Great Basin Unified Air Pollution Control District

Owens Valley PM-10 Planning Area Best Available Control Measures State Implementation Plan

June 29, 1994

Ellen Hardebeck
Control Officer

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 Short St. Suite #6 - Bishop, CA 93514
(619) 872-8211

June 29, 1994

I HEREBY CERTIFY that at a meeting of the Great Basin Unified Air Pollution Control District in the Alpine County Board of Supervisors Chambers in the town of Markleeville, California on June 29, 1994, an order was duly made and entered as follows:

ADOPTION OF BACM SIP FOR OWENS VALLEY

A motion was made by Supervisor Payne, seconded by Supervisor Lawrence adopting the BACM SIP for Owens Valley with page 87 replaced by revised page 87 (as passed out at the Board Meeting and dated June 1994), page 88 eliminated and typing errors corrected. Motion carried unanimously and so ordered.

WITNESS: B/O #062994-10

ATTEST:

Donna Leavitt

Donna Leavitt, Clerk of the Board

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
OWENS VALLEY PM-10 PLANNING AREA
BEST AVAILABLE CONTROL MEASURES STATE IMPLEMENTATION PLAN

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SUMMARY

The purpose of this document, known as the Owens Valley PM-10 Planning Area Best Available Control Measures State Implementation Plan (BACM SIP), is to update the efforts underway to solve the particulate matter air pollution problem in the southern Owens Valley and to determine the best control measures available at this time for implementation. This document describes the Planning Area, the air pollution sources, the quantities of air pollution and the measures being developed to control the problem. It evaluates all the control measures under consideration in terms of such items as effectiveness, feasibility and cost and designates three measures as "best available control measures" or BACM.

The high levels of particulate matter air pollution (PM-10) in the Planning Area cause human health problems, affect national security interests and adversely impact the innumerable plant and wildlife resources found in the Eastern Sierra. Daily concentrations of PM-10 in the Owens Valley are among the highest measured in the country. The Federal Standard for 24-hour average concentration is 150 micrograms per cubic meter ($\mu g/m^3$). Concentrations in the community of Keeler have been measured as high as 1,861 $\mu g/m^3$, or over 10 times the Federal Standard.

Owens Dry Lake is the source within the Planning Area responsible for 99.9% of the PM-10 air pollution. The lake was dried early in this century when Owens Lake's water sources were diverted to the City of Los Angeles. Since then, Owens Lake has become the largest single source of anthropogenic air pollution in the country. On a peak day, about 50,000 tons of PM-10 are emitted from the Lake. The yearly emissions average about 1,000,000 tons.

The Great Basin Unified Air Pollution Control District (District) is working with members of the public, the City of Los Angeles, the State of California and the Environmental Protection Agency to develop a solution to the problem at Owens Lake. Eleven possible control measure candidates are described and evaluated in this document. However, a number of measures have been eliminated by the lake bed owner, the California State Lands Commission, as being unacceptable because they do not take into account the public trust resources of the lake. The State Lands Commission has so far determined that three measures are acceptable: flood irrigation, vegetation and riparian corridors. They have found three measures to be

unacceptable: gravel blankets, chemical stabilizers and waste material coverings. There has been no determination on the other five measures under consideration: refilling the lake, sprinklers, salt flats, shallow groundwater lowering and closely-spaced sand fences.

As a requirement of this document, the District has determined that the best available control measures are three measures that are both available for implementation and are acceptable to the State Lands Commission: flood irrigation, vegetation and riparian corridors. All of these measures have been implemented on a limited basis and will be expanded where feasible. The District is presently concentrating its efforts on completing the testing of these three measures in order to determine the control effectiveness, the large-scale implementation feasibility and the costs associated with the BACMs. At the request of the State, the District is using only locally adapted native plant species in all vegetation-based testing.

The EPA has set a date of February 8, 1997 for preparation and submittal of a final plan that demonstrates attainment of the PM-10 Standard. As shown in the schedule contained in this document, all research and test results will be ready in time to choose and begin implementation of the measures necessary for Standard attainment by the February 1997 deadline. Attainment of the Standard needs to be accomplished by the end of 2001.

SECTION 1 - INTRODUCTION

FEDERAL CLEAN AIR ACT MANDATES
BACM ADOPTION AND OWENS LAKE

1.1 FEDERAL CLEAN AIR ACT MANDATES

On July 1, 1987 the United States Environmental Protection Agency (EPA) promulgated a new National Ambient Air Quality Standard (Standard) for particulate matter 10 microns in diameter or less (PM-10). The PM-10 Standard was set at 150 micrograms per cubic meter ($\mu g/m^3$) for the 24-hour standard and 50 $\mu g/m^3$ for the annual average standard. These levels were selected to protect the health of people who are sensitive to exposure to fine particles.

On August 7, 1987 the EPA designated the southern Owens Valley, between Tinemaha and Haiwee Reservoirs, as an area that violated the new PM-10 Standard. The Great Basin Unified Air Pollution Control District (Great Basin) adopted a PM-10 State Implementation Plan (SIP) in December 1988 and submitted it to the California Air Resources Board (CARB), where it was also approved in December, 1988 and forwarded to the EPA. No action was taken by EPA to approve or disapprove the 1988 SIP.

In November 1990, the federal Clean Air Act Amendments (CAAA) were signed into law, setting into motion new statutory requirements for attaining the PM-10 Standards. All areas in the United States that were previously classified as federal non-attainment areas for PM-10, including the southern Owens Valley, were designated as "moderate" PM-10 non-attainment areas. In response to a request through the CAAA, in November 1991 the District prepared an addendum to the 1988 SIP that updated the air quality information and the work performed since 1988.

Section 188(b) of the CAAA specifies that any area that cannot attain the standards by December 1994 would subsequently be reclassified as a "serious" non-attainment area. In January 1993, EPA completed its initial reclassification process, and included the southern Owens Valley among five nationwide areas reclassified as "serious" effective February 8, 1993. Section 189(b) of the CAAA further specifies that a SIP revision is due within 18 months of the reclassification (August 8, 1994). This revision must assure that implementation of BACM, including "best available control technology" (BACT), will be effective within four years of the reclassification date, which is February 8, 1997. The purpose of this document is to satisfy Section 188(b) of the CAAA for BACM SIP submittal.

In early 1993, EPA released draft guidance to local districts indicating the requirements which would be necessary to meet CAAA statutes. This was followed by a number of BACM SIP workshops.

According to the EPA guidance, BACM SIP submittals must contain:

- A baseline inventory of PM-10;
- An evaluation of source category impacts;
- An evaluation of the technological feasibility of each candidate BACM;
- An evaluation of the costs associated with each candidate BACM;
- A rationale for the selection of each BACM from the candidate list of BACMs;
- Provisions to lower the emissions level for sources that are classified as "major sources" to include any point sources that emit 70 tons per year of PM-10 or more, and
- Assurances that implementation of selected BACM (including BACT), are effective by February 8, 1997.

This document addresses each of the elements contained in the EPA guidance.[1]

Other requirements for Serious areas will be addressed in the Demonstration of Attainment (DOA) SIP that must be submitted to the U.S. EPA by February 8, 1997. For the Owens Valley Planning Area, the DOA SIP will include:

- A control strategy with a list of measures for implementation at Owens Lake,
- An air quality model that will demonstrate that the proposed control measures will bring the area into attainment with Standard, and
- Quantitative milestones that will be evaluated every three years to demonstrate that "reasonable further progress" is being made to attain the Standard.

The CAAA further requires that the PM-10 Standard be attained by December 31, 2001. However, there are provisions in the Act for extensions of this date.

1.2 BACM ADOPTION AND OWENS LAKE

The Clean Air Act requires that Serious areas adopt BACM for sources identified in the BACM guidance documents. The only significant source of PM-10 in the Owens Valley Planning Area is Owens Dry Lake. The BACM Guidance Documents, which satisfactorily address urban fugitive dust sources, are not easily transferable to the problem at Owens Lake. Because of the enormous size of the area that must be controlled at Owens Lake (about 46 square miles), and because the control measures must be maintained for as long as water from the Eastern Sierra is diverted to Los Angeles, the criteria to evaluate and select BACM will be investigated specifically for Owens Lake. BACM for Owens Lake must be carefully developed and evaluated for different parts of the lake considering each control measure's technical feasibility, potential emission reductions for PM-10, economic cost, and long-term environmental impacts.

The District has worked diligently with other parties to determine what control measures should be considered BACM for Owens Lake. Since 1983, the District has worked closely with the Los Angeles Department of Water and Power, the California State Lands Commission, the California Air Resources Board, the California Department of Fish and Game, the California Regional Water Quality Control Board, the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers and the U.S. Navy. In addition to the public agencies, a long list of environmental groups, scientific experts, and local citizens have participated in the effort to develop fugitive dust controls for Owens Lake.

With regard to Owens Lake, this BACM SIP document summarizes the list of candidate BACMs that have been considered for implementation on the lake bed. Then, based on a set of evaluation criteria, the measures that represent BACM are identified. These evaluation criteria include: the measure's potential effectiveness based on the results of testing to date, available natural resources, large-scale implementation feasibility, large-scale implementation cost and the mandate from the lake bed property owner, the California State Lands Commission, that measures implemented preserve or restore public trust values.

The DOA SIP due in 1997 will contain a final control measure implementation plan that identifies which Standard attainment control measures will be applied on Owens Lake, where each final measure will be applied and a measure implementation phasing schedule. This schedule will provide for full deployment of the final measures by the 2001 Standard attainment deadline.

SECTION 2 - OWENS VALLEY PLANNING AREA

PHYSICAL CHARACTERISTICS
GENERAL CLIMATIC CONDITIONS
WIND CHARACTERISTICS

2.1 PHYSICAL CHARACTERISTICS

The Owens Valley Planning Area (OVPA) is located in eastern California in west central Inyo County, completely within the boundaries of the Great Basin Unified Air Pollution Control District (Figure 1). The OVPA has been defined by the EPA as hydrologic unit number 18090103 on the State of California Hydrologic Unit Map 1978. The area encompassed is approximately 70 miles long and 20 miles wide (Figure 2).

The crest of the Sierra Nevada Mountain Range defines the western edge of the area, from approximately Taboose Creek in the north to Round Mountain in the south. The southern boundary crosses the Owens Valley eastward at Haiwee Reservoir and into the Coso Mountain Range to Coso Peak. At Coso Peak the boundary curves northward across Lower Centennial Flat and runs along the crest of the Inyo Mountain Range to approximately Waucoba Mountain. From this northeast corner of the area, the northern boundary crosses the Owens Valley at Tinemaha Reservoir. The OVPA lies in the deepest valley in the country; the low elevation of 3,552 feet above mean sea level occurs at Owens Lake while the high elevation of 14,494 occurs at the peak of Mount Whitney.

The OVPA is very rural in nature and includes no incorporated cities. However the area does include the unincorporated communities of Independence (Inyo County seat), Lone Pine, Dolomite, Keeler, Cartago and Olancha. Additional small ranches and housing tracts are located throughout the area. The permanent population within the Planning Area is approximately 3,400 people.[2] Nearly all of the land within the OVPA is public land under the jurisdiction of the Bureau of Land Management, the U.S. Forest Service, the U.S. Department of Defense, the California State Lands Commission, the County of Inyo and the City of Los Angeles.

2.2 GENERAL CLIMATIC CONDITIONS

Due to the large elevational differences within the OVPA, the climate ranges from a high desert type on the floor of the Owens Valley to an alpine type along the crest of the Sierra. Because the air pollution associated with the Planning Area occurs at the lower elevations and because the permanent population resides on the valley floor, climatic conditions will be described there.

Weather in California is a continuous interaction of maritime air masses with those of continental origin. The Owens Valley is well protected from the ocean air masses by its mountainous surroundings and consequently experiences a predominantly high desert type of climate. This climate is characterized by warm to hot summers, moderate winters, large daily and seasonal temperature ranges and low humidities.

Daily temperature variations are often about 40°F between the high and the low. Summer high temperatures often exceed 100°F, followed by evenings in the mid-60s to low 70s. Winter temperatures are moderate and, on average, fail to rise above freezing only about 10 days per year. Most of the area's precipitation falls as a mix of rain and snow during the months from December through March. Precipitation totals on Owens Lake averages about 4 inches per year. Summer rain falls as brief thundershowers in the mid to late afternoon. Humidity is low throughout the year and, as is the case with desert areas, sunshine is abundant year-round.

2.3 WIND CHARACTERISTICS

Large-scale movement of air masses over the Great Basin and the extreme topography of the Owens Lake area govern the direction, intensity and duration of surface winds. The north to south orientation of the 10,000 foot deep valley causes the vast majority of surface winds to flow up-valley (predominantly south-southeast) or down-valley (north-northwest). Four prominent wind flow patterns are observed in the Owens Lake area, two resulting in up-valley flow and two resulting in down-valley flow. The up-valley flow conditions result from

- storm fronts that pass south of the Owens Valley and
- local heating differentials between the valley floor and surrounding mountains,

whereas the down-valley flow conditions result from

- channeling of the prevailing maritime westerlies and
- local drainage flows resulting from radiative cooling of the surrounding mountains.

Winds are relatively constant throughout the year, typically averaging 7 mph to 9 mph each month. Locations at the higher elevations (e.g. Bishop) have better exposure to upper air patterns than those at lower elevations (e.g. Ridgecrest) and consequently experience slightly higher monthly average wind speeds.

Winter weather can occur from November through February and, during this season, down-valley surface winds are prevalent. During this time of year, up-valley winds greater than 10 mph occur less than 10 percent of the time, usually as a result of the storm fronts passing south of the area. The threshold velocity for sand movement on the lake is about 18 mph at 10 meters above lake bed ±2 mph depending on sand grain size and surface roughness. Spring weather (March through June) results in an equal occurrence of up-valley and down-valley winds greater than 10 mph. Both up-valley and down-valley winds greater than 10 mph occur over 20 percent of the time. In the summer, up-valley surface winds are prevalent. Down-valley winds greater than 10 mph occur less than 5 percent of the time during July and August. Fall weather patterns are either a continuation of the summer or an early beginning of winter.

The typical day is a pattern of night and morning down-valley flow and afternoon and evening up-valley flow. The drainage effect, one of the conditions producing down-valley winds, is stronger in the winter, while the upslope effect, one of the conditions producing up-valley winds, is stronger in the summer, particularly during the afternoon. Starting around June, the up-valley flow begins to be established earlier in the morning, accounting for the larger proportion of up-valley winds at this time of year. The strongest winds, those associated with storm fronts, usually have a westerly component and their intensity and duration depends on the track of the storm. There have been occurrences of strong west winds across the area, but northwesterly winds are the more frequent direction of strong winds. The peak annual gust (approximately five seconds duration) in the area is usually between 65 mph and 75 mph.[3]

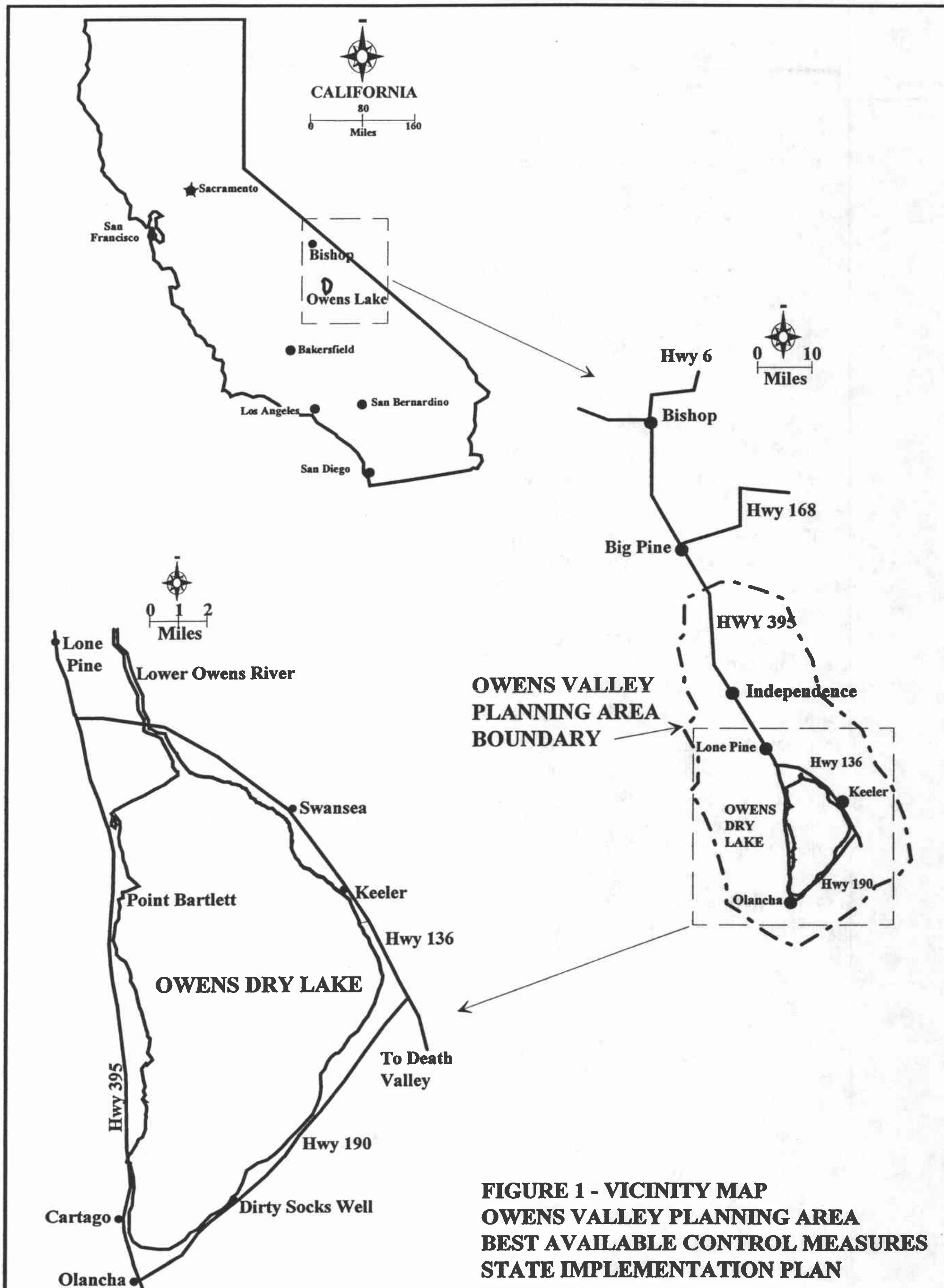
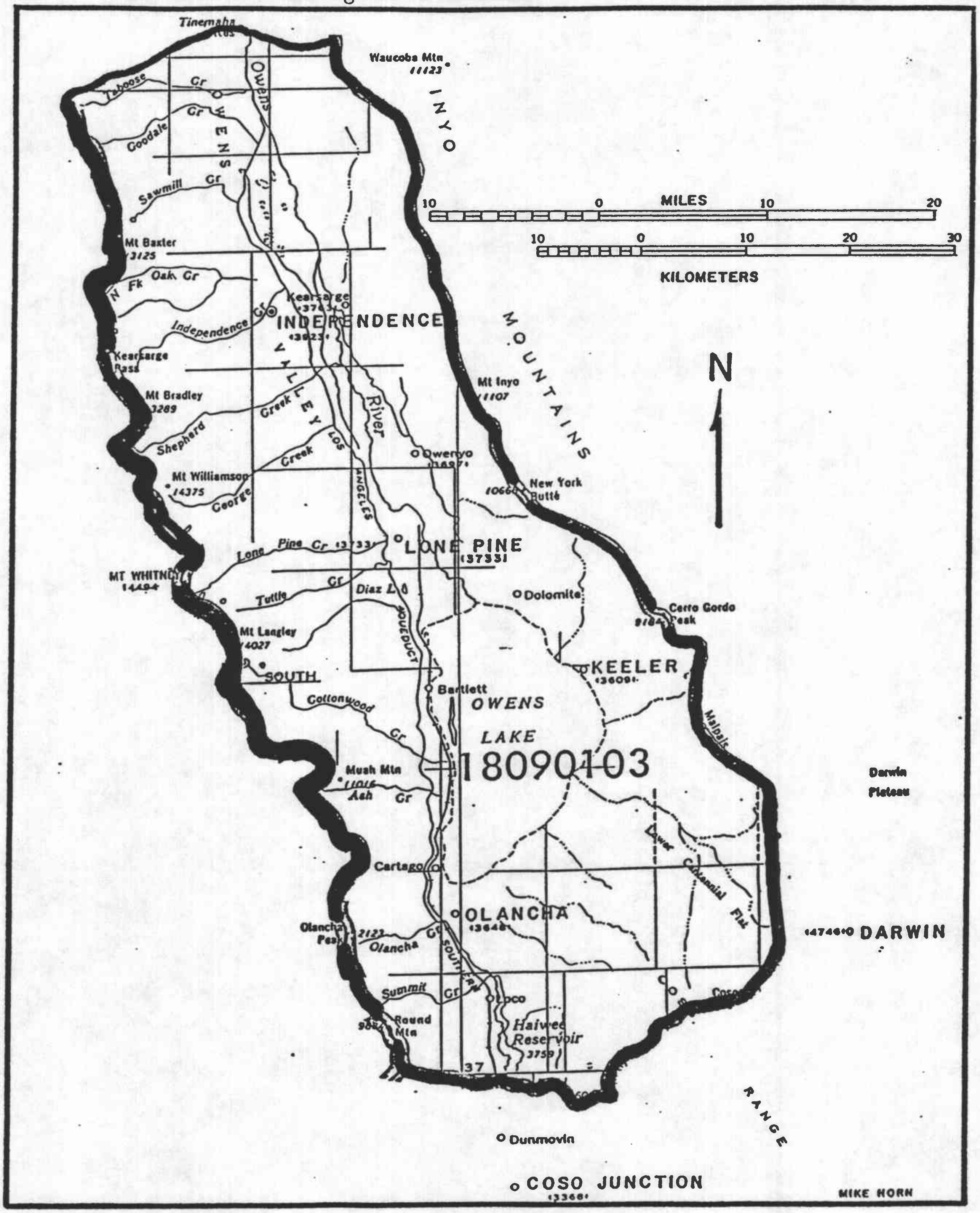


FIGURE 1 - VICINITY MAP
OWENS VALLEY PLANNING AREA
BEST AVAILABLE CONTROL MEASURES
STATE IMPLEMENTATION PLAN
MAY 1994

FIGURE 2 - Planning Area Boundaries



SECTION 3 - AIR QUALITY SETTING

IMPACTS OF PM-10 ON HUMANS, PLANTS AND ANIMALS
PLANNING AREA PM-10 CONTRIBUTORS
PM-10 DATA SUMMARY
OWENS LAKE DUST TRANSPORT PROCESS
CONTINUING AIR QUALITY MONITORING

3.1 IMPACTS OF PM-10 ON HUMANS, PLANTS AND ANIMALS

Both EPA and the State of California have established ambient air quality standards for PM-10. The California 24-hour and annual average standards, which are considerably more stringent than the federal standards, were set with the intention of:

> "Prevention of excess deaths from short-term exposures and of exacerbation of symptoms in sensitive patients with respiratory disease. Prevention of excess seasonal declines in pulmonary function, especially in children." (CAC, Title 17, Section 70200[4])

In developing these standards many sources of health effects data were considered including epidemiology studies, clinical studies of controlled human exposures, animal toxicology, short-term bioassays, and biochemical studies. The development of the final standards focused primarily on epidemiological studies.

