LAS VEGAS WASH

CLARK COUNTY, NEVADA

draft **environmental impact statement**

Las Vegas Wash/Bay
Pollution Abatement Project

Paul De Falco, Jr
Regional Administrator
October 21 1974

100 california street **san francisco ca**

ENVIRONMENTAL IMPACT STATEMENT

DRAFT (x) OCT 21 1974

FINAL ( )

Prepared by the United States Environmental Protection Agency, Pacific Southwest, Region IX, San Francisco, California 94111

1. Type of Action:

   a. Administrative

2. Description of Project:

The objective of this project is to eliminate existing secondary discharges from municipal sources in the Las Vegas Wash/Bay drainage area. Currently three separate sewage treatment outfalls discharge to Las Vegas Wash, providing a year-round flow that supports a vegetative habitat similar to many lush riparian environments and serving as a contrast to the vast desert within which it sets.

Secondary effluent has been a major source of accelerated water quality degradation in Las Vegas Bay, where nutrients have supported algal blooms. Salt concentrations in Las Vegas Bay have been accelerating due to contributions from municipal sources, industrial sources, ground water return flows and other diffused sources.

A 180-day enforcement notice to clean up all discrete discharges to the Wash was issued by the Environmental Protection Agency in December of 1971. A December 1972 submittal of a plan to the Nevada Legislature by the Las Vegas Valley Water District, resulted in the designation of Clark County as the responsible entity to undertake examination of an additional alternative, in lieu of the 9 alternatives presented in the December 1972 findings.

Basically all alternatives are regional in scope, linking the existing communities of Las Vegas, North Las Vegas, and Henderson. Only the "no action" alternative would result in perpetuation of the three existing separate secondary effluent discharge outfalls. At issue is the attainment and maintenance of State-Federal Water Quality Standards through limitations imposed on the Wash dischargers by EPA under the National Pollutant Discharge Elimination System permit program (NPDES), as established by Congress in the Federal Water Pollution Control Act Amendments of 1972.

After careful analysis, the Environmental Protection Agency has concluded that Alternative 10 is the alternative which best represents the desires of the local populace in abating pollution in Lake Mead. In the selection of this alternative a reclamation/reuse proposal to export 36-38 million gallons per day (mgd) of AWT effluent to the proposed Allen Power Plant was recommended by the applicant. EPA will need to evaluate this proposed reclamation/reuse intention as further information becomes available on it. Therefore the Agency has reserved judgment on this portion of the selected project.

SUMMARY

The proposed action includes the construction of a first phase 90 million gallon per day (MGD) advanced waste treatment (AWT) plant, a collection system from the four existing secondary treatment plants to the AWT Plant, a pilot desalination and pilot ground water recharge program of 1.0/mgd, and discharge to Las Vegas Wash through a single outfall. Return flow will benefit an in-valley irrigation system and the crediting of return flows reaching Lake Mead. Primarily, this action is confined to Clark County, Nevada and the downstream remainder of the Lower Colorado River.

3. Impacts of the Proposed Alternative Actions.

Of the ten alternatives proposed, four alternatives were considered as viable for economic and engineering reasons in meeting the project objective, the abatement of pollution in Lake Mead. Alternative 9, no action, was not among them.

The primary impact of each viable alternative considered varies. Normal construction impacts can be anticipated with each, with all alternatives emphasizing disposal with a Wash maintenance discharge. Vegetative and wildlife habitats will be impacted differently due to the difference in the quantity and quality of flow from each alternative. Each viable alternative will result in commitment of land for facilities, with alternatives 2 and 7 setting aside large tracts of land for evaporation ponds, and all alternatives will, no doubt, change the use of land. Each alternative will result in an increase in the use of energy. Each alternative represents a major commitment of financial resources. Air quality will be degraded if a proposed power plant is accomodated with AWT or secondary effluent.

Secondary impacts in the form of increased population growth and urbanization will occur through capacity accommodated in all of the Alternatives. Increased resource consumption, whether it be from per capita, commercial, or industrial sources will affect resource exploitation. All alternatives would accommodate a proposed power plant with either AWT or secondary effluent for cooling purposes. The accommodation of this power plant could affect future power development projects for the Los Angeles Metropolitan area and would initiate strip mining of coal in Southern Utah, along with attendant air and water pollution problems arising from both actions. A system of crediting return flows to Lake Mead from Abatement Project discharges would compensate for Southern Nevada Water Project withdrawals from the Colorado River system as adjudicated to Nevada.

Each viable alternative will result in the abatement of pollution in Lake Mead which has perpetuated itself due to long overdue remedial action.

4. Alternatives Considered.

Ten alternatives were considered, with four being considered economically and engineeringly capable of satisfying the environmental objective of the recognized pollution problem, "no action" not being one of those alternatives. Alternatives considered further in the statement for their environmental impact are: Alternative 2-Complete Treatment, Alternative 3-AWT and Return to Lake Mead, Alternative 7-Combination Alternative and, Alternative 10-Amended Combination Alternative.

5. Dates Available to CEQ

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6. Distribution List attached.

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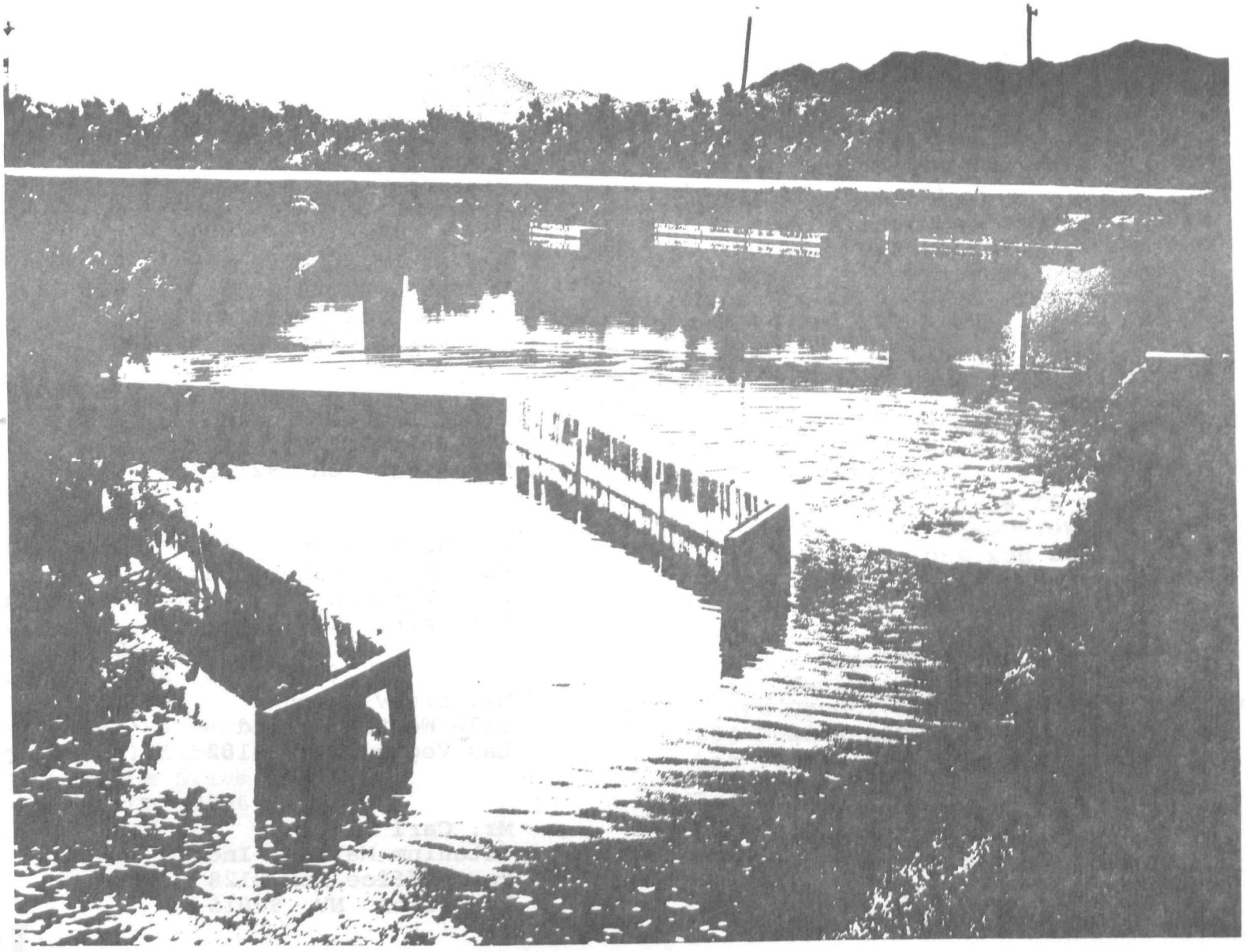

introduction

The Las Vegas Valley has experienced a phenomenal growth in the past 40 years. With the construction of Hoover Dam in the 30's, the foundation was laid for the beginning of a spiraling economic growth that is still being realized. With the advent of Nevada's quick-divorce machinery and the legalization of most types of gambling, a life style unique to that of any state in the United States boomed after World War II as casinos began to pock the pristine desert landscape. The valley population has increased from 122,957 people in 1960 to an estimated 316,725 in 1973. Estimates of population by the year 2000 range from a low of 500,000 people to a high of 1,500,000 people. For planning purposes this impact statement has adopted the Clark County Regional Planning Council's year 2000 medium population projection of 700,000 people for Las Vegas Valley.

As this snowballing phonomena of urban growth boomed, the quality of life improved, yet began to take its toll on the quality of the environment. After a history of damming, diverting, and dividing up the Colorado River, man-made tributaries of nutrients, toxins, solids, and salts began to replace the once pristine streams. The increased automobile traffic into and within the area, and the construction of in-valley fossil fueled power plants soon degraded the clarity of the desert skies. By the end of the sixties, the new decade brought a national awakening of an environmental conscience.

Municipal and industrial waste waters rich in nitrogen, phosphorus and dissolved solids are discharged into Las Vegas Wash. These discharges, along with highly saline subsurface flows, are polluting Lake Mead and downstream Colorado River. The principal effects that have resulted are increased algal mats that die-off, lowering dissolved oxygen, causing odors, and reducing the potability and useability of the water due to poor taste, bacterial contamination and/or salt concentration.

Major efforts toward developing a pollution abatement program in the Las Vegas Wash/Lake Mead area were initiated in 1967. Through the efforts of citizens within the Las Vegas Valley, and the concern of Federal, State, and local agencies to check any further pollution of water resources, a commitment among them was joined to

define and determine the future environmental goals and objectives of such an undertaking.

Repeated investigations and reports failed to produce a unified strategy for abatement of pollution. In December of 1971, a conference was called by the U.S. Environmental Protection Agency to discuss with all responsible agencies and in-valley dischargers a pending 180-day enforcement action against them by EPA for failing to do so. In 1971, the Nevada Legislature designated the Las Vegas Valley Water District (LVWD) as the agency responsible for developing a plan to abate the pollution caused by municipal waste water flows in Las Vegas Wash. Industry would provide their own means of meeting discharge requirements set by the Environmental Protection Agency.

The plan, which outlined a program of exporting polluted waters to the Dry Lake area, was completed in December of 1972. The 1973 Nevada State Legislature, through it's passage of Senate Bill 288 (NRS 790) approved the final written report of the Las Vegas Valley Water District. This recommended plan of export however was unacceptable to EPA since the return to the system of high quality return flows was considered more beneficial than disposal by export. The Legislature reflected this concern by recognizing that there may be further alternative solutions to the pollution abatement problem, and in Senate Bill 288 transferred the responsibility for developing a solution of the problem to the Clark County Board of County Commissioners.

In July of 1974, the Board of County Commissioners submitted to the Environmental Protection Agency 10 alternatives of abatement action in their Facilities Plan - Annex A and Addendum to the Environmental Assessment - Annex B for the Las Vegas Wash Bay Pollution Project. Prior to these latest submittals, numerous supporting documents were used in this effort. The 1972 Environmental Assessment prepared for the Las Vegas Valley Water District, was part of the 1972 submittal to the State Legislature. The assessment evaluated 9 possible actions formulated to accomplish waste water management in Las Vegas Valley. Six of the possible actions were presented in a "Phase III" Engineering Project Report also prepared for the LVWD. The seventh alternative, which was selected by the LVWD, combined several of the "Phase III" alternatives. The eighth alternative was suggested at a public meeting and the ninth, "no action" alternative was included to comply with The National Environmental Policy Act of 1969.

In accordance with directives of Senate Bill 288, the Board of County Commissioners considered a tenth alternative in their July 1974, Annex A and Annex B.

Therefore the purpose of this environmental impact statement is to now evaluate the environmental implications of meeting the approved Federal-State water quality standards through the alternatives pro-

posed and any permit issued by EPA in compliance with the National Pollution Discharge Elimination System to regulate municipal discharges in Las Vegas Wash. The alternative recommended by the applicant as economically and engineeringly viable will be evaluated. The Environmental Quality Objectives, supported by the Board of County Commissioners, as the guiding criteria for viable alternatives selection in their Facilities Plan and Environmental Addendum are:

1. Attain a clean desert environment.

2. Maintain Las Vegas Wash as a permanent riparian environment.

3. Develop additional greenbelts by in-valley irrigation.

4. Optimize the use of water.

5. Protection of the environment from the adverse impact of construction.

The environmental quality objectives providing guidance to EPA in this environmental impact statement for the selection of the most environmentally viable alternative are those specified in Section 101 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA) and Section 101 of the Clean Air Act of 1970. This statement shall conform to the provisions of Section 102 (c) of the National Environmental Policy Act (NEPA) of 1969; the April 23, 1971 Guidelines for the preparation of Environmental Impact Statements published in the Federal Register by the Council on Environmental Quality (36 FR 7724) and; the July 17, 1974 Notice of Proposed Rulemaking by the U.S. Environmental Protection Agency as published in the Federal Register concerning the Preparation of Environmental Impact Statements (39 FR 138). The Environmental Protection Agency's Notice of Proposed Rulemaking is attached as Appendix A.

This Environmental Impact Statement is written to indicate a process by which a decision has been made and the rational behind making that decision. Chapter 7 of the Statement discusses the selected alternative and summarizes the reasons for its selection. In the process of analysis undertaken by the Environmental Protection Agency, the selection of the plan deemed most feasible was the final step, and occurred only after careful and critical review of all the alternatives including the alternative recommended to EPA by the Board of County Commissioners.

The Environmental Protection Agency wishes to gratefully acknowledge the assistance provided by the many contributors in this on-going process. The numerous interested organizations, individuals, and public agencies whose efforts through the public have provided direction in the preparation of this draft statement are greatly appreciated. Of note are the efforts of the Board of County Commissioners, the Clark County Waste Water Management Agency, the Sewage and Waste Water Advisory Com-

mittee (SWAC) of Clark County, and the Las Vegas Valley Water District and their engineering and environmental consultants. Much of the information assembled and presented in previous engineering project reports and environmental impact assessments by those previously mentioned, was either edited or transcribed verbatim. Communications with the staffs of NECON, VTN, Jones and Stokes Associated, Incorporated, and the Clark County Waste Water Management Agency has facilitated the expeditious resolution of this significant environmental action, the benefits of which will be felt for many years to come.

Finally, we wish to acknowledge the efforts of the State of Nevada through it's State Legislature and executive agencies in the furtherance of statewide programs to improve the quality of the nation's waters.

ENVIRONMENTAL CONSTRAINTS

As part of any ecological system, man has to contend with limitations in his adaptability as a biological organism. Place him in a barren, extremely arid, hot water-short desert environment . . . and the picture these "Environmental Constraints" present to planners is one of neverending attempts at the resolution of some very fundamental necessities of life.

Simply stated, the availability of water, shelter from the sun's heat, and fuel must first be satisfied before man is capable of carrying on any consideration of being there in the desert for any sustained period of time.

Las Vegas however, runs on a very unique statement of the American phenomena. As was described in the Las Vegas Report 1974 published by the Greater Las Vegas Chamber of Commerce, "the city where . . . . money flows freely was founded and has prospered on the carefree individual, millions of them, all seeking refuge from doldrums of day-in and day-out living". Therefore the human organism is provided for so that it can pursue this unique refuge.

The ground rules for making the necessary environmental decisions in this instance have been spelled out by Congress. The National Environmental Policy Act of 1969 was enacted at the end of a phenomenal decade of American Growth, awareness, and social upheaval that expounded a national ethic heralding the need to evaluate what had been going on. The national government responded with a major reformation in the emphasis of several federal programs and agencies by Executive Order coupled with congressional enactment of the Clean Air Act of 1970 and the Federal Water Pollution Control Act Amendments of 1972, mandating the Environmental Protection Agency to administer and regulate the cleaning up of the nation's air and water and keeping them clean.

Water, whether it be it's quality or abundance, is by far the most limiting con-

straint in this analysis. What it provides, as far as sustaining the Las Vegas community in the style it is accustomed to, is life. From this Agency's perspective if economic viability and population growth are to continue, water quality degradation of existing and future potable water supplies from salt, nutrients, and toxins must be abated. The capability of the emerging in-valley megalopolis to continue to assimilate its excesses, its wastes, back into the environment is by far the leading action of this Agency.

Air quality is an equally significant responsibility of this Agency and is as equally well defined as a resource as is water quality. Gases and particulates are translated into clarity, tolerance, and irritant standards by Federal and State law. Human life-style and the kind of urban residential, commercial, and industrial growth it spawns inversely impacts concentrations of these gases and particulates. In this instance, we again must speak in terms of the assimilative capability of man's environment to meet this air quality constraint.

By providing this capability to assimilate wastes, Las Vegas will be establishing many new dependencies and interrelationships with a much larger environment. This larger environment must be capable of assimilating Las Vegas.

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GREAT BASIN REGION
UPPER COLORADO REGION
LOWER
LITTLE COLORADO
MAIN
STEM
GILA
CALIFORNIA REGION
GRANDE REGION
RIO
WHITE PINE
NYE
LINCOLN
IRON
WASHINGTON
ST. GEORGE
KANE
UTAH
ARIZONA
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GRAHAM
GRANT
PINAL
LORDSBURG
WILLCOX
TUCSON
PIMA
HIDALGO
COCHISE
SANTA CRUZ
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Lake Havasu
Horseshoe Reservoir
Bartlett Reservoir
Roosevelt Lake
Apache Lake
Canyon Lake
Whitlow Ranch Reservoir
Painted Rock Reservoir
Greens Canal
Salt
Gila
Santa
Pedro
Puerco
Verde
Salt River
Gila River
Santa Cruz River
Colorado River
Little Colorado River
Virgin River
Las Vegas Wash
Bill Williams River
Pedro River
Willcox Playa
LEGEND
REGION BOUNDARY
SUBREGION BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
COLORADO RIVER DRAINAGE
SCALE 20 0 20 40 60 MILES
M E X I C O

figure 1

the environment

The present environment will be the standard against which the future environments accommodated by any of the proposed alternative actions will be contrasted. This reference point provides the foundation from which the beneficial and detrimental effects of construction and operation of each project alternative are evaluated.

In the course of making environmental evaluations, it has been advantageous to divide the present environment into the following descriptive categories:

(1) The regional environment, including the Las Vegas Basin, Las Vegas Bay and the Lower Colorado River System.

(2) Several area environments, encompassing Dry Lake, Eldorado, Jean Lake and Hidden Valleys and the Las Vegas Valley/Wash drainage.

(3) Specific site environments, consisting of and relating to the site-specific locations of the proposed project facilities and areas of project impact.

LOCATION

Regional Locations

The regional environment, including the Las Vegas Basin, Las Vegas Bay as it relates to the Las Vegas Wash, and the Lower Colorado River System, is located at the junction of the States of Nevada, Arizona and California. The combined areas are either a part of Clark County or a part of the border between the above-mentioned States.

To the southwest of the Las Vegas Basin are the lofty Spring Mountains which reach an elevation of nearly 12,000 feet. The northeast has several somewhat lower mountain ranges, chiefly, the Sheep and Las Vegas Ranges. Indian Spring Valley, that forms the northern part of the project area, is bordered by a series of spurs from the north-trending Pintwater and Desert Ranges and by the southern end of the Spotted Range. The McCullough Range and Eldorado Mountains are to the south of the area of concern while the Muddy Mountains and Frenchman Mountain form a part of the eastern border.

Las Vegas Bay is an arm of the Boulder Basin area of Lake Mead. Las Vegas Wash enters the Bay at its western extremity. As the immediate recipient of its flows, the chemical, physical and biological conditions of the Bay are directly influenced by the outflow from the Las Vegas Wash.

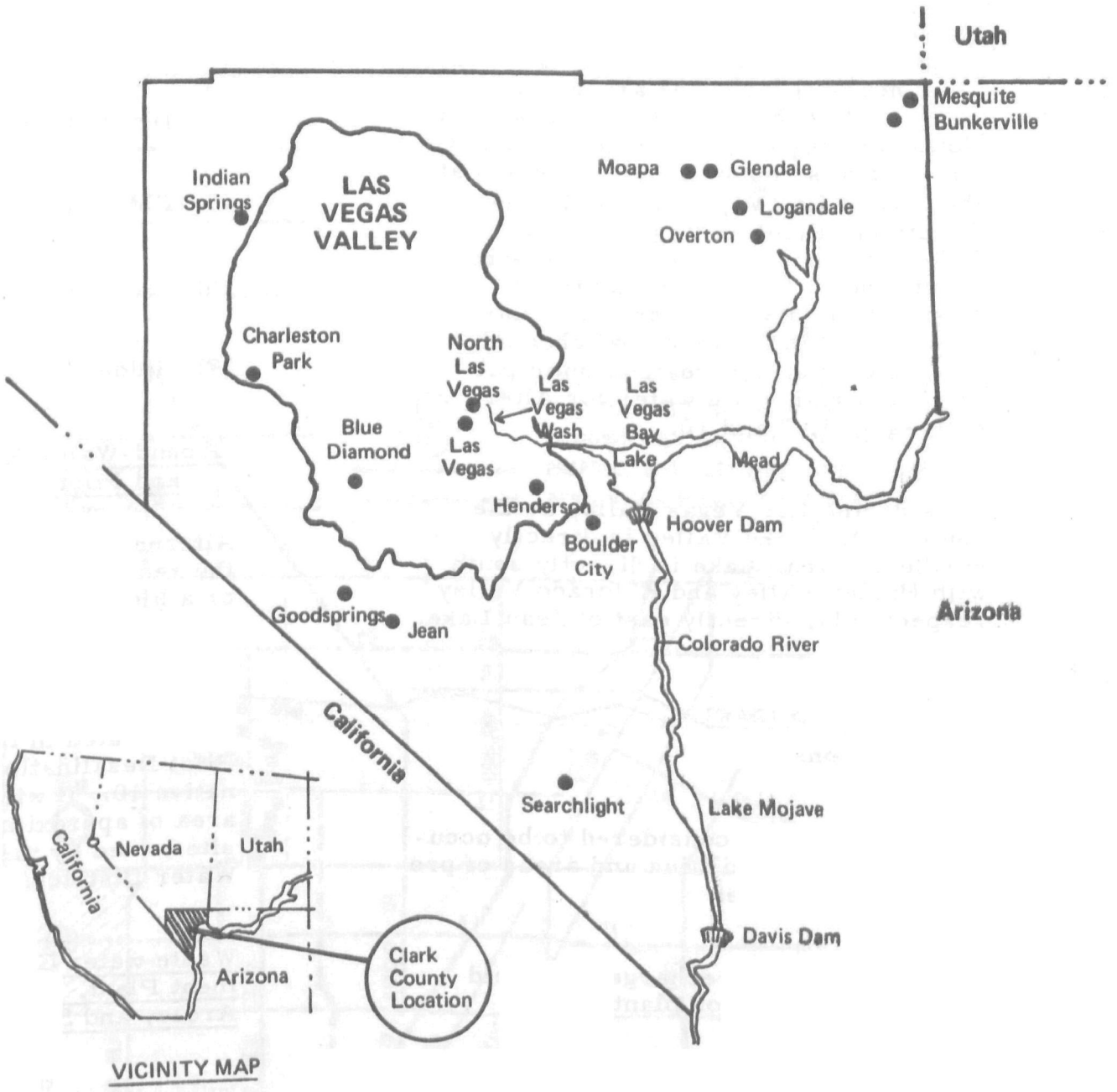
The Colorado River begins at the Continental Divide near Mount Richthofen, a peak with an elevation of 13,000 feet. It flows in a generally southwesterly direction from its headwaters in north central Colorado for about 1400 miles to the Gulf of California. The Colorado Basin is composed of rugged mountains, high plateaus, deep canyons, deserts and plains, covering an area of 244,000 square miles (approximately 1/12 the area of the entire continental United States). The Colorado River Basin includes parts of Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming.

Lee Ferry, Arizona, located approximately 17 miles downstream of Glen Canyon Dam near the confluence of the Paria River, was established in the Colorado River Compact of 1922 as the point in which the Colorado River Basin is divided into the "Upper Basin" and "Lower Basin" for legal, political, institutional and hydrologic purposes. The Lower Basin encompasses about 55% of the drainage area of the Colorado River Basin, and includes Las Vegas Wash. After leaving Glen Canyon Dam, the Colorado River flows into the Lower Basin and passes through the Grand Canyon into Lake Mead. This locates the Colorado River system east of the study area. Hoover Dam restricts Colorado River flow to form Lake Mead, which at one time was the largest reservoir in the world.

From Hoover Dam to the Mexican Border, the River travels 326 miles, nearly 40% of which is contained within reservoirs. The reach below Lake Mead and Hoover Dam includes Davis Dam, Parker Dam and Imperial Dam which impound Lake Mojave, Lake Havasu and Imperial Reservoir, and provide water for major diversions such as the All-American Canal, the Gila Canal and Colorado River Aqueduct. Minor dams within the reach include Headgate Diversion Dam, Palo Verde Diversion Dam and Laguna Diversion Dam.

Area Locations

Las Vegas Valley, the most important of the area environments, trends southeast about 50 miles from Indian Springs to Las Vegas Wash. The northern part of the Valley, which extends 30 miles from Indian Springs to Tule Spring, is irregularly shaped and relatively narrow; it ranges from 4 to 10 miles in width. South of Tule Spring the Valley widens into a rectangular-shaped basin that is approximately 18 miles wide and 24 miles long. The cities of Las Vegas and North Las Vegas are in the center of this part of the Valley, and are approximately 11 miles to the west of Lake Mead.



Source: NECON

Prepared by VTN

figure 2

The Las Vegas Wash is the chief drainage channel of the 1,590 square-mile Las Vegas Valley drainage basin. The only perennial stream in the area, it is located east of the City of Las Vegas and flows easterly to Lake Mead. For purposes of this report the Wash begins at the City of Las Vegas Waste-Water Treatment Plant on Vegas Valley Drive and ends 11 miles downstream beyond North Shore Road where it flows into Las Vegas Bay. The Las Vegas Wash is the principal channel for removal of the treated municipal and industrial waste water for Alternatives 2, 3, 7 and 10.

Considering Las Vegas Valley as the center, Dry Lake Valley is directly northeast, Jean Lake is directly south with Hidden Valley and Eldorado Valley respectively, directly east of Jean Lake.

Site Locations

The site locations considered to be occupied by project facilities and areas of project impact include:

(1) Ground-water recharge well field and Pilot desalination plant,

(2) Waste-water collection system, Treatment plant, Deep disposal well field areas, and Sludge disposal site,

(3) Las Vegas Valley lands to be irrigated,

(4) Dry Lake Valley,

(5) Eldorado Valley,

(6) Jean Lake,

(7) Hidden Valley.

Ground-Water Recharge Well Field and Pilot Desalination Plant

Alternatives Nos. 1 and 10 propose the recharge of desalinized waste water or a blend of advanced waste treatment (AWT) and desalt water into the middle aquifer of the ground-water basin. The injection well field site is to be located to the west side of the City of Las Vegas. Also located in the same area will be a Pilot Desalination Plant as part of Alternative 10. It will occupy a gross land area of approximately two acres on a site owned by the Las Vegas Valley Water District.

Waste-water Collection System, Treatment Plant, Deep Disposal Well Field Areas, and Sludge Disposal Site

The collection system, treatment plant, deep well disposal field and sludge disposal site are all located to the eastern

1 MGD
PILOT GROUNDWATER RECHARGE SITE LOCATION

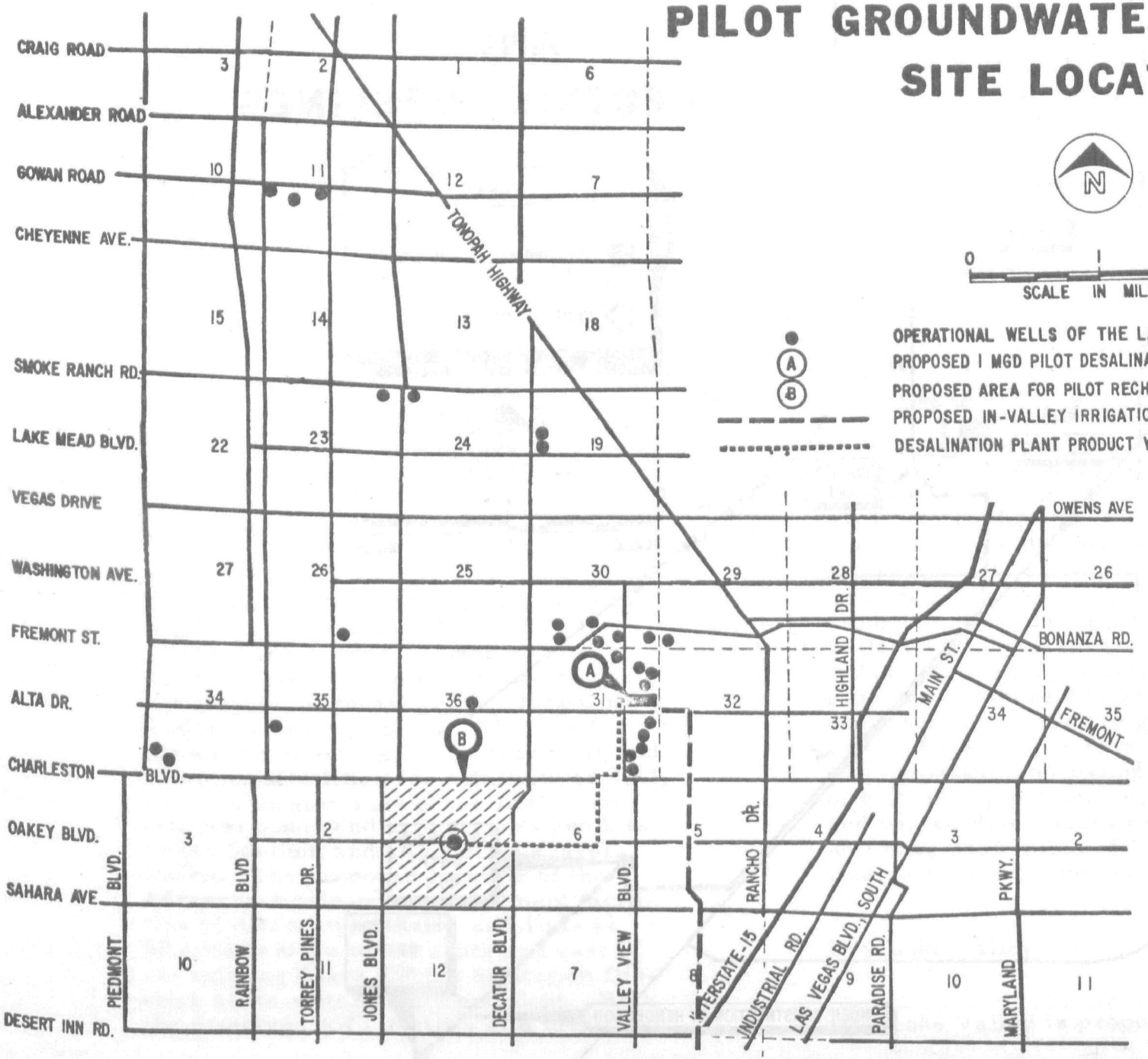


figure 3

AWT PLANT AND COLLECTION PIPELINES

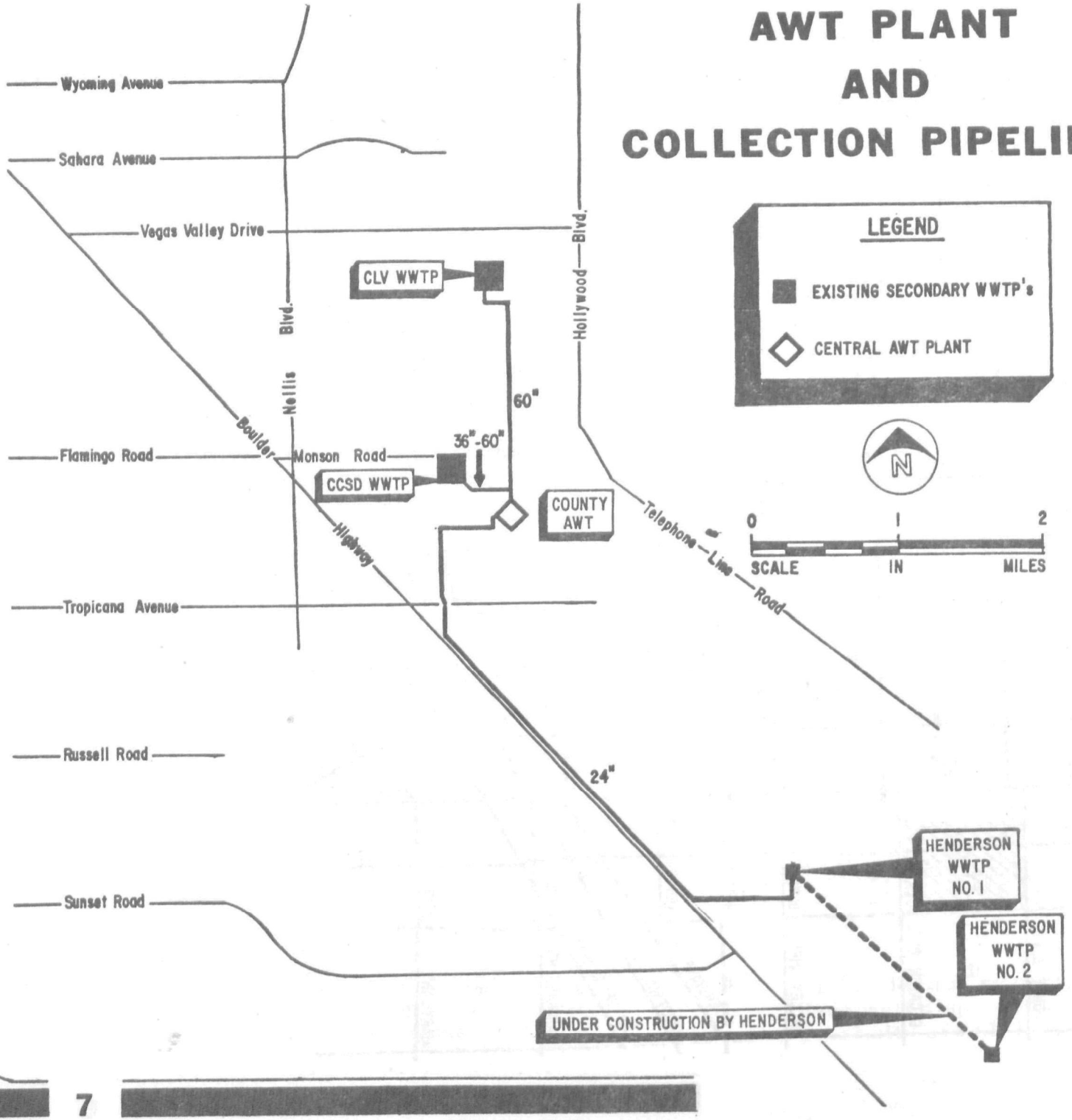


Figure 4

side of the City of Las Vegas.

