ENVIRONMENTAL ANALYSIS RECORD

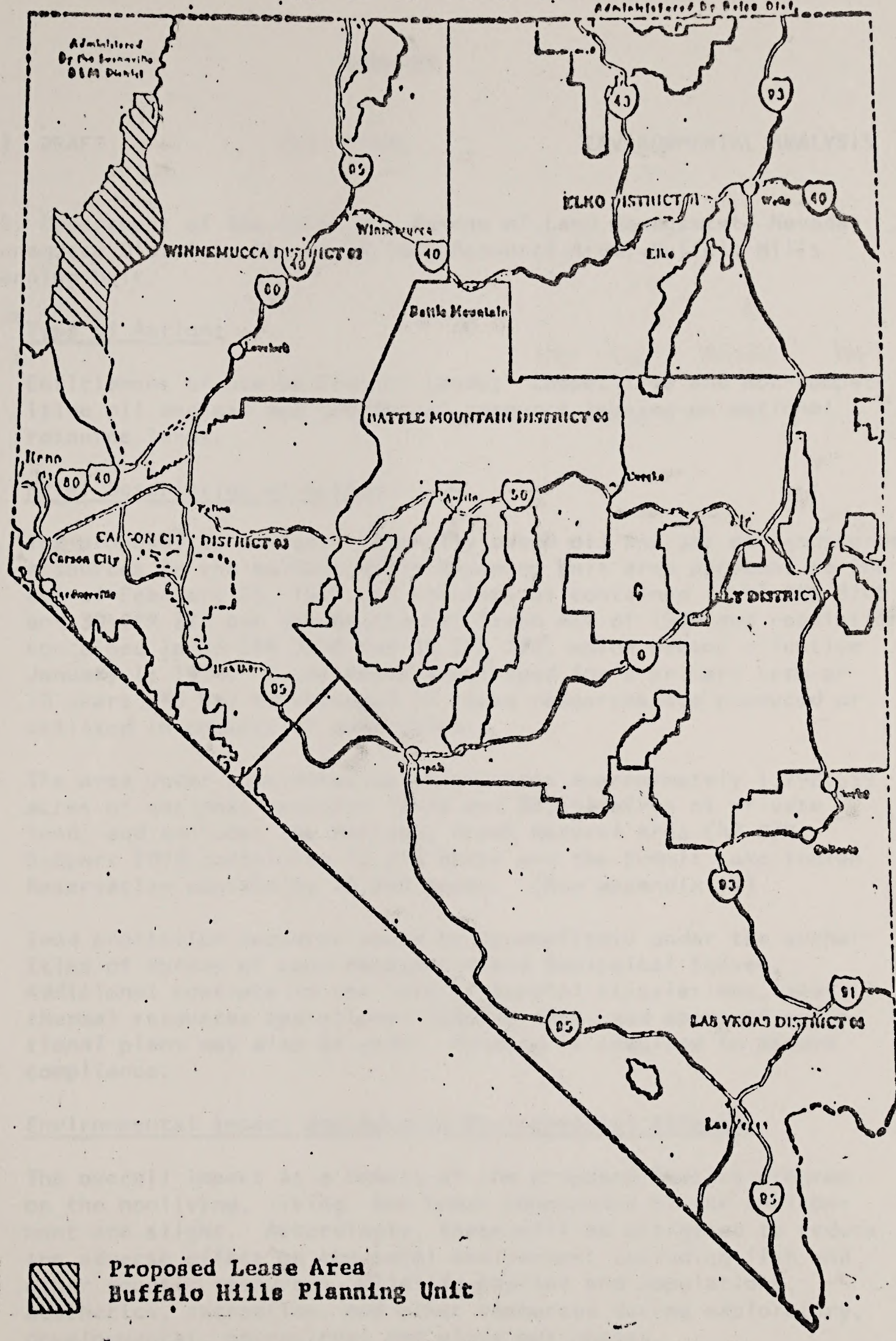
OIL AND GAS/GEOTHERMAL LEASING

WINNEMUCCA DISTRICT
SONOMA-GERLACH RESOURCE AREA
BUFFALO HILLS PLANNING UNIT

EAR No. 27-020-4-99

March 1975

NEVADA


Administered By Elko Dist.
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WINNEMUCCA DISTRICT 03
ELKO DISTRICT
Winnemucca
Battle Mountain
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BATTLE MOUNTAIN DISTRICT 03
Reno
Carson City
CARSON CITY DISTRICT 03
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ELY DISTRICT
LAS VEGAS DISTRICT 03
Las Vegas
Proposed Lease Area
Buffalo Hills Planning Unit

SUMMARY

( ) DRAFT (X) FINAL ENVIRONMENTAL ANALYSIS

U.S. Department of the Interior, Bureau of Land Management, Nevada, Winnemucca District, Sonoma-Gerlach Resource Area, Buffalo Hills Planning Unit.

1. Type of Action:

Entitlement of use on Federal Lands: Competitive and non-competitive oil and gas and geothermal resource leasing on national resource lands.

2. Brief Description of Action:

The proposal is to lease federally owned oil and gas and geothermal resources in the Buffalo Hills Planning Unit area pursuant to the act of February 25, 1920 and regulations contained in 43 CFR 3100 and 30 CFR 221 and the Geothermal Steam Act of 1970 and regulations contained in 43 CFR 3200 and 30 CFR 270, which became effective January 1, 1974. Such leases are issued for a primary term of 10 years and may be extended if these resources are produced or utilized in commercial quantities.

The area under consideration encompasses approximately 1,298,559 acres of national resource lands and 86,651 acres of private land, and excludes the Mahogany Creek Natural Area (43 CFR, Subpart 2070) containing 12,316 acres and the Summit Lake Indian Reservation containing 10,240 acres. (See appendix IV)

Land protection measures would be accomplished under the authorities of Bureau of Land Management and Geological Survey. Additional controls in the form of special stipulations, geothermal resources operational (GRO) orders, and approved operational plans may also be used. Bonding is required to assure compliance.

3. Environmental Impact and Adverse Environmental Affects:

The overall impact as a result of the proposed leasing program on the nonliving, living, and human components of the environment are slight. Accordingly, these will be mitigated to reduce the adverse effect on the total environment including fish and other aquatic resources, wildlife habitat and populations, aesthetics, recreation, and other resources during exploratory, developmental, operational and close out phases.

It has been recommended that portions of the Black Rock Desert is elibible for inclusion in the National Registry of Natural Landmarks. Any surface disturbance of the desert in these areas could adversely impact natural and cultural values. The rare and threatened fish species, Eremichthys acros (Desert dace), which inhabits some of the thermal springs in the vicinity of Soldier Meadows, could be adversely impacted as a result of this action. It is therefore essential that these areas be excluded from the leasing program pending further environmental study. Mahogany Creek (not affected by this action) is the spawning ground for the rare and threatened Lahontan cutthroat trout.

4. Alternatives considered:

Alternatives considered in addition to the proposed action include (1) decline to lease and (2) postpone leasing.

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APPENDICES

I. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

Proposed Action

Lease federally-owned, potential geothermal, and oil and gas resource in the Buffalo Hills Planning Unit, Sonoma-Gerlach Resource Area.

Alternatives

1. Decline to lease
2. Postpone leasing pending further study

The environmental analysis boundary deviates from the planning unit boundary in order to conform the proposed area to legal subdivisions. It incorporates lands under the administrative jurisdiction of the Susanville, California District.

The geothermal energy leasing program will be conducted under the 1970 Geothermal Steam Act and regulations contained in 43 CFR 3200, which became effective January 1, 1974. The proposal involves:

1. The approval of "Notices of Intent to Conduct Geothermal Resource Exploration Operations" on areas not connected with a lease.
2. Issuance of Non-Competitive Geothermal Resource Leases.
3. Issuance of Geothermal Resource Leases on Known Geothermal Resource Areas by competitive bidding.

Oil and gas leasing will be conducted under the Act of February 25, 1920 and regulations contained in 43 CFR 3100, and 30 CFR 221. The proposal involves:

1. Issuance of Non-Competitive Oil and Gas Leases
2. Issuance of Competitive Oil and Gas Leases

Stages of Implementation

Four Separate Stages of Implementation have been identified for both geothermal and oil and gas development:

1. Exploration - includes all activities from the decision to explore through the drilling of one or more "wildcat" or exploration wells. The discrete operations are:

    a) Airborne exploration
    b) Off-road vehicular travel
    c) Road, trail and drill site construction
    d) Drilling
    e) Rehabilitation

2. Development - This is the stage of most intense activity. The producing limits of the field(s) are outlined by developmental drilling. Because of the intense drilling at this time, accidental spills, leaks, blowouts, and fires are more likely to occur and have the greatest impact on the surface. Development includes the following discrete operations:

    a) Road construction
    b) Drill site development
    c) Geothermal and oil/gas pipelines
    d) Power plant construction (geothermal)
       Pump station and tank construction (oil/gas)
    e) Electric transmission lines
    f) Rehabilitation

3. Production - This phase is principally the operation and maintenance interval. It includes the following discrete operations:

    a) Drilling
    b) Waste disposal
    c) Maintenance of existing facilities
    d) Production

4. Close-out - This interval is the site abandonment phase. The discrete operations are:

    a) Removal of equipment
    b) Capping and cementing drill holes and wells
    c) Surface reclamation and restoration

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. Nonliving Components

1. Air

a. Air Movement Patterns - The prevailing winds are from the west-southwest. Occasionally arctic air invades from the north bringing northerly winds and extreme cold temperatures in the winter. The area is subject to gale force winds throughout the year. During the dry summer months intense winds pick up sand and dry topsoil to cause localized dust storms. Air inversion is not a problem because of the wind factor. There are no air monitoring stations in the area. The closest dust monitoring stations are at Lovelock, Fernely and Fallon and are operated by the State Bureau of Environmental Health.

b. Temperature - Extreme temperatures are not uncommon in the area. Summer temperatures often exceed 100°F in July and August, while continental air masses moving down from the north, in January and February, can plunge temperatures to -20°F.

c. Particulate Matter - Solid and liquid material suspended in the air has not been quantified for the planning unit. Dust from wind storms constitute the largest particulate matter suspended in the air for any extensive time, except in the vicinity of Empire. Here the United States Gypsum Company operates a processing and manufacturing plant. At present, the amount of particulate matter emitted by the plant is above the acceptable level set by the State Bureau of Environmental Health. The United States Gypsum Company has until June 30, 1975 to comply with the state standards.

d. Noxious Gases - No comprehensive data is available on the level of concentration, areal extent or persistence of carbon monoxide, hydrocarbons and nitrogen oxides. Small amounts of each are dispelled by vehicles traveling Nevada Highway 81 and aircraft. However, the concentration of vehicles and aircraft is not significant to cause a level that infringes on air quality standards.

e. Radiological Contaminants - No known man caused radiological contaminants.

f. Non-ionizing Radiation - Not known.

2. Land

a. Soil Depth

Most soils in the unit are formed from igneous rocks including volcanic surface flows and granitic intrusives. Valley bottom land soils are formed from mixed alluvium. Some soils on the Fox Range are formed from metamorphic rocks. Soil depth varies from over 60 inches on the valley bottoms to 10 inches or less on steep mountain ridges. Hard pan limit the soil depth on old terraces.

b. Soil Structure

Soil structure is a function of soil forming factors including parent material, climate, and time. Most upland soils are predominatly granular in the surface

and either blocky or columnar in the subsoil. Silica hardpans occur from 20 to 30 inches below the surface on the flatter topography. Soils around the periphery of the playas supporting desert vegetation are usually platy in the surface and sometimes massive in the subsoil.

c. Soil Nutrient Properties

Soil nutrients are plentiful in most soils. Eighty percent of the upland areas consist of Tertiary volcanic material containing most elements that plants require. Some igneous intrusive rocks on the Fox Range and Granite Mountains are probably low in some vital plant productive elements. However, nearly all soils produce a reasonable amount of vegetation. Most of the bottom land soils contain an excess of some necessary plant foods in the form of salt and alkali, including sodium, potassium, calium, magnesium, restricts or precludes vegetative growth.

d. Soil Pollutants Properties

There is negligible soil pollution in the unit.

e. Soil Erosion

Soil erosion from the action of water on the uplands, ranges from slight through critical, depending on soil type, steepness of slope and vegetative condition (See appendix III, Soil Erosion Susceptibility Map) Wind Erosion on the bottomlands is moderate and critical especially where vegetation is sparse, or absent. Extensive fine mineral material is moved east from the two large playas by prevailing westerly winds. Some of this material is carried as far east as Elko County (250 miles).

f. Geology

The southern and eastern part of the Buffalo Hills Planning Unit is typical of the Basin and Range geomorphic province; a series of relatively short, north-northeast trending mountain ranges of moderate to high relief separated by alluvium-filled valleys or basins.

The northern and western part of the unit lies in a transitional zone between the Columbia Plateau province. Flat-lying volcanic and sedimentary rocks are prominent in this area.

Approximately 90% of the surface area of the unit consists of rocks of Tertiary and Quaternary age. Pre-Tertiary rocks are predonimantly Mesozoic intrusives. The Tertiary rocks are mostly volcanics of rhyolitic to basaltic composition. Quaternary deposits include poorly consolidated to unconsolidated alluvial and lacustrine sediments. The youngest of the deposits are represented by recent alluvial fans, and stream and eolian sediments. Silts, clays, and minor sand and gravel found in the central portions of the basins represent Pleistocene and Recent lacustrine sediments. The oldest Quaternary deposits in the unit are dissected pre-lake Lahontan terrace, alluvial fan, and pediment gravels.

Permian and Triassic metamorphic rocks are exposed in the Granite Range, about 11 miles north of Gerlach.

Intermediate to basic Permian volcanic rocks crop out in a small area on the southwest side of the Black Rock Range.

Triassic and Jurassic metamorphic rocks of the Nightingale sequence occur in the Fox and northern Lake Ranges. A recrystallized limestone hundreds of feet in thickness is associated with the clastic rocks of the Fox Range. Undefined metasedimentary rocks of Triassic or Jurassic age are exposed on Donnelly Peak in the Calico Mountains.

Jurassic and Cretaceous intrusive rocks occur in scattered areas in the planning unit. The largest intrusive is the granodiorite of the Granite Range. Granitic rocks of this age are also exposed in the Fox Range north of Pyramid Lake. Gabbro pendants in granodioritic intrusions occur on the western slope of the Fox Range. Granitic rocks dated as pre-late Tertiary outcrop in a small area on Donnelly Peak in the Calico Mountains and west of Pahute Peak in the Black Rock Range.

All of the Mesozoic granitic bodies in this area appear to be stocks, except for the Granite Range which has batholithic dimensions. It is possible that the Mesozoic plutonic rocks of this area represent the eastern extent of the Sierra Nevada batholith.

Intense vulcanism began approximately 30 million years ago (late Cenozoic time) and extruded vast quantities of lava and pyroclastics across Nevada.

This was the beginning of the Basin and Range topography. Large blocks of the earth's crust were raised or tilted alosg normal faults creating the north-northeast trending mountain ranges and basins typical of today. Erosion has dissected the mountains and deposited sediments in the deep valleys.

