The seismic investigation will be conducted on the lake bed and will require vehicular travel over much of the northeastern and southeastern portions of the lake bed. Travel `ll probably be conducted by 4WD pickup trucks and ATV's. The fie_d work for the project will be composed of setting up lines of small geophones in an array away from a central charge. The charge will probably consist of a small explosion of dynamite buried a few feet under the lake bed surface. The detonation of the dynamite should not generate any significant above ground noise or crater in the ground surface.

The TEM survey will be conducted along the shore line and alluvial fans adjacent to the southeastern side of the lake and along the northwestern shoreline of the lake. Vehicular travel during the survey will be conducted by 4WD pickup trucks and ATV's off the lake bed. The survey areas do not include the habitat area for the dune weevil. The field work for this survey will consist of setting up transmitter loops to induce a transient electromagnetic field into the earth. The electromagnetic field generated during data collection should not harm any plant or animal life in the survey area.

Component 5-Surface Water Investigation

The numerous seeps and springs along the shore of Owens Lake provide a perennial, though variable, source of surface water. Any bioremediation plan must make provisions both for the presence of this water and for the protection of the ecological value of the environments it creates. There are also ephemeral water sources such as storm runoff from the surrounding mountains and diversions from the Los Angeles aqueduct down the Owens River. Flash floods entering the Lake bed appear to be one of the primary mechanisms for distributing salts and sediments onto the Lake bed. The halo of salts near the Lake bed margins created from evaporation of waters from the marginal seeps and springs is easily dissolved and transported out onto the bed of the Lake by these flash flood events.

Long term studies focusing on the areal extent, chemistry and sources of water entering Owens Lake have been designed in conjunction with the Desert Research Institute. Information from this component will be used to conduct a preliminary storm water hydrology study to identify potential quantities and routes of storm water flows. A combination of aerial photography and field investigations will be used for this component. The field investigations would consist primarily of taking water samples from the various streams and gullies entering the Lake bed. These samples will chemically analyzed and correlated with field notes describing the site where the sample was taken.

Component 6-Vegetation Research

Vegetation has been an accepted means for stabilizing soils to prevent wind erosion in many locations, and this methodology may play a role in the bioremediation of Owens Lake dust releases. The potential for vegetation in this application is unknown because the effects of the limiting factors presented by the harsh Lake bed environment on plants are largely unquantified. Known limiting factors for plant growth include the presence of salts, toxic ions, flooding, evaporative stress and sand blast damage to leaves and bark. Previous studies, which involved attempts to grow plants on the Lake bed, did not quantify these limitations.

This component is divided into two studies. The first study includes a field reconnaissance of the existing conditions on and off the dry Lake bed and studies of the mineral concentrations in the tissue of naturally occurring candidate species of plants growing on or near the Lake bed environment. There will be minimal collection of plant material. If there is available water near the plants sampled, then Ph, salinity and ionic contents of the water will be determined. The second study will determine the tolerance of candidate species to salinity, toxic ions, flooding and simulated sand blast treatments under greenhouse conditions. These studies will be done by staff of the University of California, Davis, under the leadership of Dr.s Dahlgren and Richards, working under the review of GBUAPCD staff.

Component 7-Aeolian Transport Study

While it is known that large amounts of material are transported across and off Owens Lake during high wind events, the actual amount of movement has never been adequately studied. Soil erosion and deposition play important roles in the identification of areas suitable for the testing and deployment of any proposed dust bioremediation measures. An understanding of the source areas for sand, dust and salt, as well as the natural depositional and erosional processes is needed to properly design and orient bioremediation measures that capture sand, such as sand fences.

This component will determine the extent and amount of materials transported, eroded, and deposited by aeolian process during high winds at Owens Lake. It will be split into two parts. The first part will focus on quantifying the areal extent and amounts of deposition and erosion, as well as the flux of particle migration on and adjacent to the Lake bed. This part of the component will consist of transects oriented perpendicular to the prevailing wind directions which will be instrumented with sand transport catchers, dust deposition pans and small sections of sand fences for sand impoundment measurements. The second part will focus on addressing the impact of dust plumes originating from the Owens Dry Lake bed on areas south of the Lake into the Indian Wells Valley. Standard EPA methods for measuring PM_{10} will be used to determine the potential human health impacts in relation to the air quality standards.

Component 8-Physical Characterization of the Lake Bed

This component is a continuing effort to map and characterize the soils and surface conditions on the Lake bed. The Owens Lake Data Base and Physical Characteristics Mapping Project of 1991-1992 is adding significantly to the knowledge of soils on the Lake bed and created a detailed topographic base map of the Lake bed and surrounding area. This knowledge is still incomplete. A general knowledge of the location of dust sources, Lake bed features, geomorphology, soil type distribution, extent of wetlands and Lake bed gradients is now available. Much of this data has, however, been gathered on a coarse scale, and has not been accurately mapped.

This component will map, at a detailed level, dust source areas, man-made and natural geomorphology, wetland features and Lake bed gradients. The data points will be more closely spaced than in previous work. Mapping will be done using a Global Positioning System (GPS) so that data can be directly entered into the GBUAPCD and SLC geographic information systems. Additionally, this component will utilize 50 historic satellite images from the 1970's and 1980's to investigate the spatial variation of certain features on the Lake bed over time and images in 1992.

Component 9-Pre-Bioremediation Engineering Studies

The identification of engineering restraints is important to the selection of final bioremediation measures. If a selected bioremediation cannot be constructed due to conditions at a specific site that can't be overcome with engineering design, that bioremediation cannot be used at that site.

