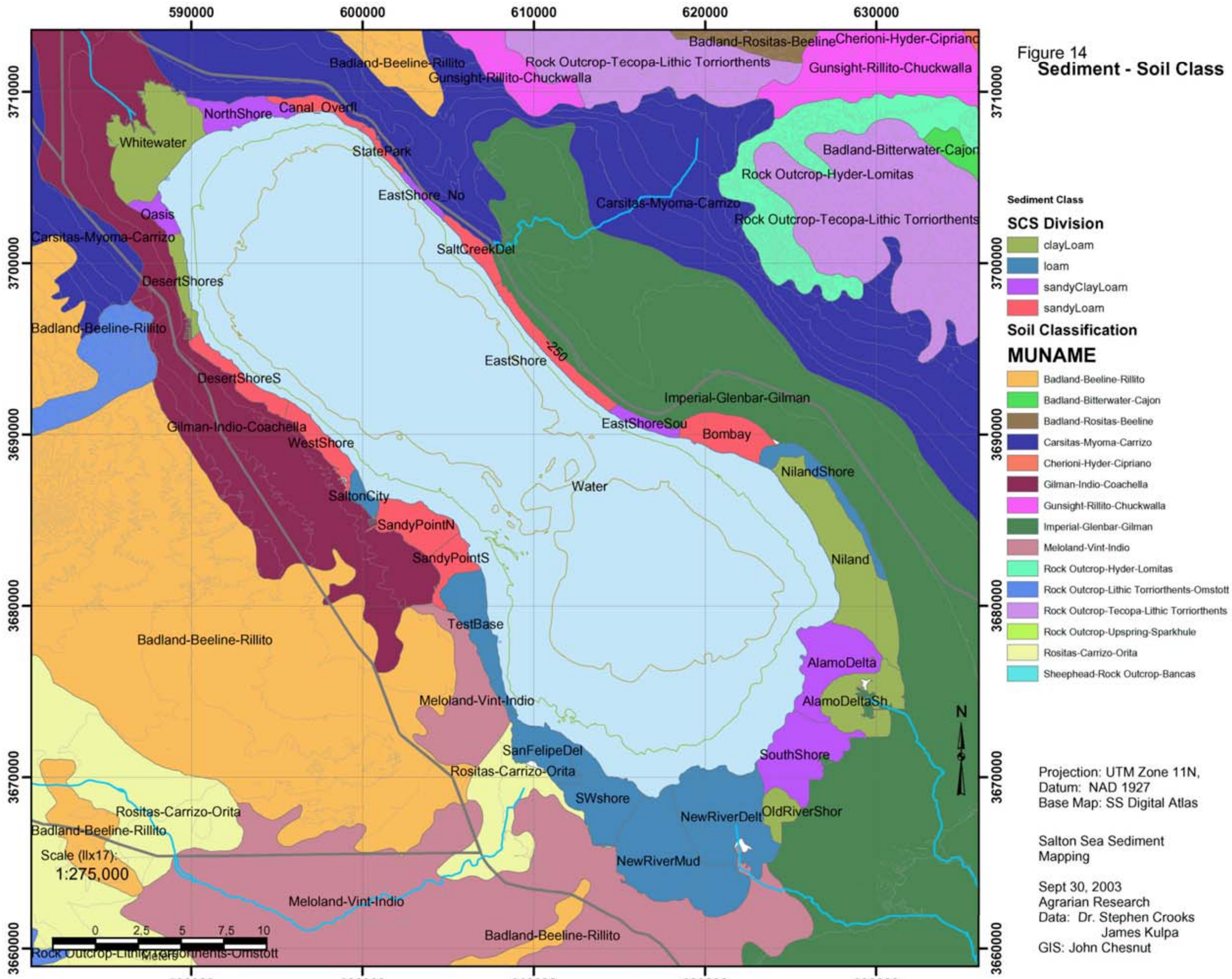


Figure 5. Summary figure from USGS/Agrarian sampling of sediment cores to 20 feet of depth in Salton Sea.

To be included in the Framework, layout of land use classes related to each alternative will need to be developed. Land use class effects on PEP can be applied based on this layout, and any significant variation in these effects as a function of soil and sediment properties can be applied based on available mapping of these properties.

b. Disturbance

For many classes of Playa and land use, disturbance is a critical land use variable. This is the case for all dry land surfaces. In agriculture, for instance, ground-disturbing operations of tillage and harvest are the primary factors considered in PEP estimates. Undeveloped areas of Playa may lack vegetative cover and the occasional irrigation processes that seasonally stabilize agricultural lands, so that the effects of disturbance on Playa PEP may linger long after the actual disturbing event. Conversely, certain features of undisturbed Playa (e.g., crusts) tend to reduce their PEP. But this protection can be destroyed when the Playa surface is disturbed.

One of the dominant features of Playa relative to other desert land is the potential for formation of a (sometimes) protective, salt-cemented crust. Traffic or other mechanical disturbance can break, loosen, or even pulverize the crust and dramatically increase the Playa's PEP.

To be included in the Framework, the level of disturbance related to each land use class (including level of access control) will need to be defined. Further, the effect of each level of disturbance on land surfaces, particularly on stable crusts, will need to be quantified. Initial efforts at this are included in a later section (Predicting Emissions).

c. Crust Hardness, Including Comparison to Owens Lake Conditions

As mentioned previously, crust hardness can strongly influence PEP of the Playa, and crust hardness depends to a large extent on the nature of salt cementation at the soil surface. A previous analysis (CH2M HILL, 2003) examined the response of sodium sulfate salts in playa crusts to climatic variation. That analysis has been extended for this technical memorandum.

Surface Crusting and Chemistry. Formation of surface crusts on the Playa is expected. These crusts result from cementation of surface sediments by evaporite salt minerals that form as evaporating saltwater concentrates at the Playa surface. Where the capillary fringe drops to significant depth, this resupply may become interrupted. In these areas, salt supply to the soil surface may eventually be slowed or depleted, reducing the thickness and strength of crusts.

This salt crust can protect soil, reducing erodibility. Salt crust hardness depends primarily on the sea water chemistry, and on the type of minerals formed upon sea water evaporation.

Climate strongly affects the extent to which minerals are hydrated. Hydrated minerals expand, and this expansion can result in a softened crust; when hydration does not occur, cemented crusts may remain quite hard and resistant to erosion.

One of the most extensive data sets relating climatic conditions to air quality is from Owens Playa, where conditions differ from those at the Salton Sea. However, similarities in some aspects of the chemistries of the two playas make a close analysis of the climate – and air quality relationships at the Owens Playa one useful basis for evaluating PEP at the Salton Sea.

Like the waters of Owens Lake, those at the Salton Sea have a sodium-chloride chemistry, representing the waters' dominant ions (Figure 6). However, Salton Sea water differs from that of Owens Lake in that it has higher percentages of calcium and magnesium, while lacking bicarbonate and carbonate. As the Salton Sea level drops, water along the edges will evaporate to dryness, leaving chloride and sulfate salts, the most common of which are halite (NaCl), gypsum ($CaSO_4{\cdot}2H_2O$),

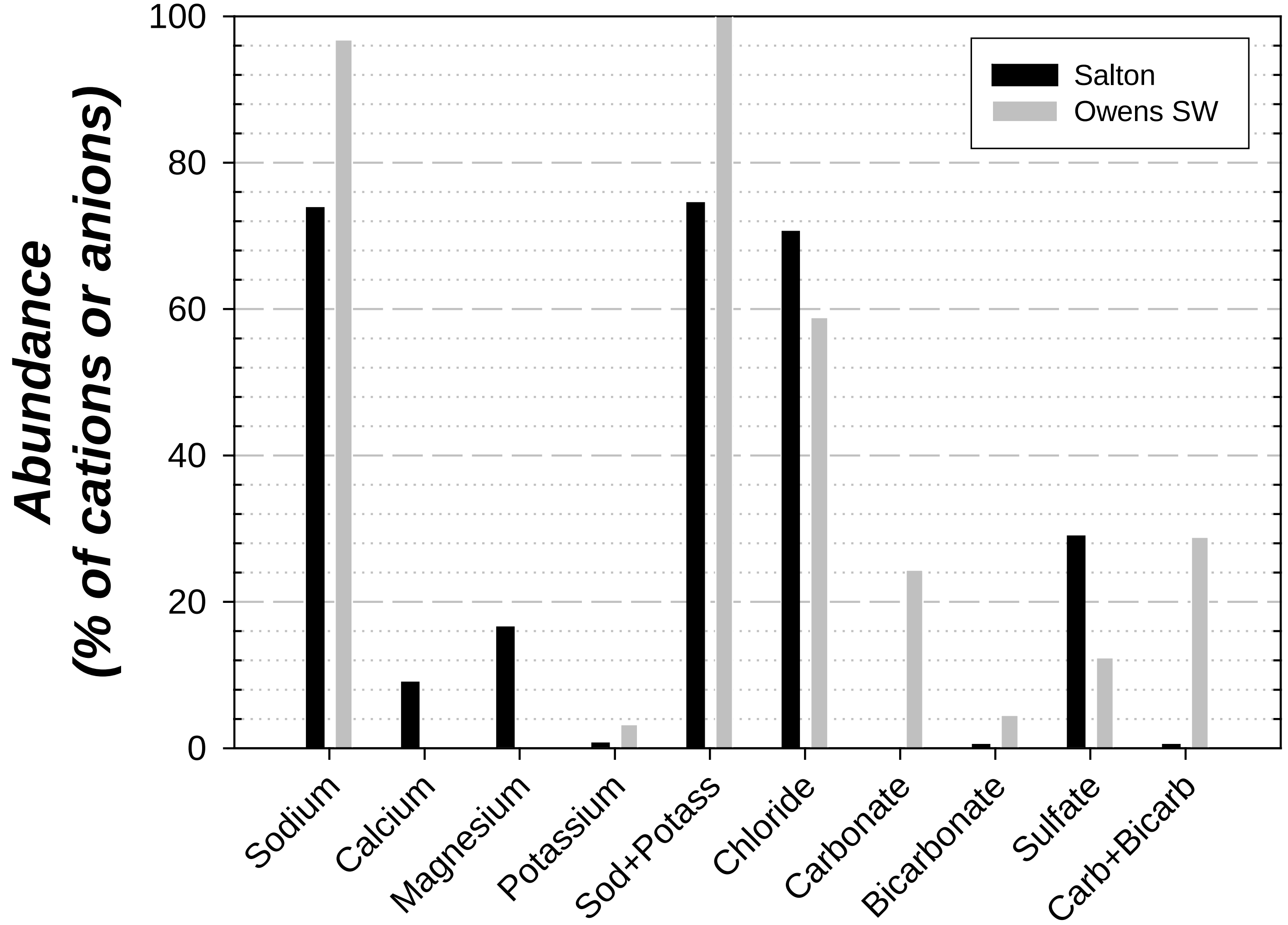


FIGURE 6

Relative Abundance of Major Cations and Anions at Salton Sea (Bertram Station, 1996-2001) and in Subsurface Drainage Water at Owens Lake (Agrarian and Tree Rows Sites, October 1998). Abundance for cations (sodium, calcium, magnesium, and potassium) is given as a percentage of the total cations, and for anions (chloride, carbonate, bicarbonate, and sulfate) as a percentage of total anions (milliequivalents/liter). Source: IID Water Conservation and Transfer Draft EIS EIR epsomite ($MgSO_4 \cdot 7H_2O$), and mirabilite ($Na_2SO_4 \cdot 10H_2O$) or thenardite (Na_2SO_4). The Owens Lake playa has carbonate salts in addition to the chlorides and sulfates; the presence of carbonates or sulfates may contribute to soil crust softening as discussed later.

Although there are exceptions (Dixon and Weed, 1989), chloride salts are usually not hydrated and therefore are less important in determining erodibility. Also, they tend to be less dominant in airborne salt mixtures (Reheis, et al., 2001).

Compared to Owens Lake, salts that form from Salton Sea water will have a higher percentage of chloride. This may result in a decreased erodibility at this site. Summer dehydration of salts is expected to be similar to that at Owens Lake, because of similar summer temperatures. Winter temperatures at the Salton Sea are warmer, and may result in less frequent and prolonged hydration.

Temperature and Humidity Effects. Temperature and humidity affect the hydration state of salts. In winter, when temperatures drop, evaporative demands decrease and humidity increases, providing water molecules that can hydrate salts. When salts are hydrated, they are expanded to a volume several times that of the nonhydrated form. For example, mirabilite, a hydrated sodium sulfate, occupies a volume 4.1 times that of thenardite (nonhydrated sodium sulfate). These expanded crystalline structures are common in sulfates and carbonates, and create less dense, “fluffy” material, significantly softening the soil crust until dehydrated salts form again. When this soil crust softening occurs, the surface can be much more erodible. At Owens Lake, this condition partly determines the duration of the dusty season (Saint-Amand 1987). Patterns of temperature and humidity, the main factors driving this transformation, have been compared between the two locations to determine how significant the potential for this transformation is at the Salton Sea, relative to Owens Lake. These patterns are compared to thenardite/mirabilite transformation thresholds, and correlated to PM_{10} emissions events at Owens Lake.

Five-day moving averages for temperature and relative humidity (RH) data available for Owens Lake and Brawley were calculated. Recent (2002 to present) data from weather stations on Owens Lake were used to develop corrections to temperature data from nearby Haiwee, and RH data from Bishop. Data for much of the period from 1991 to present were available from these stations.

These averages are plotted relative to mineral stability thresholds (Troi et al. 2002; Figure 7). Owens Lake points scatter farther into the range of mirabilite stability (the expanded hydrated form), but the frequency and timing of this occurrence is not clear from this data display.