In developing a short-term (24-hour) health-based standard for PM-10, EPA considered health effects reported in the literature including mortality and various morbidity indicators such as reduced lung function. Mortality effects were considered in the development of a short-term standard, although they were not used to derive a specific threshold for effects. Morbidity studies, which were most important in the development of the 24-hour standard for PM-10, were conducted by Dockery, et al. (1982[5]) and Dassen et al. (1986[6]). These studies showed a decrease in lung function following episodes of particulate pollution. The changes were small, but significant, and persisted for two to three weeks. In the Dockery study, there was a higher response in some children indicating that there may be sensitive subgroups in the population.

Several studies have noted a correlation between mortality rates and long-term exposure to particulate pollution levels (USEPA 1986[7]). These studies have raised concerns for possible premature mortality due to particulate pollution. Although these studies have been given less weight in the setting of standards for PM-10 due to methodological shortcomings, studies of this type were taken into consideration in the evaluation of the margin of safety for the standard.

The data that were most influential in the development of the annual average PM-10 standard were published by Ware et al. (1986[8]) involving about 10,000 six- to nine-year-old children in six U.S. cities. The study reported an association between particulate pollutant levels and reports of coughing, bronchitis, and respiratory illness.

Because of the limited scope and number of longer-term quantitative studies, qualitative data from epidemiological and animal studies were also considered in the development of the standard. These studies support the concerns, especially for sensitive groups (asthmatics, bronchitic individuals, and the elderly).

The Federal PM-10 standards are based on total particle mass without consideration of the chemical components. However, studies indicate that heavy exposure to desert dust may be harmful to human health. A syndrome referred to as "desert lung syndrome" [nonoccupational pneumoconiosis] has been described in the literature. Cases have been reported from the Sahara, Arabian, and Negev deserts. The syndrome is characterized by deposits of sandy dust in the lungs. There is some evidence that these deposits may be associated with changes in lung function; however, data addressing this issue are very limited. Desert dust also contains crystalline silica. Exposure to this compound has been associated with adverse health effects in occupational settings (i.e., fibrosis, silicosis).

PM-10 concentrations near Owens Lake are among the highest measured in the country. Concentrations of more than 10 times the 24-hour standard have been measured in the community of Keeler on the east shore of the lake (1,861 $\mu g/m^3$ on 2/3/89) . In addition to Keeler, the communities of Lone Pine to the north and Olancha to the south routinely see standard violations (e.g. Keeler annually averaged 18 exceedences of the 150 $\mu g/m^3$ Federal Standard over the 5 year period 1988 to 1993). Although the Owens Valley Planning Area itself has only about 3,400 permanent residents, the areas regularly affected by the dust storms include all of Inyo County and the communities to the south of Ridgecrest, China Lake and Inyokern. The permanent population of these regularly affected areas is about 50,000. In addition, because the Eastern Sierra is a popular vacation destination, the seasonal population can be substantially higher.

National security interests are also affected by the fugitive dust from Owens Lake. The Department of Defense has expressed concern for air quality and visibility in the airspace (designated R-2508) located to the south of the Planning Area. The China Lake Naval Weapons Center is located partially within the Planning Area (Figure 3). Good atmospheric visibility is a requirement for flight and weapons testing at the Center. Dust storms from Owens Lake adversely affect operations between 5 and 10 days per year costing hundreds of thousands of dollars per day in lost range time.[9]

In addition to human populations at risk from and affected by the PM-10, the Owens Valley Planning Area contains significant plant and animal resources that are also exposed to elevated levels of fugitive dust from Owens Lake. Three Class 1 Wilderness Areas in the Inyo National Forest are within the Planning Area and are all less than 10 miles from the edge of the playa: the John Muir Wilderness, the Golden Trout Wilderness and the South Sierra Wilderness. These are pristine natural areas designated for preservation and protection from human impacts. Visibility and excellent air quality are high priorities in these areas in order to protect their uniqueness. Dust from Owens Lake routinely blows into these three wilderness areas. In addition to the important resource areas within the Planning Area, the Dome Lands Wilderness Area, Kings Canyon National Park, Sequoia National Park and Death Valley National Monument are located within 25 miles of the Area's boundaries (Figure 3).

The Planning Area is also within about 25 miles of a unique plant resource. The oldest single living organisms in the world are the Bristlecone pine trees located in the Ancient Bristlecone Pine Forest in the White Mountains along the eastern side of the Owens Valley. These trees are over 4,000 years old. The impacts that the dust from Owens Lake has on the trees are unknown, but a resource as exceptional as these trees should not be put at any risk.

3.2 PLANNING AREA PM-10 CONTRIBUTORS

The Emissions Inventory conducted for the December 1988 SIP for the Owens Valley Planning Area examined point sources and area sources of PM-10 emissions. This study concluded that point sources, mobile sources and community area sources such as wood stoves make an insignificant contribution to PM-10 emissions on windy days when 24-hr PM-10 violations occur. Owens Lake was identified as the major cause of these violations, but the emissions from Owens Lake were not quantified.

A study prepared for the California Air Resources by the University of California, Davis (Barone, 1979[10]) used air quality samplers and chemical analysis to show that the dust from the lake bed was the major contributor to downwind air quality violations.

Estimates of PM-10 quantities from Owens Lake and other sources are discussed in more detail in Section 4.

3.3 PM-10 DATA SUMMARY

With respect to the information presented in the 1988 SIP regarding meteorological and air quality monitoring, there are no important changes. This section presents a summary of the PM-10 data collected since 1988. PM-10 data are presented for three sites surrounding Owens Lake: Keeler (east of lake), Lone Pine (north of lake) and Olancha (south of lake). The monitoring sites are shown in Figure 4.

Appendix 4 presents quarterly and annual PM-10 averages for the six year period between 1988 and 1993. It can be seen that the annual standard was exceeded in 1989 and 1990 in Keeler. However, an average of the 5 years of valid data shows that the annual PM-10 average is 46.9 $\mu g/m^3$. This is below the Federal annual standard of 50 $\mu g/m^3$, but it violates the State standard of 30 $\mu g/m^3$.

Appendix 5 presents a summary of 24-hour average PM-10 concentrations for the three PM-10 monitoring sites around Owens Lake whenever the concentration at any one site exceeded 50 $\mu g/m^3$ (the California 24-hour PM-10 Standard) between January 1988 and December 1993. Also included in the summary are the daily average wind speed and direction and the maximum hourly average wind speed and direction. It can be seen that during the 60 month monitoring period, during which 1 in 6 days were sampled, there were 23 measured exceedences of the federal 150 $\mu g/m^3$ standard; 5 exceedences at Olancha, 3 exceedences at Lone Pine and 15 exceedences at Keeler. For Keeler, which is the worst pollution site, the expected number of violations for this 5 year period is six times the number of measured violations due to the sampling frequency. This yields 90 exceedences in 5 years or about 18 violations per year.

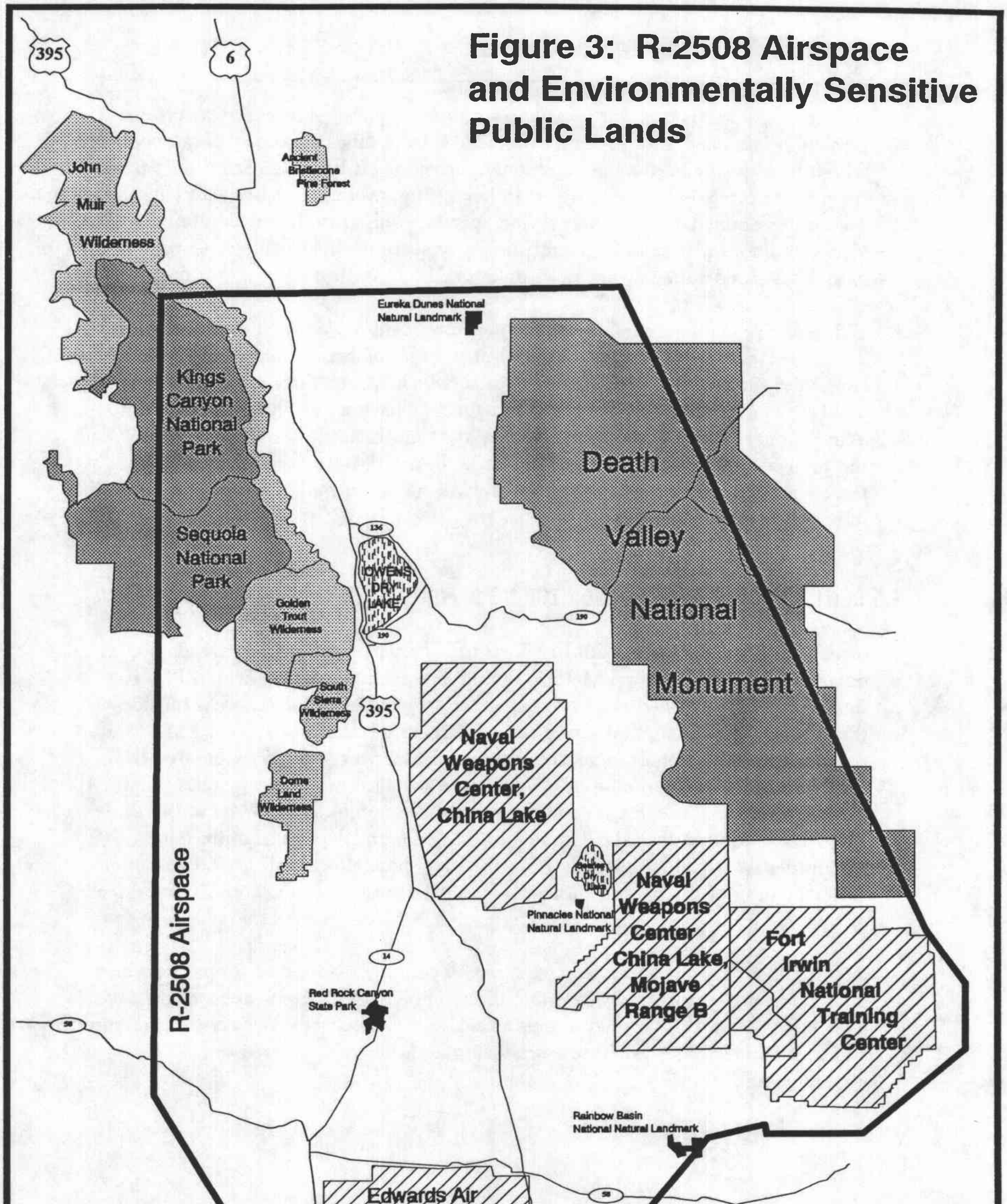
3.4 OWENS LAKE DUST TRANSPORT PROCESSES

On Owens Lake, there are three primary sources of airborne dust: clay and silt layers unprotected by crusts, fine materials created through surface abrasion by wind-driven sand-sized particles and fine salts created by efflorescence. Whether such dust becomes airborne depends on the presence of winds with sufficient speed to initiate movement, the condition of the local surface (protected or unprotected by crust or moisture) and on the local roughness of the surface.

The drying and heating of the surface that occurs in the heat of spring and summer buckles the newly formed crusts, exposing the clay and silt layers immediately below. These exposed fine particles can then be lifted by the wind.

Dust lofting through abrasion occurs when saltating sand-sized particles impact the surface crust and abrade particles of small diameter. Saltation is the bouncing

Figure 3: R-2508 Airspace and Environmentally Sensitive Public Lands



movement of sand-sized particles that are driven by the wind across a surface. A particle is launched and driven by the wind until it lands on the surface once again where its impact can dislodge additional particles as it bounces. Saltation particle trajectories rarely exceed one meter in height; the average height of all saltating material is about 10 centimeters. Wind speeds required to drive saltation vary with local conditions and sand characteristics; a typical threshold value at Owens Lake with a sustained surface wind is 18 miles per hour at 10 meters above the surface.

Efflorescence occurs when subsurface moisture is drawn upward by dry surface conditions, carrying saturated salts with it. As the moisture evaporates, the salts are left at the surface in fine powdery deposits, which can be lifted by the turbulent winds.[11] These powdery efflorescent salt surfaces have a very high PM-10 content. Wind tunnel tests of efflorescent surfaces at Mono Lake showed that up to 90% of the total suspended particulate mass can be in the PM-10 size fraction. In general, these surfaces also have lower threshold wind speeds to initiate dust generation than other surfaces on the playa.

3.5 CONTINUING AIR QUALITY MONITORING EFFORTS

Great Basin is continuing with its efforts to collect meteorological and air quality data in the Owens Valley PM-10 Planning Area. The area over which PM-10 monitoring is performed has been expanded to included affected areas outside of the Planning Area. Monitors have been set up to the south of Owens Lake (the predominant direction of large dust storms) in a network covering the area from Lone Pine to the community of Ridgecrest, a distance of about 75 miles (Figure 4). The District has also installed continuous PM-10 monitors (TEOMs) at the three PM-10 sites around the lake (Olancha, Lone Pine and Keeler). Future data summaries will include this daily PM-10 data. These efforts will provide a better understanding of the overall effects of Owens Lake dust storms and allow analysis of trends.

Testing of surface erosion characteristics will continue with wind tunnel tests and sand transport sampling to determine the erodibility of different areas of the lake. This information will be used to help evaluate the effectiveness of control measures and to help locate the worst dust producing areas for control measure implementation.

Figure 4: OWENS LAKE PM-10 MONITORING NETWORK

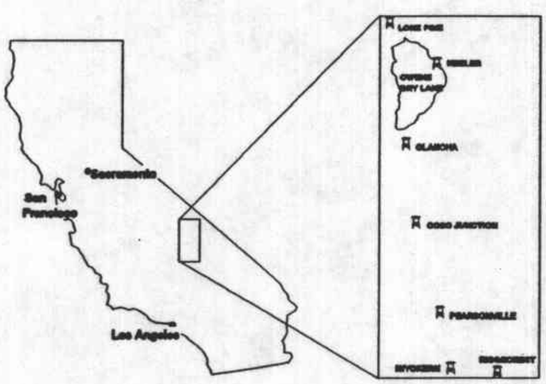
SSI = Size Selective Inlet PM

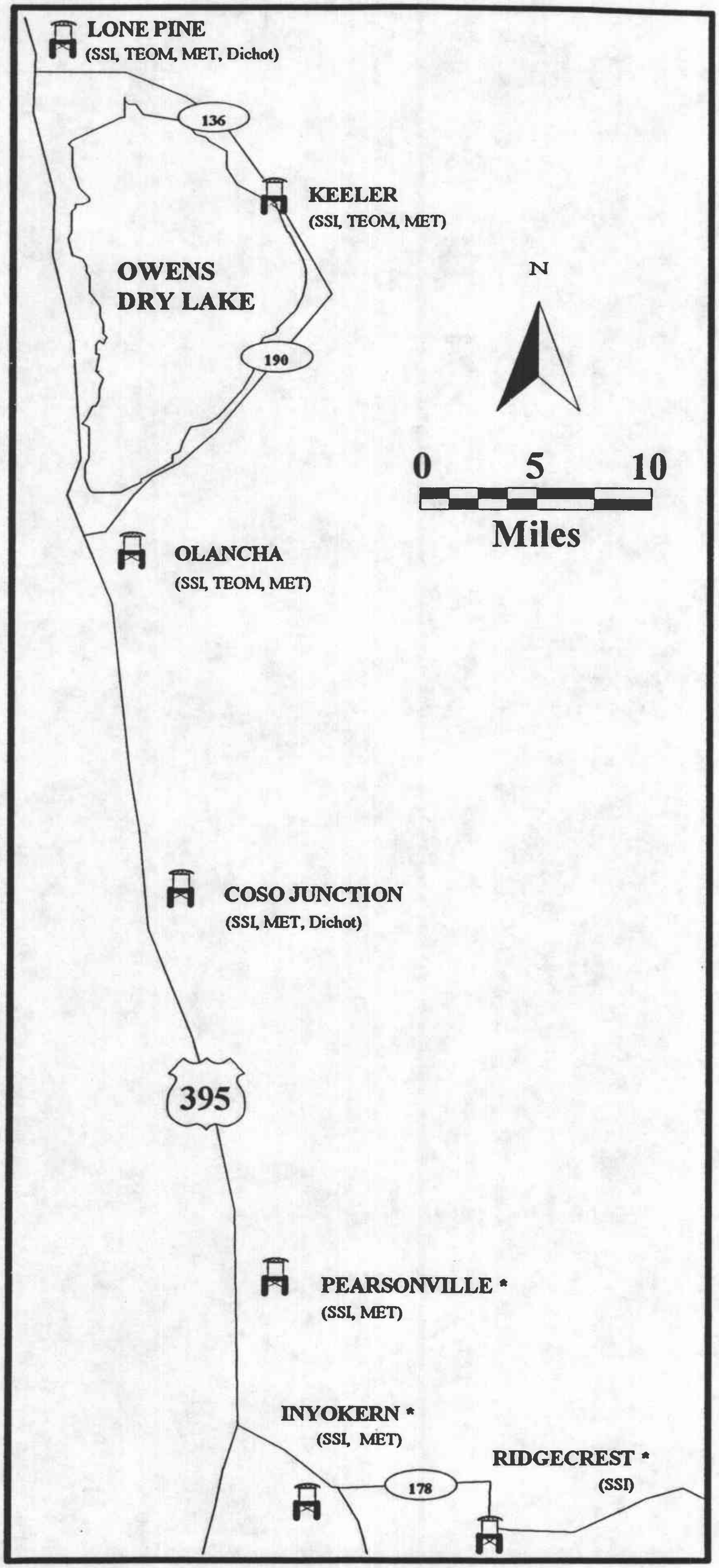
TEOM = Hourly PM-10 Concentrations

Dichot = Dichotomous Sampler
PM-10, PM-2.5 and Chemistry

Met = Meteorological 10m Wind Speed,
Wind Direction and Temperature

* = Episode Sampling Only





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SECTION 4 - EMISSIONS INVENTORY

INVENTORY SUMMARY
OWENS LAKE EMISSION ESTIMATES
FUTURE WORK
CONCLUSION

4.1 INVENTORY SUMMARY

As mentioned in the previous section, the emissions inventory conducted for the 1988 SIP concluded that all point, mobile and community area PM-10 sources make an insignificant contribution to PM-10 emissions on windy days when PM-10 violations occur. The SIP identified Owens Lake as the major cause of the violations, but the emissions were not quantified. A more complete emissions inventory for the expected control area is provided below.

TABLE 1 - 1994 Owens Valley Planning Area PM-10 Emissions Inventory

	Tons PM_{10} Per Day	Tons PM_{10} Per Year
Industrial Facilities		
Big Pine Distributors	0.06	16.6
Pacific Lightweight Products	0.09	18.4
Federal White Aggregate	0.08	28.1
Owens Lake Soda Ash Co.*	0.51	179.7
(*Projected to begin operation in 1996)		
Area & Mobile Sources		
Residential wood combustion	0.24	36.3
Entrained Road Dust - Paved	1.25	456.3
Entrained Road Dust - Unpaved	0.16	58.4
On-Road Mobile	0.13	47.5
Total of Non-Owens Lake Sources	2.52	841.3
Owens Lake Windblown Dust**	50,000	1,000,000

** Mid-range value -- see text for range of estimates

AREA COVERED BY THE EMISSIONS INVENTORY

The emissions inventory includes sources within the expected control area for the plan. This covers the southern half of the designated non-attainment area, which includes the community of Lone Pine on the control area's northern boundary. Areas outside of this control area are significantly impacted by Owens Lake dust. These areas, however, do not include any permitted sources, or any area sources that could reasonably be expected to cause a violation of the Federal PM-10 standard. There are no expected increases in this inventory except for the Owens Lake Soda Ash Company project which is expected to begin operation in 1996.

ESTIMATION METHODS FOR NON-OWENS LAKE PM-10 EMISSIONS

Entrained Road Dust (Paved Road) and On-Road Mobile

PM-10 emissions are based on CARB's 1989 emissions inventory which estimates 4.8 tons of PM-10 per day (T/D) for all of Inyo County. Since the primary vehicle traffic count and mileage is on Highway 395, a simple proportion of the length of highway 395 in the control area yields an estimate for the emissions;

(30 miles/115 miles) x 4.8 T/D = 1.25 T/D Entrained Road Dust - Paved

(30/115) x 0.5 T/D = 0.13 T/D On-Road Mobile

Entrained Road Dust (Unpaved Road)

An estimate of 0.16 T/D of PM-10 from off-road activities is estimated for the control area. This assumes 50 vehicles per day with an average trip length of 10 miles, a 20 mph vehicle speed, a mean vehicle weight of 6,000 pounds, 4 wheels, and a silt content of 5%. Using AP-42 to derive PM-10 emissions from unpaved roads, yields 0.63 pounds of PM-10 per vehicle mile travelled.

500 VMT/D x 0.63 lbs/VMT = 315 lbs/D
= 0.16 T/D Entrained Road Dust - Unpaved

Residential Wood Combustion

An estimate of 0.24 tons of PM-10 per day and 36.3 tons/year is given for residential wood combustion (RWC) in the control area. This is based on wood usage in Bishop and the AP-42 emissions factor for wood stoves. Wood usage per woodstove in Bishop, which is 60 miles north of the control area, is estimated at 2 chords of pine/year (density, 800 kg/chord) for a heating season of 150 days. The latest population estimate for the control area is 2,745.[12] A high end estimate for the number of woodstoves is one for every two people (1,372.5 woodstoves).

Mass of wood = (2 chords/150 days) x (800 kg/chord) = 10.66 kg/day
PM-10 emissions per woodstove = (15 g/kg of wood) x 10.66 kg/day = 160 g/stove-day

1,372.5 stoves x 160 g/stove-day = 219.6 kg/day = 484 lbs/day
= 0.24 tons/day RWC - Daily
150 days x 0.24 tons/day = 36.3 tons/year RWC - Annual

4.2 OWENS LAKE EMISSION ESTIMATES

A number of methods have been used to estimate annual Owens Lake emissions. It must be pointed out that these are very rough estimates; they contain a number of assumptions and uncertainties. However, they do help give some idea as to the size of the problem at Owens Lake and they all yield numbers within the same order of magnitude.

AERIAL PHOTOGRAPHS

Reinking and others (1975[13]), from study of a high altitude photo taken during a dust storm on March 26, 1975 and using a particulate concentration of 1,800 $\mu g/m^3$, estimated that at the time of the photo about 18,000 tons of material was in the air. Assuming that the actual particulate concentration from the entire storm is several (3) times greater than this yields a concentration of 54,000 tons per storm. Multiplying this by an average of 20 major storms per year results in an annual particulate emission estimate of 1,080,000 tons per year. This estimate is for total suspended particulates (TSP). Assuming that PM-10 emissions are one-half the TSP estimates yields an annual PM-10 emission of 540,000 tons. It should be pointed out that this is an estimate for major storms only; smaller dust storms affecting the local area can occur on an almost daily basis.