One of the outstanding present day features in the planning unit is of Lake Lahontan influence. This glacial lake dried up about 10,000 years ago, but prominent wave-cut terraces and glacial deposits can be seen at several elevations on the flanks of the surrounding mountains.

Mineral Occurrences

The Cottonwood District, located in the Fox Range, has produced $100,000 on silver, gold, lead, zinc, copper and antimony. The latest recorded production was in 1929.

The Deephole District, located in the Granite Range has no recorded production sunce 1951. Gold, silver, copper, and lead production from 1939 to 1951 totaled $92,453. Tungsten potential exists at the Mountain View Tungsten Prospect, but the extent of the mineralized zone is unknown.

The Donnelly District, located in the Calio Mountains has yielded small amounts of gold from quartz veins injected into granodioritic and metamorphic rocks. Production figures are inconsistent.

The Leadville District, located in T. 37 N., R. 23 E. is the largest producer of lead and silver in Washoe County. From 1920 until 1925, the Leadville Mine produced over 1,000,000 ounces of silver, 3,500,000 pounds of lead, and minor amounts of gold and copper. No production has been recorded since 1941.

The San Emidio prospect, also known as the Mud Flat prospect, is located in T. 29 N., R. 23 E. approximately 20 miles south of Gerlach. Cinnabar occurs in altered Pleistocene alluvium along with sulfur. It appears that these deposits are expressions of extinct hot springs located along the trace of a north-trending fault. Warm ground in this area indicates that some of these springs are still slightly active. There has been no production to date.

Numerous uranium prospects exist in the planning unit. Concentrations of these prospects occur near Slum Gullion Creek and Smokey Canyon. More exploration is necessary to determine the potential in these areas.

Montmorillonite

Montmorillonite is a group of clay minerals characterized by swelling in water. These clays are used as drilling fluids and as sealers for ditches and reservoirs.

Exposures of these minerals are visible in prospects located near the northwestern end of the Lake Range (T. 30 N., R. 23 E.) More exploration and testing is necessary to determine whether or not this material is suitable for commercial uses.

Gypsum

The United States Gypsum Company has a processing and manufacturing plant located at Empire, five and one-half miles south of Gerlach. The Gypsum is mined approximately six miles south-southeast of the plant in Pershing County where it is stockpiled, blended, crushed and then trucked to the plant. Here plaster, plasterboard, cement rock, and agricultural gypsum are manufactured.

Sodium Chloride

Salt (Sodium Chloride) was produced in the Buffalo Springs District in the late 1800's and early 1900's. This area, located on the west side of the Smoke Creek Desert (T. 31 N., R. 20 E.) produced over 1500 tons of salt, primarily used in the treatment of silver ores. Brine pumped from wells was evaporated in large vats, and the salt recovered. Major production ceased in 1907.

Borate

Ulexite, hydrous sodium and calcium borate, was discovered near the hot springs about a mile northwest of Gerlach. An unpublished Geological Survey memorandum indicates that 3,000 tons of borate were produced in the 1890's.

Nitrates and borates are also known to occur in the Soldier Meadows hot springs area, but no production has been recorded.

Geothermal Exploration

Potential for the development of goethermal resources exists in the Buffalo Hills Planning Unit, as indicated by numerous areas of anomalous earth heat flows and hot springs. Most of the planning unit is underlain by Tertiary volcanics and thick units of Quaternary alluvium. Many of the hot springs are located along major faults which form the boundary between the valleys and mountain ranges.

On the basis of geological data, the U.S. Geological Survey has designated thirteen Known Geothermal Resource Areas (KGRAs) in Nevada. Three of these KGRAs lie within the Buffalo Hills Planning Unit; Double Hot Springs, Fly Ranch, and Gerlach. The Survey has also designated the area from Gerlach and Fly Ranch northeast across the Black Rock Desert as having geothermal potential (See appendix VII).

Several other competitive interest areas have been formed on the basis of overlapping geothermal lease applications during the same filing period. These areas are located in the vicinity of Gerlach, Fly Ranch, Double Hot Springs, Soldier Meadows, San Emidio Desert, and the Black Rock Desert Playa (See appendix VII).

According to Nevada Bureau of Mines and Geology Report 21, there have been two wells drilled in the planning unit for geothermal exploration. These wells were drilled around 1965-65 at Wards Hot Springs (Fly Ranch) by Western Geothermal Incorporated. The first, lcoated in the $SW\frac{1}{4}$, Sec. 2, T. 34 N., R. 23 E. was drilled to a depth of 1000 feet plus. The second, located in Sec. 35? T. 34 N., R. 23 E., was drilled to a depth of 300 feet. Data is incomplete, but a maximum well temperature greater than 220°F was recorded for these two wells.

Several private companies are conducting geothermal resource exploration throughout the unit. Mapping, gravity, resistivity, magnetic and telluric surveys, and drilling of shallow temperature gradient holes are in progress.

U.S. Geological Survey Open File Report, The Chemical Composition and Estimated Minimum Thermal Reservoir Temperatures of the Principal Hot Springs of Northern and Central Nevada, was recently completed. Data from this report, concerning hot springs sampled in the unit, is presented in appendix VIII.

Geologic Hazards

The geology of the area has not been studied in sufficient detail to define any specific geologic hazards (or lack thereof). Slopes in the area appear generally stable, but specific sites for proposed exploration or development activities sholld be examined to assure that they meet stability criteria.

Historical records and the apparent lack of recent fault scarps or other recent evidence of seismically disturbed ground indicate that the seismic risk of the area is generally low. Surface manifestations of geothermal activity (hot springs and geysers), on the other hand, are often associated with areas of somewhat higher than normal seismic activity. A more detailed assessment of seismic risk must be made and appropriate safeguards incorporated in any structures associated with geothermal development.

Valleys, canyons and arroyos in the area may be subject to flash flooding. Any exploration and development activities must avoid areas where a risk of inundation exists.

Oil and Gas Exploration

To date there have been no oil and gas wells drilled in this area. Two oil and gas lease applications have been submitted in the vicinity of the northeastern Smoke Creek Desert. One is located in T. 31 N., R. 22 E. MDB&M, and the other in T. 32 N., R. 22 E. MDB&M.

g. Land Use Compatability - Existing land uses are compatible with adjacent lands. The subject area is presently used for livestock grazing, hunting, sightseeing, off-road vehicles, rockhounding, prospecting, farming, railroading, and manufacturing. Many people use the hot springs north of Gerlach for bathing. Fishing is available only at scattered private lakes and reservoirs.

Evidence of man's presence can be found throughout the area. Roads, trails, utility lines, railroad tracks, ranches, mines, prospects etc. are visible in the unit.

All of these uses are physically compatible in their present environment and are not subject to public controversy.

h. Land Use Suitability

Lands within the proposed area are suitable for the existing uses.

3. Water

a. Hydrologic Cycle and Ground Water

The planning unit area consists of about 2,180 square miles. Assuming average annual precipitation is 8 inches, then the annual unit water application is 921,000 acre feet. (2,180 square miles x 640 x 0.66). Of this total, about 5 percent recharges the valley aquifers and the remainder is evapo-transpired. According to Water Bulletin #30 Department of Conservation and Natural Resources, (Nevada), about 6.6 percent of the annual precipitation is runoff. This is an average figure that varies with intensity of precipitation, soil texture, soil depth, slope and vegetative cover.

The greatest ground water storage facilities in the unit are its alluvial basins. Runoff from the surrounding mountains collects and drains toward the lowest parts of these basins. The percolation of surface water downward into the ground water reservoirs is maximized along the perimeter of the basins through the coarse textured soils and alluvium. Aquifer recharge also occurs through subsurface ground water migration.

Bedrock aquifers also exist in the unit. Secondary fractures in relatively impermeable rock provide paths for ground water migration and storage. Porous formations may have local importance. However, compared to the broad, deep alluvial basins, bedrock aquifers are presently of minor importance.

In general, ground water quality decreases from the periphery of the basins toward the playas where salts are concentrated through evaporation.

Ground water discharge occurs through evapotranspiration, spring and well development for livestock, irrigation, and domestic purposed, and in some cases, subsurface drainage from one ground water reservoir to another.

There are eleven hydrologic units that are wholly or partly in the Buffalo Hills Planning Unit. Of these eleven, three (Duck Lake, Winnemucca Lake, Pyramid Lake) contribute no water to ground water reservoirs whose main bodies lie within the planning unit boundaries.

The main ground water aquifers are the Black Rock Desert, Mud Meadow, Smoke Creek Desert, San Emidio Desert, and Hualapai Valley. Smaller hydrologic units which contribute water to the above units are Summit Lake, High Rock Lake, and Granite Basin. (See appendix X for hydrologic unit data)

b. Sediment Load

Water transported sediment load in the unit originates primarily in the uplands, and is carried toward the valley floors. According to the Winnemucca watershed conservation and development analysis about 2.65 tons per acre of soil material is displaced annually by this process. Most of this sediment displacement occurs during spring runoff from the action of snow melt. Some streams carry as much as 5.6 percent suspended solids for short periods during spring runoff or high intensity convection storms. (L^1 - Forest Influences, by Kittredge, p. 289)

c. Dissolved Solids

From Geological Survey inventories, the dissolved solids in the waters within the unit ranges from 163 p.p.m. (parts per million) at the head of Negro Creek to 3,060 p.p.m. in an underground water sample on the Black Rock Desert. (L^2) The main ions and elements in the upland water consists of bicarbonate (HCO_3), silica (Si), sodium (Na) chloride (Cl), sulphate (SO_4), and nitrate (NO_3). Those that predominate in underground waters are bicarbonate (HCO_3), chloride (Cl), and sodium (Na).

Waters with dissolved solids over 750 p.p.m. and sodium-

adsorption ratios over 10 are limiting to many agriculture plants. Sodium-adsorption ratios are less than 10 in the uplands but range as high as 49 in some of the valley ground waters, (L^2-Ground Resources - Recon. Series - U.S.G.S., reports #11 and #20.

d. Chemicals, Heavy Metals, and Toxic Substances

Some chemicals and toxic substances probably find their way into the underground water table from crop spray in the Hualapai Valley. Other toxic substances and heavy metals may contaminate areas around some mine dumps. This contamination, if it exists, is only on a very small scale.

e. Nutrients

Other than the ions and elements found in the waters mentioned under dissolved solids, no other information is available.

f. Solid Debris

Solid debris consisting of uprooted shrubs is a common sight along some of the main tributaries where they have been carried during infrequent flash floods, or high spring runoff.

g. Coliform Contamination

No Coliform testing has been initiated to date except for the culinary water systems of Empire and Gerlach. It is assumed from testing in other areas that most perennial streams in this unit are high in fecal coliform bacteria counts. This results from heavy livestock concentration along these streams during the growing season. Undeveloped springs should also show high coliform concentrations. More testing of these waters will occur in the future because of increasing public use of the national resource lands.

h. Acid Balance (pH)

The natural waters in the uplands range around 6.8 to 7.5 pH. This is due to the neutral condition of the geologic soil parent material. Those waters originating from the valley water tables range in pH from about 7.5 to 9.0 depending on the amount of cations present. Most of these waters contain higher concentration of dissolved solids than the upland waters because of the age-long process of salt accumulation in lowlands and subsequent evaporation of the water.

i. Dissolved Oxygen

No information

j. Temperature

The natural water temperature in this unit range from around 60°F during the summertime to 32°F in the wintertime. There are several hot springs that range from 136°F at Black Rock Hot Springs to probably 212°F at the Great Boiling Spring at Gerlach. Many of the Soldier Meadow warm springs support a small rare fish.

k. Radiological Contaminants

No data

B. Living Components

1. Plants (Aquatic)

The aquatic habitat on national resource lands in the proposed lease area consists of: seeps, hot and cold spring, one natural lake (High Rock), small perennial streams and stock watering reservoirs. Most of the aquatic habitat is on private land and controlled by ranchers in the area. Several large irrigation reservoirs have been built on private land. The largest body of water is Summit Lake Indian Reservation (600+ acres).

The following is a breakdown of the aquatic plants on national resource lands in the proposed lease area:

a. Vascular Plants - These are rooted plants with a stalk structure either submerged, protruding above the water or growing on the waters edge.

1. Seeps - Generally speaking these are bog or wet meadow areas that support a wide variety of grasses, sedges and forbs. Some of the more common species are:

Grasses

Poa spp. - bluegrass
Hordeum spp. - barley
Phleum spp. - timothy
Festuca spp. - fescue
Agrostis spp. - bentgrass
Deschampsia spp. - hairgrass
Agropyron spp. - wheatgrass

Sedges and Wire-grass

Carex spp. - sedge
Juncus spp. - wiregrass

Forbs

Taraxicum officinale - dandelion
Iris Missouriensis - iris
Achillea lanulosa - yarrow
Equisetum spp. - horsetail
Erigeron spp. - daisy
Aster spp. - aster
Senecio spp. - groundsel

2. Springs - This aquatic habitat can be divided into: (1) hot springs (2) cold springs

a. Hot springs - By and large, most hot springs occur at lower elevations and along the edges of vast playas. The vegetation consists of:

Grasses

Distichilis stricta - salt grass
Elymus condensatus - Great Basin wild rye
Polypogon monspeliensus - rabbits foot grass

Sedges and Wire-grass

Carex spp. - sedge

Immergent Vegetation *

Typhus latifolia - cattail
Scirpus spp. - bullrush

*The larger "cooler" hot springs have cattails and rushes. The smaller, hotter, pools have no immergent vegetation.

b. Cold springs - This aquatic habitat is found generally at higher elevations throughout the proposed lease area. The same vegetation described under seeps (wet meadows) usually is found around cold springs (See vegetation for seeps). In addition the following can also be found:

Typhus latifolia - cattails
Scirpus spp. - bullrushes
Rorippa nasturtium - aquaticum - water cress

3. High Rock Lake - Depending on annual precipitation, High Rock Lake can occupy about 600 surface acres. During dry years or periods of drought, the lake all but drys up. Because of the drastic water level fluctuation, poor drainage, and alkaline soils

around the lake, there is virtually no aquatic vegetation. Here is a vegetative breakdown of what is found in and around the lake:

- Shallow water (less than 6" deep) - Sedges (Carex spp.) and wiregrass (Juncus spp.)

- Lake edge - poverty weed (Iva axillaris)
  seep week (Suaeda spp.)
  Russian thistle (Salsola-kali)
  greasewood (Sarcobatus vermiculatus)

4. Small Perennial Streams - The aquatic vegetation in and along the small streams in the proposed lease area consists of:

Grasses, Forbs, and Sedges

(See plants listed under seeps)

Most of the grass, forbs and grass-like plants that form the stream-side and meadow associations along the small perennial streams are the same as the wet meadow associations throughout the planning unit. The major difference is the tree and shrub species associated with the water courses.

Populus tremuloides	- quaking aspen
Populus spp.	- cottonwood
Salix spp.	- willow
Alnus spp.	- alder
Prunus spp.	- choke cherry
Rosa spp.	- wild rose

Although the above species are not "aquatic" in the true sense of the word, they are water associated and are treated as part of the aquatic habitat.