The collection system begins south of Vegas Valley Road, following the border of agricultural lands to the Clark County plant discharge ditch. For Alternatives 1, 4, 6, 7, and 8 effluent will be collected from Henderson sewage treatment facilities via a subsurface pipe. For Alternatives 2, 3 and 5, effluent would be conveyed from the Clark County plant to the regulating reservoir via an open channel. The collection system for Alternative 10 will consist of three pipelines - one from each of the existing secondary waste-water treatment plants, Clark County, the City of Las Vegas and the City of Henderson. These secondary effluent lines will join at the influent surge pond located adjacent to the Clark County plant.

The sites for the waste-water regulating reservoir and treatment facilities for Alternatives 1, 4, 6, 7, and 10 and deep disposal well field for Alternative 8 are located southeast of the Clark County Sanitation District plant. The site for the waste-water regulating reservoir and treatment facilities for Alternatives 2, 3, and 5 is located west of the BMI waste disposal ponds and directly between Las Vegas Stadium and an existing gravel works. The proposed location of the Advanced Waste-water Treatment facilities of Alternatives 2, 3, and 10 is an 80 acre pasture to the south and east of the existing Clark County Sanitation District waste-water treatment plant. Both the prototype AWT facility site identified for Alternative 7 and the AWT plant site identified in Alternatives 1 and 8 are located some three miles north of the aforementioned AWT facility for Alternatives 2, 3, and 10.

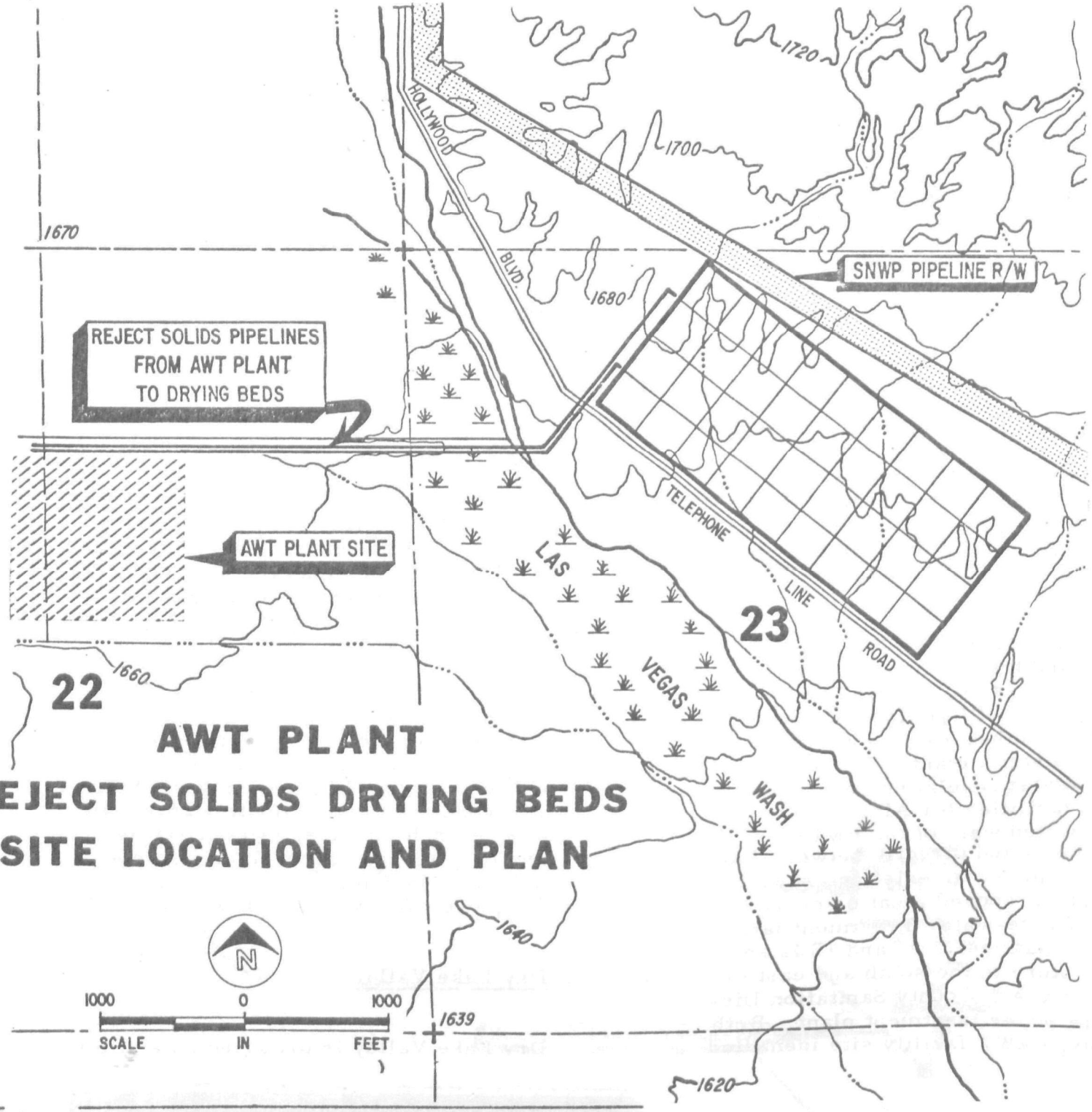
Sludge from the proposed Clark County Advanced Waste-water Treatment plant will be transported by pipeline from the plant facilities to a 48 acre evaporation site approximately 1/4 mile to the east of the Clark County Sanitation District Plant.

Las Vegas Valley Lands to be Irrigated

Five of the proposed alternatives (1, 2, 3, 8 and 10) include a system of using AWT water other than the secondary treated sewage proposed for use in Alternatives 4, 5, 6 and 7 for the irrigation of parks, golf courses and greenbelt areas in the Las Vegas Valley. This system consists of 18 miles of buried pipelines, four open, concrete one-acre reservoirs, and three pump stations. The irrigation program will be developed in four stages. Stage 1 will consist of approximately 26.4 miles of 4-30 inch pipeline, two lift stations and two storage reservoirs. Stage 4 will have 33.5 miles of 4-24 inch pipeline, two lift stations and two reservoirs.

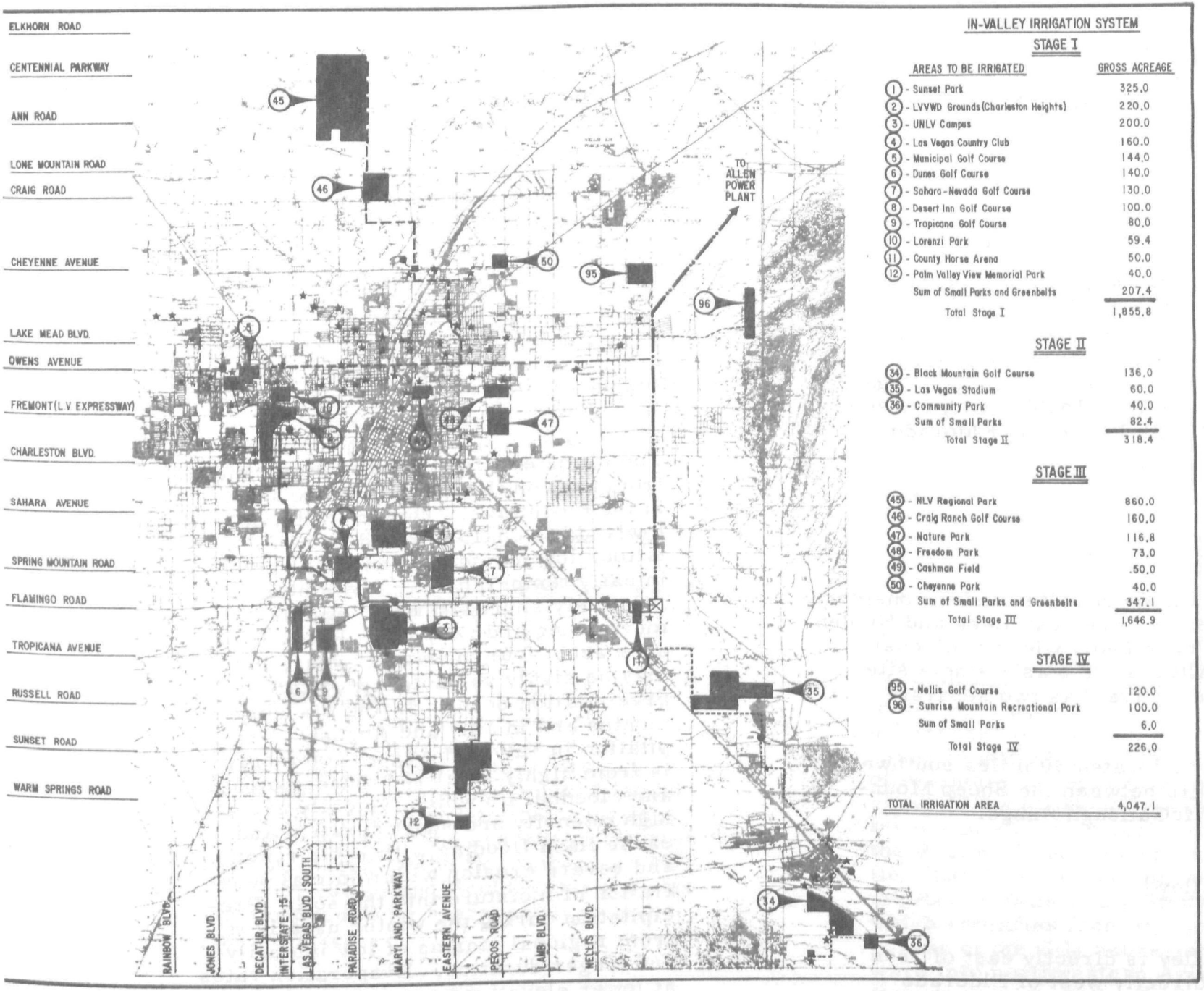
Dry Lake Valley

Dry Lake Valley is proposed as a site to



AWT PLANT
REJECT SOLIDS DRYING BEDS
SITE LOCATION AND PLAN

Figure 5



IN-VALLEY IRRIGATION SYSTEM

STAGE I

AREAS TO BE IRRIGATED	GROSS ACREAGE
(1) - Sunset Park	325.0
(2) - LVVWD Grounds (Charleston Heights)	220.0
(3) - UNLV Campus	200.0
(4) - Las Vegas Country Club	160.0
(5) - Municipal Golf Course	144.0
(6) - Dunes Golf Course	140.0
(7) - Sahara-Nevada Golf Course	130.0
(8) - Desert Inn Golf Course	100.0
(9) - Tropicana Golf Course	80.0
(10) - Lorenzi Park	59.4
(11) - County Horse Arena	50.0
(12) - Palm Valley View Memorial Park	40.0
Sum of Small Parks and Greenbelts	207.4
Total Stage I	1,855.8

STAGE II

(34) - Black Mountain Golf Course	136.0
(35) - Las Vegas Stadium	60.0
(36) - Community Park	40.0
Sum of Small Parks	82.4
Total Stage II	318.4

STAGE III

(45) - NLV Regional Park	860.0
(46) - Craig Ranch Golf Course	160.0
(47) - Nature Park	116.8
(48) - Freedom Park	73.0
(49) - Cashman Field	50.0
(50) - Cheyenne Park	40.0
Sum of Small Parks and Greenbelts	347.1
Total Stage III	1,646.9

STAGE IV

(95) - Nellis Golf Course	120.0
(96) - Sunrise Mountain Recreational Park	100.0
Sum of Small Parks	6.0
Total Stage IV	226.0

TOTAL IRRIGATION AREA	4,047.1

LEGEND

- Stage I Main
- Stage I Lateral
- Stage II Main
- Stage III Main
- Stage III Lateral
- Stage IV Lateral
- Export line to Allen Power Plant
- Pumping Station
- Reservoir
- County AWT Plant
- Small Land Area
- Pilot Desalt Plant

N

0 1 2 4
SCALE IN MILES

STAGED IN-VALLEY IRRIGATION SYSTEM

figure 9

evaporate exported brine and/or secondary effluent as part of Alternatives 1, 2, 4, and 7. The Valley is 27 miles northeast of Las Vegas on the Salt Lake City highway between the Arrow Canyon and Dry Lake Ranges.

Eldorado Valley

Alternative No. 5 proposes export of effluent to Eldorado Valley for agricultural irrigation and/or evaporation. This Valley is directly east of Jean Lake, 28 miles southeast of Las Vegas, and to the south of Boulder City between the McCullough Range and Eldorado Mountains.

Jean Lake

The third and fourth sites under consideration for export are Jean Lake and Hidden Valley. These two Valleys are considered in Alternative 6 as a single site and in Alternative 7 as two separate sites.

Jean Lake is located 30 miles southwest of Las Vegas between the Sheep Mountains and McCullough Range.

Hidden Valley

Hidden Valley is directly east of Jean Lake and directly west of Eldorado Valley. It is bounded on the north and west by a low range of unnamed hills, and on the south and east by the McCullough Range. A low rocky pass exists between Jean Lake and Hidden Valley.

Refer to the figures in Chapter 2 for the specific geographic location of these sites.

CLIMATE

Regional Climate

The climate of the regional area ranges from arid on the valley floor to semiarid in the mountains. The arid climate of the lowlands is characterized by low precipitation, low humidity, and wide extremes in daily temperature. The winters are relatively short and mild, and the summers, long and very hot. Rainfall averages about four inches per year, but may be highly variable. Most of the precipitation occurs during the winter months and in July and August. Precipitation in July and August commonly is from highly localized thunderstorms and cloudbursts which typically are of high intensity and short duration and cause flash flooding with rapid runoff and severe erosion with minimal penetration of moisture into the soil. Precipitation during the winter usually is from regional storms of low intensity and longer duration. Evaporation rates at lower elevations are extremely high and probably exceed 80 inches per year.

Relative humidity averages 28%. Strong winds are common throughout the year but are prevalent during the spring. The growing season (frost free) approximates 241 days. Irrigation is required for lawns and practically all crops.

The climate at Las Vegas Bay/Lake Mead is arid. Mean annual temperature at Las Vegas is 66°F (19°C) and annual precipitation is less than 5 inches, according to Weather Bureau records. Maximum temperatures of 110° F(43°C) are not uncommon in July and August, but the heat is not oppressive because of low humidity. Average minimum temperature in January is 30°F(-1° C). Winds are generally light. Water-surface temperatures at Lake Mead lag about one month behind air temperatures at Lake Mead and Las Vegas. Nearly all of the difference in air temperatures is attributable to the fact that the altitude of Las Vegas airport is about 1,000 feet higher than Lake Mead.

Rainfall on the lake surface, averages less than one-half of one percent of the inflow. Two tipping-bucket recording rain gages are used to measure rainfall; they are located on Boulder Island in Boulder Basin and on the barge in Boulder Basin. The average of the rainfall recorded by the two rain gages at Boulder Island and Boulder Basin Barge is assumed to be representative of the entire lake.

Wind speeds at the eight-meter level on the barge in Boulder Basin over the Lake are, in general, higher than wind speed at the Las Vegas airport. The anemometer at the airport is almost exactly eight meters above the ground so that the records are comparable in this respect. During much of the year the circulation is thermally induced rather than the result of large-scale cyclonic activity, and the local terrain has a great influence on both wind speed and direction. If the vapor pressure at Las Vegas can be considered representative of unmodified air in this region, it is apparent that the air over Lake Mead is substantially modified during its passage over the Lake. It is also apparent that the vapor blanket extends above the eight-meter level at mid-lake. In general, the vapor pressure difference between the two- and eight-meter levels is less than the difference between Las Vegas and the eight-meter level.

One of the chief characteristics of the climate of the Lower Colorado Region is its variety. The wide range in climatic conditions is the result of large differences in altitude, a considerable range in latitude, and the distribution of mountain ranges and highlands. Because of the different topographical features and elevation variations throughout the Region, a number of different climatic classifications are present. Most of the Region falls into a Steppe climate, which stretches from the southeastern corner of the Gila Subregion northwestward into northwestern Arizona and the Nevada portion of the Region.

Along the Colorado River, average annual precipitation varies from 25 inches or more along the North Rim of the Grand Canyon to five inches or less along the River below Lake Mead. The western and southern portions of the Subregion are characterized by mild winters and hot summers. Summer temperatures average in the mid-seventies at the Grand Canyon and a hundred plus degrees at Las Vegas.

Area Climate

In Las Vegas Valley, weather observations are taken at McCarran Airport, seven miles south of downtown Las Vegas, and about five miles southwest and 300 feet higher than the lower portions of the Valley. Since mountains encircle the Valley, drainage winds are usually downslope toward the center, or lowest part of the Valley. This condition also affects minimum temperatures, which in lower portions of the Valley can be from 15° to 25° colder than recorded at the airport on clear, calm nights.

The four seasons are well defined. Summers are typically "desert" with maximum temperatures usually in the 100° plus bracket. The proximity of the mountains contributes materially to the relatively cool summer nights, with the majority of the minimums being between 70° and 75°. There is a period of about two weeks almost every summer when warm, moist, tropical air predominates weather conditions in this area, and causes scattered thundershowers, occasionally quite severe, together with higher than average humidity. Although maximum temperatures are much lower during this humid period, minimum temperatures are higher than usual, and many natives consider this the most unpleasant weather of the year. Soil erosion, especially near the mountains and foothills surrounding the Valley, is evidence that these summer thundershowers have in the past, on occasion, developed into "cloudburst" proportions.

Aside from this short, humid period, summers are not as uncomfortable as indicated by the daytime maxima, because of the prevailing low humidity. Winters, on the whole, are mild and pleasant. Daytime temperatures average near 60° with mostly clear skies and warm sunshine. Winter minimum temperatures average 35°. The spring and fall seasons are generally considered most ideal, although rather sharp temperature transients occur during these months. The average annual evaporation rate is about 72 inches.

The Sierra Nevada Mountains of California and the Spring Mountains immediately west of Las Vegas Valley, the latter rising to elevations over 10,000 feet above the valley floor, act as effective barriers to moisture-laden storms moving eastward from the Pacific Ocean. It is mainly these barriers that result in a minimum of dark, overcast and rainy days. Rainy days

average from less than one in June to three per month in the winter months. Snow rarely falls in this Valley, and it usually melts as it falls, or shortly thereafter. The one real exception occurred during January 1949 when 16.7 inches of snowfall was recorded.

Strong winds, associated with major storms, usually reach this Valley from the southwest or through the pass from the northwest. Winds over 50 m.p.h. are infrequent, but when they do occur, they are probably the most provoking of the elements experienced in the Las Vegas Valley, because of the blowing dust and sand associated with these stronger winds. (U.S. Department of Commerce, 1971).

Climate at Las Vegas Wash is the same as that described for Las Vegas Valley. A typical arid desert climate with low rainfall, abundant sunshine, mild winters and long, hot summers characterizes the area. Due to the local thunderstorms and cloudbursts during the summer months, the flow in the Wash increases by more than 30% on an average of 11 days each year.

Climate at Dry Lake is typical of that described for Las Vegas Valley. The two significant climatic factors for this Valley are the high evaporation rate of 72 inches per year and the strong northeasterly winds which blow across the Valley, usually in August.

Climate at Eldorado, Jean Lake and Hidden Valleys is also typical for that described for Las Vegas Valley. The two significant climatic factors for these areas are the evaporation rate of 72 inches per year and the southwesterly winds which occur most of the year.

GEOLOGY

Regional Geology

The regional area lies within the Basin and Range Physiographic province. The province is characterized by desert basins having interior drainage flanked by mountains that generally are sparsely covered with vegetation. The high mountains usually are dissected by deep ravines that open onto broad alluvial fans. Commonly, fans from adjoining canyons have coalesced and formed a continuous alluvial slope along the base of the mountain ranges. These slopes extend outward into the valleys, where they merge with the valley floor or extend across the valley toward the adjacent mountain ranges to form alluvial divides. Beyond the toes of the fans is the valley floor. The valley floors are usually flat and contain one or more playas, or dry lakes, where periodic runoff from storms accumulates and eventually evaporates. The surface area of the Basin is about 3000 square miles. Elevation varies from near 500 feet at the Colorado River to over 11,900 feet at Charleston Peak.

The terrain surrounding Las Vegas Bay consists of rugged, faulted desert mountains which slope steeply into rock strewn alluvial slopes and washes. These gentler slopes drop down to the shore of the Bay. The shoreline of Las Vegas Bay is highly irregular with many small coves and inlets. There are a few beach areas but significant erosion of the bulk of the shoreline has not, as yet, occurred. Las Vegas Wash is the only tributary which enters Lake Mead in the vicinity of the Bay.

The Lower Colorado Region lies within two of the major physiographic provinces of the Southwest, the Basin and Range Province, and the Colorado Plateau Province. The Basin and Range Province is of importance to this study as it occupies the southern and western portions of the Region and is within the drainage area of the Colorado River.

The Province is characterized by isolated mountain blocks separated by broad alluvial-floored basins. The elevations of the mountain blocks are as much as 10,000 feet above mean sea level and usually are between 1,000 and 4,000 feet above the floors of the subjacent basins. The elevations of these basins range from 100 feet to as much as 5,000 feet. Most of the valleys in the Basin and Range Province trend north to northwest. These alternating mountains and valleys were produced by large-scale faulting in which the mountain blocks were uplifted and the basins were depressed. Subsequent to and during faulting, the valleys were filled with alluvial material eroded from the mountain masses which are composed chiefly of granite, gneiss, schist, and quartzite. Many mountains are capped with volcanic rocks. Along some of the mountain fronts, the hard rocks have been planed by erosion to gentle slopes.

During Tertiary time, the large-scale movement along predominantly northwest-trending faults formed the general outlines of the Basin and Range structural pattern. It is probable that some movement on a smaller scale continues to the present time. In many valleys, the basement rocks are overlain by a coarse material of generally low permeability,. which has eroded from the nearby highlands. Concurrent with this sedimentation, faulting occurred and volcanic eruptions deposited lavas. In some areas the basin drainages were dammed forming lakes and playas in which fine-grained sediments were deposited. Subsequent erosion of the mountains caused thick alluvial fill to be deposited in the valleys. Volcanism continued intermittently and lava flows, in some places, are interbedded with the alluvium.

The alluvium, which represents several stages of deposition under different environments, is the major deposit in the structural basins and consists of lenses of gravel, sand, clay, and silt in varying thicknesses. Locally it may be as much as 3,000 feet thick. Common to the fill in the central part of many of the valleys are areas of considerable thicknesses of clay. Locally, these clay beds contain

lenses of gravel and sand. Sand and gravel are deposited along the larger streams and along the mountain fronts.

Channel deposits along the present drainages consist of mixtures of unconsolidated gravel, sand, and silt. These deposits include alluvial fill that underlies the flood plains of the present streams in the Basin and Range province. This alluvial fill is the major ground-water reservoir in the Basin and Range province. Recharge to the fill occurs near the mountain fronts and along the stream channels as seepage from the few perennial and many intermittent streams. Only occasionally do the main drainages carry water their full length for more than a few days.

The Colorado River became a through-flowing stream in late Cenozoic time. Downcutting by the River and its tributaries resulted in deep entrenchment of the entire system resulting in the spectacular canyons. Runoff from the plateaus in the Lower Colorado Region is to the Colorado, Little Colorado, and Virgin Rivers. The Colorado and Virgin Rivers are perennial and all the other streams are intermittent, except for some short reaches.

Area Geology

Las Vegas Valley is a basin with smooth gentle alluvial slopes bounded by numerous isolated, relatively high, steeply sloping mountain ranges which trend north-south. The Valley may be classified in three physiographic units: the mountains, the alluvial aprons and the basin lowlands.

The mountains have a relief of several thousand feet and have areas of erosion where streams have cut (and are continuing to cut) deep ravines and canyons. The highest peaks are in the Spring Mountains to the west where Charleston Peak reaches an elevation of 11,910 feet. The Sheep Mountains to the north are less than 6,000 feet above the floor of Las Vegas Valley, which is at an elevation of about 2,000 feet. The "bedrock" of the area, which forms the mountains and underlies the alluvial valley fill, is composed of consolidated rocks of relatively low permeability. These rocks have been extensively faulted and folded into complex geologic structures. Las Vegas Valley is a structural depression in the bedrock which has been filled with alluvium forming a huge reservoir that, for all practical purposes, is watertight.

The alluvial aprons are made up of numerous coalescing fans. They have much less relief and the slopes are more gentle and regular than those in the mountains. These areas of deposition are eroded and dissected. The alluvial deposits in the Las Vegas Valley are composed principally of boulders, gravel, sand, silt and clay derived from the adjacent mountain ranges. These deposits contain virtually

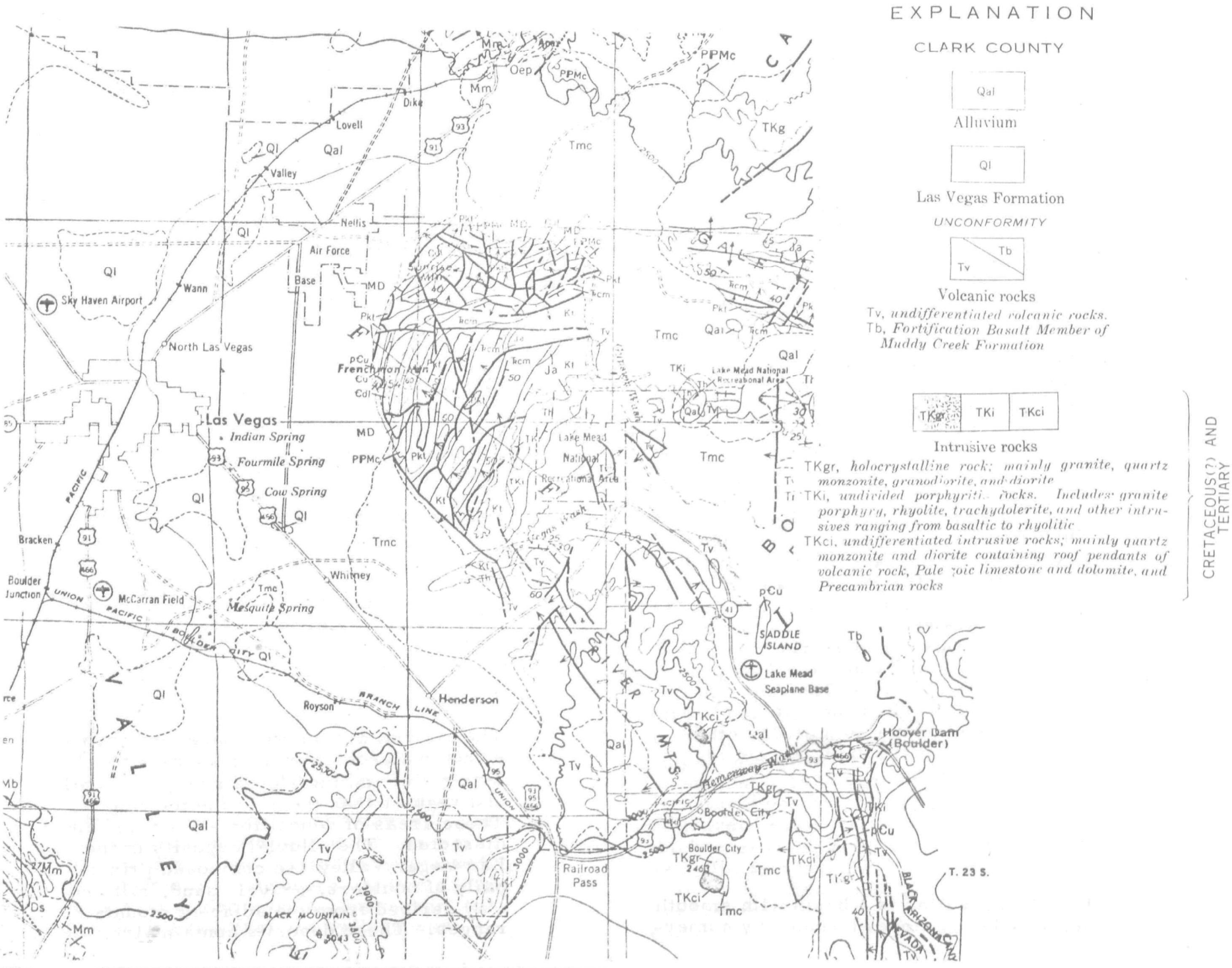
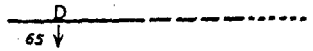

EXPLANATION
CLARK COUNTY
Qal
Alluvium
Ql
Las Vegas Formation
UNCONFORMITY
Tb
Tv
Volcanic rocks
Tv, undifferentiated volcanic rocks.
Tb, Fortification Basalt Member of Muddy Creek Formation
TKgr
TKi
TKci
Intrusive rocks
TKgr, holocrystalline rock; mainly granite, quartz monzonite, granodiorite, and diorite
TKi, undivided porphyritic rocks. Includes granite porphyry, rhyolite, trachydolerite, and other intrusives ranging from basaltic to rhyolitic
TKci, undifferentiated intrusive rocks; mainly quartz monzonite and diorite containing roof pendants of volcanic rock, Paleozoic limestone and dolomite, and Precambrian rocks
CRETACEOUS(?) AND TERTIARY
Las Vegas
Indian Spring
Fourmile Spring
Cow Spring
Mesquite Spring
Henderson
Boulder City
Railroad Pass
Lake Mead National Recreational Area
Lake Mead Seaplane Base
Hoover Dam (Boulder)
Sky Haven Airport
North Las Vegas
Air Force Base
McCarran Field
Boulder Junction
Bracken
Whitney
Royson
Lovell
Valley
Nellis
Dike
Wann
Frenchman Mtn
SADDLE ISLAND
BLACK MOUNTAIN
T. 23 S.

figure 7

Contact

Long-dashed where approximately located; short-dashed where sketched or inferred



Fault, showing dip or direction of dip

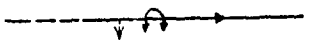
Long-dashed where approximately located; short-dashed where inferred; dotted where concealed. D, downthrown side of reverse fault. No arrow on vertical or nearly vertical faults

Thrust fault

Saw-teeth indicate thrust plate. Dashed where approximately located; dotted where concealed

Anticline

Showing trace of axial plane and direction of plunge of axis. Dashed where approximately located



Overturned anticline

Showing trace of axial plane, direction of dip of limbs, and plunge of axis

Syncline

Showing trace of axial plane and direction of plunge of axis. Dashed where approximately located

Strike and dip of beds

Strike and dip of overturned beds

Strike of vertical beds

Horizontal beds

Strike and dip of beds overturned through more than 180°

Strike and dip of foliation

Strike of vertical foliation

all the ground water of economic importance in the area. The maximum thickness of this alluvial fill may be as much as 5,000 feet.

The basin lowlands, with low relief and smooth surface, appear level in contrast to the alluvial aprons and the mountains. By comparison, little erosion takes place in the lowlands which are sites of deposition for the large quantities of material eroded from the mountains during and following heavy storms. The alluvial fill is frequently interfingered with lenses of silt and clay or stratified with alternate layers of pervious sand and gravel and less pervious silt and clay. There are also frequent zones of lime deposition (caliche) which may be impermeable or nearly so. It has been observed that coarser materials are found in the west and northwest portions of the Valley, with finer materials occurring to the south and southeast.

Playa deposits and sand dunes are present in several locations in the basin lowlands. Few dunes are active, being mostly mounds built up around Mesquite trees and covered with a thick growth of Mesquite. Many scarps, resulting from faults in the Valley fill, are found in the southern part of the Valley near Las Vegas. They vary in height from a few feet to nearly 150 feet and are conspicuous features. Upward leakage and springs occur along these scarps.

Las Vegas Valley has experienced earthquakes in the past, and may reasonably be expected to feel additional quakes in the future. Earthquake activity apparently increased following the filling of Lake Mead, and is now decreasing again. The regional and local seismic history and fault structures of the Las Vegas area have been taken into consideration within the 1972 Design Appendix prepared by NECON.

The Las Vegas Wash, an anomaly in the desert, was made green as an unplanned by-product of man's development of the Valley. The Wash is considered to be that area lying between desert riparian habitats which border each side. The Wash consists of two areas -- one is a wide, dense marsh type area and the second is dense vegetation passing through high, steep canyon walls.

Dry Lake Valley, is a north-south trending valley, five miles wide and eleven miles long. It is bounded by steeply rising mountain ranges, the Arrow Canyon Range on the west and the Dry Lake Range on the east. The southwestern end of the valley is bounded by steeply rising hills and lower gently-sloped passes, with the northeastern end bounded by a rising mesa. The valley is relatively flat, with a barren dry lake bottom at an elevation of 1,968 feet, with gently rising moderately vegetated alluvial slopes rising to the foot of the mountains. Dry Lake is dry except after storms.

At Dry Lake two deep holes were drilled

in 1966 under the supervision of the United States Geological Survey. One, near the middle of the lake, penetrated Holocene and Quarternary clays from the ground surface to a depth of 310 feet, then Pleistocene Muddy Creek formation (mostly clays) from 310 feet to the total depth of 1,500 feet. A second deep hole, on the alluvial fan to the west of the lake, shows 35 feet of gravels at the top, Pleistocene clay deposits from 35 to 185 feet, Muddy Creek formation from 185 to 958 feet and Paleozoic limestones (bedrock) from 958 to the total depth of 970 feet.

