CHAPTER 5

PM_{10} Control Measures

FIGURES

TABLES

5

PM_{10} Control Measures

5.1 INTRODUCTION

Owens Lake PM_{10} control measures or, more commonly, dust control measures (DCMs), are defined as those methods of PM_{10} abatement that could be placed on portions of the Owens Lake playa and when in place are effective in reducing the PM_{10} emissions from the surface of the playa. Since 1980 the District and other researchers have been involved with the study of the lake environment and the mechanisms that cause Owens Lake's severe dust storms. Since 1989 the District has pursued a comprehensive research and testing program to develop PM_{10} control measures that are effective in the unusual Owens Lake playa environment. Three dust control measures have been approved for use on the lake and have been designated as a Best Available Control Measure (BACM) by the District (GBUAPCD, 2003). These measures include Shallow Flooding, Managed Vegetation, and Gravel Blanket. In addition, as provided for in the 2006 Settlement Agreement (GBUAPCD, 2006b) and based on the results of a demonstration project conducted by the City of Los Angeles (City), a fourth dust control measure may be implemented on a portion of the Dust Control Area (DCA). This alternative measure is known as Moat & Row.

Dust control measures that were tested on the lake, but were shown to not be effective or practical dust control measures for the SIP, include the use of sprinklers, chemical dust suppressants, surface compaction, sand fences and brush fences. These measures were discussed in the "Owens Valley PM_{10} Planning Area Demonstration of Attainment SIP Projects Alternatives Analysis" document (GBUAPCD, 1996), in the Final Environmental Impact Report (EIR) (GBUAPCD, 1997), EIR Addendum Number 1 (GBUAPCD, 1998b) for the 1998 SIP and in the EIR for the 2003 SIP (GBUAPCD, 2003).

Implementation of all DCMs on the lake bed is subject to appropriate analysis under the California Environmental Quality Act (CEQA) and permitting and approvals by other responsible agencies. A detailed analysis of the environmental impacts of the DCMs to be completed by April 1, 2010 can be found in the project-level EIR prepared for this 2008 SIP (GBUAPCD, 2008). In addition to the District using the 2008 EIR as the CEQA-compliance document for this SIP, the City intends to use the document to meet its CEQA requirements for issuance of construction contracts for the project. Additional descriptions of the control measures as they have been implemented by the City are found in the City's two Mitigated Negative Declarations for Phases 1 and 2 of the project (LADWP, 2000 and LADWP 2001). For the attainment demonstration included in Chapters 6 and 7 of this 2008 SIP, the District is specifying that the PM_{10} control measures used will be BACM and consist of Shallow Flooding, Managed Vegetation and Gravel Blanket, as well as the possibility of the non-BACM demonstration measure known as Moat & Row. All dust control measures shall be designed, constructed, operated and maintained to achieve the required minimum dust control efficiencies (MDCE) as described in the 2006 Settlement Agreement.

This chapter includes a brief description of the three BACM dust control measures, a discussion of the PM_{10} emissions after the control measure is implemented and the conditions that need to be met to achieve the necessary level of control. This chapter also includes a conceptual description of the Moat & Row dust control measure. A more detailed description of the Moat & Row measure will be available following the results of the current testing being conducted by the City. These descriptions contain both mandatory and conceptual elements and are provided to illustrate how the control strategy mandated by this 2008 SIP may be feasibly implemented. Chapter 7 of this document will show where these controls will be used on the playa to achieve the National Ambient Air Quality Standard (NAAQS) for PM_{10}. The mandatory elements of the control strategy are set forth in the Board Order in Chapter 8. Control strategy elements not mandated by this 2008 SIP are left to the discretion of the City and are subject to approval by the California State Lands Commission (CSLC) when DCMs are applied on lands under their management. Nothing in this SIP is intended to give the CSLC, or any other public agency, more authority than their authority under law.

5.2 SHALLOW FLOODING

5.2.1 Description of Shallow Flooding for PM_{10} Control

The naturally wet surfaces on the lake bed, such as seeps, springs and the remnant brine pool, are resistant to windblown dust emissions. These naturally wet areas are found where groundwater is discharged on to the lake bed or where surface water (such as water from the Owens River or Cartago Creek) flows across the lake bed surface (Figure 5.1). The areal extent of wetting depends mainly upon the amount of water present on the surface, evaporation rate and lake bed topography. The size of the wetted area is less dependent on soil type because, once the water table is raised to the playa surface, surface evaporation is virtually soil-type independent. The Shallow Flooding DCM mimics the physical processes that occur at and around natural springs and wetlands and can provide dust control over large areas with reasonably minimal and cost-effective infrastructure. The goal of Shallow Flooding is to provide dust control by maintaining sufficiently wet surfaces. As a result ponding will occur in topographic lows creating habitat conditions for insects and shore birds.

Two methods of Shallow Flooding have been employed by the City on the lake bed since the first DCMs began operation in 2001. The first, known as sheet flooding, consists of releasing water from arrays of low-flow water outlets spaced at intervals of between 60 and 100 feet along pipelines laid along lake bed contours. The pipelines are spaced between 500 and 800 feet apart. This arrayed configuration of water delivery creates large, very shallow sheets of braided water channels. Water depths in sheet flooded areas are typically at most just a few inches deep. The lower edge of sheet flooded areas has containment berms to capture and pond excess flows. The water slowly flows across the typically very flat lake bed surfaces downhill to tail-water ponds where pumps recirculate the water back to the outlets. Figure 5.2 shows sheet flooding from ground level. Figure 5.3 is an aerial photo of a sheet flooded area.

To maximize project water use efficiency, flows to sheet flow areas are regulated at the outlets so that only sufficient water is released to keep the soil wet. Although the quantity of excess water is minimized through system operation, any water that does reach the lower end of the control area is collected and recirculated back through the water delivery system. At the lower end of the sheet flooded areas, or at intermediate locations along lower elevation contours, excess water are collected along collection berms and pumped back up to the outlets to be reused.

The second method of Shallow Flooding employed by the City is known as pond flooding. Pond-flooded areas have water containment berms that allow ponds to be formed that submerge the emissive lake bed areas. These ponds are much deeper than sheet-flooded areas—pond waters are up to four feet deep. The containment berms are typically rock-faced to protect them from wave erosion. Water is usually delivered through one large water inlet per pond. Water is delivered to the pond area until the pond reaches a size and depth sufficient to submerge the required amount of emissive area. Water delivery then ceases until evaporation reduces the pond size to a set minimum. Figure 5.4 shows pond flooding from ground level. Figure 5.5 is an aerial photo of a pond-flooded area.

Based on the City's operation of Shallow Flood DCMs in 2006 and 2007, approximately 3.1 to 4.2 acre-feet of supplied water, respectively, were required to control PM_{10} emissions from an acre of lake bed. It should be noted that below normal rainfall in 2007 resulted in the need to supply more water to the Shallow Flood DCMs to maintain the required 75% wetness cover. It is anticipated that after April 1, 2010 the annual amount of water needed for each acre of Shallow Flood DCM will be reduced as a result of relaxing the wetness cover requirements during the fall and the spring ramping flow periods as discussed in Section 5.2.3.

Non-wetted infrastructure associated with the Shallow Flood DCM includes raised berms, roadways, equipment pads and their associated sloped shoulders (Figure 5.6). In some cases the shoulders are rock-faced to protect them from wave erosion. Well-traveled roads are typically paved with gravel; less-traveled roads and berms are unpaved.

Shallow Flooding requires water transmission, distribution and outlet infrastructure, excess water retention, collection and redistribution infrastructure and the construction of electrical power lines, access roads and water control berms as discussed in the EIR for the 2008 SIP.

The City is required to construct water-retention berms along the down-gradient and side boundaries of each Shallow Flooding irrigation block to prevent leakage and increases in the rate, quantity, or quality of dust control waters and storm water flows to the brine pool area or mineral lease area. These berms will be designed to collect both natural and applied excess surface water along the side and downslope borders of each irrigation block. The requirement to provide water-retention berms does not apply to Shallow Flood area T36-4, due to its adjacency to the Owens River delta and the need to minimize surface disturbances in this area.

5.2.2 PM_{10} Control Effectiveness for Shallow Flooding

Shallow Flooding has been shown to be very effective on a large scale for controlling wind-blown dust and PM_{10} at Owens Lake. Between 1993 and 1996 the District conducted a 600-acre test on the sand sheet between Swansea and Keeler. Effectiveness was evaluated in four ways; a) from aerial photographs assuming that flooded areas provided 100 percent control, b) from portable wind tunnel measurements of test and control areas, c) from fetch transect (1-dimensional) analysis of sand motion measurements, and d) from areal (2-dimensional) analysis of sand motion measurements. The average control effectiveness was 99 percent with surface water coverages of 75 percent and about 60 percent when the site was 30 percent wet (Hardebeck, *et al.*, 1996).

In 2000 the City began construction on a 13.5 square-mile shallow flood project on the north end of the lake bed. Shallow Flooding operations began in December 2001. By December 2006 the City had constructed and is currently operating over 26 square miles of Shallow Flooding DCMs. Visual observations and monitoring since the implementation of existing shallow flood facilities have shown no significant dust plumes originating in properly operated Shallow Flooding areas.

PM_{10} emissions from the 16.5 square mile Shallow Flood dust control area that was completed at the end of 2003 were calculated based upon Dust ID program emission estimates before and after controls were implemented. The control efficiency for this shallow flood area averaged 99.8 percent in 2004. Prior to shallow flooding, PM_{10} emissions for the area were estimated at 35,775 tons in 2000. After shallow flooding, PM_{10} emissions were reduced to an estimated 60 tons from the same area in 2004.

Due to the extreme levels of PM_{10} emissions from Owens Lake before the implementation of DCMs began in 2000, the District required that the City construct and operate all Shallow Flood DCMs to achieve 99 percent PM_{10} control efficiency. Based on the District's research in the 1990s, this meant that all Shallow Flood areas had to be maintained at 75 percent wet. However, not all of the additional emissive areas that require control under this 2008 SIP (Supplemental Dust Controls) require 99 percent effectiveness in order to achieve the PM_{10} NAAQS at the historic shoreline. Based on data collected between July 2002 and June 2006, air quality modeling shows that the actual required levels of PM_{10} control vary from 30 percent to over 99 percent. These varying required control efficiencies reflect the fact that different areas of the lake bed have different emissions rates and that areas closer to the historic shoreline require higher control efficiencies than similar areas well away from the shoreline. Based on air quality modeling conducted using the 2002 through 2006 data, the minimum dust control efficiencies (MDCE) for the Supplemental Dust Control areas are shown in Figure 5.7. All additional DCMs constructed under the provisions of this 2008 SIP will be constructed and operated to achieve the MDCEs shown in Figure 5.7. All DCMs constructed prior to 2007 will be required to continue to achieve 99 percent MDCE, except during the ramping flow periods discussed in Section 5.2.3.