5. Stock Watering Reservoirs - This aquatic habitat is man caused. Small reservoirs (less than one acre) have been created throughout the proposed lease area for livestock water. These small reservoirs are in various stages of succession depending on the time they have been in existence. The newer ones have little or no aquatic vegetation while the older ones have partially filled with silt and support luxuriant growth such as cattails, sedges, and rushes. Generally most of the small reservoirs have a combination of the following vegetation:

Typhus latifolia - cattail
Scirpus spp. - bullrush
Carex spp. - sedge
Equisetum - horsetain
Juncus spp. - sedge
Salix spp. - willow

(Associated grass species are the same as listed under seeps)

2. Plants (Terrestrial)

Vegetative types are limited by altitude and precipitation. They vary from the salt desert shrub associations along the edge of the 3900 foot high Black Rock Desert to the low sage-bunchgrass asssociation atop 9020 foot Granite Peak. The following is a vegetative breakdown of the proposed lease area:

Major Vegetative Types *

Type	Acres in Type	% of Total Acres
Big Sagebrush	277,165	19.9%
Low Sagebrush	266,759	19.1%
Greasewood	131,059	9.3%
Shadscale	219,341	15.7%
Annual Grass	24,344	1.7%
Meadow	4,000	.3%
Desert Shrub	26,145	1.9%
Winterfat	5,600	.4%
Waste	441,038	31.7%

Big Sagebrush is found at the higher elevations, on the deeper, well developed soils, associated with Sandburg bluegrass (Poa secunda), Needlegrass (Stipa spp.), and other bunchgrasses. Low sagebrush is found at higher elevations on rocks shallow bluebunch wheatgrass. Shadscale is found in the valleys and terraces on fine alkaline silts. It is associated with winterfat (Eurota lanata) and budsage (Artemisia spinescens). Greasewood is found at the lowest valley elevations on alkaline and saline soils. It is associated with shadscale and budsage. This desert shrub type is located throughout the unit in small areas, but its most extensive area is at the southern extremity of the Black Rock Range.

Because the vegetation is so diverse the major vegetative types do not portray smaller associated types within each major type. The following is a list of smaller, but important, vegetative types:

* See Buffalo Hills Unit Resource Analysis

Mountain Mahogany (Cercocarpus ledifolius) - This type is associated with the sagebrush-grass community between 6000 and 8000 feet. Generally it is found in the northern reaches of the proposed lease area.

Juniper (Juniperus utahensis) - Again this type is associated with the sagebrush-grass community and is generally found between 5000 and 7000 feet. It is distributed throughout the proposed lease area.

Aspen (Populus tremuloides) - Aspen stringers are generally associated with water courses or wet areas above 6000 feet. On the higher mountains, such as the Granite and Black Rock Ranges, large groves of aspen (several hundred acres) can be found around 8000 feet.

3. Animals (General)

Personal interviews and a literature review established a list of 58 mammals, 115 birds, 5 amphibians, 20 reptiles, and 9 species of fish. This list is available in the Buffalo Hills Unit Resource Analysis, of these, the Prairie Falcon (Falcon mexicanus), Desert dace (Eremichthys acros) and the Lahontan cutthroat trout (Salmo clarkii henshawi) are listed as threatened or endangered.

The Desert dace is of major concern in this analysis because it exists in the Soldier Meadows hot springs, a potential geothermal steam lease area.

a. Mammals - The Buffalo Hills proposed lease area looks desolate and void of wildlife to the casual observer. A closer look reveals many small animal burrows and tracks. Deer, antelope, bobcat, coyote, and black-tailed jackrabbits are very common in this high desert biome. The common small mammals include: The desert woodrat, kangaroo rat, pocket gopher, antelope ground squirrels, pipistrelle bat, kit fox, and cotton tail rabbits. Approximately 2200 horses and 10 burros exist in the proposed lease area.

b. Birds - Most of the area is suited for ground and shrub nesting birds. The small scattered groves of aspen, cottonwood and mountain mahogany do provide limited habitat for birds which require trees for nesting and food. The rock cliffs provide nesting habitat for prairie falcons and golden eagles.

Waterfowl use the isolated hot springs and other aquatic areas.

c. Amphibian and Reptile - These animals are very common in this area. The best indicator species appear to be the sagebrush lizard, collard lizard, great basin fence lizard, northern desert horned lizard, great basin gopher snake, great basin rattlesnake, boreal toad, western aquatic garter snake and the leopard frog.

d. Fish - This area contains a variety of aquatic habitats and environments preferred by fish. The common species include the Lahontan cutthroat trout, Rainbow trout, Lahontan tuichub, Lahontan redshiner, Lahontan speckled dace, and the Soldier Meadow dace.

The Lahontan cutthroat trout (Salmo clarkii henshawi) exists and spawns in Mahogany Creek. The 1974 edition of the United States Department of Interior, Endangered Fauna, lists this species as endangered.

This trout matures and lives in Summit Lake, into which Mahogany Creek drains, and spawns in the creek each spring. This area is the only reliable egg source available to assure a disease-free hatchery stock. The Summit Lake Lahontan cutthroat is also the only known pure strain of this trout species.

e. Invertebrates - Several hundred species of insects inhabit a desert area such as the Buffalo Hills proposed lease area. The following species have been identified with certain host plants in this area:

Plant	Insect
Winterfat Eurotia lanata	Weevil Ophryastes latirostris
Shadscale Atriplex confertifolia	Mealy bug Phena coccus and Ant Cremato gester

	Ant Camponotus sayi and Termite Reticuli termes
Spiny hopsage Grayia spinosa	
Indian Ricegrass Oryzopsis humenoides	Thrips Haplo thrips
Budsage Artemisia spinescens	Aphid Microsiphum oreganensis
Big sage Artemisia spp.	Sage Brush Moth Aroga websteri

4. Animals (Hot Springs Environment)

Most large hot springs are on private land. Many times the run off from these hot springs and smaller hot springs traverse national resource lands. In either case the aquatic wildlife on national resource lands are many times dependent upon what happens on private lands.

a. Soldier Meadows Desertfish (Eremichthys acros), also known as the Desert dace is endemic to the Soldier Meadows basin. This fish appears to exist only in the larger hot springs which are on private lands. The run off from these hot springs, which occasionally passes through national resource lands, also contains this small fish.

These remarkable little minnows living in thermal waters were fisrt described by Carl Hubbs and Robert Miller (1948). Mclane (1970) suggested they were apparently a product of an ancient relic, and have probably long occupied their present habitat. La Rivers (1962) and Nyquist (1963) generally described the fish to be 1-1/8 to 2-1/16 inches standard length. They inhabit water ranging from 64 to 100.3 degrees Farenheit. This is the highest recorded water temperature habitat in western North America in which native fishes of the family Cyprinidae live.

The Desert dace is protected by the State of Nevada Board of Fish & Game Commissioners and is classified by them as rare. The United States Fish & Wildlife 1973 Resource Publication 114 classified this species as threatened.

b. Aquatic Invertebrates

The most abundant animal life in hot springs are invertebrates. Insecta appear to be the most important invertebrates present. Annelida, Crustacea, and Gastropoda are also represented.

The following is a list of the representative aquatic invertebrates observed by Nyquist (1963) in his hot spring survey in the Soldier Meadows area:

ANNELIDA

Oligochaeta	aquatic earthworms
Hirudinea	leeches

CRUSTACEA

Cladocera	water fleas
Copepoda	copepods
Ostracoda	ostracods
Amphipoda	scuds
Decapoda	
Hydracarina	water mites

GASTROPODA

Ctenobranchiata	snails
Amnicolidae	

INSECTA

Plecoptera	stonoflies
Ephemeroptera	mayflies
Odonata	dragonflies and damselflies
Libellulidae	skimmers
Coenagrienidae	damselflies
Coleoptera	
Dytiscidae	predacious diving beetles
Hydrophilidae	water scavenger beetles
Hemiptera	true bugs
Belestomatidae	giant water bug
Corixidae	water boatmen
Diptera	
Hymonoptera	bees, ants, wasps
Sphecidae	mud dauber
Leipidoptera	moths, butterflies
Orthoptera	grasshoppers, crickets
Tettigoniidae	mormon cricket

C. Ecological Interrelationships

1. Process

a. Succession - The proposed leasing area is classified as a cold desert biome. Desert ecosystems are exceptionally vulnerable to misuse and in many places are subject to rapid change. Unlike grasslands and forests where vegetative renewal begins quickly on disturbed areas, the process of natural revegetation or successional pattern and recovery is especially slow. If a desert plant community is denuded, the plants from the surrounding climax species usually return to form the original exosystem. There are no intermediate successional stages. Exceptions often take the form of introduced noxious species such as halogeton, Russian thistle and cheatgrass. Consequently, the restored community was the one there in the beginning and often takes decades to re-establish.

b. Food Relationships - The pathways over which energy moves through the desert community explains the dependence of wildlife on vegetation. The food chain is relatively simple in the proposed leasing area starting with green plants to insects, to rodents to raptors. Coyotes and bobcats share the top of the chain. (On page 22 is a biotic pyramid showing a portion of a food web)

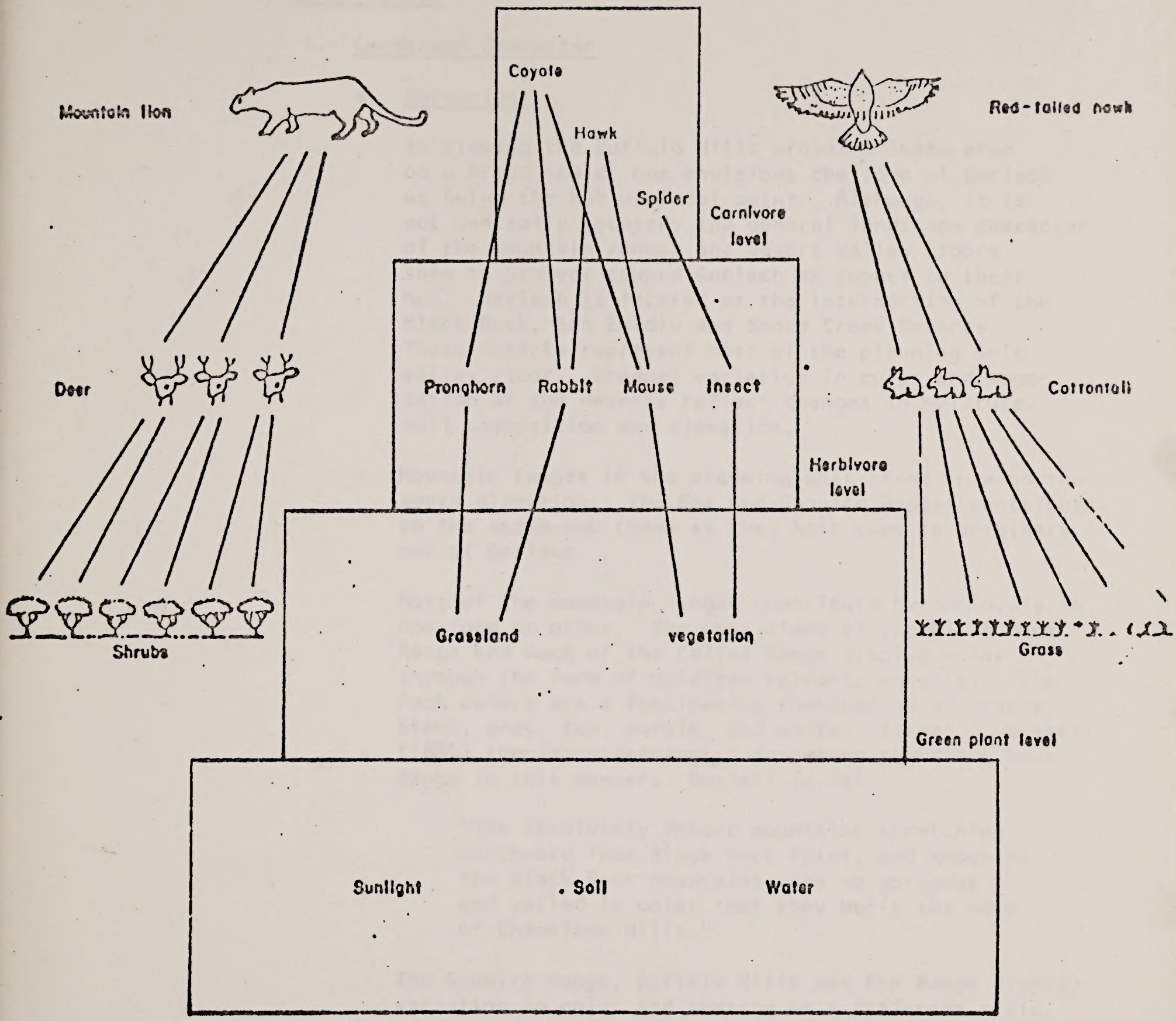
c. Community Relationships

A community is an assemblage of species of plants and animals inhabiting a common area. The areas that animals occupy, and the food they eat make each species dependent upon one another.

Each area has a theoretical maximum growth rate which is the biotic potential of the area. That means the area can maintain x number of birds, plants, and animals. Any change in the density of one species will ultimatley affect the density of another.

Food chain

Food chain



Biotic pyramid showing portion of a grassland food web

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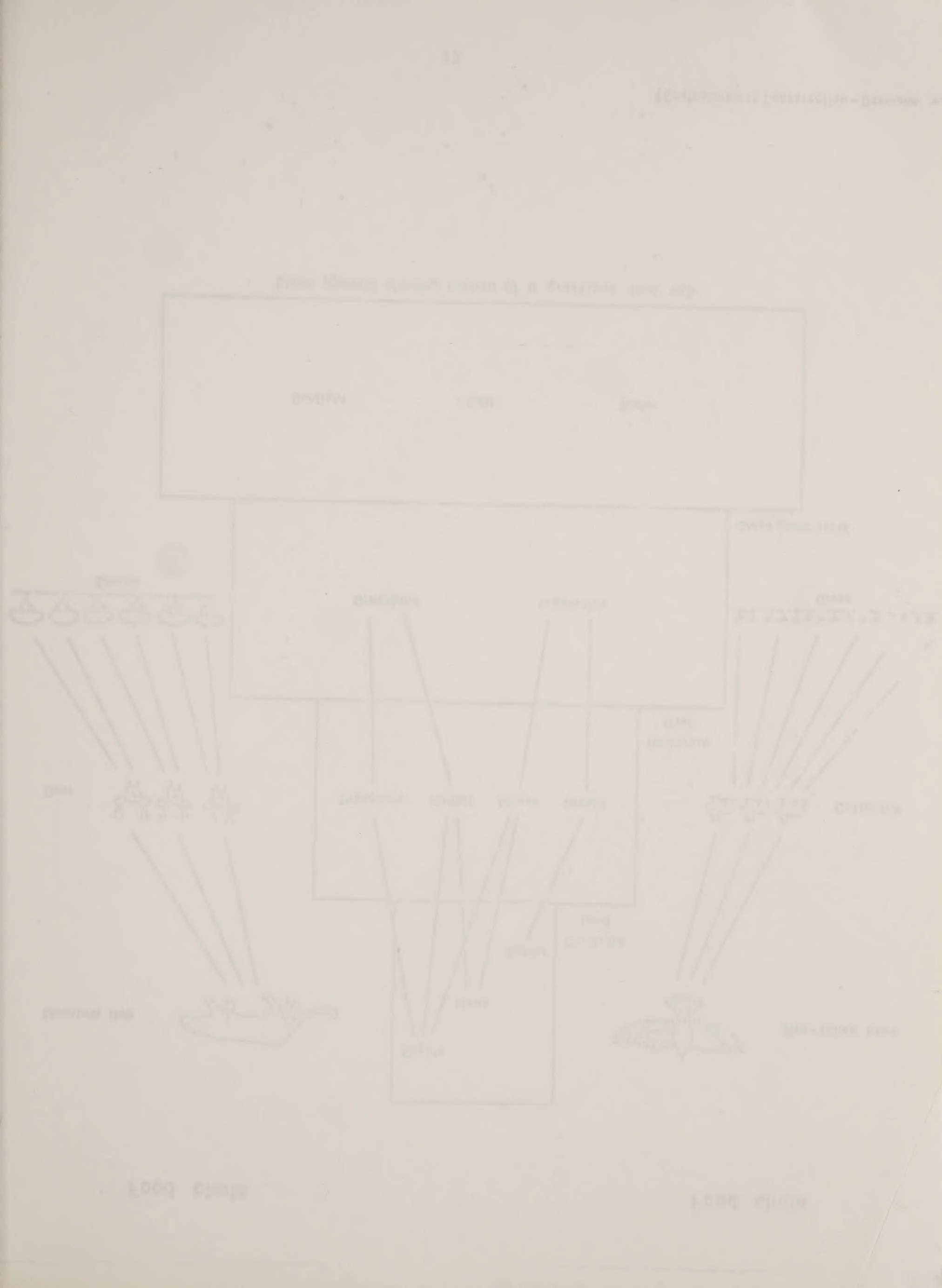


D. Human Values

1. Landscape Character

a. Harmonious

In viewing the Buffalo Hills proposed lease area on a broad scale, one envisions the town of Gerlach as being the hub or focal point. Although, it is not centrally located, the general landscape character of the mountain ranges and desert valley floors seem to project toward Gerlach as spokes to their hub. Gerlach is located at the intersection of the Black Rock, San Emidio and Smoke Creek Deserts. These deserts represent most of the planning unit valley floor. Gradual variation in color and vegetation of the deserts reflect changes in moisture, soil composition and elevation.