This component will address Lake bed access, drainage and leaching designs and irrigation methods. Lake bed access has presented problems in all tests done to date on the Lake bed and will likely be a major issue in future tests and final bioremediation implementation. It is critical to have good access under varying conditions to all areas of the Lake being tested or being used as a bioremediation site. Similarly, if a water based bioremediation is incorporated in the final bioremediation plan, it is important to identify the best method and frequency of water application to produce the result required with the least possible amount of water applied. In certain areas of the Lake bed, leaching and drainage of Lake bed soils may be desired to prevent salt build up in the root zones of vegetated areas. Engineers from the University of California, Davis, will work on this component with staff of GBUAPCD. Most of this work will be done in the office, with some leaching tests being performed on the Lake bed. These tests would be done on areas already having access, and would cover less than 100 square meters.

Potential Impacts and Mitigations Incorporated Into the Program

For components 1,2,3 and 7 travel will include construction crews, maintenance over the life of the pilot, and investigators evaluating the results from each site. For components 4,5,6 and 8 only the investigative aspects involve traffic in the project area. The traffic will consist of small numbers of four-wheel drive vehicles and small groups of people on foot. Construction, maintenance and research personnel will be instructed to avoid any direct disturbance to wildlife, including the Tule elk and water birds, encountered while in the field.

Damage to the Lake margin habitats will be minimized by using only existing roads and trails which lead to the Lake bed. Access for each project component will be surveyed in advance by a qualified biologist for sensitive plant and animal species and routes will be selected which avoid disturbance of sensitive plants, animals and habitats. The survey process will consist of walking the area of the proposed access routes and determining the presence of sensitive species and estimating their probable or actual use of that area.

The pipeline for the south test area in Component 1 may cross some vegetated areas. However, no significant impacts to vegetation is expected. The pipeline will be placed on the ground surface and access will be kept to the minimum necessary. A biologist will survey the south pipeline route for Component 1 in advance to avoid the possibility of impacts to vegetation, including sensitive plant species,. A route which is the least damaging to vegetation and which avoids any sensitive plant species will be selected for the pipeline. Construction and maintenance crews will be instructed to use designated access routes and minimize any vegetation disturbance.

All moist alkaline grassland areas which could be affected by any construction, access roads, piezometer placement, or other maintenance or investigative procedure will be surveyed in advance by a biologist to avoid potential impacts to alkaline meadow sensitive plants or the Owens Valley California Vole. The alkaline meadow areas of the Owens Lake bed have been significantly trampled by cattle. This habitat destruction minimizes the likelihood that Owens Valley Voles are present. As noted above, the entire pipeline route for the southern test site will be surveyed. Impacts to any moist grassland vegetation will be minimized and impacts to any sensitive species will be avoided by the selection of the least sensitive right of way for the pipeline. Prior to placing the pipeline or locating any test equipment in grassy areas, a biologist will examine the area for signs of vole burrow or runway activity. If any areas of meaningful or viable vole population size are discovered, they will be avoided, thus eliminating the potential for any significant adverse impact.

A potential impact from the proposed projects is the possible disturbance of nesting Western Snowy Plovers, a California Species of Special Concern. The male Plovers begin arriving in March, and start to establish breeding territories. If forced to move, they may abandon breeding for that season. The young have become independent enough to leave the nesting site by mid-to late September. Because this period is also when the Lake bed surface is most stable, it is not possible to avoid construction for the whole 7 month breeding season. Observations by staff trained in recognition of the Plover nesting sites have found them on all parts of the Lake at one time or another, so it is also impossible to completely avoid habitat areas.

Any particular line of access to a project would have only limited potential to intersect a nest site since Snowy Plover nests are typically widely and sparsely distributed over a large area. During previous work done by the GBUAPCD, trained survey staff marked out routes free of Plover nesting sites for the major routes to and from the project sites. This mitigation, to be carried out by a trained biologist, is incorporated into this pilot program as well. This circumstance will greatly reduce the impact of the program on the Plovers. Staff of the GBUAPCD have been trained in Western Snowy Plover identification and identification of nesting sites by recognized Snowy Plover expert Gary Page of the Point Reyes Bird Observatory.

Construction, maintenance, and research crews working along the individual pilot transects, dune fences and pipelines will be briefed on the Plover's presence and habits. Disturbance of Plover behavior and habitat, in particular, nesting sites, will be avoided as much as possible. All active nests discovered in the course of this project will be reported to the CDFG. Destruction of any active nests will be avoided, pusuant to § 3505 of the Fish and Game Code.

Over the course of the three years that components of the program will be in operation, it is anticipated that some minor impacts may affect the resident Plovers, primarily due to the disturbance of a few nesting individuals. This impact is not considered significant, due to the small numbers effected and the large area of the Lake which can remain unaffected.

Environmental Setting

The proposed program area is the dry Lake bed of Owens Lake. Owens Lake is an alkaline dry Lake, or playa, in the southern end of Inyo County on the eastern side of the Sierra Nevada mountain range. The elevation of the Lake bed is approximately 3,551 feet above sea level. The Lake bed extends about 17 miles north and south and 10 miles east and west and covers an area of approximately 108,000 acres. The current Lake bed surface consists of eight different playa environments: salt pan, salt crust, mudflat, sand flat, dunes, delta deposits, beach deposits and spring mounds.

Saint-Amand (1986), and references cited therein, provide evidence that a lake or a series of lakes existed in the proto-Owens Valley from at least the early Pleistocene, about 1.8 million years ago. During much of this time frame, the water in the lake flowed out of the basin through Rose Valley and into China Lake. Although it is thought by many that Owens Lake probably dried up several times during the Pleistocene, two deep cores on the lake bed (U.S.G.S. and Pittsburgh Plate Glass Co.) have failed to identify any previous episodes of desiccation. The high stand of the lake that produced the shorelines at an elevation of 3,880 ft. is estimated to have occurred 15,000-16,000 years ago. It is believed that from this date to the present that Owens Lake has been a continuously closed basin.