WIND TUNNEL PM-10 EMISSION MEASUREMENTS AT OWENS LAKE

Over 200 PM-10 emission measurements at Owens Lake have been made with a portable wind tunnel. Based on the wind tunnel measurements and a calibration of the District's tunnel with an EPA AP42 wind tunnel (Midwest Research Institute, 1994[14]) the emission rates measured range from 0.00008 to 0.28 grams per square meter per second (g/m^2-sec). Assuming the average value of 0.012 g/m^2-sec, 800 hours of winds over 17.5 mph per year, and 46 square miles of emissive lake bed area, total emissions of PM-10 from Owens Lake would equal 4,400,000 tons per year.

EMISSION ALGORITHM FOR MONO LAKE

An emissions algorithm was developed by the District from wind tunnel measurements made in 1990 for a modeling study of Mono Lake (TRC Environmental Corp., 1993[15]). Later wind tunnel measurements in Spring, 1993 gave values more than ten times higher. Assuming the larger measurements are more representative of conditions at Owens Lake (0.00292 g/m^2-sec at 22 mph), 800 hours of winds over 17.5 mph per year, and 46 square miles of emissive area, yearly PM-10 emissions would total 1,100,000 tons.

SALT EFFLORESCENCE

The source of some fraction of the PM-10 from Owens Lake is salt deposited on the lake surface during evaporation of saline groundwater. Evaporation rates were measured on two dust producing areas during the summer of 1993 by Scott Tyler of Desert Research Institute (private communication, March 7, 1994). Assuming the measured flux of 0.2 mm/day as the yearly average, a dissolved solids mass of 80 kg per m^3 of fluid evaporated, and a dust producing zone covering 190 km^2, Tyler estimated the annual rate of salt deposition to the surface at 1,200,000 tons. A more conservative estimate of dust producing area (120 km^2) results in an annual rate of 760,000 tons. Since insoluble material (soil particles) has been measured to be about 70% of the PM-10 from the lake (St. Amand et al, 1986[16]), the total mass could be up to 2,500,000 tons per year if all the salt produced by evaporation is lofted.

4.3 FUTURE WORK

In March of 1993 a team of Russian and American scientists led by Dale Gillette of the National Oceanic and Atmospheric Administration took measurements of light scattering in dust plumes from Owens Lake in an attempt to measure the total flux during dust storms. In addition, they used images from the GOES/VISSR (Geostationary Operational Environmental Satellite/Visible-Infrared Spin-Scan Radiometer) to track the dust plume from a single storm. Results are expected by the end of 1994.

4.4 CONCLUSION

Measurements of the actual total annual PM-10 emissions and 24-hour emissions from Owens Lake are still uncertain. Most estimates fall in the range from about 500,000 to 4,000,000 tons per year.

SECTION 5 - CONTROL MEASURE DEVELOPMENT

5.1 INTRODUCTION

Dust control on a source the type and size of Owens Lake has never been attempted. The ultimate PM-10 mitigation measures will likely be implemented on very large scales. The construction of the final control measures, whatever they may be, will cover or affect about 46 square miles (30,000 acres) of lake bed (Figure 5). Because the problem is unique, nontraditional control measures need to be developed and implemented. Attainment of the PM-10 Standard for the Owens Valley Planning Area, within the time frames established, requires that a comprehensive mitigation measure development and implementation program be developed and adhered to.

Due to the size of Owens Lake, the cost of implementing any type of mitigation measure on a large scale is likely to be considerable. In order to avoid unsuccessful measures, the District has adopted a control measure development program. This program is a logical, step-by-step approach to generating a final plan in the least amount of time, for the lowest possible cost, with the greatest possible chance of ultimate success. This approach allows for a certain amount of flexibility along the way. As more is learned about the Lake, its physical processes and which mitigation measures appear to offer the most promise, the plan can be adjusted and modified. However, the framework of the plan must be adhered to in order to maximize the chances that a timely, cost effective and successful plan will be implemented. In February 1992 the District set forth this approach in a document known as the "Long Range Dust Mitigation Program for Owens Dry Lake" (Reference document 1).

Great Basin feels that it is of particular importance to involve members of the public and affected government agencies during all parts of the control measure development effort. Therefore, in order to keep all interested and affected parties involved in the process, Great Basin has established the Owens Lake Advisory Group which is open to anyone with an interest in the efforts to control the PM-10 emissions. The Advisory Group meets twice a year and provides ideas, peer review and input regarding work that has been or will be done. A current list of Advisory Group members is contained in Appendix 9.

5.2 PROGRAM APPROACH

The mitigation measure development program can be divided into three main steps. The first step is a thorough understanding of the Lake's physical characteristics and the generation mechanisms of PM-10 events. The District and other researchers have been involved with the study of the Lake environment for a number of years. Only since 1991, however, has the District pursued a comprehensive plan to develop a thorough understanding of the physical processes that cause, or prevent, dust storms.

The second step of the measure development program is the actual testing of promising measures. Feasibility studies, small-scale tests and large-scale tests all provide opportunities to evaluate control measures in cost effective increments. The District is currently investing most of its resources in this phase of the program.

Finally, the third step is measure implementation. Measures that prove successful, environmentally acceptable and cost effective will become elements of a comprehensive implementation plan and will be put into place. Monitoring will continue to ensure that attainment is achieved.

5.2.1 OWENS LAKE PHYSICAL CHARACTERISTICS AND DUST MECHANISMS

Before the dust pollution from Owens Lake can be controlled, the Lake itself must be understood. This requires an inventory of the Lake's diverse and sometimes unique physical characteristics and a more complete understanding of the processes and conditions associated with dust events. In 1991, the District began a comprehensive program of assembling the data compiled to date, identifying additional needs and collecting the required information. The following is a list of the physical properties of Owens Lake and the surrounding area that have been or are being inventoried:

- Meteorology
- Air quality
- Topography
- Geology
- Soil types
- Soil chemistries
- Groundwater characteristics
- Surface water characteristics
- Flooding potentials
- Soil erosion potentials

- Existing vegetation types and locations
- Existing wetlands types and locations
- Existing wildlife resources
- Actual and potential wildlife habitat

In addition to an understanding of the Lake's physical properties, it is important to understand how and where dust storms originate. By studying the connection between the Lake's physical characteristics and meteorological processes it is hoped that the factors that influence the initiation of dust storms can be understood and thereby controlled. This work involves identifying the mechanisms of dust generation on the lake, including both dusts that are directly airborne, such as salts and fine soil particles, and dusts generated from larger particles via the saltation process. Much of this research is being provided by consultants and advisors to the District such as the California Air Resources Board, the National Oceanic and Atmospheric Administration, the Midwest Research Institute and the University of California, Davis.

In order to obtain accurate geographic data and use the data collected to make sound decisions, a formal data collection, management and analysis system has been set up. This system uses global positioning systems (GPS) to accurately locate data collected and a geographic information system (GIS) to manage and manipulate the large volume of data that is being compiled and analyzed.

5.2.2 CONTROL MEASURE TESTING

The information collected during the study of the Lake's physical characteristics is then used to determine the control measure or measures that are most appropriate for implementation in a particular area. Two main criteria are used to identify potential control measures. First and foremost, the measure must show some promise of being effective and feasible. If, based on our knowledge of the lake's environment, a potential measure either will not reduce PM-10 sufficiently to meet the National Ambient Air Quality Standards or cannot be implemented, the measure will not be pursued.

The second criterion used to evaluate potential control measures is that of compatibility with the existing and former lake environment. The lake bed is owned by the State of California and is managed by the State Lands Commission. It is the State Lands Commission's responsibility to protect the public trust resources associated with the lands under their jurisdiction and control. In letters to the District dated October 1991 and August 1993 (Appendix 6) the State Lands Commission informed the District that control measures that did not take into account the public trust values of the Lake were unacceptable. On January 8, 1992 the Great Basin Board ordered District support of the State Lands Commission's desire to concentrate on control measures that restore the Lake's public trust values. Therefore, before a control measure can be tested and ultimately implemented, it must be effective, feasible and environmentally appropriate.

The first step in any effectiveness test is the preparation of a feasibility study. The study will address such issues as small and large scale testing, expected effectiveness, measure advantages and disadvantages, full implementation, environmental impacts and costs.

For all the measures that are identified by the preliminary studies as being feasible and environmentally acceptable, small-scale tests will be designed and implemented to test the measures' actual effectiveness under varying field conditions. The size of these small-scale tests would be variable and dependent on the measure tested, but would be no larger than necessary to determine whether or not the measure showed some promise of being effective on a large scale.

The next step in control measure development is to design and implement large-scale tests for those measures that show promise on a small scale. The purpose of this final level of testing would be not only to test control effectiveness on a large scale, but also to ascertain the costs and obstacles associated with implementing, operating and maintaining a large-scale system. In some cases, these large-scale tests could provide some level of PM-10 control.

The final step in the measure development process is to use the results of all the studies and testing to generate a comprehensive implementation plan. The plan will address not only the specific control measures to be employed and locations of the measures, but will also deal with such issues as access to the lake bed, management of ground, surface and storm waters, mitigation of adverse environmental impacts and long-term operation and maintenance of the entire system.

5.2.3 CONTROL MEASURE IMPLEMENTATION

The final step in the mitigation program is the actual implementation of the comprehensive plan. Implementation may occur as one large project or it may be brought about one area or one partial mitigation measure at a time as measures are developed that provide control. Therefore, it is conceivable that actual mitigation projects could be under way in some areas of the lake bed, while measure development is still occurring in other areas. A mitigation

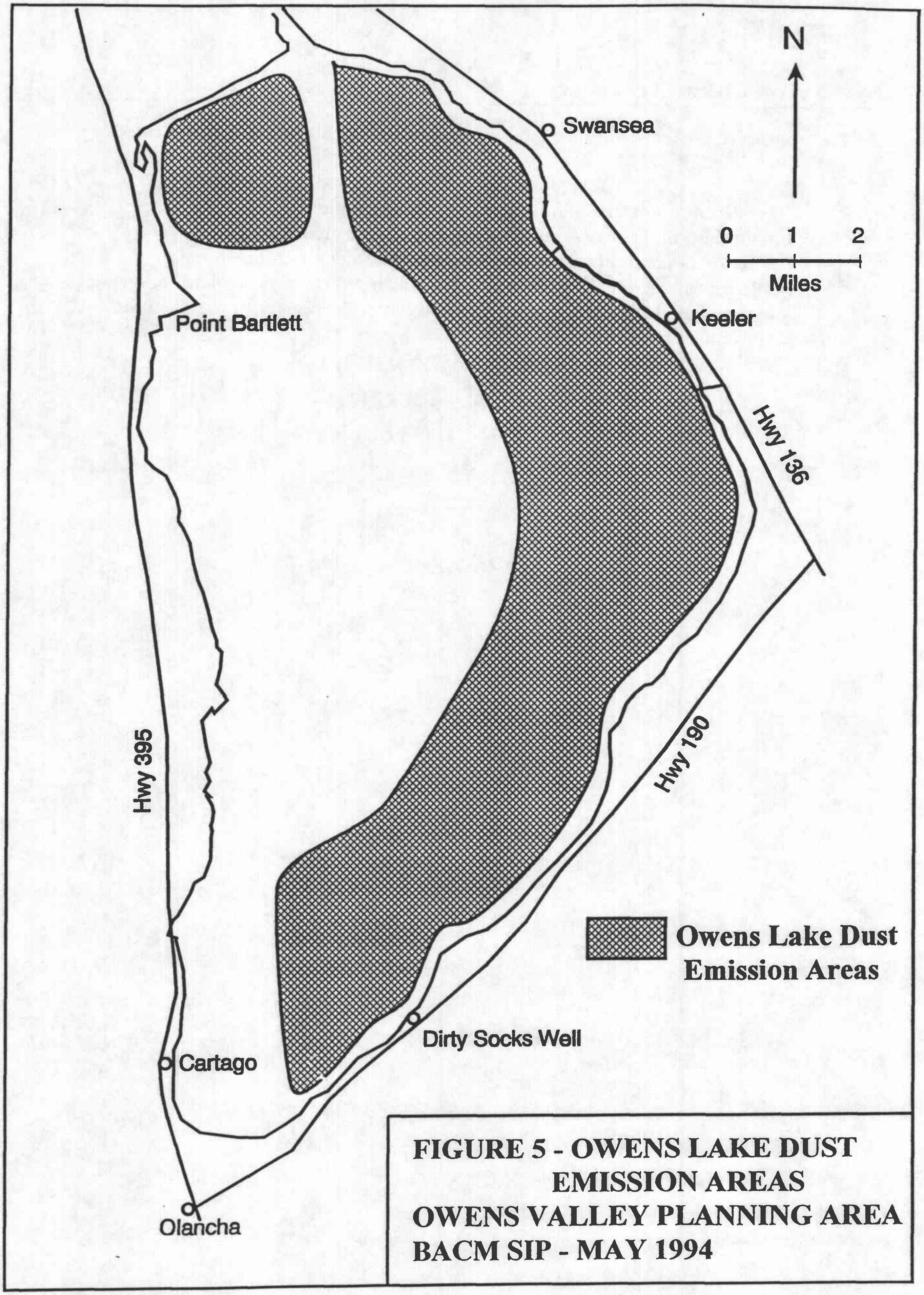

FIGURE 5 - OWENS LAKE DUST EMISSION AREAS
OWENS VALLEY PLANNING AREA
BACM SIP - MAY 1994

measure proven to be successful for a particular area could be implemented at any time.

In addition to implementing control measures, continuing effectiveness monitoring will be necessary. This will include air quality monitoring and inspection of control facilities. It is doubtful that the control measures implemented will be completely of the "walk away" type. Some level of ongoing long-term commitment to providing the resources necessary to maintain the control measures will be required.

SECTION 6 - CANDIDATE CONTROL MEASURES

6.1 INTRODUCTION

Since Great Basin's adoption of the original PM-10 SIP in December 1988 and the SIP Addendum in November 1991, the development and testing of candidate control measures identified in the original SIP documents has proceeded. The work performed since the start of the program in 1981 and the conclusions arrived at are summarized below and in Table 2 at the end of this section. In addition, the status of current and proposed future work efforts is addressed. Details regarding the past and current efforts are contained in a variety of annual project proposals, test design documents, protocols, reports and studies. For each measure discussed, the pertinent technical documents are referenced. A list of the referenced documents can be found in Appendix 2. Appendix 3 contains a selected bibliography of additional documents regarding the work performed at Owens Lake.

The control measures described below fall into four main categories: water-based measures, vegetation-based measures, sand fence-based measures and surface protection-based measures. This is simply a list of all the candidate BACMs under consideration. The actual BACM determination will take place in the next Section. The control measures implemented to attain the Standard will almost certainly be a combination of the measures discussed below. Measure testing and resource evaluation needs to be completed before a final decision can be made as to which Standard attainment measures will be carried out. The Demonstration of Attainment State Implementation Plan due in 1997 will contain the final mitigation measure implementation plan.

6.2 WATER-BASED MEASURES

The availability of water for mitigation is the single most important issue affecting the final "vision" of a mitigated Owens Lake. If unlimited amounts of water were available, the lake could simply be refilled, solving the air pollution problem and completely restoring the lake's environmental quality. If no water was available, then mitigation would be restricted to dry sand dunes or some type of surface covering, such as gravel, and the final mitigated lake would almost certainly have diminished ecological value. Based on the investigations performed to date, it appears that significant water resources are available on and around the lake. Much of this water is of low quality; that is, it could not be used for human or traditional agricultural uses, but it could be used to keep the surface of the lake bed wet or to establish salt tolerant vegetation. It is important then, to quantify the amount of water available for mitigation measures. The quality of the available waters is also important, as it will determine the uses to which the waters can be put.

Three steps are necessary in order to incorporate water-based measures into the final solution to the Owens Lake air pollution problem:

1) an evaluation of the locations, quantity and quality of water being considered for use in mitigation measures,

2) development of successful water-based mitigation measures through small and large scale pilot tests and

3) incorporation of successful measures into a comprehensive lake-wide mitigation plan.

These steps are discussed in detail below.

6.2.1 WATER RESOURCE EVALUATION

The first step in the development of successful water-based mitigation measures is a comprehensive investigation of the available water resources. Water at Owens Lake is available from three sources: deep groundwater aquifers, shallow groundwater aquifers and surface water. The location, quantities and qualities of water from these sources must be ascertained before they can be successfully used for dust mitigation. The District is currently working with scientists from the Water Resources and Quaternary Sciences Centers at the Desert Research Institute on a comprehensive program to quantify the water resources available for PM-10 mitigation. This work is summarized below. Details regarding the water resource characterization effort can be found in Reference Documents 2, 3, 4, 5, 6 and 7.

DEEP GROUNDWATER AQUIFERS

The purpose of an investigation of the deep aquifers of Owens Lake is to address the issue of how much water is available from the local deep groundwater system on a sustained basis. In order to achieve this goal, a thorough understanding of the local groundwater basin is needed. Unlike the portions of the Owens Valley north of Owens Lake, where the groundwater systems have been studied extensively, very little is known of the groundwater basin in the vicinity of Owens Lake.

The development of groundwater resources can be viewed as a multi-stage process. First, there is an exploration or investigation stage, in which surface and subsurface geological and geophysical techniques are used to search for suitable aquifers. Second, there is an evaluation stage that includes the measurement of hydrogeologic parameters, the design and analysis of wells, the calculation of aquifer yields, and an assessment of the interactions between groundwater development and the regional hydrologic system. Third, there is a management stage which involves the consideration of an optimal development strategy.

The drilling and pump testing of the existing wells at the Owens River delta (Deep River Well and Shallow River Well) and on the central eastern shore (Mill Site Well) provided the District with some of the information needed to evaluate deep groundwater resources (Figure 5). However, this information is not sufficient for complete evaluation of lake-wide deep aquifer systems. The basic configuration and hydrologic properties of the deep aquifer system in the Owens Lake area are still unknown. Evaluation of the water producing capabilities from the deep aquifers is impossible until more data is obtained on the areal extent, depth, thickness, and hydrologic properties of aquifers identified as having the potential for water development. The best methods for obtaining this information are through surface geophysical surveys, well drilling, and pump testing (Reference Documents 8 and 9).

The District is currently obtaining information about the basin's subsurface geophysical properties by means of a comprehensive basin-wide seismic reflection surveying program (Reference Documents 10 and 11). By analyzing the characteristics of induced shock waves, we can determine basic stratigraphic and aquifer configurations and determine the locations of potential faults.

The next step following the geophysical surveys is the drilling and installation of several more monitoring and production wells. The number and location of these wells will be determined from the results of the geophysical survey and from testing existing wells. Pump tests from the new wells will provide critical information about the deep aquifer system's long-term aquifer yields.

Results of the tests described above will be analyzed along with other geologic, geochemical, and isotopic data in a numeric model of the deep aquifer system that will provide a more complete picture of the groundwater flow system. This groundwater flow model will be used to estimate the sustained yield of the aquifer system, to evaluate the potential effects of long-term pumping, and to design a pumping program to minimize adverse effects. The District is currently working with the Desert Research Institute to develop a lake basin groundwater model.

The evaluation stage will be completed when the following questions can be answered:

1) How many wells can be installed? How many wells are needed? What pumping rates can they sustain? Where should the wells be located?

2) What will be the effect of pumping on regional water levels?

3) What are the long-term yield capabilities of the aquifer(s)?

4) Will the proposed development detrimentally influence other components of the hydrologic cycle? and

5) Will there be any undesirable effects of water development, such as land subsidence or adverse effects on existing water supplies?

SHALLOW GROUNDWATER AQUIFERS

The near surface groundwater system of Owens Dry Lake is largely unstudied. It is important to understand this potential water resource prior to large mitigation efforts on the lake bed for several reasons:

1) the near surface groundwater system appears to play a central role in the distribution of salts onto the lake bed,

2) the level and chemistry of the near surface groundwater appear to be integral factors in the production of an efflorescent salt "fluff" which forms a serious dust source,

3) it is necessary to investigate the extent of interactions between the deep aquifer system and the near surface groundwater to evaluate potential impacts to the shallow system caused by development of the deep aquifers,

4) the chemistry of the near surface groundwater is critical in the success

of any mitigation effort that uses vegetation,

5) the distribution of the near surface groundwater dictates physical access to many areas on the lake bed and

6) the shallow groundwater itself is a potential water resource for use in mitigation measures and thus needs to be quantified and qualified.

The shallow groundwater investigation has been underway since 1992 and is studying the characteristics and chemistry of the near surface groundwater and its relation to the chemistry and mineralogy of the surface crusts through a series of strategically placed transects that run from the lake bed margins toward the center of the lake (Figure 5). These transects are instrumented with piezometers (small diameter monitoring wells) to establish a permanent shallow groundwater monitoring network across the lake bed. The monitoring network will also allow the quantity and quality of the shallow groundwater resource to be tracked over time as mitigation measures are tested and implemented (Reference Documents 12, 13, and 14).

SURFACE WATER SOURCES

The numerous seeps and springs along the shore of Owens Lake provide a perennial, though variable, source of surface water. Any mitigation efforts on the lake must make provisions to channelize, redirect and/or utilize this resource. Additionally, there are ephemeral water sources such as storm water runoff from surrounding mountains and diversions from the Los Angeles aqueduct down the Owens River that, because of their high peak flows, short duration, and high sediment load, could have devastating impacts on lake bed mitigation measures.

It is thought that flash floods entering the lake bed are an important mechanism for distribution of salts and sediments onto the lake bed. The halo of salt near the lake bed margins created by evaporation of waters from marginal seeps and springs is easily dissolved and transported onto the lake bed during flash flood events. These salts later precipitate out along with fine sediments carried in suspension in the flood waters in areas subject to wind erosion. This mixture of fine silts and salts creates a prime source for dust emissions. Therefore, it is critical to quantify the strength of past flash floods and to identify those water sources that must be controlled before implementing mitigation measures.

Surface water resource evaluation studies that focus on the areal extent, chemistry, and sources of the perennial and ephemeral waters flowing onto Owens Lake are underway. The District is working with experts from the Desert Research Institute to evaluate the area's surface water resources (Reference Documents 2, 3 and 4).

6.2.2 WATER-BASED CONTROL MEASURE DEVELOPMENT

In addition to evaluating the availability of water resources, there is also a concurrent effort to develop efficient ways to use the available water to mitigate dust emissions and restore ecological values. The water must be pumped, transported, applied and drained as appropriate. If the water itself is being used to keep the surface in a wet and nonemissive condition, it must be spread or ponded. If the water is being used to support vegetation establishment, it must be of the proper quality and must be applied in the most efficient manner possible. Provisions for leaching and draining salts from vegetation areas must also be made. Water is a precious resource in an arid environment like the Owens Valley; the water used for dust mitigation and environmental enhancement must be used as wisely as possible.