During June and July of 1972, Converse, Davis and Associates, under contract with the Las Vegas Valley Water District, drilled some 21 holes in and around Dry Lake. Except in the area well to the south of the lake, clays were found at elevations higher than those of the lake itself (elevation 1,968). The south holes (No. 8 and 9) were not drilled deep enough to reach the Muddy Creek formation. In general, the clays show a cup-shaped configuration, with gravels covering the peripheral slopes.

Eldorado Valley is bounded on three sides by steeply rising mountain ranges. The McCullough Range bounds the western side of the valley, the Highlands Range to the south, Eldorado Mountains to the east and a range of gently sloping hills to the north, with Boulder City located at their base. The Colorado River flows to the south on the east side of the Eldorado Mountains. The Valley encompasses 90 square miles with a barren flat, dry lake located in the northeast section of the valley floor. The dry lake bottom is at 1,708 feet elevation and has an area of about three and one-third square miles. Rising from the valley floor are dense to isolated vegetated alluvial slopes. The geologic indications are that the dry lake clays may not extend horizontally much beyond the existing dry lake.

The Jean Lake portion of the Ivanpah Valley, is bounded by gently rolling desert on the north and northwest, the Sheep Mountains on the west and southwest, rising desert on the south and a range of unnamed hills on the east. The valley has a flat, barren dry lake bottom (Jean Lake) which covers about two square miles and lies at an elevation of 2,780 feet with gently rising desert and alluvial slopes. The geologic indications are that lake clays do not extend horizontally much beyond the present dry lake.

Hidden Valley contains an indistinct flat dry lake bottom one-quarter square mile in area at elevation 2,995 feet, and moderately vegetated steep alluvial slopes. The valley is relatively small, six miles long and two miles wide. The geologic indications are that the dry lake deposits of Hidden Valley are very limited in extent.

SOILS

The general soil map for a portion of Clark County, Nevada has been prepared at a scale of 1:500,000 by generalization of data from detailed and reconnaissance soil surveys. It has been designed to dis-

play soil landscapes.

Soil Formation

The pertinent area is located in the southern portion of the Basin and Range Physiographic Province and includes a number of generally north-south oriented mountain ranges and intervening valleys. Important landforms include high mountains, foothills, flood plains, terraces and mesas, playas, sand dunes, and broad alluvial fans and aprons which flank mountain ranges and encroach on valley lowlands.

Soils in the general southwestern portion of the area have formed in materials derived dominantly from igneous granitic and volcanic rocks with admixtures of some materials from sedimentary and metamorphic rock. In the remaining portion of the area limestone, sandstone, quartzite, shale, conglomerate and gypsiferous rocks are the primary source of parent materials for soils.

The soils in the area have formed under a warm arid to semiarid climate. Average annual precipitation in the valleys varies between about 4 to 7 inches, and in the mountains ranges upward to as high as 20 inches. Average annual air temperature in higher parts of mountains is less than 47°F., and in the valley ranges upward to more than 60°F.

Vegetation varies from a sparse stand of desert shrubs and annuals in the arid valleys to sagebrush and pinyon-juniper woodland at higher elevations on mountain ranges.

The ages of landscape surfaces vary considerably within the area. Relatively recent surfaces include those of steep mountain slopes where erosion is active, and those of flood plains and alluvial fans which are undergoing present-day aggradation. Old surfaces occur on alluvial fans and terraces which have been stable over a very long period of time. Some of these older surfaces are believed to date back into the early Pleistocene. Surfaces of intermediate age occur on land surfaces which have experienced either erosion or deposition of sediment at time periods between the older and recent surfaces. The age of a surface reflects the time period which soil parent material has been subjected to weathering and soil development.

The older surfaces consequently have soils with strongly developed profiles in which original rock structure is not discernible. Old soils within the area formed in parent materials high in lime have large accumulations of carbonates and some layers are usually cemented. Those formed in mixed materials usually have accumulations of clay in their subsoils with underlying cemented layers. In contrast to the older soils, the soils of recent surfaces may show very little modification except for possibly organic matter gains and movement of salts. Rock structure including stratification of sediments is readily discernible in the young soils. Progressive decrease in rock weathering, the accumu-

lation and development of layers of calcium carbonate, gypsum, clay and salts occur as ages of surfaces transition from the old to recent landscapes.

Because of the aridity of the climate, soils formed on valley landscapes are generally low in organic matter, and have accumulated soluble salts, lime and gypsum in their subsoils. Lime-cemented hardpan and high gypsum accumulations characterize old soils formed in valley-fill materials derived from sedimentary rock. Clay accumulations overlying layers of lime accumulation are typical for older soils formed in materials derived from igneous rock.

Transitions in kinds of soils of comparable age from the dry valleys to those of semiarid mountainous landscapes is reflected in decreases in accumulations of lime, gypsum, and salts, and increases in organic matter content.

Soil Map Units

Soil map units, delineated on the general soil map, group a large number of different kinds of soil in accordance with general characteristics. Major kinds of soils and contrasting inclusions are described.

General interpretations pertaining to suitability for irrigated crops and pasture, available water capacity (ability of soil to store and yield water for plant use), and susceptibility to water and wind erosion are given for each of the major soils comprising map units.

Use Of The General Soil Map

The general soil map has been designed to display only broad soil patterns and associated potential use limitations and hazards. It can be used to compare different parts of the area in order to ascertain potential problems which may be associated with specific uses. It is not suitable for planning the use or management for a specific tract of land.

Soil Map Unit Descriptions

11.--This unit consists of deep, saline, silty clays and silty clay loams which occupy nearly level basins (playas) where slopes are less than 2 percent. The soils are grayish brown in color; moderately well to somewhat poorly drained; and subject to occasional flooding. They are slow to very slowly permeable, and for the most part barren of vegetation. The soils are not presently considered to be suitable for irrigated crops or pasture. (Land capability class VIII). The soils have a low water erosion hazard, but will blow if disturbed by construction, vehicular traffic and similar disturbances.

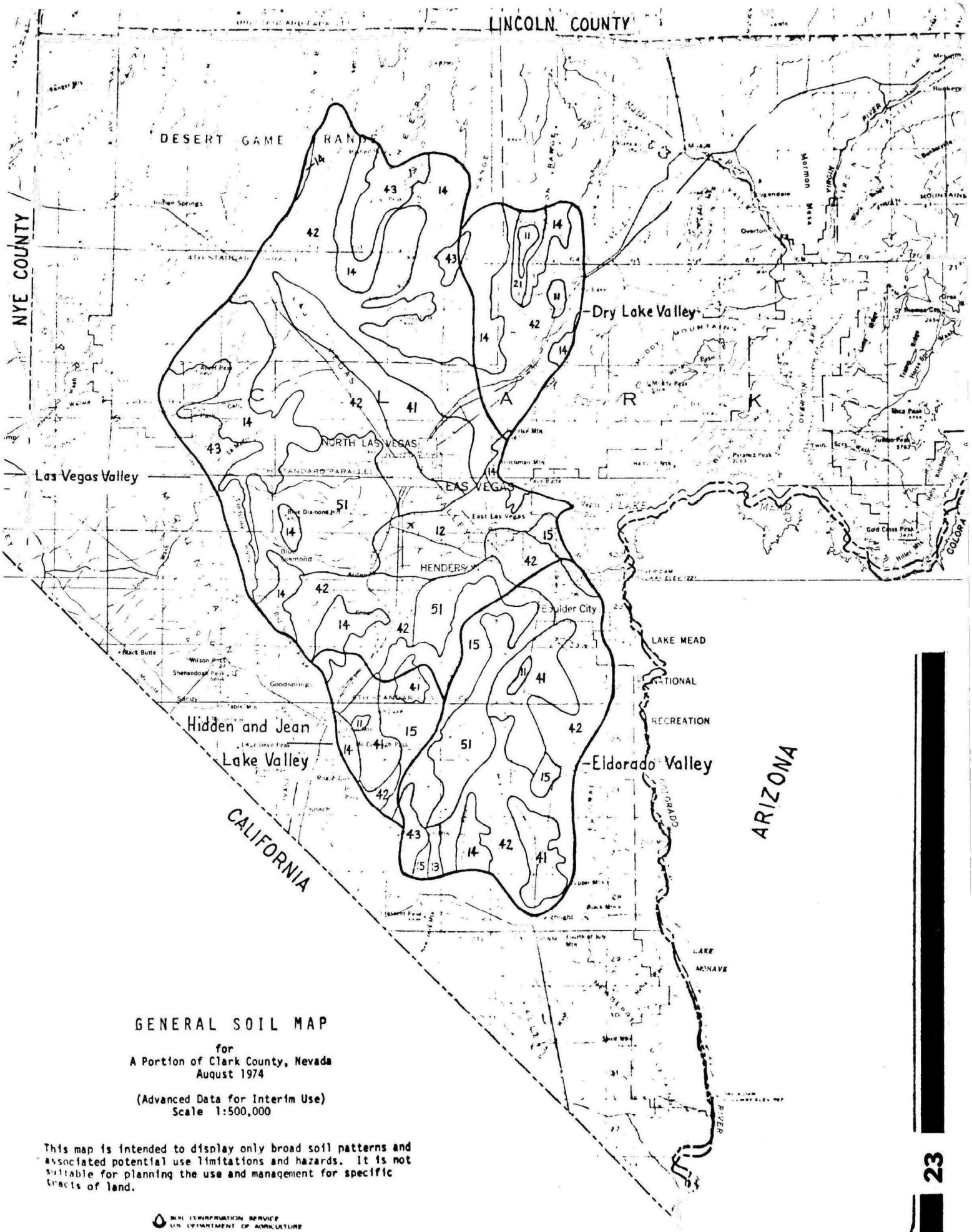

LINCOLN COUNTY
NYE COUNTY
DESERT GAME RANGE
Dry Lake Valley
Las Vegas Valley
NORTH LAS VEGAS
LAS VEGAS
HENDERSON
Boulder City
LAKE MEAD NATIONAL RECREATION
Hidden and Jean Lake Valley
Eldorado Valley
CALIFORNIA
ARIZONA
LAKE MOHAVE
GENERAL SOIL MAP
for
A Portion of Clark County, Nevada
August 1974
(Advanced Data for Interim Use)
Scale 1:500,000
This map is intended to display only broad soil patterns and associated potential use limitations and hazards. It is not suitable for planning the use and management for specific tracts of land.
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

figure 8

Included in the unit are less than 5 percent soils with sandy textures and small gravelly areas along the outer boundaries.

12. --This unit occurs on alluvial fans and terraces in the southeastern part of Las Vegas Valley.

Major soils comprising the unit include:

(a) About 40 percent light yellowish brown, deep, well drained very gravelly loamy sands to very gravelly loams on lower alluvial fans with 2 to 8 percent slopes. Some of these soils have slight to moderate calcium carbonate cementation in the subsoils and underlying layers.

Available water capacity for plants is low; the profile permeability is slow to moderate; and the potential for water and wind erosion is moderate. They are not considered suitable for irrigated crops or pasture. (Land capability unit VII).

(b) About 35 percent pink, deep, well drained, gravelly loamy sands and sandy loams which contain subsoil and substrata layers containing considerable gypsum and calcium carbonate. They occur on old alluvial fans and terraces with 2 to 4 percent slopes.

Available water capacity for plants is low to moderate; the profile permeability is moderately slow; and the potential erosion hazard from water and wind is moderate to severe. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

Included with the major soils are about 25 percent Badlands (eroded scarps and breaks); deep, wet loams and sandy soils along narrow flood plains; and shallow loams and sandy loams over indurated hardpan. Small areas of the deep loams and sandy soils are suited for irrigated cropland.

The soils in the unit generally have a low density cover for creosotebush, white bursage, and some grasses and annuals.

They are being used mostly for urban, commercial, industrial, and related uses.

13. --This unit occurs on upper alluvial fans and foothills mostly in the southwestern part of Jean Lake Valley.

Major soils comprising the unit include:

(a) About 40 percent light yellowish brown, deep, well drained, very gravelly loams and very gravelly sandy loams on upper alluvial fans and foothills with 8 to 30 percent slopes.

Available water capacity for plants is low; the profile permeability moderate to moderately rapid, and the potential water and wind erosion hazard is moderate. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

(b) About 30 percent yellowish red to reddish brown, deep, well drained, very gravelly loamy sands on upper alluvial fans with 4 to 8 percent slopes. These soils have low available water capacity for plants; the profile permeability is moderately rapid to rapid; and the potential water and wind erosion hazard is moderate. They are suited for irrigated pasture with very severe limitations. (Land capability class IV).

(c) About 20 percent reddish brown, well drained, very gravelly clay loams which are underlain by lime-cemented hardpan at 20 to 40 inches. They occur on upper alluvial fans with 4 to 8 percent slopes.

Available water capacity for plants is low; the profile permeability above the hardpan is moderately slow; and the potential water and wind erosion hazard is moderate. The soils are suited for irrigated hay and pasture with very severe limitations. (Land capability class IV).

Included with the major soils are about 10 percent shallow to very shallow soils overlying hardpan, and stony soils similar to the major components.

The soils in the unit have low density cover of creosotebush, white bursage, yucca, and some grasses and annuals.

Present land use includes grazing, wildlife and some recreation.

14. --This unit occurs on lower mountain slopes at elevations of about 4,500 to 7,000 feet.

Major soils comprising the unit include:

(a) About 40 percent light to dark brown, deep, well drained, very gravelly loams and very gravelly sandy loam on 8 to 30 percent slopes.

Available water capacity for plants is low; the profile permeability is moderate to moderately rapid; and the potential erosion hazard for water and wind is moderate to slight. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

(b) About 25 percent light brown, well drained, very gravelly

sandy loams and very gravelly loamy sands overlying lime-cemented hardpan at less than 20 inches. They occur on 8 to 30 percent slopes.

Available water capacity for plants is low; the profile permeability above the hardpan is moderately rapid; and potential erosion hazard for water and wind is severe to moderate. These soils are not suited for irrigated crop or pasture. (Land capability class VII).

(c) About 25 percent rock outcrop (limestone, quartzite, dolomite, sandstone) on 15 to 50 percent slopes. (Land capability class VIII).

Included with the major soils are about 10 percent shallow to very shallow soils on bedrock, and very stony soils similar to the major components.

The soils in the unit have a cover of shrubs mostly yucca, white bursage and creosotebush at lower elevations which grade through blackbrush to sagebrush, juniper, pinyon, and other shrubs at higher elevations.

Present land use includes grazing, wildlife and some woodland, and recreation.

15. --This unit occurs on mountain slopes at elevations of about 5,000 to 7,000 feet.

Major soils comprising the unit include:

(a) About 40 percent rock outcrop (intrusive and extrusive volcanics) on 15 to 50 percent slopes. (Land capability class VIII).

(b) About 35 percent reddish brown, well drained, gravelly loams to very gravelly sandy loams which are underlain by hard bedrock at 10 to 20 inches. They occur on 15 to 50 percent slopes.

Available water capacity for plants is low; the profile permeability above bedrock is moderate; and the potential erosion hazard by water is severe. Not suited for irrigated crops or pasture. (Land capability class VII).

(c) About 15 percent light reddish brown, gravelly sandy clay loams overlying hard bedrock at 10 to 20 inches. They occur on 8 to 15 percent slopes.

Available water capacity for plants is low; the profile permeability above bedrock is moderately slow; and the erosion hazard by water is severe. Not suited for irrigated crops or pasture. (Land capability class VII).

Included with the major soils are about

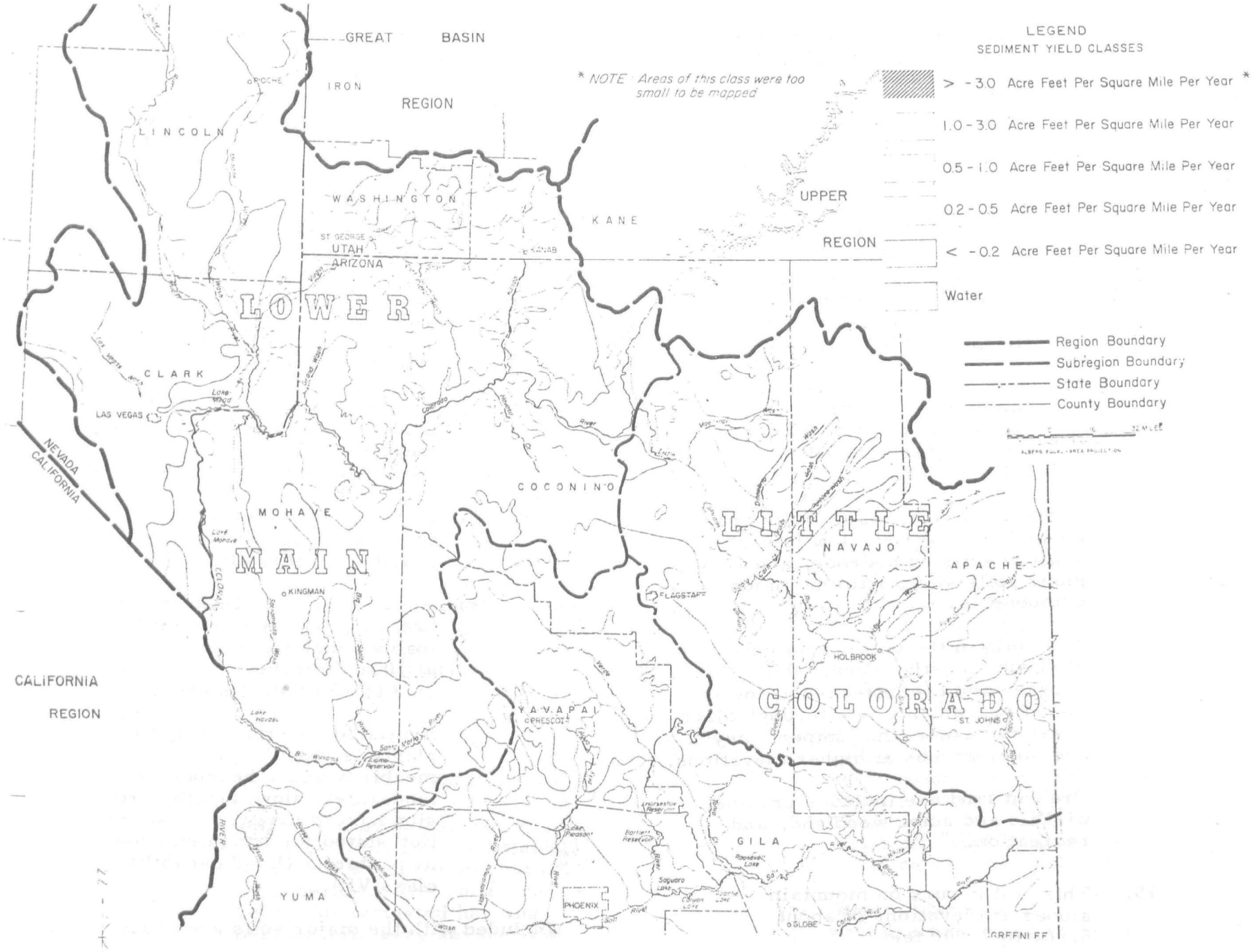

GREAT BASIN
IRON
REGION
* NOTE Areas of this class were too small to be mapped
LEGEND
SEDIMENT YIELD CLASSES
> - 3.0 Acre Feet Per Square Mile Per Year *
1.0 - 3.0 Acre Feet Per Square Mile Per Year
0.5 - 1.0 Acre Feet Per Square Mile Per Year
0.2 - 0.5 Acre Feet Per Square Mile Per Year
< - 0.2 Acre Feet Per Square Mile Per Year
Water
Region Boundary
Subregion Boundary
State Boundary
County Boundary
LINCOLN
WASHINGTON
KANE
UPPER
REGION
ST GEORGE
UTAH
ARIZONA
LOWER
CLARK
LAS VEGAS
NEVADA
CALIFORNIA
MOHAVE
MAIN
KINGMAN
COCONINO
LITTLE
NAVAJO
APACHE
FLAGSTAFF
HOLBROOK
CALIFORNIA
REGION
YAVAPAI
PRESCOTT
COLORADO
ST JOHNS
GILA
YUMA
PHOENIX
GLOBE
GREENLEE

figure 9

10 percent deep gravelly loams and sandy loams, and very stony and extremely stony soils similar to the major components.

The soils in this unit have a highly varied plant cover which includes numerous shrubs and grass species, and pinyon and juniper at higher elevations.

Present land use includes grazing, wildlife, and some watershed and recreation.

21. --This unit occurs on flood plains, and low adjacent alluvial fans and terraces. The component major soils are subject to occasional flooding.

    Major soils comprising the unit include:

    (a) About 40 percent grayish brown, deep, moderately well to somewhat poorly drained silty clays and silty clay loams on floodplains with 0 to 2 percent slopes.

        Available water capacity for plants is high; the profile permeability is slow; and the potential wind and water erosion hazard is moderate. These soils are suited for irrigated crops and pasture with severe limitations. (Land capability class III).

    (b) About 30 percent pale brown, deep, well drained gravelly loamy sands and gravelly loams on flood plains and low adjacent alluvial fans and terraces with 0 to 2 percent slopes.

        Available water capacity for plants is moderate; the profile permeability is moderately slow to moderate; and the potential wind erosion hazard severe. These soils are suited for irrigated crops and pasture with severe limitations. (Land capability class III).

    (c) About 20 percent light brown, deep, well drained loamy sands on flood plains and adjacent low terraces, alluvial fans, and dune areas with 0 to 8 percent slopes.

        Available water capacity for plants is low; the profile permeability is moderately rapid; the potential wind erosion hazard is high. These soils are suited for irrigated crops and pasture with severe limitations. (Land capability class III).

Included among the major soils in the unit are about 10 percent stony soils and deep very gravelly sandy soils.

The soils in the unit have a low density plant cover consisting of saltbush, creosotebush and white bursage.

Present land use includes grazing, wildlife, and some recreation.

41. --This unit occurs on alluvial fan toeslopes and on inset alluvial fans where slopes are less than 8 percent.

Major soils comprising the unit include:

(a) About 35 percent reddish brown, deep, well drained sandy loams on alluvial fan toeslopes with 2 to 8 percent slopes. Some of these soils contain slight to moderate lime cementation in their subsoils.

Available water capacity for plants is moderate; the profile permeability is moderate to moderately rapid; the potential water and wind erosion hazard is severe and moderate. These soils are suited for irrigated crops and pasture with severe limitations. (Land capability class III).

(b) About 30 percent pinkish brown to brown, deep, well drained gravelly sandy loams and gravelly loams on inset alluvial fans with 0 to 4 percent slopes. Some of these soils contain gypsum accumulations in their subsoils.

Available water capacity for plants is low to moderate; the profile permeability is moderately slow to moderate; and the potential wind and water erosion hazard is moderate. These soils are suited for irrigated hay and pasture with very severe limitations. (Land capability class IV).

(c) About 15 percent pink, well drained, gravelly fine sandy loams underlain by lime-cemented hardpan at 10 to 20 inches. They occur on alluvial fan toeslopes with 2 to 8 percent slopes.

Available water capacity for plants is low; the profile permeability to the hardpan is moderate to moderately rapid; and potential water and wind erosion hazard is moderate to severe. These soils are suited for irrigated crops or pasture. (Land capability class VII).

Included with the major soils in the unit are about 20 percent deep, wet, saline silt loams, and deep, well drained sand; badlands; stony soils; and deep clays adjacent to playas. Small areas of included deep soils are suited for irrigated cropland and pasture.

The soils in the unit have a shrub-plant cover consisting mainly of creosotebush, white bursage, and some grasses, annuals, saltbush and yucca.

Present land use includes grazing, wildlife, urban, industrial, and some recreation.

42. --This unit occurs on alluvial fans and foothills where slopes are 4 to 30 percent.

Major soils comprising the unit include:

(a) About 35 percent reddish yellow to reddish brown, deep, well drained gravelly and very gravelly sandy loams on smooth and dissected alluvial fans with 4 to 15 percent slopes. Most of these soils have slight to moderate lime cementation in their subsoils.

Available water capacity for plants is low to moderate; the profile permeability is moderate to moderately rapid; the potential water and wind erosion hazard is moderate. The soils are not suited for irrigated crops or pasture. (Land capability class VII).

(b) About 35 percent light brown, well drained, very gravelly loamy sands and very gravelly sandy loams which are underlain by lime-cemented hardpan at less than 20 inches. They occur on smooth and dissected alluvial fans with 4 to 15 percent slopes.

Available water capacity for plants is low; the profile permeability to the hardpan is moderately rapid; and the potential for water and wind erosion is moderate. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

(c) About 20 percent pale brown, deep to moderately deep, well drained, stony and cobbly very gravelly sandy loams and very gravelly sands on foothills and inset alluvial fans with 4 to 30 percent slopes.

Available water capacity for plants is low; the profile permeability is moderate to rapid. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

Included with the major soils are about 10 percent deep, gravelly sandy loam, soils which are underlain by bedrock, and some gypsiferous very gravelly soils.

The soils in the unit have a sparse plant cover of creosote bush, white bursage and some yucca, annuals, and saltbush.

Present land use includes grazing and wildlife and some urban, industrial, and recreation.

43. --This unit occurs on high mountain slopes at elevations of about 5,000 to 10,000 feet.

Major soils comprising the unit include:

(a) About 35 percent yellowish brown, moderately deep to deep, well drained, stony very gravelly loams overlying bedrock with 8 to 30 percent slopes.

Available water capacity for plants is low to moderate; the profile permeability is moderately slow to moderate, and the potential erosion hazard by water is severe. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

(b) About 30 percent pale brown to dark brown, deep to moderately deep, stony and very stony very gravelly sandy loams and very gravelly loamy sands overlying bedrock with 4 to 50 percent slopes.

Available water capacity for plants is low; the profile permeability is moderately rapid; potential erosion hazard by water is severe. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

(c) About 25 percent brown, well drained, stony and very stony gravelly loams which are underlain by bedrock at 10 to 20 inches. They occur on 8 to 50 percent slopes.

Available water capacity for plants is low; the profile permeability above bedrock is moderate; potential erosion hazard by water is severe. These soils are not suited for irrigated crops or pasture. (Land capability class VII).

About 10 percent of the unit includes with the major soils: rock outcrops, rock rubble, and more steeply sloping soils similar to the major components.

The soils in the unit have a plant cover which includes sagebrush, grasses, forbs, pinyon pine, juniper, and various species of mountain shrubs.

Present land use includes grazing, wildlife, watershed, and recreation.

51. --This unit occurs on valley terraces and alluvial fans.

Major soils comprising the unit include:

(a) About 60 percent pale brown, well drained, gravelly sandy loams and loamy sands which are underlain by lime-cemented hardpan at 10 and 20 inches. They occur on 0 to 8 percent slopes.

Available water capacity for plants is low; the profile permeability above the hardpan is moderate to moderately rapid; and potential water and wind erosion hazard is moderate.

These soils are not suited for irrigated crops or pasture. (Land capability class VII).

(b) About 30 percent reddish yellow to pale brown, deep, well drained, gravelly and very gravelly sandy loams with 2 to 8 percent slopes.

Available water capacity for plants is low; the profile permeability is moderate to moderately rapid; potential water and wind erosion hazard is moderate. These soils are suited for irrigated hay and pasture with very severe limitations. (Land capability class IV).

About 10 percent of the unit includes soils overlying bedrock at very shallow depth, stony soils, and soils overlying hardpan at less than 10 inches.

The soils in the unit have a sparse plant cover consisting of creosotebush, white bursage, yucca, and some annuals.

Present land use includes grazing, wildlife, urban, industrial, and some recreation.

Glossary

Soil map unit - A specific area of major kind(s) of soil and minor included soils which are delineated on soil maps.

Soil depth - (To hardpan or bedrock)

Very shallow: less than 10 inches.
Shallow: 10 - 20 inches.
Moderately deep: 20 - 40 inches.
Deep: more than 40 inches.

Profile permeability - (Excluding permeability of hardpan or bedrock)

Very slow: less than 0.06 in./hr.
Slow: 0.06 - 0.2 in./hr.
Moderately slow: 0.2 - 0.6 in./hr.
Moderate: 0.6 - 2.0 in./hr.
Moderately rapid: 2.0 - 6.0 in./hr.
Rapid: 6.0 - 20 in./hr.
Very rapid: more than 20 in./hr.

Available water capacity - The inherent capacity of soil to store and yield water for use by plants. As used herein it indicates the estimated total within the soil to a depth of 5 feet or to hardpan or bedrock if at a depth shallower than 5 feet.

Low: less than 4.0 inches.
Moderate: 4.0 - 7.0 inches.
High: more than 7.0 inches.

Land capability classification - Groupings of soils which show in a general way, the suitability of soils for common field crops. The soils are grouped according to their limitations when used for crops, the risk of damage when they are used, and the way they respond to treatment.

Class I - soils have few limitations that restrict their use.

Class II - soils have moderate limitations that reduce the choice of plants or that require

moderate conservation practices.

Class III - soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV - soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V - soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI - soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII - soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland or wildlife habitat.

Class VIII - soils and landforms that have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply or to esthetic purposes.

WATER RESOURCES

Regional Hydrology

The Las Vegas Ground Water Basin is comprised of the alluvial fill of Three Lakes Valley, the southern part of Indian Spring Valley, the northern part of Ivanpah Valley, and Las Vegas Valley. The entire Basin is surrounded by a series of high mountain ranges which act as barriers to ground water movement and form the general limits of the ground water basin. From a hydrologic standpoint, the Spring Mountains that make up the western topographic divide, are the dominant features of the watershed. These mountains are the highest in the region, and large alluvial fans from these mountains extend far out into the Valley below. In contrast, the alluvial fans from the eastern side of the Valley are small in areal extent.

Based upon their hydrologic properties, the geologic formations of the area can be divided into two general groups; (1) consolidated rocks of low permeability that underlie the alluvium in the Valley and form the mountains that encircle the ground water basin, and (2) the relatively permeable sedimentary deposits of the valley fill that form the Las Vegas ground water basin. These alluvial deposits contain virtually all of the ground water of economic importance in the basin, occurring in a large, leaky artesian system under both confined and unconfined conditions.

Major drainage within the watershed is

towards the southeast through Las Vegas Wash to the Colorado River. Storm runoff is usually limited to the higher elevations above 6,000 feet where it ultimately infiltrates into the porous alluvial fans. After intense summer storms, however, runoff may be sufficient to flow onto the floor of the Valley, and discharge into Las Vegas Wash.

Las Vegas Bay is a part of the Boulder Basin area of Lake Mead which covers a surface area of 157,736 acres and drains an area of 167,800 square miles. The largest reservoir in the United States, its usable capacity is 27,207,000 acre feet. As a multipurpose reservoir it is used for flood control, irrigation, municipal uses, navigation, and power.

The Colorado River is the main source of surface inflow into Lake Mead. The nearest stream-gaging station, which is near Grand Canyon, Arizona is 190 river miles above the convergence (at usual reservoir levels), which is defined as the boundary between the muddy Colorado River water and the clear Lake Mead water. The only Colorado River tributary below the Grand Canyon gaging station whose flow is measured is Bright Angel Creek, which enters the main stream a quarter of a mile below the Grand Canyon gaging station. All other tributaries between Bright Angel Creek and the convergence are unmeasured. Time of travel for measured flows between Grand Canyon and the head of the reservoir, is from two to three days depending on the flow. Virgin River is the only other major tributary to Lake Mead whose flow is measured.

Unmeasured inflow includes the runoff entering Colorado River between the mouth of Bright Angel Creek and the head of the reservoir, and flow of all streams except those of the Virgin River that discharge directly into Lake Mead. The area from which this runoff is derived has topographic and climatic characteristics not greatly different from those of the Virgin River basin. Unmeasured runoff is therefore, considered to be proportional to Virgin River flow.

Reservoir releases are the major surface outflow from Lake Mead. Outflow is measured at a stream-gaging station located one mile below Hoover Dam and the records thus obtained are checked against figures obtained from power plant records. Pumping from Lake Mead for domestic and industrial uses, is less than one-tenth of one percent of the outflow and is disregarded.

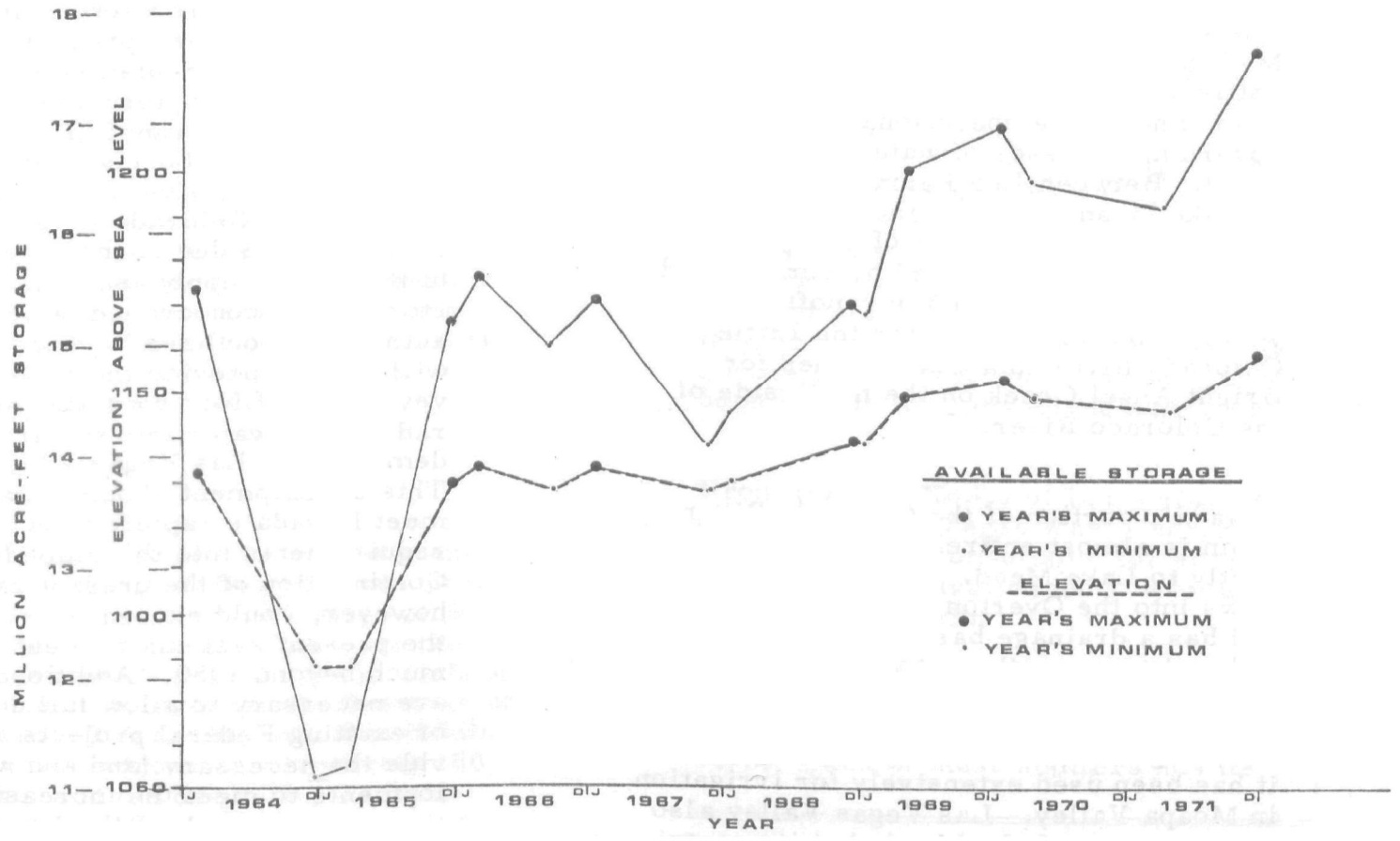
The capacity of the reservoir is slightly reduced because of the addition of sediment to the Lake. The slight change in capacity is of little consequence because the sediment is deposited at the bottom of the Lake, where the temperature of the water remains almost constant throughout the year. Thus, the small capacity change has no effect on computed figures of change in energy storage. Changes in Lake stage are recorded on a Stevens remote-registering gage with the actuating element mounted over a stilling well built into Hoover Dam. The gage-indicator dial and a Stevens water-stage recorder are located in the powerhouse.