There was considerable agriculture in the Owens Valley, but the Lake was originally a focus for mining interests. Silver mines on the east shore led to steam navigation on the Lake, and attempts to recover valuable salts from the Lake itself began in 1884. Sodium carbonate (Trona) mining began to provide a major raw material for glass manufacturing.

In 1917, the City of Los Angeles completed a fresh water aqueduct system that diverted the water of the Owens River south to the City. With its primary water supply gone, Owens Lake was virtually dry by 1925.

Air Quality

Normally, air quality in the Owens Valley is excellent. However, the region does experience periods of strong winds that result in blowing sand and dust. Such episodes contribute to visibility degradation and an overall reduction in air quality from suspended particulate matter over a wide region.

The 1988 Owens Valley PM_{10} Planning Area State Implementation Plan and its associated Long Range Dust Bioremediation Plan describe the impetus behind the development of dust bioremediation efforts on the Owens Lake bed. The SIP identifies that the violations of the Federal and State PM_{10} standards in the southern Owens Valley are primarily the result of dust storms arising from the dry bed of Owens Lake. These dust storms produce significant reductions in the air quality downwind of the Lake and create conditions which exceed the significant harm to health levels set by the EPA.

Geology

Owens Valley is a fault-bounded basin, between the upraised blocks of the Sierra Nevada and Inyo Mountains. The Lake bed itself is made up of Holocene alluvium and lacustrine deposits. The project area is within a seismically active region. Significant earthquakes have been recorded from 1872 to the present. Historic earthquakes have had epicenters on the Owens Lake Fault, the Sierra Nevada Fault, and several unnamed faults on the east side of the Lake bed. Estimates of magnitude range from 4.0 to 6.5 on the Richter scale. The Lake deposits may liquify under strong seismic shaking.

Soils

Soils on the Owens Lake bed are moist within one to six inches of the surface throughout the year. Salt crusts develop on the Lake bed surface in varying thicknesses and textures from season to season. When wind speeds exceed the soil erosion threshold, dust emissions rise from the dried and damaged surface soils.

As shown in Figure 7, eight different playa surfaces have been identified in earlier investigations by the Desert Research Institute. These are, in order of descending size, salt pan, salt crust, mudflat, sand flat, dunes, delta deposits, beach ridges and spring mounds. The salt pan in the center of the Lake bed is the largest single area. Salt crusts are interspersed along the perimeter of the salt pan with the largest crust areas existing at the eastern side between Keeler and Olancha. Mudflats and sand flats make up the remainder of the eastern and southern portions of the Lake bed while a large delta deposit is interspersed with smaller salt crust areas along the northern end of the bed. Beach ridges exist between salt crusts along the western shore.

The salt crust undergoes an annual cycle in terms of both hardness and adhesion. Typically during the summer months, the surface rind is hard, while the near-surface sublayer remains soft above a very hard compacted layer. At these times, the hardness of the base layer allows four-wheel drive vehicles to traverse the Lake bed on a line from Keeler to Olancha with little difficulty except in a few softer areas where surface drainage from shoreline springs weakens the sublayer. Where the rind is direct contact with the sublayer, it forms flat plates of hydroscopic crystals.

A noticeable change in the salt crust occurs in early winter as a result of a combination of cooler temperatures and precipitation. The first rain of the winter season creates a rapid series of changes in crust morphology. Water leaches salts from the surface layers, which form a rind with a mulch-like texture. The clays left behind are saturated with water and become slippery, but remain very cohesive. During this period, traversing the surface by truck becomes almost impossible due to a lack of traction and frictional drag.