To further investigate the effects of temperature and RH on PM_{10} emissions, an erodibility index (EI) was developed from the 5-day moving averages of these two variables. For any point, the index is the shortest distance between the point and the transition curve; units are (deg $F^{2\,*}$ percent RH^2) $^{0.5}$. The EI is negative when it is in the thenardite range, and positive when in the mirabilite range. No scaling of the two variables (temperature and RH) was done because they vary in approximately the same range and magnitude. The resulting EI provides a single number indicating how far conditions on a particular day depart from the mineral stability threshold, and whether conditions favor formation thenardite (negative) or mirabilite (positive). About 13 years of EI data for both sites are plotted on Figure 8. It is readily apparent that the index fluctuates from values below -40, to values as high as 20, during each year at Owens Playa.

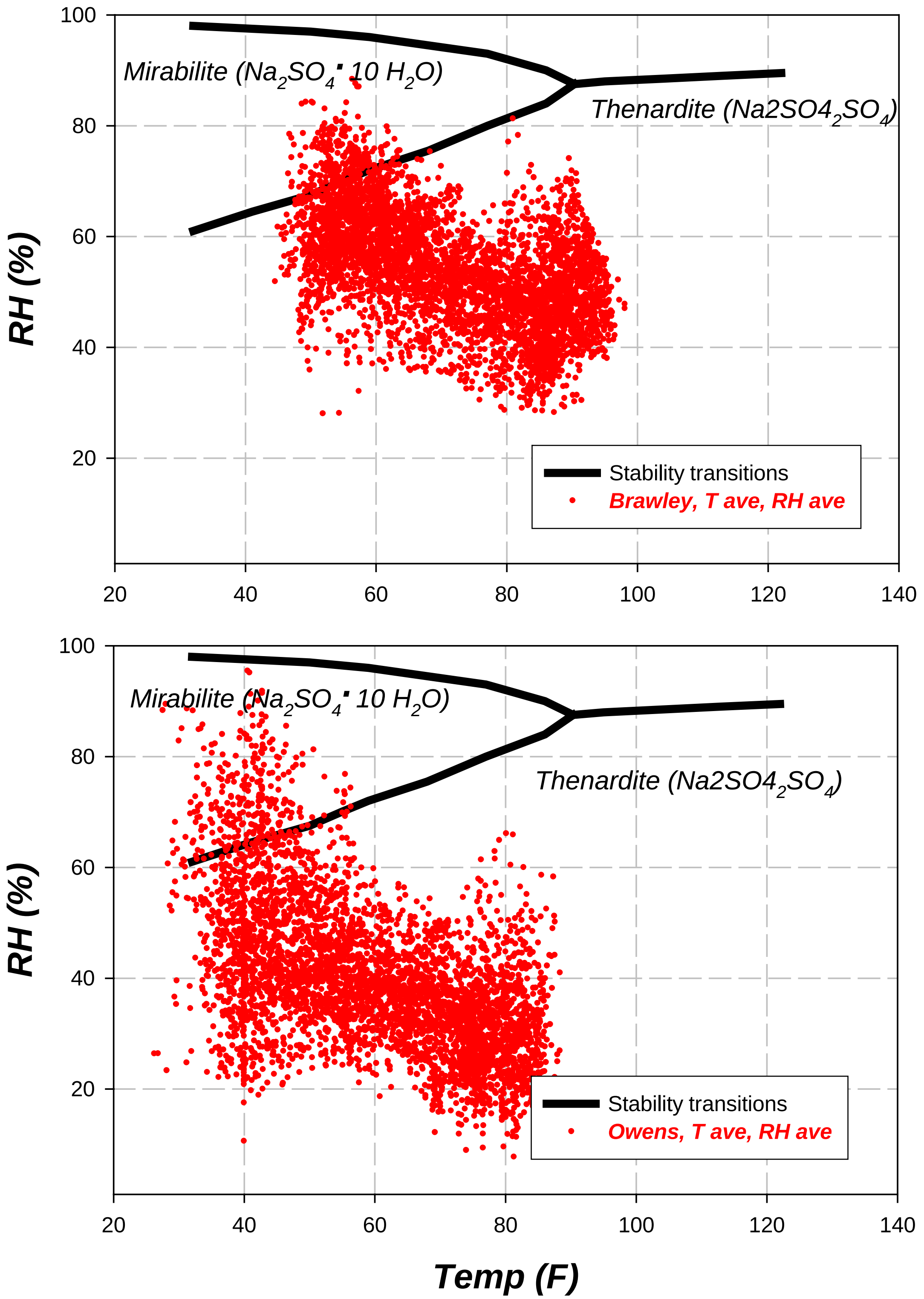


Figure 7. Distribution of 5-day running average temperature-humidity points relative to sodium sulfate mineral stability thresholds. Salton Sea and Owens Lake, 1991 through 2003

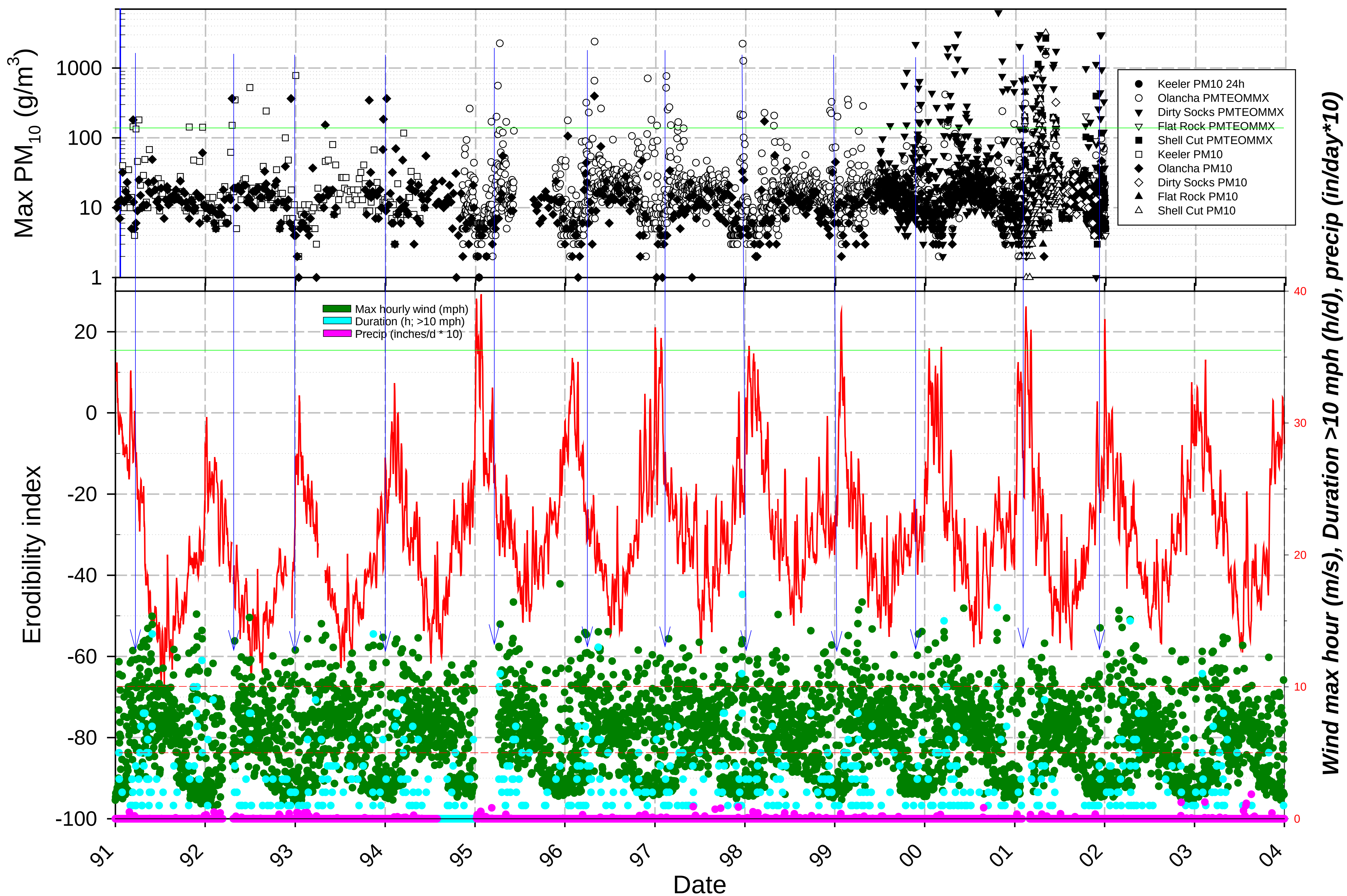


Figure 8. Long-term fluctuations in erodibility index and climatic variables at Owens Lake,. Air quality data from CARB for the same period.

Also on Figure 8, patterns of PM_{10} concentrations (from the California Air Resources Board [ARB] database), wind, and precipitation are shown. Arrows were subjectively placed at the onset of the peak dust season each year. This frequently coincides with the first sustained high wind (5 to 10 h/d at > 10 m/s) after EI moves into the high range of its annual cycle. This corresponds with field observations that it is during these cool periods that the crust softens and the worst dust storms occur.

This view is expanded to look at a 5-year period in Figure 9 and related to maximum PM_{10} concentrations recorded by Great Basin Unified Air Pollution Control District at the Dirty Socks monitoring station on the south end of the Playa. The peak concentrations are significantly higher than data plotted in Figure 8, but a similar pattern holds. Arrows were subjectively placed at the onset of the dust season, and at its peak. The peak again corresponds quite well with the first sustained high wind (5 to 10 h/d at > 10 m/s) after EI moves into the high range of its annual cycle.

In neither Figure 8 nor Figure 9 is a relationship of air quality to precipitation obvious.

Figure 10 shows plots max wind speed data from several sites at Salton Sea. This view is expanded for the period when data were available for Niland in Figure 11. Niland (at the southeast edge of the Playa) appears to have the highest winds among the three stations, and might represent the most conservative basis for evaluation of wind speed on the Playa.

Figure 12 shows Niland wind and precipitation with Brawley EI. Note that Brawley EI peaks are substantially lower than those at Owens Playa, while high winds at Niland are less frequent. Table 1 shows another comparison of Niland with Owens Playa wind speed

Table 1
Comparison of Wind Speed Frequency at 10 m Above Ground Surface for Salton Sea and Owens Lake

Location	Percent of time winds are >8.5 m/s (19 mph)	Percent of time winds are >11.0 m/s (25 mph)
Niland (Near Salton Sea)	4.4	1.4
Tower N3 (Owens Lake)	18.9	7.9

Source: IID Water Conservation and Transfer Draft EIS EIR

Figures 13 and 14 show similar analyses, replacing Niland wind and precipitation data with data from Westmoreland and Indio, respectively southwest and north of the Playa. As noted previously, wind in these areas is substantially less than at Niland, and of course less than that observed at Owens Playa.

Figure 15 illustrates the cumulative distribution of EI for Owens Playa and Brawley. Owens generally has more values at both extremes than Brawley. On the high end, where crust softening occurs, the maximum value at Owens Playa is about 14 points higher than at Brawley. The EI exceeds a value of 5 about twice as often at Owens Lake as at Brawley. Values above 10 occurred in 10 of 13 years at Owens Playa, and 3 times at Brawley.

While the geochemistry of the two playas differ, certain salts that soften in response to low temperature and high humidity occur at both locations. The driving forces for crust softening and Playa disturbance by wind are significantly less pronounced at Salton Sea than at Owens Playa. However, conditions correlated with crust softening and PM_{10} emissions at Owens Playa do occasionally occur at Salton Sea. Therefore, the periodic softening of Playa crust may be a dominant factor in determining periods of maximum Playa PEP.

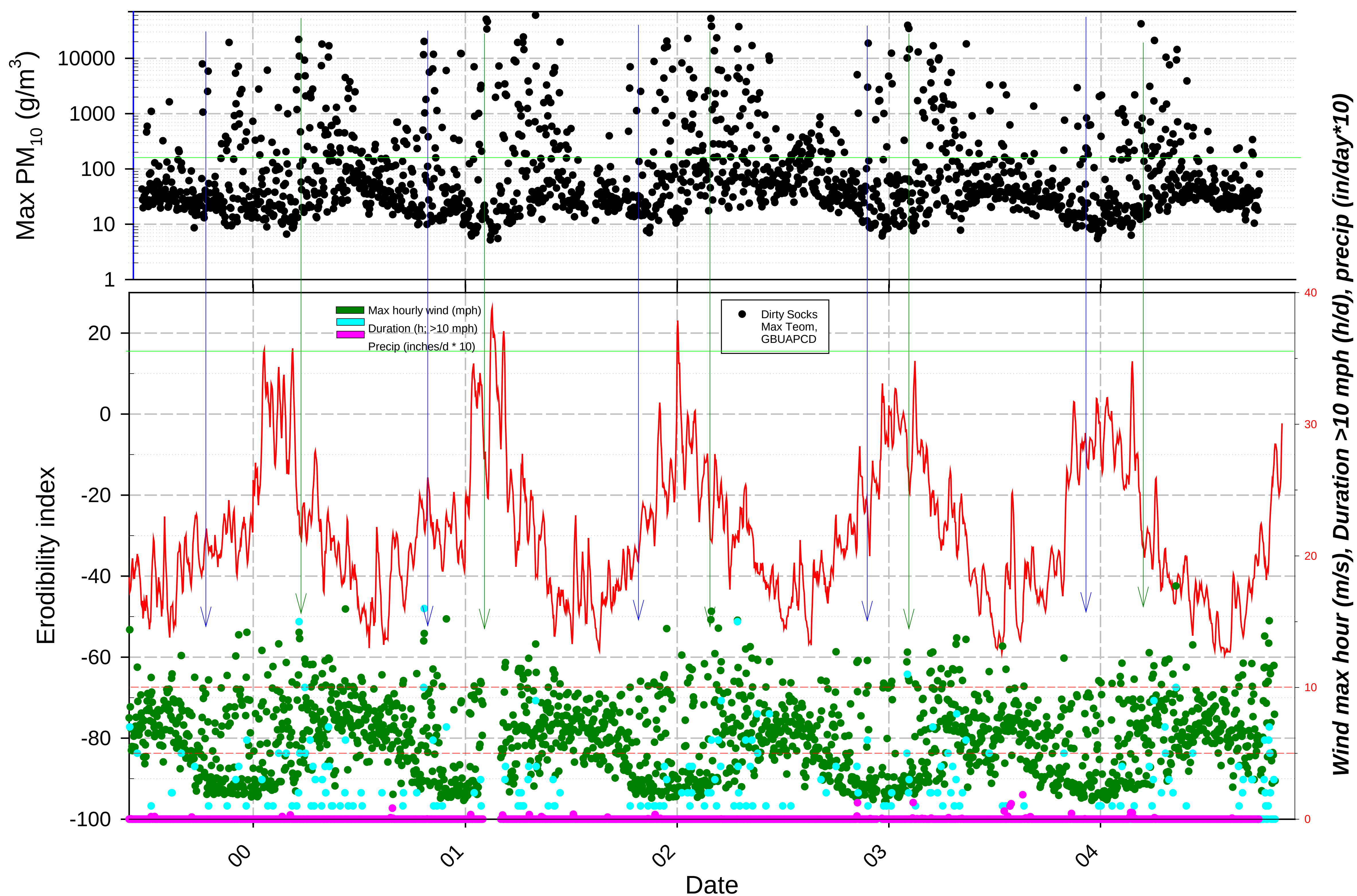


Figure 9. Fluctuations in erodibility index and climatic variables at Owens Lake,. Air quality data from GBUAPCD for Dirty Socks for the same period.