The Lower Main Stem Subregion of the Lower Colorado Region includes the Colorado River drainage basin from Lee Ferry (one mile downstream from the Paria River) to the southerly international boundary with Mexico, with the exception of the Little Colorado River Basin, the Gila River Basin above Painted Rock Dam, and the California portion of the Colorado River Basin. In addition, the Subregion includes Mexican drainage west of Lukeville, Arizona and closed basins in Southeastern Nevada covering 3,200 square miles. The total area is 56,554 square miles, of which 17,310 square miles are in Nevada. About 52,100 square miles of the area contribute to the Colorado River. The River follows a generally westerly course from Lee Ferry through the Grand Canyon and into Lake Mead. Below Lake Mead, it flows southward forming the border between the States of Arizona and Nevada and further south, Arizona and California. Elevations range from near 12,000 feet at Charleston Peak near Las Vegas to about 75 feet at the southerly international boundary. Between Lee Ferry and Hoover Dam (353 river miles) the principal tributaries are the Little Colorado River, the Virgin River, Bright Angel, Tapeats, Kanab; and Havasu Creeks, and Las Vegas Wash. Springs contribute about 300,000 acre-feet annually in this reach. (Refer to Figure 1)

The total long-term average annual undepleted tributary runoff to the Colorado River is estimated at nearly 2.4 maf, including over 1 maf from the Gila River and 0.4 maf from the Little Colorado River. The undepleted net gain of the Colorado River from Lee Ferry (15.09 maf) to the international boundary (15.94 maf) is about 0.85 maf annually. Since the undepleted inflow to the main stem is estimated as about 2.4 maf, an apparent river loss of 1.5 maf under the natural environment is indicated. Present water requirements in the Subregion, are estimated as 1.3 maf annually. Additional demands on the supply of the river below Lee Ferry are for main stem reservoir evaporation and spills, channel losses, exports to the California Region, and Mexican Treaty obligations. These demands presently total about 9 maf annually.

The water supply available for use in the Lower Main Stem Subregion consists of (a) natural runoff originating in the Subregion, (b) a portion of the Main Stem Colorado River water released from the Upper Colorado Region at Glen Canyon Dam under the provisions of the Colorado River Compact, and (c) ground water. Most of the presently available runoff originating in the Subregion occurs between Lee Ferry and Hoover Dam. Releases from Glen Canyon Dam constitute the Subregion's major water source. Completed in 1963, Glen Canyon Dam provides the storage required to meet downstream water requirements under the Colorado River Compact of 1922, storage requirements for Upper Colorado Region water development, and for power production.

In 1965, gross ground-water pumpage



LAKE MEAD STORAGE AND SURFACE ELEVATIONS

figure 10

provided over one-half million acre-feet to satisfy uses in the Subregion. Groundwater overdraft occurs in some areas, notably in Nevada. The Southern Nevada Water Project, currently under construction, will provide the facilities to develop the major portion of Nevada's Colorado River entitlement and will reduce the rate of overdraft in Las Vegas Valley. The surface-water supply of the Lower Main Stem Subregion depends almost entirely on releases from Glen Canyon Dam, and on the operational criteria governing releases of water from Lake Mead. Between Lee Ferry and the head of Lake Mead, many of the tributaries flow only during periods of heavy rainfall; however, several are fed by springs and are perennial. Tributary runoff varies widely from 0.3 inches for the Little Colorado River to about 5 inches for Bright Angel Creek on the north side of the Colorado River.

Nevada's portion of the Colorado River basin is almost entirely tributary directly to Lake Mead. The Muddy River flows into the Overton arm of the Lake and has a drainage basin of 8,200 square miles; however, the actual inflow to Lake Mead from this large area is restricted in most years to the water discharged from the Moapa Springs after it has been used extensively for irrigation in Moapa Valley. Las Vegas Valley also is tributary to Lake Mead, but its contribution is chiefly in flood runoff from the lower part of the Valley plus a small amount of effluent seepage from the ground-water reservoir. Like the intermontane valleys in the White River basin, Las Vegas Valley is analogous to valleys in the Great Basin in that the precipitation upon its drainage area is practically all returned to the atmosphere within that area; but, Las Vegas Valley is closely related to the Colorado River because it imports water from Lake Mead.

The Subregion has a total water supply in excess of its own present requirements. Supplies exceed depletion requirements by 1.3 to 2.5 million acre-feet annually, dependent upon the runoff period inspected. Seasonal water shortages do occur, however, principally on the developed tributaries of the Colorado River. These shortages are due to the erratic nature of the water supply and to lack of adequate storage and conveyance facilities. The authorized Southern Nevada Water Project will shortly provide the facilities to convey a part of Nevada's allocation of Colorado River water into the area of greatest demand, the Las Vegas-Eldorado Valley. This development should be adequate to meet Nevada's rapidly growing water requirements into the immediate future. Continuation of the present rapid growth, however, could exceed the capability of the present systems to meet demands much beyond 1980. Additional facilities are necessary to allow full development of existing Federal projects and to provide the necessary land and water developments to meet the increasing recreation pressures along the Lower Colorado River.

Future main stem reservoir evaporation can be expected to decline without augmentation, but not by great amounts

through the 2020 level of development. Main stem channel losses are also projected to decline as a result of the authorized Bureau of Reclamation Colorado River program for increasing water yield. The present losses of 660,000 acre-feet were accordingly reduced by 170,000 acre-feet from selective phreatophyte control and by 170 acre-feet from river channelization.

Future water supplies available to the Subregion will decline from 11.42 maf in 1980 to 9.65 maf in 2020. Water requirements exceed the available water supply in year 2020, even under a favorable runoff period. Nevada is grossly short of water to meet demands, and the problem needs to be solved through development of sources other than the Colorado River, be it augmentation or by further use of Nevada ground-water resources.

Area Hydrology

Geologists have divided the aquifers underlying Las Vegas Valley into four principal hydrologic units on the basis of their stratigraphic positions. These are the near-surface aquifer from ground surface down to about 200 feet, the shallow zone of aquifers from 200 to 500 feet, the middle zone of aquifers from approximately 500 to 700 feet, and the deep zone aquifers below 700 feet. Water in the near-surface aquifer occurs under both water table (unconfined) and artesian conditions, while water in the last three hydrologic units occurs under artesian (confined) conditions.

Shallow ground water is found in Las Vegas Valley at depths from 1 to 50 feet below ground surface. This shallow water body is referred to as the near-surface aquifer. Water within this aquifer is generally unconfined in the Las Vegas Valley. The maximum thickness of the near-surface aquifer system is about 200 feet thick. Beds and lenses of caliche, sand, silt and clay make up the near-surface aquifer system. In the Valley these beds are commonly saturated with ground water within a few feet of the surface. Recharge of the near-surface aquifer occurs from upward leakage from the deeper aquifers and from surface recharge from cooling water, sewage effluent, lawn and parkway irrigation and possibly from surface ponding of storm runoff. While the chemical character of the near-surface ground water varies considerably across the Valley, most samples have been high in total dissolved solids (TDS)*.

From the city limits of Las Vegas southeast to the Las Vegas Wash, shallow ground water is unsuitable for either domestic or irrigation uses because of high mineralization.

In the Las Vegas Valley there are three major aquifer zones which are under pressure. Each of these aquifers has its

*Typically TDS levels range from 2000 to 8,000 mg/l. Measurements assembled by the Desert Research Institute, University of Nevada, indicate that the average concentration may approach 5,000 mg/l.

own pressure (piezometric) surface or level; the deeper zones are generally under greater confining pressure. Within the Valley, pressures within the various aquifers have tended to become equalized by vertical movement of water within individual water wells and between formations. Vertical interchange between aquifers has resulted because of irregular deposition and erosion of sediments, faulting in the valley fill and leakage due to improper well construction. Geologic investigations of the southeast part of Las Vegas Valley have indicated that only insignificant amounts of this confined water escapes from the Valley via subsurface flow. Studies of the Valley margins indicate that escape of the underground water is unlikely in any part of the Valley. Total discharge of waters from the upper, middle and lower aquifer zones is represented by well extractions, upward leakage into the near-surface aquifer and discharge into springs. The shallow zone of aquifers lies between 200 and 500 feet below ground surface. Four principal sand and gravel lenses within this horizon provided most of the potable water from the Valley prior to 1940. A marker bed of blue clay separates the shallow zone from the middle zone. The middle zone of aquifers lies from 500 to 700 feet deep. This is the most productive aquifer in Las Vegas Valley and presently supplies most of the water pumped in from the Basin. All of the aquifers lying below 700 feet have been included in the deep zone of aquifers. Only small quantities of water are presently being withdrawn from this depth. The sediments consist of siltstones interbedded with thin, sandy strata of fine sand and silt. All or most of the deep zone aquifers occur in the Muddy Creek formation.

Almost all of the natural recharge that occurs to the confined aquifer system is by infiltration of rainfall and runoff occurring principally in the Spring Mountains and in the Sheep Range. At altitudes above 6,000 feet, rainfall commonly accumulates in quantities sufficient to permit some water to percolate through the alluvial material into the saturated groundwater zone. Runoff from heavy mountain rainfall infiltrates into the fractured mountain rock and into the porous alluvial aprons where it can percolate downslope into the Valley fill. The main recharge (intake) area for the Las Vegas ground water basin is probably along the base of the mountains, particularly to the west in the areas of the large alluvial fans radiating out from the Spring Mountains. From these principal recharge areas, the ground water moves downslope and laterally in the direction of the hydraulic gradient toward the discharge areas to the southwest portions of the Valley. In the lower parts of the Basin below elevation 6,000 feet, the annual rainfall averages less than five inches per year. There is probably no direct natural recharge to the near-surface or the confined aquifers, because of the high soil moisture demand. All of this rainfall is undoubtedly lost to the processes of evaporation and transpiration.

Ground-water recharge via septic tank effluents in the Valley contributed another 1,254 acre-feet during 1973. Seepage from the BMI waste-water discharge

ponds may have been responsible for adding another 5,000 acre-feet of highly mineralized water during 1973. Thus, the total recharge to the near-surface ground-water system from man's activity in the Valley was in excess of 40,000 acre-feet during 1973. The quantity of new salt which was carried into the ground-water system by man's actions is not quantifiable at this stage of investigation, but the amount must be significant as evidenced by the very high TDS levels of the upper horizon of the near-surface ground-water system.

Of the total of 47,996 acre-feet of water which was applied to lawns and crops throughout the Valley, about 9,427 acre-feet was supplied from secondary treated effluent. Odor and soil plugging problems have been experienced in using secondary treated effluent for golf course irrigation in Las Vegas Valley. In 1973, the odor problem became so acute at the Winterwood Golf Course that they are converting to use of ground water to alleviate the problem. It appears that the use of secondary effluent where land is not cultivated will be seriously restricted in light of the problems encountered.

The complexity of the Las Vegas ground-water basin due to the nature of sediment deposition and subsequent faulting within the alluvium, has created many obstacles to understanding hydrodynamics of subsurface flow. While there have been many ground-water wells drilled within the Valley, there were virtually none that were constructed for monitoring both water levels and water quality of specific aquifers.

Low in the Valley and closer to the Las Vegas Wash, where the sands and gravels become thin, the artesian water slowly leaks upward through silts and clays and contributes to high water tables. Before the advent of man, all the water recharged to the Las Vegas ground-water basin was discharged by evapotranspiration - a combination of evaporation and transpiration by specialized plants (phreatophytes) which thrive in places where the water table is close to the ground surface. In those early days, all the water was consumed in the upper reaches of Las Vegas Wash and there was no perennial flow in the lower reaches. Presently, all water delivered to the developed portions of Las Vegas Valley which is not consumed, returns to the near-surface aquifers. Thus, all cesspool and septic tank contributions must be considered as recharge to the near-surface aquifers. Irrigation of any type, such as for agriculture or golf courses, has limited efficiency. This means that more water must be delivered than the plants use. The consequence of this is that there is always some water which moves down through the irrigated soils and joins the near-surface aquifers. Such water is always higher in dissolved minerals than the water which is delivered. Under present conditions, this irrigation return water, now in the near-surface aquifers, will move downslope, rise to the ground surface, and augment the present surface flow of Las Vegas Wash. In addition to these ground-water flows, the Wash has

become the principal channel for removal of much of the treated municipal and industrial waste water produced in the Las Vegas Valley. The present waste water flow of more than 40 million gallons per day (mgd) supports a perennial, densely vegetated marsh of about 2,000 acres, with a diverse and abundant wildlife population.

Dry Lake, Eldorado, Jean Lake, and Hidden Valleys are characterized by deep water tables, indicating that natural recharge, however small, must be escaping via underground exits. Concern has been expressed that sewage effluent, if spread on these dry lake and flanking alluvial fan areas, would percolate to great depths, to join and pollute the deep regional ground waters.

At Dry Lake, results of laboratory tests indicate that percolation to the deep water table would be extremely slight, and for all practical purposes, insignificant.

From Eldorado Valley there is believed to be underground leakage easterly through the volcanic rocks of the Eldorado Mountains to the Colorado River below Hoover Dam. A deep well near the south end of the dry lake encountered bedrock at a depth of 1,040 feet. This well was drilled through low permeability materials to a depth of 475 feet, where an artesian aquifer was reached. The water rose 200 feet to a depth of 275 feet. This well was pumped for 14 hours at 920 gallons per minute with a drawdown of 95 feet. The water had a total dissolved solids content of 1,275 ppm. In Eldorado Valley Converse, Davis & Associates drilled three bucket auger test borings to depths between 37 and 48 feet, and one rotary wash boring to a depth of 80 feet. The Muddy Creek formation, as a thick, low permeability zone, does not appear to be present at depth. Thus, water spread on the peripheral alluvial fan surfaces may have an opportunity of reaching the regional ground water. There is believed to be deep drainage from beneath Jean Lake easterly into Eldorado Valley and northerly into Hidden Valley.

The deepest well near Jean Lake was drilled to a depth of 470 feet; depth-to-water is about 343 feet. The water has an electric conductivity of 1,300. The indications are that the yield of the well was very low. Converse, Davis & Associates drilled two bucket auger borings to depths of 22 and 41 feet, and two rotary wash borings to depths of 60 and 105 feet. Spreading of water on the peripheral alluvial fan might result in substantial downward leakage to the regional ground water.

In Hidden Valley, one well was drilled to a depth of 1,490 feet; depth-to-water is about 950 feet. No more than one-fourth mile to the northwest, across the McClanahan Fault, depth-to-water is only about 600 feet. Converse, Davis & Associates drilled one 33-foot bucket auger boring near the middle of the dry lake in Hidden Valley. The dry lake deposits are very limited in extent and if

water is spread on the peripheral alluvial fans, there are no thick lake clays to prevent percolation to the regional ground water.

WATER QUALITY

Historically, the initial negotiations of water allocation among the states of the Colorado River Basin was primarily a matter of who was going to get how much rather than whether it was of a quality they could use once they got it. The Colorado River Compact, in 1922, was set up to provide for the diversion of waters in the Colorado River System. It also established a preference for agriculture and domestic uses over all other uses. However, no explicit provisions regarding water quality was contained.

The United States and Mexico in 1944 adopted a Treaty for the Utilization of the Colorado and Tijuana and of the Rio Grande. The Treaty, allotted to Mexico 1,500,000 acre-feet annually . . . of the waters of the Colorado River, from any and all sources . . ." The delivery of treaty waters to Mexico began in 1950 with the completion of Morelos Dam, Mexico's major diversion structure on the Colorado River.

A major plan for the development of the Upper Colorado River Basin was approved by Congress in 1956 in a bill called the "Colorado Source Project and Participating Project." The Plan called for the construction of several large dams, reservoirs, and hydroelectric generating plants on the Colorado River and its principal tributaries above Lee Ferry, Arizona, and for an undefined number of "participating" reclamation projects within the Upper Basin. In addition, language in the Act directed the Secretary of the Interior to investigate and report periodically to Congress and to the Colorado River Basin states on water quality conditions in the Colorado River.

Amendments concerning the study of the River's water quality and the specification of a schedule for reporting thereon, were also inserted in authorizing legislation for the Navajo Indian Irrigation Project, the initial stage of the San Juan-Chama Project, and the Fryingpan-Arkansas Project. These projects provided both for in basin irrigation development and diversions out of the Colorado River Basin. It was hoped that, with the accumulation of basic information on water quality and analyses of effects on future projects, studies could be made of ways to eliminate salinity problems. As of 1970 the Secretary had submitted four reports on water quality in the Colorado River Basin.

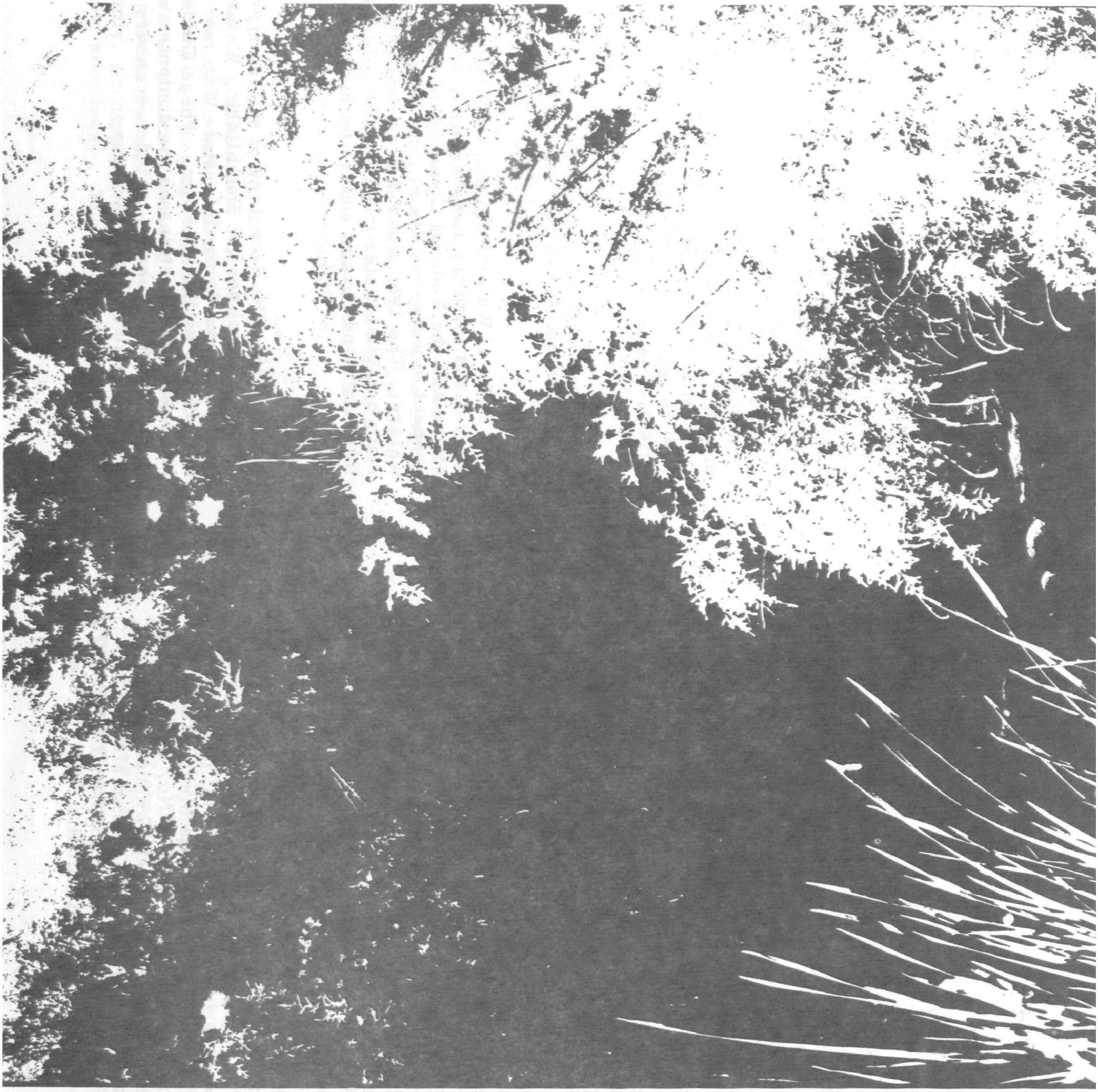
In the fall of 1961, the salinity of the Colorado River rose sharply in the water arriving at the International Boundary prior to its entry into Mexico. This resulted when pumped drainage of highly mineralized ground water had begun back into the Colorado earlier in the year on the Wellton-Mohawk Project in Arizona.

These highly saline waters from the Project were discharged into the River downstream of all United States diversions, but upstream of all Mexican diversions. The Mexican Government immediately lodged strong protests with the United States Government over the River's salinity.

The United States and Mexico met to discuss the problem, and in 1965 entered into a five-year agreement that was embodied in Minute No. 218 of the International Boundary and Water Commission. The agreement provided for construction and operation of a channel that would bypass saline drainage water from the Wellton-Mohawk Project around the Mexican point of diversion at Morelos Dam. It also gave Mexico the right to decide when drainage water was to be bypassed, and further provided that during the periods of October 1 and February 28, when Mexico was taking water at the minimum winter rate, the United States was to control water reaching the limitrophe section of the river so that, without including Wellton-Mohawk drainage water, the flows would average the minimum winter rate of 900 cubic feet per second. These bypass waters were replaced by other waters largely from above Imperial Dam. By the end of 1971, these operations, coupled with a gradual improvement in the quality of Wellton-Mohawk drainage waters, had reduced the average annual salinity of waters made available to Mexico to about 1,245 parts per million TDS, with monthly averages varying from 1,105 to nearly 1,500 ppm TDS.

Meanwhile, Mexico concluded that it could not use waters with salinity greater than about 1,240 parts per million TDS (1,300 parts per million, if the Mexican method of analysis is used in the Mexicali Valley. The United States under terms of Minute No. 218 agreed to bypass an additional 40,000 to 75,000 acre feet of Wellton-Mohawk drainage flows annually. The effect was to further reduce the average salinity of water diverted by Mexico at Morelos Dam to about 1,160 parts per million TDS.

Before Minute No. 218 was to have expired on November 15, 1970, the United States proposed a new five year agreement to further reduce salinity. The United States offered to bypass additional volumes of Wellton-Mohawk drainage and to substitute equal volumes of better waters to reduce the average annual salinity of waters delivered to Mexico at the Northerly International Boundary to about 1,140 parts per million, TDS, subject to increases in salinity at Imperial Dam. This salinity would approximate that of waters delivered to Mexico above Morelos Dam if all United States projects below Imperial Dam were operating in a salt balance. Salt balance in this context means that the same percentage of salt is returned to a river from an irrigation project in drainage as is diverted to it in irrigation waters. The Administration of President Diaz Ordaz of Mexico considered the proposal constructive, but decided to leave the matter to the Administration of President Echeverria, who took office in December 1970. Minute No. 218



was therefore extended one year.

In 1971 and early 1972, the Government exchanged several proposals in an attempt to reach an agreement, extending Minute No. 218 in November 1971 for another year so that the discussion might continue. After further conversations in early 1972, Mexico requested a prompt, permanent settlement. The Presidents of the United States and Mexico met and issued a joint communique on June 17, 1972. With this communique the search for a solution entered another phase. The then President of the United States assured President Echeverria of his desire for a definitive, equitable, and just solution to the problem, announced that he was prepared to undertake certain actions immediately to improve the salinity of waters delivered to Mexico, and indicated he would designate a special representative to develop a solution and to submit a report to him.

To immediately further improve the quality of water delivered to Mexico above Morelos Dam, the two governments approved a new Minute No. 241, signed July 14, 1972. It provided for the bypass of 18,000 acre-feet of Wellton-Mohawk drainage waters annually without charge against the Treaty, more than twice the rate of the United States bypass under Minute No. 218, and a replacement by other waters from above Imperial Dam and from wells on the Yuma Mesa. The operations under Minute No. 241 resulted in reducing the average annual salinity of waters made available to Mexico from 1,245 parts per million TDS in 1971 to 1,140 parts per million TDS for the year ending June 30, 1973. Operations under this Minute continued until August 30, 1973, when they were terminated by provisions of Minute No. 242.

In addition to the United States operations under Minute Number 241, Mexico requested the United States to bypass, without replacement, the remaining drainage waters in the Wellton-Mohawk districts to the Colorado River below Morelos Dam. This additional bypass amounted to about 100,000 acre-feet annually. This further reduced the average salinity of water diverted by Mexico at Morelos Dam from 1,160 parts per million TDS in 1971 to less than 1,000 parts per million TDS for the year ending June 30, 1973.

Protection of Quality under the Water Quality Act of 1965

The Federal Water Pollution Control Act of 1965 set forth the responsibility of the states and the Federal Government with respect to water quality of interstate waters. The 1965 Act required that each state establish water quality standards for interstate and coastal waters within each state.

In May 1966, the Secretary of the Interior issued "Guidelines for Establishing Water Quality Standards for Interstate Waters" as directed by the 1965 Act. These Guidelines advised the states on the contents these standards should include necessary for acceptance by the Secretary.

The Guidelines stated that the purpose of establishing water quality standards was to "enhance the quality of water" and in no case would standards be acceptable that provided for less than existing water quality. Further, a minimum of secondary treatment must be achieved prior to discharge into any interstate water regardless of the water quality criteria or uses adopted. The establishment of standards, along with the development of water quality criteria, and a plan for implementation and enforcement were to be submitted to the Secretary of the Interior for his approval by June 30, 1967. Standards submitted by the State of Nevada were approved without exception by the Secretary of Interior in a letter of June 27, 1968 to Governor Laxalt.

Development of Colorado River Policies and Standards

In 1966, representatives of all seven Colorado River Basin states met to consider a common framework of guidelines so that the Water Quality Standards for the Colorado River System (to be set separately by each of the seven states of the Basin) would be mutually compatible.

The conferees did not attempt to settle the very difficult problems of establishment of numerical criteria for salinity. Instead, it was agreed that the proposed water quality standards should state the criteria for salinity in qualitative terms only, pending the acquisition of more data and knowledge. The conferees finally agreed on January 13, 1967, to a document entitled "Guidelines for Formulating Water Quality Standards for the Interstate Waters of the Colorado River System".

Based upon the Guidelines, all basin states adopted policies and standards for the Colorado River and submitted them to the Secretary of Interior.

On August 26, 1969, the Nevada State Board of Health adopted water quality standards applicable to Las Vegas Wash. Since the Wash is an intrastate stream, these standards are not subject to Federal approval. The standards establish two sets of water quality criteria, an interim set to take effect in 1973 and more stringent requirements to take effect in 1980.

In December 1971, the United States Environmental Protection Agency instituted a 180-day enforcement action against the major polluting municipalities and industries who were discharging waste water into Las Vegas Wash. At the same time the Nevada Legislature enacted a law which would have the practical effect of preventing the construction of these subdivisions after July 1973 unless the pollution was abated. The local Interim-Agency Water Pollution Control Task Force and the Colorado River Commission of Nevada previously studied the problem, but were not in power to implement a solution. In 1971, the Nevada legislature designated the Las Vegas Valley Water District as the agency responsible for developing and

WATER QUALITY STANDARDS
LAS VEGAS WASH

CONTROL POINT

North Shore Road (No sampling will be required upstream of the control point if the regulations are satisfied at the control point.

TEMPERATURE °C

Monthly Mean	June 1 to September 30	Not more than 27°
" "	October 1 to May 31	Not more than 23°
Single Value in 90% of samples	June 1 to September 30	Not more than 31°
" " " " " "	October 1 to May 31	Not more than 27°

pH UNITS

Monthly Median	Within range 6.5 - 8.5
Single Value in 90% of samples	Within range 6.5 - 8.5

DISSOLVED OXYGEN - mg/l

Monthly Mean	Not less than 5.0
Single Value in 90% of samples	Not less than 4.0

BOD_5 - mg/l

Monthly Mean	Not more than 10.0
Single Value in 90% of samples	Not more than 15.0

COD - mg/l

Monthly Mean	Not more than 40.0
Single Value in 90% of samples	Not more than 50.0

SS - mg/l

Monthly Mean	Not more than 20
Single Value in 90% of samples	Not more than 5.0

MBAS - mg/l

Monthly Mean	Not more than 0.8
Single Value in 90% of samples	Not more than 1.0

PHOSPHORUS AS P - mg/l

Monthly Mean	Not more than 0.5*
Single Value in 90% of samples	Not more than 1.0*

* But not to exceed 400 pounds/day during April through October

TURBIDITY - JTU

Monthly Mean	Not more than 5.0
Single Value in 90% of samples	Not more than 10.0

FECAL COLIFORM - The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100 milliliters.

The beneficial uses to be protected in the Las Vegas Wash are as follows: Fish and wildlife, esthetics, irrigation and stock watering and recreation.

SOURCE: State of Nevada, Water Pollution Control Regulations, adopted by the State Environmental Commission on October 24, 1973.

table 1

implementing a plan for abating the pollution caused by waste water flow in Las Vegas Wash. In accordance with the district directives of that legislation, the district prepared a plan and submitted it to the Nevada legislature in December 1972.

The Nevada State Legislature approved the 1972 final written report of the Las Vegas Valley Water District, which outlined a program for export of polluted waters to the Dry Lake area. The legislators' response came in the form of Senate Bill 288 which directed: a) the Board of County Commissioners to make a review of the program proposed in December 1972; b) complete the review by September 1, 1973 and recommend a course of action to the Legislative Committee and the Governor of Nevada; c) after approval by the appropriate authorities, the Board of County Commissioners were authorized to construct the project through the issuance of state supported bonds provided that the Federal Government provide at least 50% of the financing required.

Colorado River Basin Salinity Control Act

The Colorado River Basin Salinity Control Act, introduced into the U.S. Congress as HR 12165 on January 21, 1974, was developed in response to the need for a definitive solution to the international salinity problem in the Colorado River. This Bill, if adopted, would authorize the construction, operation, and maintenance of certain works in the Colorado River Basin to control the salinity of water delivered to users in the United States and Mexico. Section 202, Part IV of the proposed legislation identifies the Las Vegas Wash unit, Nevada, as consisting of "Facilities for collection and disposition of the falling ground water of Las Vegas Wash..." The potential for facilities identified in this proposed legislation emphasizes the relationship of the proposed Las Vegas Wash/Bay Pollution Abatement Project to areawide planning at Federal, State, and local levels.

Present Water Quality Standards

Water Pollution Control Regulations (WPCR), for the waters of the State of Nevada were adopted by the State Environmental Commission on October 24, 1973. Existing standards for the state include the revisions adopted April 10, 1973, June 26, 1973, and those of October 24, 1973. The October 24, 1973 standards were approved with one exception by the U.S. Environmental Protection Agency on November 30, 1973.

The one exception to EPA's approval of the October 24, 1973 Water Pollution Control Regulation was the temperature criterion for Las Vegas Wash. A standard for temperature was included as one of the ten proposed amendments which accompanied EPA's approval of the Octo-

ber regulations. On April 9, 1974, after continuing discussion of an acceptable temperature standard, the State Environmental Commission adopted a temperature standard that will be included in the State regulations if approved by EPA. The October 24, 1973 WPCR and the April 9, 1974 revisions to the regulations are shown in Appendix C.

The U.S. Environmental Protection Agency along with its approval of the Nevada Water Pollution Control Regulations' proposed amendments to 40 CFR 120, "Interstate and Intrastate Waters of the State of Nevada." Two of the ten proposed amendments are particularly relevant to the evaluation of any presently proposed project alternative. As noted above, discussions on the proposed amendments continued, and on April 9, 1974, the State Environmental Commission adopted revisions to the State regulations. These State-adopted revisions were essentially the same as those proposed by EPA.

Among the original amendments proposed by EPA was the salinity standard for Las Vegas Wash. On March 28, 1974, in a letter to the Governor of Nevada, the EPA Regional Administrator elected to hold the salinity standard in abeyance pending the conclusions of negotiations with the Colorado River Basin Salinity Control Forum. Thus, there is not presently a numerical salinity standard for Las Vegas Wash.

Quality of Las Vegas Water Supplies

The present quality of the Valley's three major water resources is shown in Tables 2 through 5. All three resources are characterized by water hardness and by moderate to high salinity concentrations. With little doubt, the ground water resource affords the highest quality water, followed by Colorado River Water and last by waste water.

The future quality of the Valley's groundwater resources might be expected to remain fairly constant. However, lawn and landscaping irrigation in the Valley using water of higher salinity than the ground water, could result in some degradation of the deeper, better quality ground water resources by downward migration through the low permeability aquitards. Groundwater recharge programs using reclaimed waste water could have either beneficial or detrimental effects upon the quality of the ground-water resources, depending upon the character of the recharged water. These effects would depend for the most part upon the level of treatment provided prior to recharge.