During the Spring, the surface dries rapidly and becomes a

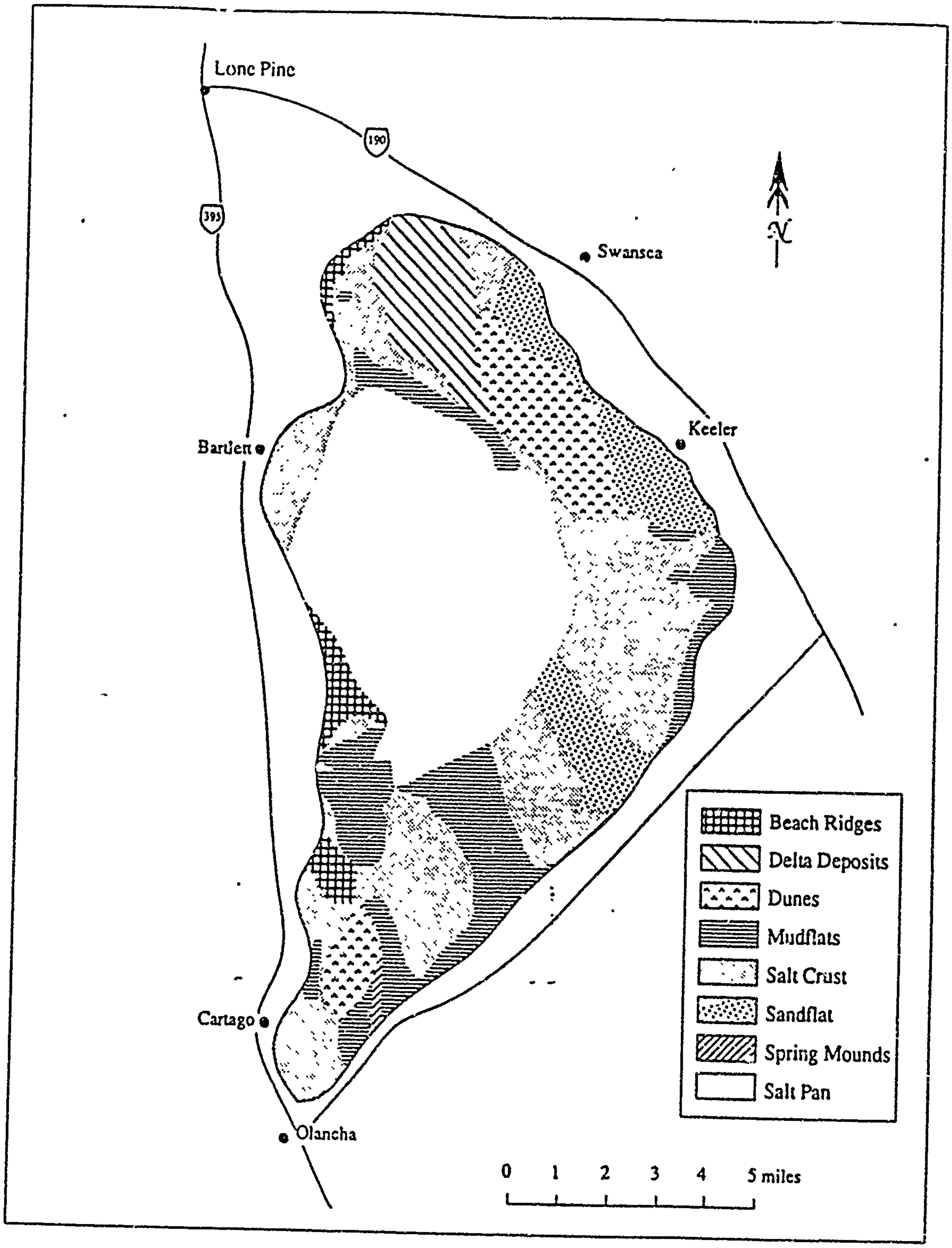

FIGURE 7 Sketch of the lakebed surface showing eight different playa environments identified in the Phase I investigation.

wick for the salts that were dissolved by the rains. Capillary action brings the salt back to the surface. At this point, the semi-soft rind undergoes a buckling action as it forms numerous irregular knobs that are soon covered with a white bicarbonate salt powder resembling thousands of soft small heads of cauliflower. The thin rind separates from the sublayer except along irregular support points. There are lumps in the rind layer due to differences in salt hydration and dehydration between the rind and the loose sublayer. With the onset of warmer temperatures and the end of the rainy season, the sublayer surface under the rind dries and a fine powdery aggregate layer forms at the surface; its appearance is often mistaken for snow by passing summer season traffic along the highway.

The on-Lake sand fields represent a second source for airborne dust. Sand fields are defined, for this study, as areas with a depth of sand greater than one-quarter inch. The largest sand fields exist along the Lake bed perimeter northwest of Keeler. Many smaller fields are scattered along the eastern side of the Lake bed, and some large, mobile dunes have formed in the east-central part of the bed. These fields both provide a source of emissions and a source of sand that can damage the salt crusts and increase the emissions from those areas as well.

<u>Climate</u>

Weather in California is a continuous series of interactions between maritime air masses and those of continental origin. The Owens Valley and Lake are well protected from the maritime influences by the masses of the Sierra Nevada, and so experience a much more continental climate pattern. This climate is characterized by warmer summers, colder winters, greater daily and seasonal variation in temperatures and generally lower relative humidities than maritime climates.

According to the National Weather Service and data gathered by the GBUAPCD, summer temperatures in the valley often exceed 100° F, followed by evenings in the mid-60's to low 70's. Afternoon temperatures in mid-winter are moderate and, on the average, only fail to rise above freezing about 10 days per year. More than half of the area's precipitation, falling largely as a mix of rain and snow, occurs from December to March. Precipitation totals range from 5 to 10 inches per year. Summer rain come mainly as brief thundershowers in the middle to late afternoon. Humidity is low during the summer months and moderately low during the winter months.

The intensity and duration of surface winds over the Owens Lake area, within 300 feet of ground level, are governed by the topography which influences the large-scale synoptic patterns over the Basin and Range provence. This results in the vast majority of surface winds flowing up-valley (predominantly from the south or southeast) or down-valley (north or northwest). Four main wind flow patterns have been observed in the Owens Lake area, two resulting in up-valley flow and two resulting in down-valley flows. Up-valley flows usually stem from storm fronts passing south of the Owens Valley or local heating differentials between the valley floor and the surrounding mountains. Down-valley flows come from channeling of prevailing maritime westerlies or local drainage flows resulting from radiative cooling of the mountains. An important threshold velocity for surface winds is 10 mph. Sand begins to move on the Lake surface at and above this velocity.

Winter weather can occur from November through February. 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 storm front passage. Spring weather (March through June) results in an equal occurrence of up-valley and down-valley patterns. Both patterns have winds greater than 10 mph over 20 percent of the time. The summer pattern (July and August) has up-valley winds predominating, with down-valley winds of greater than 10 mph appearing less than 5 percent of the time. The Fall pattern is weak and is comprised of either a continuation of the summer pattern or an early beginning of winter.

The typical daily pattern of wind movement is a down-valley movement at night and in the morning, and up-valley flow in the evening. The drainage effect, one of the conditions of down-valley winds, is stronger in the winter, while the upslope effect, which produces up-valley flows, is stronger in the summer, particularly in the afternoon. Beginning in June, the up-valley flow begins to be established earlier in the morning which accounts for higher proportions 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. While strong west winds do occur occasionally in the area, the more frequent direction of strong winds is northwesterly. The peak gust experienced annually in the area is usually between 65 mph and 75 mph.

Water

Owens Lake lies within a hydrologically closed basin. It is located between the Sierra Nevada range on the west and the Inyo and Coso Mountains on the east. Elevations range from 3,551 feet on the Lake bed to 14,495 feet at Mount Whitney. The Lake bed has been dry since the mid-1920's. The basin is bounded by the basement rock complex-valley fill contact on the east and west and the divides for surface flow on the north and south.