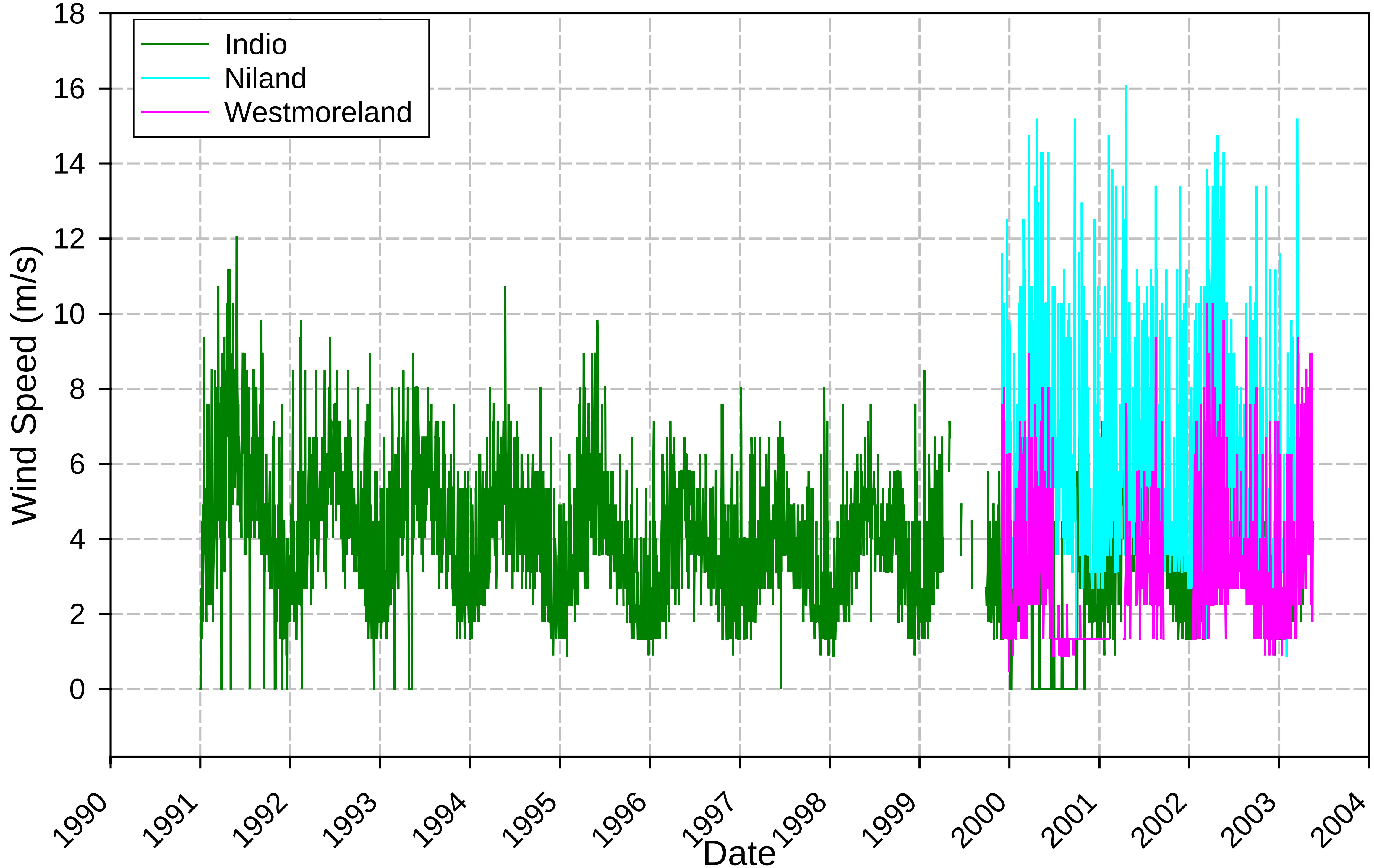


Figure 10. Wind speed data from Niland, Westmoreland, and Indio, CA.

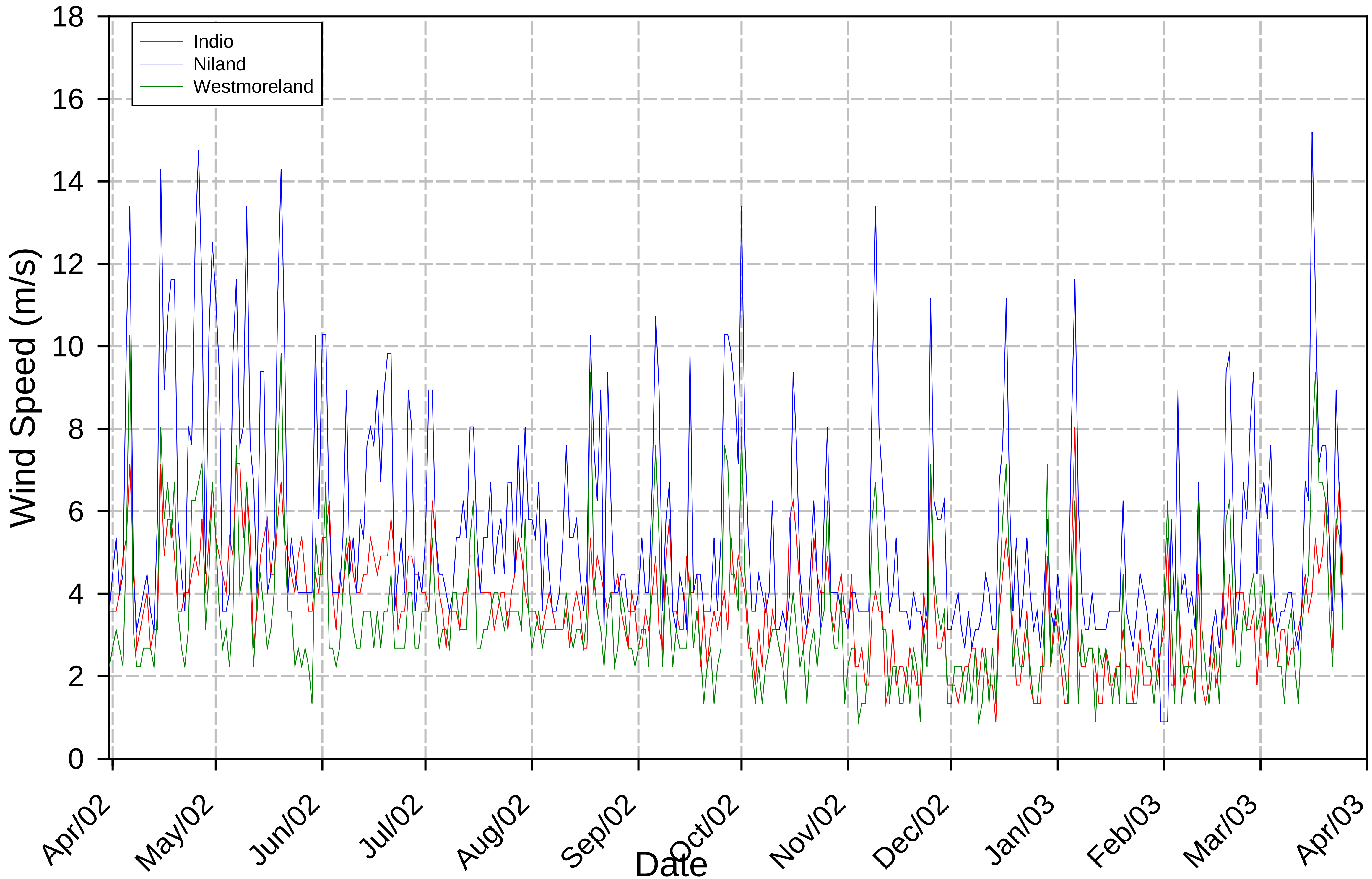


Figure 11. Fluctuations in wind speed at Niland, Westmoreland, and Indio, CA.

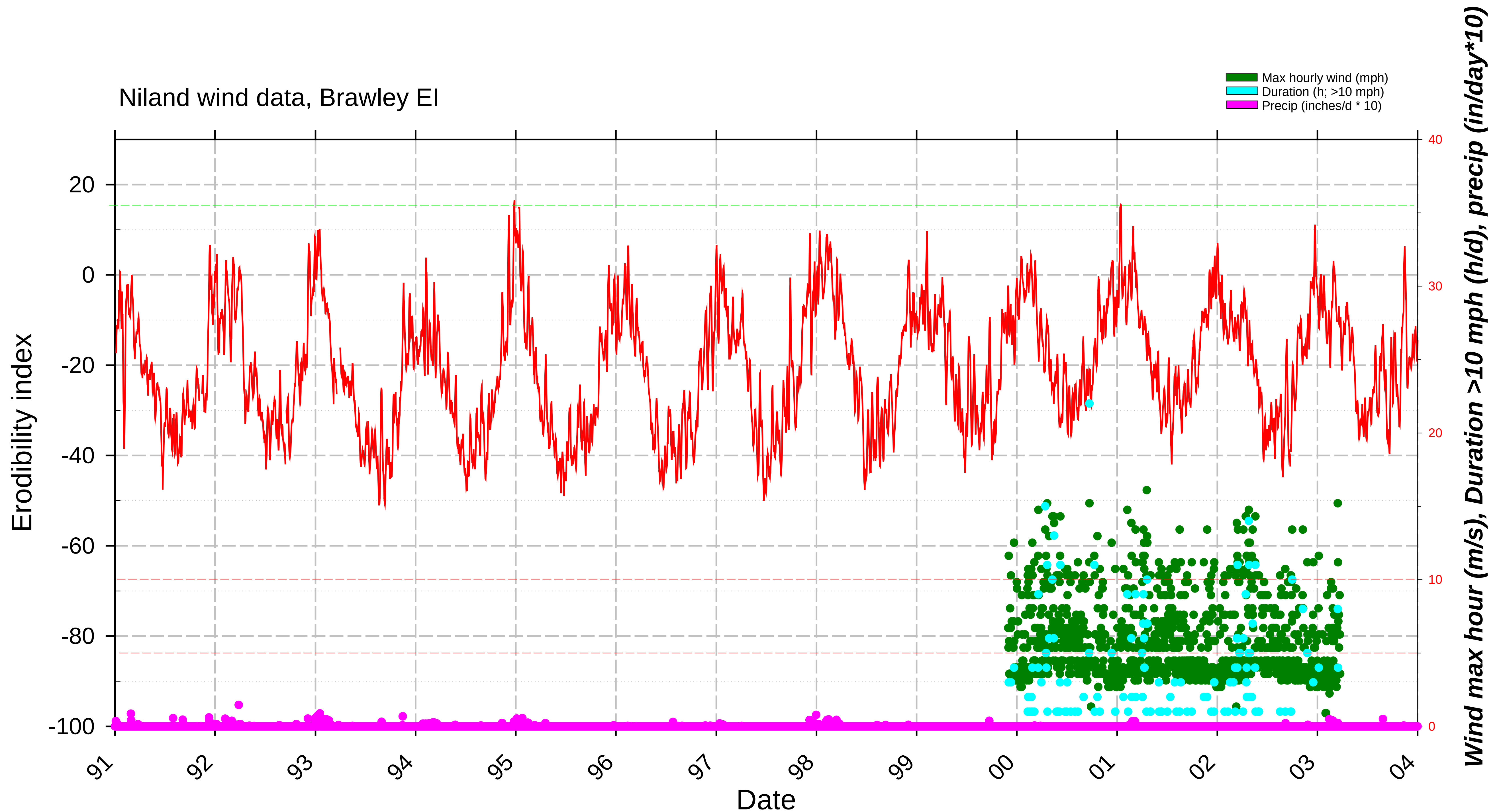


Figure 12. Erodibility index at Brawley, with wind speed data from Niland.