For Shallow Flooding, varying MDCEs can be provided by varying the percent of an emissive area that is kept wet. Based on the District's research, a curve has been developed that relates percent water cover with percent PM_{10} control efficiency. This curve is shown in Figure 5.8. The City will use this curve, along with the MDCEs shown in Figure 5.7 to construct and operate the Shallow Flooding Supplemental Dust Control areas. The required control efficiency for Shallow Flooding areas constructed prior to 2007 will remain at 99 percent. The District and the City will collaboratively work to refine the curve in Figure 5.7.

5.2.3 Fall and Spring Shallow Flooding Ramping Flow Operations

Based on data collected between 2002 and 2006, air quality modeling shows that areas normally requiring 99 percent control efficiency during the most intense wind and surface emissivity conditions do not require that extreme level of control at other, less emissive, times. Dust emissions from the lake bed during early October and from mid-May through June are typically lower in intensity than during the peak winter through early spring dust season. These periods of

Figure 5.1 – Natural shallow flooding – flows from shoreline seeps and springs out on to lake bed

Figure 5.2 – Shallow Flooding – ground level view of sheet flood method

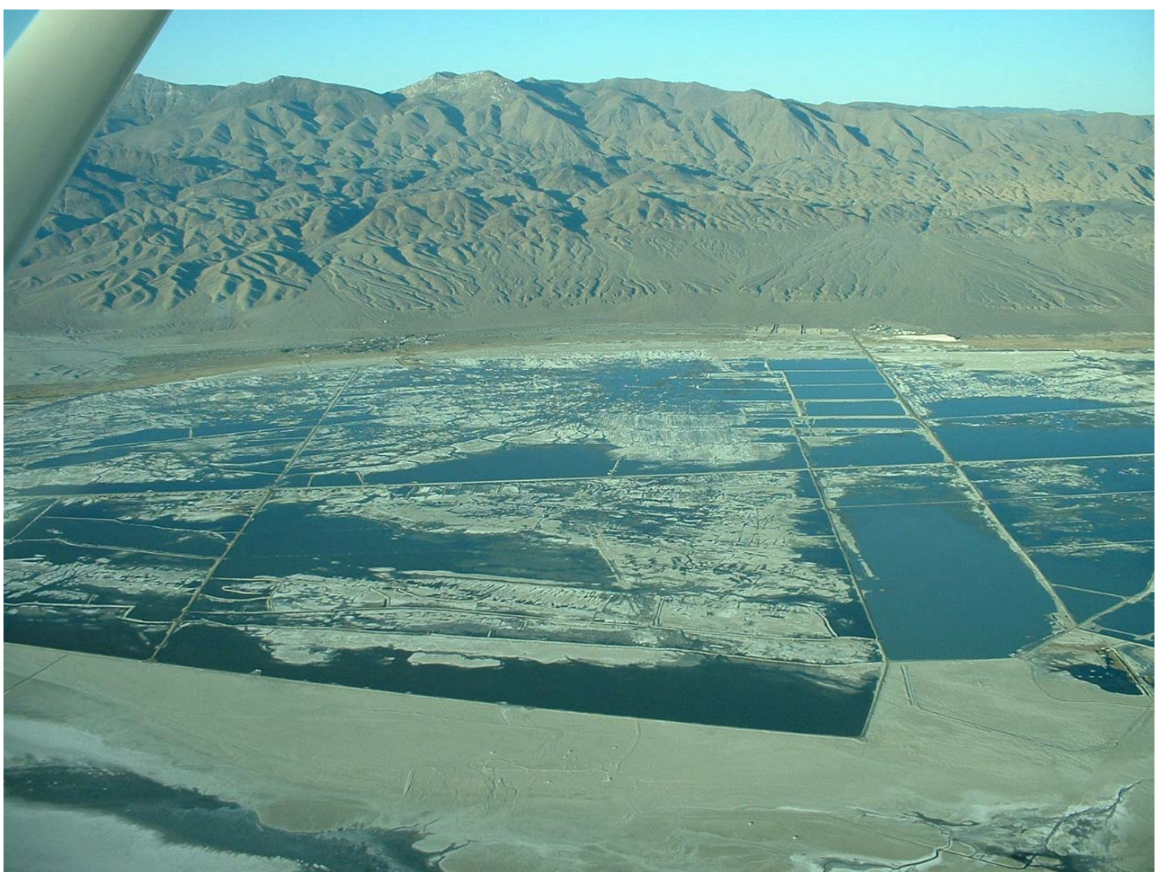

Figure 5.3 – Shallow Flooding – aerial view of sheet flood method (left side of photo)

Figure 5.4 – Shallow Flooding - ground level view of pond flood method

Figure 5.5 – Shallow Flooding – aerial view of pond flood method (left side of photo)