Colorado River Water

The quality of Colorado River water is acceptable but not as good as that of the ground water. It is harder and has a higher concentration of TDS. Water quality records for the Colorado River show that annual average TDS at Hoover

WATER QUALITY CHARACTERISTICS
LAS VEGAS VALLEY WATER SUPPLIES

PARAMETER	UNITS	LAKE MEAD ①		SNWP ②		GROUNDWATER ③	
		RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE
CALCIUM as Ca	mg/l	86-94	90	86-90	87	30-60	55
CHLORIDE as Cl	mg/l	86-96	92	88-96	92	0-10	< 5
FLUORIDE as F	mg/l	.33-.68	0.5	.35-.75	0.5	.2-1	.4
IRON as Fe	mg/l	0-.05	.02	0-.03	.02	0-.1	.02
MAGNESIUM as Mg	mg/l	23-32	27	23-32	27	20-40	30
NITRATE as NO_3	mg/l	.2-2.1	1.1	.2-1.7	1.1	5-15	6
SODIUM and POTASSIUM as Na and K	mg/l	102-122	109	105-133	113	10-50	30
SULFATE as SO_4	mg/l	290-345	320	290-365	326	30-100	65
ALKALINITY as $CaCO_3$	mg/l	100-111	106	105-108	107	150-240	170
BICARBONATE as HCO_3	mg/l	122-135	129	128-132	130	180-280	210
CARBONATE as CO_3	mg/l	NEGLIGIBLE				0-12	< 1
HARDNESS as $CaCO_3$	mg/l	316-365	335	311-349	330	190-290	240
COLOR	—	NA	5.0	0-<5	< 5	0-5	< 3
ODOR	TON	2-4	3	NA	1.4	NA	NA
pH	value	7.7-8.2	7.9	7.8-8.2	8.0	7.5-7.8	7.6
TOTAL DISSOLVED SOLIDS	mg/l	722-781	745	737-755	746	200-400	300
TURBIDITY	JTU	.18-.35	.24	.02-.08	.05	.03-1.6	.04

NA No Data Available

SOURCES: ① 1973 records for the Alfred Merritt Smith Water Treatment Plant.

② 1973 records for treated Lake Mead water delivered to the Southern Nevada Water Project(SNWP) from the Alfred Merritt Smith Water Treatment Plant.

③ Water quality records for 57 wells operated by the Las Vegas Valley Water District, North Las Vegas and Nellis Air Force Base. Range does not include extreme values which may occur in 20% or less of the wells. Average values are flow weighted averages.

table 2

HISTORIC WASTEWATER CHARACTERISTICS
WWTP EFFLUENT
CITY OF LAS VEGAS

EFFLUENT PARAMETER	UNITS	1971		1972		1973	
		RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE
SUSPENDED SOLIDS	mg/l	15-29	18	14-28	21	13-29	18.4
BOD_5	mg/l	7-26	20	12-29	18	10-21	14.7
COD ①*	mg/l	—— NO DATA AVAILABLE ——					
PO_4 as P	mg/l	7.0-9.9	9	7.0-9.3	9	6.4-9.3	9
NH_3 as N	mg/l	14-21	17	12-22	18	15-23	18
TDS	mg/l	820-1000	898	977-1080	1006	1027-1073	1058
ALKALINITY as $CaCO_3$	mg/l	220-290	246	220-269	241	210-266	247
HARDNESS as $CaCO_3$	mg/l	312-372	338	340-400	377	340-535	413
CALCIUM as Ca	mg/l	61-78	71	62-83	74	62-96	80
TEMPERATURE (INFLUENT)	°C	17.8-25.6	22.7	17.2-27.2	21.1	17.2-27.2	22.7
pH		7.6-7.8	7.7	7.6-7.7	7.6	7.5-7.7	7.6
CHLORINE RESIDUAL	mg/l	1.0-1.0	1.0	1.0-1.0	1.0	1.0-1.0	1.0
LAS	mg/l	—— NO DATA AVAILABLE ——					

①* COD: Range 100-120 mg/l, Average 110 mg/l December 1968 Tests by Boyle-CH_2M.

SOURCE: Based on Wastewater Plant Records for CLV WWTP and Nevada Power Company's Sunrise Power Station.

table 3

HISTORIC WASTEWATER CHARACTERISTICS
WWTP EFFLUENT
CLARK COUNTY SANITATION DISTRICT

EFFLUENT PARAMETER	UNITS	1971		1972		1973	
		RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE
SUSPENDED SOLIDS	mg/l	15-30	25	18-48	30	18-80	38
BOD_5	mg/l	18-43	26	13-58	26	19-40	30.5
COD	mg/l	83-130	99	71-186	108	88-242	128
PO_4 as P (1)	mg/l	7.3-9.1	8.2	7.3-9.5	8.2	9.5-13.4	10.7
NH_3 as N	mg/l	11.7-17.7	14.7	11.5-18.7	15	14.7-18.9	16
TDS	mg/l	1244-1680	1496	1545-1853	1666	1706-1934	1831
ALKALINITY as $CaCO_3$	mg/l	213-258	234	214-240	223	220-252	236
HARDNESS as $CaCO_3$	mg/l	528-658	602	501-706	622	501-589	546
CALCIUM as Ca (2)	mg/l	89-145	119	96-136	121	78-153	124
TEMPERATURE(INFLUENT)	°C	24-30.1	27.4	22.5-29.1	26	21.5-28.8	25.2
pH		7.0-7.5	7.2	7.4-7.6	7.5	7.5-7.6	7.5
CHLORINE RESIDUAL	mg/l	1.0-1.9	1.4	1.6-4.2	2.9	1.5-3.3	2.4
LAS	mg/l	0.6-1.5	1.1	0.7-1.9	1.2	1.0-2.9	2.3

(1) Represents ortho-phosphates only for 1971 and 1972; 1973 measurements are for total phosphates as determined after April 1973.

(2) From Desert Research Institute records of station LW027.

SOURCE: Based on Wastewater Plant Records for CCSD WWTP.

table 4

HISTORIC WASTEWATER CHARACTERISTICS
WWTP EFFLUENT
CITY OF HENDERSON
WWTP NO. 1 AND WWTP NO. 2

EFFLUENT PARAMETER	UNITS	WWTP NO. 1				WWTP NO. 2	
		1968 (1)		1971 (2)	1973 (3)	1971 (2)	1973 (3)
		RANGE	AVERAGE	AVERAGE	AVERAGE	AVERAGE	AVERAGE
SUSPENDED SOLIDS	mg/l	35-137	86	59	NA	283	NA
BOD_5	mg/l	NA	30	85	NA	133	NA
COD	mg/l	104-169	137	NA	NA	NA	NA
PO_4 as P	mg/l	4.5-5.0	4.8	NA	NA	NA	NA
NH_3 as N	mg/l	NA	10.9	10.9	NA	10.4	NA
TDS	mg/l	4148-4920	4534	NA	2293	NA	1000
ALKALINITY as $CaCO_3$	mg/l	NA	NA	NA	319	NA	240
HARDNESS as $CaCO_3$	mg/l	NA	NA	850	825	340	270
CALCIUM as Ca	mg/l	NA	NA	NA	305	NA	100
TEMPERATURE (INFLUENT)	°C	NA	NA	NA	NA	NA	NA
pH		NA	NA	7.4	7.2	8.0	7.4
CHLORINE RESIDUAL	mg/l	NA	NA	NA	NA	NA	NA
LAS	mg/l	NA	NA	NA	NA	NA	NA

NA — No Data Available

SOURCES: (1) A Comprehensive Water Quality Control Program for the Las Vegas Drainage Basin - Phase I, February 1969 by Boyle Engineering and CH_2M.

(2) Analysis by Clark County Sanitation District Laboratory in August 1971.

(3) Analysis by Atlas Chemical Testing Laboratories, Inc. letter of May 1, 1973.

table 5

Dam has increased from 671 mg/l in 1960 to 745 mg/l in 1973. Efforts are currently underway by the seven Colorado River Basin States and the Bureau of Reclamation to institute a program which has as its objective, maintenance of TDS levels in the lower main stream of the Colorado River at or below 1972 levels. If this is accomplished, the future quality should be essentially the same as that shown for 1973 on Table 3-7.

Reclaimed Waste Water

For the most part, the waste water resources of Las Vegas Valley may be characterized as high quality secondary waste water plant effluents.

The City of Las Vegas' and the County's trickling filter treatment plants presently treat 96% of the waste water flow being considered for reclamation. The City of Henderson's waste water plants contribute the remaining 4% of Las Vegas Valley's present waste water resource.

The results of recent analyses of treatment plant effluents from the City of Las Vegas, the Clark County Sanitation District and the City of Henderson are presented in Tables 3, 4 and 5, respectively.

The information on the City of Las Vegas plant and the Clark County plant represents the range of qualities experienced and yearly averages based on plant records of tests conducted. The information presented for the City of Henderson is incomplete. The parameters listed are based on limited grab samples. Henderson's waste water flow has, and probably will continue to have, only a negligible effect on the overall characteristics of the combined flow.

The Tables demonstrate that two trickling filter plants operated by the City of Las Vegas and the Sanitation District are accomplishing a high degree of treatment and are producing good quality effluents. Table 5 indicates that the City of Henderson is experiencing difficulty in producing an adequately treated secondary effluent. Henderson is presently refurbishing and remodeling its facilities in order to improve the quality of effluent to a level comparable to that now produced by the other waste water treatment plants.

It is believed that such secondary effluent parameters as; biochemical oxygen demand (BOD), suspended solids (SS), chemical oxygen demand (COD), phosphorous and nitrogen (PO_4 as P and NH_3 as N) will not significantly change between now and the year 2000. However, as the water supply in the Valley becomes more dependent upon the Colorado River, it is expected that there will be increases in the concentrations of calcium, chloride, sulfate, sodium and potassium.

Many homeowners, hotels, casinos and

commercial establishments in the Valley have softening units or purchase partially demineralized bottled drinking water. It is believed that waste brine waters from softener regenerations frequently find their way into the waste water collection and treatment facilities, thus, accounting in part for the high concentrations of total dissolved solids noted in Valley waste water treatment plant discharges. The Clark County Sanitation District and the City of Las Vegas will soon undertake studies to locate and quantify sources of high TDS inflow to their respective waste water systems. Concentration projections of individual chemical constituents have not been made. There are, however, indications that if no corrective action is taken, the salinity (TDS) of the combined City of Las Vegas and County Sanitation District plant effluents may reach about 1600 mg/l by 1980, 1800 mg/l by 1990, and 1990 mg/l by the year 2000.

Colorado River Basin

The water quality in the Colorado River declines markedly between its origins in the Rocky Mountains and the International Border to Mexico. The reasons for poor quality water arise from both natural and man-made sources. The most important sources of salt loads in the Colorado River Basin are from natural sources which account for about 2-1/3 of the average annual salt load passing Hoover Dam. Surface runoff, including ground water inflow comes in contact with the soil and picks up mineral salts from the surrounding drainage area and then flows into the Colorado River System. These are called diffused sources and come primarily from several relatively small areas, such as Paradox Valley in the Upper Basin. They account for about half of the salt burden in the entire Colorado River Basin. Discrete or point sources also add saline water to the system from mineral springs that occur throughout the Basin. Mineral springs add more salt to the Colorado River in the Lower Basin than any other type of salinity source. Blue Springs, the largest point source of salinity in the entire river basin, is located near the mouth of the Little Colorado River and contributes salt loads of about 547,000 tons each year, or about 5% of the annual salt load at Hoover Dam.

There are also major contributions by Dotsero and Glenwood Springs which produces a total of 518,000 tons of salt each year. (Las Vegas Wash contributes 150,000 tons of salt each year.)

The major man-made source of salinity to the river is from irrigation. Municipal and industrial sources of salinity that are found in flows such as the Las Vegas Wash only contribute about 1% of the average salt load at Hoover Dam each year. A summary of salt load distribution can be found in Table 6.

In the Environmental Protection Agency's report, "The Mineral Quality Problem in the Colorado River Basin" a projection is

made of future average salinity concentrations in mg/l based on initial base concentrations in 1960. The table shown below is divided into two categories: unlimited vs. limited development conditions. The first category details salinity projections on the basis that no limits would be placed on future water resources development other than those applicable under existing water laws. The second category was based on the possible limitations of future water resource development in the Basin.

Environmental Protection Agency, "Report on Pollution Affecting Las Vegas Wash, Lake Mead & The Lower Colorado River, Nevada-Arizona-California", the average discharge of dissolved solids (TDS) by the Las Vegas Wash into Lake Mead was 150,000 tons per year or about 411 tons per day. This report also indicated that these contributions increased from 10 mg/l and 12 mg/l in the TDS concentrations at Hoover and Imperial Dams, respectively.

Comparison of Salinity Projections

	Unlimited Development Conditions			Limited Development Conditions	
Location	1960 Base	1980	2010	1970	1980 & 2010
Hoover Dam	697	876	990	760	800
Parker Dam	684	866	985	760	800
Palo Verde Dam	713	940	1082	800	850
Imperial Dam	759	1056	1223	865	920

The discharge of waste water into Las Vegas Wash has produced flows of exceptionally high TDS, and, according to a report by Hoffman, Tramutt and Holler, an average of 4.48 tons per acre-foot entered Lake Mead during their sampling period in 1968. This figure can be compared with the 1968 average TDS of Colorado River water measured in the Grand Canyon equal to .91 tons per acre-foot. In another report by the

If all flow from Las Vegas Wash were terminated and did not enter the Colorado River System at another location, then the salt load could be expected to decrease by approximately 409 tons per day below Hoover Dam and approximately 363 tons per day at Imperial Dam. The present increase in TDS concentrations that result from flow out of Las Vegas Wash caused an economic loss, according to the applicant, of $670,000 per year to the regional

table 6

Summary of Salt Load Distributions

Source	Salt Load (1,000) T/Yr. Upper Basin	Lower Basin	Above Hoover Dam	Percent of Total Load Upper Basin	Lower Basin	Above Hoover Dam
Natural Diffuse Sources	4,400	1,400	5,760	52.2	52.1	53.7
Natural Point Sources	510	770	1,280	6.1	28.6	11.9
Irrigation	3,460	420	3,540	41.1	15.6	33.0
Municipal and Industrial	50	100	150	0.6	3.7	1.4
Total	8,420	2,690	10,730	100.0	100.0	100.0

economy in Arizona and Southern California. Inclusive in this impact is the savings that would result from agricultural concerns who would use water from the Colorado River of a lower salinity and thus incur a beneficial impact on crop yields and the corresponding cost of operation.

In addition to dissolved solids concentration, the Colorado River is also subject to increased concentrations of nitrogen and phosphorus which act as nutrients that support algae blooms.

Within Lake Mead, substantially larger concentrations of algae can be found in the area near the mouth of the Las Vegas Wash in addition to correspondingly larger concentrations of nitrogen and phosphorus. In tests by the Federal Water Quality Administration (EPA) during 1970, Colorado River waters in Lake Mead, upstream from Las Vegas Bay, were slightly lower in algae growth potential than they were after release from Hoover Dam.

Another important parameter to consider when discussing water quality in the Colorado River Basin is temperature. Temperature fluctuations within the River can vary from freezing to above 90° F. These changes are primarily due to natural climatic conditions; however, other influences include upstream releases from reservoirs affecting downstream temperatures, thermal springs, waste water discharges and irrigation return flows. Warmer temperatures can reduce the amount of dissolved oxygen in the water and as a result will have an adverse affect on fish life. High temperatures can also increase the rate of chemical reactions in addition to the rate of growth and decomposition of organic matter resulting in bad odors and tastes.

Water temperatures leaving Hoover Dam fluctuate very little. Data for 1941 to 1968 indicates average monthly temperatures ranging between 54° and 58° F.

Salinity Control

Four salinity control projects would be authorized for construction under the Colorado River Basin Salinity Control Act that will benefit water users in the United States and Mexico. These projects would achieve the near-term objective of EPA and the seven Colorado River Basin States by removing 514,000 to 594,000 tons of salt annually. The four projects are:

1. Paradox Valley, Colorado: A 14,000 foot thick, pure salt dome is within six feet to 100 feet of the ground surface. Rising groundwater picks up over 200,000 tons of salt per year. The project plans to lower groundwater by well pumping and transporting brines to an evaporation reservoir for disposal. Estimated salt removal is 108,000 tons per year which will reduce salinity at Imperial Dam by 20 ppm in the year 2000.

2. Grand Valley, Colorado: About 80,000 acres of land are irrigated in the valley. The soils are derived from Munco Shale which have a high salt content. Return flows from agricultural lands are estimated to contain 500,000 tons per year of salt. The Grand Valley salinity control project would include: a) improved irrigation management methods such as scheduling times and amounts of water to apply, b) lining drainage canals and laterals to reduce seepage, and c) on-farm improvements such as measuring and control devices and installation of proper drains. Estimated salt load reductions are expected to be 2,000 to 280,000 tons per year with a subsequent reduction of TDS at Imperial Dam of 23 to 32 ppm by the year 2000.

3. Crystal Geyser, Utah: The Crystal Geyser is an abandoned oil test well which erupts periodically. The water has a TDS of 11,000 to 14,000 ppm and contributes 3,000 tons of salt per year to the River. The project plan would construct a dike around the geyser and drain in the water to an evaporation pond. Estimated salt removal is 3,000 tons per year and would reduce salinity at Imperial Dam by 0.3 ppm in the year 2000.

4. Las Vegas Wash, Nevada: The Wash adds about 150,000 tons of TDS per year to the Colorado River System. Sources are both point and diffused and contribute approximately 20% and 80% of the total, respectively. Rising ground water (discussed further under the next heading) over long established groundwater mounds beneath the industrial waste ponds and other discharges constitute the diffused source. The proposed project plan would collect groundwater flow by subsurface drains and pump the water to evaporation ponds. Estimated salt load reduction is 94,500 tons per year, which would reduce TDS at Imperial Dam by 13 ppm.

Other potential salinity control projects are shown in Figure 11.

Water Quality in Las Vegas Bay

Water quality conditions in the Las Vegas Bay portion of Lake Mead have been declining noticeably during the past 20 years. A study conducted in the late 1940's and 1950's by Nevada's Department of Fish and Game indicated no evidence of pollution except for one unexplained fish kill in 1953 and an unusual reduction in the water's transparency caused by a large algae bloom in 1952 (Nevada Fish and Game, 1953).

Through the years, as more and more nutrients and dissolved solids were discharged into Las Vegas Bay, the more severe the pollution problems became. Within the last few years algal growth and blooms have risen to levels resulting in a substantial reduction of water quality and have at times reduced the recreational attractiveness of the area.

Many studies have been conducted to de-

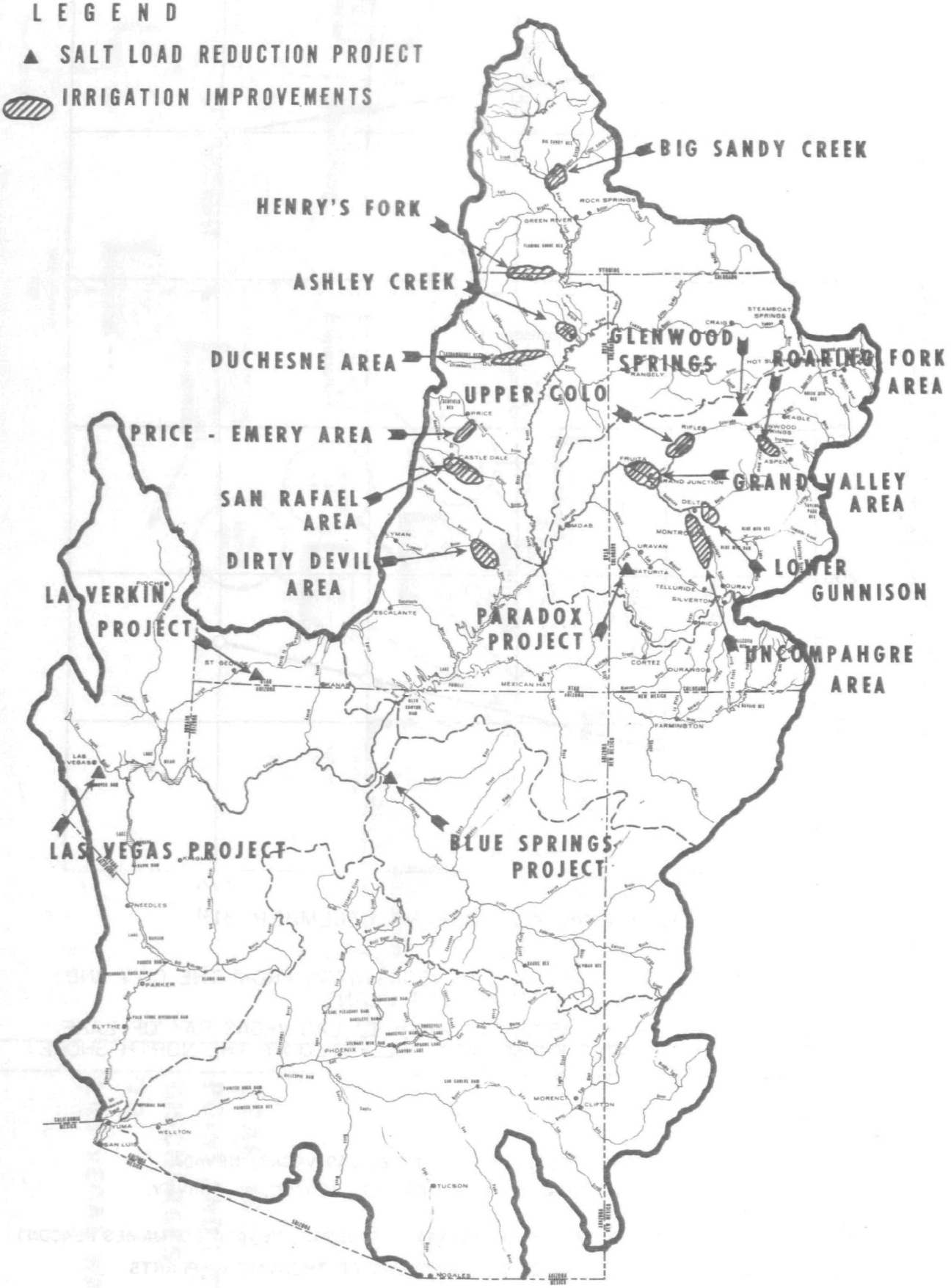
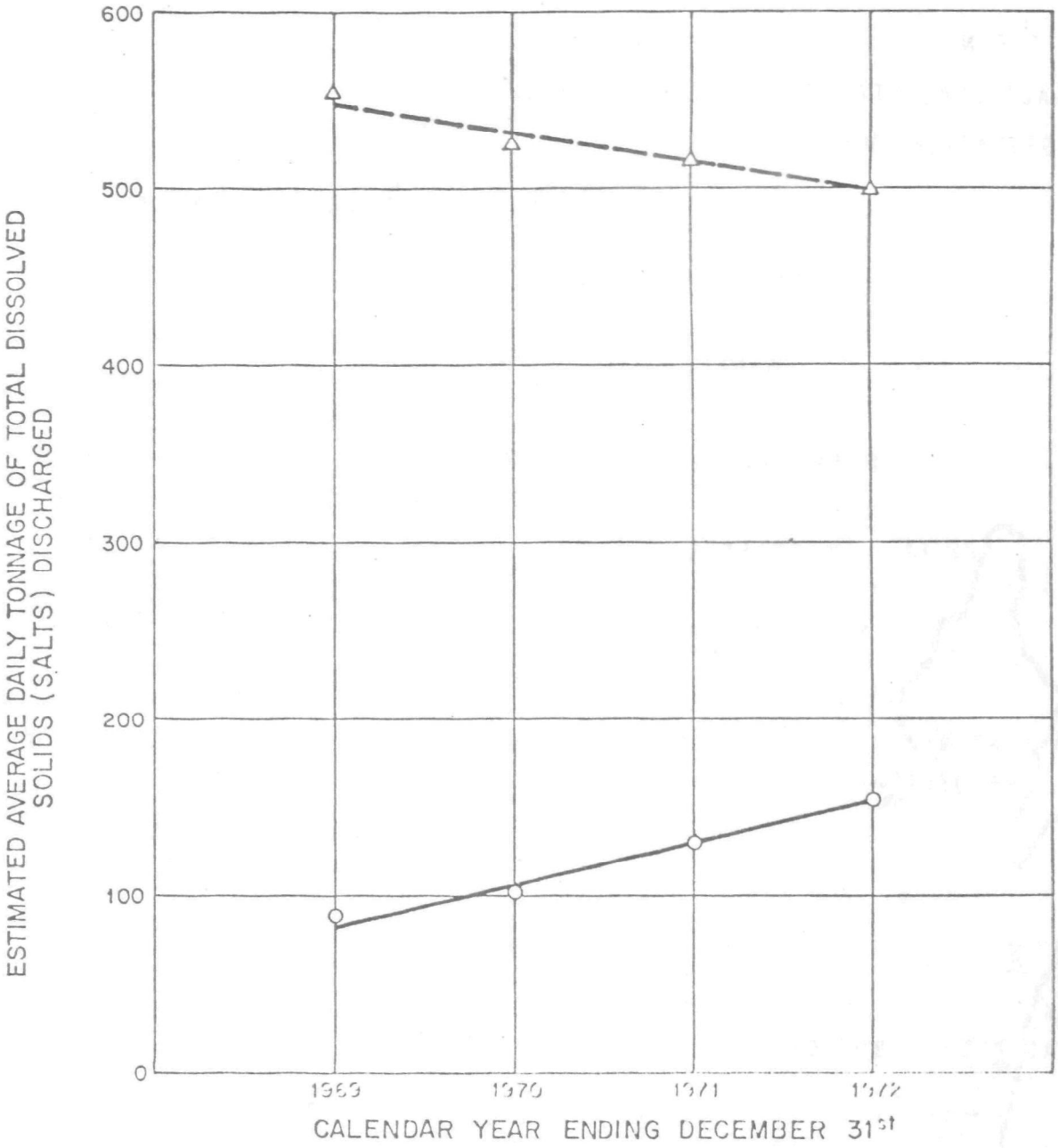

LEGEND
▲ SALT LOAD REDUCTION PROJECT
IRRIGATION IMPROVEMENTS
BIG SANDY CREEK
HENRY'S FORK
ASHLEY CREEK
DUCHESNE AREA
GLENWOOD SPRINGS
ROARING FORK AREA
UPPER COLO
PRICE - EMERY AREA
GRAND VALLEY AREA
SAN RAFAEL AREA
DIRTY DEVIL AREA
LOWER GUNNISON
LA VERKIN PROJECT
PARADOX PROJECT
UNCOMPAHGRE AREA
LAS VEGAS PROJECT
BLUE SPRINGS PROJECT
ROCK SPRINGS
GREEN RIVER
CRAIG
STEAMBOAT SPRINGS
RIFLE
ASPEN
GRAND JUNCTION
DELTA
MONTROSE
OURAY
TELLURIDE
SILVERTON
PRICE
CASTLE DALE
MOAB
LYMAN
URAVAN
NATURITA
ESCALANTE
ST GEORGE
CORTEZ
DURANGO
MEXICAN HAT
FARMINGTON
LAS VEGAS
NEEDLES
PARKER
BLYTHE
PHOENIX
MORENCI
CLIFTON
YUMA
WELLTON
SAN LUIS
TUCSON
NOGALES

figure 11

ESTIMATED AVERAGE DAILY TONNAGE OF TOTAL DISSOLVED SOLIDS (SALTS) DISCHARGED TO LAS VEGAS WASH AND TO LAS VEGAS BAY OF LAKE MEAD



LEGEND:

- o COMBINED DISCHARGES TO LAS VEGAS WASH FROM THE CITY AND COUNTY WASTEWATER TREATMENT PLANTS.
- Δ DISCHARGES FROM LAS VEGAS WASH TO LAS VEGAS BAY OF LAKE MEAD AS ESTIMATED FROM DATA COLLECTED AT THE NORTH SHORE ROAD GAGING STATION.

DATA SOURCE:

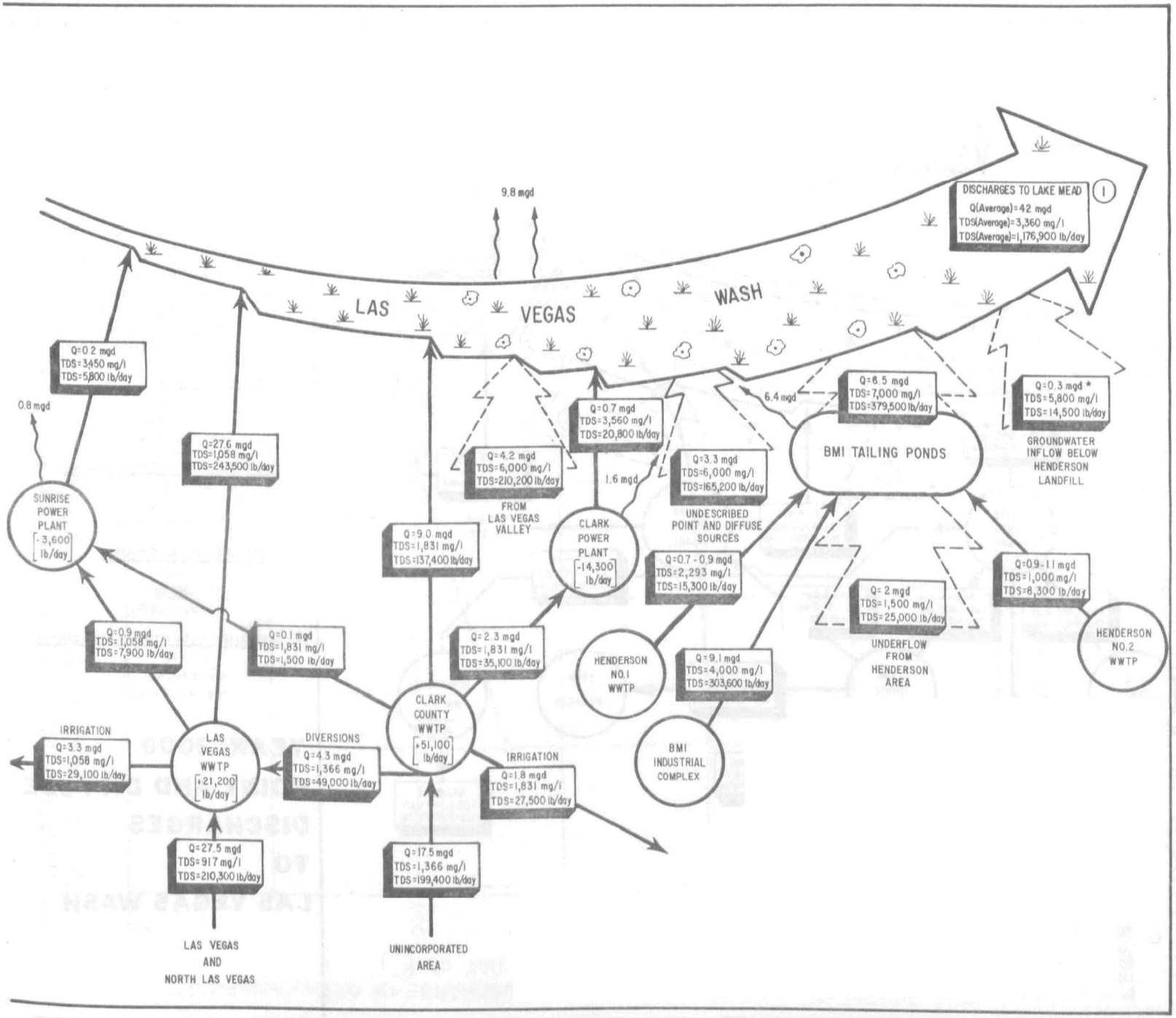
1.) RECORDS OF THE DESERT RESEARCH INSTITUTE, LAS VEGAS, NEVADA.

2.) RECORDS OF THE U.S. DEPARTMENT OF INTERIOR, GEOLOGICAL SURVEY, CARSON CITY, NEVADA.

3.) RECORDS OF THE UNIVERSITY OF NEVADA, LAS VEGAS, NEVADA (Dr. JAMES DEACON).