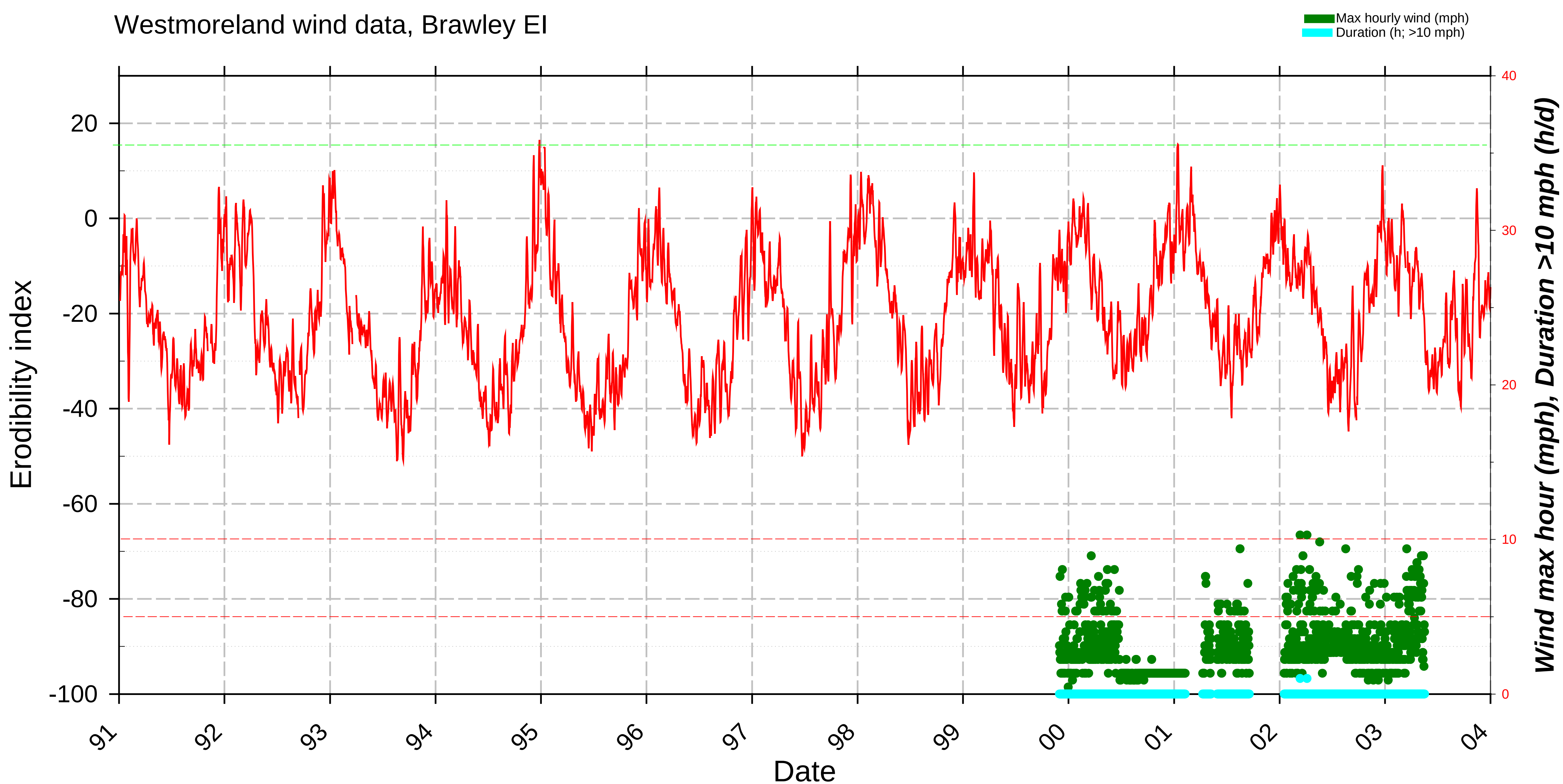


Figure 13. Erodibility index at Brawley, with wind speed data from Westmoreland.

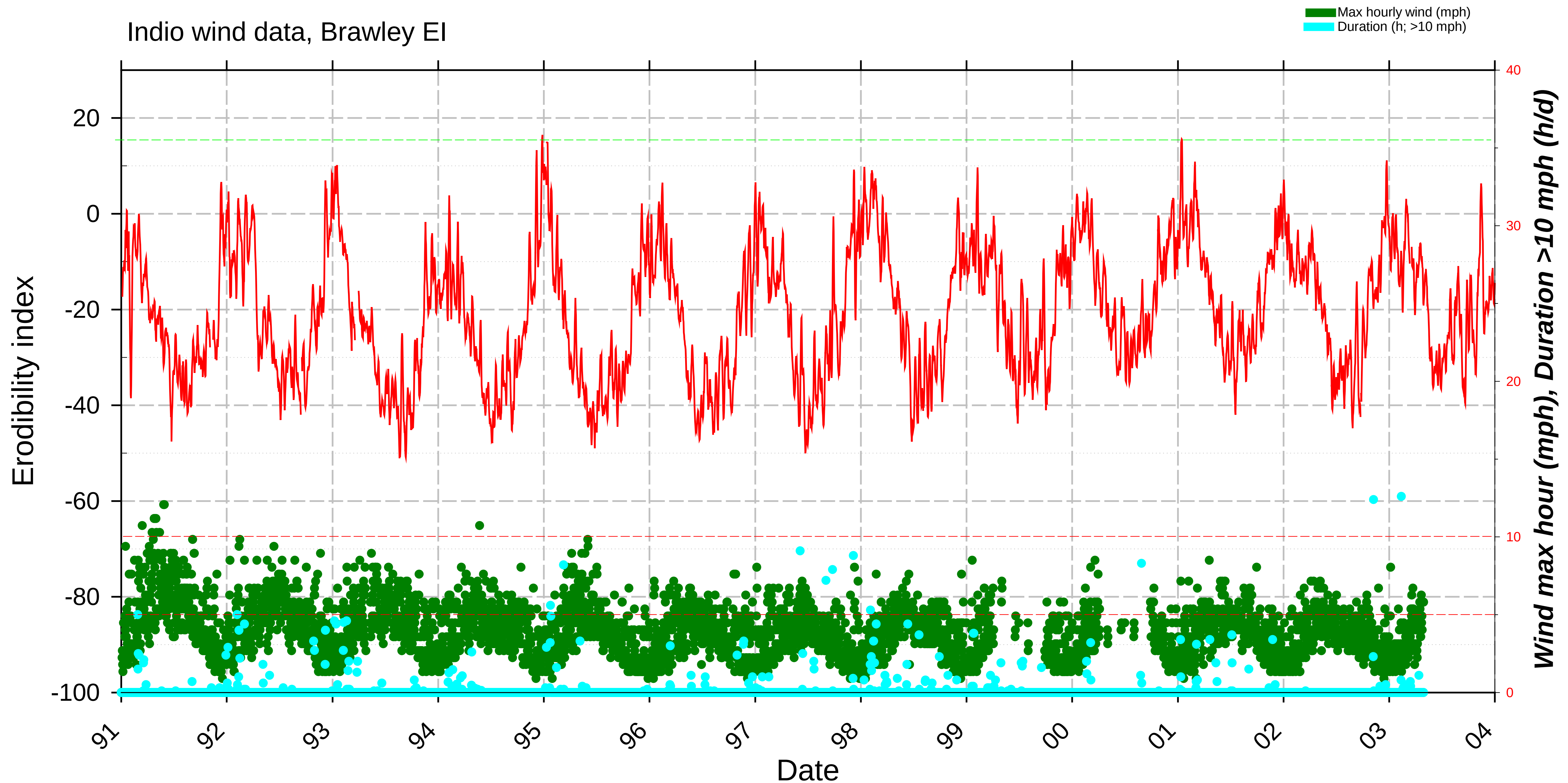


Figure 14. Erodibility index at Brawley, with wind speed data from Indio.

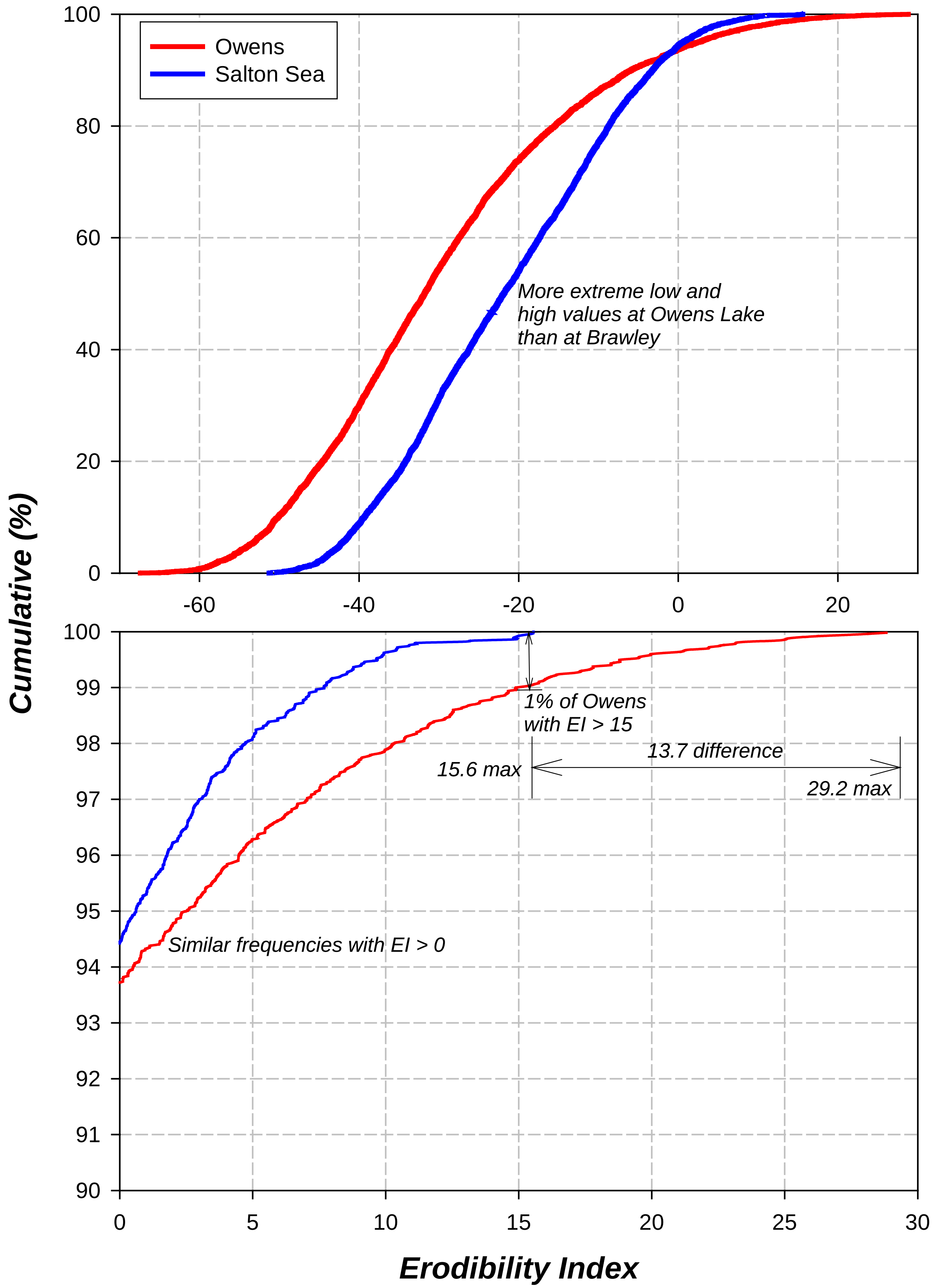


Figure 15. Cumulative EI distributions for Owens Lake and Brawley, 1991-2004.

Crusting is most important on undeveloped playa, where little protection is present. On surfaces that are protected by some other land use regime, crust dynamics will be less significant. Indeed, where the Playa is wetted, the nature of the crust may change significantly.

To be included in the Framework, the following crusting information will be required:

- Additional observations of crust dynamics on undeveloped areas near the Salton Sea shoreline, that have historically been flooded. These should include observations of durability in relation to temporal variation in climatic conditions, and spatial variability due to changes in soil and shallow groundwater conditions.
- Inclusion of crusted and noncrusted areas in wind tunnel tests. These can either be run on naturally soft, or on artificially destroyed crusts, which will at once provide data on emissions from areas impacted by mechanical or meteorological crust destruction.
- Develop PEP factors representing surfaces protected by competent crust, and areas not so protected due to weakening or destruction of the crust by rainfall, sand motion, traffic, etc.
- Develop a predictive calendar indicating when to apply factors representing competent and climate-weakened crust.

d. Soil and Sediment Properties

Available data on soil and sediment properties was discussed previously under “mapping”. In general, soil survey data include a number of variables that can be used to help predict rates of wind erosion (texture, organic matter, wind erodibility group [WEG], rock fragments at the surface, etc.) Texture and organic matter data are available from sediment sampling, as is an indication of barnacle encrustation. As mentioned previously, soils variables are important, but can be dominated by land use and crusting variables. Where barnacle encrustation occurs, it should protect the surface like a stable crust or rock fragments, and may therefore significantly affect PEP.

Soil and sediment data will be included in the Framework either through inclusion in emissions models, or by relating wind tunnel observations to soils variables. Emissions rate relationships can then be distributed based on available soil and sediment mapping.

As previously discussed, sand motion is a key driving force for dust emissions. Free sand sources such as dunes and sandy soils, which can blow and abrade exposed playa surfaces, are mostly quite distant from the shoreline where the greatest amount of Sea playa will be exposed. Sandy soils and dunes are located in western and eastern shore areas, where steep bathymetry will limit exposure under some restoration alternatives. Playa soils to be exposed are mostly fine textured, as shown by core and soil survey data (Figure 5).

Another potential source of sand-sized particles is the Playa crust itself. When surface crusts are abraded, sand sized particles of crust can be generated, and subsequently increase the amount of mobile sand available on the Playa surface.