Figure 5.6 – Shallow Flooding – raised equipment pads with armored berms

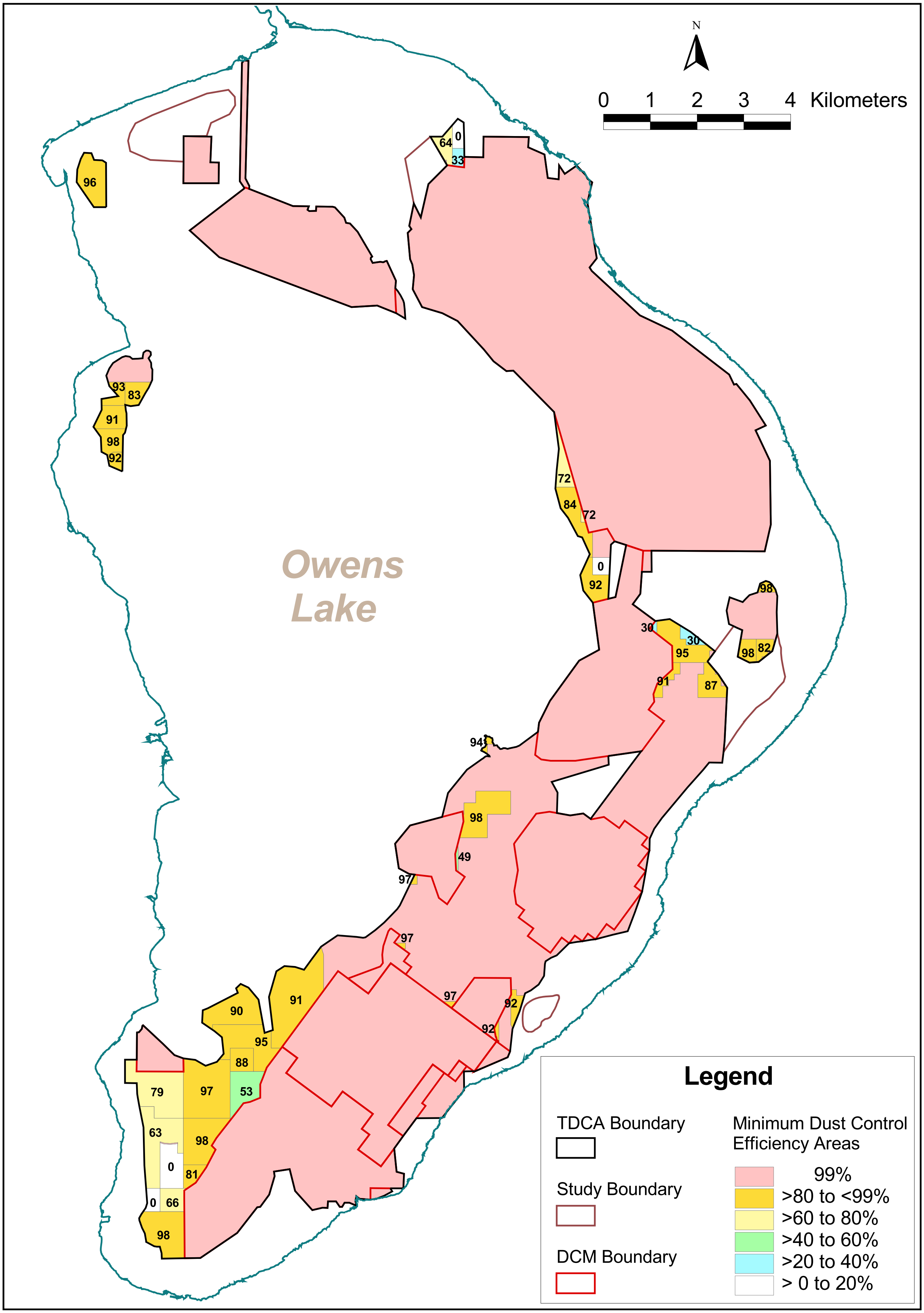

Figure 5.7 - TDCA Minimum Dust Control Efficiency map

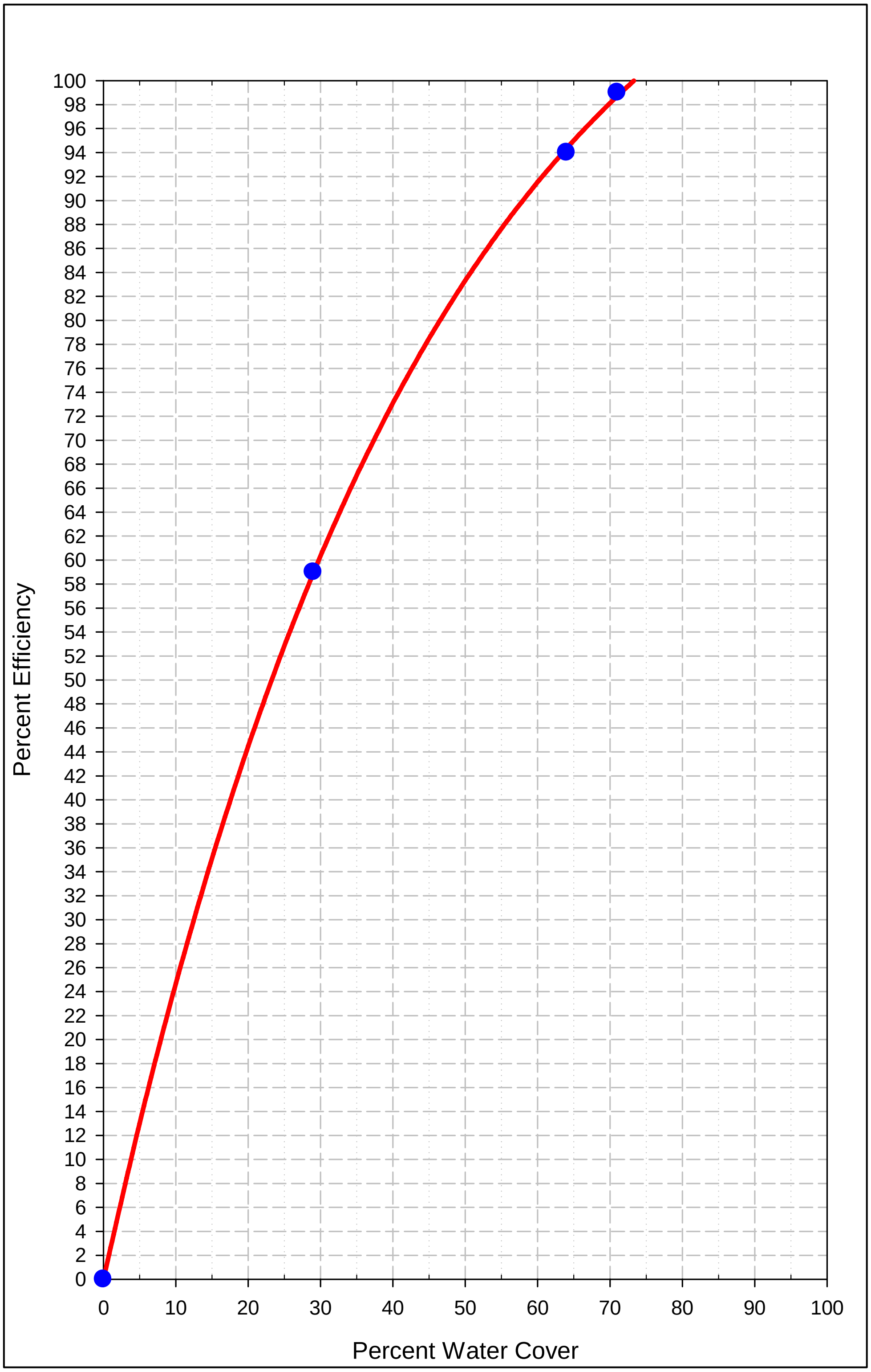

Figure 5.8 - Shallow Flood control efficiency curve

lower emission conditions are referred to as the PM_{10} "shoulder seasons." These lower emission conditions are a result of lower wind speeds and less emissive conditions during the shoulder seasons. Therefore, in order to conserve water resources, while providing the level of PM_{10} control necessary to attain and maintain the federal PM_{10} NAAQS, the provisions of this 2008 SIP will allow the City to reduce the PM_{10} control efficiencies of the Shallow Flooding DCM during the period from October 1 through October 15 and from April 1 through June 30.The percentage of dust control areas that are required to be wet will be ramped up in the fall and ramped down in the spring. The amount of wetting reductions are described below.

5.2.3.1 Fall Shoulder Season — October 1 through October 15

Under the provisions of the 2003 SIP, the City is required to have Shallow Flooding DCM areas fully wetted and operational at the start of the dust season on October 1 of every year. However, in order to get the current 26 square miles of Shallow Flooding areas sufficiently wet by October 1, water deliveries actually start in late August. This means that some level of dust control is actually being provided outside the dust control season as the DCM areas "wet up." Based on data collected during the period from July 2002 through June 2006, as well as District staff's experience over more than two decades on the lake bed, the first two weeks of October are not a period when the lake bed typically experiences highly emissive conditions. Therefore, in order to conserve water resources, full levels of dust control will not be required until October 16 of each year. From an operational standpoint, however, gradually increasing levels of dust protection will occur starting in early September as water deliveries begin. These protection levels will ramp up as additional water is delivered until full levels of protection are provided on October 16. The October shoulder season adjustments will go into effect in October 2010.

5.2.3.2 Spring Shoulder Season — May 16 through June 30

Under the provisions of the 2003 SIP, the City is required to have Shallow Flooding DCM areas fully wetted and operational through the end of the dust season on June 30 of every year. However, based on data collected during the period from July 2002 through June 2006, the required MDCEs are lower during the late spring than they are during the winter and early spring. This is due to the formation of durable, less emissive summer salt crusts on the surface of the lake bed. Late spring is also a time when temperatures in the Owens Valley begin to warm dramatically. The 21-year (1985 through 2005) average temperature for Keeler in March is 54°F—it rises 24 degrees to 78°F for June. Higher air temperatures mean that more of the water applied to DCM areas is lost to evaporation. Therefore, in acknowledgement that the lake bed is naturally less emissive in late spring than during the winter and that, due to increasing temperatures, the City has to apply more water to wet the same amount of area, in order to conserve water resources, starting after April 1, 2010, areas requiring 99 percent MDCE will have the following wetness requirements:

- From October 16 of every year through May 15 of the next year, Shallow Flooding areas with 99 percent MDCE shall have a minimum of 75 percent areal wetness cover.
- From May 16 through May 31, Shallow Flooding areas with 99 percent MDCE shall have a minimum of 70 percent areal wetness cover.
- From June 1 through June 15, Shallow Flooding areas with 99 percent MDCE shall have a minimum of 65 percent areal wetness cover.
- From June 16 through June 30, Shallow Flooding areas with 99 percent MDCE shall have a minimum of 60 percent areal wetness cover.

If any of the Shallow Flooding areas that are allowed to have reduced wetness during the spring shoulder season fail to meet even the reduced wetness requirements, it is possible that the areas failed to meet their minimum targets because not enough water could be delivered through the water distribution infrastructure. Therefore, if the City fails to meet the spring shoulder season targets that start on May 16 and there were no monitored or modeled exceedances of the federal standard at the historic shoreline, those areas that did not meet the reduced minimums will be deemed to be in compliance, if the City demonstrates in writing and the APCO reasonably determines in writing that maximum water delivery mainline flows were maintained throughout the applicable period. This provision does not penalize the City as long as the maximum amount of water is delivered to the site and there are no NAAQS exceedances.

Shallow Flooding areas with less than 99 percent MDCEs shall not be allowed any spring shoulder season areal wetness reductions.

5.2.4 Shallow Flooding Operational Refinements

The District's research on the Shallow Flooding DCM in the 1990s established the relationship between the amount of water coverage on an emissive area and the PM_{10} control effectiveness provided (Hardebeck, *et al.*, 1996). Research control effectiveness varied from as high as 99 percent when 75 percent of an area was wetted down to 60 percent control when water covered 30 percent of the test area. As most of the areas on which the City deployed DCMs in the period from 2000 through 2006 required high levels of control, both the 1998 and 2003 SIP required 99 percent PM_{10} control effectiveness in all DCM areas. This means that all existing Shallow Flooding areas must be 75 percent wetted in order to be in compliance, except as provided during the "shoulder seasons" described in Section 5.2.3.

However, it is possible that the District's research developed percent-wetted requirements that are conservative and the City's large-scale Shallow Flooding DCMs are being operated with more water coverage than is necessary to provide 99 percent PM_{10} control effectiveness. Therefore, this 2008 SIP contains a provision to "fine tune" the amount of water required for 99 percent control. Two types of refinement tests are provided for: 1) an immediate test on up to 1.5 square miles of existing Shallow Flood area requiring 99 percent PM_{10} control efficiency and 2) a large-scale test that allows annual reductions averaging 10 percent wetness, once a set of preconditions have been met. The detailed procedure for the Shallow Flooding operational refinements are set forth in Attachment D to the Board Order in Chapter 8 ("2008 Procedure for Modifying Best Available Control Measures (BACM) for the Owens Valley Planning Area"). The procedure will be summarized here, but, as with all such descriptions, the actual Board Order takes precedence over the summary.

The Shallow Flooding adjustment procedure allows the City the option of immediately conducting a preliminary wetness cover refinement field test on up to 1.5 square miles of existing Shallow Flooding dust control area that requires 99 percent control. The City must select a test area and prepare a test design for it. The District's Air Pollution Control Officer (APCO) must approve the test area and test design prior to implementation. The City is required to conduct all required environmental analyses and secure all necessary permits and approvals for the test. The City can then use the results of the test as a basis for the larger-scale Shallow Flooding wetness refinements, described below.

In addition to the 1.5 square-mile Shallow Flood wetness cover refinement test discussed above, the City may undertake Shallow Flooding wetness refinements in annual increments averaging 10 percent wetness reduction on a large scale, after the following preconditions have been met:

1. All the DCMs required by this 2008 SIP have been constructed.
2. All the DCMs required by this 2008 SIP have been operational for one full year (365 consecutive days).
3. There have been no monitored exceedances of the PM_{10} NAAQS at or above the historic shoreline caused solely by emissions from the 2008 total DCM area for one full year (365 consecutive days).
4. The City prepares a written wetness cover plan that takes into account the results of the preliminary wetness cover refinement field test described above, as well as the results of the fall and spring “shoulder season” wetness reductions described in Section 5.2.3. The City is required to conduct all required environmental analyses and secure all necessary permits and approvals for the test.
5. The APCO approves the wetness cover plan. (Depending on the location and extent of refinement, CSLC approval may also be required.)

Once the above preconditions have been met, the City will be permitted to implement the wetness cover plan and reduce the wetness cover by an average of 10 percent over the Shallow Flooding areas that require 99 percent control efficiency. If shoreline PM_{10} monitors show any exceedances from anywhere in the Planning Area, no further reductions will be permitted for any Shallow Flooding area that has contributed to any exceedance and wetness increases will have to be made in those areas from which excess PM_{10} emissions originated. If there are no monitored 24-hour PM_{10} values exceeding 130 $\mu g/m^3$ or modeled PM_{10} values exceeding 120 $\mu g/m^3$ for one full year after the City has implemented the wetness cover plan, the City may apply to the APCO to further reduce wetness coverage in areas requiring 99 percent control. These adjustments may continue until monitored/modeled PM_{10} values exceed the respective 130/120 $\mu g/m^3$ limits discussed above.

It should be noted that, for state lands on the Owens Lake bed, the California State Lands Commission may have discretionary authority over modifications to the project description for implementing DCMs, including the above-described operational refinements. However, nothing in this SIP is intended to give any regulatory agency more authority than their authority under law. In addition, operational refinements may require CEQA analysis of the potential environmental impacts, particularly to vegetation and wildlife. The responsibility for all CEQA analyses and all required permits and approvals associated with DCM operational refinements are the responsibility of the City.

5.2.5 Shallow Flooding Compliance Monitoring

Using the required MDCE for each DCM area set forth in Figure 5.7, the MDCE vs. wetness curve set forth in Figure 5.8 and adjusting the required wetness during the spring shoulder season, a minimum wetness value can be determined for all Shallow Flooding DCM areas at any time during the year. The actual wetness coverage for Shallow Flooding areas can be determined by aerial photography, satellite imagery or any other method approved by the APCO (Hardebeck, *et al.*, 1996, Schade, 2001, HydroBio, 2007). Currently the District is using publically available USGS Landsat satellite imagery and a process developed by the District’s remote sensing consultant, HydroBio, to determine the percent wetness for Shallow Flooding areas. Figure 5.9 shows one of the satellite images and Figure 5.10 shows the compliance status for the image date. Figure 5.11 is a detail showing the wet and dry areas on a portion of the satellite image.