Efficient ways to use the available water resources are developed through demonstration projects and pilot tests. The tests may involve the use of water alone or water in conjunction with one or more other types of measures such as vegetation and sand fences. The tests have included or may include sprinklers, surface flooding, wetland development, vegetated sand dunes (riparian corridors), grass/shrub-lands and brine ponds. The results of the initial water resource evaluation phase will indicate the location, quantity and quality of water available for the testing. Other necessary background information such as topography, soil composition and appropriate vegetation will dictate the type of lake bed environment, and hence the location most appropriate for the tests.

The tests themselves must be carefully and thoroughly designed, implemented, operated and analyzed if the results are to be useful in making decisions to expand the measures to a lake-wide scale. Project designs and protocols specify what the projects look like, what is being studied and how data is collected and analyzed. Project construction work and data collection device deployment generally occurs during the summer or early fall to allow access to the lake bed. Due to the harsh environment on the lake bed, data collection equipment must be as rugged as possible and significant redundancy is designed into the data collection system. The tests must be operated for a sufficient amount of time to assess the measures under the most severe lake bed conditions. This is especially true if vegetation is involved with the test. The minimum operation period is generally one year. The final phase of mitigation measure development is the data analysis. This occurs with the assistance and review of all parties involved in the testing.

6.2.3 WATER-BASED CONTROL MEASURE IMPLEMENTATION

The final step in using water-based measures on a large scale is the development of a comprehensive mitigation plan incorporating the successful measures. This must occur in conjunction with results from the testing of the other three types of measures: vegetation, sand dunes and surface coverings, while keeping in mind the total water resources available for long term mitigation. Implementation of successful water-based measures may occur as one large project on a lake-wide basis or may be brought about one area at a time as water supplies are developed and made available. It is conceivable that actual mitigation measure implementation and subsequent dust control utilizing measures successful for some areas could be occurring while mitigation measure development and testing for other areas is still taking place. A measure proven to be successful and feasible for a particular area can be implemented at any time.

6.2.4 WATER-BASED CONTROL MEASURES

The following is a discussion of the water-based candidate control measures that have been or are being considered for implementation. Information provided includes: measure description, tested or anticipated control effectiveness, advantages, disadvantages, implementation logistics, economic feasibility, additional information needed to judge implementation feasibility and acceptability to the property owner (California State Lands Commission).

SPRINKLER SYSTEMS

<u>Description</u>

In 1990 a large scale test of agricultural sprinklers to control dust emissions took place. It involved the construction of two sprinkler systems to wet the lake bed prior to predicted wind events in an attempt to reduce PM-10 emissions by bringing salts to the surface to form an emission resistant crust. The first test site was in the northeast corner of the lake bed in an area dominated by sandy soil. Approximately 150 acres were sprinkled via solid set agricultural sprinklers with water from a well and pump station installed in the river delta. 100 acres were left unsprinkled but instrumented as control (Ref. Docs. 15, 16 and 17).

The second test site was much smaller and was located near the eastern shoreline in an area dominated by fine soils and salts. As there is no water supply in the area, water for the tests was trucked to the site and applied with a portable pump.

Effectiveness

- In areas dominated by sandy soils, the sprinkling did not consistently form a crust that incorporated and immobilized the sands and fine particulates. Therefore, since PM-10 generation in these areas is primarily caused by saltating sand, for sand dominated areas, sprinkling cannot be relied upon to significantly reduce PM-10 emissions.
- In the clay and salt dominated soils sprinkling established a competent, protective crust that was more resistant to saltation than adjacent, unsprinkled areas.

Advantages

- Efficiently and completely spreads water over emission area.
- Can be used on all types of lake bed terrain.
- Water only needs to be applied when dust events are imminent.

Disadvantages

- Limited or no effectiveness in sand dominated soils.
- Predicting storms far enough in advance of dust events is difficult and sometimes impossible.
- As only limited areas can be sprinkled at any one time, sprinkling large areas is time consuming and may not be feasible.
- Extensive piping/valving system required.
- Sprinkler heads difficult to keep operational in harsh Owens Lake environment.
- High operational and maintenance manpower requirements.
- Requires water, which may not be available from local groundwater sources in needed quantities.
- Restores little or no public trust value to lake.

Implementation Logistics

- Requires availability of adequate amounts of water.
- Requires extensive access system to all portions of dust producing areas for installation and ongoing operation and maintenance of system.
- If water is supplied from local wells, electrical supplies need to be provided.

Economic Feasibility

- Infrastructure, operation and maintenance costs would be considerably higher than the same costs for flood irrigation (see below).

- Would use less water and electricity than flood irrigation.

Additional Information Needs
- Determine sustainable amount of water available.
- Determine appropriate areas for measure.

Acceptability to Property Owner
The State Lands Commission has determined that this measure may not be acceptable.

FLOOD IRRIGATION

Description
In 1992 and 1993 the District conducted a test of the effectiveness of shallow flood irrigation to control dust emissions. The test attempted to mimic the physical and chemical processes that occur at and around natural springs and wetlands located on the lake bed. These naturally wet areas are dust emission resistant due to the wet surfaces and vegetation cover. The test consisted of outletting water near the historic shoreline and letting it flow downhill toward the center of the lake. Due to the flat, uniform nature of the lake bed, the water spread over wide areas creating shallow ponded areas. The water was generally not over 1 inch deep. Not only did the flooded areas not generate any PM-10, they also acted as sand traps to catch sand blowing across the lake bed to prevent it from generating additional dust (Reference Documents 18, 19, 20 and 21).

Effectiveness
Based on preliminary results, flood irrigation appears to be effective in preventing PM-10 emissions from the flooded areas. It is also seems to be effective in controlling emissions from areas adjacent to the standing water due to the elevated groundwater saturating the soil to the surface. In addition, due to the fact that it traps blowing sand, it appears to prevent the sand from abrading stable crusts and causing further emissions. Runoff from flood irrigation could be used to control emissions in evaporation ponds (see below).

Advantages
- Effective in all types of soil.
- Large areas can be controlled with minimal infrastructure.
- Requires minimal maintenance.
- Low manpower requirements.
- Operation and maintenance requires minimal lake bed access.
- Can be shut off or operated at reduced flows during "calm" seasons.

- Establishes habitat suitable for some plants and animals.
- Restores considerable public trust value to lake.

Disadvantages
- Not appropriate for use in areas where lake bed is not flat.
- Water must be applied during entire "windy" seasons, even when wind is not blowing.
- Requires water, which may not be available from local groundwater sources in needed quantities.
- Infrastructure would likely be in difficult to access areas (wet areas near shoreline).

Implementation Logistics
- Requires availability of adequate amounts of water.
- If water is supplied from local wells, electrical supplies may need to be provided.

Economic Feasibility
- Infrastructure, operation and maintenance costs would be considerably less than the same costs for sprinkling (see above).
- Would use more water and electricity than sprinkling.

Additional Information Needs
- Develop methods to maximize water use efficiency (e.g. irrigation schedules and water outlet designs).
- Determine sustainable amount of water available.
- Determine appropriate areas for measure.

Acceptability to Property Owner
The State Lands Commission determined that this measure is acceptable.

REFILL LAKE

Description
The PM-10 problem at Owens Lake is caused by the City of Los Angeles' diversion of Eastern Sierra surface waters to the City. If this diversion ceased and Owens Lake's natural water sources were be reestablished, the lake would refill and the PM-10 problem would be solved.

Effectiveness
If enough water was available to completely fill the lake, no infrastructure or improvements would be required and the measure would be completely

effective. If there was not enough water to fill the lake, the available water, or possibly some amount less than the total available, could be used in conjunction with flood irrigation on the exposed portions of the lake bed to make the measure completely effective.

Advantages
- Effective on all portions of the dust emitting areas.
- Little or no infrastructure requirements.
- Little or no maintenance and manpower requirements.
- Completely restores public trust values to Owens Lake, Owens River and diverted streams.

Disadvantages
- Most inefficient use of available water resources.
- City of Los Angeles may not be able to secure replacement water.
- Much of the water discharged onto the lake would be used to fill the area over the central nonemissive portion.
- Mining of evaporite deposits would be precluded.
- At average inflow rates it would take many years to refill (approx. 10 to 20).

Implementation Logistics
- If adequate water is available, implementation is simple, stop diversions.
- If adequate water is not available, infrastructure to support the companion measure or measures would be required, in addition to elimination or reduction of diversions.

Economic Feasibility
- Implementation, operation and maintenance costs would be negligible.
- Cost of replacement water for the City of Los Angeles, if available, would be hundreds of millions of dollars per year.

Additional Information Needs
- Model to predict refill rate.
- Sources of replacement water for City of Los Angeles.

Acceptability to Property Owner
The State Lands Commission has not determined the acceptability of this measure.

LOWER SHALLOW GROUNDWATER TABLE

Description

In those areas of the lake bed where efflorescent salt crusts are the primary source of PM-10 emissions, it may be possible to prevent these crusts from forming by lowering the shallow groundwater table. It is the proximity of this saline groundwater to the surface that is responsible for transporting the salts contained in the subsoils to the surface where the water evaporates and the emissive salts are left on the lake bed. Based on observations of other playas, efflorescent crusts tend not to develop on playa surfaces where the depth to groundwater is at least 10 feet below the surface (Reference Document 22).

There are many areas on Owens lake where efflorescent salts readily form and where the depth to the groundwater is much less than 10 feet; often it is less than one foot. A potential mitigation measure for these areas was suggested by Pierre St-Amand in 1986. The measure would entail pumping the shallow groundwater from efflorescent salt areas (possibly via windmills) and using the water to flood, leach or irrigate other areas. If the water table could be lowered to the point that the capillary connection between the surface and the groundwater could be broken, salt transport to the surface could be stopped. At this time, this is a speculative mitigation measure. It has not been tested on Owens Lake.

Effectiveness

Lowering of the water table has not been tested at any scale on Owens Lake. However, if the concept did work, it would be effective only in those areas where the primary source of PM-10 is efflorescent salt crust. It would not be effective in the areas where blowing sand causes fugitive dust emissions.

Advantages

- By pumping water to solve the dust problem in some areas, water would be made available to mitigate other areas.
- Does not require a source of water.
- If wind power was used to pump the groundwater, it would not require an external power source.

Disadvantages

- Mitigates PM-10 emissions only from efflorescent salt crust areas.
- Due to high soil porosities in many areas, a large number of small pumps or a few very large capacity pumps would be needed to keep the water table uniformly low.
- Pumped water may be very saline and have limited use for other measures.

- On large scales, it would probably be maintenance and lake bed access intensive.
- Restores little or no public trust value.

Implementation Logistics
- Very careful evaluation of appropriate areas would be necessary.
- Would need to be coordinated with a use for the pumped water.
- If wind powered pumping is not viable, electrical supplies would need to be provided.

Economic Feasibility
- Difficult to ascertain until measure is tested on Owens Lake.

Additional Information Needs
- Conduct full scale testing.
- Determine appropriate implementation areas.

Acceptability to Property Owner
The State Lands Commission has not determined the acceptability of this measure.

6.3 VEGETATION-BASED MEASURES

Vegetation is an accepted means for stabilizing soil to prevent wind erosion and it may play a role in the mitigation of Owens Lake dust releases. The lake playa has been exposed for about 70 years and has not been significantly colonized by local plant species. This indicates that existing conditions must somehow be modified or non-local plant species must be used if vegetation is to be used to control PM-10 emissions. The factors that limit plant establishment in the harsh lake bed environment are not completely understood. Limiting factors for plant growth include salts, toxic ions, soil oxidation/reduction potential, flooding, desiccation, sand blast damage to leaves and a generally poor plant germination/establishment environment. Previous studies that attempted to grow plants on the lake bed demonstrated, but failed to quantify, these limitations.

As with the evaluation of water-based measures, the evaluation of vegetation as a dust mitigation measure consists of three parts:

1) evaluation of existing conditions and resources,
2) the development of successful vegetation-based measures through small and large scale testing and

3) incorporation of successful measures into a comprehensive lake-wide mitigation plan.

6.3.1 VEGETATION RESOURCE EVALUATION

Although there are some locations on Owens Lake where vegetation is established, the vast majority of the lake bed remains devoid of any plant life. The specific reasons for this lack of vegetation need to be investigated and quantified before any attempt to establish plants will be successful. Therefore, the first step has been to characterize the limiting factors present on the lake bed. This has included an evaluation of the range of environmental conditions present and the range of conditions tolerated by the local species. This initial evaluation phase has included physical characteristic mapping and chemical analysis of the lake's soils, near surface waters and plant materials. Once existing conditions are characterized, those factors that preclude vegetation can be identified.

The next step in evaluating vegetation resources is to investigate possible modifications to the limiting soil and water conditions and to identify candidate plant species for application to the Owens Lake system. Due to requirements set forth by the lake bed owner, the California State Lands Commission, the emphasis has been on evaluating and testing existing, locally adapted species. The efforts at this step are to determine if any species will grow under existing conditions and how conditions need to be modified to enable selected species to become permanently established.

6.3.2 VEGETATION-BASED MITIGATION MEASURE DEVELOPMENT

Once the evaluation of vegetation conditions and resources is completed, the information developed is used to incorporate vegetation into small and large scale, on-lake pilot tests. These projects test the ability of selected species to establish and survive in the variety of soil, water, topographic and climatic conditions found on the lake. They test irrigation systems and schedules, leaching and drainage systems, and the ability to lessen the effects of limiting factors.

As with water-based tests, vegetation projects must be carefully and thoroughly designed, implemented, operated and analyzed. Detailed project designs, protocols, deployment plans and data collection plans must be developed.

6.3.3 VEGETATION-BASED MITIGATION MEASURE IMPLEMENTATION

The final step in using vegetation-based measures on a large scale to control dust emissions is the development of a comprehensive mitigation plan incorporating the successful measures. This must occur in conjunction with results from the testing of the other three types of measures: water based, sand fences and surface protection, while keeping in mind the factors that will limit vegetation establishment, such as water availability and unmitigable plant toxins.

6.3.4 VEGETATION-BASED CONTROL MEASURES

The following is a discussion of the vegetation-based control measures that have been or are being considered for implementation. As with the water-based measures, information provided includes: measure description, tested or anticipated control effectiveness, advantages, disadvantages, implementation logistics, economic feasibility and the additional information needed to judge implementation feasibility.

GRASS\SHRUB-LANDS

<u>Description</u>
This is a current test project that focuses on establishing drought and salt tolerant grasses and shrubs directly on the lake bed in stands of sufficient density to reduce or eliminate dust emissions. The grassland portion of the project has two main components. The first is saltgrass (*Distichlis spicata*) testing on the lake bed under a variety of soil and water conditions. The second component is a saltgrass breeding program that will generate a strain of saltgrass entirely derived from local material that will be uniquely and particularly adapted to conditions on Owens Lake. Once grass is established, the focus will shift toward salt tolerant shrubs which may be more appropriate or effective in certain areas or which may act to provide additional protection and diversity to grasslands. A recent study by the District of the tolerance of local cultivars of saltgrass to salinity and flooding indicates that there is a significant range of adaptation of the local species to the local conditions (Reference Documents 12, 13, 14, 23, 24, 25 and 26).

<u>Effectiveness</u>
It is well known that in sufficient densities, vegetation cover can completely protect soil surfaces from aeolian erosion. Just how dense a cover is necessary on Owens Lake to meet emission standards is unknown at this time. One

component of the vegetation testing will be to determine cover density requirements.

Advantages
- With flood irrigation, large areas can be controlled with minimal infrastructure.
- May use less water than flood irrigation without vegetation.
- May self-spread to bare, unvegetated areas.
- Requires minimal maintenance.
- Establishes habitat for a wide range of plants and animals.
- Restores considerable public trust value to the lake.

Disadvantages
- Probably not appropriate for very high salt or high clay soils.
- May not be appropriate in areas with low electrochemical reduction conditions.
- If flood irrigated, not appropriate for use in areas where lake bed is not flat. However, if sprinkled or drip irrigated, terrain is not limiting.
- Requires water, which may not be available from local groundwater sources in needed quantities.

Implementation Logistics
- Requires availability of adequate amounts of water.
- Requires access to all portions of the dust producing areas for planting and maintenance.
- May require supplemental protection during establishment to prevent sand abrasion.
- Existing soils may require fertilization during and/or after establishment.

Economic Feasibility
- Infrastructure, operation and maintenance costs would be higher than flood irrigation, but vegetation may use less water and therefore be more economical in long run.

Additional Information Needs
- Current testing program needs to be completed to determine ability to establish vegetation on lake bed.
- Total water use for vegetation needs to be compared to total water use of other water-based measures to determine most water efficient measure.
- Determine sustainable amount of water available.

Acceptability to Property Owner
The State Lands Commission determined that this measure is acceptable.

WETLANDS

Description

Because of adverse soil conditions present over much of the lake (mainly high salt levels), traditional drought tolerant vegetation may not survive in such areas. An alternative to grass/shrub-land vegetation is the establishment of wetland/riparian type vegetation. Although wetland type vegetation would use more water than the drought tolerant vegetation addressed above, it may use less water than flood irrigation without any vegetation. Flood irrigation areas would be established and flushed of salts. Wetland type vegetation would be introduced and water use cut back as compared to the continuous water use associated with flood irrigation. This measure is currently being tested as part of the flood irrigation measure test project (Reference Documents 12, 13, 14, 23 and 24).

Effectiveness

As with flood irrigation, wetland areas should be an effective measure to prevent PM-10 emissions. In addition, areas that bordered the wetlands may be suitable for grassland type vegetation due to the water supplied to the local near surface groundwater table. Runoff from wetland areas could control emissions through flood irrigation or evaporation ponds (see above).

Advantages

- May be as effective as flood irrigation, but use less water.
- Large areas can be controlled with minimal infrastructure.
- Will spread to bare, unvegetated areas.
- Requires minimal maintenance.
- Operation and maintenance requires little or no lake bed access.
- Establishes habitat for a wide range of animals.
- Restores considerable public trust value to the lake.

Disadvantages

- May not be appropriate in areas where soil is not suitable for vegetation.
- Not appropriate for areas of lake bed where surface is not flat.
- Requires water, which may not be available from local groundwater sources in needed quantities.

Implementation Logistics

- Requires availability of adequate amounts of water.
- Requires access to all portions of the dust producing areas for planting and maintenance.
- Existing soils may require fertilization during and/or after establishment.

Economic Feasibility

- Infrastructure, operation and maintenance costs would be higher than flood irrigation, but vegetation may use less water and therefore be more economical in long run.

Additional Information Needs

- Current testing program needs to be completed to determine ability to establish vegetation on lake bed.
- Total water use for vegetation needs to be compared to total water use of other water using measures to determine most water efficient measure.

Acceptability to Property Owner

The State Lands Commission determined that this measure is acceptable.

6.4 SAND FENCE-BASED MEASURES

Sand and sand sized particles saltating across Owens Lake are known to generate large amounts of dust from the lake bed during high wind episodes. By controlling the migration of these particles, a significant reduction in the concentration of PM-10 dust should be achieved. One way to control these blowing particles is through the use of fences to break the wind, cause sand particles to stop their movement and form sand dunes. This has been tried on Owens Lake in the past on fairly small scales with single and parallel dunes with some success.

It is known that sand fences will capture saltating sand and sand-sized aggregates and provide an element of surface roughness not present on most of the lake bed that may be beneficial in reducing wind speeds at the lake bed surface for some distance downwind of the fence. With this knowledge researchers have designed and are currently conducting a demonstration-scale mitigation test to determine if such fences will significantly reduce PM-10 concentrations from the lake bed. This project is testing the effectiveness of sand fence arrays in capturing and controlling saltation particles and reducing the erosion potential of wind at the surface. One of the benefits of using sand fences is that they may reduce or eliminate the need for water resources and vegetation. Another benefit is that they do not require the electric power required by water- and vegetation-based measures to extract and distribute water.

As with water -and vegetation-based mitigation measures, sand fences also require a background investigation phase, a large scale testing phase and a final implementation phase.

6.4.1 SAND FENCE RESOURCE EVALUATION

A number of factors that will affect the growth and stability of the sand dunes that form on sand fences must be ascertained prior to large scale implementation of fences as a dust control measure. The location, quantity, migration rate and migration direction of sands on the lake bed must be determined in order to design fence locations, spacings and configurations. Since barriers can collect large volumes of sand, the source area for the sands must be well understood. There must be an understanding of how much deflation or deposition will occur in an area, both with and without fences and how this deflation or deposition may have an impact on the lake environment. Such impacts may include surface gradient changes affecting drainage patterns, shallow groundwater table changes affecting evaporation and salt flux to the ground surface, or changes in soil type.

The predominant wind directions for wind speeds greater than the threshold speed at which particles begin to move must be determined to orient dune corridors or arrays perpendicular to this direction. The frequency of high winds from directions other than the predominant direction is important for understanding failures in the control of dust and sand migration into surrounding nondune areas. Changes in wind patterns due to the presence of the corridor or array might cause increased erosion in other areas or sand accumulation in areas where it is not wanted. Fences must be designed and constructed to withstand the strongest winds in the area. The District has been collecting meteorological data in the vicinity of Owens Lake since about 1985.

Soil particle size distribution is also important. Enough sand sized saltation particles must be available for impoundment around the sand fences to create the dune fields. Soils must support guying for the fences and vehicle access. The soil chemistry and type must be suitable if vegetation is to be established on the resulting dunes. The amount of irrigation water required for leaching is also dependent on the soil type.

Sand migration rates, boundaries and paths are also important. If the rate is too slow it may take many years to build the dunes. If the migration rate is high dunes may form quickly and sands may continue to move through the dune areas. Accurate delineation of migration boundaries is required to allow the fences to be placed in the proper areas. Variable sand migration paths due to winds from different directions must be identified and designed, so that sands do not move out of the dunes and into areas where sands were not previously found. The District and other researchers have collected data on the movement of sand on the lake bed (Reference Document 12).

This background information for sand dunes is important because once dunes are formed on Owens Lake they may become permanent topographic features. An improperly placed or constructed sand dune may not only be ineffective at reducing dust emissions, it may also prevent other successful measures from being properly implemented.

6.4.2 SAND FENCE MEASURE DEVELOPMENT

Once an evaluation of the factors that will affect the growth and stability of sand dunes has been performed, large-scale sand dune tests will be developed and performed. These projects will include both tests of individual sand fence design elements (size, material, mounting and guying details) as well as tests of dune field alignments and configurations. Dunes will be tested in a number of saltation dominated areas of the lake bed. They will be tested as dry dunes and in conjunction with water- and vegetation-based measures in an effort to develop a mitigation measure that combines the elements from different measure types to produce the most successful possible solution. It is important to determine the sand capture efficiency of both single fences and various fence arrays. This can be done both with field testing and with wind tunnel and computer modeling. Another important element of the measure development effort is to determine the distance downwind from fences and fence arrays at which saltation reestablishes and PM-10 emissions recommence. This distance is referred to as the "dead zone".

As with water- and vegetation-based tests, sand dune projects must be carefully and thoroughly designed, implemented, operated and analyzed. Detailed project designs, protocols, deployment plans and data collection plans must be developed.

The California State Lands Commission and their subcontractor, the University of California, Davis, are currently conducting a project that involves collection of the required background data, fence design, small scale fence array field testing and evaluation of impacts the fences may have on the lake environment. Work on the project began in May 1993.