The sand drift potential in the vicinity of the lake could be further quantified to provide information regarding the potential for sand to migrate and potentially impact areas of exposed shoreline. Sand drift potential can be expressed in “sand roses”, which are a circular histogram showing the mean magnitude and upwind direction of the wind field. The lengths of the arms are proportional to the potential amount of sand drift from the upwind direction. (Helm and Breed, 1999).

In summary:

- Sand sources at the Salton Sea are widespread, although they do exist in some areas where exposure may be quite limited under most alternatives, due to steep bathymetry.
- Absence of an existing, nearby sand supply may reduce the potential for dust emissions. However, there is potential for sand sized particles to be generated from Playa crust breakage, and these particles also have the potential to drive emissions when blown by high winds.

6. Predicting Emissions

The first step in predicting emissions is to identify variables that might affect PEP, and to test their effect on emissions. Several tools are discussed below, and the results of preliminary testing of one tool are presented.

On a general note, a key feature of emissions prediction approaches to be used in a credible PEIR analysis is regulatory acceptability. The work plan and associated stakeholder meetings provide an opportunity to review, refine, and vet approaches and tools described below.

a. Wind Erosion Prediction System (WEPS) Pilot Testing

Available literature on erosion models suggested that WEPS would contain the richest set of modeled relationships with which to characterize conditions on the Playa. Therefore, we pilot tested a beta version of the WEPS model to evaluate its potential for use in an impact analysis. Briefly, this model is intended to combine known relationships between climate, land and soil properties, and wind erosion from land surfaces. Such a model is one of the few ways to achieve the task goal of assessing "*…the particulate emission potential (PEP) of current and future exposed soils and sediments in the study area.*" Time did not permit an extensive application of the model to the types of Playa that may arise from the alternatives to be evaluated in the PEIR. However, local climate and representative land and soil input data were developed, and the model was run. The focus was on evaluating the sensitivity of the output emissions to certain properties that either have been, or will be, mapped, or that could otherwise be inferred for the Playa.

WEPS is a process-based, continuous, time-step computer model that simulates weather, field conditions, and erosion. It is intended to replace the Wind Erosion Equation (WEQ), a mostly empirical model developed in 1965. Given the schedule and scale of PEP assessments required to develop the PEIR, and the spatial and temporal variability inherent in the Playa, even limited applicability of an emissions model would be useful. Some specific potential advantages of the WEPS model include the following:

1. A rich library of input and output variables, allowing for the possibility to represent spatial and temporal variability more fully. (This is also a disadvantage, because the required input data set may require inputs that are not readily available in a soil survey).
2. Daily time-step, allowing for simulation of wind erosion events that influence air quality.
3. Based on documented processes and relationships, increasing the defensibility of results.

The WEPS model output is the average soil loss or soil deposition rate over a user-selected time period. It has the ability to simulate spatial and temporal variability of field conditions and the soil loss/deposition within a field. The size and shape of the field can be varied to represent real conditions in a location. The saltation, creep, suspension, and PM_{10} components of eroding material can be calculated and reported separately by direction in WEPS. The model uses input from seven submodels (soil properties, hydrology, management, weather, crop, deposition, and erosion).

The soil submodel goal is to simulate the soil temporal properties that control the wind erodibility of soil on a daily basis, and affect the emissions rate resulting from the driving forces of wind erosion. The soil input file includes the soil taxonomic order, the number and thickness of soil layers, a detailed particle size distribution, wet and dry bulk densities, aggregate stability-density-size distribution, soil crust properties, ridges, roughness, soil water characterization, dry albedo, organic matter, pH, calcium carbonate, and cation exchange capacity.

Soil survey information available from the Natural Resources Conservation Service (NRCS) was reviewed to determine representative soil series (a soil series is the lowest most refined category of the U.S. system of soil taxonomy) that were mapped near the Salton Sea shoreline.

Reviewing these mapped soils, two textural extremes were selected. The Imperial Silty Clay, Saline phase was selected to represent the finer textured soils, and a Niland Loamy Fine Sand was chosen to represent coarse textured soils. Measured soil properties from these mapped soils were drawn from the NRCS Soil Survey Geographic (SSURGO) soil layer data base, and were used to populate the submodel input file. Inputs for these soils are summarized in Table 2.

Some inputs (such as aggregate size) were not readily available. In these cases, a typical soil profile description for the soil series was reviewed for size and type of structure (such as fine granular structure for the surface soil horizon). This description was used to estimate the size of an aggregate. For instance fine granular structure by definition is 5 to 10 mm in size.

Soil textures were used to predict soil hydraulic conductivity in the soil layers. While not exact, those conductivity rates are expected to be relatively close to those measured in the field. In a similar manner, where soil physical characteristics were not known, estimates and assumptions were developed based on available data and an understanding of soil science.

However, some inputs could not be readily addressed in this manner. In those cases, we reviewed documentation for the Soil Submodel to determine the typical ranges of input values. Values were then selected based on consistency with other soil properties.

Additionally, the WEPS model was run for another soil profile synthesized from the subsoil of the sandy textured soil and the surface of the clayey profile to create a “middle of the road” textured soil. Thus, the model was run on an actual mapped sandy, coarse-textured soil and a clayey, fine-textured soil, along with a created medium-textured soil.

Inputs for these 3 soil profiles were altered to test the sensitivity of the model to various parameters. Profile descriptions were altered, sequentially testing input values from the high and low end of possible ranges for these parameters. These results provided a sense of some of the functional limitations of this model for application to the soils around the Salton Sea.

Some assumptions employed when running the model include the following:

- Runs were based on a 1 km by 1 km field, without rotation to adjust for prevalent wind angles.
- No wind barriers around the field edges were assumed.
- No vegetation planting was assumed.
- No other management activities were assumed.
- Data were processed over 1-year period.
- Run in default NRCS mode. This processes the data by multiple iterations.

This method provides the average (expected) outcome, with an error bar reported as the standard deviation.

Standard deviation of the resulting total soil loss was about 1 percent of the mean.

Figure 16 shows that PM_{10} emissions tracked monthly average wind energy through the year. This would imply that the land surface was almost equally erosive throughout the year.

Figure 17 shows average wind energy and precipitation. Note that on Figure 16, the PM_{10} line sometimes dropped below the average wind energy line when there was (even relatively slight) rainfall. This suggests that the model (as would be expected) corrects for changes in surface erodibility caused by other factors.

Figures 18 and 19 show the annual erosion rates as a function of alterations in the soil texture. Figure 18 shows the results for each of the three soil profiles tested, as a function of the percent fines in each. The finer textured soils erode more rapidly. Figure 19 shows the effect of a single parameter change in sand fraction in the surface layer of the intermediate textured soil. Again, the finer the soil texture, the more rapid the erosion. This implies that relatively little account of surface soil structure is taken. Finer particles are more easily suspended, but only if they are first detached from aggregates. Also, this is opposite from what would be predicted if a soil were protected by a soil crust. In that case, sand (or sand sized particles) acts as an abrasive when driven at the crust by wind, and may cause crust breakage and particle detachment, thus increasing erosion rates. Nevertheless, for the inferred assumptions (little structure, no crust), the results are reasonable. The magnitude of the soil texture's effect on erosion rate is very large.

Figure 20 shows the effect of aggregate diameter on erosion rates. The observed increase at small aggregate diameter is expected. When aggregates get larger than 5-10 mm, soil loss levels out and larger aggregates have little additional effect. However, continued high emissions rates at large aggregate sizes is not expected. A soil composed of aggregates larger than several millimeters should be very hard to entrain.

The magnitude of variation from aggregation is relatively slight.

Figures 21 and 22 show the, sheltering effect of rock fragments, which increases in importance as the soils of finer textures are protected. This may be the part of the model that most resembles the function of a stable soil crust. Otherwise, the documentation indicates that WEPS creates nonemissive surface crusts in the presence of sufficient precipitation or irrigation moisture, but not under dry conditions. Sensitivity runs indicated that no protective crusts were present, even when crusting variables were introduced. It appears that WEPS defines and handles the crust strength and formation differently from what occurs on playas, which is not surprising. This feature warrants discussion with the model developers to determine how WEPS deals with crusts, and how to adjust the analysis to account for Playa surface properties.

Figure 23 shows the effect of altering the organic matter content of the intermediate-textured soil. As would be expected, there is a slight increase in erodibility as organic matter decreases from 1 percent to 0.1 percent. The likelihood of an organic (10 percent organic matter) soil in the desert is very small, but if it existed, the organic fraction might be quite erodible in its own right, as suggested in the figure.

In general, the model shows some promise, particularly for application in extending wind tunnel results across diverse landscapes and time frames. Its place in the Framework may be developed with this goal in mind.

WEPS does require many input variables. This limitation is recognized. Although WEPS is somewhat complex and demanding in terms of data input, it appears to be a better tool for dealing with wind erosion on the Salton Sea Playa. This is specifically because factors affecting emissions from the Playa are thought to be, like other playas, different from farmland and the like for which models were principally formulated. WEPS offers potential for capturing these processes either through identification of appropriate subroutines in WEPS, or through enhancement of key subroutines to improve simulation of Playa erosion processes.

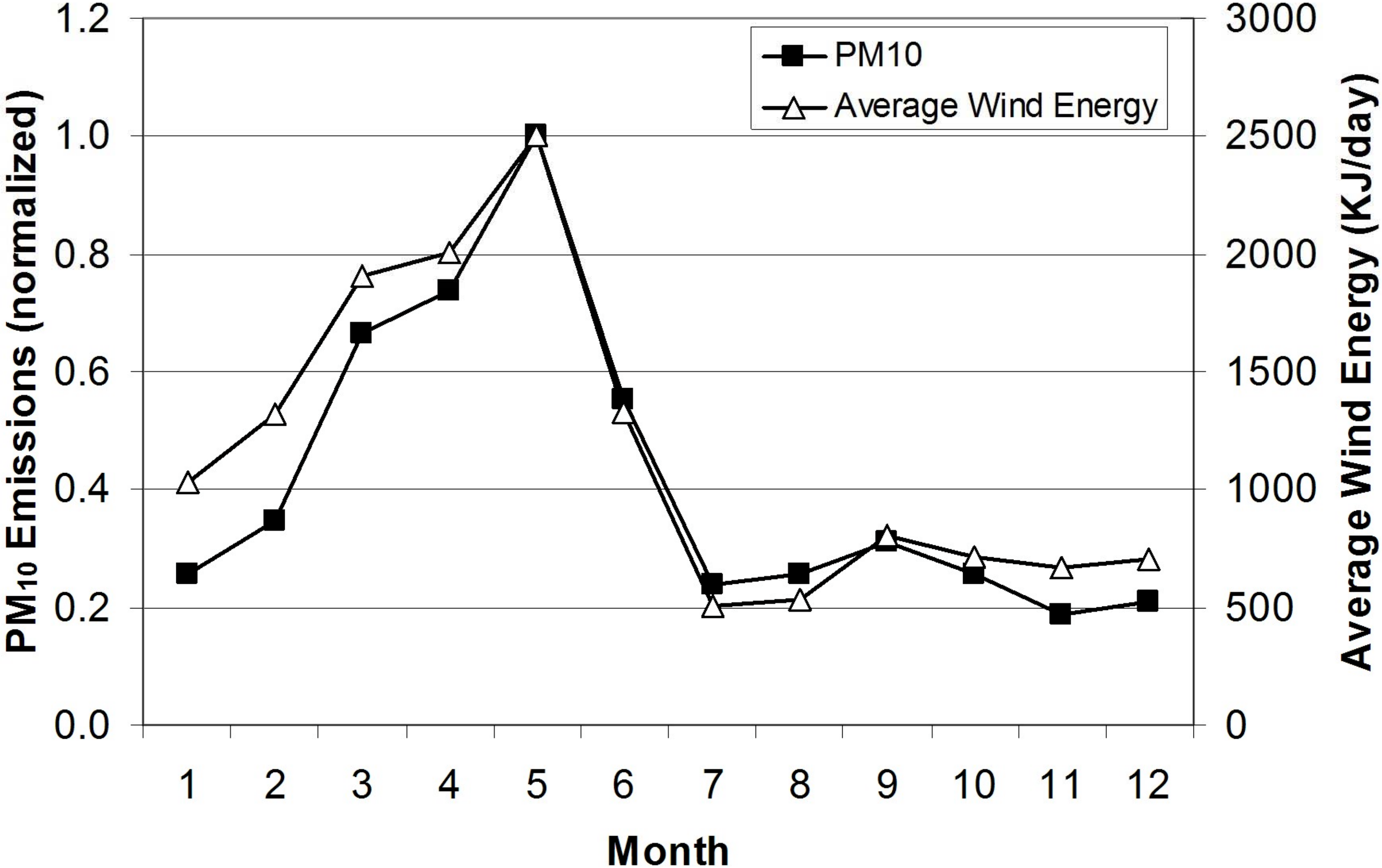


Figure 16. PM10 emissions and wind energy throughout the year, as modeled by WEPS.