The following portions of the areas designated for control with Shallow Flooding are exempted from the wetness coverage requirements:

1) Raised berms, roadways and their shoulders necessary to access, operate and maintain the control measure which are otherwise controlled and maintained to render them substantially non-emissive.
2) Raised pads containing vaults, pumping equipment or control equipment necessary for the operation of Shallow Flooding infrastructure which are otherwise controlled and maintained to render them substantially non-emissive.

"Substantially non-emissive" shall be defined to mean that the surface is protected with gravel or durable pavement sufficient to meet the requirements of District Rules 400 and 401 (visible emissions and fugitive dust).

5.2.6 Shallow Flooding Habitat

When fresh water is distributed across the playa for Shallow Flooding, opportunistic plant species establish themselves where the water has a low salinity creating favorable growing conditions. Limited stands of cattails (*Typha* spp.), sedges (*Carex* spp.), saltgrass (*Distichlis spicata*) and other species associated with saturated alkaline meadows of the region colonized the immediate vicinity of the water outlets on the District's 1993 to 1996 flood irrigation project. However, during the operation of the first phases of the City's Shallow Flood DCMs, recirculated flood waters generally keep the salinity of the water high preventing significant establishment of volunteer vegetation. Based on testing performed by the District at the North Flood Irrigation Project test area and the City's operation of the first phases of Shallow Flooding, naturally established vegetation can be expected to occur on between zero and 0.5 percent of the area that is controlled with Shallow Flooding.

The expansive shallow flooded areas provide ephemeral resting and foraging habitat for wildlife use. Figure 5.12 is a photo of one of the City's Shallow Flooding control areas west of the community of Keeler. Shorebirds can be seen using the wetted area. Shorebird utilization of wet areas on the lake bed was common during the District's control measure testing as well as during the City's operation of the first phases of large-scale Shallow Flooding (Ruhlen and Page, 2001, 2002). Based on these previous experiences, it is anticipated that Shallow Flooding will create large areas of wildlife habitat in areas where very little previously existed.

In addition to desirable plant species, such as those listed above, that may grow and help control PM_{10} emissions, there is the possibility that undesirable non-native plants may invade wet playa areas. Fortunately, the existing saline soil conditions inherent to the lake bed are inhospitable to most plants including exotic pest plants such as tamarisk, puncture weed and Russian thistle and noxious grasses such as *Cenchrus*. The Board Order requires the City to remove all exotic pest and weed plants from the dust control areas. Removal will be accomplished through an appropriate combination of biological, mechanical and chemical control methods. Depending on

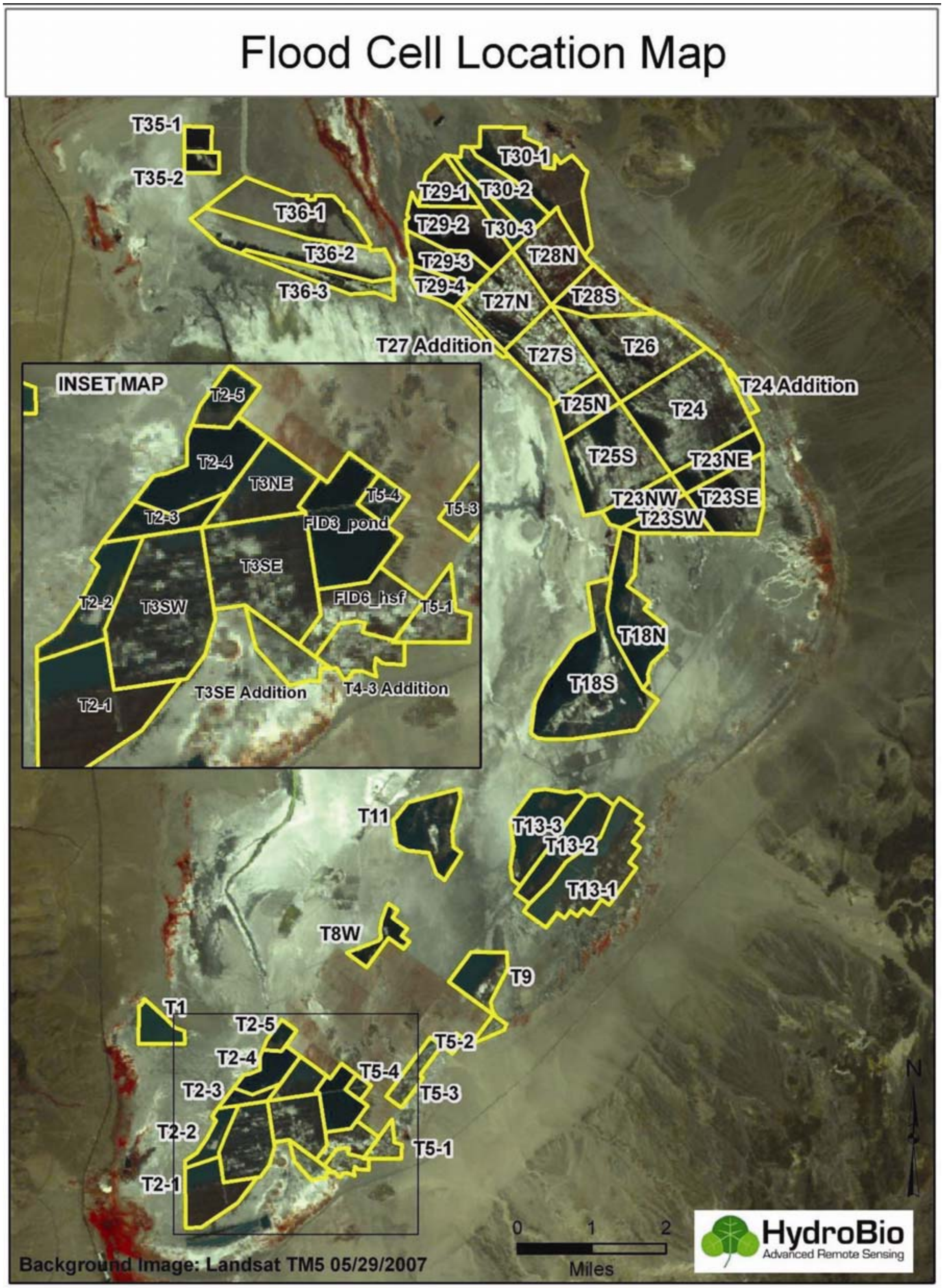

Figure 5.9 – Shallow Flooding satellite image

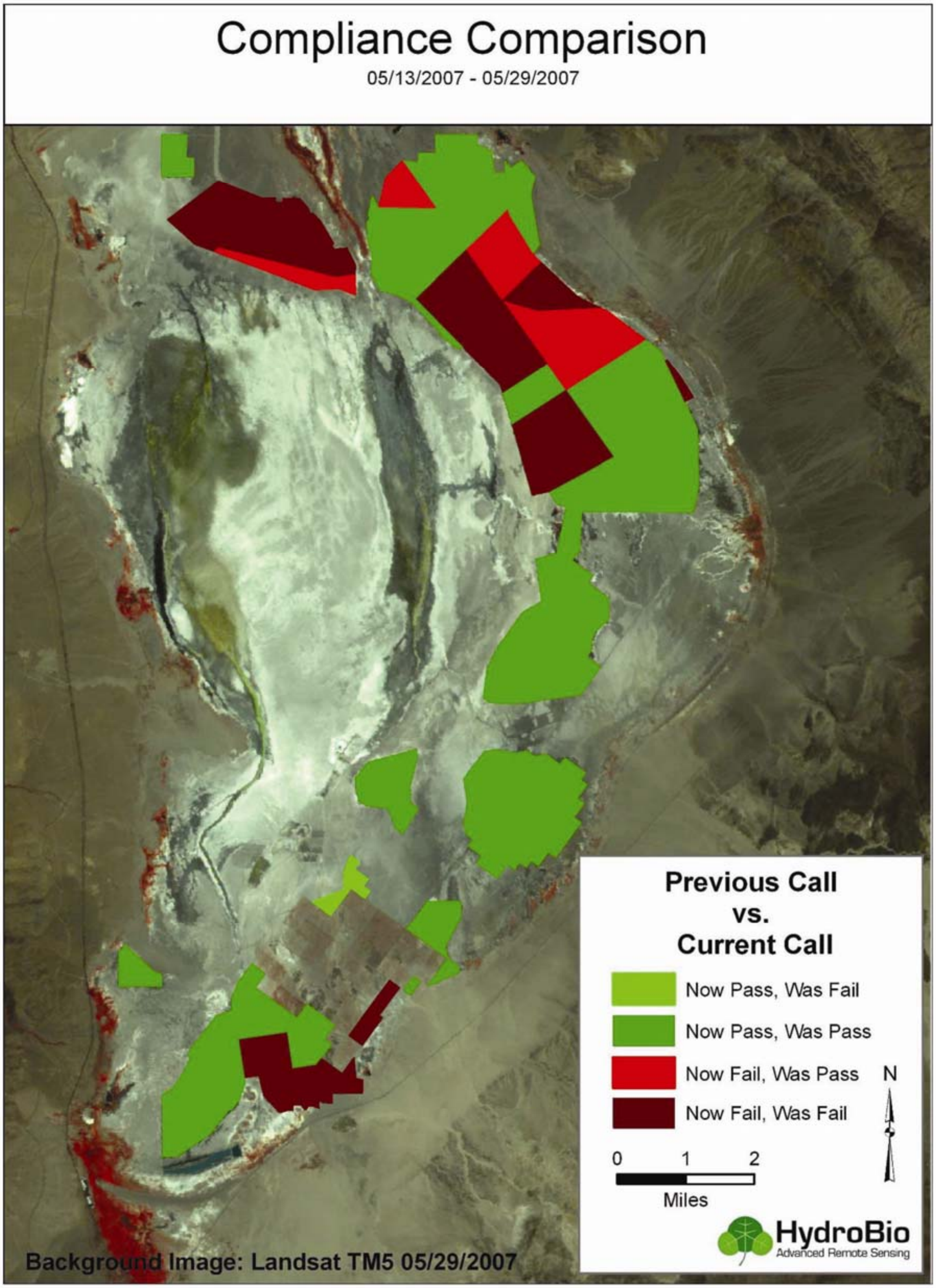

Figure 5.10 – Shallow Flooding compliance status

This view shows the NW region of the Owens Lake with failing cells outlined in red and compliant (wet) pixels shown in blue