6.4.3 SAND FENCE MEASURE IMPLEMENTATION

Once again, as with water- and vegetation-based measures, the final step in using sand dunes on a large scale to control dust emissions is the development of a comprehensive mitigation plan incorporating the successful designs. This must occur in conjunction with results from the testing of the other three types of measures: water, vegetation and surface protecting, while keeping in mind the factors that will limit sand dune establishment, such as soil type, particle size, water table effects and rate and location of sand movement.

6.4.4 SAND FENCE CONTROL MEASURES

The following is a discussion of the sand fence-based control measures that have been or are being considered for implementation. Sand fences have not yet been proven as a measure that will control PM-10 emission rates on Owens Lake to the extent that air quality standards will be met. Adequate testing to determine their level of control, both by themselves and in conjunction with other measures, is important.

SAND FENCES

Description

In 1983 and 1988 the District, in conjunction with the State Lands Commission and the Los Angeles Department of Water and Power, tested the effectiveness of using single rows of sand fences to capture and hold PM-10 producing saltating sand. When located in areas with high sand flux rates, the fences filled very quickly. The filled fences cause a linear dune to form, trapping large amounts of sand that then is not available for saltation erosion. It appears that as the fences are filling total suspended particulate (TSP) concentrations are reduced up to 50% on the down wind side (Reference Document 27).

The next step in the development of sand fences as a control measure is testing fences in arrays to see if saltation erosion could be further reduced. This is the project that the California State Lands Commission and the University of California, Davis are currently conducting. Fences would be placed in locations where high sand fluxes occurred in order to tie up sands and prevent their further saltation across the lake bed (Reference Documents 28 and 29).

Effectiveness

The effectiveness of single fences was not enough to provide the necessary reductions in dust levels to meet the Federal 24-hour PM-10 Standard. The increased effectiveness provided by fence arrays has not yet been determined. If the results of the current small-scale array test are promising, a large-scale test of fence array effectiveness will be conducted.

Advantages
- Fences require no water or electricity.
- Provides rooting zone above lake bed for plants to take advantage of (above high reduction/oxidation conditions).
- May provide dune habitat for plants and animals.
- If "dead zone" of saltation reestablishment exists downwind of array, only a percentage of the lake bed would need measures constructed on it in order to control the entire dust emitting area.

Disadvantages
- Fence arrays by themselves may not provide the level of effectiveness necessary to reduce the emission levels to the point where air quality standards are met.
- Dust emissions from areas between arrays may not be controlled ("dead zone" may not exist). This would require all dust emission areas to be completely covered with fences separated by 10 to 20 fence heights.
- Filled fences (dunes) must be stabilized to be effective.
- Sand fences require high levels of maintenance during fence filling.
- If sand fences are not effective, other types of control measures may be difficult or impossible to implement, due to the altered topography caused by dunes.
- Provide little or no public trust restoration value.

Implementation Logistics
- If "dead zone" does not exist, many miles of fence would be required for control (approximately 44 miles of 6 foot fence per square mile of lake bed).
- Requires ability to stabilize dunes after fences have filled.
- If dunes are to be stabilized with vegetation, dunes must be leached with water to remove high concentrations of salt collected during dune growth.
- Requires access to all portions of the dust producing areas to install and to maintain the fences.

Economic Feasibility
- The costs of infrastructure and maintenance would be high. However, because the measure uses no water or electricity (unless water is required to maintain dune stabilizing vegetation), the long term costs may make it an economical control measure.

Additional Information Needs
- The effectiveness of fence arrays needs to be determined.
- Techniques need to be developed to stabilize the dunes formed on filled fences.

- The existence and extent of saltation "dead zone" must be established which will determine required fence spacing.

Acceptability to Property Owner

The State Lands Commission determined that this measure is acceptable only if minimal fences are required (i.e. the "dead zone" is large). The Commission has not determined the acceptability of fences if they are required at close spacings throughout the lake bed.

RIPARIAN CORRIDORS

Description

This control measure would use grass, shrub and wetland vegetation in conjunction with flood irrigation and sand fences to create corridors at intervals across the lake bed that controlled dust emissions. Sand fences would first be placed where the corridors were to be located. As the sand fences filled, they would become sand dunes that would need an irrigation system in order to flush them of salts. The water for flushing would be supplied by flood irrigation along the corridor. Finally, the sand dunes would be stabilized with vegetation. Since filled fences are not effective in capturing sand, new fences would be added along the outside edges of the corridor until all the sand in the area was collected in the corridor. The concept of riparian corridors was developed by the University of California, Davis' Owens Lake Task Group (Reference Document 30).

Effectiveness

Effectiveness of corridors and required spacing intervals are undetermined at this time. The results of the flood irrigation, vegetation and sand fence testing projects may give some indication of effectiveness, but a large scale test will be necessary in order to have confidence in an effectiveness level. The level of control that corridors provide to the unmitigated areas between the corridors is unknown and must be determined.

Advantages

- May be a very efficient use of available water resources.
- Salt leaching on dunes may be more effective than on flat lake bed.
- Provides root zone above water table (above high redox conditions).
- Establishes a wide range of plant and animal habitats.
- Restores public trust values to the areas where the corridors are located.
- If "dead zone" of saltation reestablishment exists downwind of corridor, only a percentage of the lake bed would need measures constructed on it in order to control the entire dust emitting area.

Disadvantages

- Dust emissions from areas between corridors may not be controlled ("dead zone" may not exist).
- As artificial dunes have higher salt content than surrounding lake bed, flushing and vegetation establishment may be difficult.
- Requires water, which may not be available from local groundwater sources in needed quantities.
- Requires large amounts of sand fence and irrigation infrastructure.
- Sand fences and irrigation systems require high levels of maintenance.

Implementation Logistics

- Requires availability of adequate amounts of water.
- Requires ability to flush salts from dunes.
- Requires ability to stabilize dunes during vegetation establishment.
- Requires ability to establish and maintain vegetation on artificial dunes.
- Existing soils may require fertilization during and/or after establishment.
- Multi-step measure would take considerable time to implement. Steps would consist of: fence construction, waiting for fences to fill, installation of irrigation/drainage system, flushing salts from soil and planting and establishing stabilizing vegetation cover.

Economic Feasibility

- The costs of infrastructure, the multi-step implementation process, operation and maintenance would be higher than flood irrigation and the other vegetation measures, but the corridors may use less water than other measures and therefore be more economical in the long term. Feasibility also depends on required spacing between individual fences and between corridors, which is unknown at this time.

Additional Information Needs

- The current sand fence array, vegetation and flood irrigation projects need to be completed. In addition a comprehensive large-scale test needs to be designed and conducted in order to establish the level of control associated with corridors.

Acceptability to Property Owner

The State Lands Commission determined that this measure is acceptable.

6.5 SURFACE PROTECTION CONTROL MEASURES

There may be areas of the lake where the only reasonable dust mitigation solution will be to provide some type of protective covering to the surface to prevent dust emissions. An example of a naturally occurring surface covering is the salt flat evaporite deposit at the center of the lake. As the lake evaporated, a thick salt crust was formed which prevents the underlying soil from blowing. Other areas of the lake bed are naturally forming graveled desert pavement type surfaces as fine material blows away and leaves larger materials behind.

In addition to natural surfaces, there may be some types of artificial surface protections that are appropriate or necessary in order to control PM-10 emissions from some portions of the lake bed. Some of the natural and artificial surface protection measures that may be appropriate for certain areas are described below.

SALT FLATS

Description

The soils on the bed of Owens Lake contain large amounts of chloride, sulfate and carbonate salts. Thus, the waters used in conjunction with measures such as surface flooding or vegetation irrigation tend to become more saline as they flow across the lake bed. It may be possible to capture these briny drainage waters into ponds, evaporate the water and create a thick, durable salt crust to protect the surface. Such surfaces exist in the center of the lake as a natural evaporite deposit formed as the lake was desiccated in the 1920's. In addition to waste waters from other mitigation measures, natural brines that exist above and below the surface of the lake could be utilized to form nonemissive salt flats.

Effectiveness

Evaporite crusts are quite durable and nonemissive if they are of the proper chemical makeup (predominantly sodium chloride) and are of sufficient minimum thickness (about 2 inches). Many naturally formed crusts at the edges of springs and seeps around the lake have developed sufficient thicknesses to control PM-10 emissions. Large scale test would need to be performed to determine effectiveness.

Advantages

- Uses discharge waters from other water-based measures.
- Can be implemented in all lake bed terrains and soils.
- Requires minimal maintenance.
- Low manpower requirements.
- Prevents discharge waters from uphill measures from affecting mining activities in center of lake.

Disadvantages

- Depending on location, may require significant earthwork in the form of containment berms and collection ditches.
- Restores little or no public trust value to lake.

Implementation Logistics

- Requires availability of adequate amounts of salt and water.
- Requires some type of access to pond areas.

Economic Feasibility

- Initial construction costs would be significant; long term operation and maintenance costs would be minimal.
- As it uses drainage water from an uphill control measure, it requires no additional water or electricity.

Additional Information Needs

- Has not been tested on a large scale.
- Amount of area controlled is dependent on discharge from uphill measure which, in turn, is dependent on amount of water available. Therefore, determine sustainable amount of water available.
- Determine appropriate areas for measure.

Acceptability to Property Owner

The State Lands Commission has not determined the acceptability of this measure.

GRAVEL BLANKET

Description

The District has tested, on a very small scale, the use of gravel blankets to protect the surface and prevent the efflorescence of salts. A 4-inch thick layer of ¼- inch and larger washed gravel was placed on the lake bed surface in areas with fine soils and salt efflorescence.

Effectiveness

After 7 years the small blankets continue to successfully control dust emissions and salt efflorescence in areas not subject to sand movement or flash flooding. A thinner layer of gravel may be effective in those areas where salt efflorescence does not occur and PM-10 is primarily caused by saltating particles.

Advantages

- Very effective in controlling saltating particles and salt efflorescence.

- Provides continuous protection.
- Can be installed on all types of lake bed topographies and soils.
- Requires no water or electricity.
- Low maintenance requirements.

Disadvantages
- Depending on blanket thickness, high initial cost.
- Eventually, even if it takes many years, the gravel blanket may fill with airborne dust, allowing salt to effloresce on the surface. This would require more gravel to be placed.
- No local gravel quarry large enough to provide material for entire dust area presently exists. Due to high transportation costs, a local quarry would need to be developed.
- Subject to inundation and wash-out from lake bed flooding events.
- Low public trust restoration value.
- Low habitat restoration value.

Implementation Logistics
- Requires extensive access system to all portions of the lake bed for installation.
- Under certain conditions, large areas may have to be installed in a short time period to prevent sand from outside the graveled areas from blowing onto the gravel blanket.
- Should contain provisions for controlling flooding from off the lake bed.

Economic Feasibility
- Installation costs would be higher than most other measures, however, long term operation and maintenance costs would be among the lowest of any control measure.

Additional Information Needs
- The ability to and feasibility of establishing a local gravel source needs to be investigated.
- Additional testing is needed to determine the minimum blanket thicknesses for the various soil types and the need for any subgrade preparation.
- A large scale test is needed to determine the most efficient means of transporting and spreading gravel.

Acceptability to Property Owner

The State Lands Commission determined that this measure is not acceptable.

SOIL STABILIZING CHEMICALS

Description

Soil stabilization with chemicals is often used to control PM-10 emissions. On Owens Lake, however, due to the large size of the area to be controlled (approximately 30,000 acres) and the dynamic nature of the soil due to salt efflorescence and temperature induced soil heaving, chemicals have shown very little promise.

Effectiveness

In 1983, 1987 and 1988 the District and others tested the effectiveness of chemicals that were thought to have the potential to modify the lake bed salts and produce a more durable surface crust. The chemicals used have included magnesium chloride, calcium chloride, plastic polymers and an acetate salt. The chemicals have been applied at various lake bed locations on a variety of surface types with a number of application rates. The treated surfaces were then monitored against control plots at each location. Although there may have been some minor increase in surface stability on some the treated sites, there was no evidence that chemicals would be a useful large scale, long term dust control measure. This is most likely due to the high salt levels in the soil and the dynamic nature of the natural soil crusts.

Advantages

- If a chemical was found that was both effective and nonhazardous to the lake bed environment, it could be applied and dust control would be immediate.

Disadvantages

- Not shown to be effective.
- If effective chemical were found, it would probably have to be reapplied at yearly intervals, making it potentially a very costly long term measure.
- Public access to the lake bed would have to be prohibited to prevent destruction of chemical crust.
- Any dust created by failed areas would have the dust suppressant chemical contained in it.
- Potential for groundwater contamination.
- Potential for contamination of evaporite deposit, which would adversely affect mining operations.
- No habitat enhancement.
- Low public trust restoration value.

Implementation Logistics

- A means of accessing all portions of the dust emitting areas with vehicles capable of spreading large amounts of chemicals would have to be found.

- Chemical would have to have the characteristic of creating a surface that was water permeable, in order to allow precipitation and surface flows to percolate into lake bed.
- Chemical would have to have the characteristic of not allowing blowable salts to effloresce on the surface.

Economic Feasibility

- Significant costs would be associated with regular reapplication of chemicals.

Additional Information Needs

- An effective chemical would have to be identified that meets the additional physical characteristic and environmental compatibility requirements.
- No further tests of chemical dust suppressants are planned because of the objections to this type of control measure by the lake bed land owner, the California State Lands Commission and the current mining leaseholder, the Owens Lake Soda Ash Company.

Acceptability to Property Owner

The State Lands Commission determined that this measure is not acceptable.

OTHER SURFACE PROTECTION

Description

Other materials such as discarded automobile tires, vegetative wastes, compressed trash or asphalt products could be used to simply cover the lake bed, which would prevent PM-10 emissions. Any materials used, however, would have to be permeable to water to allow precipitation and surface flows to sink into the lake bed and not flood the salt mining operation in the center of the lake. In addition, the materials could not allow groundwater evaporation to form efflorescent salt crusts on the surface.

In addition to covering the surface to protect it, it may be possible to modify emissive surfaces in order to render them non- or less emissive. Such a modification might be something like the tilling under of fine blowable sands and the exposure of more stable clay soils.

Effectiveness

If the protection could meet the requirements of being stable, durable, permeable and nonefflorescent it should be effective.

Advantages

- Very effective in controlling saltating particles and salt efflorescence.
- Provides continuous protection.
- Can be installed on all types of lake bed topographies and soils.
- Requires no water or electricity.
- Low maintenance requirements.
- May allow reuse of materials previously considered waste.

Disadvantages

- Depending on material, could further degrade public trust value of lake bed.
- Depending on material, subject to inundation and wash out from lake bed flooding events.
- Materials may degrade and deteriorate over time and require replacement.
- Depending on material, may degrade groundwater quality.
- Depending on material, low or no habitat restoration value.

Implementation Logistics

- Requires extensive access system to all portions of the lake bed for installation and ongoing maintenance.
- Large areas must be installed at one time to prevent sand from outside the covered areas from blowing onto the covering.
- Should contain provisions for controlling flooding from off the lake bed.

Economic Feasibility

- If waste materials were used, materials costs could be low. Installation costs would be higher than most other measures. Long term operation and maintenance costs would be among the lowest of any control measure.
- The cost of a surface modification such as tilling would be low, but would probably be ongoing if areas had to be retilled.

Additional Information Needs

- For surface coverings, undetermined until covering material is identified.
- For surface modifications, full scale testing needs to take place.

Acceptability to Property Owner

The State Lands Commission determined that surface coverings are not acceptable. The State Lands Commission has made no determination regarding surface modification measures.

6.6 CONTROL MEASURE IMPLEMENTATION LOGISTICS

Identification of logistical restraints are an important element in the final mitigation measure selection process. If a mitigation measure cannot be constructed due to conditions in an area that cannot be overcome through design and engineering, then the measure cannot be implemented in that area. To be successful, the mitigation effort must address such engineering problems as vehicle access onto the lake bed, power supplies, irrigation methods for applying water and methods of leaching and draining the various areas and soils of the lake bed.

LAKE BED ACCESS

Lake bed access has presented problems in past mitigation tests and studies done on the lake bed. It is critical to have good access onto all parts of the lake bed where large-scale mitigation tests and final mitigation projects are going to be placed. This phase of the mitigation plan development will involve testing different methods of providing vehicular access onto the lake bed.

FLOOD CONTROL

Flood control is another issue that will need to be considered in the development of the final implementation plan. Due to Owens Lake's position at the foot of three significant mountain ranges (Sierra Nevada, Inyo and Coso), the lake bed is subjected to substantial flash floods from which mitigation measures need to be protected. Therefore, it will also be necessary to develop a lake-wide plan to manage the lake's surface and storm waters.

SOIL LEACHING AND DRAINAGE

If a water-based mitigation is incorporated in the final mitigation plan, it is important to identify the best method and frequency of water application to minimize the amount of water required. Additionally, in certain areas of the lake bed, leaching and drainage of lake bed soils may be required to prevent salt build-up in the root zones of vegetated areas. In order to do this, it is critical to identify the feasibility and methods of irrigating, leaching and draining different soil types prior to implementation of the desired mitigation.

ELECTRICAL POWER

The type and location of electrical power sources for operating data collection and pumping equipment also need to be considered. This phase of the plan development will study the various ways of providing for the project's electrical power needs, including traditional line power, wind generated power and solar power.

Other logistical constraints will doubtlessly be identified as the final mitigation plan is developed. It is important to identify these constraints and work on solutions before they become obstacles to measure implementation.

6.7 DUST GENERATION MECHANISMS RESEARCH

In conjunction with developing an understanding of the lake's physical characteristics, it is important to continue research into the mechanisms of dust storm generation. By studying the connection between the lake's physical properties and meteorological processes that act on the lake, it is hoped that the factors that influence the initiation of dust storms can be understood and thereby controlled. In addition to studying on-lake dust mechanisms, the off-lake extent and effect of the fugitive dust will continue to be investigated. Much of this work has been performed by scientists from the University of California, Davis and the National Oceanic and Atmospheric Administration (Reference Documents 31 and 32).

6.8 CURRENT EFFORTS

The District is currently involved in testing the four measures deemed acceptable for implementation on the lake bed by the State Lands Commission: flood irrigation, grasslands, wetlands and riparian corridors/sand fences. In addition, the development of a chemical surface protectant using only materials found on the lake is being conducted by private parties.

FLOOD IRRIGATION

Flood irrigation testing is occurring at two sites, a large site (approximately one square mile) along the northeast shoreline in a sand dominated area and a smaller site in a clay dominated area along the southeast shore. The north site testing has been under way for approximately 18 months. Initially, there was one year of pre-flood baseline monitoring to characterize the test site and develop appropriate test equipment. Flooding has been occurring since January 1994. A detailed test design and test protocols have been prepared (Reference Documents 18, 19, 20 and 21).

Water is outlet from a pipe along the shoreline and allowed to flow across the surface toward the center of the lake. Due to the extremely low slopes and flat topography, a 1- to 2-inch deep sheet of water spreads over the flooded area, saturates the soils and prevents the surface from blowing. In addition to preventing wet areas from blowing, the measure creates ponded areas that capture sand that blows in from uncontrolled areas, preventing it from generating any further PM-10. Based on initial results, the measure appears to be nearly 100% effective in controlling PM-10 emissions.

Testing at the south site is scheduled to begin in the summer of 1994. The south site will be smaller in scale than the north site. It will test a number of irrigation schedules in order to maximize the efficient use of available water resources. The south site will also test different soil leaching techniques in an effort to remove salts from the soil and make it more conducive to vegetation establishment. In addition to flood irrigation and leaching at the south test site, there will also be a soil modification test that will use tilling to modify existing emissive soils. Test design and operational protocol documents are currently being prepared for the south site.

VEGETATION

The District is also currently engaged in a number of vegetation studies to determine the feasibility of establishing vegetation on Owens Lake and the level of PM-10 control associated with any vegetation that is established. The emphasis at this point is on the grass species *Distichlis spicata*, or saltgrass, which is the local plant species that is best adapted to the variety of difficult conditions found on the lake bed. We are conducting studies to determine how saltgrass establishes itself, what the limiting factors to establishment are and which local cultivars are best suited for the various types of conditions found on the lake bed. In addition, we are working with a group of grass breeding experts to develop techniques to improve the germination, vigor and seed development characteristics of the local saltgrass cultivars. We are also conducting on-lake testing of the local saltgrass under a variety of soil type and water quality and quantity conditions. Testing is taking place both in dry lake bed areas and on and adjacent to the concurrent flood irrigation test site. Reference Documents 23, 24 and 25 contain details of the program and some preliminary results.

SAND FENCES/RIPARIAN CORRIDORS

The final measure under development at this time is the concept of using sand fences to establish riparian corridors. Corridors are a mixture of three types of measures: vegetation, flood irrigation and sand fences. The current testing of vegetation and flood irrigation measures are detailed above. The University of California, Davis is currently studying the ability of sand fence arrays to trap sand and prevent PM-10 emissions.

The Davis scientists are conducting the sand fence research from two perspectives: a moderate-scale, on-lake test of sand fences on the south end of the lake bed and a laboratory wind tunnel and mathematical modeling effort. The on-lake effort is being conducted to test actual sand fence designs and to determine the efficiency of sand capture and PM-10 reduction. The wind tunnel and mathematical work allows a number of fence designs and array configurations to be tested before deciding on the best design for an actual large-scale, on-lake test. Reference Documents 28, 29 and 30 contain details of the current Davis research.