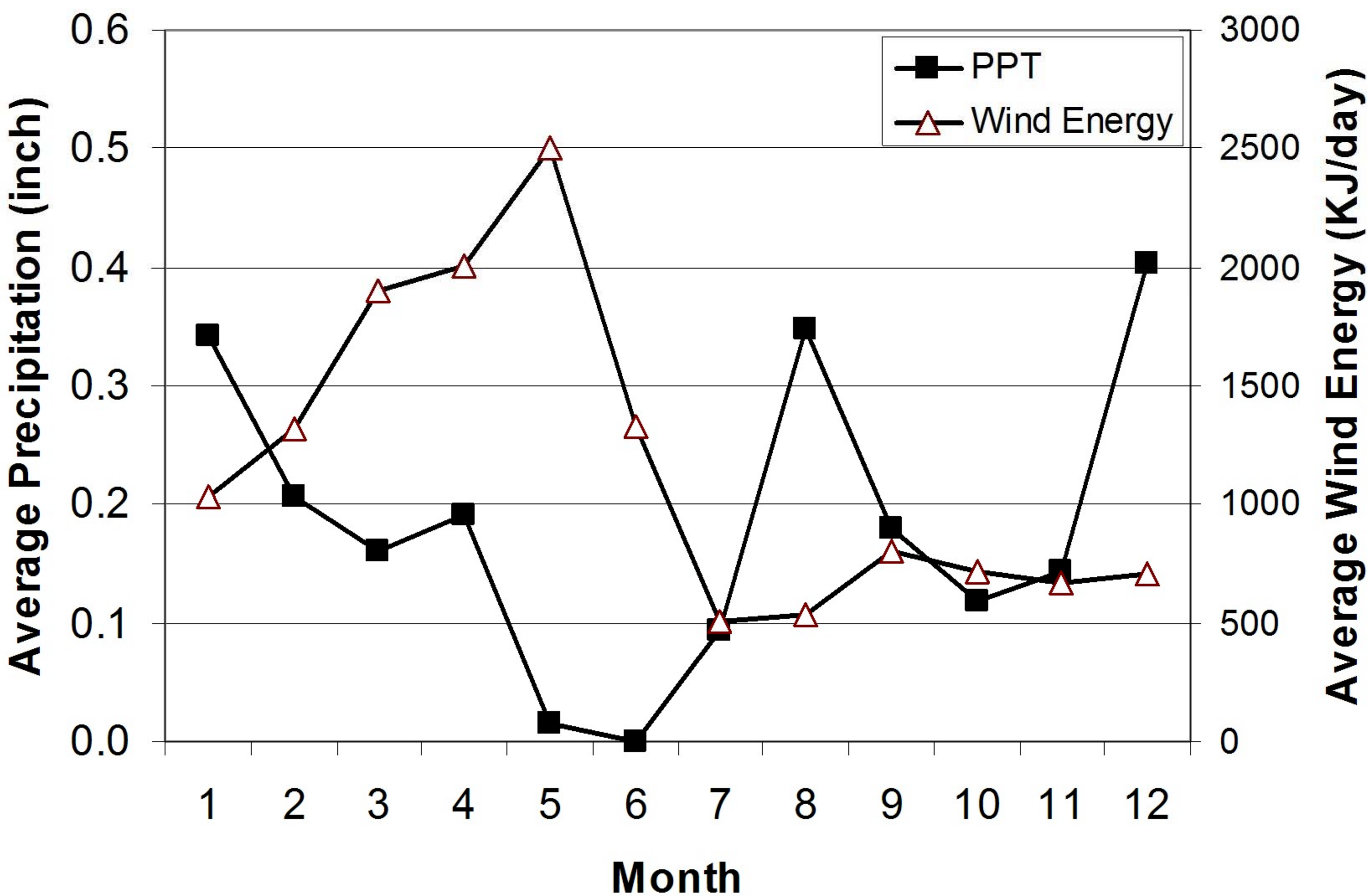


Figure 17. Precipitation and wind energy throughout the year, as input to WEPS.

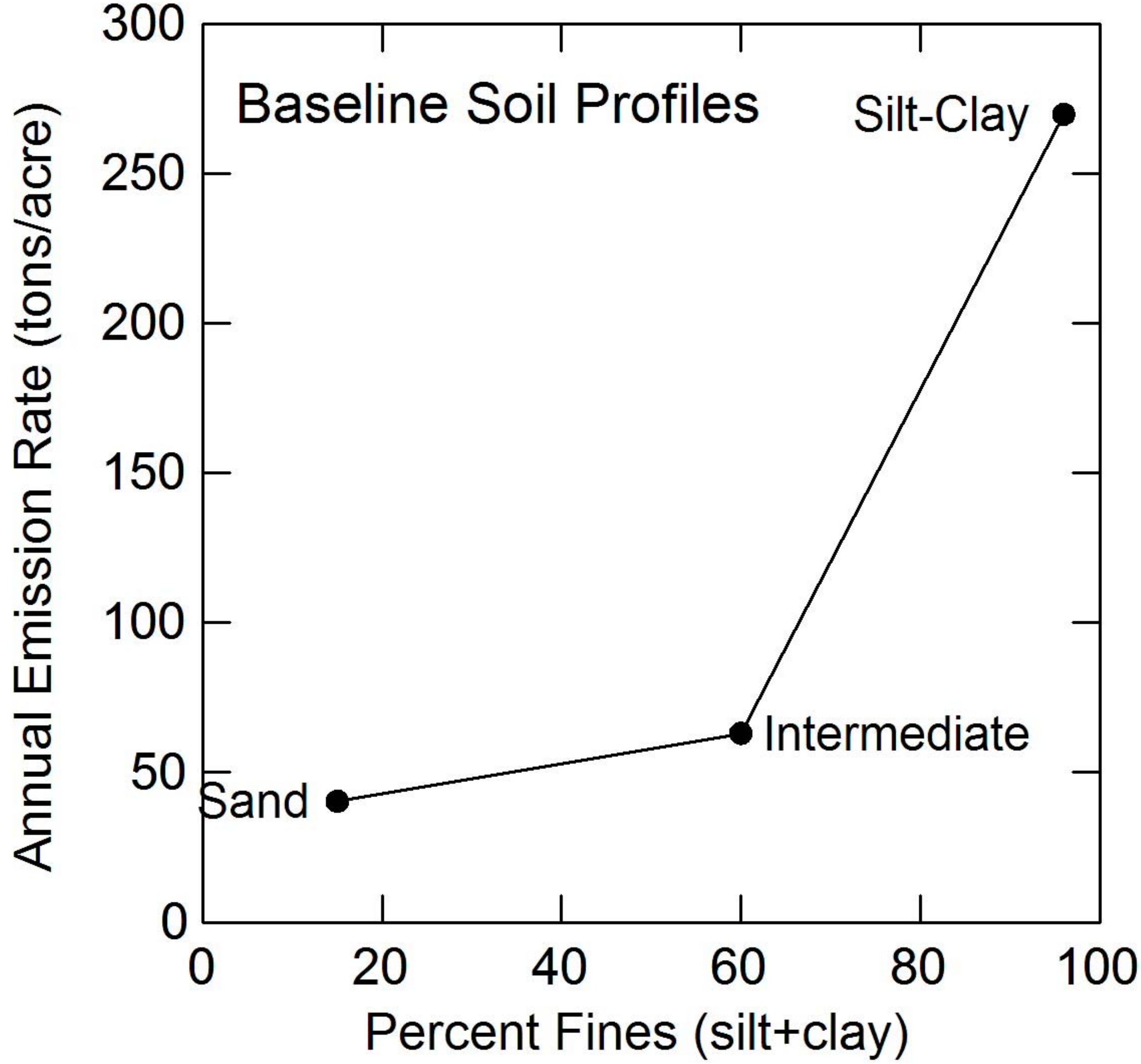


Figure 18. Annual emissions rate for three modeled soil profiles, as modeled by WEPS.

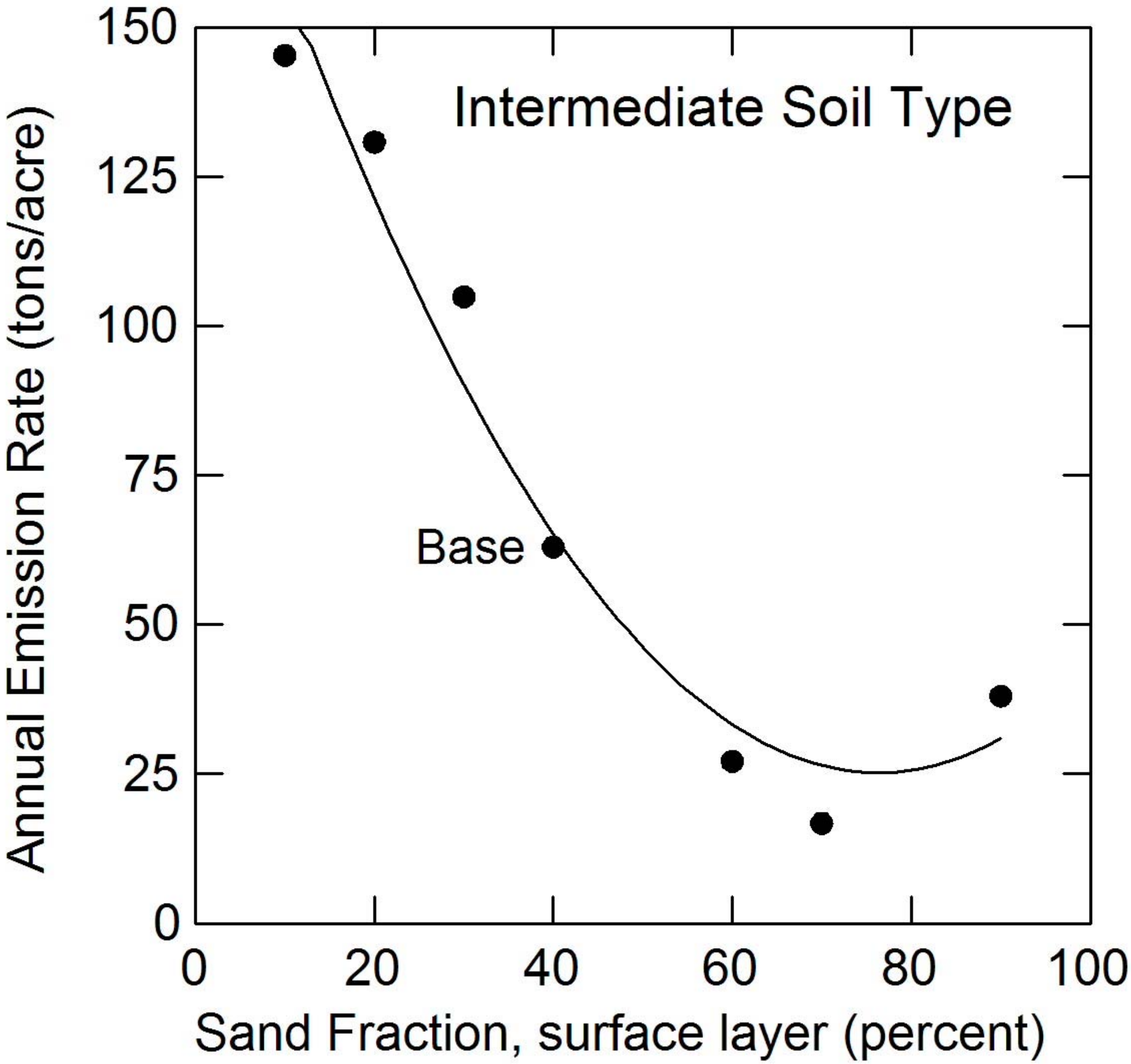


Figure 19 Annual emissions rate as a function of changes in sand fraction, as modeled by WEPS.

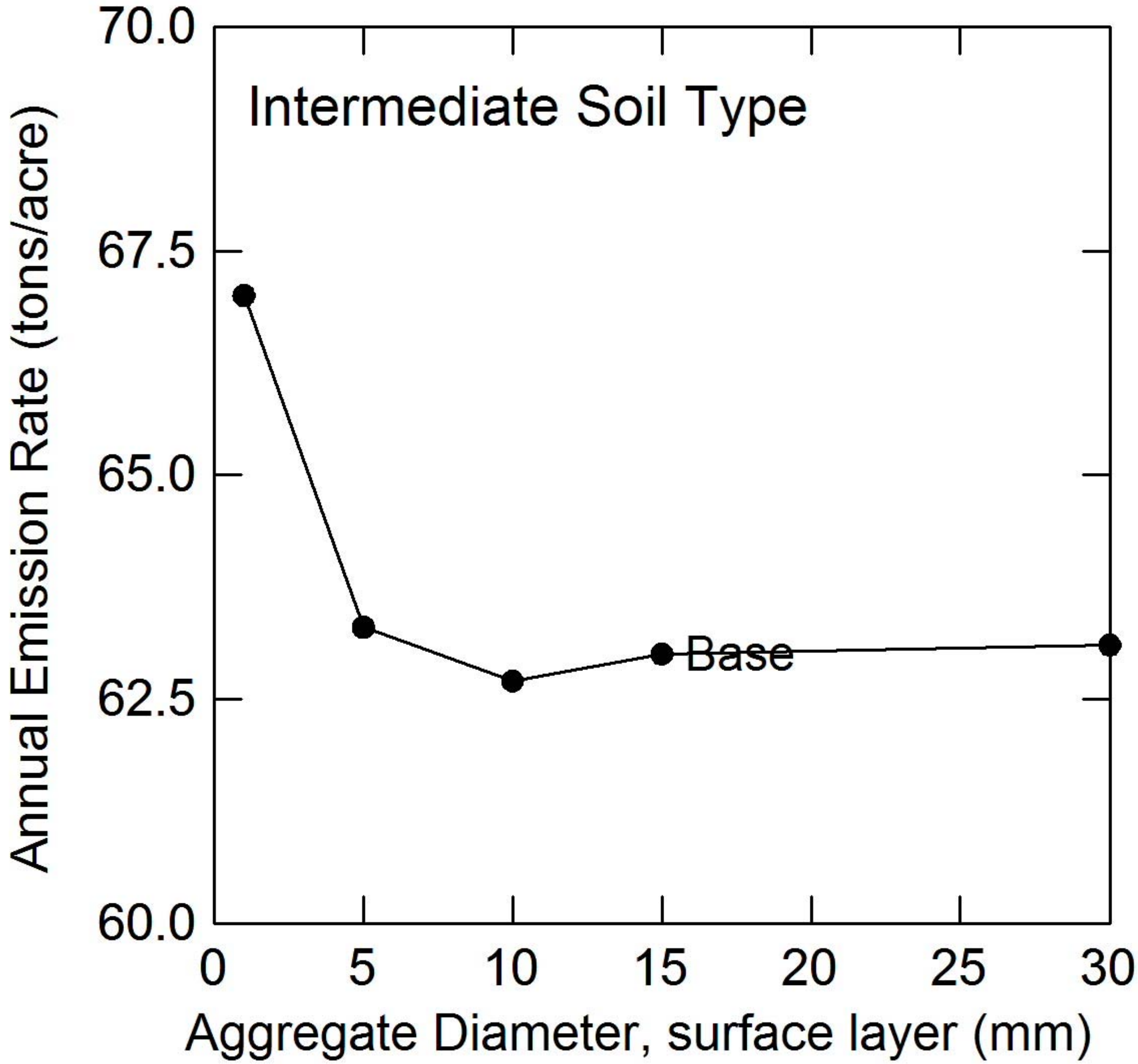


Figure 20. Annual emissions rate as a function of alterations in aggregate diameter, as modeled by WEPS..