Water inflow to the Owens Lake basin comes from four sources: 1) precipitation; 2) the Owens River; 3) intermittent mountain runoff; and 4) subsurface flow from outside the basin.

Owens Lake is within the "rain shadow" of the Sierra Nevada range immediately to the west. Precipitation along the eastern slopes of this range decreases sharply along with elevation. The annual rainfall along the Sierra crest is over 22 inches per year, while Keeler, on the east side of the Owens Lake, receives less than 4 inches on average. Precipitation still provides, nonetheless, the largest component of water inflow into the basin. An average of 75,000 acre-feet falls on Owens Lake and the surrounding valley fill deposits.

The Owens River carries an estimated base flow of approximately 3,000 acre-feet of water annually to Owens Lake. During high runoff years, water is released from the Aqueduct System into the lower Owens River for operational purposes. The mean annual inflow to the Lake at the Keeler Bridge for the period 1940 to 1980 is 10,700 acre-feet.

Runoff from the surrounding mountains is the second largest component of inflow to the area. Significant recharge of the groundwater basin occurs when the creeks pass over the highly permeable alluvial material surrounding the Lake. Approximately 45 percent of the base of mountain flow infiltrates the groundwater basin by the time the flow reaches the aqueduct. Occasional flash floods reach the Lake through numerous intermittent stream channels. An estimated 40,000 acre-feet recharges the Owens Lake Basin groundwater system annually.

Subsurface inflow to the groundwater system occurs from Centennial Flat, the intermediate mountain recharge area and the upper Owens Valley. An estimate of the average subsurface inflow to the basin is 18,800 acre-feet per year.

Owens Lake is located at the lowest point within the basin and groundwater entering the area as subsurface flow and percolating runoff generally flow towards the Lake. Several well defined aquifers exist below Owens Lake. The aquifers consist of coarse sand and gravel separated by layers of clay. Water naturally escapes the groundwater basin as spring flow or evaporation of confined water leaking upward.

Several springs exist along the margins of the Lake bed, some flowing intermittently and others permanently. These have been poorly mapped and their flows are not documented. Those with stronger or more lasting flows have generated wetland areas along the old Lake shore. These areas support some salt-resistent plants and related wildlife.

A large confined aquifer system about 250-300 feet deep exists on the eastern side of Owens Lake. Several artesian wells near the eastern shore of the Lake tap into this aquifer and flow at approximately 300-600 gpm. These wells are sometimes called "springs" and provide the source of the ponds in the interior of the Lake bed. Some plants have established themselves near the water and algal mats have formed in most of the ponds. This aquifer is most likely recharged by runoff from the Inyo Mountains. The western extent of this aquifer is unknown, but it appears to extend southerly beneath the eastern portion of Owens Lake.

Biology

The descriptions of the biological setting in this section are derived from limited site visits by SLC staff, review of aerial photos and maps on file at the SLC, and various environmental documents and reports done for previous projects at Owens Lake. These studies, listed below, were based on results of both field work and literature reviews.

Great Basin Unified Air Pollution Control District. 1988. State Implementation Plan for Owens Valley PN-10 Planning Area and Negative Declaration, SCH. No. 88110703.

California State Lands Commission. 1977. Lake Minerals Corporation Proposed Salt Harvesting Operations at Owens Lake Negative Declaration, SCH. No. 77040473.

Los Angeles Department of Water and Power. 1990. Unpublished vegetation survey done for GBUAPCD dust mitigation studies, Southern Test Site.

Other information sources are cited in the text.

The Owens Lake area is considered essentially an ecotone between the northern Mojave Desert and the Great Basin Desert. This implies that one might find plant or animal species from either or both regions within the project area. However, the Owens Lake area has the dry, hot summers characteristic of the Mojave, but the elevations provide the colder winters of the Great Basin, and this tends to limit species one might otherwise expect to find. The high salinities and absence of vegetation limits many other species.

Vegetation

The vegetation in the project vicinity was characterized by the GBUAPCD in a Negative Declaration prepared in 1988. In this document, Groeneveld describes three plant communities (assemblages) on the margins of, and onto, the Lake surface. The vegetation classification is based primarily on hydrology and geochemistry. In increasing order of drought and salt tolerance, the communities identified are: 1) emergent aquatic vegetation; 2) phreatophytic vegetation (plants which tap ground water); and 3) desert fan/Lake margin vegetation.

Emergent aquatic vegetation, while uncommon at Owens Lake, is dominated by plants which grow in relatively fresh water. In the project area, this vegetation occurs only around the springs located on the Lake margins. Species typical for this community include bulrushes (Scirpus sp.) and cattail (Typha sp.). Less frequently, floating plants such as duckweed (Lemna sp.) or water fern (Azolla sp.) can also be found. The springs and wells further on to the Lake bed do not support this group of plants because the dissolved salt level is too high. Mapping coverage for this group is good and the probability of discovering previously unknown locations around the Lake bed is low.

Phreatophytic vegetation is dominated by plants which require shallow groundwater, but have a higher tolerance for drought and soil salts than do the freshwater plants described above. This community is often dominated by alkaline meadow grasses such as alkali sacaton (Sporobolus airoides), saltgrass (Distichlis spicata var. stricta), and rabbitfoot grass (Polypogon monspelliensis). Other plants found in association with these grasses include wire rush (Juncus balticus), the herb yerba mansa (Anemopsis californicum) and the wild sunflower (Helianthus annuus var. jaegeri). Around the margins of the interior springs the dominant shrubs are rabbitbush (Chrysothamnus nauseosus var. viridulus) and greasewood (Sarcobatus vermiculatus).

