Enhanced Vegetation Pilot Study on the Salton Sea Playa

Background

The Imperial Irrigation District (IID) Water Conservation and Transfer Project (Water Transfer Project) includes a long-term transfer of up to 303,000 acre-feet of water annually from IID to the San Diego County Water Authority, Coachella Valley Water District, and Metropolitan Water District of Southern California. The Water Transfer Project, along with other factors affecting Salton Sea inflows and water balance, will result in accelerated exposure of the Salton Sea floor. As the Sea continues to recede, there is potential for windblown dust emissions from the exposed dry lakebed (the playa). A significant portion of this windblown dust is PM_{10} (particulate matter with an aerodynamic diameter of 10 micrometers or less). PM_{10} are approximately 1/7th the thickness of a human hair, are small enough to be inhaled, and represent a potential human health risk.

The primary source of PM_{10} emissions from exposed Salton Sea playa will likely be from saltation of sand and sand-sized soil particles. Saltation is the bouncing or leaping of sand and soil particles across the playa surface. As particles saltate, they abrade surfaces and dislodge smaller particles, generating dust (Figure 1). Windblown erosion can also expose underlying, sometimes more erodible soil layers. Dust control measures (DCMs) on the Salton Sea playa will be designed to reduce PM_{10} emissions by reducing the availability and/or kinetic energy of saltating particles.

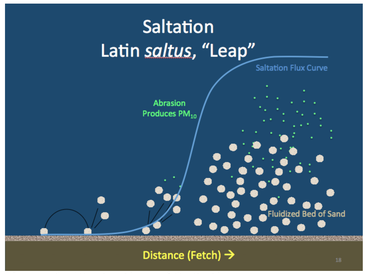

Figure 1. *Illustration of Saltation*

Vegetation Enhancement as Pro-Active Dust Control

Vegetation is widely recognized as an effective DCM on bare, unprotected surfaces and is an approved Best Available Control Measure (BACM) by Imperial County Air Pollution Control District (ICAPCD). Vegetation provides dust control in three ways: (a) by directly protecting underlying soils from erosion, (b) by physically trapping soil particles that enter the vegetated area, and (c) by modifying the airflow and decreasing the wind velocity at the surface.

As the Sea recedes, existing plant communities along the shoreline are naturally expanding onto the playa (Figures 2 and 3). This natural process occurs most often on historic linear 'beach ridges' formed by wave action as the Sea recedes. Vegetation patterns observed around the Salton Sea suggest that after initial establishment by beach ridge species, many other species will fill in the gaps between ridges, eventually leading to more continuous vegetation.

The central concept of this pilot study is to understand these natural processes and then use that information to speed the rate of vegetation establishment as the Sea recedes. Establishing vegetation on otherwise bare playa will pro-actively reduce the potential for future PM_{10} emissions as the Sea recedes.

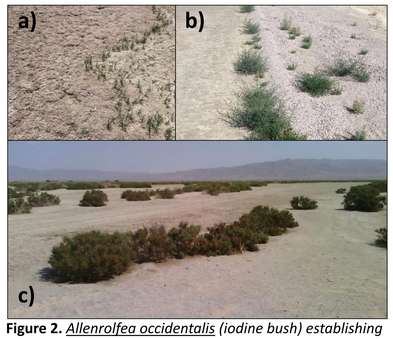

Figure 2. *Allenrolfea occidentalis (iodine bush) establishing along shoreline ridges around the playa.*
***a)** 5-10 cm tall seedlings in March 2015, **b)** 20-30 cm tall seedlings in May 2015, **c)** fully established plants at Bombay Beach, averaging 1.0 m tall with diameters ranging from 1.5-2.0 m. These plants likely germinated in 2009-2010.*

Purpose of Pilot Study

The purpose of this pilot study is to perform an operational field test to determine the best practices for enhancing vegetation on the playa as the Sea recedes. The pilot study will evaluate the enhancement and creation of vegetated beach ridges for optimal plant growth and pro-active dust control. This includes the diversity of native species seeded; vegetative cover characteristics; agronomic characteristics of the soil; playa surface and subsurface conditions; groundwater depth and quality; and beach ridge orientation and composition. Vegetated beach ridges will be enhanced or created at five study sites: Bombay Beach, Johnson's Landing, Salton City Wash, Poe Road, and near 76th Ave in Coachella. This poster focuses on the Bombay Beach site (Figure 3).