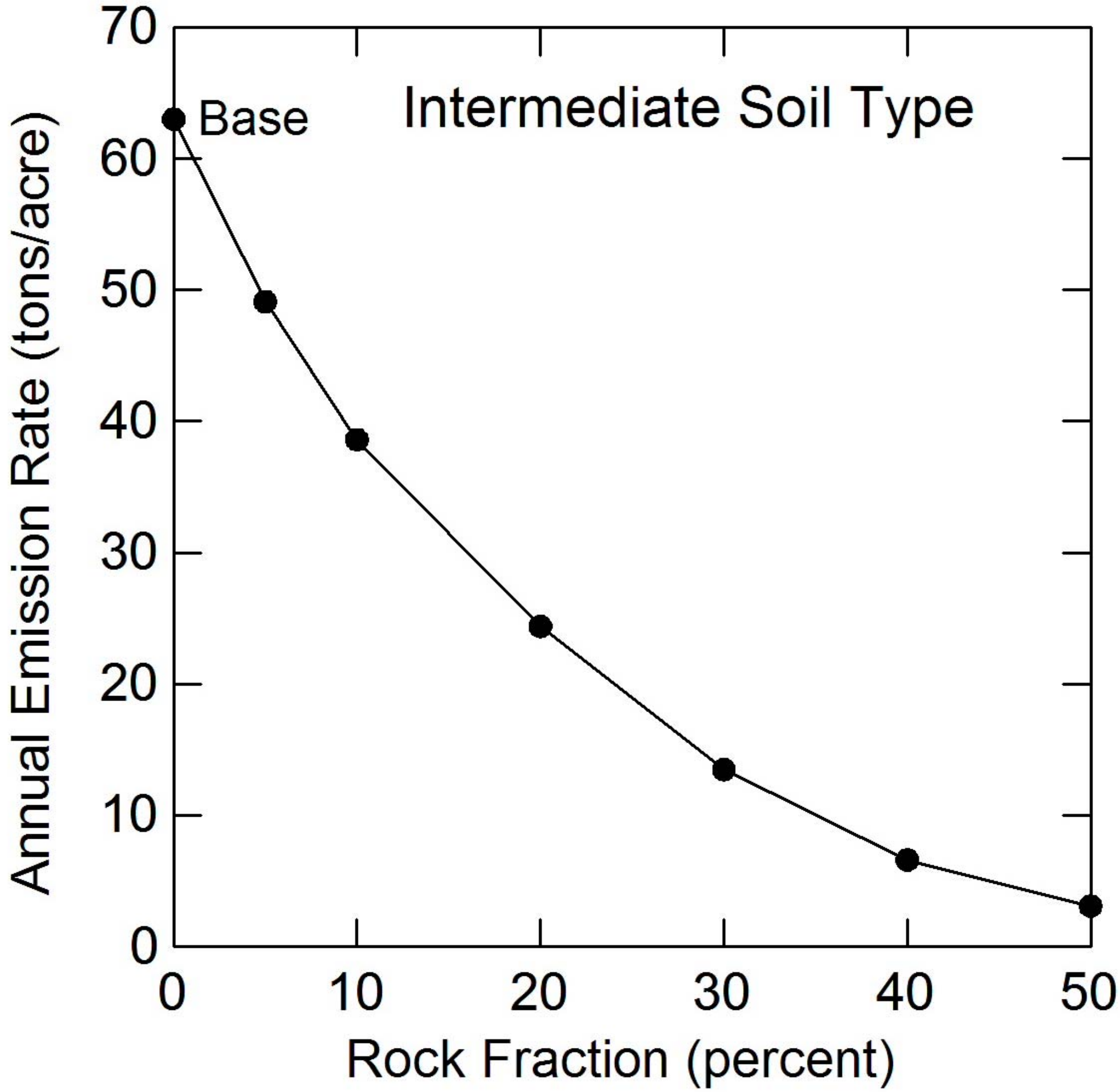


Figure 21. Annual emissions rate as a function of variations in rock fraction for an intermediate soil texture, as modeled by WEPS.

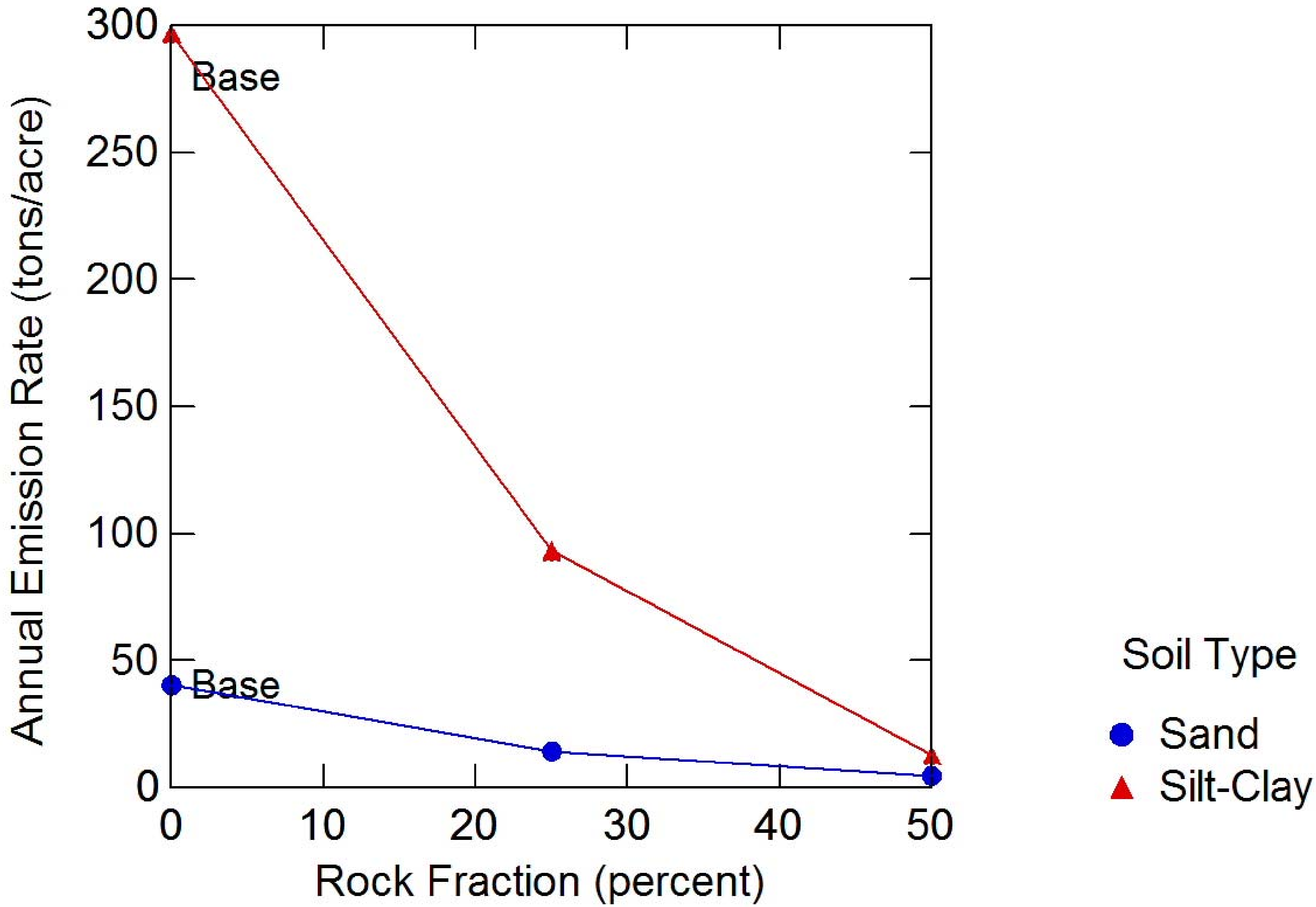


Figure 22. Annual emissions rate as a function of variations in rock fraction for sandy and silt-clay soil textures, as modeled by WEPS.

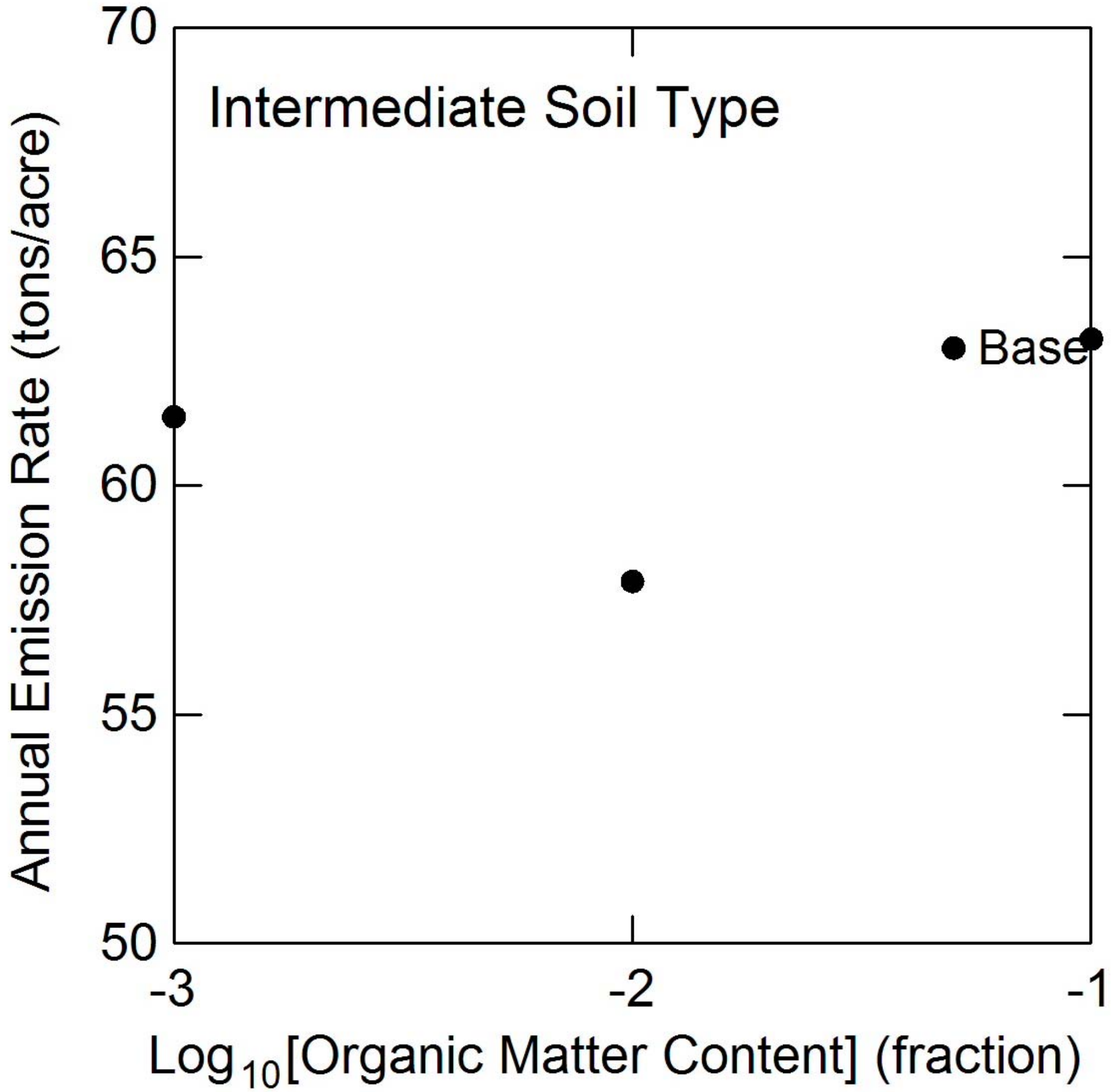


Figure 23. Annual emissions rate as a function of variations in organic matter fraction for an intermediate soil texture, as modeled by WEPS.

Table 2
WEPS Model Inputs

Type		Soil Layers					Sand Fraction					Density		Aggregate Size					
	Soil Layer	Layer Thick. (mm)	Sand Frac.	Silt Frac.	Clay Frac.	Rock Frag.	Coarse	Med.	Fine	Very Fine	Water Disp. Clay	Bulk (dry)	Bulk (1/3 bar)	Geo. Mean Dia.	Geo. Stnd. Dev.	Max Agg. Size	Min. Agg. Size	Agg. Density	Agg. Stability
Fine Textured	Surface	305	0.04	0.45	0.51	0.00	0.00	0.00	0.02	0.02	0.00	1.45	1.35	1.50	5.00	50.00	0.01	1.00	2.00
	Sub	1524	0.04	0.36	0.60	0.00	0.00	0.00	0.02	0.02	0.00	1.45	1.35	30.00	10.00	100.00	0.01	1.00	3.00
Intermed.	Surface	445	0.40	0.25	0.35	0.00	0.00	0.02	0.20	0.18	0.00	1.45	1.35	15.00	10.00	50.00	0.01	1.00	3.00
	Sub	1524	0.04	0.45	0.51	0.00	0.00	0.00	0.02	0.02	0.00	1.45	1.35	1.5	5.00	50.00	0.01	1.00	2.00
Coarse Textured	Surface	584	0.85	0.10	0.05	0.00	0.00	0.043	0.43	0.377	0.00	1.70	1.60	0.10	4.00	50.00	0.01	1.00	2.00
	Sub	1524	0.40	0.25	0.35	0.00	0.00	0.02	0.20	0.18	0.00	1.45	1.35	30.00	10.00	100.00	0.01	1.00	3.00

Table 2 (cont.)