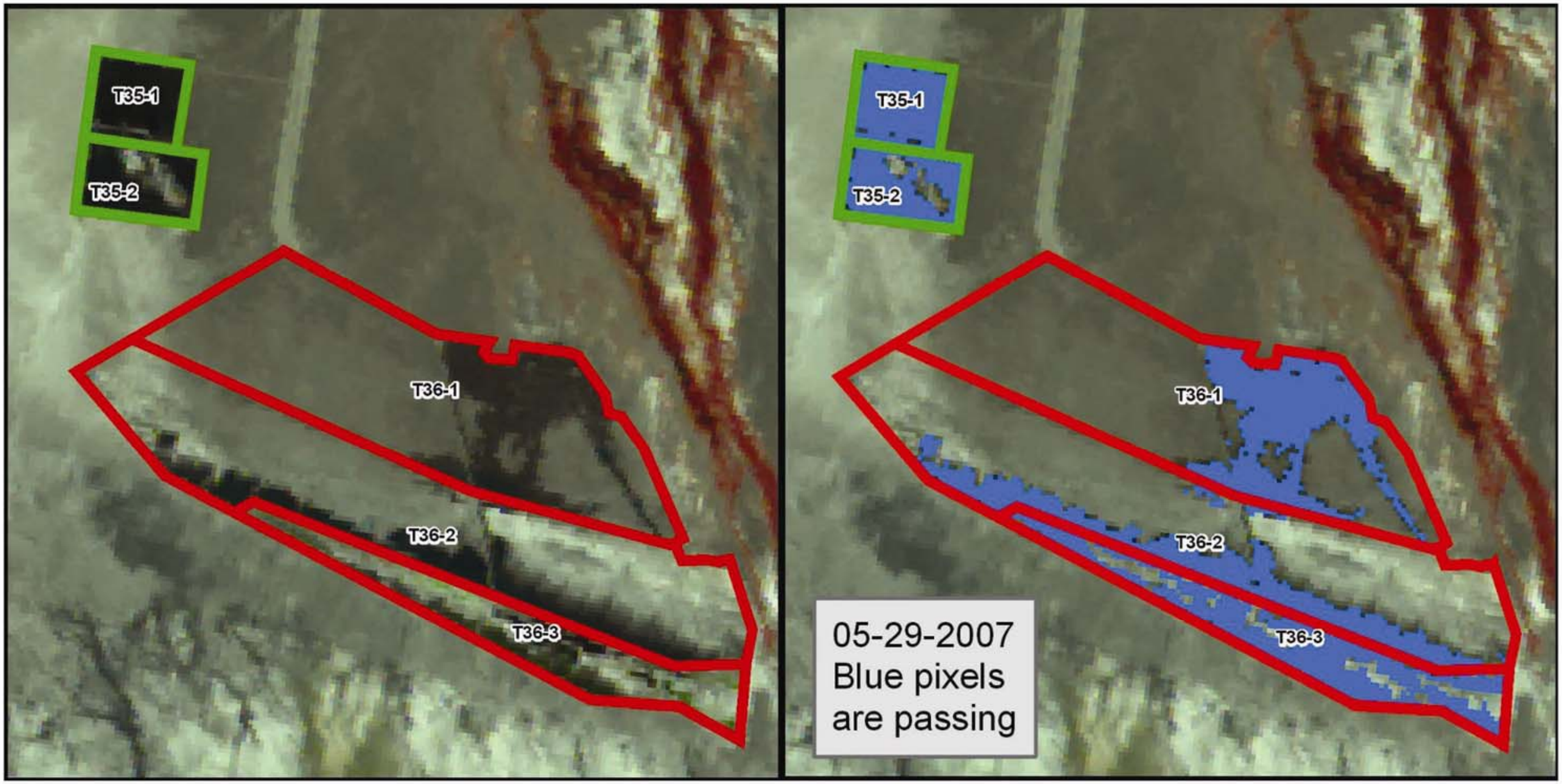

Figure 5.11 – Shallow Flooding compliance detail

Figure 5.12 – Shallow Flooding wildlife

the method of exotic pest and weed plant control selected by the City, the City may need to conduct the appropriate CEQA analysis and secure approval from other responsible agencies, especially the State Lands Commission, for activities on state lands. In addition, a mitigation monitoring program for all potentially significant impacts to wildlife may be required.

Field investigations were performed by mosquito entomologists from the University of California, Davis at District Shallow Flooding test sites and at natural pond, spring and seep areas around Owens Lake to determine the potential for water-based control measures to create mosquito-breeding habitat (Eldridge, 1995). These investigations concluded that mosquito habitat had limited potential to occur on the lake bed, but could occur when water depths range from 2 to 20 inches and when water had essentially no movement.

A mandatory element of this project will be a program to abate mosquito and other pest vector breeding and swarming. Abatement activities may include site design elements to minimize vector breeding habitat, application of pesticides and/or biological controls. These measures are successfully used throughout the Owens Valley. As an alternative to a separate mosquito and pest abatement program, the City of Los Angeles may petition the County of Inyo to annex all water-based control measure areas into the Inyo County Mosquito Abatement Program. If annexation occurs, appropriate assessments may be levied to ensure that abatement activities can take place. In recognition of the location of the source emission control areas in an area that is a stopover location for shorebirds and waterfowl, the mosquito and pest abatement programs shall be designed to minimize the potential impacts on the breeding success of western snowy plovers and other birds that use the playa. Depending on the method of mosquito and pest insect control selected by the City, the City may need to conduct the appropriate CEQA analysis and secure approval from other responsible agencies, especially the State Lands Commission for activities on state lands. In addition, a mitigation monitoring program for all potentially significant impacts to wildlife may be required. All mosquito and pest insect abatement costs shall be the sole financial responsibility of the City.

5.2.7 Shallow Flooding Operation and Maintenance

Water flows between October 15 and June 30 will be maintained to provide the required water coverages in substantially evenly distributed standing water or surface-saturated soil. Based on the City’s actual operation of large-scale Shallow Flooding area in 2006 and 2007, operating the Shallow Flooding control measure is predicted to use approximately 3.1 to 4.2 acre-feet per year (ac-ft/yr) of water per acre controlled. Drains installed near naturally occurring wetlands would be operated so as not to cause significant groundwater drawdown or loss of surface water extent in the adjacent areas. The District will continue its program of monitoring water levels and vegetation cover in Owens Lake bed wetlands to ensure installed drains are not adversely impacting existing wetlands.

Maintenance activities associated with Shallow Flooding consist of grading, addition of supplemental water outlets, and berming on the control areas to ensure uniform water coverage and prevention of water channeling. Other activities include regular and preventative maintenance of pipeline, valves, pumping equipment, berms, roads and other infrastructure. Based on District projects and operation of the first phases of Shallow Flooding by the City, staffing requirements for operation and maintenance of the Shallow Flooding areas will be approximately one full-time equivalent employee (FTEE) per 580 acres of flooded area.

5.3 MANAGED VEGETATION

5.3.1 Description of Managed Vegetation for PM_{10} Control

Vegetated surfaces are resistant to soil movement and thus provide protection from PM_{10} emissions. Vegetation that has established 50 percent total surface cover provides a very effective barrier that prohibits wind speeds from reaching the threshold velocity for emissions at the playa surface. Vegetation has naturally become established where water appears on the playa surface with quantity and quality sufficient to leach the salty playa soils and sustain plant growth. Natural saltgrass meadows around the playa margins and the scattered spring mounds found on the playa are examples of such areas (Figure 5.13). Observation of these naturally vegetated areas has shown that very little dust emissions are generated from them. The Managed Vegetation strategy is modeled on these naturally protective saltgrass vegetated areas. Dust control using Managed Vegetation is a mosaic of irrigated fields provided with subsurface drainage that create soil conditions suitable for plant growth using a minimum of applied water. Aerial and ground-level views of existing Managed Vegetation PM_{10} controls constructed by the City are shown in Figures 5.14, 5.15a and 5.15b.

The Managed Vegetation control measure consists of creating a farm-like environment from currently barren playa. The saline soil must first be reclaimed with the application of relatively fresh water, and then planted with salt-tolerant plants that are native to the Owens Lake basin. Thereafter, soil fertility and moisture inputs must be managed to encourage rapid plant development to, and maintenance of, 50 percent cover. Existing Managed Vegetation controls on the lake bed are irrigated with buried drip irrigation tubing and a complex network of buried tile drains capture excess water for reuse on the Managed Vegetation area or in Shallow Flooding areas.

Managed Vegetation is sustainable at Owens Lake only if salt from the naturally occurring shallow groundwater is prevented from rising back into the rooting zone. Leaching and irrigation water applied to the Managed Vegetation serves to create and maintain a gradient of salts down and away from the rooting area of the planted vegetation. A subsurface drainage system is present beneath each Managed Vegetation field and allows collection of irrigation flows and removal of high salinity groundwater so that levels do not rise into the root zones of the established saltgrass. Drain water is pumped from the site and placed into brine storage ponds where it can be recycled and used for Shallow Flooding or for mixing with fresh irrigation water so that the applied water has salinity sufficient to maintain the soil structure as well as irrigate the salt tolerant *Distichlis spicata* (saltgrass). However, depending on local site conditions and compliance requirements, alternative irrigation and drainage configurations, water supply quality, irrigation scheduling regimes, and plant communities may be employed, so long as the essential ground coverage compliance requirements for an approved DCM are achieved. In clay dominated soils irrigation with low-salinity or fresh water can potentially cause a collapse of the soil structure, preventing water infiltration and salt leaching. The City's existing Managed Vegetation site has a target applied water salinity of approximately 9 decisiemens per meter (a measure of electrical conductivity—seawater has a salinity of about 35dS/m) and requires addition of saline drain water to reach this salinity level. Drains installed near naturally occurring wetlands are operated so as not to cause significant groundwater drawdown or loss of surface water extent in the adjacent wetland areas.

Figure 5.13 – Natural saltgrass meadows on northeast corner of the Owens Lake bed

Figure 5.14 – Managed Vegetation – aerial view

Figure 5.15a – Managed Vegetation – ground level view

Figure 5.15b – Managed Vegetation – equipment pad with sand filters and chemical tanks

The clay soils found on many areas of the lake bed are appropriate for the construction of earthen infrastructure. The native profiles, texture and fractured structure of the clay soil makes it well suited for water distribution and drainage. The lower profiles in clay soils often include a network of existing fractures, facilitating effective drain water collection and natural drainage so that the groundwater does not intrude into the rooting zone. The fine clay particles have a very high pore volume (approximately 50 percent) and therefore retain water for long periods between irrigation events (Stradling, 1997 and Ayars, 1997).

Tests by the District and others have shown that vegetation covers ranging from 11 to 54 percent provide the surface protection necessary for the 99 percent PM_{10} control needed at Owens Lake in order to meet the NAAQS. In order to provide the margin of safety necessary to prevent PM_{10} emissions in all conditions, the District has determined that 50 percent total cover averaged over every acre is an appropriate, conservative prescription for the Managed Vegetation PM_{10} control measure. Total cover includes living plants and any dead plant materials, as both function to prevent PM_{10} emissions. Once the target cover of 50 percent is attained, saltgrass stands can be sustained at or above this level of cover with less than 2.5 acre-feet per year of irrigation water (GBUAPCD, 2002a, 2002c).