The last community, desert fan/Lake margin vegetation, includes those plants which do not require groundwater, existing on precipitation water alone. They also have a fairly high tolerance to the dissolved salts which have become enriched in the local soils. The dominant perennials in this group are the shrubs cheesebush (Hymenochlea salsola), shadscale (Atriplex confertifolia), spiny sagebrush (Artemisia spinescens), desert tomato (Lycium sp.) and spiny horsebush (Tetradymia axilaris). Parry's saltbush (Atriplex parryi) and desert holly (Atriplex hymenelystra) is common on the southeastern margins of the Lake.

These three communities exist almost exclusively on the margins of the old Lake, with very little colonization of the Lake bed interior. The third community, desert fan, occupies the majority of the margins, occupying the fans encroaching on the Lake from the surrounding mountains which are very well drained and above the areas of shallow groundwater. The first two communities exist where soil wetness, fine soil texture and low soil oxygen preclude upland plants of the third community and foster the growth of wetland species. The amount and salinity of the water available determine which of the first two communities predominate at a given site. The boundary lines between communities can fluctuate over time as the groundwater level goes up or down, or, on a shorter scale, during exceptionally wet or dry years.

Vegetation is almost absent on the surface of the Lake bed itself. Occasional colonists venture onto the surface in wetter years, but are almost universally killed by lack of water or sand blasting. Earlier experiments have shown that plants can establish themselves on the playa soils, but need varying degrees of supplemental water and/or sand protection for long -term survival.

Project Component 1 involves flooding lands at two sites on the Lake bed, one in the northeast near Swansea and one in the southeast about five miles south of Keeler. The water for these sites will be delivered by above-ground pipelines. The north site pipeline will come from a well near the Owens River Delta. The southern pipeline will come from the Mill Well in Section 15, T17S R38E, south of Keeler. The north area to be flooded and traversed by the pipeline is presently devoid of vegetation. The southern test site has little or no vegetation, but the pipeline feeding it may cross areas of alkaline meadow or drier salt-tolerant scrub vegetation as noted above. Most of this vegetation, particularly alkaline meadow, has been previously degraded or destroyed by cattle grazing.

The species that dominate the three communities around Owens Lake are found throughout the Owens Valley, the Northern Mojave Desert and the Western Great Basin. Although they may be infrequent around the saline environments of Owens Lake, none of the species found in the communities are unique in the region.

Sensitive Plants

From a review of records (12/01/91) in the Natural Diversity Data Base (NDDB) of the California Department of Fish and Game, three sensitive plant species have been identified as potentially occurring with the project area:

1. Owens Valley Checkerbloom (Sidalcea covillei)
   State Endangered; Federal Candidate 2; CNPS List 1B
   Habitat: Moist alkaline meadows & freshwater seeps, fine sandy loam soil (one occurrence in stoney calcareous soil; 3500-5000 ft.

2. Nevada Oryctes (Oryctes nevadensis)
   Federal Candidate 2; CNPS List 2
   Habitat: Chenopod scrub, mojavean desert scrub; dry sites in loose sandy soil in washes and desert foothills in the Owens Valley; 3600-4000 ft.

3. Inyo County Mariposa Lily (Calochortus excavatus)
   Federal Candidate 2; CNPS 1B
   Habitat: Alkaline meadows; mostly fine, sandy loam with alkaline salts; 4000-6400 ft.

Occurrence of these rare plants in areas which would be affected by the proposed project is unlikely. However, the three species may be observed by various of the field investigations, including placement of piezometers in Component 3, or during the placement of the pipeline connecting the Mill Well Site to the southern test site in Component One. Disturbance to the above three species will be avoided.

Wildlife

One habitat that has had insufficient study to date is the ponds and springs around the Lake margin. It is possible that various aquatic species live in these environments, isolated from other similar groups by the prehistoric fall of the Lake level and the more recent desiccation of the Lake bed. The current project will not effect the hydrology of any of these springs, and further environmental work will be done before later expansions of any of the bioremediation measures are implemented.

Amphibians are noticeably absent in the project area, as is to be expected in an area with so little water, and much of the water that does exist being so saline. Surveys done in conjunction with earlier projects have found Great Basin Spadefoot Toads (Scaphipus intermontanus) and Red-spotted Toads (Bufo punctatus) in low densities around some of the fresher marginal springs. No amphibians have been seen around the interior sulphate springs.

As might be expected, reptiles are better represented than the amphibians. Several species of both lizards and snakes are known to inhabit the Owens Valley, and most are at least occasional visitors to the Lake bed. Surveys have not been done for reptiles on the Lake bed or around the margins, but the following may be present according to range maps:

Desert Banded Gecko	Coleonyx variegatus
Mojave Zebra-tailed Lizard	Callisaurus draconoides rhodostictus
Desert Iguana	Dipsosarus dorsalis dorsalis
Long-nosed Leopard Lizard	Gambelia wislizenii wislizenii
Southern Desert Horned Lizard	Phrynosoma platyrhinos calidiarum
Western Chuckwalla	Sauromalus obesus obesus
Northern Sagebrush Lizard	Sceloporus graciosus graciosus
Desert Side-blotched Lizard	Uta stanssburiana stejnegeri
Great Basin Western Whiptail	Cnemidophorus tigris tigris
Western Blind Snake	Leptotyphlops humilis
Desert Rosy Boa	Lichanura trivirgata gracia
Western Shovel-nosed Snake	Chionactis occipitalis
Desert Night Snake	Hypsiglena torquata deserticola
Red Coachwhip	Masticophis flagellum piceus
California Kingsnake	Lampropeltis getulus californiae
Desert Striped Whipsnake	Masticophis taeniatus taeniatus
Western Spotted Leaf-nosed Snake	Phuyllorhynchus decurtatus perkinsi
Great Basin Gopher Snake	Pituophis melanoleucus deserticola
Western Long-nosed Snake	Rhinocheilus lecontei lecontei

Mojave Patch-nosed Snake	Salvadora hexalepis mojavensis
Ground Snake	Sonora semiannulata
Western Black-headed Snake	Tantilla planiceps utahensis
Mojave Desert Sidewinder	Crotalus cerastes cerastes
Panamint Speckled Rattlesnake	Crotalus mitchelli stephensi
Mojave Rattlesnake	Crotalus scutulatus

The most easily observable form of animal life in the project area are birds. The marginal springs, shallow ponds from the interior wells and standing water following rainfall events all support a varied collection of shore and water birds. A few small passerine and ground living birds have also been identified around the Lake margins, but not in the quantities of the wetland birds.