Type		Soil Crust						Water Content							
	Soil Layer	Crust Thick. (mm)	Crust Density	Crust Stability	Crust Surface Fraction	Loose Mat. (kg)	Fraction Loose Mat.	Initial Water Content	Saturation Water Content	Field Capacity Content	Wilting Point Content	Bar On Sand	Soil CB Value	Air Entry Potential	Sat. Hydraul. Conduct.
Fine Textured	Surface	2.00	1.00	4.00	0.25	0.50	0.25	0.10	0.208	0.15	0.06	0.012	5.00	-9.00	1.0E-6
	Sub	N/A	N/A	N/A	N/A	N/A	N/A	0.10	0.208	0.15	0.06	0.012	5.00	-9.00	1.0E-7
Intermed.	Surface	1.00	1.00	2.50	0.25	0.75	0.15	0.13	0.208	0.15	0.10	0.012	5.00	-15.00	1.0E-6
	Sub	N/A	N/A	N/A	N/A	N/A	N/A	0.13	0.208	0.15	0.06	0.012	5.00	-9.00	1.0E-6
Coarse Textured	Surface	1.00	1.00	0.50	0.25	1.00	0.04	0.07	0.208	0.08	0.06	0.012	5.00	-15.00	0.001
	Sub	N/A	N/A	N/A	N/A	N/A	N/A	0.13	0.208	0.15	0.10	0.012	5.00	-15.00	1.0E-6

Table 2 (cont.)

Type		Other					
	Soil Layer	Random Rough.	Dry Soil Albedo	Organic Matter (fraction)	Soil PH	CaCO3 Equiv.	Cation Exch. Capacity
Fine Textured	Surface	4.00	0.30	0.005	8.50	0.15	30.00
	Sub	N/A	N/A	0.010	8.50	0.10	40.00
Intermed.	Surface	5.00	0.30	0.050	8.00	0.10	35.00
	Sub	N/A	N/A	0.010	8.50	0.15	30.00
Coarse Textured	Surface	6.00	0.30	0.000	8.00	0.15	2.00
	Sub	N/A	N/A	0.050	8.00	0.10	35.00

Sensitivity analysis show how the various subroutines respond to changes in key variables. Users could now detail how WEPs can most appropriately be used for this project, identify model issues to be researched in greater detail or addressed with developers, and define a methodology for developing input data sets.

Readily available soil survey data does not specify each of the possible input parameters. However, missing or vague parameters can be deduced, selected, or calculated based on soil survey data, known soils relationships, and anticipated land management. In general, the professional judgment required during input parameter development would be minimized.

SUITABLE LOCATIONS FOR WIND TUNNEL TESTS

Several locations for wind tunnel tests were identified. Criteria included representation of a range of soil conditions that might effect PEP, as well as proximity to the Salton Sea shoreline, so that the area might be as reflective of adjacent, flooded sediments as possible.

NRCS soil survey mapping was reviewed, and several potential locations were identified (see Figure 24). Soils were studied adjacent to and/or in close proximity to the Salton Sea shoreline. As the water level in the Sea becomes lower and exposes Playa, these soils should have similar properties to soils that are adjacent to the shoreline. However, because Playa soils have been submerged for a significant period of time, their properties will reflect the influence of this condition (higher salinity, influence of wave action, deposition, anaerobic conditions, etc.). The basic physical characteristics should still resemble the adjacent, mapped soils. *Locations indicated on the Figure 24 should be refined and finalized based on field evaluation of local site conditions.*

In general, wind tunnel experiments should be conducted on a coarse-textured sandy soil, a soil that is covered with gravel or rock fragments (i.e., in an area that might mimic how a barnacle encrusted soil might react to winds), and on a variety of finer textured soils that exist around the lake. These finer soils have been mapped and reflect various levels of wetness, flooding, and salinity.

Table 3 lists soils representing a wide range of characteristics that are found nearby to the Salton Sea shoreline. Field reconnaissance will be required to properly locate the study locations and to make sure the mapped soils accurately reflect the characteristics as mapped.

Table 3
Soil Mapping Units Identified for Wind Tunnel Testing

		Surface Texture	Organic Matter (%)		
Mapping Unit	**Survey Area**	**USDA**	**Surface**	**Subsurface**	**Wind Erodibility Group**
104	Imperial	Varies but finer than LS	1 to 2	0.5 to 1	Not estimated
113	Imperial	SiC	0.5 to 1	0 to 0.5	4
114	Imperial	SiC	0.5 to 1	0 to 0.5	4
115	Imperial	SiC	0.5 to 1	0 to 0.5	4
122	Imperial	vfSL	0.5 to 1	0 to 0.5	4L
132	Imperial	fS	0 to 0.5	0	1
CrA	Riverside	fS	0 to 0.5	0	2
CdC	Riverside	grS	0 to 0.5	0	Not estimated
McB	Riverside	fS	0 to 0.5	0	1

Dry soil aggregates more than 0.84 mm (percent by weight); estimated, to be confirmed in field
SiC – Silty clay; vfSL – Very fine sand loam; fS – Fine sand; grS – Gravelly sand

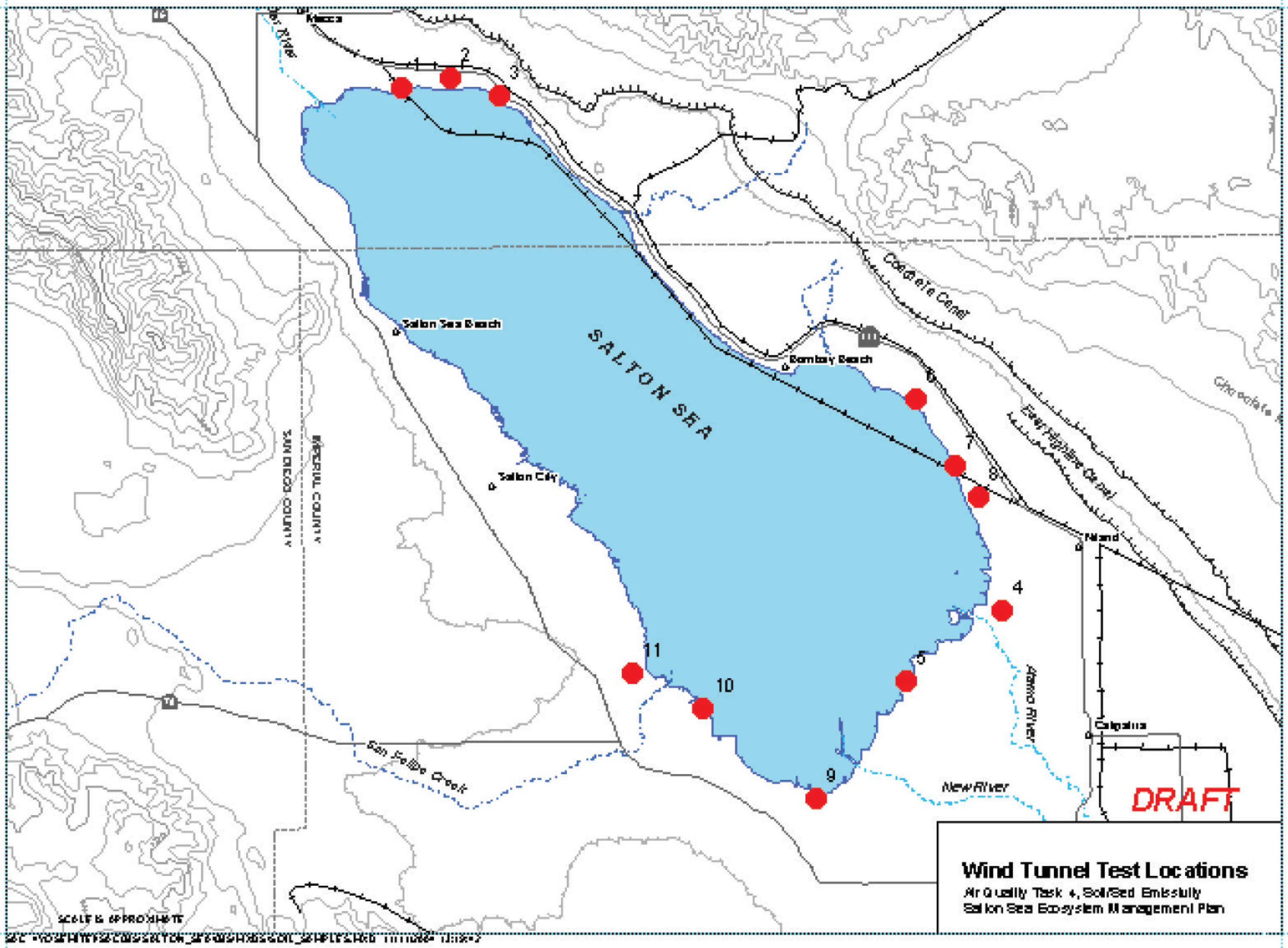


Figure 24. Proposed wind tunnel testing locations at Salton Sea.

Table 4 lists the mapping units and wind erosion groups for each sampling location, as numbered on Figure 24.

Table 4
Mapping Units for Wind Tunnel Testing Sites Shown on Figure 24

Site no.	Mapping Unit	Survey Area-County	Soil Series	WEG
1	CrA	Riverside	Coachella fine sand	2
2	McB	Riverside	Myoma fine sand	1
3	CdC	Riverside	Carsitas gravelly sand	Not estimated (slight)
4	114	Imperial	Imperial silty clay, Wet	4
5	115	Imperial	Imperial-Glenbar silty clay loam	4
6	113	Imperial	Imperial Silty clay loam, Saline	4
7	104	Imperial	Fluvaquents, Saline	Not estimated
8	114	Imperial	Imperial silty clay, Wet	4
9	114	Imperial	Imperial silty clay, Wet	4
10	122	Imperial	Meloland very fine sandy loam, Wet	4L
11	132	Imperial	Rosita fine sand	1

Wind tunnel testing will likely form a key part of the PEP assessment, as indicated in the Framework. If some improvements can be achieved in the WEPS model to improve its applicability, it may provide a basis for adjusting wind tunnel results to address a broader range of Playa conditions than can be evaluated in the field with available time and budget.

CONCLUSIONS AND NEXT STEPS

Figure 1, showing the PEP assessment framework, may serve as a useful roadmap in developing Playa emissions estimates for analysis of potential Ecosystem Restoration Plan alternatives. The highest priority tools and data should be sought first, focusing on factors that will likely have a dominant effect on Playa PEP, and which can be employed credibly in the PEIR development timeframe.

REFERENCES

CH2M HILL. 2003. Response to comments on the Environmental Assessment for the Wastewater Conveyance and Treatment Project for the Mexicali II Service Area (dated August 2003). December.

Dixon, J.B. and S.B. Weed (Eds). 1989. Minerals in Soil Environments, 2nd ed. Soil Science Society of America Book Series: 1. p. 310.

Haff, P. K. & Presti, D.E., 1995, Barchan Dunes of the Salton Sea Region, California, in Tchakerin, v. p., ed., Desert Aeolian Processes: Chapman & Hall, London, pp. 153-177

Helm, P., and C.S. Breed, 1999, Instrumented field studies of sediment transport by wind, in Breed, C.S., and Reheis, M., eds., Desert Winds: Monitoring wind-related surface processes in Arizona, New Mexico, and California, Volume USGS Professional Paper 1598: Washington, DC, United States Government Printing Office, p. 30-51.

Levine Fricke (LFR). 1999. Synthesis Document of Current Information on the Sediment Physical Characteristics at the Salton Sea. Riverside and Imperial counties, CA. March 3.

MacDougall, C.R., M.F. Uhl. 2002. Empirical method for determining fugitive dust emissions from wind erosion of vacant land: "The MacDougall Method". http://www.epa.gov/ttn/chief/conference/ei12/fugdust/present/macdougall.pdf

McKenna Neuman, C., and C. Maxwell, A wind tunnel study of the resilience of three fungal crusts to particle abrasion during aeolian sediment transport, Catena, 38, 151-173, 1999.

Rice, M.A., and I.K. McEwan, Crust strength: a wind tunnel study of the effect of impact by saltating particles on cohesive soil surfaces, Earth Surface Processes and Landforms, 26, 721-733, 2001.

Rice, M.A., B.B. Willetts, and I.K. McEwan, Wind erosion of crusted soil surfaces, Earth Surface Processes and Landforms, 21, 279-293, 1996.

Rice, M.A., I.K. McKewan, and C.E. Mullins, A conceptual model of wind erosion of soil surfaces by saltating particles., Earth Surface Processes and Landforms, 24 (5), 383-412, 1999.

Saint-Amand, P., et al. 1987. Owens Lake, an Ionic Soap Opera Staged on a Natric Playa. Geological Society of America Centennial Field Guide – Cordilleran Section. p.113-118.

Troi, A., et al. 2002. Indoor environment measurements and salt degradation on cultural heritage. Poster presentation.

Wagner, L.E. 1996. An overview of the wind erosion prediction system. USDA ARS and Kansas Ag. Ex. Station, Contribution No. 96-205-A.