4.) RECORDS OF THE CITY AND COUNTY WASTEWATER TREATMENT PLANTS.

figure 12

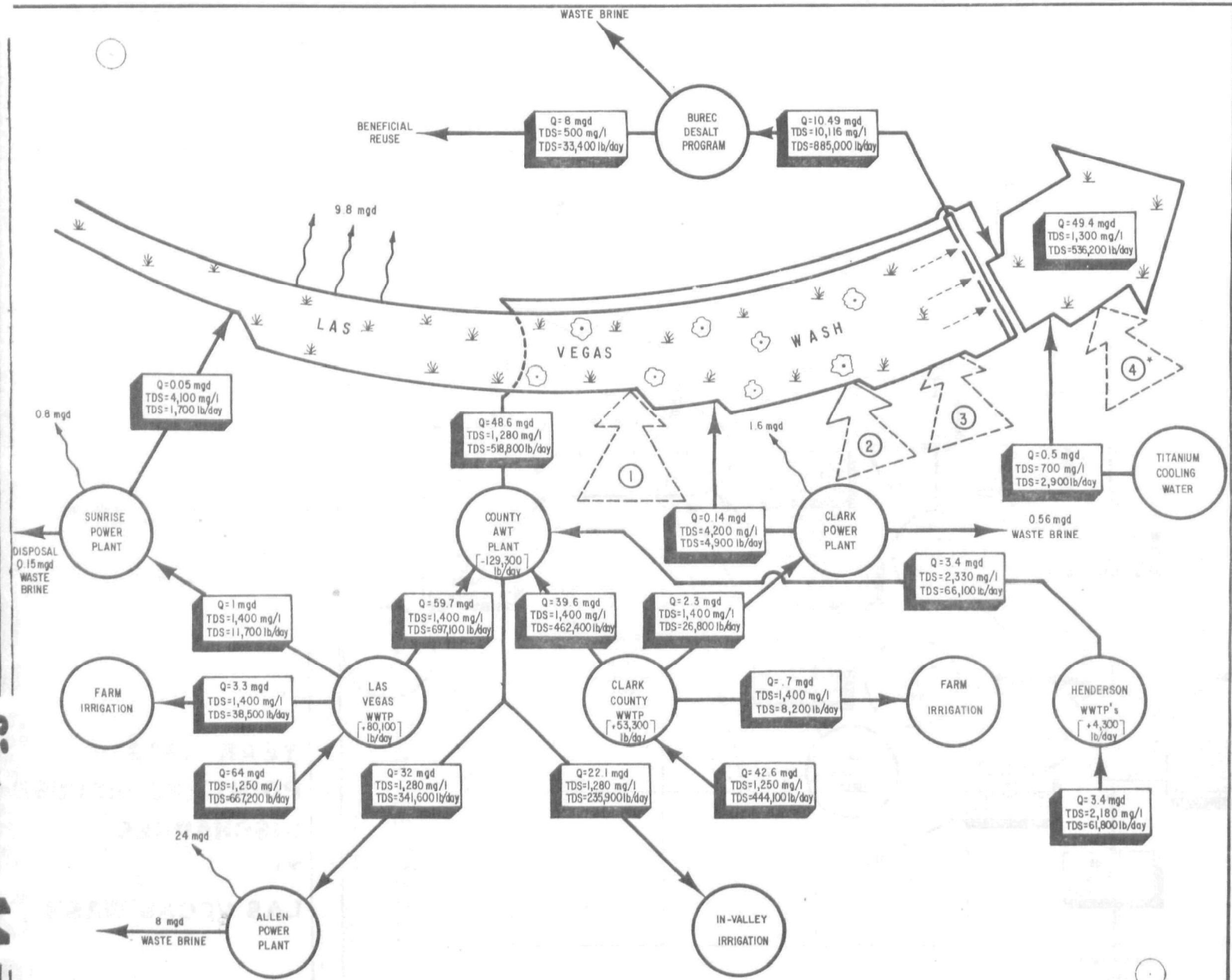


LEGEND

- POINT SOURCE DISCHARGE
- DIFFUSE SOURCE DISCHARGE
- EVAPORATION AND/OR TRANSPIRATION
- PHREATOPHYTES
- HYDROPHYTES
- WWTP — WASTEWATER TREATMENT PLANT
- BMI — BASIC MANAGEMENT INC.
- TDS — TOTAL DISSOLVED SOLIDS
- mg/l — MILLIGRAMS PER LITER
- mgd — MILLION GALLONS PER DAY
- (1) — COMPUTED FROM MEASUREMENTS AT NORTH SHORE ROAD
- * — NET AFTER EVAPOTRANSPIRATION FOR PHREATOPHYTES BELOW HENDERSON LANDFILL

YEAR 1973
POINT AND DIFFUSE DISCHARGES TO LAS VEGAS WASH

figure 13



LEGEND

- POINT SOURCE DISCHARGE
- DIFFUSE SOURCE DISCHARGE
- EVAPORATION AND/OR TRANSPIRATION
- PHREATOPHYTES
- HYDROPHYTES

WWTP	WASTEWATER TREATMENT PLANT
AWT	ADVANCED WASTEWATER TREATMENT
TDS	TOTAL DISSOLVED SOLIDS
mg/l	MILLIGRAMS PER LITER
mgd	MILLION GALLONS PER DAY
*	NET AFTER EVAPOTRANSPIRATION FOR PHREATOPHYTES BELOW HENDERSON LANDFILL

(1) FROM LAS VEGAS VALLEY -
Q = 9.4 mgd
TDS = 6,000 mg/l
TDS = 470,500 lb/day

(2) UNDESCRIBED POINT AND DIFFUSE SOURCES -
Q = 7.3 mgd
TDS = 6,000 mg/l
TDS = 365,400 lb/day

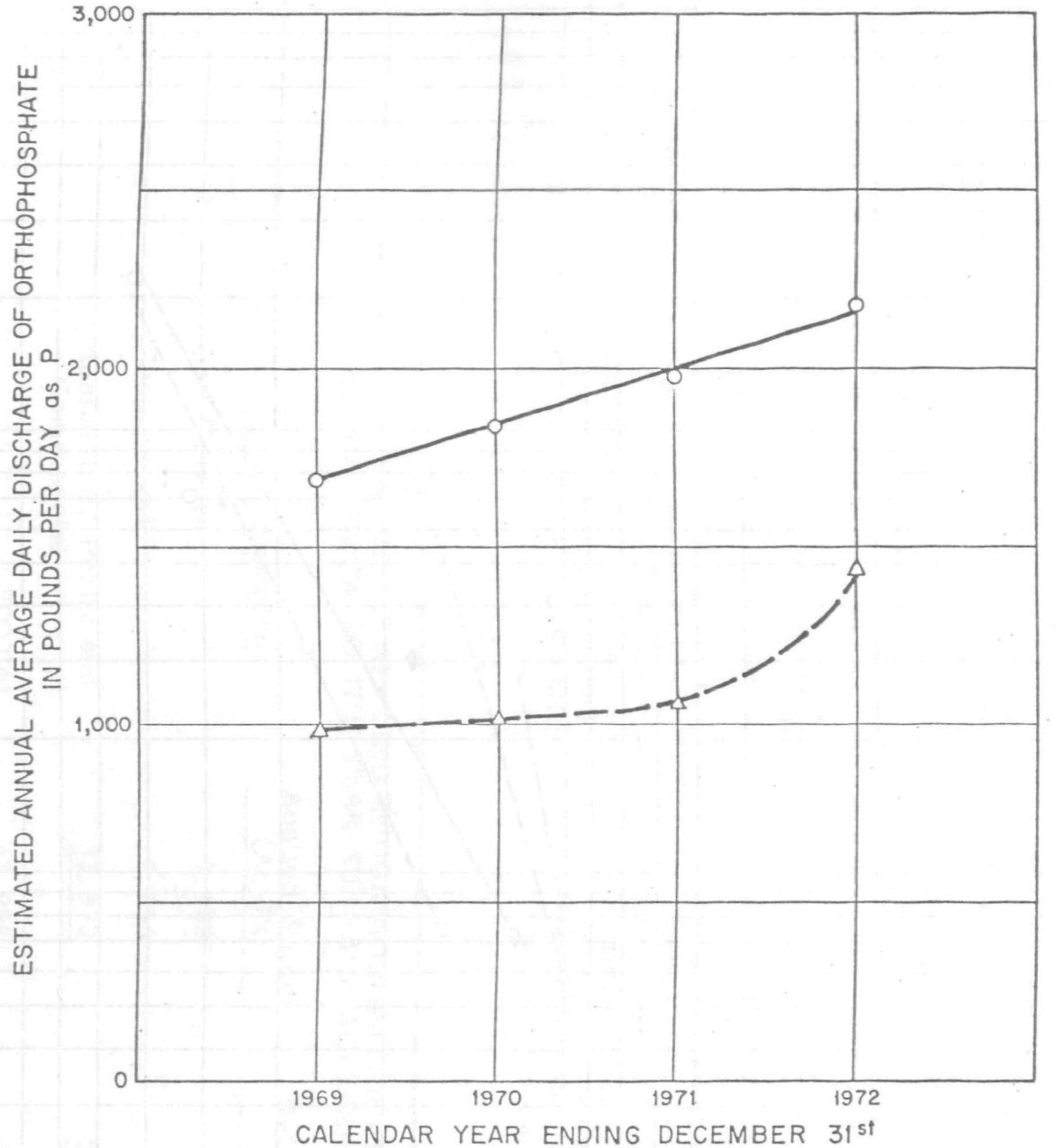
(3) UNDERFLOW FROM HENDERSON AREA -
Q = 3.4 mgd
TDS = 1,500 mg/l
TDS = 42,500 lb/day

(4) GROUNDWATER INFLOW BELOW HENDERSON LANDFILL -
Q = 0.3 mgd *
TDS = 5,800 mg/l
TDS = 14,500 lb/day

YEAR 2000 POINT AND DIFFUSE DISCHARGES TO LAS VEGAS WASH

Figure 14

ESTIMATED ANNUAL AVERAGE DAILY PHOSPHOROUS DISCHARGES
TO LAS VEGAS WASH AND TO LAS VEGAS BAY OF LAKE MEAD



LEGEND:

- o COMBINED DISCHARGES TO LAS VEGAS WASH FROM THE CITY AND COUNTY WASTEWATER TREATMENT PLANTS.
- Δ DISCHARGES FROM LAS VEGAS WASH TO LAS VEGAS BAY OF LAKE MEAD AS ESTIMATED FROM DATA COLLECTED AT THE NORTH SHORE ROAD GAGING STATION.

DATA SOURCE:

1.) RECORDS OF THE DESERT RESEARCH INSTITUTE, LAS VEGAS, NEVADA.

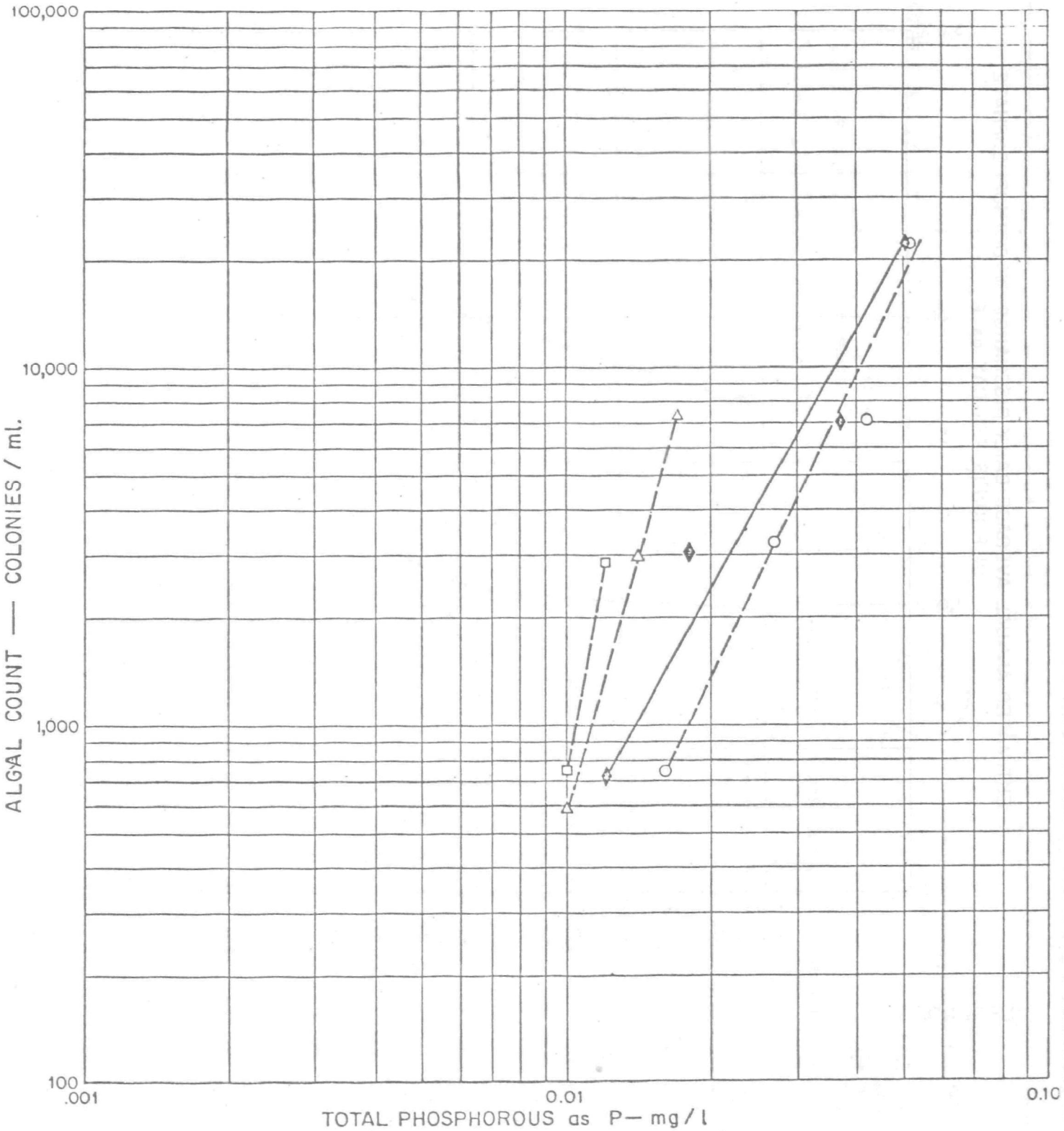
2.) RECORDS OF THE U.S. DEPARTMENT OF INTERIOR, GEOLOGICAL SURVEY, CARSON CITY, NEVADA.

3.) RECORDS OF THE UNIVERSITY OF NEVADA, LAS VEGAS, NEVADA (Dr. JAMES DEACON).

4.) RECORDS OF THE CITY AND COUNTY WASTEWATER TREATMENT PLANTS.

figure 15

ALGAL COUNT vs. TOTAL PHOSPHOROUS IN LAS VEGAS BAY OF LAKE MEAD



LEGEND:

- ○ INNER BAY
- △ MIDDLE BAY
- □ OUTER BAY
- ◆ COMPOSITE OF ENTIRE L.V. BAY

DATA SOURCE:
"FINAL REPORT ON LAS VEGAS BAY OF LAKE MEAD TO LAS VEGAS VALLEY WATER DISTRICT" BY UNIVERSITY OF NEVADA, LAS VEGAS, Dr. JAMES DEACON AND Dr. RICHARD TEW AUTHORS; SPRING 1973.
NOTE: CURVES BASED ON 204 LAKE SAMPLES TAKEN 5-1-72 THRU 10-16-72.

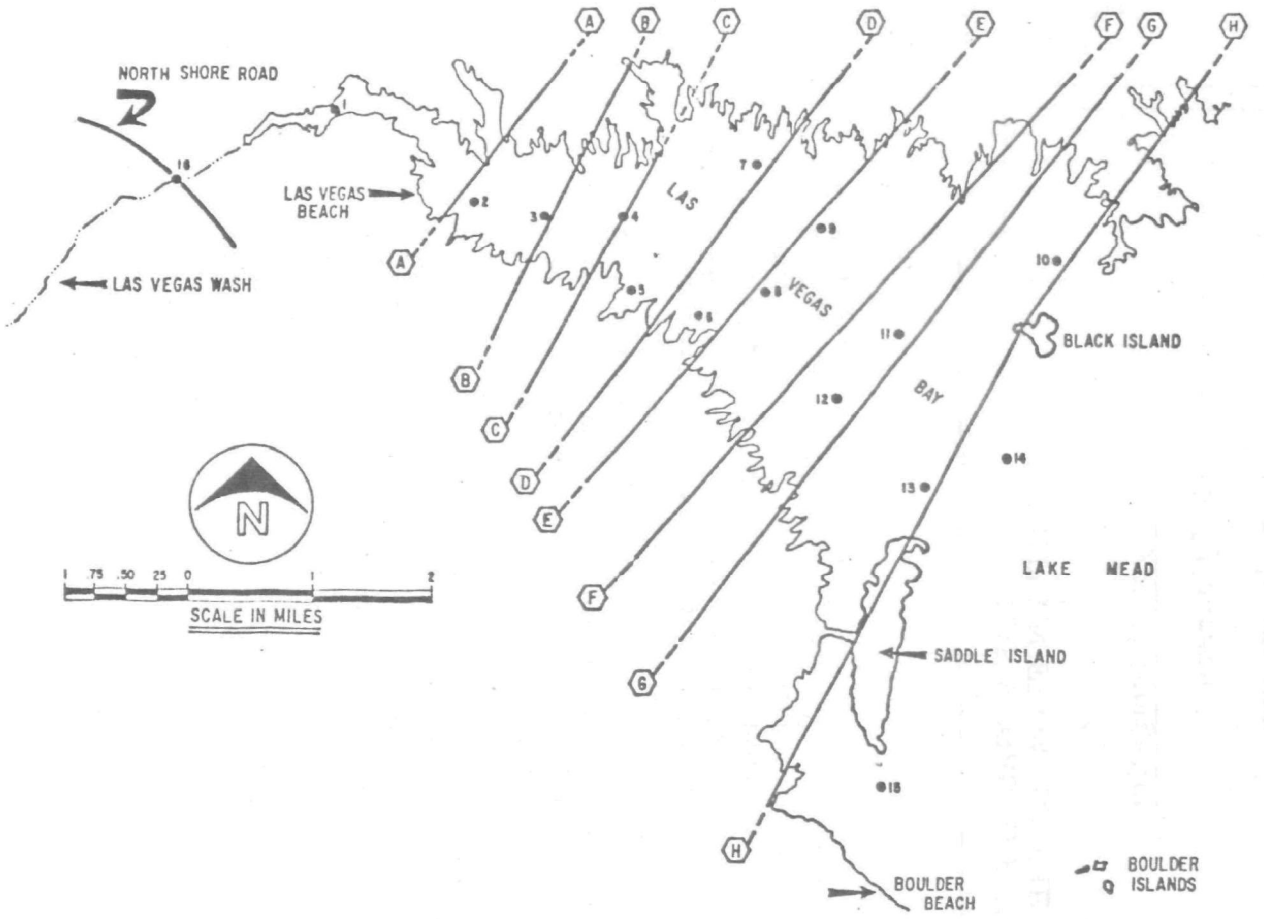
figure 16

termine the cause and extent of this problem. Conclusions drawn from these studies indicate that the primary problem is the effluent from Las Vegas Wash, which is high in nutrients and dissolved solids. Algal growth resulting from the increased availability of these nutrients, especially phosphorous, will produce objectionable aesthetic conditions. If these conditions are allowed to persist, they could eventually affect the quality of the area's recreation and pose a public health hazard. Studies conducted in 1972 and 1973 by Dr. James Deacon, indicate that plankton populations increase in Las Vegas Bay during the warm summer months. During this period, the upper water layers of the Bay are considered mildly eutrophic or nutrient-rich. This is in contrast to the oligotrophic (characteristic of a deep lake having low nutrient concentration) conditions which occurred during most of the year (Las Vegas Valley Water District, 1972).

In order to better understand the interrelationship between Las Vegas Wash discharges and water quality and algal populations in Las Vegas Bay, a county-funded monitoring study will be conducted on a continuing basis by Dr. Deacon and his staff. This program will involve the establishment of eight sampling stations including one at North Shore Road, one in the channel at the head of Las Vegas Bay, the mouth of Las Vegas Bay (3 stations), one above Hoover Dam, one below Boulder Canyon and one at the Boulder Basin. At these stations the following parameters will be analyzed: number and kinds of phytoplankton per mililiter, chlorophyll content in miligrams per cubic meter, dissolved and total phosphorus, nitrate, nitrogen, and turbidity in Jackson turbidity units. Additional measurements will include temperature, conductivity, dissolved oxygen, pH, COD, coliform count, total free chlorine, BOD, and methylene blue active

LAS VEGAS APPLIED IRRIGATION WATER AND RETURN FLOW TO THE NEAR-SURFACE AQUIFER - 1973

Type of Irrigation	Applied Water (Ac-Ft)	Return Flow (Ac-Ft)
Golf Courses	7,468	3,357
Crop Irrigation	7,156	3,693
Residential, Public and Commercial	33,372	21,624
TOTAL	47,996	28,674



	SURFACE AREA OF BAY (SQUARE FEET)		VOLUME OF BAY (CUBIC FEET)	
WATER LEVEL	1150'	1200'	1150'	1200'
INNER BAY	29.0×10^6	51.0×10^6	0.5×10^9	2.5×10^9
MIDDLE BAY	45.4×10^6	68.2×10^6	2.3×10^9	5.1×10^9
OUTER BAY	140.3×10^6	171.6×10^6	13.2×10^9	21.0×10^9
TOTAL	214.7×10^6	290.8×10^6	16.0×10^9	28.6×10^9

CROSS-SECTIONAL AREA (SQUARE FEET)		
SECTION	WATER LEVEL	
	1150'	1200'
A	35,640	131,515
B	119,300	266,945
C	442,550	711,760
D	367,800	822,925
E	451,675	799,175
F	1,546,875	2,160,625
G	2,077,750	2,765,250
H	2,057,850	2,823,350

NOTES:

1. INNER BAY IS DEFINED AS THAT PORTION OF THE BAY WEST OF SECTION (C).
2. MIDDLE BAY IS DEFINED AS THAT PORTION OF THE BAY BETWEEN SECTION (C) AND SECTION (E).
3. OUTER BAY IS DEFINED AS THAT PORTION OF THE BAY BETWEEN SECTION (E) AND SECTION (H)

DATA SOURCE: STATIONS SHOWN i.e. ●2 ARE AS DEFINED IN THE UNIVERSITY OF NEVADA, LAS VEGAS STUDY, "INTERRELATIONSHIPS BETWEEN CHEMICAL, PHYSICAL AND BIOLOGICAL CONDITIONS OF THE WATERS OF LAS VEGAS BAY OF LAKE MEAD" BY DR. JAMES E. DEACON AND DR. RICHARD W. TEW, MAY 1973.

LAS VEGAS BAY ARM OF LAKE MEAD
VOLUMES, SURFACE AREAS AND CROSS-SECTIONAL AREAS

figure 17

substance (a means of determining presence of detergents) (UNLV/Clark County Contract, 1974).

In the Las Vegas Valley excess lawn irrigation water percolating to the shallow water table is probably the greatest source of salinity in the entire groundwater basin. The water passing the root zone of the grass and ornamental plants contains saline concentrations significantly higher than the applied irrigation water due to the processes of evapotranspiration which tends to concentrate salts in the drainage waters. For example, in 1973 over 33,000 acre-feet of irrigation water was applied to lawns and shrubs in the Valley. Of that amount, it was estimated that almost 22,000 acre-feet was percolated to the shallow groundwater table. From the evapotranspiration processes, the salt concentration of the return flow would be estimated to be about 40% greater than applied water salinity. In addition, significant quantities of soluble fertilizers were probably carried with the downward percolating return flow. An even greater source of salinity is the native salt which is present in the alkali soils that cover much of the Valley. Due to the low yearly rainfall in the Basin, natural leaching of these salts has not taken place in recent geologic time. With the development of subdivisions, and the subsequent "over-irrigation" practices of the typical homeowner, these saline soils are now increasingly flushed out by the ensuing return irrigation flows. The total impact of agricultural and lawn watering practices in the Valley cannot be quantified, but the cumulative effect of evapotranspiration, fertilizers and saline soils must be significant. In addition to the residential lawn watering practices in the Valley, the irrigation of golf courses, agricultural crops, park and school lawns, and miscellaneous commercial lawns contributes to the degradation of the near-surface aquifer system. The above table describes the volumes of water that were used for irrigation in 1973, and the estimated excess irrigation water that probably percolated past the root zone in that year.

WATER RIGHTS

Surface Water Rights

White settlers began irrigation lands on the upstream tributaries of the Colorado River and the Las Vegas Valley area, using surface water, during the 1850's. The history of water development in this region is largely one of deficient surface water supplies, being supplemented by the ground-water resources.

Some of the major documents concerning the Colorado River are briefly summarized below.

The Colorado River Compact, in 1922, was set up to provide for the diversion of waters from the Colorado River System. It also established a preference for agricultural and domestic uses over uses for power generation. The water supply of the Colorado River system is less than that expected by the Commissioners who

CONTRACT
ALLOCATIONS

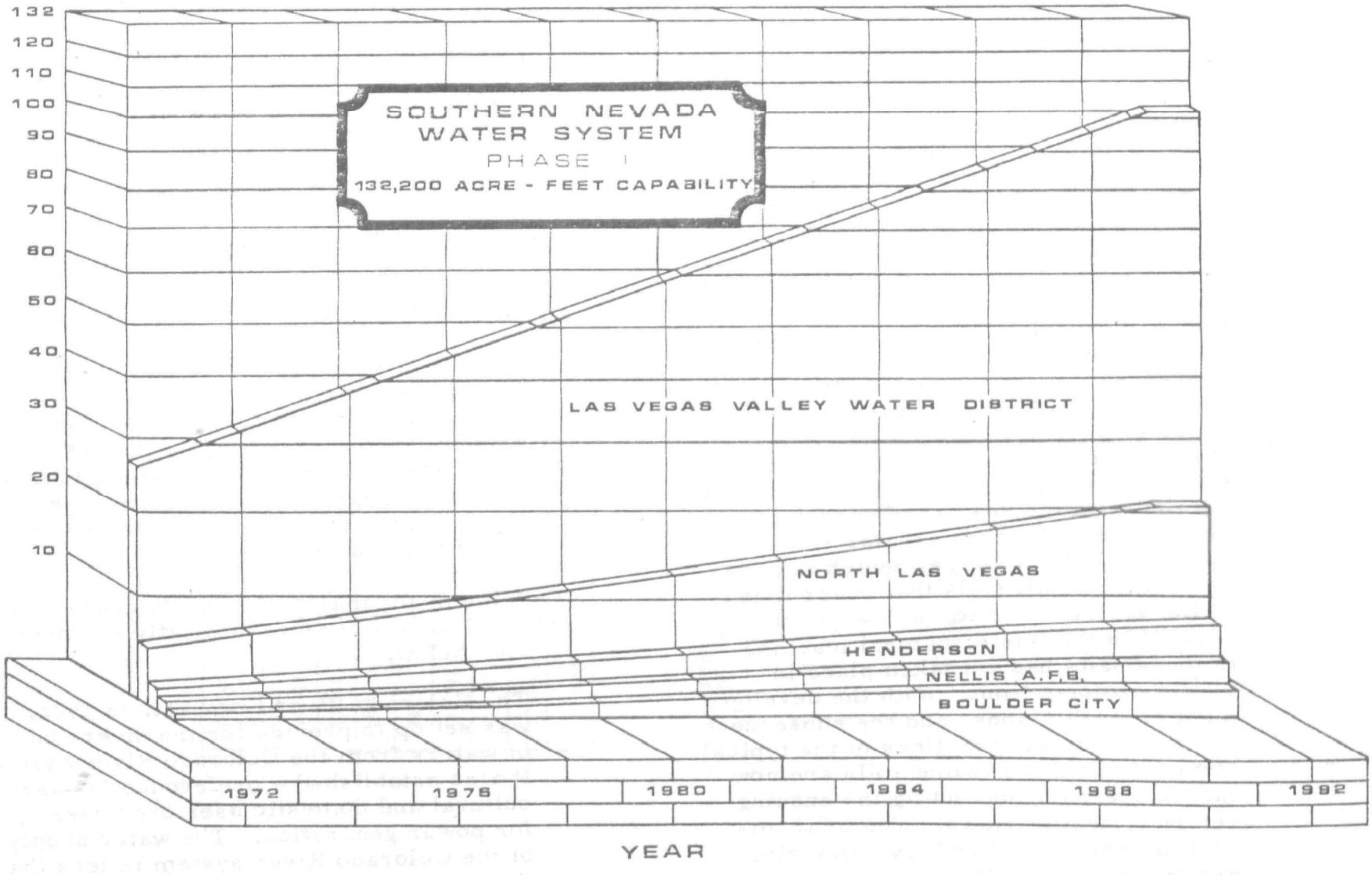


table 7

negotiated the Compact.

The Boulder Canyon Project Act of 1928 authorized the construction of Hoover Dam and Powerplant and the All-American Canal. The Act also authorized the States of Arizona, California and Nevada to enter into an agreement whereby the 7.5 million acre-feet of water that was apportioned annually to the Lower Basin States of the Colorado River Compact would be as follows: to California, 4.4 million acre-feet; to Arizona, 2.8 million acre-feet; and to Nevada, 0.3 million acre-feet.

The Upper Colorado Basin Compact of 1948 apportioned the Upper Basin share of the Colorado River waters among the States within that Basin.

The Mexican Treaty of 1944 allocated to Mexico 1.5 million acre-feet of Colorado River system water annually, to be increased in years of surplus to 1.7 million acre-feet, and also provided for a proportionate reduction during extraordinary drought.

The Colorado River Basin Project Act of 1968 authorized the Central Arizona Project, the Dixie Project in Utah, and five projects in the Upper Basin. The Central Arizona Project will provide the conveyance and storage facilities to import Arizona's remaining share of Colorado River water into the Gila River Basin. The Act also directs the Secretary of the Interior to prepare long-range water resource studies directed toward the augmentation of the Colorado River, to prepare criteria for the coordinated long-range operation of the Colorado River reservoirs, and to undertake programs for water salvage and ground-water recovery along and adjacent to the main stream of the Colorado River.

Existing contracts for Nevada's allocation of Colorado River water include both Las Vegas Valley use and use below Hoover Dam. Use of water in Nevada in the Moapa Valley and along the Virgin River is not charged against Nevada's allocation of Colorado River water. Table 7 summarizes water delivery contracts for the Southern Nevada Water Project. Table 8 is a summary of the existing contracts for Colorado River water.

Existing contracts do not exceed the 300,000 acre-foot allocation, but with the addition of potential future contracts, there is approximately 100,000 acre-feet annually of excess demand from about 1990 on. Two possibilities exist for meeting this demand for Colorado River water that exceeds the present allocation. One would be to obtain credit for return flows to Lake Mead resulting from the diversions, and the other would be to divert Las Vegas Wash flows to the Alfred Merritt Smith Treatment Plant for recycling.

Ground Water Rights

Nevada has a specific ground-water statute.

Water Delivery Contracts for the
Southern Nevada Water Project

Agency	Delivery Contract First Stage (acre-feet/year)	Delivery[a] Contract Option (acre-feet/year)	Ultimate Delivery Potential (acre-feet/year)
Nellis Air Force Base	4,000	0	4,000
North Las Vegas	20,000	20,000	40,000
Las Vegas Valley Water District	99,200	100,800	200,000[b]
Henderson	7,000	33,000	40,000
Boulder City	2,000	13,000	15,000
	132,200	166,800	299,000
Estimated Losses	5,800	5,200	11,000
Diversion Acre-feet Per Year	138,000[c]	172,000	310,000

a. Contract provision option, which is subject to construction of additional stages, availability of water, and payment of charges.

b. Includes 15,407 acre-feet/year which, after June 1, 1990, is expected to be delivered to the Las Vegas Valley Water District through this system. Contract No. 14-06-300-2130 dated September 22, 1969, with United States.

c. Contract between United States and Colorado River Commission dated August 25, 1967, Contract No. 14-06-300-1974.

Source: Colorado River Commission of Nevada.

Legislation in 1913 provided a law for the conservation of underground waters, and declared all sources of water supply within the boundaries of the State, whether above or beneath the surface of the ground, to belong to the public. To appropriate water, which is the property of the State, an application must be made to the State Engineer. If there is no interference with existing water rights on the source, a permit may be issued to develop the waters to a beneficial use. A certificate will be granted within a limited time for the actual quantity of water placed to a beneficial use which is then the limit and extent of the water right. The Ground Water Act of 1939 provided the first specific legislation for the regulation of underground waters.

Much of the present economic development of the area has been made possible through the use of ground-water reserves. Even though these ground-water reserves are still large, many problems attendant to extraction and use may preclude the further economical development within this region of much of this resource. Continuing dependency on ground-water overdraft to sustain or expand the region's economy must be analyzed carefully. The area of greatest demand in this planning region is the Las Vegas Valley, which has relied substantially on the ground-water resource. Since the days of flowing artesian wells in the 1940's, depths-to-water for important wells have increased markedly. In some areas ground-water levels have declined as much as 20 feet annually. In some cases, this overdraft has been accompanied by ground subsidence and decreased water quality. The mineral quality of ground water ranges from excellent to unsuitable for any purpose. Ground water in the alluvial deposits of the Basin and Range lowlands, for example, contains from less than 100 to more than 100,000 milligrams per liter of dissolved solids. In most of these deposits, however, dissolved solids concentrations are less than 1,000 milligrams per liter. Concentrations vary not only with location, but also with depth. As a result, the concentrations of dissolved solids for a given well will change abruptly and so will the ionic makeup. With the introduction of Southern Nevada Water Project deliveries, ground-water overdraft is being curtailed by the State Engineer, and ground water pumpage reduced to 50,000 acre-feet per year.

AIR QUALITY

The air quality of the region is good except in the areas of urban development. All urban areas have a high percentage of particulate matter in the air due to dust from a disturbed desert environment. In the desert a fine crust is formed on the top layer of soil after each rain. Breaking this crust allows the fine, dry soil to be blown away. In all areas of the region, construction and dirt road driving combined with high winds creates a dust problem.

Nitrogen dioxide, carbon monoxide, and hydrocarbon counts are steadily increasing in the Las Vegas area, causing growing concern. Air quality in the Las Vegas

1973 EMISSIONS INVENTORY SUMMARY FOR CLARK COUNTY, NEVADA

Emission Source	(Tons Per Year) Particulates	SO_2	CO	HC	NO_X	Source Total (tons per year)
1. Mobile	1,951 (2.63)	2,661 (6.72)	162,442 (97.0)	42,527 (81.43)	35,057 (51.92)	244,638
2. Industrial Processes	41,986 (56.7)	519 (1.31)	3,001 (1.79)	8,480 (16.24)	1,489 (2.2)	55,475
3. Power Generation	16,127 (21.8)	35,257 (89.14)	1,810 (1.08)	861 (1.65)	28,929 (42.84)	82,984
4. Domestic, Industrial, Commercial Space Heating	458 (.61)	1,107 (2.8)	169 (0.10)	345 (.66)	2,047 (3.03)	4,126
5. Solid Waste Disposal	19 (.02)	8 (.02)	32 (.02)	14 (.02)	9 (.01)	82
6. Other Fugutive Dust	13,478 (18.2)	-0-	-0-	-0-	-0-	3,478
TOTAL EMISSIONS	74,019	39,552	167,454	52,227	67,531	400,783

Note: Number in parenthesis is percent of total emissions

Source: Air Pollution Control Division of the District Board of Health of Clark County

metropolitan area is considered poor relative to the standards adopted by EPA. The topographic features of the Las Vegas bowl aggravate atmospheric pollution problems. Atmospheric inversion conditions prevail November through January; periods of stagnation often last for several days. The most complete measurement of air pollutants in the Las Vegas Valley area are taken at the Clark County District Health Department measuring station.