The City currently has about 3.5 square miles of Managed Vegetation PM_{10} controls on the lake bed. The Managed Vegetation area is in one contiguous block near the south end of the lake bed. Initial site planting occurred in the summer of 2002 and the City has worked since that time to improve vegetation cover. Although there are portions of the existing Managed Vegetation area that meet the 50 percent cover requirement, the overall site vegetation cover averages about 24 percent. This is well below the SIP requirement of 50 percent vegetation cover on every acre. However, the 3.5 square mile site, as a whole, has achieved a high level of PM_{10} control (Air Sciences, Inc., 2006).

As part of the 2006 Settlement Agreement between the District and the City entered into in December 2006, (Chapter 8, Attachment A, 2006 Settlement Agreement, Paragraph 6) the parties agreed that the existing Managed Vegetation site had achieved a high level of PM_{10} control. They also agreed that the City would prepare an Operation and Management Plan that ensured the site continued to achieve control sufficient to prevent emissions that caused or contributed to NAAQS violations. The Plan is to be approved by the APCO. As long as the City continues to operate and maintain the site such that it meets the Plan’s requirements and as long as the site does not cause an exceedance of the NAAQS at the historic shoreline, the District will deem the existing Managed Vegetation site to be in compliance.

The City prepared a draft of the required Managed Vegetation Operation and Maintenance Plan and submitted it to the District prior to the July 1, 2007 deadline set forth in the Settlement Agreement. The Plan will not be approved prior to the adoption of this 2008 SIP, but will be approved by the APCO as expeditiously as possible. The provisions of the Plan only apply to the Managed Vegetation area that was in place and operational prior to January 1, 2007. Any Managed Vegetation dust controls that are constructed after January 1, 2007 must meet the 50 percent cover on every acre requirement.

The following portions of the areas designated for control with Managed Vegetation are exempted from the vegetative cover requirements:

1) portions consistently inundated with water, such as reservoirs, ponds and canals,
2) roadways and equipment pads necessary to access, operate and maintain the control measure which are otherwise controlled and maintained to render them substantially non-emissive, and
3) portions used as floodwater diversion channels or desiltation/retention basins.

“Substantially non-emissive” shall be defined to mean that the surface is protected with gravel, durable pavement or other APCO-approved surface protections sufficient to meet the requirements of District Rules 400 and 401 (visible emissions and fugitive dust).

Percent cover can be measured by the point frame method or via ground-truthed remote sensing technologies such as aerial photography or satellite imagery or by any other method approved by the APCO (Scheidlinger, 1997, Groeneveld, 2002, HydroBio, 2007).

Saltgrass (*Distichlis spicata)* is currently the only plant species approved for introduction into Managed Vegetation fields. Saltgrass is tolerant of relatively high soil salinity, spreads rapidly via rhizomes and provides good protective cover year-round even when dead or dormant. It is adapted to produce its most vigorous growth during the spring and autumn, and then use minimal amounts of applied water during the hot summer. Saltgrass grows vigorously in conditions of soil salinity that exclude invasive pest exotics. Eventually, salt-tolerant, locally native shrubs such as salt bushes (*Atriplex* spp.), greasewood (*Sarcobatus vermiculatus*), and seepweed (*Sueada moquinii*) may be introduced to established saltgrass fields to increase diversity and possibly reduce total water demand. Locally adapted native plant species other than saltgrass may intentionally be planted for dust control only upon approval of both the District and the California State Lands Commission.

5.3.2 PM_{10} Control Effectiveness for Managed Vegetation

Field and wind tunnel research using Owens playa soils and saltgrass indicate that even sparse populations of saltgrass are effective in reducing sand migration and PM_{10} emissions within the stand (Lancaster, 1996, White, *et al.*, 1996, Nickling, *et al.* 1997, White, 1997, Air Sciences, Inc., 2006). Lancaster concluded that for the coarse sands on the northern portion of Owens Lake, a 95 percent reduction in sand movement can be achieved with a saltgrass cover of between 16 to 23 percent, depending on wind speed and direction. White showed that in wind tunnel tests a vegetation cover of 12 to 23 percent will significantly reduce the amount of entrained sand and PM_{10}. Nicking *et al.* showed that on clay soils PM_{10} was reduced by two orders of magnitude from vegetated surfaces as compared to the natural playa surface. Similar PM_{10} reductions were also observed from non-vegetated leached clay soils. This indicates that treatment of the clay surfaces at Owens Lake by watering and leaching surface salts can by itself significantly reduce wind erosion without vegetation. However, saltgrass vegetation cover will provide additional surface protection after evaporation decreases the initial protection provided by surface wetting. In a companion project by White (1997), Owens Lake clay soils planted with saltgrass were subjected to various wind speeds in a wind tunnel at the University of California

Davis. Results indicate that 54 percent vegetation cover reduces the emission rate of PM_{10} at wind speed of 45 mph by 99.2 percent as compared to emissions from the natural playa at Owens Lake. Air Sciences (2006) concluded that the existing Managed Vegetation dust control implemented by the City of Los Angeles on the lake bed controlled sand motion by 99 percent with average vegetation covers of over 20 percent.

Control efficiencies were calculated for Owens Lake clay soils in both the field on natural plant stands and in the laboratory using wind tunnels. The field studies showed 99.5 percent control efficiency with 11 to 23 percent saltgrass cover and the laboratory study demonstrated 99.2 percent control efficiency at 54 percent cover as compared to uncontrolled emissions at Owens Lake. A high control effectiveness for low levels of plant cover in agricultural-type soils is supported by field research performed by Buckley and Grantz, *et al.* in places other than Owens Lake, which indicate that a plant cover of even 30 percent can achieve better than 99 percent reduction of soil erosion (Buckley, 1987; and Grantz, *et al.*, 1995). Based on the Buckley and Grantz field studies, the field studies at Lake Texcoco, near Mexico City, other work relating to PM_{10} emissions and vegetation and studies done at Owens Lake, the District believes that more than 99 percent reduction of soil erosion and PM_{10} will be achieved at Owens Lake with a saltgrass cover of 50 percent. The cover achieved within the Managed Vegetation would include a mix of live, dead and/or dormant stems. This level of cover will be retained with appropriate plant husbandry and irrigation during the growing season. It will function during winter months without irrigation. Table 5.1 summarizes research results regarding vegetation cover and control effectiveness.

5.3.3 Managed Vegetation Habitat

Even if saltgrass is the only plant species that is intentionally introduced to the Managed Vegetation area, other native plant species are expected to establish themselves opportunistically. Native plant species observed on saltgrass test plots include inkweed (*Nitrophila occidentalis*), alkali sacaton (*Sporobolus airoides*), arrowscale (*Atriplex phyllostegia*), cattail (*Typha latifolia*) parry saltbush *(Atriplex parryi*), seablight (*Sesuvium verrucosum*) and stinkweed (*Cleomella sp*.). The species typical of transmontane alkaline meadows elsewhere in the Owens Basin, including sedges (*Scirpus* spp.), greasewood (*Sarcobatus vermiculatus*), and yerba mansa (*Anemopsis californica*) would also be expected to appear where soil leaching is most complete, adding diversity and wildlife habitat value to the fields. Although these species are not yet approved for intentional planting, they are locally-adapted native species and do not need to be removed by the City.

On saltgrass test plots established by the District on the playa, evidence of use by birds, rabbits, mice, kangaroo rats, gophers, foxes, coyotes, and a diverse group of invertebrates has been found. Care must be taken to avoid creating disturbed, highly freshened habitats that facilitate pest vector (e.g., mosquito) or noxious weed (e.g., salt cedar) infestations. The mosquito and salt cedar control programs discussed in Section 5.2.6 would also take place on the Managed Vegetation control measure. The Board Order requires the City to remove all exotic pest plants from the dust control areas. Removal will be accomplished through an appropriate combination of biological, mechanical and chemical control methods.

5.3.4 Managed Vegetation Operation and Maintenance

Water use is highest during the initial stages of development of this measure, in order to leach the root zone soil to a salinity level tolerable to saltgrass. Since the later stages of leaching can be accomplished after planting, the total water input that will be required for the first year of implementation will be at most seven ac-ft/ac. Managed Vegetation will consume up to 2.5 acre feet of fresh or mixed water per irrigated acre once the target cover of 50 percent is reached. The City's existing Managed Vegetation site was established with about 2.5 ac-ft/ac of water and their actual water use (with less than 50% average cover) has been between 1.0 to 1.3 ac-ft/ac per year. Non-irrigated acres used for roads, berms, water infrastructure and water storage will alsouse some water for maintenance of protective (non-emissive) salt-crusted surfaces. The distribution of the water over the entire vegetated area will be irregular, because at any given time some fields will be irrigated for maximum growth while others will receive minimal amounts of water allowing for minimal stand maintenance.

Operation and maintenance activities for Managed Vegetation consists of implementing irrigation and fertilization schedules for the fields and monitoring drainage and vegetation conditions, as are appropriate for any sustainable perennial cropping system. Necessary maintenance will include repair and periodic replacement of water delivery and drainage infrastructure. Based on District projects and actual large-scale implementation of Managed Vegetation by the City, staffing requirements for operation and maintenance are approximately one full-time equivalent employee (FTEE) per 230 acres of vegetated area.

5.4 GRAVEL BLANKET

5.4.1 Description of Gravel Blanket for PM_{10} Control

A four-inch layer of coarse gravel laid on the surface of the Owens Lake playa will prevent PM_{10} emissions by: (a) preventing the formation of efflorescent evaporite salt crusts, because the large pore spaces between the gravel particles disrupt the capillary movement of saline water to the surface where it can evaporate and deposit salts; and (b) creating a surface that has a high threshold wind velocity so that direct movement of the large gravel particles is prevented and the finer particles of the underlying lake bed soils are protected. Gravel Blankets are effective on essentially any type of soil surface.

The District constructed small-scale gravel test plots on the Owens Lake bed that were in place for approximately 17 years and continued to completely protect the emissive surfaces beneath. Gravel placed onto the lake bed surface will be durable enough to resist wind and water deterioration, physical/mechanical/chemical weathering and leaching and, to minimize visual impacts, will be approximately the same color as the existing lake bed. The City installed about 90 acres (0.14 square-miles) of Gravel Blanket on the northern portion of Owens Lake in 2005 from rock taken from the Dolomite gravel quarry. A picture of the large scale Gravel Blanket is shown in Figure 5.16.

Under certain limited conditions of sandy soils combined with high groundwater levels, it may be possible for some of the Gravel Blanket to settle into lake bed soils and thereby lose effectiveness in controlling PM_{10} emissions. To prevent the loss of any protective gravel material into lake bed soils, a permeable geotextile fabric may be placed between the soil and the gravel, where necessary. This will prevent the settling of gravel particles into lake bed soils.