Mountain ranges in the planning unit trend in a north-south direction. The Fox and Granite Ranges contribute to the spoke-hub theme as they both seem to originate out of Gerlach.

Most of the mountain ranges contribute harmoniously in one form or other. The west flank of the Black Rock Range and much of the Calico Range display color through the form of oxidized volcanic material. The rock colors are a fascinating combination of orange, black, gray, tan, purple, and white. Israel C. Russell (1885) the famous geologist described the Black Rock Range in this manner: Russell (p.39)

> "The absolutely desert mountains stretching northward from Black Rock Point, and known as the Black Rock Mountains, are so gorgeous and varied in color that they merit the name of Chameleon Hills."

The Granite Range, Buffalo Hills and Fox Range display variation in color and texture in a different style.

The rugged Granite's almost perpendicular slopes, are pleasingly transformed into meadows at its top. Natural vegetation is varied in the meadow and the surrounding slopes that have enough soil for plant growth and soil stabilization. The Buffalo Hills are unlike the other ranges in that their topography is not as pronounced. The hills were formed from a large lava flow and are creased with precipitous basalt canyons. The flats are cobbled with boulders that contrast with

scattered junipers.

b. Accentuating

Water is not abundant in the planning unit although most of the mountains have streams that trickle through the canyons only to dissipate on the desert floors.

Water almost seems unnatural as so much of the unit is dry and barren. Lakes and reservoirs occur as sporadic water collection sites that have been built for livestock. Virtually no change in vegetation and color exists at lakes and reservoirs except for the murky blue water itself. The shores are muddy and often have the aroma of decay.

Streams stand out and are usually associated with rugged canyons that have been eaten away by erosion. Many are lined with aspens or cottonwood trees that look totally out of place to the surrounding landscape.

Hot springs are unique but relatively abundant. Historically, they have been used as public baths. Many people believe that because of the minerals in the water, hot springs provide certain medicinal characteristics. This is best illustrated by the large number of people who spend much of their time at the Gerlach Hot Springs.

The livestock industry is the largest contributor to the presence of structures in the planning unit. Ranch sites are typically located at the base of the mountain ranges in direct association with the availability of water. Ranches are not consistent with the natural landscape but do contribute aesthetically. Trees and grass fields are commonly associated with ranches. They provide a colorful relief from the surrounding monotypic natural landscape. Fence roads are seen throughout the planning unit separating district boundaries and livestock allotments.

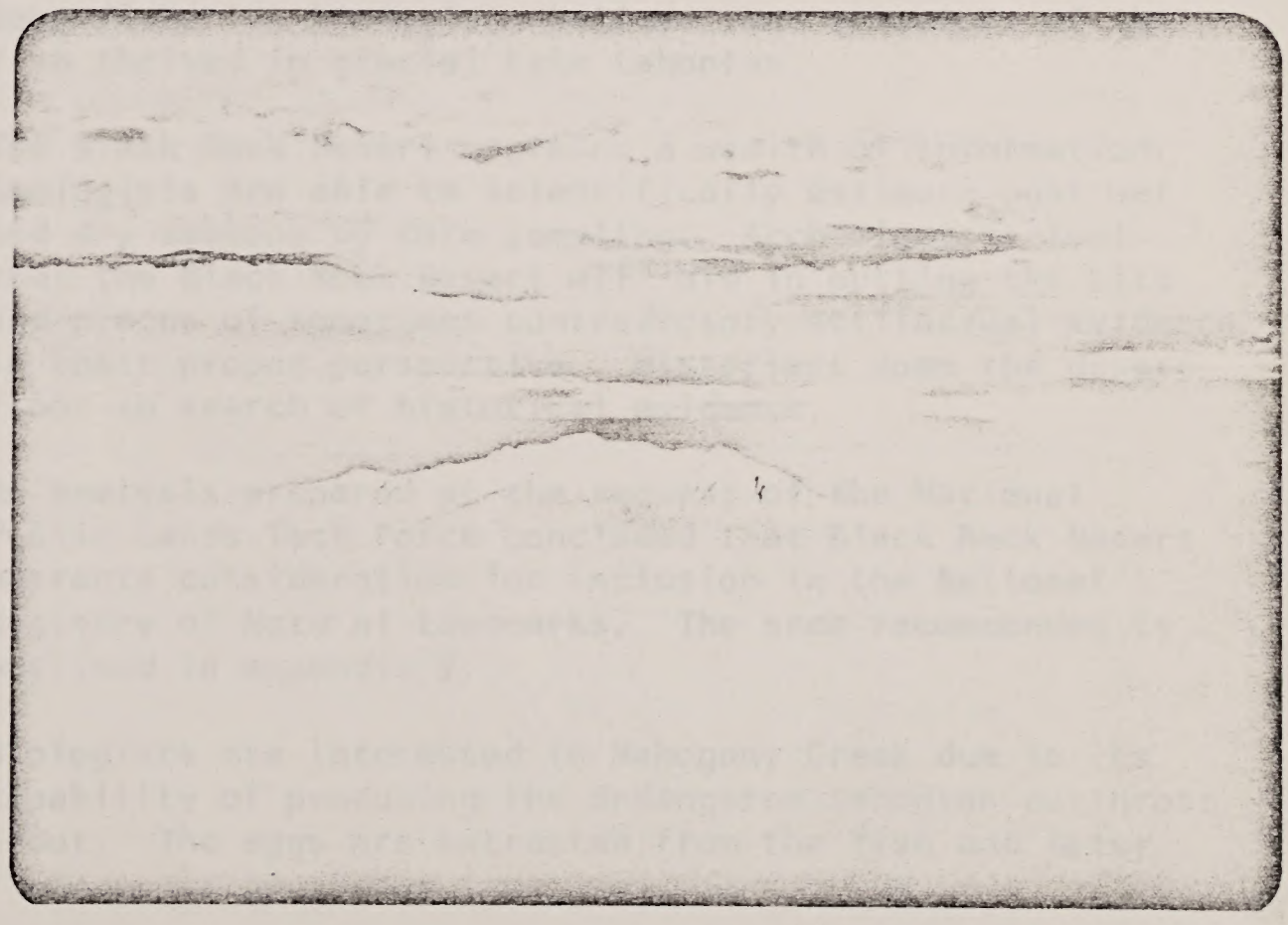
Evidence of mining operation is easily visible throughout the planning unit. Scars from mining exploration can be seen on nearly all the mountain ranges. Many of the existing roads in the unit are associated with access to mining claims.

Most of the main access roads are indiscernably located on the valley floor giving the traveler essentially the same perspective as the early immigrants. Access to areas that provide a relief from the barren valley floor is available by the numerous side roads that deviate from main access roads.

The Western Pacific Railroad, and the Los Angeles Water and Power Transmission Line provide striking evidence of mans' presence as they traverse the long dry valleys.

Gerlach and Empire, the only population center, are a pleasant surprise to the travelers who have spend hours driving through the "endless" deserts. They provide food and drink and a place to stretch and relax.

One of the most striking features of the proposed lease area is the Black Rock Desert. It is a vast alkali playa, 20 miles wide, that stretches north and south for 80 miles. At first sight, the Black Rock Desert is nearly featureless - a level expanse of several miles, without a blade of grass, stretching to the horizon. This vast nothingness is accentuated by the surrounding high mountains. Although the mid-day sun may deaden their appearance, the mountain brilliance is brought to life in the early mornings and evenings. In analyzing Russell's description of his experience of being on the Black Rock Desert, it is apparent that few changes have occurred in nearly a hundred years (Russell p. 82-83).



Scenic view across the Black Rock Desert
(A view similar to those described in diaries of early immigrants)

2. Sociocultural Interests

a. Educational/Scientific

The Buffalo Hills proposed lease area contains numerous hot springs and possible geothermal resources. This relates to the relatively young volcanic formations that exist in the unit. Educational and scientific information collected around hot springs is beneficial in updating historical knowledge as well as adding to the general understanding of natural processes and ecological interrelation ships.

Hot springs are of current interest in the search for alternate sources of power in that they are surface manifestations of geothermal activity. In this capacity, they indicate general areas which might yield subterranean pockets of hot water or steam. Preliminary exploration is presently being carried out at several locations in the planning unit.

Natural phenomena associated with hot springs can also be of scientific interest. Unusual organisms specially adapted to the environmental conditions around hot springs have been used in scientific research. The hot springs in the Soldier Meadows area is the only known habitat for the threatened Soldier Meadows dace. Some fisheries biologists believe that ancestors of the fish thrived in glacial Lake Lahontan.

The Black Rock Desert contains a wealth of information. Geologists are able to scientifically estimate past wet and dry seasons by core sampling. Archeologists feel that the Black Rock Desert will aid in putting the bits and pieces of sometimes contradictory artifactual evidence in their proper perspective. Historians roam the desert floor in search of historical evidence.

An analysis prepared at the request of the National Public Lands Task Force concluded that Black Rock Desert warrants consideration for inclusion in the National Registry of Natural Landmarks. The area recommended is outlined in appendix V.

Biologists are interested in Mahogany Creek due to its capability of producing the endangered Lahontan cutthroat trout. The eggs are extracted from the fish and later

transferred to other bodies of water for rearing and future fishing opportunities.

Archeological sites are found throughout the planning unit. Major concentrations are the Smoke Creek and Black Rock Desert, High Rock Lake, and Summit Lake Indian Reservation. Archeologist that study Nevada's prehistory say for a general rule, where water is, or has been present, an archeological site is also present.

Donald R. Tuohy, Curator of Anthropology at the Nevada State Museum identified the time depth of artifacts found on the Black Rock Desert to be equal to any known locality in western North America. A Clovis Point estimated at 11,500 years old was found on the Black Rock Desert and is associated with the new world mammoth hunters who made entrance into the U.S. through Alaska and Canada when a gap opened between the Cordilleaan and Laurentide ice sheets some 13,000 years ago.

Mr. Tuohy also pointed out that unlike other parts of the country, 75-80% of Nevada's prehistory is in the form of lithic scatter (on the ground surface). Because of this fact, and relatively easy access to sites, arrow head collection (which is illegal) is common. Minimally disturbed sites are rare and extremely valuable to archeologists.

b. Historical

The planning unit has an interesting past. The earliest accounts were recorded by John C. Fremont in his explorations of 1843-44. With his lead scout, Christopher (Kit) Carson, he entered the planning unit at High Rock Lake via High Rock Canyon. He passed through the Black Rock Desert in the dead of winter, appropriately naming it Mud Lake.

Later in 1846, Jessy and Lindsay Applegate persuaded immigrants of the Humboldt River route to backtrack Fremont's route for a short-cut to Oregon. This was later referred to as the Applegate-Lassen Road. Black Rock Springs was a common watering spot along the road. Approximately seven miles north of the hot springs is the ruins of Hardin City. Originally developed for silver mining, the colorful city was built from native rhyolite blocks which were shaped by hand. Reports show that it was near here that Peter Lassen was murdered. The Applegate trail was later known as a "Trail of Death." Rumors suggest that Lassen stored his riches here. The rumor has never been repudiated.

In 1851, the Noble Road was established as immigrants wished to avoid the difficult portions of the Lassen Road. Both trails were identified to Black Rock Springs, but at that point the Noble Road broke southwest through the Smoke Creek Desert to eventually end in Shasta, California. The Noble cut-off passes just north of the town of Gerlach. During the mid 1800's, this area was inhabited by hostile northern Paiutes, resulting in establishment of several forts. Several famous battles ensued.

During the 1860's the Black Rock Desert presented itself as a battle field on several occasions. One was led by Colonel Frederick West Lander in 1860 and another by Caption Almond B. Wells, 1865.

Camp McKee was established on Granite Creek, after Indians burned the stage station there in April, 1865. It was built and abandoned in the same year. The supplies were moved to Camp McGarry -- Summit Lake because of better location. Its purpose was to protect the Idaho-California mail and stage road.

By 1871, the army had left and the Reserve was turned over to the Department of the Interior for a Paiute and Shoshone Indian Reservation, now known as the Summit Lake Indian Reservation.

Although the threat of Indian battles had virtually come to an end, the final Indian Massacre in the United States was at High Rock Canyon (1912). This began the final chase and killing of "Shoshone Mike" who was known as the leader of a small Indian band who still led the nomadic existence of their ancestors.

The town of Gerlach was established as a division headquarters of the Western Pacific Railroad, which was constructed in 1905-06. The railroad was the second railroad to use the general course of the Humboldt River as the basis for a route across Nevada.

c. Cultural Values

The Summit Lake Indian Reservation is the only location in the planning unit that has subcultures still in practice. This occurs once a year during the Lahontan cutthroat trout spawning runs in the spring. There are no permanent year-round residences on the reservation.

All of the Indians live off the reservation in California and Nevada. Of the 200 tribal membership, 18-20 members return to the reservation each spring to gaff the spawning trout in essentially the traditional way of their ancestors.

d. Recreation

The unit appeals to the recreationist who seeks the primitive-wilderness experience. Many roads are present and the country is vast enough that many people enjoy the solitude without disturbance from others. Camping and picnicking areas are primitive throughout the unit and are located along streams and springs where trees provide shade.