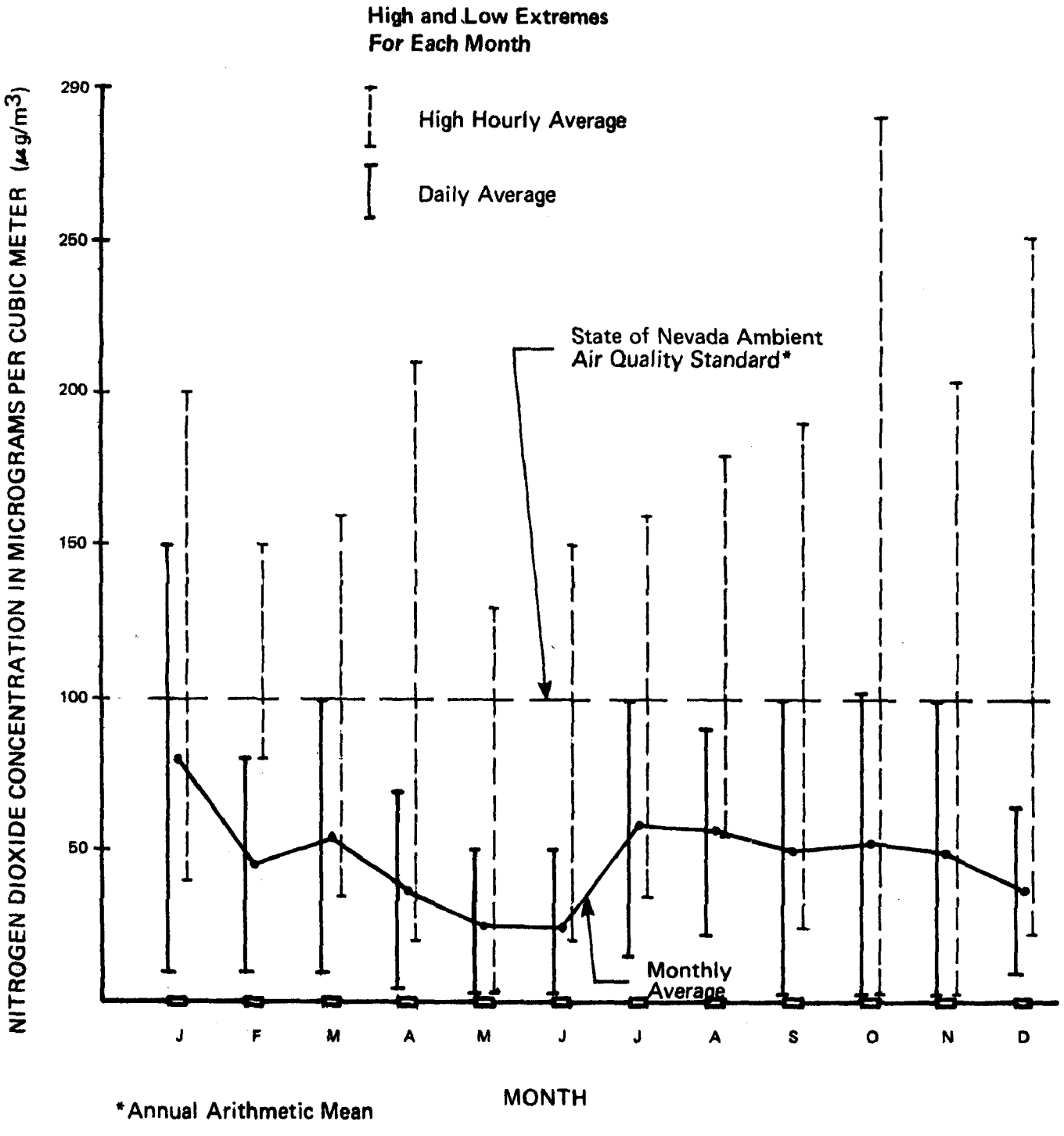
Motor vehicles are the major contributors to air pollution in Clark County, Nevada, accounting for 97.0%, 81.43% and 51.97% of the carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxide (NO) emissions, respectively. The other industrial activities responsible for air quality degradation in the County are power generation and various process operations. The power plants discharge 89.14% of the sulfur dioxides and 21.8% of the total particulates. In the 1973 emissions inventory summary for Clark County shown in Table 9, mobile sources are responsible for the annual discharge of 162,442 tons CO; 42,527 tons HC; 35,057 tons NO; 2,661 tons SO_2; and 1,951 tons of particulates for a total of 244,638 tons/year as compared to 82,984 tons/year for power plants and 55,475 tons/year for industrial processes.

This data identifies the importance of controlling motor vehicle emissions as a means for the attainment and maintenance of clean air standards. In addition, the evaluation of the potential air quality impact associated with the proposed project must consider not only the various project elements, but the motor vehicle activity associated with those elements. This consideration is further emphasized by the "complex source" amendments to Nevada Air Quality Regulations.

Nevada has been among the earliest State governments to adopt "complex sources" amendments to their Air Quality Regulations. These Air Quality Regulations, as shown in Appendix D, define a complex source as a facility which involves secondary activities that may emit any air contaminant for which there is an ambient air quality standard. Thus, shopping centers, parking lots, residential or institutional developments, and water, sewer, power, and gas lines are examples of facilities which will involve increased air pollutant emissions from motor vehicles. In the assessment of the impact of these emissions on the ambient air quality, the need for background air quality data becomes mandatory. Thus, the final air quality is represented by the sum of the emissions from a complex source and the existing or background concentrations on the various pollutants.

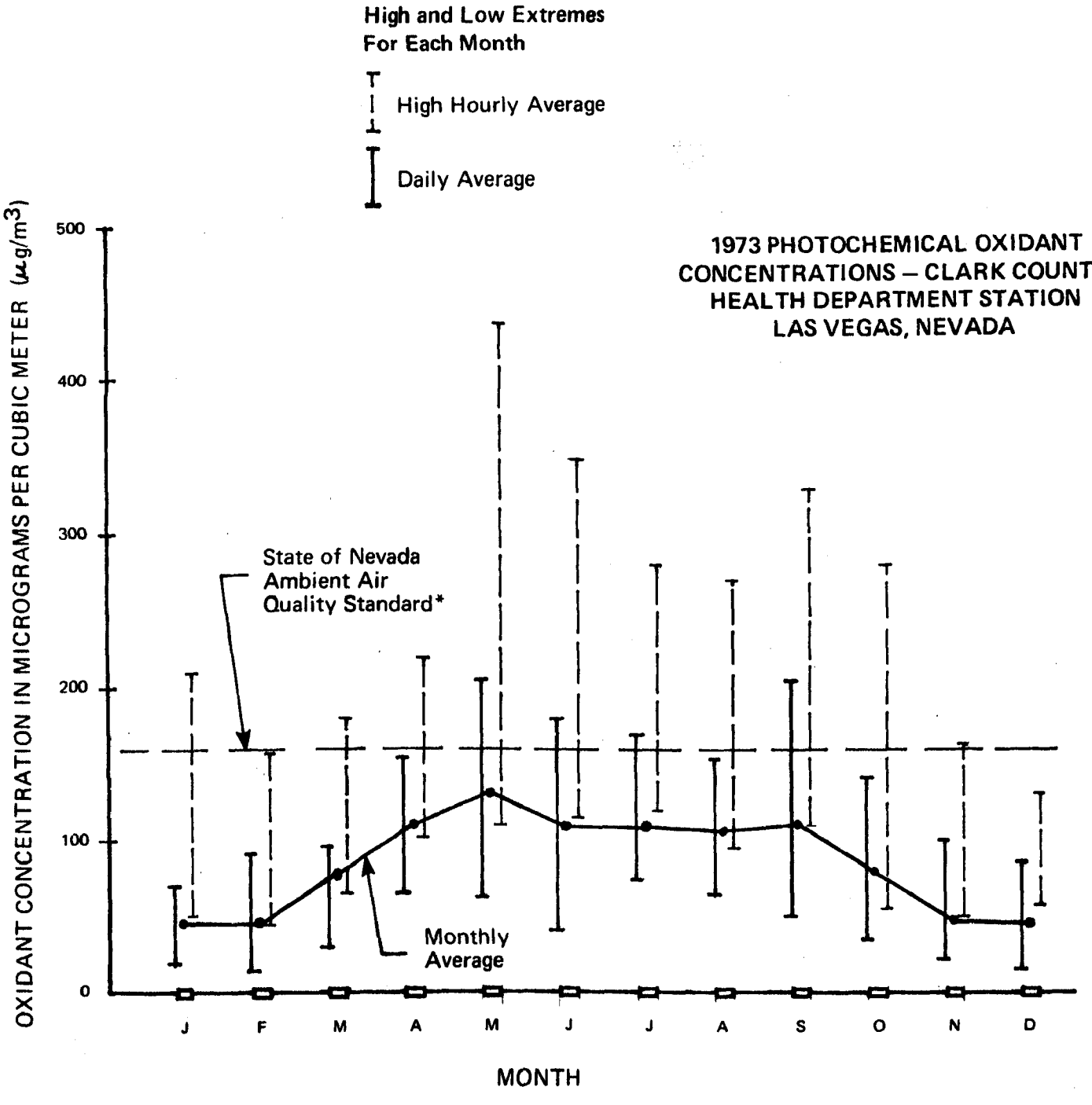
The Air Pollution Control Division of the District Health Department of Clark County has developed some background data for oxidants photochemically produced from the reaction of nitrogen oxides and hydrocarbons, nitrogen oxides and particulates. These are shown in Figures 18 and 19 for each month of the year 1973 as monitored in the vicinity of downtown Las Vegas. The values of each

1973 NITROGEN DIOXIDE CONCENTRATIONS
CLARK COUNTY
HEALTH DEPARTMENT STATION
LAS VEGAS, NEVADA



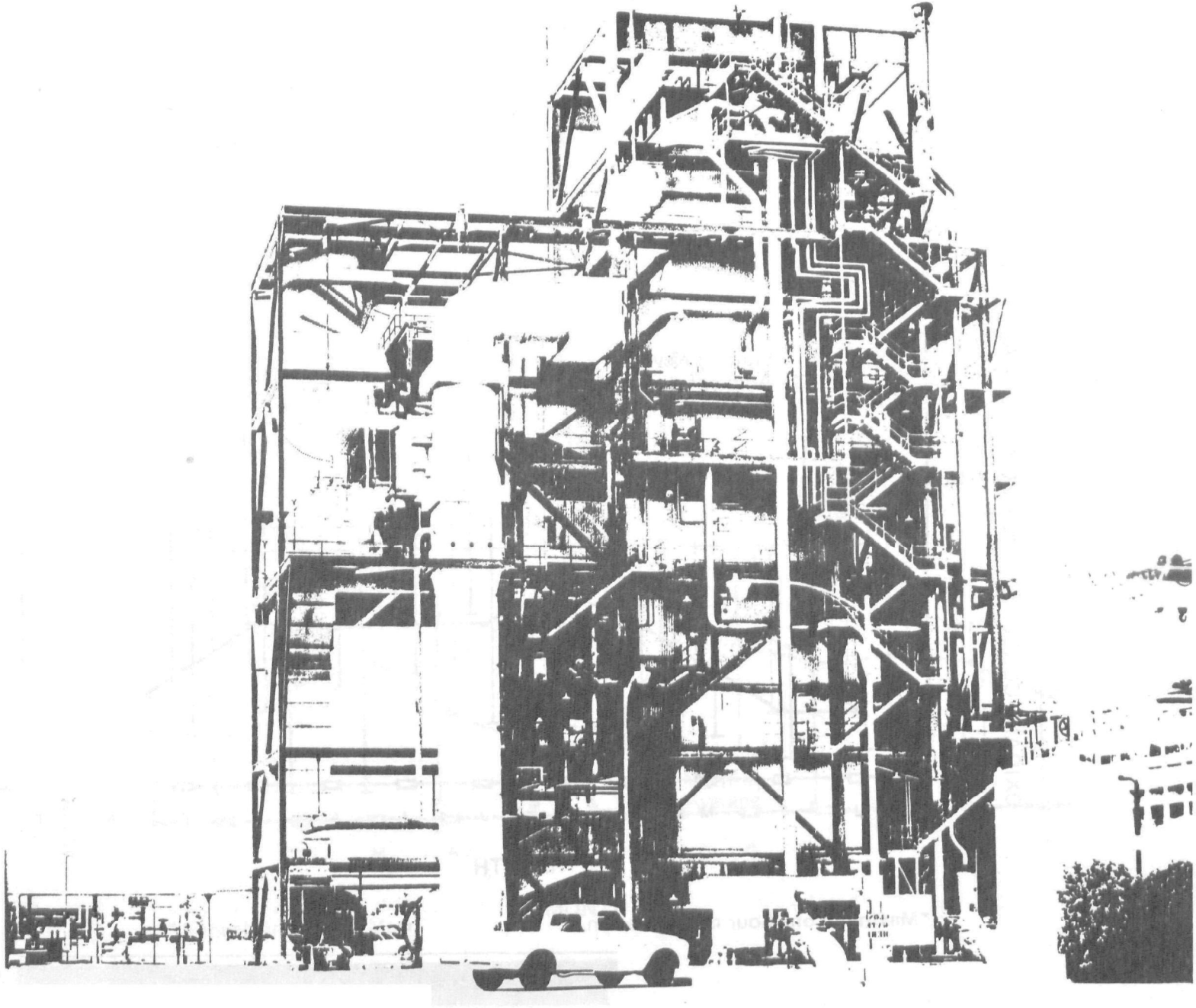
*Annual Arithmetic Mean

figure 18



*Maximum one-hour concentration.

Figure 19



pollutant are plotted against a reference value representing the State of Nevada Ambient Air Quality Standards; 160 ug/m^3 for the oxidants, 100 ug/m^3 for nitrogen oxides and 150 ug/m^3 for particulates. Both the photochemical oxidants and particulates ambient air concentrations lie above the standard values. Parallel data for CO and HC are unavailable at the present time.

Because of the major role played by motor vehicles in the degradation of air quality in Clark County, Nevada, the complex source legislation constitutes a realistic approach for the assessment of automotive emission sources. However, there is a requirement for additional background air quality data for the implementation of the complex source regulation. Aware of this need, the U.S. Environmental Protection Agency awarded a contract to TRW, Inc. in mid-February 1974 to develop air quality projections for Clark County. This study involves the examination and upgrading of the previous 1973 emission inventory for both mobile and stationary sources followed by the conversion of these values to air quality concentrations for CO and oxidants.

In order to assist in the implementation of the complex source regulations, the State of Nevada has contracted Aerovironment, Inc. to monitor ambient air quality and develop data on wind patterns, vertical temperature structure, and inversion incidence in Nevada. This data will permit the development of diffusion models to facilitate the conversion of motor vehicle emissions to ambient air concentration for the major pollutants. This study will also address itself to the meteorological and topographical conditions peculiar to the State of Nevada.

Due to the inconclusive state of present air quality data development, it is difficult to assess the meaning of existing data since this planning process is still underway. However, data available for 1971 may serve as some kind of historical indicator.

The annual arithmetic mean of nitrogen dioxide measured at the Health Department in 1971 was 36 micrograms per cubic meter (ug/m^3). This compares with the maximum annual arithmetic mean allowed under the National Primary Ambient Standard for nitrogen oxides of 100 ug/m^3.

The annual 1971 arithmetic mean of suspended particulates measured at the Health Deparment was 70 ug/m^3, compared with the National Primary Ambient Standard of 75 ug/m^3. This mean value of suspended particulates at the Health Department tends to increase near more congested metropolitan areas and tends to decrease away from the central city area.

The measurement of particulates at the Health Department reached a maximum of 240 ug/m^3 for one 24-hour period in 1971, compared with the National Primary Ambient Standard of 260 ug/m^3.

AMBIENT AIR QUALITY STANDARDS

1. The following concentrations of air contaminants shall not be exceeded at any single point in the ambient air:

   a. Sulfur oxides as sulfur dioxide:

Annual arithmetic mean	60 ug/M^3	(0.02 ppm)
Maximum 24 hr. concentration	260 ug/M^3	(0.1 ppm)
Maximum 3 hr. concentration	1300 ug/M^3	(0.5 ppm)

   b. Suspended particulate matter:

Annual geometric mean	60 ug/M^3
Maximum 24 hr. concentration	150 ug/M^3

   c. Carbon monoxide:

Maximum 3 hr. concentration	10 mg/M^3	(9.0 ppm)
Maximum 1 hr. concentration	40 mg/M^3	(35.0 ppm)

   d. Photochemical oxidant:

Maximum 1 hr. concentration	160 ug/M^3	(0.08 ppm)

   e. Non-methane hydrocarbons:

Maximum 1 hr. concentration	160 ug/M^3	(0.24 ppm)

   f. Nitrogen dioxide:

Annual arithmetic mean	100 ug/M^3	(0.05 ppm)

2. ug/M^3 means micrograms of air contaminant per cubic meter of air.

   mg/M^3 means milligrams of air contaminant per cubic meter of air.

   ppm means parts of air contaminant by volume per million parts of air by volume.

3. The methods of measurement shall be those precribed in Appendices A through F, inclusive, of § 410 of Chapter IV, Title 42, Code of Federal Regulation, published in the Federal Register on April 30, 1971. These may change from time to time.

4. Adoption of these Ambient Air Quality Standards shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of Clark County.

Photochemical oxidants at that time were the most excessive form of air pollutants in the Las Vegas area. The National Primary Ambient Standard states that photochemical oxidants should not exceed 160 ug/m^3 for a one hour period more than once during any one year. At the Health Department station, the quantity of photochemical oxidants exceeded the Standard for 1,304 hours during 1971, and on one occasion reached a one-hour maximum of 478 ug/m^3. It would appear the above average amount of sunshine in the Las Vegas area is a factor in the formation of photochemical oxidants.

Carbon monoxide was only measured during a five-week period in November and December of 1971. During this period, the amount of carbon monoxide measured at the Health Department exceeded the National Primary Ambient Standard of 10 mg/m^3 during an eight-hour period more than twofold. This exceedance of the Standard occurred at two different times rather than once as permitted by the Standard. One-hour concentrations of carbon monoxide at the Health Department in 1971 never exceeded the Standard for a one-hour period during the test in November and December.

At that time there was no equipment in the Las Vegas area that measured hydrocarbon, even though hydrocarbon concentrations were believed to be high. Sulphur dioxide in the area was considerably well below the National Primary Ambient Standard and in some cases it was below the point of measurability.

A more complete breakdown of measurement taken at the Clark County District Health Department for photochemical oxidants and nitrogen dioxides during 1973 is included in Appendix D.

Air Quality Contributions From The Proposed Allen Power Plant

The proposed Allen Power Plant will contribute substantial amounts of sulfur oxides, oxides of nitrogen, and particulate matter into the atmosphere close to Las Vegas. Foreseeably through atmospheric reactions, the formation of sulfates and nitrates will increase the possibility for the formation of ozones, one of the prime ingredients in photochemical smog. The volume of particulate matter emitted will make ambient standards attainment difficult and maintenance all but impossible for that pollutant in the near future.

The Allen Power Plant will contribute substantially to the degradation of air quality in Clark County, Nevada, and the Clark-Mojave-Yuma Interstate Air Quality Control Region.

The combustion of 16,000 tons per day of low-sulfur coal (80% of the plant capacity) will result in 14.4 tons per day (5,260 tons per year) of particulate matter to be emitted into the atmosphere. Atmospheric reaction will transform approximately 10% of the power plant's 150 tons per day (54,800 tons

per year) oxides of nitrogen emissions and 10% of the plant's 34.5 tons per day (12,600 tons per year) sulfur dioxide emissions into nitrates and sulfates. These nitrates and sulfates comprise the particulate matter air quality reading. A total of 2,000 tons per year of atmospheric pollutants will be measured as particulate matter in Las Vegas, and the Clark-Mojave-Yuma Interstate Air Quality Control Region.

The State Air Quality Implementation Plan records a 1970 estimate for Clark County of man-made particulate emissions to be 88,996 tons. By 1973 these emissions of particulate matter decreased through enforcement of stringent emission control regulations to 74,019 tons per year. The State Plan estimated the National Ambient Air Quality Standard for particulate matter as:

150 ug/m^3 - maximum 24-hour average not to be exceeded more than one time per year

60 ug/m^3 annual geometric means of 24-hour average.

With such a substantial increase in the emissions of particulate and the formation of additional sulfates and nitrates in the atmosphere, the Allen Power Plant promises to cause serious degradation in the quality of the air in and around Las Vegas.

The recorded level of particulate matter in 1970 was more than double the National Ambient Air Quality Standard with the maximum 24-hour concentration of 371 ug/m^3 and an annual geometric mean of 137 ug/m^3. The 1971 24-hour concentration of particulates as presented in the Environmental Assessment for the Las Vegas Wash/Bay Pollution Abatement Project showed that the maximum 24-hour concentration had increased to approximately 480 ug/m^3. No annual geometric mean was provided but from the statement of the annual arithmetic mean (70 ug/m^3) it can be assumed that the annual geometric mean concentration was substantially lower than in 1970.

VEGETATION

Regional Vegetation

The Lower Colorado Region has a wide variation in vegetative cover types and related categories. The forest types extend from the small alpine areas on top of Mount Baldy in the White Mountains, the tip of Humphrey Peak in the San Francisco Peaks, and the crest of Charleston Mountain, Nevada; through the coniferous forest zones of spruce-fir, ponderosa pine, and the pinon-juniper and oak woodlands and the chaparral types. The rangeland type extends from the forest type through the northern and southern desert shrubs, the northern and desert grasslands down through a small area of true desert near the mouth of the Colorado River on the boundary between Mexico and Arizona. Scattered

through the Region are areas of cultivated land, including irrigated pasture, with the largest blocks in the Lower Gila and the southern half of the Lower Main Stem Subregions. More than 500,000 acres of the Region are developed as urban and industrial areas. More than 300,000 acres of the Region are occupied by water in the form of streams, lakes, impoundments, and reservoirs. The vegetative cover type is dependent upon the precipitation, topography, soil, and climate. In addition, each type is limited to rather specific ranges in elevation. Vegetal cover in the area of concern is Southern Desert Shrub.

The perennial southern desert shrub types occur in the southern and western portion of the Region between 3,000 and 4,500 feet in elevation. The type is characterized by cacti, woody plants, forbs and grasses.

The ephemeral southern desert shrub types occur along the western part of the Region, usually at elevations below 3,000 feet and less than 8 inches of annual rainfall. The type is composed largely of creosote bush with some bursage growing in open stand with little to no perennial ground cover. Numerous annual forbs and annual grasses may occur during favorable periods of moisture.

Outside of the developed areas of the regional environment, there is very little vegetation. The area appears brownish-grey, treeless, consisting of woody shrubs rarely over one meter in height with small annuals dispersed across the desert floor. Grass is scarce in the area, appearing quite often only after rains along with green, succulent annuals which remain for only a few weeks. The ground is easily discernible due to little or no natural ground litter and distance between vegetation.

KEY TO RELATIVE VEGETATION DENSITIES

Barren	No growth.
Isolated	Plant set alone in large area.
Sparse	Distance between vegetative units greater than the canopy size of these units.
Moderate	Distance between vegetative units same as the canopy size of those units.
Dense	Distance between plants or vegetative units so small as to be difficult to walk between.

Three vegetation types and eight biotic communities occur in the Las Vegas region. These are as follows:

a. Desert Shrub vegetation type
   (1) creosote bush community

b. Shrub and Woodland vegetation type
   (1) desert riparian community
   (2) saltbush community
   (3) mesquite community
   (4) salt cedar community
   (5) pickleweed community

c. Marsh vegetation type
   (1) cattail community
   (2) bulrush community

Of these the mesquite, salt cedar, pickleweed, cattail and bulrush communities are recognized as occurring only in the Las Vegas Wash and therefore are described in the appropriate section.

Predominant biotic communities of the Las Vegas region, are the creosote bush, desert riparian and saltbush communities. They are characteristic of the common arid desert conditions. The creosote bush community is most dominant in the Las Vegas Valley area and will be described in that section.

The desert riparian community is common along the desert washes and is characterized by such floral species as cheese weed (Hymenclea salsola), snake weeds (Gutierrizia sp.), bladder sage (Salazoria mexicana), golden weeds (Haplopappus sp.), and mesquite (Prospis juliflora).

The saltbush community is characteristic of the playas between the creosote bush and sagebrush deserts. Shrubs are small to large, spacing is variable with arid to seasonal surface moisture. Characteristic plant species include shadscale (Atriplex confertifolia), hop sage (Grayia spinosa), red molly (Kochia americana), mesquite and other species of Atriplex.

Las Vegas Bay/Lake Mead has two types of vegetation, terrestrial and aquatic.

Terrestrial

Lake Mead lies within the Lower Sonoran Life Zone. The dominant forms of vegetation are creosote and mesquite. Other species present include saltbush, arrow weed, greasewood, prickly pear cactus, and barrel cactus. The hardy, alkali-tolerant salt cedar, an introduced shrub, has extensively colonized the wetland immediately surrounding the Lake.

Aquatic

The relative abundance of the green and blue-green algae, diatoms, dinoflagellates and other phytoplankton of Las Vegas Bay appears to fluctuate widely and with surprising regularity. This phenomenon is not yet completely understood. However, it is believed that the variations are due to changes in the distribution of nutrients

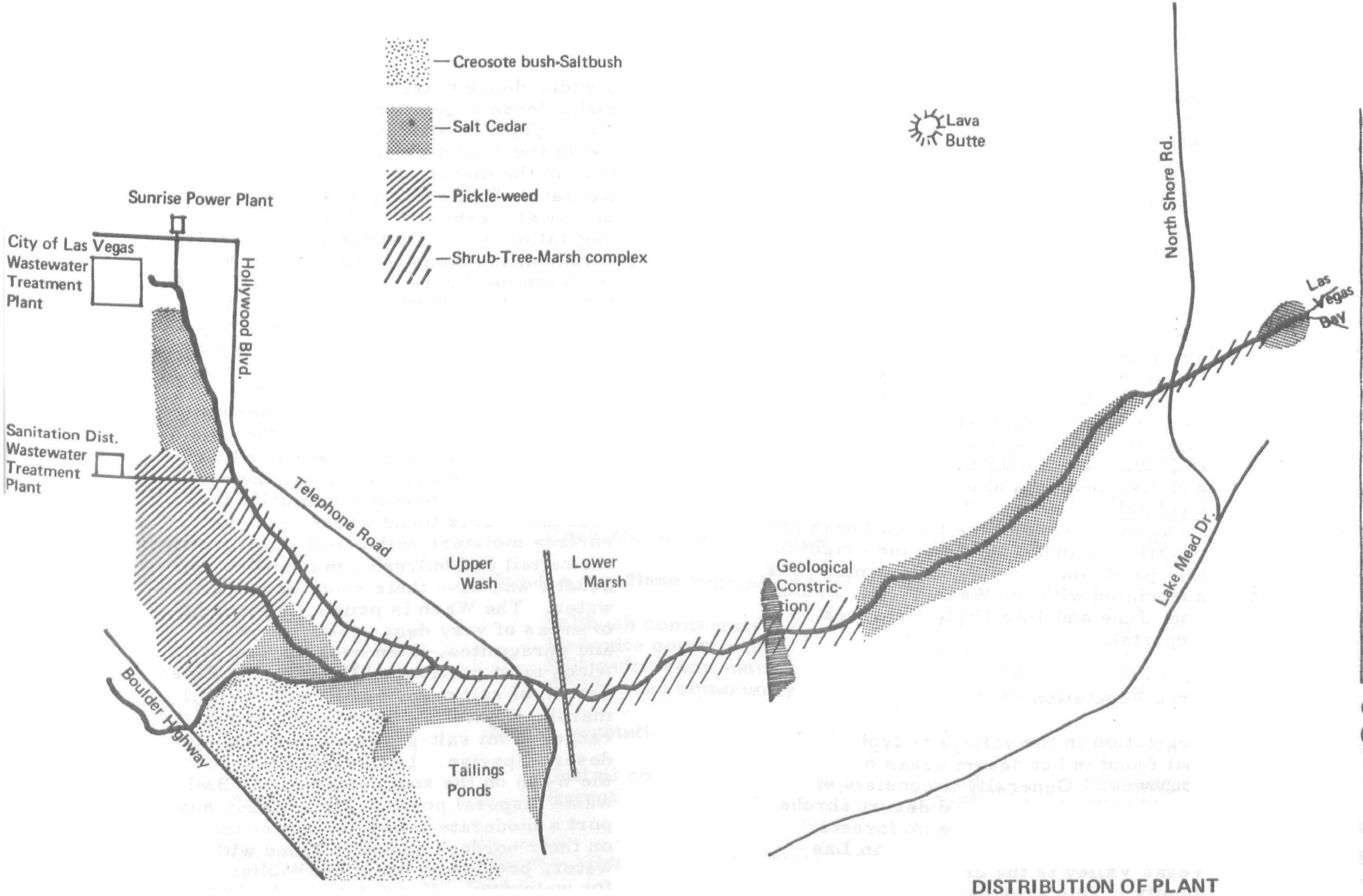


figure 20

DISTRIBUTION OF PLANT COMMUNITIES ALONG LAS VEGAS WASH AS DETERMINED BY BRADLEY AND NILES (1973)

contributed by the Las Vegas Wash outflow, within Las Vegas Bay. The regularity of fluctuation may be due in part to human factors, and in part, to natural succession. In any case, a controlling factor in the phytoplankton population size at any one time, appears to be the presence or lack of stratification within the Bay waters.

During June large populations of colonial green algae occurred throughout Las Vegas Bay, but not near the Wash entrance to the Bay. At this time, a particular motile green algae (Carteria) had high populations at the Wash entrance. In July, the colonial green algae declined and disappeared and were replaced by Cyclotella diatoms. The location of these organisms as the bloom began and progressed indicates that "the origin of this particular population maximum was associated with the Wash". (Dr. J. Deacon, June and July 1972, Progress Reports).

Area Vegetation

Vegetation in the valleys is typical of that found in hot desert areas of the Southwest. Generally it consists of sparse growth of stunted desert shrubs and grasses. There are no forests. The dominant vegetation type in Las Vegas Valley is the creosote bush community. This area has arid, low, widely-spaced shrubs.

Las Vegas Wash consists of two areas - a wide, dense marsh type environment and a dense vegetation area. Data shows that vegetative species diversity is greatest in the desert plant communities rather than in the marsh and stream riparian habitats. This is basically due to the lack of annual (herb) species within the marsh vegetation type. Distribution of the plant communities along the Las Vegas Wash is shown on Figure 20. Generally speaking, the classification of these biotic communities is based on moisture gradients as shown in Table 11. As stated previously, the mesquite, salt cedar, pickleweed, cattail and bulrush communities are recognized as occurring only in the Las Vegas Wash. The mesquite community is of the woodland vegetation type with roots reaching the water table. The pickleweed community is seasonal. It is found where there is surface moisture with a salt crust. Both the cattail and bulrush communities are aquatic and have their roots in standing water. The Wash is primarily made up of areas of very dense cattails, reeds and phragmites, often over six feet tall. Along most portions of the Wash, a dense growth of salt cedar borders the cattail marsh. Beyond the salt cedar, habitat ranges from salt-grass communities to desert riparian. Located adjacent to the Wash on the south side are the BMI waste disposal ponds. These ponds support a moderate growth of salt cedar on their borders and when filled with water, provide an excellent habitat for waterfowl. Vegetation in the Las Vegas Wash as recorded by Bradley and Niles (1972) appear in Appendix B.

The present extent of the marsh environ-

VEGETATION TYPES AND BIOTIC COMMUNITIES OF THE LAS VEGAS WASH

Vegetation types & biotic

Community	Soil Salinity	Soil Moisture
Desert shrub vegetation type		
Creosote bush community	0.4%	1.6%
Shrub & woodland vegetation type		
Saltbush community	0.5%	2 - 5%
Mesquite community	0.5%	4.1%
Salt cedar community	0.4 - 2%	8.5%
Pickleweed community	1.8 - 6%	15 - 30%
Marsh vegetation type		
Cattail community	0.8%	standing water
Bulrush community	0.5%	standing water

Source: Bradley & Niles (1973)

table 11

ment found in Las Vegas today is not natural. Artesian springs fed Las Vegas Wash until man began pumping water in Las Vegas Valley. The artesian springs stopped flowing and Las Vegas Wash became an ephemeral stream; the upper region exhibiting the same type of vegetation as now exists, but not as dense. The lower region of the Wash was like any other dry wash in the Las Vegas area. Today, except during periods of precipitation, the main flow of water in the Wash is from sewage effluent and ground water seepage, resulting in a densely vegetated, vividly green marsh in the middle of a very dry, sparsely vegetated desert.

Site Vegetation

A list of basic biota of the selected site environments, excluding the valley sites is given in Appendix B.

Ground Water Recharge Well Field and Pilot Desalination Plant

This site is moderately vegetated, displaying the creosote bush and the desert riparian biotic communities. The creosote bush community occurs in isolated patches on the flat mesas. The desert riparian community type is dominant. Because of the rocky soil and washes, this site appears as a somewhat barren and desolate area. Vegetation observed in the area includes creosote bush, mormon tea, ratney, niggerheads, challa caeltis, prickly pear cactus and mojave yucca of the Creosote Bush Community. Also observed was the desert wash willow, snake weed, and indigo bush of the Desert Riparian Community. At the pilot desalination plant, the area is sparsely vegetated with remnants of desert riparian flora, particularly adjacent to the ephemeral Wash.

Waste Water Collection System, Treatment Plant, Deep Disposal Well Field Areas, and Sludge Disposal Site

The route of the collection system for Alternatives 1, 4, 6, 7 and 8 is densely vegetated with salt cedar along most of its distance. For Alternatives 2, 3 and 5 the route is scarred, having a sparse growth of creosote and salt cedar crossing through scattered marsh type vegetation. Vegetative species common at the waste-water collection system for Alternative 10, include salt cedar, bassica, bermuda grass, and other grass species.

The site for the waste-water regulation reservoir and treatment facilities for Alternatives 1, 4, 6, 7 and 8, located southeast of the Clark County Sanitation District plant has sparse vegetation of creosote with dense areas of salt cedar and a small area of marsh vegetation. For Alternatives 2, 3 and 5, the site is sparsely vegetated. Portions of the eastern boundary of the advanced waste-water treatment plant site for Alternative 10, are vegetated with dense areas of salt cedar and some marsh vegetation within the Las Vegas Wash itself. A preponderance of the site is irrigated pasturage of bermuda grass.

The area of the sludge disposal site is sparsely vegetated, displaying the creosote bush community. The vegetated areas are primarily restricted to wash areas while the more exposed areas are generally barren. Because of the rocky soil and washes, this site appears as a somewhat barren and desolate area.

Las Vegas Lands to be Irrigated

Much of the land to be irrigated or used for pipeline routing, has been disturbed considerably by man's activities. As a result, the areas support few floral species characteristic of the more natural areas. Vegetation found at this site includes creosote bush, cat's claw, big galleta grass and shadscale.

Dry Lake Valley

The dominant biotic community of Dry Lake Valley is the creosote bush community. Yucca and cacti are found on the higher alluvial slopes. The lake bottom is barren except for fingers of creosote, burro bush or mixed stands reaching toward its center. Plant species observed at this site during field reconnaissance are creosote bush, burro bush, mormon tea, mojave yucca, cholla cactus, ratney, prickly pear cactus and barrel cactus of the Creosote Bush Community. Also found were snake weed, cat's claw, desert holly, and salt cedar of the Desert Riparian Community.