Table 5.1 – Summary of studies relating the surface cover of vegetation to percent control of PM_{10} emissions

Reference	Surface Cover Characteristics	Wind Speed	% Control
Air Sciences, Inc., 2006	20% saltgrass cover on Owens Lake clay and sand soils	NA	99%
Buckley, 1987	30% ground cover.	NA	99%
Fryrear, 1994	50% canopy cover.	48 mph	96.3%
Grantz, *et al.*, 1995	31% cover on sandy soil.	NA	99.8%
Lancaster, 1996	16-23% saltgrass cover at Owens Lake on sandy soil.	39 mph	95%
Musick & Gillette, 1990	25% vegetation lateral cover, 19.4 mph threshold on bare surface.[1]	NA	100%
Nickling, *et al.,* 1997	11-30% saltgrass cover at Owens Lake on clay soil.	$\geq$ 45 mph	99.5%[3]
van de Ven, *et al.*, 1989	4-5 inch high stubble, 30 stems/ sq. ft 19.28 mph threshold on bare surface.	NA	100%
White, *et al.*, 1996	12% cover on loose Owens Lake sand in a wind tunnel.	44 mph	97.1%[2]
White, 1997	54% saltgrass cover in wind tunnel at UC Davis in clay soil	45 mph	99.4%[3]

Notes:

[1] Wind speeds are normalized to an equivalent 10 meter wind speed at Owens Lake. This conversion uses the surface boundary layer equation assuming 0.01 cm surface roughness and the free stream speed for a given height if 10 meter wind speeds are not available.

[2] Measured PM_{10} emission reduction in the wind tunnel.

[3] Use uncontrolled $PM_{10} = 2.6 \times 10^{-3}$ g/m^2/s (from 1998 SIP (GBUAPCD, 1998a))

Figure 5.16 – Gravel blanket on north end of Owens Lake bed

To prevent pore space infilling and possible capillary rise of emissive salts to the surface, Gravel Blanket areas must be protected from water- and wind-borne soil and dust deposition. The Gravel Blanket should be the last control measure to be installed or graveled areas should be surrounded by non-emissive areas. This will minimize wind-borne depositions into the Gravel Blanket. Gravel areas should also be protected from flood deposits with flood control berms, drainage channels and desiltation/retention basins. The large pore spaces between the coarse gravel particles must be maintained to ensure that the Gravel Blanket will remain an effective PM_{10} control measure for many years.

To attain the required PM_{10} control efficiency, 100 percent of all areas designated for Gravel Blanket must be covered with a layer of gravel four inches thick. All gravel material placed shall be screened to a size greater than ½-inch in diameter. The gravel material shall be at least as durable as the rock from the three sources analyzed in the EIR and EIR Addendum Number 1 associated with the 1998 SIP. The material shall have no larger concentration of metals than found in the materials analyzed in the 1998 EIR. To minimize visual impacts, the color of the gravel material used shall be such that it does not significantly change the color of the lake bed.

5.4.2 PM_{10} Control Effectiveness for Gravel Blanket

A Gravel Blanket forms a non-erodible surface when the size of the gravel is large enough that the wind cannot move the surface. If the gravel surface does not move, it protects finer particles from being emitted from the surface. Gravel and rock coverings have been used successfully to prevent wind erosion from mine tailings in Arizona (Chow and Ono, 1992). The potential PM_{10} emissions from a Gravel Blanket can be estimated using the USEPA emission calculation method for industrial wind erosion for wind speeds above the threshold for the surface (USEPA, 1985). PM_{10} will not be emitted if the wind speed is below the threshold speed.

Based on a minimum particle size of ½ inch, the proposed Gravel Blanket will have a threshold wind speed of more than 90 miles per hour measured at 10 meters (USEPA, 1992, Ono and Keisler, 1996). This wind speed is rarely exceeded in the Owens Lake area. A more typical gust for Owens Lake is around 50 miles per hour.

The proposed four-inch thick Gravel Blanket is intended to prevent capillary movement of salts to the surface. Fine sands and silts that fill in void spaces in the gravel will allow the capillary rise of salts and reduce the effectiveness of a Gravel Blanket to control PM_{10} at Owens Lake. In addition, finer particles will lower the average particle size and lower the threshold wind speed for the surface. Gravel Blanket tests were performed at two sites on Owens Lake starting in June 1986. These tests showed that four-inch thick Gravel Blankets composed of ½ to 1½-inch and larger rocks prevented capillary rise of salts to the surface. Observations of ungraveled test plots in the same area, one with no surface covering and another with local unscreened, unsorted alluvial soil, showed that salts would otherwise rise to the surface (Cox, 1996).

The PM_{10} emissions are expected to be virtually zero for the Gravel Blanket since the threshold wind speed to entrain gravel, and thus PM_{10}, is above the highest wind speeds expected for the area. This will result in 100 percent reduction of PM_{10} from areas that are covered by the Gravel Blanket.

5.4.3 Gravel Blanket Operation and Maintenance

Because fine particles cannot be allowed to cover or significantly infill the gravel, the Gravel Blankets should be the last measure implemented after all adjacent erodible areas are controlled. Once the Gravel Blanket has been applied to the playa, limited maintenance would be required to preserve the Gravel Blanket. The gravel will be visually monitored to ensure that the Gravel Blanket was not filled with sand or dust, or had not been inundated or washed out from flooding.

If any of these conditions were observed over areas larger than one acre, additional gravel will be transported to the playa and applied to the playa surface. The District estimates that operation and maintenance staffing requirements are one FTEE per five square miles of gravel and an average ongoing maintenance amount of gravel of 7,000 cubic yards per square mile per year (this allows for complete gravel replacement once every 50 years).

5.5 MOAT & ROW

5.5.1 Description of Moat & Row for PM_{10} Control

In 2006, during the settlement negotiations between the District and the City over the APCO's determination that additional controls were necessary on Owens Lake beyond the 29.8 square miles required by the 2003 SIP, the City proposed a new Owens Lake PM_{10} control measure known as "Moat & Row." It was the City's intention to develop a control measure that cost less to implement and used less water than the approved BACM controls. The Settlement Agreement that resulted from the 2006 negotiations contains provisions for up to 3.5 square miles of Moat & Row to be constructed in the 2008 SIP control area. (See Board Order, Chapter 8, Attachment A, Paragraph 2.B.) However, Moat & Row is currently only a demonstration measure—it is not an approved BACM control.

The general form of Moat & Row is an array of earthen berms (rows) about 5 feet high above the lake bed surface with sloping sides, flanked on either side by slope-sided ditches (moats) about 4 feet deep. The rows are topped with sand fences up to 5 feet high that increase the effective height of the rows. Figures 5.17 and 5.18 are photographs of the Moat & Row test being conducted by the City. Moats are intended to serve to capture moving soil particles, and rows are intended to physically shelter the downwind lake bed from the wind.

The individual Moat & Row elements are to be constructed in a serpentine layout across the lake bed surface, generally parallel to one another, and spaced at variable intervals, so as to minimize the fetch between rows along the predominant wind directions. The serpentine layout of the Moat & Row array is intended to control emissions under the full range of principal wind directions. Initial pre-test modeling conducted by the City indicates that Moat & Row element spacing will generally vary from 250 to 1000 feet, depending on the surface soil type and the PM_{10} control effectiveness (MDCE) required on the Moat & Row area. See Exhibit 4 of the 2006 Settlement Agreement for conceptual drawings of the Moat & Row measure (2008 SIP Chapter 8, Attachment A).

As mentioned above, the Moat & Row PM_{10} control measure is not a currently-approved BACM. The final form of the Moat & Row PM_{10} control measure will be solely determined by

Figure 5.17 – Moat and Row test – oblique view

Figure 5.18 – Moat and Row test – ground level view

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the City based primarily on modeling and the results of a demonstration project and testing being conducted by the City at two locations on the lake bed. One of the test areas is at the northeast corner of the lake bed in primarily sandy soils and the other is in a central area dominated by clay soils. The two Moat & Row test areas total about 0.5 square mile (310 acres). Testing will be conducted on the lake bed during the 2007-2008 dust season prior to implementation on a large scale before the end of 2009. The final form of the Moat & Row PM_{10} control measure will largely be determined from the results of testing conducted by the City on the lake bed. Final design is subject to test results, required PM_{10} control effectiveness, environmental documentation, permitting, engineering, and monitoring considerations.

Areas of Moat & Row that do not function as designed or that cause or contribute to an exceedance of the federal 24-hour PM_{10} NAAQS will be remediated as specifically provided in the Board Order (Chapter 8, Attachment B, “2008 Owens Valley Planning Area Supplemental Control Requirements Procedure”). In summary, the City will use the results of their 2007-2008 Moat & Row tests to design large-scale implementation of the measure to meet all control requirements. The design will then be implemented on up to a maximum of 3.5 square miles within the 2008 SIP DCM area (See Figure 2.3). If the Moat & Row controls are not effective and contribute to a NAAQS exceedance, the City will be given one chance to improve the Moat & Row controls. If the area that was improved is subsequently the cause of a second NAAQS exceedance, the City is required to convert that area to an approved BACM control.

5.5.2 PM_{10} Control Effectiveness for Moat & Row

The District does not know how effective Moat & Row will be. The testing to be conducted by the City during the 2007-2008 dust season is intended to provide the data necessary for final configuration. However, in order for Moat & Row to be a successful dust control measure and in order for it to be designated as a BACM control at some point in the future, it will be required to attain the MDCEs for those areas on which it is implemented (See Figure 5.7).

It is anticipated that the PM_{10} control effectiveness of Moat & Row could be enhanced by combining it with other approved DCMs or other measures to increase the overall dust control effectiveness. Moat & Row enhancement measures could include the addition of Shallow Flooding and/or Managed Vegetation areas between Moat & Row elements, the addition of more Moats & Rows and/or sand fences to the areas between the initially constructed Moat & Row elements and the application of brine or rock facing to the rows to maintain them in a non-emissive condition. These enhancements would ensure that if significant dust sources (hot spots) develop within these areas, they will be addressed. Moat & Row enhancement activities beyond the scope of that anticipated and described in the EIR for this 2008 SIP would require additional CEQA analysis. As with all DCM implementation on lands under CSLC jurisdiction, enhancement measures on state lands would be subject to approval by the CSLC.

5.5.3 Moat & Row Operation & Maintenance

If the City develops a design for Moat & Row that is effective, in order for it to remain effective, it must be maintained. Moats that lose effectiveness by filling with blown soil must be cleared. Rows that deteriorate due to wind or water erosion must be repaired. Sand fences that top the rows and provide increased effective height must also be maintained. As the District has not tested Moat & Row and as the City has yet to develop its final design, it is unknown what level of maintenance will be required for the measure.