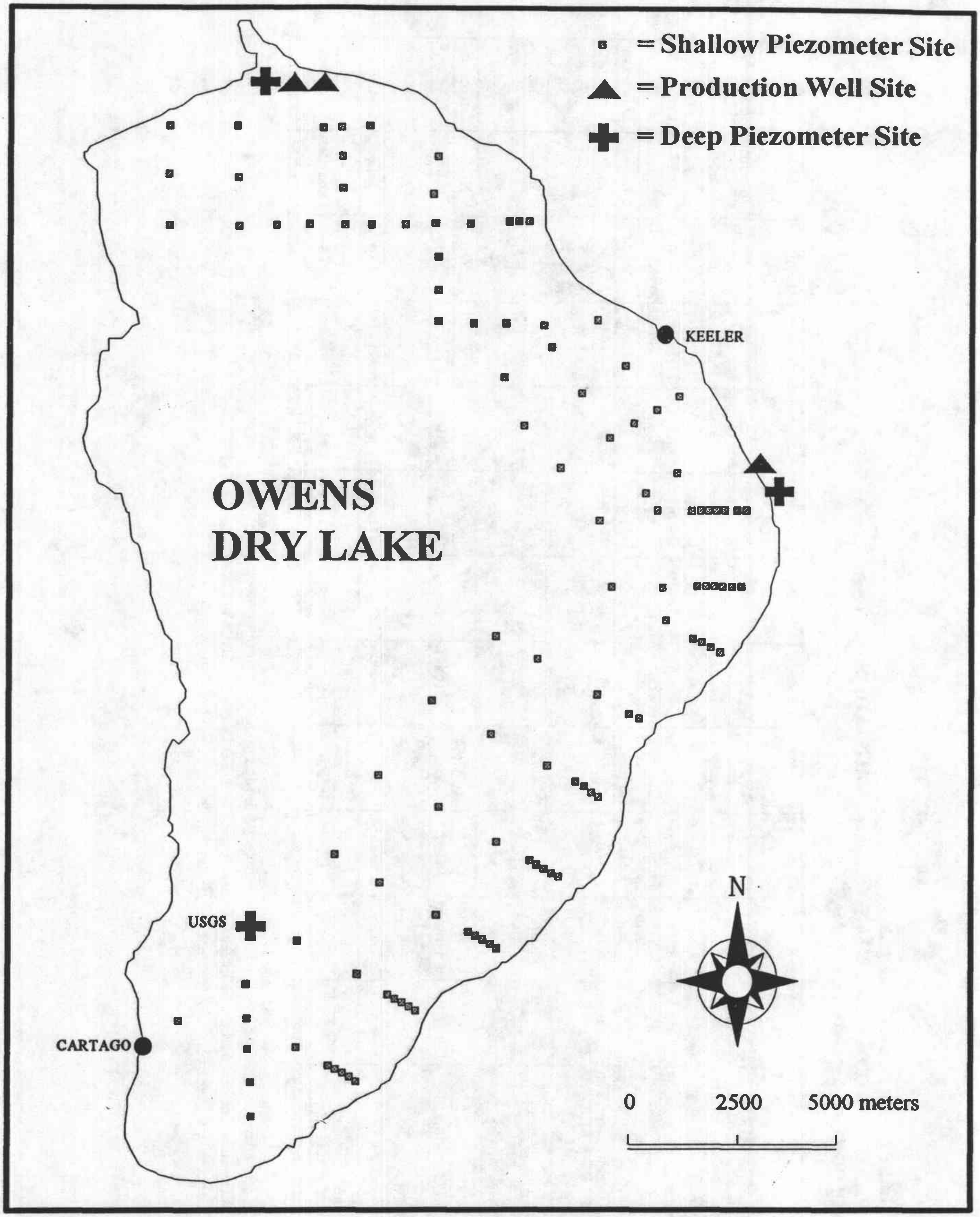

Figure 6: Piezometer Network and Deep Wells

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TABLE 2
OWENS VALLEY PM-10 PLANNING AREA
BEST AVAILABLE CONTROL MEASURES STATE IMPLEMENTATION PLAN
CANDIDATE CONTROL MEASURE SUMMARY

CONTROL MEASURE	Expected Effectiveness*		Water Reqmts.	Electricity Reqmts.	Lake Access Required	Public Trust Restore	Wildlife Habitat Restore	Infrastructure Costs		Additional Testing Needed	Affects Mining Operatns.	State Lands Acceptable
	Sand	Clay						Install	Maint.			
WATER BASED												
Sprinklers	5%	75%	Med	Med	High	Low	Low	High	High	No	None	Unknown
Flood Irrigation	95	95	High	High	Med	High	High	Low	Low	Yes	Low	Yes
Refill Lake	100	100	V. High	None	None	High	High	V. Low	None	No	High	Unknown
Lower Groundwater Tab	Unknown	Unknown	None	Med	Med	Low	None	Med	Med	Yes	Low	Unknown
VEGETATION BASED												
Lake Bed Vegetation	60-100	60-100	Med-High	Med-High	Med	High	High	High	Low	Yes	Low	Yes
SAND FENCE BASED												
Sand Fences	50	Unknown	None	None	High	Low	Low	High	High	Yes	None	Unknown
Riparian Corridors	Unknown	Unknown	Med	Med	Med	Med	Med	Med	High	Yes	Low	Yes
SURFACE PROTECTION												
Salt Flats	90	90	Med	Low	Med	Low	None	Med	Med	Yes	Low	Unknown
Gravel Blanket	95	95	None	None	High	Low	Low	High	Low	Yes	None	No
Chemical Stabilizers	5	25	Low	Low	High	Low	None	High	High	No	Unknown	No
Other Surface Coverings	Unknown	Unknown	None	None	High	Low	Low	Med-High	Low	Yes	Unknown	No

* Expected effectiveness refers to the anticipated effectiveness where the measure is implemented. Some measures may not be appropriate or feasible for implementation lakewide. These are very crude estimates based on the results of testing to date and will change based on future testing.

SECTION 7 - BEST AVAILABLE CONTROL MEASURES

7.1 INTRODUCTION

Eleven potential measures to control PM-10 emissions from Owens Lake were discussed in the previous section. It is possible that some version of all eleven measures may, at some time in the future, be implemented on the lake to control fugitive dust. Although each measure has some advantages which make it attractive as a control measure, each also has a number of disadvantages. The wide variety of conditions found on the lake, the different dust generation mechanisms and the obstacles that prevent the implementation of traditional dust control measures ensure that there will be no one measure that meets all the requirements of the "perfect" way to fix Owens Lake. As control measure research continues, measures will be refined. The final control plan that provides for attainment of the Standard will implement those measures that are sufficiently effective to attain the Standard and have the greatest overall advantages for each particular type of area or condition.

As a requirement of the 1990 Clean Air Act Amendments, however, the District is obligated in this document to determine the best control measures (BACMs) available at this time. This section of the SIP will determine what those measures are, discuss how and where the measures are being implemented and what regulations will be or are being used to ensure that the measures are implemented as provided for in this plan.

7.2 BACM DETERMINATION

The EPA procedure for determining BACM consists of four steps to be taken:

1. Inventory sources of PM-10,
2. Evaluate source category impact,
3. Evaluate candidate control techniques, and
4. Evaluate costs of control.

With regard to the first two steps of the determination, an inventory of PM-10 sources and an evaluation of source category impacts, BACM are required for all sources for which the impact on PM-10 concentrations is not de minimus. The contribution to nonattainment of any source category is presumed to be de minimus if the source causes a PM-10 impact in the area of less than 5 μg/m^3 for a 24-hour average and less than 1 μg/m^3 toward the annual mean concentration.

In Section 4, "Emissions Inventory," it was shown in Table 1 that the non-Owens Lake sources of PM-10 produced 0.005% of the emissions on a 24-hour basis and 0.084% on an annual basis. By using the highest 24-hour and annual PM-10 concentrations; 1,861 μg/m^3 and 78.1 μg/m^3 respectively, and neglecting background concentrations, the impact of the non-Owens Lake sources can be estimated by assuming the source emissions are proportional to their ambient concentration impact. This method, which is known as proportional or linear roll-back, yields 0.09 μg/m^3 for the 24-hour impact and 0.07 μg/m^3 for the annual impact of the non-Owens Lake sources. Because the impacts are less than the de minimus thresholds, BACM or BACT are not required for non-Owens Lake sources at this time. Therefore, Owens Lake is the only significant source that is required to implement BACM.

The third step of the BACM determination is an evaluation of the available candidate control techniques. This is where an evaluation of the technological feasibility of the available control measures must be made. With regard to Owens Lake, a potential control measure must meet two tests in order to be included on the BACM list. First, it must be a currently available measure that is physically able to be emplaced on the lake bed. Second, as the lake bed is public property under the jurisdiction of the California State Lands Commission, candidate control measures must neither destroy any of the lake bed's public trust values nor limit the ability to restore such values at future dates.

If relative feasibility and environmental impacts are not taken into account, all eleven of the candidate BACM measures discussed in Section 6, "Candidate Control Measures," are able to be emplaced on the lake bed to some degree. However, some of the measures will ultimately not provide the effectiveness level necessary to meet the Standard, some of the measures may not be appropriate or even feasible on some areas of the lake bed and some of the measures may cause environmental impacts that are not acceptable to government and private entities. These are factors that will be considered in the Demonstration of Attainment SIP to be completed in 1997; they do not affect the current BACM determination. Therefore, in order to determine the BACM list, the second test must be applied: acceptability to the California State Lands Commission.

The Lands Commission's authority to make control measure acceptability determinations and their determinations to date are discussed in Section 5, "Control Measure Development Program," in Section 6, "Candidate Control Measures" and in Appendix 6, "Letters from California State Lands Commission." At this time, the Lands Commission has determined that only three of the discussed measures are acceptable for emplacement on the lake bed: flood irrigation, vegetation and sand fences/riparian corridors. These three measures then, are the available candidate control techniques for Owens Lake.

The final step of the BACM determination is an evaluation of the costs of control for the available candidate measures. EPA guidance on this step dictates that consideration of economic feasibility should not rely on claims regarding the ability of a particular source to "afford" to reduce emissions. Economic feasibility should, instead, consider the cost of reducing emissions from a particular source as compared to the costs incurred by similar sources that have implemented emission reductions.

With the possible exception of the smaller scale problem at Mono Lake, Owens Lake is a unique PM-10 source. There are no analogous sources elsewhere that have implemented the types of controls in similar conditions to those under consideration at Owens Lake with which to compare costs. In those areas of Owens Lake where two or three of the available alternative control techniques are technically feasible, they should be compared to each other to determine the most cost effective implementation strategy. On some areas of the lake bed, however, only one of the measures may be feasible.

At this time there are three measures that are considered as the best available control measures for the Owens Valley Planning Area. All three measures are controls for the Planning Area's only significant PM-10 source, Owens Dry Lake. The BACMs are: flood irrigation, vegetation and sand fences/riparian corridors. Each of these measures will be implemented in the areas for which they are most suitable.

7.3 BACM IMPLEMENTATION

All three BACMs have been implemented on Owens Lake and will continue to be expanded as it continues to be technically feasible to do so. The existing level of implementation and the planned level of expansion between now and the 1997 Demonstration of Attainment SIP deadline will be addressed for each of the BACMs. Implementation costs will also be addressed. A summary of BACM implementation until 1997 is provided in Table 3.

FLOOD IRRIGATION

At this time, flood irrigation appears to be a very effective control measure. At the north test site PM-10 emissions from approximately 550 acres of the source area are being controlled by flooding. Water is supplied by two groundwater wells located in the Owens River delta at the north end of the lake. Based on preliminary test results, it appears the existing wells have the capacity to flood approximately an additional 400 to 500 acres. Funding for a south test site has been approved by the City of Los Angeles and will be available in July 1994. Flooding on the south site is scheduled to begin in mid-1995. Two additional groundwater supply wells will be installed in early 1995. Water from one of the new wells near the southeast shoreline will be used to control PM-10 from one of the most serious emission areas found on the lake bed.

Flood irrigation is the BACM that comes closest to recreating the conditions found at Owens Lake before diversion by the City of Los Angeles began early in this century. Its application on the lake bed, however, is limited by two factors: terrain and availability of water.

The measure appears to be most effective where lake bed relief is extremely flat. This allows the water to spread widely and form very shallow, expansive sheets. Any relief, such as a sand dune or drainage course, causes the water to channel. This increases water depth and decreases the area a given amount of water can cover. Fortunately, the majority of the lake bed meets the lack of relief condition.

The more restrictive limitation on the expandability of flood irrigation will probably be the availability of water. As part of the District's test of the flood irrigation measure, we will determine the acre-feet per acre per year of water required to control PM-10 emissions. In conjunction with the testing effort, the District's water resource experts will determine the long-term sustainable amount of water available for use on the lake bed (preliminary estimates range from 25,000 to 100,000 acre-feet per year). These two numbers will dictate the amount of emission area to which flood irrigation can be applied.

The cost of the infrastructure for the flood irrigation site was approximately $800,000. This included $400,000 for 5 miles of 14-inch buried pipeline and $400,000 for two groundwater wells and pump stations. However, this existing infrastructure, with minimal modifications, could be utilized to flood an area of approximately 1,000 acres. The infrastructure cost for flood irrigation then, should be between $1,000 to $1,500 per acre. Annual electricity costs are projected to be approximately $100 per acre.

Between now and the 1997 deadline for the Demonstration of Attainment SIP, flood irrigation will be expanded as appropriate areas for implementation are identified and as additional sustainable water becomes available.

VEGETATION

It is well known that plant cover can be an effective way to control fugitive dust emissions. Vegetation is the BACM that may come closest to becoming a "walk away" control measure. If vegetation can be established in the PM-10 source areas that can survive in the lake bed soils with the area's natural precipitation, then the plants may become self sustaining. However, it appears that two factors limit the ability to establish grass and wetland type vegetation on Owens Lake: the levels of salt found in the lake bed soils and, as with flood irrigation, the availability of water. There seems to be a third factor that affects the viability of shrubs: the presence of high groundwater levels that create anoxic soil conditions.

Owens Lake is a terminal lake, which means that the only way water that flows onto the lake can leave is through evaporation. As the water evaporates it leaves behind any minerals that were in it when it flowed into the lake. Over time this caused the lake waters to increase their mineral content. When diversion of the Eastern Sierra rivers and streams began early in this century, the water in Owens Lake was about twice as salty as seawater. As the lake dried the salt was left behind and eventually precipitated on and in the lake bed soils. It is this remnant salt that currently precludes the establishment of vegetation over much of the lake bed.

There are areas on the lake bed, however, where vegetation is naturally found. These are typically areas where the presence of fresher water has flushed the high levels of salt out of the local soil and allowed the establishment of plants. Examples of such areas are found among shoreline seeps and springs and in the unique lake bed "spring mounds." The District and other researchers are investigating those factors that limit lake bed vegetation and what changes can be affected to ameliorate the limiting conditions.

As with flood irrigation, the amount of water available to alter existing conditions and to establish and support vegetation dictates the amount of lake bed that can be vegetated. The water resource evaluation effort discussed above under flood irrigation will determine the sustainable amount of water available for vegetation-based measure implementation.

In addition to the many small areas on the lake bed where vegetation is establishing naturally, current vegetation implementation efforts include an attempt by the District to use water from the flood irrigation pipeline to vegetate about 1½ acres of small-scale test plots in the northeast corner of the lake bed and the introduction of wetland and grass type plants to the flood irrigation test site. Planned for late 1995 is the planting of a larger scale (approximately 20 acre) grassland in the vicinity of the Owens River delta on the north end of the lake. In addition, the south flood irrigation test site will have additional vegetation test plots.

Infrastructure costs for vegetation are similar to those for flood irrigation. Wells, pump stations and piping systems are needed for water distribution and can be expected to cost between $1,000 and $1,500 per acre. There is the additional cost of establishing and emplacing the plant materials; this could add an additional $500 per acre for a total cost of between $1,500 and $2,000 per acre. Power costs would add less than $100 per acre per year.

Between now and the 1997 deadline for the Demonstration of Attainment SIP, as the District discovers or creates areas that are appropriate for vegetation and as sustainable water becomes available for use to support vegetation, these areas will be planted.

SAND FENCES/RIPARIAN CORRIDORS

The third BACM is the use of sand fences to protect the lake bed from the blowing sand that erodes the surface and causes PM-10 emissions. It is well known that sand fences can reduce surface wind speeds to below the saltation threshold velocity if they are spaced close enough. However, it would require an extremely large amount of fence to protect all the emissive portions of the lake bed in this manner (over 4000 miles of 6-foot high fence). The State Lands Commission has not ruled that this is an acceptable measure and this option has never been actively supported by the District or any other sand fence proponent. Recent research has been directed at discovering if some other factor will allow control with larger fence spacings.

In the most desirable and cost effective use of sand fences, they would create widely spaced riparian corridors that would capture sand and break the wind's fetch along the flat unobstructed lake bed. This scenario relies on the existence of the saltation reestablishment "dead zone" discussed in Section 6.4 "Sand Fence-Based Measures." This is a use of sand fences that has been approved by the State Lands Commission and therefore is a BACM.

Even if the "dead zone" does not exist or if it is very limited in length, there is the possibility that all the saltation-sized particles could be trapped by widely spaced sand fences, thus protecting downwind areas from saltation initiated PM-10 emissions. Again the use of widely spaced fences is a control measure approved by the State Lands Commission and therefore is also a BACM.

Since 1984 approximately 7 miles of sand fence have been constructed on Owens Lake; both linear fences and fence arrays. The current research array constructed by the University of California, Davis is utilizing about ¾ of a mile of fence to create a 30 acre test array. In 1994-95 the District will be working with wind tunnel engineers from Davis to model the effects of larger scale fence arrays on the lake bed. In 1995-96 the District will use the results from the small-scale Davis array and the modeling to construct a large-scale fence array to verify the control effectiveness associated such large-scale measures.

Implementation costs for sand fences are currently between $4 and $5 per foot of fence. The cost per acre will depend on fence spacing. The UC Davis fence array, for example, contains about 4,000 feet of fence spaced 300 feet apart on a 30 acre test site. At this spacing, the fence array costs approximately $550 to $650 per acre. If vegetation is used to stabilize filled fences, the costs will increase.

7.4 BACM ENABLING REGULATIONS

The District has a number of existing regulations that provide for the implementation of the BACMs. In addition, in conjunction with this document, the District is committing to adopt a measure to ensure the implementation of BACM projects. These regulations are discussed below.

SENATE BILL 270 (HEALTH & SAFETY CODE 42316)

Great Basin has tried several local rules to control the dust emissions from Owens Lake. In 1980 the District applied Local Rule 200 to the City of Los Angeles Department of Water and Power's water gathering operations. This rule requires a permit to operate facilities that cause the issuance of air contaminants. It was, and still is, Great Basin's contention that the operation of the Los Angeles Aqueduct and all related works constitutes a facility that causes the PM-10 emissions at Owens Lake. In 1982 Los Angeles' Coso geothermal permit applications were denied by the District Air Pollution Control Officer because of City's noncompliance with rules and regulations regarding Owens

Lake. Los Angeles then petitioned the District Hearing Board for a reversal of the decision or a variance. The Hearing Board denied the variance and upheld the decision to deny the geothermal permits and require air quality permits for Department of Water and Power's water gathering operations within the District.

In 1983 Senator Dills introduced Senate Bill 270 (SB-270) which exempted water gathering operations from air quality permit regulations. Compromise language for SB-270 resulted in the passage of the bill in 1983. SB-270 became law in January 1984 and is Section 42316 of the California Health and Safety Code (Appendix 7). This Section allows Great Basin to require the City of Los Angeles to undertake and fund reasonable measures, including studies, to mitigate the air quality impacts associated with the City's production, diversion, storage and conveyance of water. Most of the funding over the last 10 years for control measure development and implementation has come from the City of Los Angeles through the provisions of SB-270. In addition, the District intends to utilize the requirements of SB-270 to implement future BACM efforts.

MAJOR SOURCE EMISSIONS THRESHOLD

District Rule 209-A (Appendix 7) was reviewed in 1993 and found to have an existing threshold that is lower than the 70 tons per year of PM-10 required by the U.S. EPA. As originally approved, District Rule 209-A set a level of 250 pounds per day of particulate matter as the lower limit for the major source definition in the District. This limit, which is equivalent to about 46 tons per year, was based on "particulate matter" emissions. It did not specify if particulate matter was measured as Total Suspended Particulates (TSP) or if it could be PM-10. If "particulate matter" was interpreted as PM-10, it would effectively relax the limit, because sources emit more TSP than PM-10. To ensure that future facilities will be required to meet the same requirements as existing facilities, District Rule 209-A was clarified in May 1993 to reflect that the 250 pound per day limit is measured as TSP and not PM-10 (District Rule 209-A.B.2.c).

One of the requirements for major sources is that they apply Best Available Control Technology (BACT) to control the emissions from their facilities. At the request of the U.S. EPA and the California Air Resources Board, the BACT requirement under Rule 209-A was also extended to modifications to major sources, where the modification would cause a net increase in emissions of 15 tons per year or more of PM-10. This was equivalent to about 80 pounds of PM-10 per day. This rule revision was approved in May 1993 as District Rule 209-A.B.2.d. (Appendix 7).

EXISTING RULES FOR PARTICULATE MATTER CONTROL

District Rules 400, 401 and 405 are existing federally approved rules that limit particulate emissions from area or point sources in the District. Rule 400 limits visible emissions from any source, except those exempted under Rule 405, to less than Ringelmann 1, or 20 percent opacity. Rule 401 requires that reasonable precautions be taken to prevent visible particulate matter from crossing the property boundary. Methods to comply with both of these rules for fugitive dust emissions are explained in the permit conditions for Permits to Operate that are issued in the District. These rules are in included in Appendix 7 and an example of the permit conditions are included in Appendix 8. The District considers Rules 400 and 401, along with conditions required under the permit to operate as Reasonably Available Control Measures (RACM) for fugitive dust from industrial sources. Because PM-10 from industrial sources comprises about two hundredths of one percent of the emissions in the Owens Valley, these RACM requirements have not been evaluated to determine if they should be considered BACM for fugitive dust from industrial sources.

COMMITMENT TO ADOPT BACM ENABLING REGULATION

At this time, the District relies on the provisions of Health and Safety Code Section 42316 (SB-270) as the legislation that provides for the development and implementation of BACMs. However, as part of the SIP process, EPA requires that the District provide an enforceable mechanism to ensure that the BACM measures identified in Table 3 are implemented. Therefore, the District commits to adopt a rule, resolution, memorandum of understanding or other mechanism approved by the EPA to ensure the implementation of the BACM measures identified in Table 3 within six months of adoption of the BACM SIP by the District.