Hunting, sightseeing and rock collecting are the major recreational opportunities the planning unit offers.

Squaw Reservoir (on private land) is the only game fish water in the unit at the present time. Summit Lake and its tributaries may one day become valuable fisheries for the general sporting public, but at present are closed to fishing, except for the Indians of the reservation. Some existing reservoirs and potential reservoir sites may possibly be developed under multiple use objectives to increase the fishing opportunities.

The planning unit holds potential for quality winter sports opportunities, but at present, is too remote.

Deer hunting is popular throughout the area and the unit is heavily hunted by Reno residents. Upland game bird hunting is present where water is available. Waterfowl may be observed at several locations, including Summit Lake, Soldier Meadows, High Rock Lake, Fly Hot Springs, and Squaw Creek Reservoir.

e. Attitudes and Expectations

People living in the area express positive attitudes about the possible development and production of geothermal steam.

The town of Gerlach will benefit economically during all phases of geothermal and oil and gas operation. Production of power will insure growth to the local community. Ranchers in the outlying areas are looking positively to production in hope that low cost power will be available to them.

Many people in the state look forward to a clean, relatively cheap energy source. The utilization of geothermal energy would provide this, and, at the same time, reduce the demand for fossil fuels in several areas.

However, there are people in larger population centers, who are concerned with the possible damage of destruction of environmental and cultural resources during the operations of geothermal and oil and gas crews in the planning unit.

III. ANALYSIS OF THE PROPOSED ACTION AND ALTERNATIVES ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

A. Anticipated Impacts

Current land uses in the area include grazing, mining, wildlife habitat, outdoor recreation, and watershed.

Development of geothermal and oil and gas resources entails, construction of access roads and well sites, drilling and testing of wells, construction of electrical transmission lines, and facilities for the disposal of solid and liquid wastes. Geothermal development includes the construction of pipelines for the conveyance of steam or hot water to electric power plants, and the construction and operation of electric power plants. Oil and gas development also entails the construction of pump stations and pipelines. Facilities for processing by products may also be required for the development of both geothermal resources and oil and gas.

Locally, land would become unavailable for certain uses such as grazing, recreation, and wildlife habitat. Terrain would be modified through construction of roads, wells, pipelines, and industrial facilities. Noise, fire, and noxious gaseous and liquid emissions could pose problems during development and production. Possible adverse effects include land subsidence due to porduction of fluids and increases seismicity due to production and reinjection of fluid wastes into nonproducing zones.

There are four stages of implementation: exploration, development, production, and close out. The impacts associated with each of these phases are discussed below.

1. Non Living Components

EXPLORATION

a. Air - There will be three basic forms of air pollution related to leasing national resource lands for geothermal and oil and gas resources: gases, vapors, and particulate matter. Gases and vapors which could be encountered include ammonia, hydrogen sulfide, mercury, methane, carbon monoxide, and carbon dioxide.

Pollution from particulate matter will be dust resulting from construction activities during exploration, development, production, and close out. The intensity of pollution will be directly related to the stage of development.

Exploratory impacts from gases or vapors will be primarily from drilling. Properly executed drilling procedures will eliminate or minimize the possibility of escaped gases from test wells. However, due to malfunctions or other unforseen events, blowouts may occur.

Impacts under the exploration phase, in some cases, will be handled by Environmental Analysis Records prepared for the Notice of Intent to Conduct Geothermal Resource Exploration Operations.

b. Land - Impacts from exploration will be based on the degree of surface disturbance. Road and trail construction, well drilling and vehicle use may alter soil depth and structure. "Scalping" of drill pad sites and soil compaction by vehicles will have negative impacts.

Should a blowout occur, large quantities of noxious gases and liquids could be extruded upon the ground. In the case of an oil and gas blowout, explosions and fires could result. This could, besides killing present vegetation, render the soil useless for an indefinite period of time.

Any surface disturbance could adversely affect any archeological or historical sites. The more intense and thorough the exploration activity, the more likely these values would be impacted.

Geologic structure alterations, as a result of exploratory drilling, could cause minor impacts beneath the ground. The primary impact will be the hole.

c. Water - Effects of exploration would include surface disturbance and denudation as a result of vehicular travel and drilling. Destruction of vegetation by crushing, "scalping", or as a result of poisoning or burning would accelerate erosion and could increase turbidity in surface waters.

Steam, water, oil and gas could be brought to the surface and may have an effect on water bearing strata by depleting or mixing with the underground reservoir.

Any form of pollution, chemical, thermal, etc., would affect organisms which inhabit the affected waters.

DEVELOPMENT

a. Air - The escape of gases and vapors into the air are greater during this stage than any other. Several wells will be drilled and tested before they are put into production. To determine the flow characteristics of geothermal systems and to clean out the hole, each new well is vented to the atmosphere. This could introduce noxious gases into the air.

Development will also call for the establishment of geothermal and oil and gas pipelines. Transporting steam and natural gas and oil through a pipe will undoubtably result in leaks.

Drill pads will be needed for each well. Clearing these pads of brush and disturbing the soil will cause dust during the clearing operation and windy period. Road development, pipeline, electric transmission line, pump plant and power plant construction will result in surface disturbance and contribute particulate matter (dust) to the air.

b. Land - Impacts on soil will be essentially the same as for exploration, but will be expanded to include affects on soil as a result of plant, pipeline and electric transmission line construction.

The excavation and construction of mud pits and earth filled impoundments will be required to handle drilling mud and for the entrapment of fluids which may escape during drilling and testing. Digging these pits will alter the soil structure and depth.

c. Water - The impacts listed under "exploration" would also apply to this stage.

PRODUCTION

a. Air - Geothermal steam can be realeased into the atmosphere at any stage during operation. New drill sites, maintenance of facilities, waste disposal (geothermal) and the production stage all have potential for allowing steam to escape.

The possibility of blowouts during the deepening of old wells or the drilling of new wells exists. Leaks in pipelines could also contribute to air pollution.

Particulate matter will be an air pollutant factor during new drill site development and the utilization of dirt roads.

b. Land - New drill site development will result in surface disturbance by construction activities. New well pads and roads will expose the soil to wind erosion.

Waste water disposal methods from geothermal steam plants vary. Disposal into evaporation ponds will require soil excavation. Likewise, fluid entrapment facilities for drill mud and oil collection will also involve soil excavation. Again, this activity will alter soil structure and depth.

Re-injection of geothermal waste water will be dependent upon the geologic characteristics of the field. Geothermal areas are typically associated with seismic activity. Bringing steam and water to the surface and re-injecting water could increase earthquake activity and cause slight geologic changes.

The removal of oil and gas from their subterranean reservoirs could cause subsidence. Injection of water and gas into peripheral wells in order to obtain oil otherwise not recoverable, could also induce seismic activity.

c. Water - During the production stage, underground water, steam, oil, and gas will be brought to the surface. It is also possible waste water will be re-injected underground. The possibility of adverse impacts on fresh water aquifers exists.

CLOSE OUT

a. Air - Removal of surface equipment will cause soil disturbance and resultant dust. Cementing and capping wells could result in small amounts of gas and vapor escaping into the atmosphere.

b. Land - At the end of production, the equipment used to remove surface and subsurface structures and equipment will undoubtedly cause surface disturbance. Again, as in the construction phase, slight effects on soil depth and structure will result in some erosion. Surface restoration may also cause temporary soil impacts.

c. Water - Once production ceases and the wells are capped, there will be no impact on underground water.

2. Living Components

EXPLORATION

a. Plants (Aquatic) - In the event of a geothermal or oil or gas blowout, surface waters could become polluted and aquatic plant habitat altered.

The possibility of geothermal wells drying up hot springs also exists. This would clearly have an adverse impact on aquatic vegetation.

b. Plants (Terrestrial) - Off-road vehicle use and drill site preparation will crush and remove some plants and cause limited destruction. The occurrence of a blowout would also impact the surrounding vegetation. Localized impact will be high.

The living animal components will be evaluated in two parts: those animals which live in hot springs environment and those animals which live in area's other than a hot springs environment.

c. Animals (Hot Springs Environment) - Impacts from exploration will be based on the degree of surface disturbance and the extent of exploration. The degree of vegetation and water destruction by exploration directly affects animals of the hot springs environment. The pollution or elimination of surface water would have an impact of eliminating most animals. Generally any change in the food, water, and cover required by the animals would have an effect on them.

d. Animals (Areas Other Than Hot Springs Environment) - The exploration phase will have few adverse impacts on these animals. Some populations of rodents, insects, or reptiles may be temporarily displaced from vehicle activity or damage to vegetation. Increase in human activity will have an adverse impact on many large animals.

DEVELOPMENT

a. Plants (Aquatic) - The possibility of pollution from leaks and blowouts in greatest during this stage. Oil, brine, and hot fluids are potential pollutants which would adversely affect the aquatic community. The possibility of drying up hot springs by geothermal development exists.

b. Plants (Terrestrial) - All phases of development will result in "scalping" or removing of surface soil and vegetation. Impacts on construction areas will be high because all vegetation will be removed in localized areas. Again, the possibility of pollution and denudation from leaks and blowouts exists.

c. Animals (Hot Spring Environment) - The adverse impacts on these animals will be in direct relation to the degree of destructiveness to water quality and aquatic vegetation. Any change in the food, water, and cover requirements of animals will affect them.

The pollution or elimination of surface water or vegetation would have an impact of eliminating most aquatic animlas in the hot springs environment.

If this great amount of rapid physical change occurred, the chance that one, or a series of these successive change(s), could bring about the extinction of the Desert dace at Soldier Meadows would be increased. This could be done by simply changing the temperature, polluting, or drying up the water.

d. Animals (Areas Other Than Hot Spring Environment) - As a specific development proceeds through test drilling and production testing, physical land modification and commotion would occur. These activities include such things as construction of roads, ponds, and drill sites and drilling of wells, which could result in loss of wildlife values including both habitat and recreational use of wildlife within the area of influence. Such modifications would physically alter or remove existing wildlife habitat and the permanance of these effects would be dependent upon the nature of the particular construction or operational activity. However, in some instances clearings, revegetated areas and roads or trails resulting from geothermal operations could improve wildlife habitat. It also should be recognized that many animals also have the ability to adapt to changed environments.

In addition to land modifications, noise and other commotion may have an effect on the wildlife community surrounding lease areas. Noise may drive some species from the area, may disturb normal preditor-prey relationships, or may affect mating and rearing habits. Most areas adjacent to or outside the immediate areas of influence would however be expected to retain part or all of their wildlife populations and habitat.

PRODUCTION

a. Plants (Aquatic) - The impacts discussed in the exploration phase would also apply here. It may be possible to establish aquatic vegetation in and around the geothermal waste evaporation ponds if the waste fluids are left on the surface.

b. Plants (Terrestrial) - The establishment of new drill sites and associated pits and impoundments will eliminate the vegetation on these localized areas.

c. Animals (Hot Spring Environment) - The possibility of geothermal wells drying up hot springs exist. This would have an adverse impact on animals by destroying their food, water and cover. Surface waters could become polluted, or dried up, and destroy the habitat for animal use. This could bring about the extinction of the Desert dace at Soldier Meadows.

d. Animals (Areas Other Than Hot Springs Environment) - Effects of production would cause an adverse impact to most wildlife species by the increase in human activity. This would especially be true around aquatic areas. Any contamination or activity of or around aquatic areas would affect all animals (birds, mammals, and amphibians) that depend on the habitat.

CLOSE OUT

a. Plants (Aquatic) - Removal of structures and equipment will cause some disturbance to the soil. This would have a tendancy to accelerate erosion and could increase turbidity, thereby affecting aquatic vegetation. Geothermal and oil and gas leaks would also have a detrimental impact on aquatic vegetation.

If aquatic vegetation is established during the production phase, rehabilitation measures could ensure maintenance of the ponds and vegetation. The impact could be highly beneficial.

b. Plants (Terrestrial) - Removal of structures and equipment will have a detrimental impact on grasses, forbs, and shrubs. The impact will be slight because equipment can be moved over established roads. Surface reclamation and restoration should have a highly beneficial impact on restoration of vegetation.

c. Animals (Hot Springs Environment) - Possible established evaporation ponds will dry up and the localized animal population will have to depend on the original source of water. If waste ponds are established and maintained, it would be a boon to the animals using and living in the ponds.

d. Animals (Other Than Hot Springs Environment) - The removal of surface equipment and buildings will allow more habitat for small rodents. The decrease in human activity will allow big game animals to return to the areas without an adverse impact.

Water attracts animals and it is likely larger populations of animals will establish around new water sources, if they become available. Surface reclamation and restoration will have a beneficial impact on vegetation, and could provide more wildlife habitat.

3. Ecological Interrelationships

a. Plant Succession - The ecological process of plant succession will be adversely affected during all four stages of implementation. Off-road vehicle traffic, road construction, well drilling, and plant pipeline, and electric trassmission line construction will eliminate vegetation locally. Because of the arid conditions, bare ground succession to the original plant community would be very slow. The adverse impacts would be having bare ground for 10-15 years at the lowest elevations and noxious weed invasion in the higher rainfall areas.

Rehabilitation (seeding, transplanting) could have a beneficial impact on the successionally set back areas. It is anticipated that they could be restored to at least the original vegetative condition.

4. Human Values

a. Landscape Character - Exploration, development, operation, and close-out could have an adverse impact on the harmonious aspect of the environment. Drill rigs, trucks, and testing equipment will cause visual change from the desert landscape during the exploration phase. Plant construction, geothermal steam and oil and gas pipelines, and

electric taansmission lines will detract from the untrammeled vastness of the cold desert biome at the onset of development and operation. The odor of hydrogen sulfide or methane gas may detract from the enjoyment of the area by visitors.

Noise from air drillings and production testing may be intense (100-125 decibels at 25 feet) and approximate the levels of an unmuffled diesel truck. This would detract from the enjoyment of the area by visitors and might limit the suitability of nearby land for some developmental uses. Close out and the removal of the plant facilities will return the landscape to a more natural state.

The presence of drill masts, exploration rigs, plant facilities and electric transmission lines may serve as a welcome break in scenery to travelers in the area. Developmental activity may accentuate the background of playas and treeless mountains. Drilling activity along I-80 on private ground has already caused many of the traveling public to pull off the freeway for a closer look. Full scale development may create sufficient visitor interest to warrant development of facilities for observation and visitor safety.

The Black Rock Desert represents a unique natural feature that holds potential for future use in recreation and science. The Winnemucca District Management Framework Plan states, " It is recommended that the Black Rock Desert be protected from all types of uses, which would disrupt its smooth surface with ditches, grades, or obstructions. " Considering this, it will be recommended that any surface development and construction be prohibited in the Black Rock Desert on the unsurveyed lands designated in the appended map pending further environmental study (appendix V).

b. Sociocultural Interests - Impacts on archeological sites are possible although no systematic survey has been made. Don Tuohy, Curator of Anthropology at the Nevada State Museum indicates that vandalism is the main concern of archeologists. Unless geothermal and oil and gas crews are informed of the intent of the National Environmental Policy Act, and State and Federal antiquities preservation acts, arrowhead collecting and pot hunting opportunities are greatly increased.

Archeological and historical sites may also be disturbed during the exploration phases. This could be caused by vehicle traffic, test drilling, and crew members.