Birds actually seen and identified on the Lake bed or around the margins over the last few years include:

Eared Grebe	Podiceps nigricolis
American White Pelican	Pelecanus erythrorhynchos
Snowy Egret	Egretta thula
Green-winged Teal	Anas carolinensis
Mallard	Anas platyrhynchos
Northern Pintail	Anas acuta
Cinnamon Teal	Anas cyanaoptera
Lesser Scaup	Aythya affinis
Old Squaw	Clangula hyemalis
Ruddy Duck	Oxyura jamaicensis
Turkey Vulture	Cathartes aura
Northern Harrier	Circus cyaneus
Gambel's Quail	Lophortyx gambelii
American Coot	Fulica americana
Western Snowy Plover	Charadrius alexandrinus nivosus
Killdeer	Charadrius vociferus
Black-necked Stilt	Himantopus mexicanus
American Avocet	Recurvirostra americana
Lesser Yellowlegs	Totanus flavipes
Willet	Catoptrophorus semipalmatus
Spotted Sandpiper	Actitis macularia
Western Sandpiper	Calidris mauri
Wilson's Phalarope	Phalaropus tricolor
Red-necked Phalarope	Phalaropus lobatus
California Gull	Larus califonicus
Common Poorwill	Phalaenoptilus nuttallii
Common Raven	Corvus corax
Sage Thrasher	Oreoscoptes montanus
Green-tailed Towhee	Pipilo chlorurus
Black-chinned Sparrow	Spizella atrogularis
Black-throated Sparrow	Amphispeza bilineata
Sage Sparrow	Amphispiza belli
House Finch	Carpodacus mexicanus

Several other sandpiper-type birds pass through the area, as well as other gull, duck, hawk and falcon species which may be occasional visitors.

The bird of most interest in the project area is the Western Snowy Plover (Charadrius alexandrinus nivosus), discussed below, under "Sensitive Animals".

Information on mammals is scanty. One major study rodents and their habitats done by Matson in 1976 around the Lake bed margins found signs of Antelope Ground Squirrels (Ammospermophilus leucurus) and pocket gophers (Thomomys bottae operarius and T. b. perpes) and live-trapped Perognathus longimembris, Peromyscus crinitus, Perognathus formosus, Peromyscus boylii Dipodomys microps, Onychomys torridus, Dipodomys deserti, Neotoma lepida, Mus musculus, Mojave Panamint Kangaroo Rats (Dipodomys panamintinus mohavensis); Merriam's Kangaroo Rats (Dipodomys merriami), Western Harvest Mice (Reithrodontomys megalotis and deer mice (Peromyscus maniculatus). Generally, population densities were low to very low even after some high precipitation years, indicating that the habitat for these species is only marginal.

In a 1990 survey done by a Great Basin biologist for a previous project on the southern and eastern shoreline area, fewer species and lower counts were found. Ammospermophilus leucurus, Dipodomys merriami, Dipodomys panamintius, Perognathus longimembris, Peromyscus maniculatus, and possibly Dipodomys ordii were identified.

Where there are rodents, there are usually predators, and the Lake margins are no exception, although the densities are probably low, due to the small prey population. Coyote (Canis latrans) and Bobcat (Lynx rufus) have been occasionally seen at the northern and eastern portions of the Lake, while Gray Fox (Urocyon cinereoargenteus) and Kit Fox (Vulpes macrotis) have been seen at the southern end of the Lake. Feral cats also prey on the local rodent population. Skunks, badgers, and several types of bats should be present, but are not documented.

Most of the area's mammal species are either cryptic, nocturnal or present only in an area during certain seasons of the year. Thus field surveys must be rigorous to reveal the real numbers and types of animals present at a given site. With only the one survey previously mentioned, and some recent work done in conjunction with previous projects, data are scarce on the local mammal population.

The northern end of the Lake, around the Owens River, is identified by the BLM as an important Tule elk (Cervus elaphus nannodes) calving area. Tule elk also range around the northwest Lake margins, and occasionally can been seen on the Lake bed itself in the area of the Owens River delta.

Sensitive Animals

From current NDDB records and the digitized data base maintained by the Bureau of Land Management for their Bishop Resources Management Plan program, the following sensitive animal species have been identified as potentially being in the project area:

1. Owens dune weevil (*Trigonoscuta owensi*)
   Federal candidate 2
   Habitat: Stabilized sand dunes

2. Owens Pupfish (*Cyprinodon radiosus*)
   State and Federal Endangered
   Habitat: Shallow water habitats in the Owens Valley; warm, clear, shallow water free of exotic fishes; need firm substrate for spawning.

3. Owens Tui Chub (*Gila bicolor snyderi*)
   State and Federal Endangered
   Habitat: Endemic to the Owens River Basin in variety of habitats; need clear, clean water adequate cover, aquatic vegetation.

4. Western Snowy Plover (*Charadrius alexandrinus nivosus*)
   California Species of Special Concern
   Habitat (Interior population): Sandy or gravelly substrate for nesting, near shore of alkaline Lakes.