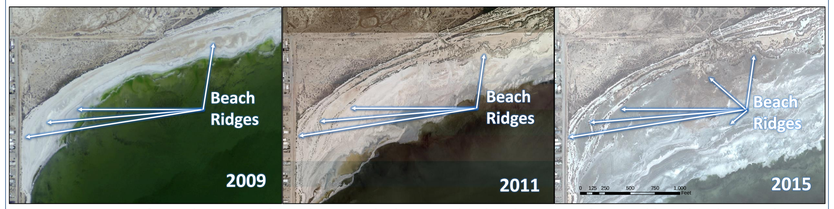

Figure 3. *A series of aerial images of Bombay Beach showing the development of natural beach ridges and vegetation since 2009. Vegetation grew larger and more dense between 2009 and 2015.*

Plants and Seeding

Allenrolfea occidentalis and *Atriplex lentiformis* are the two main species observed on recently exposed beach ridges around the Salton Sea. Over time, many other species also establish in these areas. To achieve similar diversity in the pilot study, seed from 10 native species was collected in Spring 2015 (Figure 4). Seed was collected from numerous locations around the Sea to capture adaptive genetic diversity present in the region. After collection, the seed was air dried and processed to remove vegetative material, chaff, and other non-seed materials. The seed will be tested to determine germinability and Percent Live Seed (PLS), which will inform the amount of applied seed necessary to vegetate the beach ridges.

The species diversity, including the adaptive genetic diversity, should enhance the rate of succession to more continuous vegetation as the shoreline recedes. Plant establishment will be monitored regularly to determine percent cover, vegetative density (3D), and other important growth characteristics.

Figure 4. *A vigorous, seed-producing Allenrolfea occidentalis (iodine bush) shrub on a beach ridge at the Salton Sea (April 2015)*

Reclamation and Irrigation

The native plant species chosen for this pilot study are exceptionally tolerant of salinity after establishment (Blank et al. 1998). However, germination is typically reduced to 10 percent of maximum at soil salinities equivalent to 66 dS/m electrical conductivity (Gul and Weber 1999). Maximum germination occurs at less than 20 dS/m. To achieve maximum germination, and therefore establishment, beach ridges will be leached (reclaimed) to a target of 20 dS/m. Irrigation and fertilization will support initial seed germination and establishment until the plants are able to access shallow groundwater.

Soils and Salt Crusts

In general, beach ridge sediment consists of a mixture of sand, barnacles, and organic material (fish and other dead / decaying material) (Figure 5). The organic material improves fertility and water holding capacity of the soil. Intervening playa soils may be amended with compost or other organic materials to achieve the same productivity as native ridges. Intervening playa salt crusts will be mapped and monitored throughout the study to assess erosional characteristics of the surfaces. Agronomic soil parameters will also be monitored to ensure adequate nutrients are available to the plants.

Figure 5. *Non-Vegetated Beach Ridge Soil and Playa Salt Crust.*

Groundwater Depth and Quality

Groundwater depth and quality will be monitored to understand the factors conducive to successful establishment of beach ridge species. Understanding groundwater depth and quality across the gradient of successional plant communities is essential. Multiple transects of groundwater access tubes were installed to evaluate the hydrologic and lithological characteristics of the groundwater system at each study site (Figure 6). Groundwater depth will be monitored continuously using pressure transducers. Groundwater quality will be monitored on a quarterly basis.

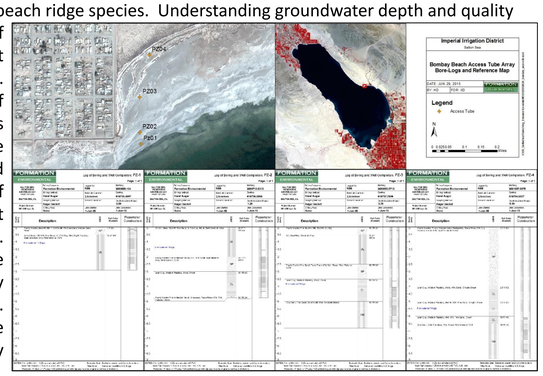

Figure 6. *Access Tube Locations and Lithological Description*

Dust Control

Pro-active dust control achieved through the establishment of vegetation will be modeled and monitored. Reductions in potential sand motion / saltation produced by the design and establishment of vegetation will be modeled using the Single Event Wind Erosion Evaluation Program (SWEEP). An aerometric monitoring network comprising cox sand catchers and video cameras will be used to demonstrate overall control efficiency. Video monitoring will also be used to document any dust plumes originating from surfaces within the study sites.

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4. Photos courtesy of Jim Richards, Hank Dickey, and Brian Schmid.