Some impacts on archeological and historical sites are eliminated by the restrictions on geothermal and oil and gas operations on the Mahogany Creek Natural Area, and the delineated portion of the Black Rock Desert.

The natural phenomena of hot springs and associated geology could have a positive educational impact along with the technology of geothermal and oil and gas resources development.

People in the proposed leasing area, and Nevada in general, are well aware of the potential for geothermal development. Drilling and testing has been going on for oil and other minerals for years. Gerlach would be the community most likely to be impacted by new residents, both temporary and permanent.

B. Possible Mitigating or Enhancing Measures

Mitigation of most of the potential environmental problems and impacts from geothermal or oil and gas exploration and development can be accomplished through enforcement of applicable Federal, State and Local laws and regulations, geothermal and oil and gas operating regulations, geothermal resource operational orders, lease and land use permit stipulations, and application of existing and yet to be developed technologies.

Most potentially known or anticipated impacts which may occur from geothermal or oil and gas development in the Buffalo Hills area have been included in the analysis. Unanticipated environmental impacts which become apparent as a result of geothermal or oil and gas development will be mitigated before implementation of a plan of development.

Mitigating Measures - Exploration

1. Off-road vehicle travel - Restrict off-road vehicle traffic in the spring or after heavy rainfall when the soils are wet and muddy. Limit vehicle travel to established roads and trails wherever possible.

2. Road and trail construction - Temporary roads for exploratory work and to test drill sites should be "brushed." In other words, the brush should be removed leaving the herbaceous cover to hold the soil. Removed brush should be scattered over abandoned roads.

3. Drilling - Removed, dead brush and vegetative matter should be scattered over abandoned drill sites.

No road or trail construction or drilling of test wells should be done until an archeological, paleontological and historical site survey has been performed.

Mitigating Measures - Development

1. Road Construction - The development phase will entail building roads to drill sites, power plants and along electric transmission lines. Some of these roads will receive moderate travel and should be graded, drained and surfaced. If dust becomes a factor, water trucks should be used to wet the roads. Temporary roads for power line construction will be of a lower standard and need no surfacing. An antiquity site survey should be made prior to development.

2. Drill Site Development - Permanent drill site pads should be surfaced (graveled) to prevent wind erosion and dust. Drill sumps should be fenced or measures taken to protect humans, livestock and other animals if toxic substances are used in the drilling operation. Should other intensive uses be developed in the area, special measures may be required to control noise and odor.

3. Plant Construction - Pumping and power plant design and architecture should be made to be harmonious with the natural desert landscape. Color schemes should be non-reflective and blend with the desert background.

4. Geothermal Pipelines - Steam pipes from the wells to the plant would be made to blend with the background at least in color. Metallic surfaces should be covered or painted to blend with the desert landscape. To eliminate a "web" of geothermal pipelines, slant drilling should be considered if feasible.

5. Oil and gas pipelines should also be made to blend with the background at least in color. Metallic surfaces should be covered or painted to blend with the desert landscape.

6. Electric Transmission Lines - Wooden structures or non-reflective towers should be used to lessen the visual impact on the area.

   Steps should be taken to prevent powerline electrocution of eagles, hawks, and other birds in designing electric transmission lines.

7. No geothermal or oil and gas development or road construction should be allowed on the surface of the Black Rock Desert within the delineated area, pending further environmental study (see appendix V).

8. No leasing, pending further environmental study, should be allowed in the vicinity of the hot springs that provide habitat for the rare and threatened species, Eremichthys acros. (See appendix VI, Soldier Meadows area)

Mitigating Measures - Production

1. New Drill Sites - These measures will be the same as for drill site development under the development phase. Should other intensive uses be developed in the area, special measures may be required to control noise and odor.

2. Waste Disposal -

   a. Evaporation Ponds - If the water quality is good, steps should be taken to develop aquatic habitat for birds, fish and amphibians. If the water is toxic, steps should be taken to prevent poisoning of animals and humans.

   b. Re-injection - Care should be taken not to contaminate fresh water zones.

Mitigating Measures - Close Out

Abandoning a geothermal or oil and gas field and removing structures and equipment will be mitigated under a restoration and reclamation plan. Surface restoration will be cumulative under close-out.

C. Recommendations for Mitigation or Enhancement of Environmental Impacts

1. Off-road vehicle travel shall not be permitted when soils are wet and muddy.

2. Antiquities and Objects of Historic Value

   a. Oil and Gas

   The lessee shall immediately bring to the attention of the Authorized Officer any antiquities or other objects of historic or scientific interest, including but not limited to historic or prehistoric ruins, fossils, or artifacts discovered as a result of operations under this lease, and shall leave such discoveries intact. Failure to comply with any of

terms and conditions imposed by the Authorized Officer with regard to the preservation of antiquities may constitute a violation of the Antiquities Act (16 U.S.C. 431-433).

Prior to operations, the lessee shall furnish to the Authorized Officer a certified statement that either no archeological values exist or that they may exist on the leased lands to the best of the lessee's knowledge and belief and that they might be impaired by oil and gas operations. Such certified statement must be completed by a qualified archaeologist acceptable to the Authorized Officer.

If the lessee furnishes a statement that archaeological values may exist where the land is to be disturbed or occupied, the lessee will engage a qualified archeologist , acceptable to the Authorized Officer, to survey and salvage, in advance of any operations, such archeological values on the lands involved. The responsibility for the cost for the certificate, survey, and salvage will be borne by the lessee, and such salvaged property shall remain the property of the lessor or the surface owner.

b. <u>Geothermal Energy</u>

The certified statement required by Section 18 of the lease form must be completed by a qualified archeologist , acceptable to the Authorized Officer.

3. Temporary roads and trails will be cleared of brush only. Upon abandonment, the roads and trails will be scarified and reseeded with plant species specified by the Authorized Officer.

4. Geothermal steam pipelines and structures will be designed, covered, or painted to lessen the visual impact on the desert landscape.

5. Electric transmission lines will be on wooden or metal towers designed, pointed, and located to maximize compatibility with the desert landscape. They will be designed to prevent powerline electrocution of eagles, hawks, and other birds.

6. The Authorized Officer shall be contacted if waste water quality is such that it may be used for domestic, livestock, or irrigation purposes.

7. Roads used by the lessee outside areas under geothermal steam leases are to be covered by permits granted under the Act of January 21, 1895 (43 U.S.C. part 956).

8. BLM developed stock watering facilities shall not be used as water sources for exploration, development or production operations.

9. No leasing, pending further environmental study, will be allowed in the Soldier Meadows area on the following unsurveyed lands:

T. 40 N., R. 24 E. MDB&M
Section : 10, 11, 12, 13, 14, 15, 22, 23, 24, 25, 26, 27, 34, 35, 36

T. 40 N., R. 25 E.
Section: 7, 8, 17, 18, 19, 20, 29, 30, 31, 32

10. No leasing, pending further environmental study, will be allowed on the surface of the Black Rock Desert on the following unsurveyed lands:

MOUNT DIABLO MERIDIAN, NEVADA

T. 37 N., R. 26 E., ALL

T. 36 N., R. 26 E., ALL

T. $35\frac{1}{2}$ N., R. 26 E., ALL

T. $35\frac{1}{2}$ N., R. 25 E.,
Sections 25, 26, 35, 36

T. 35 N., R. 25 E.,
Sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, 35, 36

T. 35 N.; R. 26 E., ALL

T. 35 N., R. 27 E.,
Sections 1 thru 13

T. $35\frac{1}{2}$ N., R. 27 E.,
Sections 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36

T. 36 N., R. 27 E., Unsurveyed TWP ALL

T. 37 N., R. 27 E., Unsurveyed TWP ALL

T. 37 N., R. 26 E., ALL

ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

Alternative #1 - Decline to Lease

This alternative would involve an administrative decision by the Bureau of Land Management not to lease for geothermal or oil and gas resource development, and of the national resource lands (NRL) within the proposed area. The environmental impacts of alternative #1 are as follows:

1. A decision not to lease would be contrary to the intent of the Act of February 25, 1920, the Geothermal Steam Act, and the attitudes and expectations of the majority of interested Nevadans who look to BLM as a major contributor toward the development of Nevada's widely publicized geothermal resources. There are national expectations, as well, which have been greatly reinforced by the recent "energy crisis" and the federal government's declared intent to encourage development of new energy sources.

2. A decision not to lease could seriously hamper efficient development of the resource on private land due to the "checkerboard" land ownership pattern. Companies now exploring and leasing geothermal resources on alternate private sections in the area have been doing so with the expectation that adjoining NRL would also become available to round out their potentially economic production units.

3. Alteration of the area's existing environment will occur to a significant degree whether the Bureau leases or not, due to geothermal and oil and gas development of private land. However, direct impacts to national resource lands due to surface disturbance would not occur.

Alternative #2 - Postpone Leasing

Under this alternative, the Bureau would "wait and see" the actual environmental impacts of its initial geothermal leasing program in the Mono Lake and Geysers areas of California before leasing in the proposed area. Advancement in oil and gas technology might also be realized during this time.

1. The environmental unknowns of geothermal leasing in the proposed area would likely be minimized using this approach.

2. Full geothermal development of the proposed area would be delayed for at least five years pending evaluation of the California leases.

3. To postpone leasing, for whatever reason, would be contrary to both statewide and national attitudes and expectations of speedy government action on a critical energy program.

IV. PERSONS, GROUPS AND GOVERNMENT AGENCIES CONSULTED

David Nyquist
Desert Research Institute
University of Nevada
Las Vegas, Nevada

United States Geological Survey
345 Middlefield Road
Menlo Park, California 94025

Don Tuohy, Curator of Anthropology
Nevada State Museum
Carson City, Nevada

Amy Mazza-Scholl
Member, Wilderness Society
1885 South Jackson Street
Denver, Colorado 80210

Ray Alcorn, Naturalist (Retired)
Bureau of Sport Fisheries and Wildlife
Fallon, Nevada

Harry E. Springer
Nevada State Mine Inspector
State Capitol Building
Carson City, Nevada

Brian Wright
Environmental Protection
Washoe County Health Department
Reno, Nevada

Robert S. Griffin
President, Trails West
1390 Mallory Land
Reno, Nevada

Gary Rankel
U.S. Wildlife Service
300 Booth Street
Reno, Nevada

Dale Lockard
Department of Fish & Game
1100 Valley Road
P.O. Box 10678
Reno, Nevada

Robert R. Miller
Professor of Zoology
University of Michigan
Ann Arbor, Michigan 48104

The Nevada State Museum has been requested to inform the Winnemucca District of any values which are on, or may be eligible for the National Register of Historic Places within the proposed leasing area.

V. INTENSITY OF PUBLIC INTEREST

Most of the public interest expressed in the proposed area concerns the development of geothermal resources. Four Known Geothermal Resource Areas (KGRA's), designated by the Geological Survey, lie in this area. There are no oil and gas Known Geological Structures (KGS's) in the proposed leasing area.

The keenest area of public interest is from applicants for geothermal exploration and geothermal steam leases. There have been several competitive interest areas formed by overlapping geothermal lease applications in the proposed area.

There are presently two oil and gas lease applications in the area. These two lease applications are located in the northeastern Smoke Creek Desert.

The public and various State and Federal agencies have expressed concern for the protection of the rare and threatened Soldier Meadows dace and Lahontan cutthroat trout, and the preservation of archeological, paleontological, and historical sites including the Black Rock Desert.

Concern has also been expressed over the possibility of "drying up" hot springs and tapping underground water reservoirs now used for irrigation.

The possibility of a new water source by desalting brine has aroused some interest. Most county governments welcome the possibility of new resource development and production and the prospects of increased tax revenue.

VI. PARTICIPATING STAFF

A team approach was used to develop the Environmental Analysis on the proposal to lease geothermal and oil and gas resources in the Buffalo Hills Planning Unit Area. Members of the team were:

Edwin Dimick - Watershed Specialist - Winnemucca District Office
Jerry Page - Wildlife Specialist - Winnemucca District Office

Larry Hand - Outdoor Recreation Planner - Winnemucca District Office
Ben F. Collins - Area Manager - Winnemucca District Office
Dennis Simontacchi - (Team Leader) - Geothermal Specialist - Winnemucca District Office

VII. RECOMMENDATION ON ENVIRONMENTAL STATEMENT

Based on a review and evaluation of information pertaining to this proposal, I have determined that the action proposed is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. I therefore recommend an environmental impact statement not be prepared.

William D. DiCarlo (Acting) — 3/12/75
Lead Responsibility — Date

I CONCUR:

Robert D. Cordell Acting — 3-12-75
Area Manager — Date

Raymond E. Monroe — 3/12/75
Raymond E. Monroe — Date
Environmental Coordinator

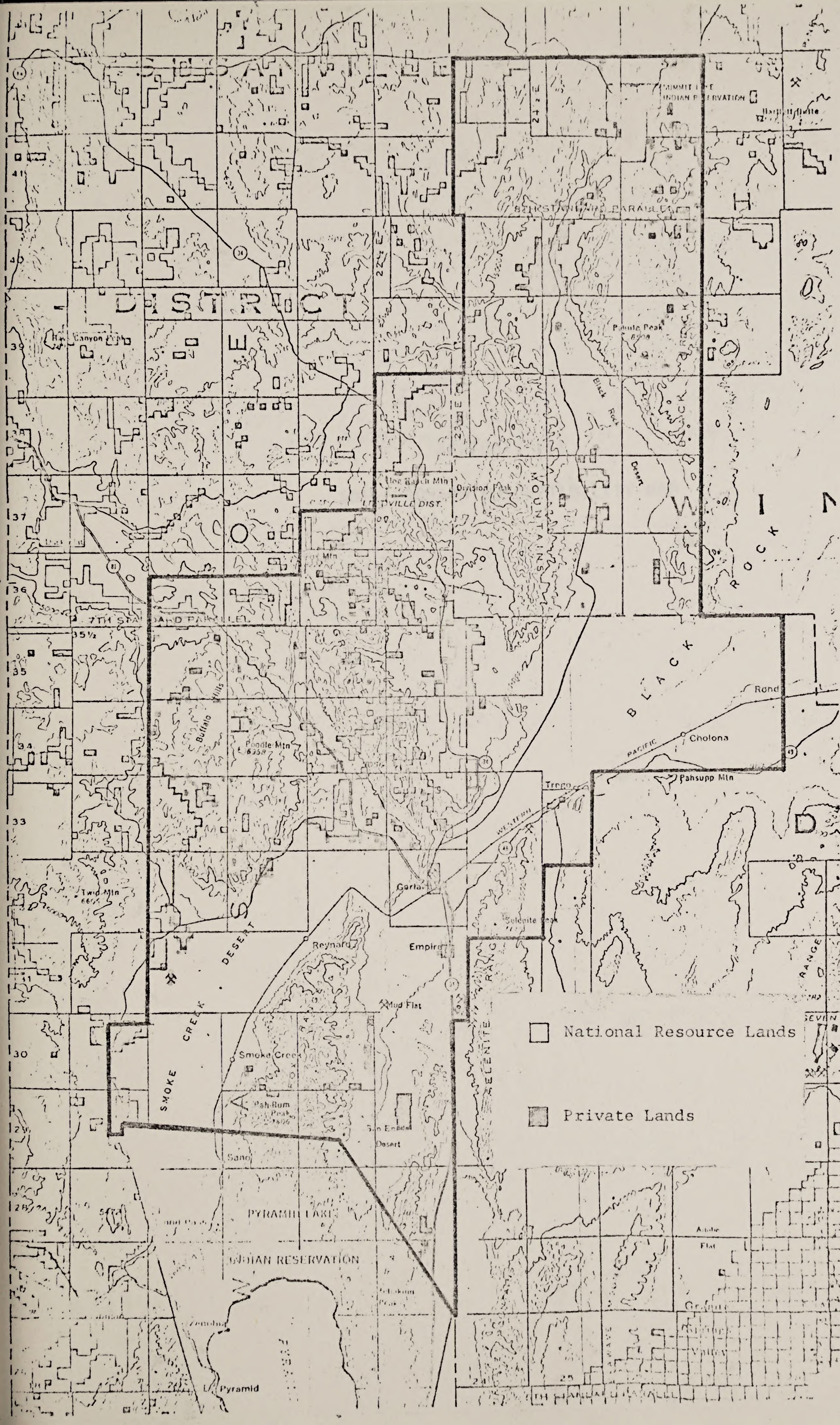
Chester E. Conard — 3/12/75
Chester E. Conard — Date
District Manager