5.5.4 Moat & Row as BACM

If Moat & Row is successfully implemented on the Owens Lake bed and achieves the required minimum dust control efficiencies, the City may apply to the District to designate the measure as BACM. The Board Order contains a procedure for designating new BACM controls (Chapter 8, Attachment D, "2008 Procedure for Modifying Best Available Control measures (BACM) for the Owens Valley Planning Area"). In summary, with regard to Moat & Row, the procedure allows the City to implement up to 3.5 square miles of Moat & Row as a test. If the test area is effective for three years, the City may apply to the District for a SIP revision to designate Moat & Row as BACM. The SIP revision is subject to approvals by the District Governing Board, the California Air Resources Board and the USEPA.

5.6 STORMWATER MANAGEMENT

The bed of Owens Lake is subject to infrequent, but significant flooding, alluvial deposition and fluctuating brine pool levels caused by stormwater runoff flows. In order to protect the PM_{10} control measures installed on the lake bed, as well as the downstream lease holders, the City shall design, install, operate and maintain flood and siltation control facilities. Flood and siltation control facilities shall be designed to provide levels of protection appropriate for the PM_{10} control measures being protected. For example, lake bed areas controlled with Managed Vegetation or Gravel Blanket may require a higher level of flood and siltation protection than areas controlled with Shallow Flooding. Appropriate flood and siltation control facilities shall be integrated into the design and operation of all PM_{10} control measures. All flood and siltation control facilities shall be continually operated and maintained to provide their designed level of protection. All flood and siltation control facilities and PM_{10} control measures damaged by stormwater runoff or flooding shall be promptly repaired and restored to their designed level of protection and effectiveness.

All flood and siltation control facilities shall be designed so as not to cause the existing trona mineral deposit lease area (California State Lands Commission leases PRC 5464.1, PRC 3511 and PRC 2969.1) to be subjected to any greater threat of water inundation and alluvial material contamination than would have occurred under natural conditions prior to the installation of PM_{10} control measures.

5.7 REGULATORY EFFECTIVENESS

Rule effectiveness is a measure of the compliance by the regulated sources with the control measures required under the plan. Since virtually all the PM_{10} emissions in the Planning Area originate from the dry playa of Owens Lake, and since a single operator, the City of Los Angeles, is required to undertake the control measures required under this plan to control those emissions, the District projects a rule effectiveness of 100 percent for the plan's control measures.

The District will enforce the plan's requirements through continual oversight and inspection of the City's efforts to construct, operate and maintain the control measures, and through periodic inspection and monitoring. The plan contains milestones in 2009 and 2010 for construction and operation of the control measures, and test methods for determining the compliance of the City's control strategy implementation with the performance standards required under this plan.

5.8 REFERENCES

Air Sciences, Inc., 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California, prepared for the Los Angeles Department of Water & Power, Los Angeles, California, July 2006.

Ayars, 1997. Ayars, James, Reclamation Studies on Owens Lake Bed Soil Using Controlled Flood Irrigation, Prepared for the Great Basin Unified Air Pollution Control District, Bishop, California, May 2, 1997.

Buckley, 1987. Buckley, R., *The Effect of Sparse Vegetation on the Transport of Dune Sand by Wind*, Nature, 325:426-29, 1987.

Chow and Ono, 1992. Chow, Judith, and Duane Ono, eds., PM_{10} Standards and Non-traditional Particulate Sources, "Fugitive Emissions Control on Dry Copper Tailings with Crushed Rock Armor," Air & Waste Management Association, Pittsburgh, Pennsylvania, 1992.

Cox, 1996. Cox, Jr., Bill, Gravel as a Dust Mitigation Measure on Owens Lake, Great Basin Unified Air Pollution Control District, Bishop, California, October 1996.

Eldridge, 1995. Eldridge, B.F. and K. Lorenzen, Predicting Mosquito Breeding in the Restored Owens Lake, University of California, Davis, California, August 1, 1995.

Fryrear, 1994. Fryrear, Donald W., letter from U.S. Department of Agriculture, Agricultural Research Service, to Ellen Hardebeck, Great Basin Unified Air Pollution Control District, Bishop, California, July 22, 1994.

GBUAPCD, 1996. Great Basin Unified Air Pollution Control District, Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan Project Alternatives Analysis, GBUAPCD, Bishop, California, October 23, 1996.

GBUAPCD, 1997. Great Basin Unified Air Pollution Control District, Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan Final Environmental Impact Report, GBUAPCD, Bishop, California, July 2, 1997.

GBUAPCD, 1998a. Great Basin Unified Air Pollution Control District, Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan, GBUAPCD, Bishop, California, November 16, 1998.

GBUAPCD, 1998b. Great Basin Unified Air Pollution Control District, Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan Final Environmental Impact Report Addendum Number 1, GBUAPCD, Bishop, California, November 16, 1998.

GBUAPCD, 2002a. Great Basin Unified Air Pollution Control District, Saltgrass Meadow Establishment and Maintenance Using Flood Irrigation: Lawrence Clay soil at Owens Lake, California (Draft), GBUAPCD, Bishop, California, 2002.

GBUAPCD, 2002c. Great Basin Unified Air Pollution Control District, Meadow Establishment and Maintenance on the North Sand Sheet at Owens Lake, 1994-2001 (Draft), GBUAPCD, Bishop, California, 2002.

GBUAPCD, 2003. Great Basin Unified Air Pollution Control District, Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan - 2003 Revision, GBUAPCD, Bishop, California, November 13, 2003.

GBUAPCD, 2006b. Great Basin Unified Air Pollution Control District, Settlement Agreement between the District and the City to resolve the City's challenge to the District's Supplemental Control Requirement determination issued on December 21, 2005 and modified on April 4, 2006, GBUAPCD, Bishop, California, December 4, 2006.

GBUAPCD, 2007b. Great Basin Unified Air Pollution Control District, 2008 Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan Draft Subsequent Environmental Impact Report, State Clearing House Number 2007021127, GBUAPCD, Bishop, California**,** September 14, 2007.

Grantz, *et al.*, 1995. Grantz, David, David Vaughn, Rob Farber, Mel Zeldin, Earl Roberts, Lowell Ashbough, John Watson, Bob Dean, Patti Novak, Rich Campbell, Stabilizing Fugitive Dust Emissions in the Antelope Valley from Abandoned Farmland and Overgrazing, *A&WMA's 88th Annual Conference & Exhibition*, June 1995, San Antonio, Texas, Paper #95-MP12.04, Air & Waste Management Association, Pittsburgh, Pennsylvania, June 1995.

Groeneveld, 2002. Groeneveld, David G., A Remote Sensing Approach to Monitoring Owens Lake Mitigation, prepared for Great Basin Unified Air Pollution Control District by HydroBio, Santa Fe, New Mexico, 2002.

Hardebeck, *et al.*, 1996. Hardebeck, Ellen, Grace Holder, Duane Ono, Jim Parker, Theodore Schade and Carla Scheidlinger, Feasibility and Cost-Effectiveness of Flood Irrigation for the Reduction of Sand Motion and PM_{10} on the Owens Dry Lake, Great Basin Unified Air Pollution Control District, Bishop, California, 1996.

HydroBio, 2007. HydroBio, Inc., Bibliographic Summary of Owens Lake Dust Control Measure Compliance Reports and Supporting Documentation, Santa Fe, New Mexico, September 2007.

LADWP, 2000. Los Angeles Department of Water and Power, Mitigated Negative Declaration, North Sand Sheet Shallow Flooding Project, Owens Lake Dust Mitigation Program, Owens Lake , California, Los Angeles, California, April 2000.

LADWP, 2001. Los Angeles Department of Water and Power, Mitigated Negative Declaration, Southern Zones Dust Control Project, Owens Lake Dust Mitigation Program, Owens Lake , California, Los Angeles, California, September 2001.

Lancaster, 1996. Lancaster, Nicholas, Field Studies to Determine the Vegetation Cover Required to Suppress Sand and Dust Transport at Owens Lake, Desert Research Institute, Reno, Nevada, July 1996.

Musick & Gillette, 1990. Musick, H.B. and D.A. Gillette, *Field Evaluation of Relationships between a Vegetation Structural Parameter and Sheltering Against Wind Erosion*, Journal of Land Degradation and Rehabilitation, December 1990.

Nickling, *et al.*, 1997. Nickling, William G., Nicholas Lancaster, and John Gillies, Field Wind Tunnel Studies of Relations Between Vegetation Cover and Dust Emissions at Owens Lake, an interim report prepared for the Great Basin Unified Air Pollution Control District, University of Guelph, Ontario, Canada, and Desert Research Institute, Reno, Nevada, May 8, 1997.

Ono and Keisler, 1996. Ono, Duane and Mark Keisler, Effect of a Gravel Cover on PM_{10} Emissions from the Owens Lake Playa, Great Basin Unified Air Pollution Control District, Bishop, California, July 1996.

Ruhlen and Page, 2001. Ruhlen, T.D. and G.W. Page, Summary of Surveys for Snowy Plovers at Owens Lake in 2001, report prepared for CH2MHILL, Santa Ana, California, 2001.

Ruhlen and Page, 2002. Ruhlen, T.D. and G.W. Page, Summary of Surveys for Snowy Plovers at Owens Lake in 2002, report prepared for CH2MHILL, Santa Ana, California, 2002.

Schade, 2001. Schade, Theodore, Procedure to Determine Compliance with SIP Performance Criterion for Shallow Flood Dust Control Measure, Great Basin Unified Air Pollution Control District, Bishop, California, November 2001.

Scheidlinger, 1997. Scheidlinger, Carla, Vegetation as a Control Measure, Great Basin Unified Air Pollution Control District, Bishop, California, May 1997.

Stradling, 1997. Stradling, Frank, Agrarian Test Area Construction Costs Summary, Agrarian Research & Management Company, Provo, Utah, January 1997.

USEPA, 1995. United States Environmental Protection Agency, Compilation of Air Pollution Emission Factors AP-42 (Fifth edition), USEPA, Research Triangle Park, North Carolina, January 1995.

USEPA, 1992. United States Environmental Protection Agency, Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, EPA-450/2-92-004, USEPA, Research Triangle Park, North Carolina, September 1992.

van de Ven, *et al.*, 1989. Van de Ven, T.A.M., D.W. Fryrear, W.P. Spaan, *Vegetation Characteristics and Soil Loss by Wind*, Journal of Soil and Water Conservation, Soil and Water Conservation Society, July-August 1989.

White, *et al.*, 1997. White, Bruce, Victoria M.-S. Tsang, Greg Hyon-Mann Cho, Final Report UC Davis Wind Tunnel A Wind Tunnel Study to Determine Vegetation Cover Required to Suppress Sand and Dust Transport at Owens (dry) Lake, California, Contract No. C9464, prepared for the California State Lands Commission and the Great Basin Unified Air Pollution Control District, Davis, California, February 1997.

White, 1997. Pers. Comm. with Bruce White, University of California Davis; and Carla Scheidlinger, Great Basin Unified Air Pollution Control District, regarding wind tunnel test results, GBUAPCD, Bishop, California, May 13, 1997.