TABLE 3
BEST AVAILABLE CONTROL MEASURES
IMPLEMENTATION SUMMARY

Measure	Date	Quantity	Funded By*
Flood Irrigation			
North Flood Site	Jan-94	500 ac	LADWP
South Flood Site	Jan-95	200 ac	LADWP
North Flood Site Expansion	Jul-95	500 ac	--
Vegetation			
Natural Establishment	Ongoing	Unknown	--
North Subplots	Jun-94	1.5 ac	LADWP
North Test Site	May-95	20 ac	LADWP
South Subplots	May-95	10 ac	LADWP
Sand Fences			
Phase I Fences	83	2 mi	SLC, LADWP, USN
Phase II Fences	88	4 mi	SLC, LADWP
UC Davis Array	Oct-93	1 mi	SLC
Large-Scale Test	Oct-95	Unknown	--

*LADWP = City of Los Angeles
SLC = California State Lands Commission
USN = China Lake Naval Weapons Center

SECTION 8 - SCHEDULE

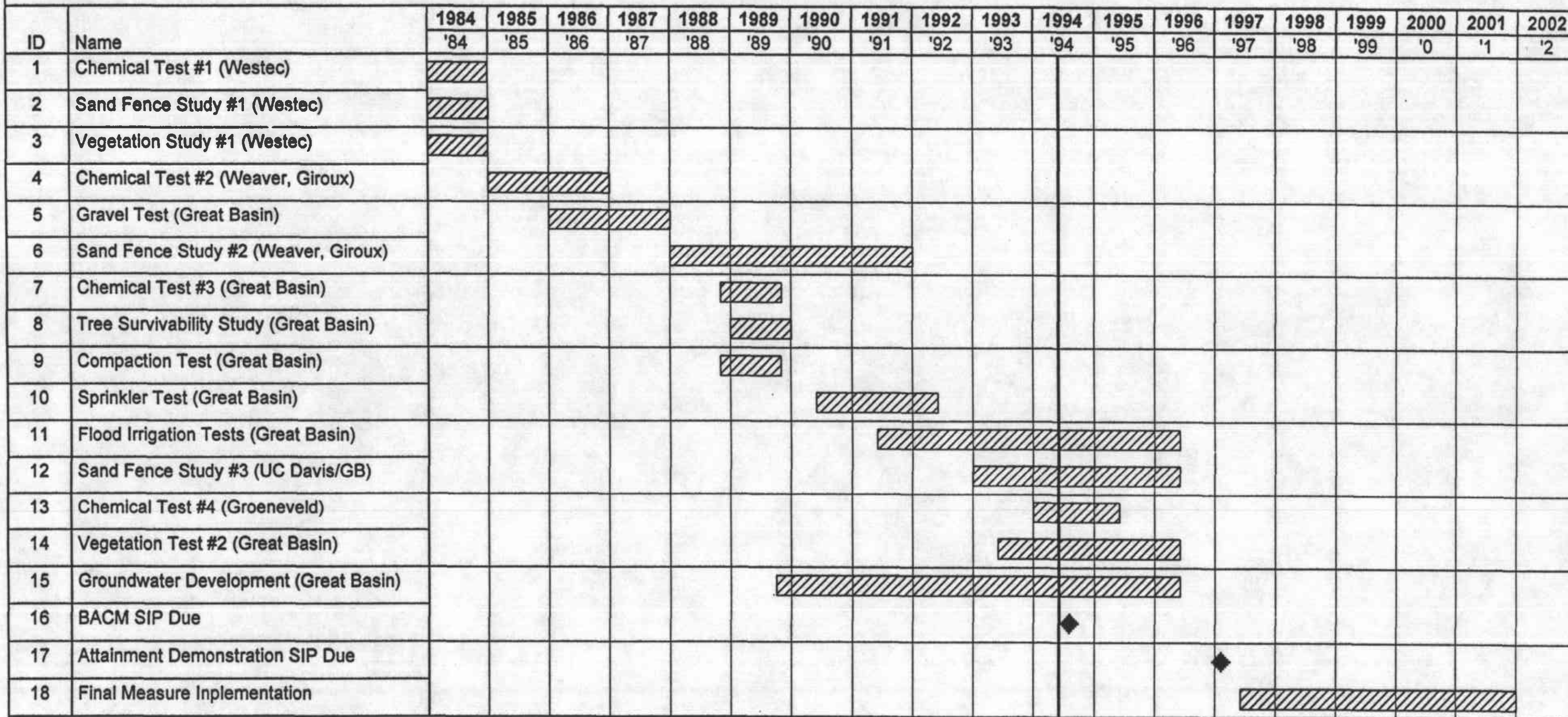
8.1 MITIGATION SCHEDULE

Presented below is a schedule for the past and future work discussed in this document. As can be seen, current projects include efforts toward refining and implementing the BACMs: the flood irrigation tests performed by the District, the sand fence/array tests performed by UC Davis and the District, the vegetation research performed by the District and the water resource development effort by the Desert Research Institute and the District.

Mitigation of the fugitive dust problem on Owens Lake is a vast undertaking. However, with the assistance of and resources available from the Los Angeles Department of Water and Power, the California State Lands Commission, the California Air Resources Board, the Environmental Protection Agency and all interested and involved citizens and researchers, the District is confident that a Standard attainment plan can be developed by 1997 and that the plan can be implemented by the 2001 deadline for PM-10 Standard compliance.

BACMSIP

OWENS VALLEY PLANNING AREA
PM-10 STANDARD ATTAINMENT
IMPLEMENTATION SCHEDULE



APPENDIX 1 - Endnotes

ENDNOTES

[1]South Coast Air Quality Management District, "Draft State Implementation Plan for PM10 in the Coachella Valley: 1994 'BACM' Revision," (March 1994), pp. 1-1 to 1-2.

[2]C. Thistlewaithe, Inyo County Planning Department, personel conversation, April 13, 1994.

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[4]Great Basin Unified Air Pollution Control District et al., "PM10 State Implementation Plan for the Searles Valley Planning Area," (November 1991), p. I-4.

[5]Ibid., p. I-5.

[6]Ibid., p. I-5.

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APPENDIX 2 - Referenced Documents

REFERENCED DOCUMENTS

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APPENDIX 4 - Quarterly PM-10 Data Averages

APPENDIX 4
QUARTERLY PM-10 DATA AVERAGES

SITE	YEAR	Q1		Q2		Q3		Q4		ANNUAL AVERAGE	
KEELER	1988	52.2	(14)	18.3	(15)	24.4	(16)	40.4	(15)	33.4	(60)
KEELER	1989	176.5	(12)	102.2	(15)	27.4	(15)	25.9	(15)	**78.1**	(57)
KEELER	1990	47.4	(15)	37.1	(15)	12.9	(14)	114	(16)	**54.5**	(60)
KEELER	1991	36.8	(14)	55.6	(15)	48.0	*(10)*	33.3	(15)		
KEELER	1992	9.5	(15)	85.0	(15)	33.7	(14)	21.5	(15)	37.4	(59)
KEELER	1993	58.7	(15)	23.8	(16)	20.1	(14)	20.1	(13)	31.1	(58)
LONE PINE	1988	30.4	(14)	18.9	(15)	18.9	(16)	19.2	(15)	21.7	(60)
LONE PINE	1989	30.3	(15)	31.2	(15)	14.9	(15)	16.1	(16)	23.0	(61)
LONE PINE	1990	17.5	(15)	17.7	(15)	17.5	(15)	16.5	(17)	17.3	(62)
LONE PINE	1991	17.8	(15)	21.2	(15)	17.5	(15)	15.1	(15)	17.9	(60)
LONE PINE	1992	10.9	(14)	25.7	(15)	15.7	(14)	16.4	(14)	17.3	(57)
LONE PINE	1993	8.4	(15)	18.5	(15)	14.9	(15)	24.1	(14)	16.4	(59)
OLANCHA	1988	20.4	(15)	15.9	(15)	21.7	(15)	23.3	(15)	20.3	(60)
OLANCHA	1989	32.1	*(6)*	25.8	(15)	23.0	(15)	26.5	(16)		
OLANCHA	1990	9.3	(15)	46.7	(15)	18.4	(15)	18.4	(16)	23.1	(61)
OLANCHA	1991	23.9	(15)	18.1	(14)	14.9	(15)	15.2	(15)	18.0	(59)
OLANCHA	1992	9.8	*(10)*	39.8	(15)	17.1	(15)	36.3	(15)		
OLANCHA	1993	7.0	(13)	24.7	(13)	ND	*(0)*	49.8	(16)		

Quarterly Averages expressed in µg/m3

Numbers in Parentheses are samples/quarter
Quarters are considered invalid if <12 samples/quarter
Annual Averages are considered invalid if any quarter is invalid

Annual Federal PM-10 Standard = 50 $\mu g/m^3$ weighed over 3 years
Annual State PM-10 Standard = 30 $\mu g/m^3$ weighed over 3 years

APPENDIX 5 - Dates of PM-10 Greater than 50 $\mu g/m^3$ at Keeler, Lone Pine or Olancha

APPENDIX 5
DATES OF PM-10 GREATER THAN 50 μg/m^3
AT KEELER, LONE PINE OR OLANCHA

DATE	SITE	24-Hour Average			1-Hour Avg.	
		PM-10 μg/m^3	SPEED mph	DIR	MAX SPD mph	DIR of MAX
1/16/88	**KEELER**	**394**	**6**	**E**	**17**	**SSW**
1/16/88	**LONE PINE**	**172**	**6**	**N**	**17**	**SE**
1/16/88	OLANCHA	25	12	W	37	W
3/9/88	KEELER	115	12	NW	30	NNW
3/9/88	LONE PINE	29	15	NNW	30	NNW
3/9/88	OLANCHA	67	12	N	35	N,NNW
3/15/88	KEELER	69	10	NW	23	WNW
3/15/88	LONE PINE	43	15	NNW	28	NNW
3/15/88	OLANCHA	18	10	N	22	N
3/28/88	KEELER	49	8	NW	19	NW
3/28/88	LONE PINE	23	14	NNW	19	NW
3/28/88	OLANCHA	50	8	S	19	S
5/5/88	KEELER	56	15	SE	30	SSE
5/5/88	LONE PINE	50	21	NNW	35	SSE
5/5/88	OLANCHA	13	16	SSE	23	S,SSE
8/1/88	KEELER	70	6	ENE	26	W
8/1/88	LONE PINE	20	ND	ND	ND	ND
8/1/88	OLANCHA	23	6	S	17	WNW
9/12/88	KEELER	52	12	NW	22	NW
9/12/88	LONE PINE	29	11	NNW	22	NW
9/12/88	OLANCHA	ND	9	NNE	23	NNE
11/17/88	KEELER	123	14	NW	22	WNW
11/17/88	LONE PINE	19	15	NW	21	NW
11/17/88	OLANCHA	55	15	N	34	W
11/23/88	**KEELER**	**324**	**ND**	**ND**	**ND**	**ND**
11/23/88	LONE PINE	64	13	NW	26	SE,SSE
11/23/88	OLANCHA	44	21	SSW	32	SW

DATE	SITE	24-Hour Average			1-Hour Avg.	
		PM-10 $\mu g/m^3$	SPEED mph	DIR	MAX SPD mph	DIR of MAX
1/10/89	KEELER	98	7	NW	27	NW
1/10/89	LONE PINE	65	11	NW	34	NW
1/10/89	OLANCHA	22	7	NNE	37	NNE
1/28/89	KEELER	12	8	N	18	N
1/28/89	LONE PINE	14	12	NNW	21	NW
1/28/89	OLANCHA	107	7	SSE	21	NNE
2/3/89	**KEELER**	**1861**	**16**	**S**	**33**	**S**
2/3/89	LONE PINE	126	18	NNW	27	SE,WNW
2/3/89	OLANCHA	ND	21	NNW	38	WNW
3/9/89	KEELER	11	13	SE	21	S
3/9/89	LONE PINE	78	ND	ND	ND	ND
3/9/89	OLANCHA	ND	21	SSE	28	SSE
4/22/89	**KEELER**	**326**	**12**	**S**	**28**	**S**
4/22/89	LONE PINE	87	ND	ND	ND	ND
4/22/89	OLANCHA	25	13	SSE	25	S
5/10/89	KEELER	44	11	SSE	25	SE
5/10/89	LONE PINE	85	ND	ND	ND	ND
5/10/89	OLANCHA	20	14	SSE	31	SE
5/22/89	**KEELER**	**165**	**14**	**S**	**28**	**S**
5/22/89	LONE PINE	34	12	ESE	23	ESE
5/22/89	OLANCHA	19	11	NE	22	SSE
5/28/89	**KEELER**	**587**	**15**	**NW**	**33**	**NW**
5/28/89	LONE PINE	96	11	NNW	35	NNW
5/28/89	OLANCHA	13	10	W	19	W
6/3/89	KEELER	97	14	NW	23	NW
6/3/89	LONE PINE	10	14	NW	20	NW,NNW
6/3/89	OLANCHA	19	8	N	20	N
6/21/89	KEELER	104	13	NW	27	NW
6/21/89	LONE PINE	24	13	NNW	22	NNW
6/21/89	OLANCHA	109	ND	ND	ND	ND

DATE	SITE	24-Hour Average PM-10 μg/m³	24-Hour Average SPEED mph	24-Hour Average DIR	1-Hour Avg. MAX SPD mph	1-Hour Avg. DIR of MAX
6/27/89	KEELER	84	11	S	25	S
6/27/89	LONE PINE	27	12	SE	22	SSE
6/27/89	OLANCHA	21	ND	ND	ND	ND
8/20/89	KEELER	115	8	NW	24	NW
8/20/89	LONE PINE	16	7	NW	18	NNW
8/20/89	OLANCHA	27	ND	ND	ND	ND
9/19/89	KEELER	59	12	NW	25	NW
9/19/89	LONE PINE	3	11	NNW	18	NW
9/19/89	OLANCHA	13	10	N	25	N
10/25/89	KEELER	23	10	NNW	19	NW
10/25/89	LONE PINE	7	ND	ND	ND	ND
10/25/89	OLANCHA	63	10	NE	20	WNW
12/6/89	KEELER	103	11	NW	25	NW
12/6/89	LONE PINE	20	ND	ND	ND	ND
12/6/89	OLANCHA	58	8	S	23	NNE
12/30/89	KEELER	120	11	NW	25	NW
12/30/89	LONE PINE	12	16	NNW	27	NNW
12/30/89	OLANCHA	27	7	N	21	N
4/23/90	KEELER	ND	ND	ND	ND	ND
4/23/90	LONE PINE	ND	12	N	24	N
4/23/90	**OLANCHA**	**200**	**13**	**WNW**	**26**	**W**
5/17/90	KEELER	ND	ND	ND	ND	ND
5/17/90	LONE PINE	26	13	SSE	22	SSE
5/17/90	**OLANCHA**	**200**	**17**	**SSE**	**32**	**W**
5/23/90	KEELER	ND	ND	ND	ND	ND
5/23/90	LONE PINE	27	17	S	25	SE
5/23/90	OLANCHA	65	17	SW	27	SSW
8/15/90	KEELER	ND	ND	ND	ND	ND
8/15/90	LONE PINE	68	9	SSE	15	SSE
8/15/90	OLANCHA	58	ND	ND	ND	ND

DATE	SITE	24-Hour Average			1-Hour Avg.	
		PM-10 $\mu g/m^3$	SPEED mph	DIR	MAX SPD mph	DIR of MAX
11/25/90	**KEELER**	**858**	**8**	**SW**	**27**	**SW**
11/25/90	LONE PINE	59	7	NW	18	S
11/25/90	OLANCHA	40	7	SSE	23	SSE
12/19/90	KEELER	ND	16	SW	27	SW
12/19/90	LONE PINE	18	10	N	18	S
12/19/90	OLANCHA	59	15	SSE	23	SSE
1/30/91	KEELER	40	2	SSW	6	NNE
1/30/91	LONE PINE	51	4	NW	7	NW
1/30/91	OLANCHA	32	ND	ND	ND	ND
3/13/91	KEELER	144	12	NW	29	S
3/13/91	LONE PINE	29	11	NW	18	SE
3/13/91	**OLANCHA**	**181**	**ND**	**ND**	**ND**	**ND**
3/25/91	KEELER	134	15	S	27	SSW
3/25/91	LONE PINE	5	18	SSE	30	SSE
3/25/91	OLANCHA	6	17	N	23	N
4/6/91	**KEELER**	**181**	**12**	**E**	**27**	**S**
4/6/91	LONE PINE	17	11	NNW	24	NW
4/6/91	OLANCHA	25	11	ESE	19	W
5/1/91	KEELER	ND	18	S	30	S
5/1/91	LONE PINE	82	21	SE	31	SE
5/1/91	OLANCHA	ND	15	WNW	23	SSW
5/18/91	KEELER	68	9	NW	25	NW
5/18/91	LONE PINE	14	12	NNW	24	NNW
5/18/91	OLANCHA	17	9	S	19	SSE
9/9/91	**KEELER**	**327**	**13**	**SSW**	**27**	**SSW**
9/9/91	LONE PINE	21	11	SE	24	SSE
9/9/91	OLANCHA	14	9	SSW	20	SW
10/27/91	KEELER	143	12	NW	28	NW
10/27/91	LONE PINE	12	14	NNW	24	NW
10/27/91	OLANCHA	7	9	NNE	22	N

DATE	SITE	24-Hour Average PM-10 $\mu g/m^3$	SPEED mph	DIR	1-Hour Avg. MAX SPD mph	DIR of MAX
12/20/91	KEELER	142	9	NW	31	NW
12/20/91	LONE PINE	9	13	NW	23	NW
12/20/91	OLANCHA	61	9	NNE	35	NNE
4/12/92	KEELER	62	ND	ND	ND	ND
4/12/92	LONE PINE	32	14	SSE	32	SSE
4/12/92	OLANCHA	13	18	S	26	S
4/18/92	**KEELER**	**151**	**ND**	**ND**	**ND**	**ND**
4/18/92	**LONE PINE**	**366**	**19**	**NW**	**26**	**NNW**
4/18/92	OLANCHA	31	13	NNE	26	NNE
4/30/92	**KEELER**	**350**	**13**	**SSE**	**30**	**SSW**
4/30/92	LONE PINE	63	13	SSE	22	SE
4/30/92	OLANCHA	19	17	SSE	27	SSE
6/29/92	**KEELER**	**526**	**17**	**SE**	**34**	**SSW**
6/29/92	LONE PINE	61	13	SE	21	ENE
6/29/92	OLANCHA	13	13	WSW	27	SSE
9/3/92	**KEELER**	**242**	**12**	**NNW**	**25**	**SSW**
9/3/92	LONE PINE	23	12	SSE	27	SE
9/3/92	OLANCHA	22	14	S	24	SSE
11/20/92	KEELER	100	18	NNW	27	NW
11/20/92	LONE PINE	21	22	NW	32	NW
11/20/92	OLANCHA	39	19	N	33	N
12/13/92	KEELER	ND	16	NW	23	NW
12/13/92	LONE PINE	ND	24	NW	33	NNW
12/13/92	**OLANCHA**	**365**	**25**	**NNE**	**36**	**NNE**
1/1/93	**KEELER**	**781**	**9**	**SSE**	**29**	**S**
1/1/93	LONE PINE	13	8	N	25	SSE
1/1/93	OLANCHA	4	15	SSE	29	SSE
5/1/93	KEELER	46	8	NW	18	SW
5/1/93	LONE PINE	31	10	NNW	17	NNW
5/1/93	**OLANCHA**	**153**	**11**	**N**	**21**	**NNE**

DATE	SITE	24-Hour Average			1-Hour Avg.	
		PM-10 µg/m^3	SPEED mph	DIR	MAX SPD mph	DIR of MAX
5/31/93	KEELER	80	11	S	24	S
5/31/93	LONE PINE	18	16	SSE	22	ESE
5/31/93	OLANCHA	18	16	SSE	22	SSE
10/26/93	KEELER	ND	19	NW	29	NNW
10/26/93	LONE PINE	ND	16	NNW	25	NW
10/26/93	**OLANCHA**	**346**	**18**	**NNE**	**29**	**NNE**
11/15/93	KEELER	67	8	NW	22	NW
11/15/93	LONE PINE	ND	11	NNW	20	NNW
11/15/93	OLANCHA	ND	9	NNE	23	NNE
12/21/93	KEELER	12	5	NW	10	NW
12/21/93	LONE PINE	17	11	NNW	22	NW
12/21/93	OLANCHA	68	4	NNE	10	NE
12/23/93	KEELER	ND	16	NW	31	NW
12/23/93	LONE PINE	34	20	NNW	31	NNW
12/23/93	**OLANCHA**	**185**	**14**	**NE**	**26**	**NE**

APPENDIX 6 - Letters from California State Land Commission

STATE OF CALIFORNIA

PETE WILSON, *Governor*

STATE LANDS COMMISSION

LEO T. McCARTHY, *Lieutenant Governor*
GRAY DAVIS, *Controller*
THOMAS W. HAYES, *Director of Finance*

EXECUTIVE OFFICE
1807 - 13th Street
Sacramento, CA 95814

CHARLES WARREN
Executive Officer
(916) 322-4105
FAX (916) 322-3568

STATE LANDS COMMISSION · STATE OF CALIFORNIA

RECEIVED
OCT 11 1991
GREAT BASIN
UNIFIED APCD

October 7, 1991

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, CA 93514

Dear Dr. Hardebeck:

I was very encouraged by our September 26 and 27 meetings and am optimistic that together we can shape a project that will improve air quality and reclaim some public trust values to Owens Lake. As we discussed, it is important to delineate the roles of each of the entities involved. With specific tasks, schedule and a budget clearly identified, we can begin working toward our goals immediately. To this end, I have set out the general procedures and tasks we discussed as essential to beginning the Owens Lake Reclamation and Conservation Project.

The three principal agencies in the project thus far are the State Lands Commission (SLC), the Great Basin Unified Air Pollution Control District (GBUAPCD) and the University of California at Davis (UCD). The SLC owns the beds of Owens Lake and the Owens River in trust for the people, and thus, seeks to protect (or in this case, reclaim) the trust resources. The GBUAPCD is responsible for developing and implementing a plan for reducing PM 10 levels in its jurisdiction. The UCD has assembled a team of professionals and has made them available to SLC for the purpose of reclaiming Owens Lake in a manner which will relieve if not resolve the PM 10 problems. We believe it is time now to consider the amenities of the lake and river and seek to reclaim some of the public trust values as well as improve the air quality in the vicinity of Owens Lake.

We are aware of a number of solutions proposed for the PM 10 problem that have been suggested for the lake that are unacceptable because they are neither practicable nor take into account the public trust resources of the lake. For example, placing tires, gravel, wastes or treating with chemicals are not practicable nor aesthetic. Further, covering the lake with an expensive grid of sprinkler systems requiring large amounts of maintenance does not seem to meet the need to reduce the PM 10 problem to the extent necessary to meet legal requirements.

The Commission has contributed substantial monies over the years to help fund GBUAPCD's testing and analysis programs. GBUAPCD's responsibility for developing a mitigation plan to resolve the air pollution problems in Owens Valley, the information gathered from Phases 1-3 of testing, as well as the expertise in working on the lake bed make your agency a vital participant in the management, oversight, testing and implementation of this proposal. GBUAPCD is the logical entity to manage the field work for this program.

The UCD has assembled a multi-disciplinary team to address lake reclamation and air quality problems at the lake. They have developed a proposal which includes establishing a series of sand dunes and using surface and ground water to create additional riparian areas to trap blowing sand. The Vice-Chancellor of UCD has committed to this effort as one of the University's chief research priorities. This team is an invaluable resource in our efforts to improve air quality in Owens Valley.

We have an opportunity to work with each other to craft a practical, aesthetic solution to a difficult problem. At our meetings last week we discussed how best to use each entities talents. SLC, GBUAPCD and UCD are committed and ready to act to implement a project that meets all of our goals. I propose establishing a management and oversight committee made up of representatives of each of those three entities with the ability to add new members as necessary. It is clear that other entities, particularly the Department of Fish and Game (DFG), have expertise we will need to tap in designing and implementing the project. The management committee may want to include DFG and others in the management committee as well as in the process.

SLC will handle legal, administrative and public relation aspects of the project. GBUAPCD will be responsible for developing the project conjunctively with UCD as well as directing field activities required to design, implement and test the project. UCD will be primarily responsible for research and design of the project with careful consideration given to determining a definite and realistic budget. Each member will coordinate with the other two members of the committee and keep the other two fully informed of the progress of its work.

By the October 22 meeting in Davis a number of tasks should be accomplished. UCD and GBUAPCD will work out technical concerns related to the current proposal. They will jointly develop a schedule and list of assignments for beginning the work on the project. UCD will also develop a definite and realistic budget to cover development, implementation, testing and all other expenses of the proposal. SLC will review the application of California Environmental Quality Act (CEQA) to the project and will examine funding sources.

The GBUAPCD and UCD technical staff will work closely together to assure technical consensus on the design and implementation of the project. GBUAPCD, UCD and SLC will meet at least monthly to review the status of the proposal and assess progress. At these meetings the parties will also seek to resolve any conflicts that have arisen. A more formal conflict resolution process will be developed if needed.