   *Note - The Pacific Coast population of the Western Snowy Plover is proposed for Federal Threatened status, but this does not apply to the interior population.

5. Owens Valley California Vole (*Microtus californicus vallicola*)
   Federal candidate 2; California Species of Special Concern
   Habitat: Wetlands and lush grassy ground in Owens Valley; needs friable soil for burrowing; clips grass for runways.

The Owens dune weevil is known from several locations in dune areas on the northeastern shore of Owens Lake, near Swansea. These dunes are immediately adjacent to the northern test area of Component One. Other dune areas on the northern shore and around the east side to south of Keeler have been mapped by the BLM as potential habitat for this species.

The Western Snowy Plover is known to nest at Owens Lake. Owens Lake and Mono Lake are the two most important breeding areas for the Plover in California, with Owens Lake having a larger population in surveys done in the 1970's, and Mono Lake having the larger population in surveys done since the mid-1980's. The Plover is a ground-nesting wading bird. It nests on the ground in a shallow scrape, which is well camouflaged by its small size and the light colored birds. Ravens are the most important predators, both of eggs and nestlings. The adults and young feed on brine flies and their larvae.

Male Snowy Plovers begin arriving in March, and start to establish breeding territories. If forced to move, it is likely they will abandon breeding for that season. The young become independent enough to leave the nesting site by mid-to late September. The breeding season coincides with the period when the Lake bed surface is most stable and construction must carried out. Observations by GBUAPCD staff trained in recognition of the Plover nesting sites have found them on all parts of the Lake at one time or another.

The Owens Tui Chub and Owens Pupfish are not known to occur in any of the springs or ponds within Owens Lake, and survive only in a few locations. It is highly unlikely that they would occur within any of the project area, but various springs and ponds in and around the Lake could be considered as potential sites for transplanting these fish in the future.

The Owens Valley California Vole occurs in meadow habitats. It has been identified in pasture lands in the southwest shore zone of the Lake. It is possible that this species could be encountered by some of the field investigations or during the placement of the pipeline connecting the Mill Well Site to the southern test site in Component One.

In addition to the above, there has been a single recorded sighting of the Mohave Ground Squirrel (Spermophilus mohavensis), a State and Federal Endangered Species, for a location near Olancha, south of Owens Lake. This would be a major extension of its range from the Mojave Desert, its currently known distribution. It is extremely unlikely that this species would be encountered by the proposed project.

Noise and Visual Resources

Unbroken vistas and silence, except for the wind, are the natural conditions of the site. The Lake bed is almost perfectly flat, and the only visual relief is provided by a trona mining operation and its associated equipment on the western margins of the Lake bed. The mining operation is also the only source of noise. The potential receptors, however, are the small town of Keeler, approximately 10 miles across the Lake bed to the northeast, and Highway 395, approximately 3 miles to the west.

Light and Glare

The sources of light near the project are natural. None come from the mining operations as they are not conducted at night.

Land Use

The mining operation currently exists on the Lake bed. There is some cattle grazing. The nature of the Lake bed surface will prevent agricultural or developmental uses.

Recreation

The Lake bed provides open space and recreational uses such as hunting, bird watching, etc.

Public Services/Utilities

Electrical power service was provided to the River Wells site by LADWP and will be utilized in the wetlands project. No power currently exists at the Mill Well site. New power lines will have to be run from the lines along Hwy 136 to the well site (approx. ½ mile.

Cultural Resources

There are no historic or prehistoric resources on the Lake bed surface. Native Americans and early settlers did use the Lake shore before the Lake dried up. The margins of the Lake were used extensively by Native Americans, and previous surveys have uncovered many sites with archaeological significance. Owens Lake has been used by man for hunting, boating and food supplies such as brine fly larvae and shellfish. All sites discovered so far are above the 3590 foot contour, just above the late prehistoric shore line. This level can be taken as a threshold, and project components below this line are highly unlikely to encounter sites of significance.

Environmental Impact Assessment Checklist
Discussion of Environmental Evaluation

A. Earth

A1. The project will not result in any unstable earth conditions or changes in geologic substructures. The placing of piezometers in Component 3 will include very shallow test holes, but will not include any major excavations.

A2. Component 2 of the proposed project will result in the creation of sand dunes, which will cover some parts of the playa surface. This is similar is size and scope to the natural dune formation process which occurs on the Lake bed surface, but will cover a larger percentage of the surface.

A3. The creation of dunes in Component 2 will alter the topography of the Lake bed. The naturally occurring dunes have a similar scale of relief.

A4. While the Lake bed itself is a unique geologic feature, the proposed project will not result in any significant changes to the overall surface.

A5. The project will test various methods of controlling wind erosion of the Lake bed surface and subsequently the existing dust problem.

A6. No beach or river sands or channels exist in the project area.

A7. The project is taking place in a seismically active area; however, this project will not expose any additional personnel or equipment to geologic hazards beyond existing levels.

B. Air Quality

B1. This project will not result in any significant additional air emissions. Only a small number of vehicles will be in use at any one time. The proposed project may contribute to the implementation of a control strategy for the fugitive dust problem by providing a test of various control strategies.

B2. The project will not release any odors.

B3. The project will not alter air movement or climate patterns in a significant manner. The dunes created in Component 2 will alter wind movement patterns on the surface of the Lake bed, but only on an insignificant scale.

C. Water

C1. No alterations to any current surface waters are proposed in this project. Component 1 has the potential to create temporary ponds or wetlands on the Lake bed.

C2. The proposed project will map, measure and test the surface runoff waters. Component 1 has the potential to create a slight increase in the runoff on the Lake bed surface.

C3. See C2, above.

C4. The project will not use any surface water but will be a source of additional discharge onto the dry Lake bed surface. The low flows proposed for the Component 1 pilot will be insignificant compared to other sources of water.