APPENDICES

I - Environmental Analysis Worksheet (checklist)
II - Land Status Map
III - Soil Erosion Susceptibility Map
IV - Mahogany Creek Natural Area
V - Black Rock Desert Playa
VI - Soldier Meadows Desert Dace Area
VII - Geothermal and Oil/Gas Map
VIII - Hot Springs Data Sheet
IX - Hot Srpings Photographs
X - Ground Water Data Sheet
XI - Historic Trails
XII - References

APPENDIX II

LAND STATUS MAP


DISTRICT
BLACK ROCK DESERT
WIND
MOUNTAINS
Black Rock Desert
Cholona
Pahsupp Mtn
Trego
Gerlach
Empire
Reynard
Selenite Peak
SELENITE RANGE
Poodle Mtn
Twin Mtn
SMOKE CREEK DESERT
Smoke Creek
Mud Flat
PYRAMID LAKE
INDIAN RESERVATION
Pyramid
Division Peak
Pahute Peak
7TH STANDARD PARALLEL
National Resource Lands
Private Lands

APPENDIX III

SOIL EROSION SUSCEPTIBILITY MAP

EROSION SUSCEPTIBILITY MAP

This map presents the relative erodibility of the soils (regarding mainly water erosion) of the Buffalo Hills Planning Unit if vegetative cover is removed or drastically reduced. Relative Water Erodibility was determined by evaluating the factors of 1) Precipitation Zones, 2) Slope Class, 3) Surface Soil Texture, and 4) the relative amount of organic matter present in the soil. By the conversion of data presented in the Soil Stability On High-Elevation Rangeland In The Intermountain Area by Richard O. Meeuwig, a range of Relative Erodibility wad determined. The spread is from 1 to 243 and this spread is broken into weighted classed, due to the parabolic nature of the curve produced.

Wind Erosion Susceptibility is not shown on this map because all areas are susceptable when the vegetative cover is removed. Finer textured soils are more susceptible to erosion than the coarse textured soils. Areas of fine textured soils show evidence of wind erosion by the presence of desert pavement playas, but extensive erosion is undiscernable because the soil is carried away by the wind. The only evidence of wind erosion on coarse textured soils is the formations of dunes in some areas. Also wind erosion susceptability could not be shown accurately because the presence of prevailing wind patterns affect considerably the erosion susceptibility of soils but little information is available for determining these patterns.

APPENDIX IV

MAHOGANY CREEK NATURAL AREA

The following described lands were disignated as the Mahogany Creek Natural Area, pursuant to the authority in 43 CFR, Subpart 2070., and are not covered by the Buffalo Hills E.A.R. (See following map)

MOUNT DIABLO MERIDIAN, NEVADA

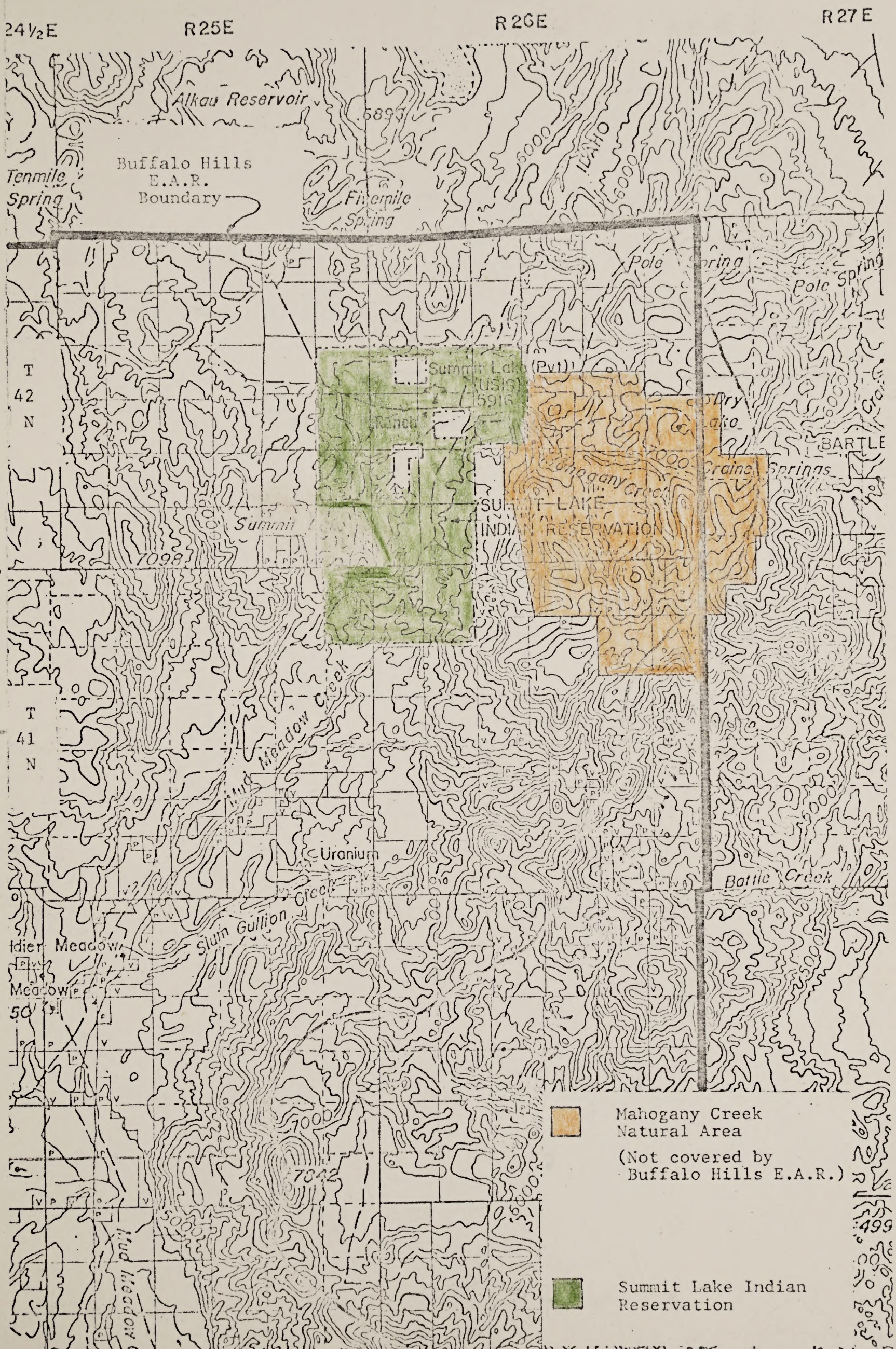
T. 41 N., R. 26 E.
Sec. 1, lots 1, 2, 3 and 6,
$SW\frac{1}{4}SE\frac{1}{4}$, $SW\frac{1}{4}SW\frac{1}{4}$, $NE\frac{1}{4}SW\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$:
Sec. 2, lots 1 and 4
$S\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}$, $W\frac{1}{2}SW\frac{1}{4}$, $SW\frac{1}{4}NW\frac{1}{4}$:
Sec. 3, All
Sec. 4, lots 1, 7 and 16
$SE\frac{1}{4}NE\frac{1}{4}$:
Sec. 11, all;
Sec. 12, lots 1 to 4 inclusive,
$N\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}NE\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$, $SW\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $W\frac{1}{2}NW\frac{1}{4}$

T. 42 N., R. 26 E.
Sec. 14, lots 5 to 8 inclusive,
$SW\frac{1}{4}$
Sec. 15, lots 7 to 12 inclusive;
Sec. 22,
$N\frac{1}{2}$, $NW\frac{1}{4}SE\frac{1}{4}$, $NE\frac{1}{4}SW\frac{1}{4}$;
Sec. 23, all;
Sec. 24, all;
Sec. 25, all;
Sec. 26, all;
Sec. 27, $W\frac{1}{2}NE\frac{1}{4}$, $S\frac{1}{2}$, $SE\frac{1}{4}NW\frac{1}{4}$, $W\frac{1}{2}NW\frac{1}{4}$:
Sec. 28,
$E\frac{1}{2}$;
Sec. 33, $E\frac{1}{2}E\frac{1}{2}$;
Sec. 34, all
Sec. 35, lots 5 to 20 inclusive;
Sec. 36, all

Unsurveyed:

T. 41 N., R. 27 E.
Sec. 6, $N\frac{1}{2}$, $SW\frac{1}{4}$,
T. 42 N., R. 27 E.
Sec. 19, $W\frac{1}{2}$;
Sec. 29, $W\frac{1}{2}SW\frac{1}{4}$;
Sec. 30, $SE\frac{1}{4}$, $W\frac{1}{2}$;
Sec. 31, all;
Sec. 32, $W\frac{1}{2}W\frac{1}{2}$

The area described above aggregates approximately 12,316 acres of public land.


24½E
R25E
R26E
R27E
Alkali Reservoir
5899
Buffalo Hills
E.A.R.
Boundary
Tenmile
Spring
Fivemile
Spring
5000
IDAHO
6000
Pole
Pole Spring
T
42
N
Summit Lake (Pvt)
(USIS)
5916
Ranch
Mahogany Creek
SUMMIT LAKE
INDIAN RESERVATION
Summit
7098
BARTLE
Springs
Meadow Creek
T
41
N
Uranium
Battle Creek
Slum Gullion Creek
Meadow
Meadow
7012
Mud Meadow
Mahogany Creek
Natural Area
(Not covered by
Buffalo Hills E.A.R.)
Summit Lake Indian
Reservation

APPENDIX V

BLACK ROCK DESERT PLAYA

The following described lands include those portions of the Black Rock Desert which should be excluded from leasing pending further environmental study:

MOUNT DIABLO MERIDIAN, NEVADA

T. 37 N., R. 26 E., All

T. 36 N., R. 26 E., All

T. 35½ N., R. 26 E., All

T. 35½ N., R. 25 E.,
Sec. 25, 26, 35, 36

T. 35 N., R. 25 E.,
Sec. 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, 35, 36

T. 35 N., R. 26 E., All

T. 35 N., R. 27 E.,
Sec. 1 thru 13

T. 35½ N., R. 27 E.,
Sec. 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36

T. 36 N., R. 27 E., Unsurveyed TWP All

T. 37 N., R. 27 E., Unsurveyed TWP All

T. 37 N., R. 26 E., All

Pahute Peak
Cairn
8508
Pahute
Mdws
Creek
Cain Springs
MILES
0 1 2 3
N
Lake
Willow
Creek
BM C 70
4704
Meadow
Reservoir
Reservoir
Creek
Donnelly Res
Creek
Division Peak
8491
Division
Finley Reb
Cow
Creek
Vogel Weine
Ranch
E. Donnelly
Peak
7687
King
Spring
Double
Hot
Springs
Desert
Quinn
Desert
T. 38 N.
T. 37 N.
T. 35 N.
T. 35 ½ N.
T. 34 N.
CALICO MOUNTAINS
BLACK ROCK DESERT
HUMBOLDT COUNTY
PERSHING COUNTY
Gambler
Rust
Black Rock Point
Black
Brush
Sand Dunes
Bar W Ranch
Steamboat Mtn
Steamboat
Alkali Flat
SULPHUR
Ronda
Pershing
Cholona
Wash
Rabbithole
RAILROAD
PACIFIC
WESTERN
Pahsupp
5355
Hot
Springs
Weepi
Trego
Mt Trego
Garrett
Barrel
Springs
Rabbithole
Spring
Fisit
Granite
Spring
Ascalon
101
95
34
49
R. 25 E.
R. 26 E.
R. 27 E.
R. 28 E.
R. 29 E.
MTNS
PAHSUPP

APPENDIX VI

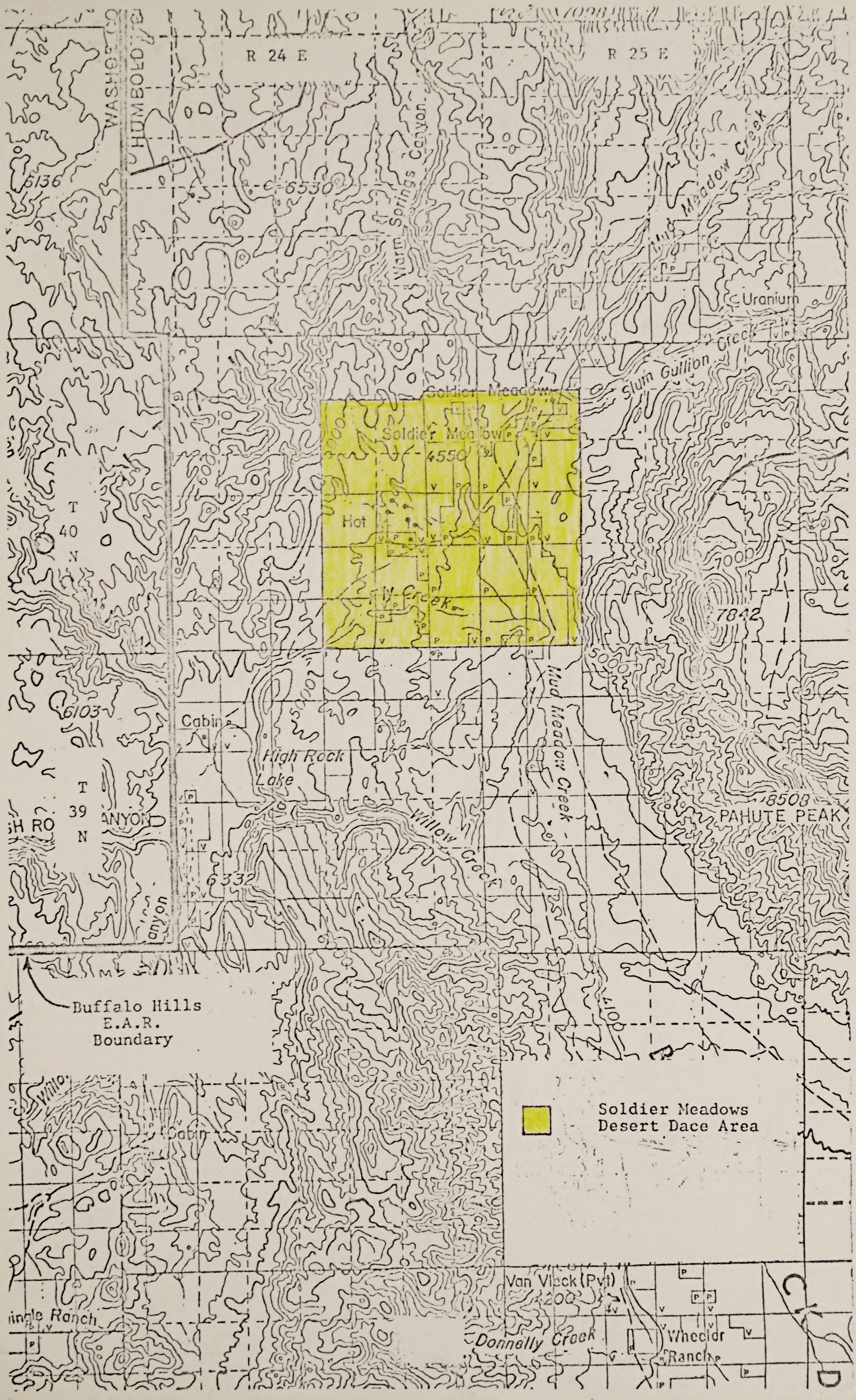
SOLDIER MEADOWS DESERT DACE AREA

On the following described lands adverse impacts caused by the proposed leasing program could gradually encroach and intrude upon Eremichthys acros, Desert dace habitat, ultimately causing deterioration or destruction of this resource.