We are all aware that this is a very dynamic process. Procedures will change as necessary. I hesitate creating limiting procedures or a heavy bureaucracy to guide the process at this time. This approach stands the best chance of succeeding if we keep each member fully informed. Free and open discussions between staff is necessary. However, to be certain we all are working from the same information I recommend that each agency designate a contact person for technical issues and one for administrative/legal issues. Those individuals will be responsible for distributing materials and information to the others within their agencies. This should ease mailing and inter-agency coordination.

With our goals clearly in mind and the talent assembled to implement them, I am certain that the Owens Lake Conservation and Reclamation Project will be a success. To represent the SLC on technical issues please contact Steve Sekelsky at (916) 322-7825. For administrative/legal issues please contact Mike Valentine at (916) 322-2277.

Sincerely,

Charles Warren
Executive Officer

cc: Gene Toffoli, Legal Advisor
Department of Fish and Game
Dr. Robert Flocchini
University of California at Davis

Dr. Thomas Cahill
University of California at Davis
Jan Stevens, Supervising Attorney General,
Department of Justice

STATE OF CALIFORNIA PETE WILSON, Governor

STATE LANDS COMMISSION

LEO T. McCARTHY, Lieutenant Governor
GRAY DAVIS, Controller
THOMAS W. HAYES, Director of Finance

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Executive Officer
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RECEIVED
AUG - 5 1993
GREAT BASIN
UNIFIED APCD

August 2, 1993

Ms. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution
Control District
157 Short Street, Suite 6
Bishop, California 93514

SUBJECT: Remediation Measures at Owens Lake for Violation of PM-10 Standards

Dear Ms. Hardebeck:

You have asked that I follow up on one aspect of my October 7, 1991 letter to you in which I mentioned that certain solutions proposed for the PM-10 problem at Owens Lake, including placement of tires, gravel, wastes or chemicals on the dry lake bed, are unacceptable to the Commission. As you will recall, the basis for the Commission's objection to these theoretical methods of limiting dust at Owens Lake is that they are inordinately destructive of public trust values at the Lake and, additionally, that they severely limit the ability to restore such values. In any case, you have requested a summary of the Commission's legal authority to control activities, including proposed remediation activities, on the lake bed. I am happy to provide such a statement.

At the time of California's entry into the Union, all of its navigable waterways and the lands underlying those waters passed from the federal government to the new state. Articles for Admission of California to the Union, 1850, 9 Statutes at Large 452. Included among these lands is the bed of Owens Lake. "Exclusive jurisdiction and control" over these lands has been granted by the Legislature to the State Lands Commission. Public Resources Code (PRC) § 6301. The Commission's powers and responsibilities in exercising the State's ownership are extensive. PRC § 6216.

The Commission's authority over activities on this property of the State are set forth in various statutes. Among them are the following:

1. The property may be sold, or otherwise disposed of, and may be leased for any purpose the Commission "deems desirable...". PRC §§ 6216, 6501.1, 6809;

2. Trespassers on the property may be ejected. PRC § 6302;

3. The land can be classified by the Commission for different uses. PRC § 6201;

4. The Commission may require removal of structures on the land, prescribe regulations for its use and issue permits to public agencies for occupancy. PRC § 6216.1, 6221.

We believe that the authority conferred on the Commission by these and other statutes is sufficiently comprehensive to support the following conclusions. Activities taken on the bed of Owens Lake, by either private or public entities, are subject to permit and regulation by the Commission. The Commission can reject permit applications on a finding that the proposed activity is unreasonably detrimental to the public's ownership in the property. Finally, the Commission can condition any permits issued to require that public trust values be protected, restored or enhanced.

If you wish to discuss these matters further, please feel free to contact me at the above number, Steve Sekelsky at 322-7825 or Mike Valentine at 322-2277.

Sincerely,

Charles Warren
Executive Officer

APPENDIX 7 - Pertinent Rules and Regulations

Senate Bill 270 (Health & Safety Code 42316)
District Rule 209-A
District Rule 400
District Rule 401
District Rule 405
Proposed District Rule 432

SENATE BILL 270

HEALTH & SAFETY CODE SECTION 42316

42316. (a) The Great Basin Air Pollution Control District may require the City of Los Angeles to undertake reasonable measures, including studies, to mitigate the air quality impacts of its activities in the production, diversion, storage, or conveyance of water and may require the city to pay, on an annual basis, reasonable fees, based on an estimate of the actual costs to the district of its activities associated with the development of the mitigation measures and related air quality analysis with respect to those activities of the city. The mitigation measures shall not affect the right of the city to produce, divert, store, or convey water and, except for studies and monitoring activities, the mitigation measures may only be required or amended on the basis of substantial evidence establishing that water production, diversion, storage, or conveyance by the city causes or contributes to violations of state or federal ambient air quality standards.

(b) The city may appeal any measures or fees imposed by the district to the state board within 30 days of the adoption of the measures or fees. The state board, on at least 30 days' notice, shall conduct an independent hearing on the validity of the measures or reasonableness of the fees which are the subject of the appeal. The decision of the state board shall be in writing and shall be served on both the district and the city. Pending a decision by the state board, the city shall not be required to comply with any measures which have been appealed. Either the district or the city may bring a judicial action to challenge a decision by the state board under this section. The action shall be brought pursuant to Section 1094.5 of the Code of Civil Procedure and shall be filed within 30 days of service of the decision of the state board.

(c) A violation of any measure imposed by the district pursuant to this section is a violation of an order of the district within the meaning of Sections 41513 and 42402.

(d) The district shall have no authority with respect to the water production, diversion, storage, and conveyance activities of the city except as provided in this section. Nothing in this section exempts a geothermal electric generating plant from permit or other district requirements.

(Added by Stats. 1983, Ch. 608, Sec. 1. Effective September 1, 1983.)

RULE 209-A. Standards for Authorities to Construct

A. General

The Air Pollution Control Officer shall deny an authority to construct for any new stationary source or modification, or any portion thereof, unless:

1. The new source or modification, or applicable portion thereof, complies with the provisions of this rule and all other applicable District rules and regulations and Sections 44300 (et. seq.) of the California Health and Safety Code.

2. The applicant certifies that all other stationary sources in the State which are owned or operated by the applicant are in compliance, or are on approved schedule for compliance, with all applicable emission limitations and standards under the Clean Air Act (42 USC 7401 et. seq.) and all applicable emission limitations and standards which are part of the State Implementation Plan approved by the Environmental Protection Agency.

B. Applicability and Exemptions

1. This rule (excluding Section D) shall apply to all new stationary sources and modifications which are required pursuant to District rules to obtain a permit to construct.

2. Section (D) of this rule shall apply to new stationary sources and modifications which result in either:

   a. A net increase in emissions of 250 or more pounds during any day of any pollutant for which there is a national ambient air quality standard (excluding carbon monoxide and particulate matter), or any precursor of such a pollutant; or

   b. A net increase in carbon monoxide emissions which the Air Pollution Control Officer determines would cause the violation of any national ambient air quality standard for carbon monoxide at the point of maximum ground level impact; or

   c. A net increase in emissions of 250 or more pounds during any day of particulate matter, measured as total suspended particulate from new stationary sources; or

d. A net increase in emissions of 80 or more pounds during any day of particulate matter measured as PM-10 (particulate matter with a nominal aerodynamic diameter less than 10 microns) from a modification to an existing stationary source that has net emissions of 250 pounds or more per day of particulate matter measured as total suspended particulate prior to the modification.

3. Any new stationary source or modification which receives a permit to construct pursuant to this rule and complying with the following two conditions shall be deemed as having met the provisions of Part C of the Clean Air Act, as amended in 1977, and any regulations adopted pursuant to those provisions.

   a. Net emissions increase of all pollutants for which there is a national ambient air quality standard, and all precursors of such pollutants, shall be mitigated (offset) by reduced emissions from existing stationary or nonstationary sources. Emissions reductions shall be sufficient to offset any net emissions increase and shall take effect at the time of, or before, initial operation of the new source, or within 90 days after initial operations of a modification.

   b. The applicant shall demonstrate, to the satisfaction of the Air Pollution Control Officer, that the proposed new source or modification will not have a significant air quality impact on any Class I area in cases where either the Air Pollution Control Officer, the Air Resources Board, or the U. S. Environmental Protection Agency requests such a demonstration at any time during the district's review of the application for an authority to construct or within 30 days of the public notice of the Air Pollution Control Officer's decision on the application.

RULE 400. Ringelmann Chart

A person shall not discharge into the atmosphere from any single source of emission whatsoever, any air contaminant for a period or periods aggregating more than three minutes in any one hour which is:

A. As dark or darker in shade as that designated as No. 1 on the Ringelmann Chart, as published by the United States Bureau of Mines; or

B. Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subsection (A) of this rule.

1. "An observer" is defined as either a human observer or a certified, calibrated, in-stack opacity monitoring system.

RULE 401. Fugitive Dust

A. A person shall take reasonable precautions to prevent visible particulate matter from being airborne, under normal wind conditions, beyond the property from which the emission originates. Reasonable precautions include, but are not limited to:

1. Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;

2. Application of asphalt, oil, water, or suitable chemicals on dirt roads, material stockpiles, and other surfaces which can give rise to airborne dusts;

3. Installation and use of hoods, fans, and fabric filters, to enclose and vent the handling of dusty materials. Adequate contaminant methods shall be employed during such handling operations;

4. Use of water, chemicals, chuting, venting, or other precautions to prevent particulate matter from becoming airborne in handling dusty materials to open stockpiles and mobil equipment; and

5. Maintenance of roadways in a clean condition.

B. This rule shall not apply to emissions discharged through a stack.

RULE 405. Exceptions

Rule 400 does not apply to:

A. Fire set by or permitted by a public officer if such fire is set or permission given in the performance of an official duty of such officer, and such fire, in the opinion of such officer, is necessary:

   1. For the purpose of the prevention of a fire hazard which cannot be abated by other means, or

   2. The instruction of public employees in the methods of fighting fire.

B. Fires set pursuant to a permit on property used for industrial purposes for the purpose of instruction of employees in methods of fighting fire.

C. Agricultural operations necessary in the growing of crops or raising of fowls or animals, or

D. The use of an orchard, field crop, or citrus grove heater which does not produce unconsumed, solid carbonaceous matter at a rate in excess of that allowed by State law.

E. The use of other equipment in agricultural operations necessary in the growing of crops, or raising of fowls, or animals.

PROPOSED RULE 432 and RELATED DEFINITIONS

Proposed Definition - Rule 101.AE:
Best Available Control Measure (BACM) - BACM is the maximum degree of emissions reduction of PM-10 and PM-10 precursors from a source which is determined on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, to be achievable for such facility through application of production processes and available methods, systems, and techniques for control of each such pollutant. (Draft Addendum to the General Preamble for the implementation of Title I, May 1993)

Proposed Definition - Rule 101.AF:
Water Mining Activities - Those activities related to the production, diversion, storage, or conveyance or water which have been developed for export purposes.

Proposed Rule 432 - Owens Lake Dust Control:

A. The City of Los Angeles shall develop and implement a dust control plan to be approved by the Air Pollution Control Officer (APCO) to reduce PM-10 emissions by applying Best Available Control Measures, where their water mining activities cause or contribute to violations of the state or federal ambient air quality standards in the Owens Valley Federal PM-10 non-attainment area. Such measures will include but are not limited to; vegetation based, water based, sand fence based, or other surface protection control measures or means as specified by the APCO.

   1. The development and implementation of the dust control plan may be satisfied by fulfilling the requirements of California Health and Safety Code Section 42316, which requires the City of Los Angeles to undertake measures to mitigate the air quality impact of its water gathering activities.

   2. The dust control plan shall include; a schedule for implementing controls that ensures that the controls will be implemented as expeditiously as practicable, any required environmental documentation, and record keeping requirements to provide evidence of the application of control measures. Records shall be submitted upon request from the APCO, and shall be open for inspection during unscheduled audits.

B. The dust control plan required under District Rule 432.A. shall be submitted to the APCO by July 1, 1996. Upon approval, the City of Los Angeles shall initiate the implementation of dust control measures on the approved schedule. Modifications to elements of the dust control plan may be made if the City of Los Angeles can show to the satisfaction of the APCO that certain requirements of the dust control plan are technically infeasible, or can show such modifications will not delay attainment of the federal air quality standards, or can show such modifications will result in a cost effective and technically superior long-term control strategy.

052694.4

APPENDIX 8 - Typical Industrial Source Permit Conditions

PERMIT TO OPERATE

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 Short St. Suite #6 - Bishop, CA 93514
(619) 872-8211

PERMIT NUMBER 632

Pursuant to the authority granted under the Rules and Regulations for the Great Basin Unified Air Pollution Control District, the

Federal White Aggregates
870-789 West Pender Street
Vancouver, B.C., Canada V6C1AZ

operations and associated equipment and buildings located at:
Dolomite Ghost Town, on Dolomite Loop Road, off Hwy 138, 7 miles southeast of Lone Pine, Inyo County.

is hereby granted a permit to operate as of July 22, 1991.

This Permit to Operate is granted for one year and may be renewed upon payment of the renewal fee on or before the anniversary date above.

EQUIPMENT DESCRIPTION FOR PERMIT: Dolomite Crushing & Screening Plant.

1 - 10 ton ore hopper	n/a	hp
1 - vibrating feeder	n/a	hp
1 - Cedar Rapids jaw crusher	50	hp
2 - conveyors (jaw to screen) 3 hp ea.	6	hp
1 - Overstrom triple deck screen	7 1/2	hp
1 - conveyor (screen to rolls)	3	hp
1 - Columbia rolls crusher	70	hp
1 - conveyor (rolls to jaw)	3	hp
2 - belt conveyors @ 5 hp ea.	10	hp
2 - coarse ore storage bins	n/a	hp
2 - Union Special sewing machines	1	hp
1 - sacking bin & sacker	n/a	hp
2 - conveyors (Overstrom to Sweco) 3 hp ea	6	hp
1 - Sweco triple deck screen	3	hp
2 - valve packers 3 hp ea	6	hp

CONTROL SYSTEM:

1 - Water truck controls pit and haul road fugitive dust emissions.

PERMIT CONDITIONS: See the attached conditional approval.

Ellen Hardebeck
AIR POLLUTION CONTROL OFFICER

Date: July 22, 1991

s Permit does not authorize the above permittee to violate any of Rules and Regulations of the Great Basin Unified Air Pollution ntrol District or Division 20, Chapter 2, Article 3, of the Health Safety Code of the State of California.

Conditional Approval for Permit to Operate No. 632

Federal White Aggregates
870-789 West Pender Street
Vancouver, B.C., Canada V6C1AZ

Located at:
Dolomite Ghost Town, on Dolomite Loop Road,
off Hwy 138, 7 miles southeast of Lone Pine

PERMIT CONDITIONS:

1. The District will be notified 48 hours prior to equipment start up and 48 hours prior to commencing seasonal start up by calling (619) 872-8211.

2. Federal White Aggregates is responsible for dust control from commencement of this project to final completion and is also responsible for insuring that subcontractor(s), employees, and all other persons connected with the project abide by the conditions of this permit.

3. The hourly input feed rate shall be limited to 10 tons per hour and is restricted to processing no more than 240 tons of dolomite aggregate per day. Daily production records shall be kept on site and made available to the District staff upon request.

4. Within 90 days after placing the crushing plant into operation, the applicant shall offset all increased emissions by dismantling the equipment covered under former Permits to Operate No. 521 (crushing plant # 2), and No. 487 (aggregate wash plant).

5. To prevent violations of District Rule(s) 400, 401 and 402, Federal White Aggregates shall have at a minimum one (1) watering truck available full time to apply water to areas in and around the plant. The applicant will give particular attention to controlling dust from:
   a. unimproved access roads used for entrances to or exit from the material pit.
   b. areas in and around the open quarry, and aggregate crushing plant.
   c. dirt and mud carried on and deposited on adjacent improved streets and roads, and these streets are maintained in a clean manner.
   d. the materials pit, and ore storage pile fugitive emissions when needed to maintain fugitive dust emissions below a Ringelmann 1 (20% opacity).
   e. all dust emissions, and that any dust emission is kept below a Ringelmann 1 (20% opacity).

6. Federal White Aggregates shall post and observe a 15 mph speed limit at the project. During normal daily activity, Federal White Aggregates, their contractor(s), and employees will observe this speed limit. The speed limit will be strictly enforced by the applicant. (Authority cited rules 402 & 210).

7. If wind conditions are such that the applicant cannot control dust, Federal White Aggregates shall shut down all operations (except for equipment used for dust control). Under no circumstance will wind generated dust be allowed to blow across a property boundary.

8. The height of all aggregate storage piles and its conveyor drop distance shall be kept to a minimum. Aggregate storage pile height shall not be allowed to exceed a 20 foot maximum height. If District Rule(s) 400, 401 or 402 are violated, water shall be applied to the storage piles as necessary to minimize fugitive dust emissions cause by high winds.

APPENDIX 9 - Owens Lake Advisory Group Members

APPENDIX 9 - OWENS LAKE ADVISORY GROUP MEMBERS

AEROVIRONMENT, INC.
ATTN: STEVE PETERSON
53 SANTA FELICIA DRIVE
SANTA BARBARA, CA 93117

ARB / ATTN: DEAN SAITO
1102 Q STREET
TECHNICAL SUPPORT DIV.
SACRAMENTO, CA 95812
916 322-8269

AIR RESOURCES BOARD
ATTN: KARLYN BLACK
2020 L STREET
EXECUTIVE OFFICE
SACRAMENTO, CA 95814

AIR SCIENCES, INC.*
ATTN: ROGER STEEN
12596 W. BAYAUD AVENUE
LAKEWOOD, CO 80228

CALIFORNIA STATE SENATE
THE HONORABLE DON ROGERS
P.O. BOX 942848, RM 5052
SACRAMENTO, CA 94248-0001

NAVAL AIR WEAPONS STATION (C0808)*
ATTN: BRENDA MOHN
1 ADMINISTRATIVE CIRCLE
CHINA LAKE, CA 93555-6001

OWENS VLY MOSQUITO ABATEMENT DIST.
ATTN: STEVEN FREDERICKSON
207 W. SOUTH STREET
BISHOP, CA 93514

SOIL CONSERVATION SERVICE
ATTN: MAXINE LEVIN
USDA / 2121-C STE 102
DAVIS, CA 95616
916 757-8206

SOUTHERN CALIFORNIA EDISON COMPANY
ATTN: ROB FARBER
374 LAGOON STREET
BISHOP, CA 93514

STATE LANDS COMMISSION
ATTN: AL WILLARD
200 OCEANGATE, 12TH FLR
LONG BEACH, CA 90802
213 590-5201

STATE LANDS COMMISSION
ATTN: ARTHUR NITSCHE
200 OCEANGATE, 12th FLR
LONG BEACH, CA 90802
213 590-5201

APPENDIX 9 - OWENS LAKE ADVISORY GROUP MEMBERS

KEITH BRIGHT
P.O. DRAWER V
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CAT BROWN
U.S. FISH & WILDLIFE SERVICE
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VENTURA, CA 93003

HOY BUELL
GREENHART FARMS, INC.
P.O. BOX 1510
ARROYO GRANDE, CA 93421-6510

THOMAS CAHILL*
CROCKER NUCLEAR LAB.
AIR QUALITY GROUP
UNIVERSITY OF CALIFORNIA
DAVIS, CA 95616

GREG CHO
UNIVERSITY OF CALIFORNIA
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THE NEWS REVIEW
109 N. SANDERS
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816 753-7600

BILL COX
GREAT BASIN UNIFIED APCD

RANDY DAHLGREN*
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APPENDIX 9 - OWENS LAKE ADVISORY GROUP MEMBERS

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619 872-1168

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GREAT BASIN UNIFIED APCD

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BRAD HICKS
LAHONTAN WATER QUALITY CONTROL BRD
15428 CIVIC DRIVE
VICTORVILLE, CA 92392-2359

ROBERT HIGHT
STATE LANDS COMMISSION
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REGINALD HILL
WAVE PROPOGATION LAB, R/E/WP
NAT'L OCEANIC/ATMOSPHERIC ADMIN 325 BROADWAY
BOULDER, CO 80303

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CALIF DEPT OF FISH & GAME
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MYKLE LOFTUS
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RIDGECREST, CA 93555
619 371-4417

RICHARD LOPEZ
KEELER COMMUNITY SERVICE DISTRICT
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9. Federal White Aggregates shall pursue and explore potential buyers for the reject waste collected by the baghouse. Any progress towards finding a market for this waste material shall be reported to the District. Until a market is established, the applicant shall take every reasonable precaution necessary to prevent this waste material from becoming airborne and prevent the transport of dust or dirt beyond the property boundary by continuously stabilizing and controlling the material. Reasonable available dust control measures may include, but need not be limited to: covering the waste material with 4 inches of overburden material, or rocks, sealing, re-vegetation, or by paving. On a temporary basis, the fine waste dust may be controlled by use of a resinous or petroleum based dust suppression agent, or otherwise stabilizing the spoils with a chemical surfactant, or latex binder. This control operation shall be performed before the close of business each operating day or at least once a day when the plant is in continual operation. Since waste crankcase oil is a hazardous waste it will not be considered or used as a dust suppression agent.

10. In the quarry, core and blast holes shall be properly drilled, using water injection, cyclone collection, or other approved methods to decrease the amount of dust created to below a Ringelmann 1 (20% opacity). During blasting, the generation of fugitive dust shall be reduced by minimizing the amount of explosives used and by preventing overshot. No blasting shall take place during periods of high winds where the wind velocity is high enough to carry dust or dirt cross a property boundary.

11. Federal White Aggregates shall keep the active quarry as small as possible. Once any portion of the quarry is exhausted of useful material, the applicant shall immediately begin reclamation of the disturbed surface. Federal White Aggregates shall not allow any abandoned portion of the quarry to remain subject to wind erosion for a period in excess of six (6) months without applying all reasonably available dust control measures necessary to prevent the transport of dust or dirt beyond the property boundary. Reasonable available control measures may include, but need not be limited to: sealing, re-vegetation, paving, or otherwise stabilizing the soil surfaces with chemical surfactants, or latex binders.

12. At the termination of mining, and prior to abandoning the site, Federal White Aggregates shall apply reasonable available control measures to prevent fugitive dust emissions from being emitted after the quarry is closed. The applicant shall comply with the mitigation measures specified by the Inyo County Planning Commission's Conditional Use Permit #88-3 dated November 17, 1988 and by the mitigation measures outlined in Reclamation Plan #88-1.

13. The provisions of this permit may be modified by the District if it determines the stipulated controls are inadequate, or if District Rule(s) 400, 401, or 402 are violated. If requested by the Air Pollution Control Officer, Federal White Aggregates shall within thirty (30) days submit a written plan to the District describing how the dust emissions will be controlled and maintained below a Ringelmann I (20% opacity). The Air Pollution Control Officer will approve or modify the plan. Federal White Aggregates shall implement the plan immediately following the APCO's approval.

14. Federal White Aggregates shall promptly notify the District in writing should they learn of or encounter conditions where toxic air emissions of concern are emitted and allowed to disperse into the ambient air. Toxic air emissions are those listed on the AB2588 list of substances as required by the California Health & Safety Code Section 44321.