It is therefore essential that these areas be excluded from leasing pending further environmental study.

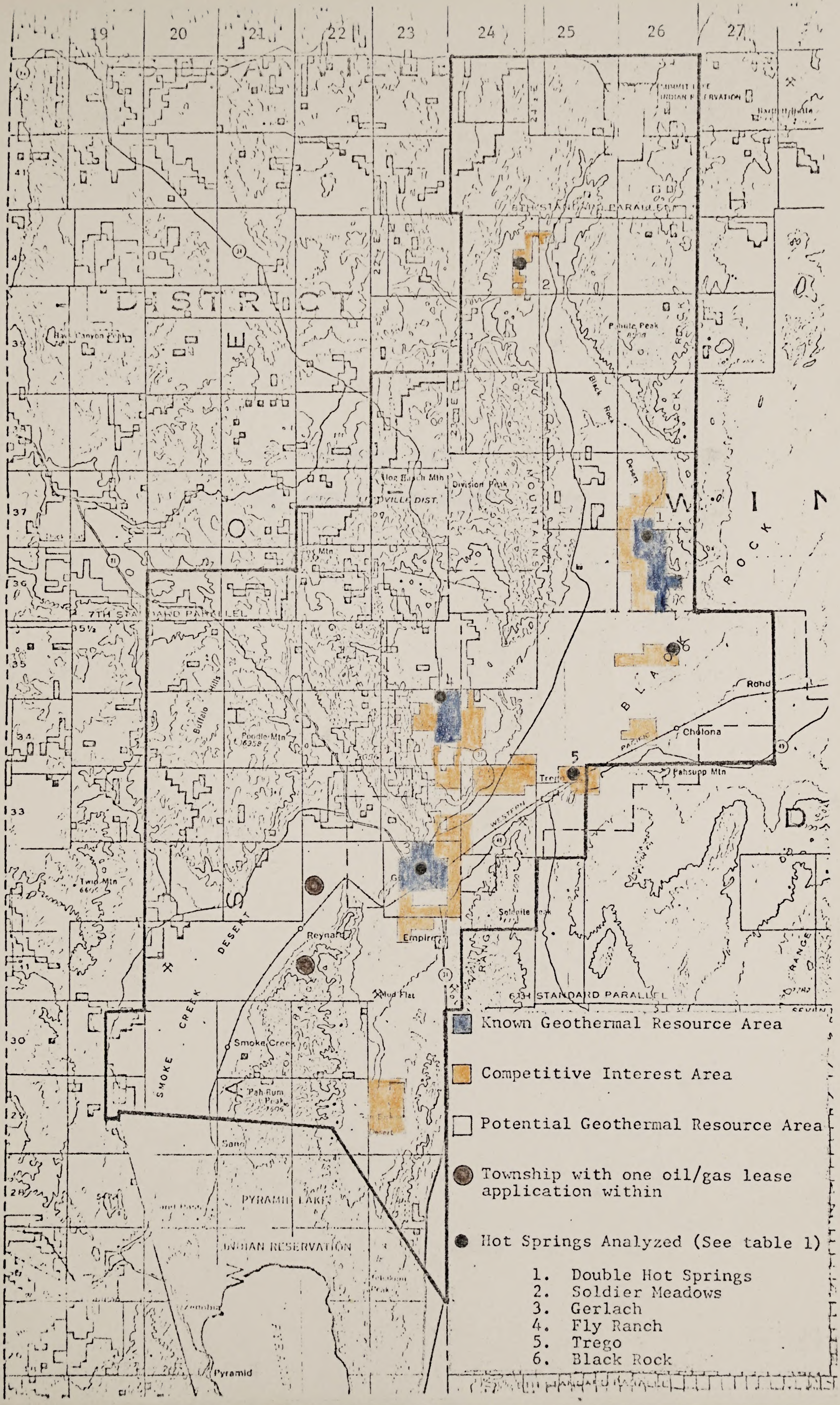
T. 40 N., R. 24 E.
Sections: 10, 11, 12, 13, 14, 15, 22, 23, 24, 25, 26, 27, 34, 35, 36

T. 40 N., R. 25 E.
Sections: 7, 8, 17, 18, 19, 20, 29, 30, 31, 32


R 24 E
R 25 E
WASHOE CO
HUMBOLDT CO
Warm Springs Canyon
Meadow Creek
Uranium
Slum Gulliion Creek
Soldier Meadow
Soldier Meadow
4550
Hot
Creek
7842
5000
Mud Meadow Creek
6136
6530
6103
Cabin
High Rock Lake
T 39 N
6332
Willow Creek
8508
PAHUTE PEAK
4100
Buffalo Hills
E.A.R.
Boundary
Soldier Meadows
Desert Dace Area
Cabin
Van Vleck (Pvt)
4200
Donnelly Creek
Wheeler Ranch

APPENDIX VII

GEOTHERMAL AND OIL/GAS MAP



19
20
21
22
23
24
25
26
27
DISTRICT
Hog Ranch Mtn
Division Peak
MOUNTAINS
Black Rock
Pahute Peak
7TH STANDARD PARALLEL
Buffalo Hills
Poodle Mtn
Twin Mtn
Road
Cholona
Pahsupp Mtn
Trego
WESTERN
PACIFIC
Reynard
Empire
Mud Flat
DESERT
SMOKE CREEK
Smoke Creek
Pah Rum Peak
6TH STANDARD PARALLEL
PYRAMID LAKE
INDIAN RESERVATION
Pyramid
Known Geothermal Resource Area
Competitive Interest Area
Potential Geothermal Resource Area
Township with one oil/gas lease application within
Hot Springs Analyzed (See table 1)
1. Double Hot Springs
2. Soldier Meadows
3. Gerlach
4. Fly Ranch
5. Trego
6. Black Rock

APPENDIX VIII

HOT SPRINGS DATA SHEET

Hot Spring	Location	Spring temperature °C	Estimated Reservoir Temperature °C	Flow g.p.m.	pH	Specific Conductance	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Lithium (L)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Boron (B)	Spring Deposits		Comments
																			$CaCO_3$	SiO_2	
Double Hot Springs	Sec 4 T36N, R26E	80	127-140	175	7.93	902	105	4.8	.1	180	4.5	.06	261	2	120	59	10	1.8	T	T	U.S.G.S. KGRA Mixed waters, Estimated Reservo temp may be low
Unnamed Hot Springs in Soldier Meadows	Sec 23 T40N R24E	54	65	50	8.55	363	63	3.1	<.1	74	1.1	.17	92	3	41	18	12	.64	--	--	- -
Great Boiling Spring Gerlach	NW¼ Sec 15 T32N R23E	86	167-175	--	7.15	7,610	165	68	1.2	1,400	130	1.6	83	<1	400	2,200	4.5	9.9	T	X	U.S.G.S. KGRA boiling
Wards Hot Spring Fly Ranch	Sec 2 T34N R23E	80	125	500	791	1,800	82	31	4.2	340	17	.46	458	4	46	240	7.0	1.9	X	--	U.S.G.S. KGRA
Unnamed Hot Spring near Trego	lat.40°46'N long.119°7'W	86	120-128	--	8.4	2,300	85	25	.2	463	9.3	N.A.	154	--	86	520	N.A.	N.A.	--	--	near boiling
Unnamed Hot Spring near Black Rock	lat.40°57'N long.118°58'W	90	117-148	-	8.1	6,590	120	35	4	1,500	20	N.A.	932	--	290	787	N.A.	N.A.	--	--	near boiling

a) Concentrations in milligrams per liter unless otherwise noted
b) N.A. indicates not available
c) T indicates Trace

Data from U.S.G.S Open File Report

APPENDIX IX

HOT SPRINGS PHOTOGRAPHS

"Fly Geyser" - Calcium carbonate tufa dome formed at the site of geothermal exploratory well. Fly Ranch T. 34 N., R. 23 E.

Geyser at Fly Ranch - Calcium carbonate tufa forming, probably at well site. T. 34 N., R. 23 E.

Double Hot Springs, Black Rock Desert T. 36 N., R. 26 E.

APPENDIX X

GROUND WATER DATA SHEET

All Figures Are In Thousands Of Acre-Feet Per Year Unless Otherwise Noted

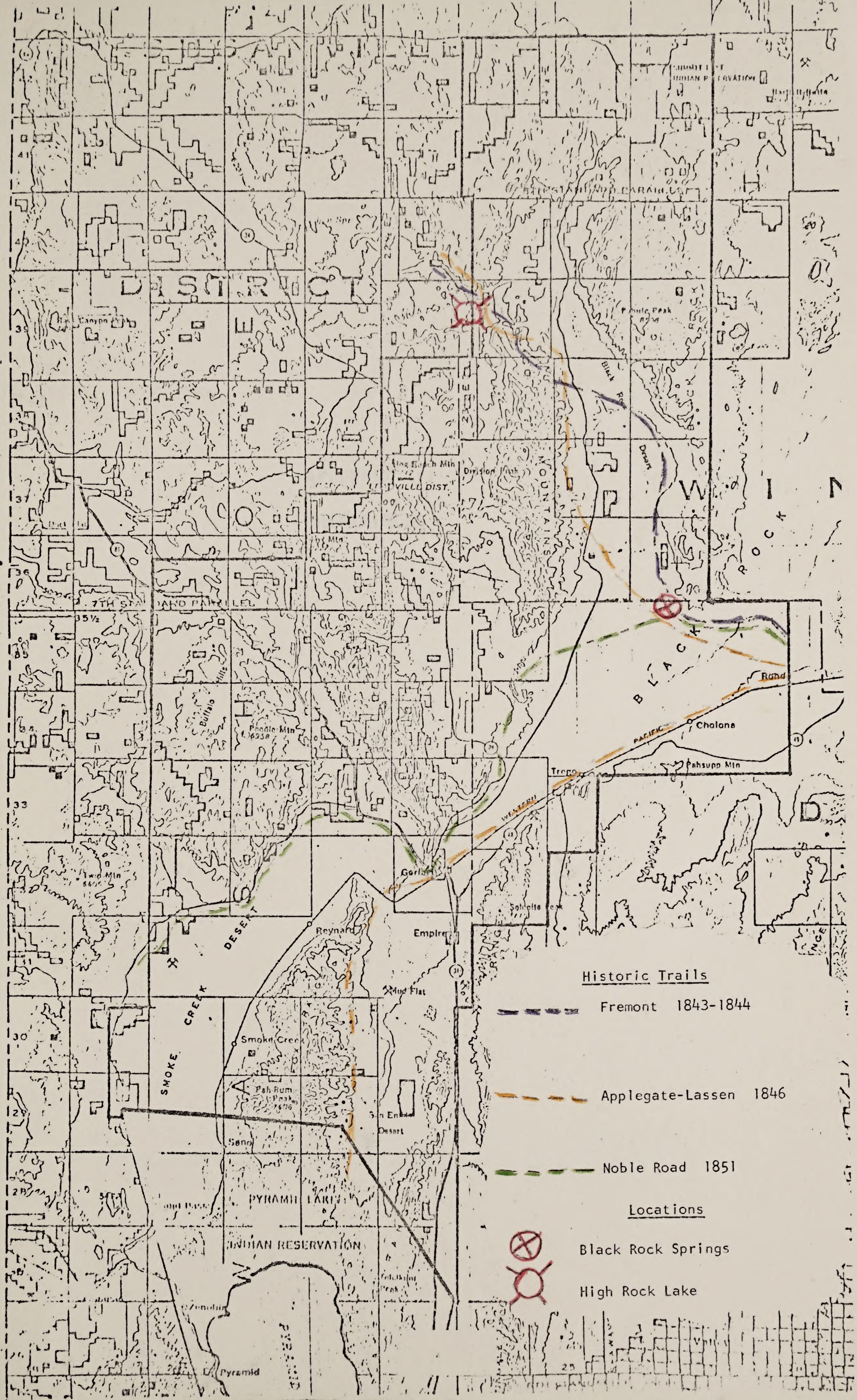
Hydrologic Unit	*Estimated Storage	**Estimated Perennial Yield	Estimate Runoff	Approximate Valley area (Sq. miles)	Ground Water Recharge	Discharge by Evapotranspiration	Comments
Black Rock Desert (includes Mud Meadow)	5,600	30	28	2,600	8 sub-basins range from 2-13	10-30	Less than 1/3 of Black Rock Desert falls in Buffalo Hills Planning Unit
Mud Meadow	850	13	24	-	-	-	surface and subsurface flow into Black Rock Desert
Smoke Creek Desert	2,000	16	20	1,120	13	19	minor pumpage
San Emidio Desert	840	3	3	308	2	3	surface and sub-surface flow into Black Rock and San Emidio Deserts minor pumpage
Hualapai Valley	350	7	5	50	7	6	sub-surface flow into Black Rock Desert 7.5 net pump (1967)

* Storage = water stored in upper 100 feet of ground water reservoir

** Perennial Yield = amount of ground water which can be removed from a hydrographic area each year without depleting the ground water reservoir.

APPENDIX XI

HISTORIC TRAILS



DISTRICT
MOUNTAINS
BLACK ROCK
Black Rock Desert
7TH STAND PARALLEL
Division Peak
Cholona
Rand
PACIFIC
WESTERN
Pahsupp Mtn
Trego
Gerlach
Empire
Reynard
Mud Flat
SMOKE CREEK DESERT
Smoke Creek
Sand
PYRAMID LAKE
INDIAN RESERVATION
Pyramid
Twin Mtn
Buffalo Hills
Poodle Mtn 6958
Historic Trails
Fremont 1843-1844
Applegate-Lassen 1846
Noble Road 1851
Locations
Black Rock Springs
High Rock Lake

APPENDIX XII

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REFERENCES

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