Eldorado Valley

Vegetation varies greatly in Eldorado Valley, ranging from barren to dense. There is a wide strip running east to west in the middle of the Valley with little or no vegetation on it. To the west of Highway 95, this barren patch is a dry lake bed, to the east of the highway it is a very loose, rocky drainage area, southward is a green patch of dense growth consisting of salt cedar and creosote bush caused by the drainage of effluent from the Boulder City sewage treatment plant. Looking north and south, vegetation ranges from sparse to dense. The southern end of the Valley next to the dry lake, is sparsely vegetated with creosote bush and small annuals. The northern end of the Valley adjacent to the dry lake, is densely vegetated with creosote bush, burro bush, big galleta grass and various annuals. Higher up, towards the mountains, in all directions, there is moderate vegetation, creosote bush being the dominant species. Plant species found at this site include, creosote bush, burro bush, russian thistle, pig weed, beavertail cactus, and cholla cactus of the Creosote Bush Community. Species of the Desert Riparian Community include desert marigold, big galleta grass, and salt cedar. Species of the Salt Bush Community include shadscale and mesquite.

Jean Lake

Vegetation at Jean Lake varies from mode-

rate to barren. The northern end and peripheries of the study area have moderate vegetation, creosote bush being the dominant species with burro bush, ratney and various annuals. Much of the study area, from the dry lake southward, except for the peripheries, is overgrazed. This area is sandy, the only vegetation being big galleta grass, grazed to the ground, leaving vegetation clumps holding the earth in place, or upright naked woody plants and creosote bush. Flora observed at this site is creosote bush, burro bush, ratney, mojave yucca, cholla cactus, barrel cactus, and beavertail cactus of the Creosote Bush Community. Representative of the Desert Riparian Community, is big galleta grass, desert marigold, wild tobacco, and desert mallow.

Hidden Valley

The major portion of Hidden Valley is almost barren. Only the outermost peripheries of the alluvial slopes on the east and west sides exhibit vegetation, with greater portions of the northern and southern ends having moderate vegetation. The north, east and southern alluvial slopes are dominated by creosote bush with ratney, burro bush and various annuals. Areas of the northern portion of the Valley are gravel, almost barren drainage areas. Here there are isolated creosote bushes, with many small annuals growing in washes. The barren, apparently overgrazed area is sandy, with big galleta grass clumps holding the soil in place, giving the area the appearance of a stormy sea. Plant species observed at this site are, creosote bush, burro bush, russian thistle, mojave yucca, cholla cactus, ratney, and mormon tea of the Creosote Bush Community. Of the Desert Riparian Community, vegetative types were big galleta grass, greenbottle bush, desert marigold, snake weed, four-wing salt bush, and chinca weed.

WILDLIFE AND FISH

Regional Wildlife

Wildlife species in the Lower Colorado Region are as many and varied as the climate, terrain and vegetative types. More than 750 species and subspecies of birds and animals occur in the Region. Over 40 of these species of wildlife provide hunting ranging from highly-prized big-game hunting to sport hunting of non-game species. Many other species, mostly small mammals and birds, provide enjoyment for the non-hunting outdoorsman for nature study and photography. For the purpose of this study, the wild game species have been classified as big game, small game, and waterfowl.

Big-game species in the Region are distributed throughout approximately 72 million acres of widely diverse habitat types. Deer are the most abundant and widespread of the big-game species, and include the desert mule deer and the white-tailed deer. Approximately 69.5 million acres within the Region are occupied by the two species of deer. The

pronghorn antelope occupy nearly 10 million acres of the rolling grassland, occurring in Arizona, and in similar areas of Nevada, New Mexico, and Utah. Desert bighorn sheep occur in several of the low desert mountain ranges in southern Nevada. Bighorns travel in small bands through this arid country and, although its numbers are low, it is one of the most prized big-game trophies of the Region. The javelina, or collared peccary, is found at a low elevation. Javelina range from the lower pinyon-juniper into the southern desert shrub and chapparral areas. Although population densities are usually relatively low, the javelina range is about 36 million acres.

Small-game species vary widely in the extent of their range, some extending nearly throughout the Region while others are quite localized in distribution. Examples of species with a regionwide distribution are the mourning dove, cottontail rabbit, the white-winged dove, and the bandtailed pigeon. Limited in distribution are the blue grouse and sage grouse. The Gambel's quail occurs primarily in the desert and lower mountain elevations of the Region. Several species of fur animals including beaver, muskrat, grey fox, and kit fox occur in the Region. While some species, such as the kit fox are relatively limited, primarily to the desert areas of the Lower Main Stem and Gila Subregions, other species, including the beaver, are widely distributed throughout the Region. The fur animals normally do not reach prime fur condition which is attained in the cooler climates, and the interest in trapping for furs solely for profit is very low.

Fur animal species, such as foxes, are also considered varmints, and as such, are relatively heavily hunted. A small number of furs are collected by varmint hunters as a secondary benefit from hunting. Several species of predatory animals and non-game animals, as well as the previously mentioned fur animals, are hunted in this Region. Most of these species are well distributed throughout the three subregions and include coyotes, bobcats, mountain lions, jackrabbits, prairie dogs, various ground squirrels, and ravens.

Waterfowl are present in greatest concentrations in the Region during fall and winter migration periods. A number of waterfowl winter in the desert wetlands of the Lower Main Stem. Suitable habitat for waterfowl consists of 42,000 acres of wetlands and marsh associated with permanent streams and man-made lakes.

The distribution of some types of wildlife in relation to human populations has a great influence on their use. Certain big-game species are not greatly affected by these factors, since hunters will travel great distances for such an attraction. A large share of the demands from the Las Vegas area is satisfied outside the Region in California and parts of Nevada. Demands on one species, therefore, do not reflect the total demands on all species of the Region. The rugged terrain of the Region, while creating a natural refuge for wildlife in many areas, is a limiting factor in the hunting of game. A lack of access limits utilization of a sizable portion of

the total wildlife resource. Although lack of easy access to rough country is more typical of remote areas, it is not limited to these areas.

Designated wildlife developments and facilities managed intensively for wildlife production, include 49 multiple-and-primary-use management areas, 568 habitat improvement facilities and access roads, comprising a total of over 4 million acres. Nine of the wildlife management areas totaling over 3 million acres, are administered by the Federal Government; 32, of approximately 72,000 acres, are administered by State governments; and 8, totaling over 930,000 acres, are administered jointly by State and Federal interests.

Nineteen of the wildlife areas in the Region, are developed primarily for big-game populations, seven areas are developed for small game, seventeen set aside for the protection of waterfowl, and three for wildlife in general. In addition, one recreation area and one public shooting range are administered by fish and wildlife interests and, are considered management areas. Areas at higher elevations are managed for the production of mule deer, elk, antelope, turkey, and other wildlife utilizing the area.

The Regional Aquatic Environment

There are about 85 species of fish in the Lower Colorado River Region. Approximately 25 species provide sport fishing. The others are of value as forage fishes, as pollution indicators, for scientific investigations, and as a source for a possible commercial fishery. Some fifty-six species of fish have been introduced into the Region. The notable introductions of game fish include all the common warmwater sport and commercial fishes and all trout, except the endangered Gila and Apache trouts. Other game fishes introduced are the coldwater species of walleye, grayling, and northern pike. The introduced warmwater species include striped bass, white bass, channel catfish, flathead catfish, yellow perch, and tilapia. The threadfin shad has been introduced into reservoirs below 4,500 feet elevation as forage for game fish. Fishes introduced into the lakes on the Colorado River include kokanee and silver salmon in Lake Mohave and Lake Mead. These fishes are expected to add to the variety of fish species available to the fisherman in the Lower Colorado Region. Native species have not provided any important sport or commercial fishing in the Region for many decades. In the cold waters impounded on the Colorado River and the cool reaches of the river below the dams, stocked rainbow trout provide year-round fishing. On Lake Mead, they provide a supplemental fishery. For the most part, introduced spiny-rayed warmwater fishes predominate in the waters of the Lower Colorado Region.

Largemouth bass is one of the major game fishes in the Region and is found in most lakes in the drainages of the Colorado. Sunfishes are abundant in many of the warmwater lakes and streams; bluegill and green sunfish are widespread throughout the Region. The warmouth

and redear sunfish are found in the lakes of the Lower Colorado River. Crappie are most common in the larger reservoirs throughout the Region. Some crappies are in smaller lakes up to 7,000 feet elevation. Striped bass are found in the Colorado River from near Blythe, California, north to Lake Mojave and just recently planted in Lake Mead. Catfishes are found throughout the Region. Channel catfish are the most prized catfish and are found in most of the large reservoirs and the Colorado River. Irrigation canals and many stock ponds throughout the Region, notably those on the Indian reservations, have been stocked with channel catfish. Black bullhead are found in small muddy streams, lakes, and canals at lower elevations. Yellow bullhead are found in some of the small, relatively clear, rocky streams.

The Region contains a variety of introduced fishes of potential commercial value. Populations of food-fishes from wild resources such as carp, buffalo-fishes, and various suckers are found in the larger reservoirs. Important species of bait fishes such as the redshiner, fathead minnow, speckled dace, redside shiner, and threadfin shad are found regionwide in most streams and lakes.

Fishing waters in the Lower Colorado Region include streams and man-made impoundments. There are no natural lakes of importance to fishing. The fishery is classified into two major categories: the coldwater trout fishery of headwaters and impoundments generally above 5,500 feet elevation; and the warmwater "spiny-rayed" fishery in the streams and impoundments of elevations below 6,000 feet elevation. The waters of the Colorado River and other streams in the Region that are stocked and provide trout fishing only during the cooler months of the year are classed as warmwater fisheries. There are approximately 2,500 miles of stream habitat for fishes in the Region comprising approximately 10,200 surface acres of which about 2,000 acres and 8,200 acres are cold- and warmwater, respectively. Impoundments provide nearly 241,000 surface acres of fishing habitat of which 7,000 acres are coldwater and 234,000 acres are warmwater.

Over 52% of the total fishing in the Region occurs in the Lower Main Stem Subregion. About 30% of the Region's coldwater fishing occurs in the reservoirs and the cool tailwaters found in the Subregion. About 60% of the Region's warmwater fishing is realized in this Subregion, mainly in the Colorado River and Lakes Mead, Mojave and Havasu. Sixty-seven percent of the fishing in the Region is in impoundments. Impoundments are generally easier to fish, provide more open water, and are more accessible than most streams. Warmwater impoundments, being more numerous and located nearer to population centers, support 49% of the total fishing as compared to 18% from coldwater impoundments. Streams accounted for the remaining 33% of the total fishing. Again, easier access accounts for warmwater streams providing 23% of the total fishing as compared to only 10% from coldwater streams. Although the overall

supply of sport fishing in the Region presently appears adequate, many factors tend to discourage or limit realization of the available capacity. Poor distribution of the supply relative to demand, is the most important factor limiting full use of the capacity. Sheer magnitude of the demands generated by the population centers causes severe localized demand-supply problems. Demand varies directly with human population, and good quality fishing opportunities vary inversely with the population. A large share of Las Vegas area demand is satisfied in southern Utah and parts of California and Nevada outside the Lower Colorado Region.

Fishery installations existing in the Region consist of approximately 97 fishing lakes and 8 fish hatcheries. The fishing lakes provide more than 6,000 acres of water for fishing. These lakes are constructed and managed primarily for fishing and use of the water surface is restricted. Nineteen of the lakes, totaling more than 1,000 acres, are administered by State fish and game agencies. Four lakes, providing about 900 acres, are administered jointly by State-Federal agencies. Five State hatcheries and three Federal hatcheries produce approximately seven million fish, most of which are trout. Therefore, over 90% of the trout caught in the Region are stocked fish. The Region's production is about 80% of the total fish stocked. The remaining fish stocked are imported from outside the Region.

Area Wildlife and Fish

Due to lack of data, excluding Las Vegas Wash and Las Vegas Bay, fauna, like the flora, is described according to biotic communities. There are 10 species of amphibians, 35 species of reptiles, 64 species of mammals and over 364 species of birds expected to be found in the regional area. Eleven of these species of fauna are rare, endangered or of uncertain status. Two hundred fifty-one of the bird species are found in Las Vegas Wash. Due to the geography of the area and it being in the Lower Sonoran Life Zone, the regional environment displays a wide diversity of species and many subspecies unique to the area. Biologically this environment is very rich. A variety of wildlife, including coyote, badger, kangaroo rats, cottontails, reptiles and bats, is native to the area.

Las Vegas Valley is predominantly Creosote Bush Community. Mammals characteristic of this Community are the desert jackrabbit (Lepus californicus), desert cottontail (Sylvilagus audubonii), white-tailed antelope ground squirrel (Citellus leucurus), several species of bats, and the Meriam's and desert kangaroo rats (Dipodomys merriami and D. deserti). Common reptiles include the side-blotched lizard (Uta stansburiana), western whiptail (Cnemidophorus tigris), zebratailed lizard (Callisaura draconoides), and the desert iguana (Byisaurus dorsalis) to name a few. Thirty-three species of birds occur in this community, among them, the cactus wren, horned-lark, Gambel's quail, common raven and Leconte's thrasher.

Las Vegas Wash has a variety of wildlife. Diversity of vegetative species is greatest

in the desert plant communities rather than in the marsh and stream riparian habitats. Conversely, the avifauna (birds) are found to be more diverse and abundant in the riparian communities as compared to the adjoining desert communities. This is due in part, to the availability of open water for waterfowl and shorebird species which constitute approximately 40% of all bird species in the shrub-woodland-marsh vegetation type. There are 251 species of birds found in the Las Vegas Wash, many of which would not otherwise be found in the area. Other fauna determined to occur in the Las Vegas Wash include 6 amphibians, 29 reptiles (1 tortoise, 13 lizards and 15 snakes), 39 mammals (1 shrew, 10 bats, 16 rodents, 2 rabbits, 9 carnivores and 1 ungulate (bighorn sheep). Many of the species are observed to occupy the ecotone between the xeric desert habitat and the hydric conditions of the marsh. Except for birds and the few species of mammals and reptiles, wildlife found in the Wash is essentially the same as that of the surrounding desert environment. Birds and species unique to the Wash, such as beaver, are listed in Appendix B. The Wash also supports two introduced species of fish, mosquito fish (Gambusia affinis), and goldfish.

The species composition of Las Vegas Bay and Lake Mead fish population is continually changing as new stocking programs and experiments are initiated. The various game fish comprised the following percentages of the total 1971 catch: Largemouth Bass - 40%, Channel Catfish - 24%, Black Crappie - 11%, Rainbow Trout 14%. The Largemouth Bass is still considered to be the most important game fish although it has comprised a steadily diminishing proportion of the total catch. The Rainbow Trout has recently increased in importance due to heavy stocking. The new stocking programs have been initiated in an effort to improve the steadily decreasing rate of angling success which has accomplished increased angling pressure on the lake. (See Table 8 - "Species of Fish Presently Found in Las Vegas Bay").

A new fish hatchery has recently been located on the Nevada side of Lake Mead on National Park Service land. It is administered by the Nevada Department of Fish and Game and is known as the Lake Mead Fish Hatchery. It has been in operation for the past year and is raising both species and hybrids of trout, (rainbow and cutthroat) and salmon (coho and chinook). Plans are to stock Las Vegas Bay/Lake Mead with 200,000 pounds of catchable fish a year.

Site Fish and Wildlife

A list of Basic Biota of the site environments, excluding the valley sites, is given in Appendix B.

RARE AND ENDANGERED SPECIES

Rare species are those whose numbers are few throughout their range of habitat. So long as conditions remain stable and favorable, such species may continue to survive in limited numbers. Endangered species are those so few in numbers or so threa-

table 12

SPECIES OF FISH PRESENTLY FOUND IN LAS VEGAS BAY

*Largemouth black bass	(Micropterus salmoides)	Abundant
*Channel catfish	(Ictalurus punctatus)	Abundant
*Black crappie	(Pomoxis nigromaculatus)	Abundant
Carp	(Cyprimus carpio)	Abundant
*Bluegill sunfish	(Lepomis macrochirus)	Common
*Rainbow trout	(Salmo gairdneri)	Common
Green sunfish	(Lepomis cyanellus)	Common
+Humpback sucker	(Xyrauchen texanus)	Common
Western golden shiner	(Notemigonus crypolencas)	Common
German brown trout	(Salmo trutto)	Rare
Black bullhead	(Ictalurus melas)	Rare
+Bonytail chub	(Gila robusta)	Rare
Mosquito fish	(Gambrusia affinis)	Rare
+Colorado River Squaw fish	(Ptychocheilus lucius)	Rare
*Cutthroat trout	(Salmo clarkii)	Common
*Silver salmon	(Oncorhynchus kisutheh)	Common
*Striped bass	(Morone saxatilis)	Common
Threadfin shad	(Dorosoma petenense)	Abundant
Walleye	(Stizostedion vitreum)	Rare

*Important game fish
+Nevada protected list

THREATENED SPECIES LIST

Common Name	Scientific Name	F.R.	B.S.F.&W.
Vegas valley leopard frog	Rana fisheri		T
Gila monster	Heloderma suspectum		U
Spotted bat	Euderma maculata		T
Prairie falcon	Falco mexicanus		T
California brown pelican	Pelecanus occidentalis	E	U
Wood ibis	Mycteria americana		U
American peregrine falcon	Falco peregrinus	E	T
Ferruginous hawk	Buteo lagopus		U
Osprey	Pandion haliaetus		U
Mountain plover	Eupoda montana		U
Long-billed curlew	Numenius americanus		U
Prairie pigeon hawk	Falco columbianus richardsonii		U
Bald eagle	Haliaeetus leucocephalus		T

1 F.R. Federal Register, vol. 38, no. 106. June 4, 1973.
2 B.S.F.&.W. Bureau of Sport Fisheries and Wildlife. Threatened Wildlife of the United States, 1973

E Endangered
T Threatened
U Status uncertain

table 13

tened by present circumstances as to be in danger of extinction.

Regional Rare and Endangered Species

There is no known rare or endangered plant species list compiled for the Las Vegas region. However, future research in the region may identify some species as needing this classification.

The U.S. Bureau of Sport Fisheries and Wildlife has updated the Federal publication of rare and endangered wildlife. The 1973 publication is entitled "Threatened Wildlife of the United States" and no longer categorizes wildlife as rare or endangered. As a result of changes in the status of several wildlife species inhabiting the Las Vegas region, 13 species are now considered threatened or of undetermined status.

In its previous publication, Number 34, "Rare and Endangered Fish and Wildlife of the United States" (Red Book), the Bureau lists the Merriam elk as the only species to become extinct in the Lower Colorado Region. Classified in the "Red Book" as "rare" forms of mammals found in the Region are the spotted bat and Kaibab squirrel. Rare fishes include the Virgin River spinedace and wound fin. The Vegas Valley leopard frog is listed as rare in the amphibian class.

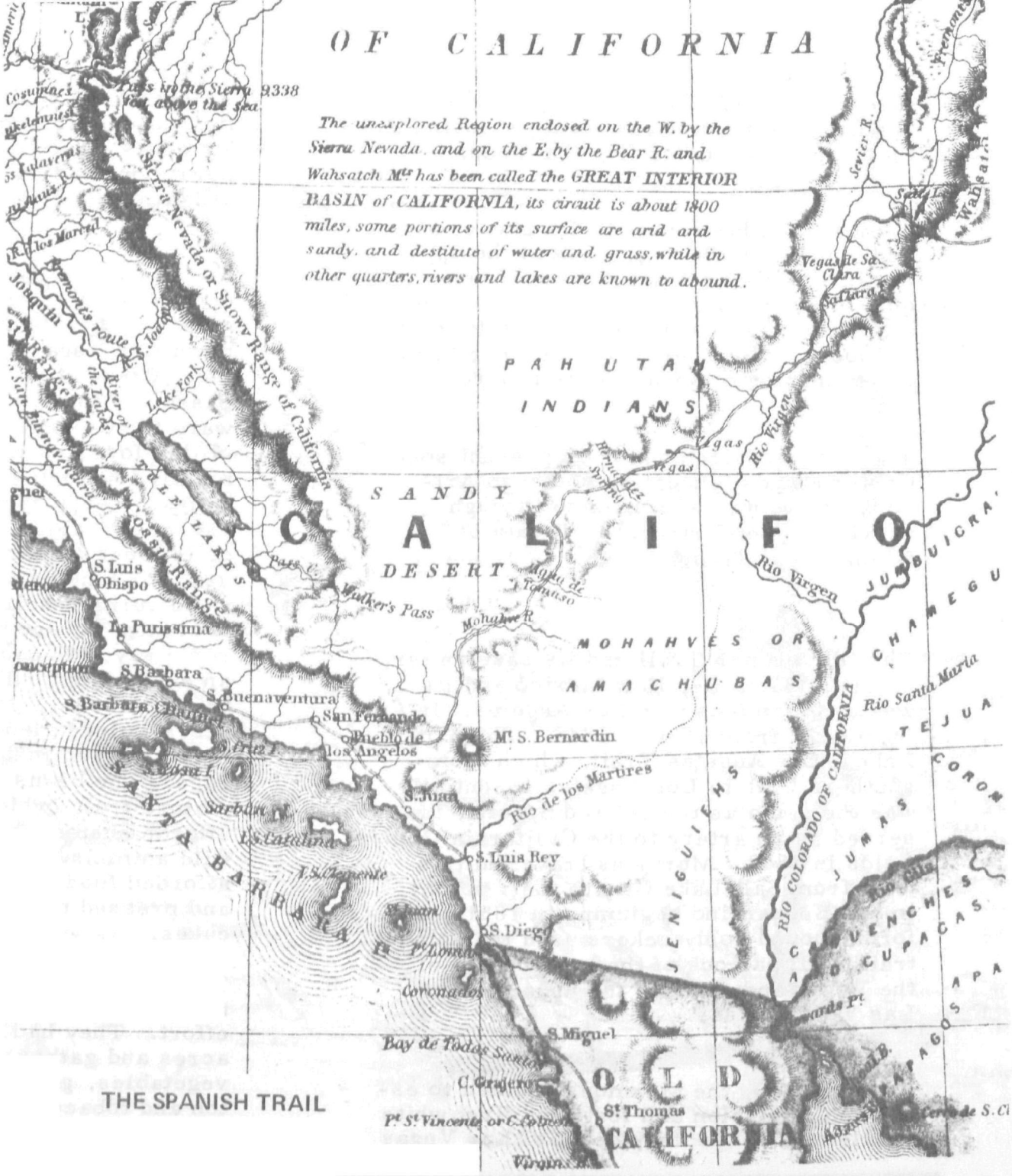
The "Red Book" lists eight "endangered" species in the Lower Main Stem Subregion. The one endangered mammal is the Sonoran pronghorn. Three birds are listed; the American peregrine falcon, the Yuma clapper rail, and the southern bald eagle. There are four fishes classified as endangered; the Arizona (Apache) trout, the humpback chub, the Moapa dace, and the Colorado River squawfish.

HISTORICAL BACKGROUND

Before the first European came to Las Vegas Wash in the winter of 1829-30, only the nomadic Southern Pahutes (Root Diggers or Pah Utah Indians) disturbed the Wash. These nomadic Indians from the nearby mountains and the Colorado River passed through on occasion and there were apparently no permanent settlements in the region. The chief attractions were the cool waters of Las Vegas Spring and the long stringed beans of the native Mesquite trees that grew in Las Vegas Valley at the upper end of the Wash.

The apparent first intrusion by Europeans into Las Vegas Wash was by a caravan entering the Wash on January 7, 1830. Rivera, a scout who rode alone and ahead of the caravan, very likely entered Las Vegas Wash about a week before when he was looking for a possible short cut for the party.

John Charles Fremont, the noted explorer and pathfinder, came to Las Vegas Wash on May 3, 1844. He commented on the springs of Las Vegas, situated in the middle of Las Vegas Valley, "With a tempera-



THE SPANISH TRAIL

ture of about 72 the springs gushed forth suddenly with a quick current producing two clear springs four or five feet deep."

Fremont, in his report to Congress, also commented on the vegetation at the upper end of Las Vegas Wash, "There were mesquite trees with their yellow flowers and a colored assortment of spring wildflowers in bloom." He also recorded a number of other species of shrub in his report.

The U.S. acquired all of its present southwestern lands (excepting southern Arizona) in the war with Mexico through provisions set forth in the Treaty of Guadelupe Hidalgo in 1848.

The Old Spanish Trail had its eastern terminus at Santa Fe, New Mexico and its western terminus was Los Angeles. It functioned from 1830 to 1848. The Salt Lake - Los Angeles Trail, which from southern Utah to Los Angeles essentially was the same as the retired Spanish Trail served as an artery to the California Goldfields in 1849. Mormons travelled this trail from Salt Lake City to their colony in San Bernardino beginning in 1851. California-bound gold seekers used the same trail. All partook of the cool waters of the Vegas and crossed the upper end of Las Vegas Wash.

In June 1855, the Mormons decided to establish a mission and fort, the first white settlement in the very heart of Las Vegas Valley on the route of the Salt Lake Trail. By that date this spot had become well known as a good place to rest and recuperate on the trek between centers of civilization.

To the east of the fort were farm and garden plots. Beyond them, was a vast mesquite forest extending from the fort down Las Vegas Wash to the base of Sunrise (Frenchman) Mountain. The forest passed by that mountain and spread out toward the Colorado River. On either side of this forest of mesquite was desert -- mostly low forms of plant life and sagebrush. There were no trees in those areas except occasionally mesquite. The mesquite trees closer to the fort were cut and used for fencing and for fuel. Mesquite wood burns readily, even when it is green. It creates a very hot fire, and as a fuel, some say it is equal to hickory. It is also an exceptional building material. The trees blossom late in spring; the fruit appears in long slender beans from which Mexicans and Indians made a cool beverage. The beans ripen in early fall; the mature fruit, which falls to the ground, affords sustenance to small birds and wild animals. The highly nutritious pods afforded food for the Indians, who crushed and pressed the beans into delectable cakes.

The Mormons abandoned their Las Vegas mission in 1857 after only two years of effort. They had cultivated nearly 150 acres and gathered some fair crops of vegetables, grains, and even some cotton and tobacco. Clearing away tracts of land proved to be an immense job

LAS VEGAS WASH – 1866

figure 22

because of the presence of saleratus -- alkali in the soil. This saleratus, or sodium bicarbonate (baking soda), appears on the top of the ground in many areas of Las Vegas Wash after a rainstorm. It bubbles up like fizz water, and leaves a coating on top of the ground which is known as alkali. After the Mormons left in 1857 (some stayed until 1858), the trail between Salt Lake and

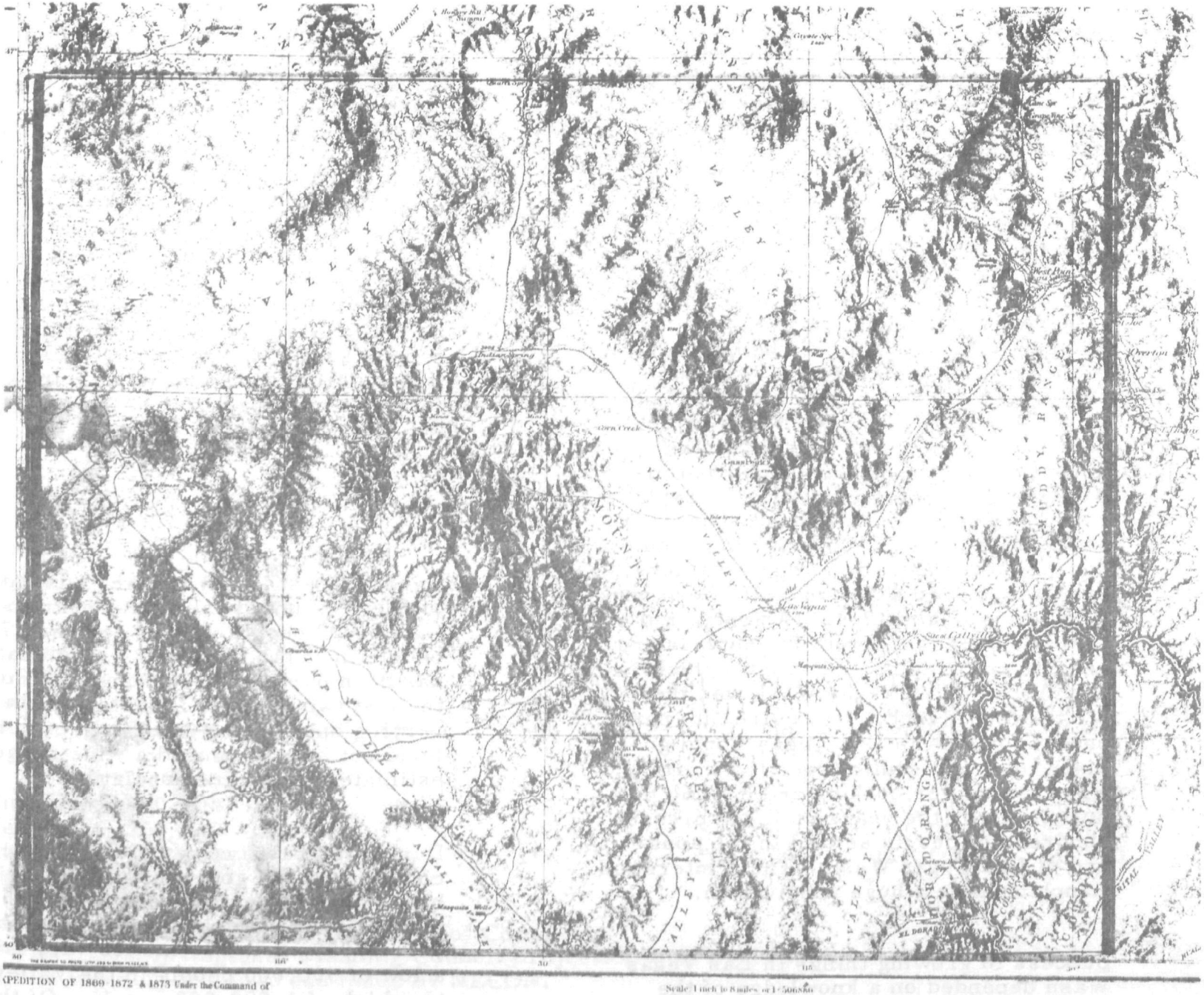
Los Angeles was busier than ever. Mormon missionaries, emigrants, mail riders, freighters and others all passed through the upper end of Las Vegas Wash and stopped at the welcome springs of Las Vegas. This was an all-year travel route, as opposed to the one through northern Nevada and northern California, which was snowbound in winter.

During 1859-1865, several settlers took up land in Las Vegas Valley for ranching and farming. They sold their surplus to travelers on the Salt Lake Trail and to miners who began working at the nearby Potosi and Eldorado Canyon mining districts. Early in 1865, Octavius Gass and two partners began to rebuild the old Mormon farms at the upper end of Las Vegas Wash but, within a few years, Gass bought them out, and by owning all of the local water, he became a virtual king of the valley. Early in 1868, as owner of the ranch, Octavius Gass tried to sell his holdings. In an advertisement in the Rio Virgen Times in Saint George, he described the soil in the upper Las Vegas Wash as a black rich loam that would produce vegetables or grains in abundance. In 1969-1970, Stanley H. Paher conducted oral interviews with the son of Octavius Gass, who recalled living at Las Vegas Ranch. He said that the dark soil was indeed good, especially for the growing of pink Mexican beans, as well as truck produce. This son, Fenton Gass, also noted the lush green belt that extended in the direction of Henderson, and further described Las Vegas Wash as a wet area with moisture.

Nevada's State Mineralogist visited Las Vegas Valley in 1871, and filed this report:

"The most productive and valuable tract of land in Las Vegas Valley is near its center, where is situated the Las Vegas Ranch... There are several hundred acres of very rich land here, though only about 150 acres are tilled. This portion of it is well fenced, and improved with shade and fruit trees. The orange, lemon, peach, apple, pear, apricot, fig and pomegranate are some of the varieties of fruit trees. Grapes also grow... the mesquite bushes, of which there are many in the valley, furnish a very nutritious bean, which all animals feed upon as soon as the grasses die in the fall. Stock keeps as fat upon this feed during the winter months, as though fed upon the best of hay and grain."

Gass sold out Las Vegas Ranch to Archibald Stewart in 1881; in 1902 the widowed Mrs. Stewart sold most of the ranch and water rights to the San Pedro Los Angeles and Salt Lake Railroad, which built a railroad across the Valley and



XPEDITION OF 1869 1872 & 1873 Under the Command of

figure 23

LAS VEGAS VALLEY – 1871

upper end of Las Vegas Wash during the winter of 1904-05. Connected with the sale, a local surveyor named J. T. Mc Williams, surveyed the Ranch in 1904. This was in preparation for the surveying of Las Vegas Townsite, which was auctioned on May 15, 1905. In 1905, when designated as a major division point of the Union Pacific Railroad, the City of Las Vegas was founded.

Las Vegas attained a population of about 800 by 1910. By that date homesteads of ranches and small farms flourished throughout the Valley, including in Las Vegas Wash. Development was naturally slow because it took several months to uproot mesquite and sagebrush and prepare the ground for cultivation. Exploration began for underground sources of water once the Las Vegas Springs could not meet the demands of homesteaders. Several hundred artesian wells were sunk between 1907 and 1914. (Artesian wells flow spontaneously from the surface and require no pumping). Probably the largest ranch in Las Vegas Wash was the Winterwood Ranch. It acquired its name because people in Las Vegas would go there to cut mesquite trees for their winter wood for cooking and heating purposes. Over the years until the present, hundreds of people settled in the upper end of Las Vegas Wash. The Winterwood Ranch became a huge subdivision.

Success in growing things in Las Vegas Wash depended on a knowledge of the Wash's soil and water make-up. The Mormons had encountered the alkali (saleratus), as did the builders of Las Vegas Stadium, which is situated in the heart of the Wash. Las Vegas remained a railroad and agricultural service center until 1931 when gambling was legalized. Growth began with the construction of the Hoover Dam and the formation of Lake Mead. There is probably nothing of historical (tangible) significance in Las Vegas Wash, except for the ruins of the so-called Mormon fort in the City of Las Vegas, at the extreme upper end of the Wash. The building of subdivisions and roads have greatly defaced the upper end of the Wash, and it may well be impossible to find additional ruins of former structures of the Mormon Mission and Las Vegas Ranch.

POPULATION

Over the past fifty years the population of Clark County has increased from less than 5,000 people in 1920 to over 270,000 people in 1971. The high growth rate has been particularly pronounced during the last two decades. Rapid growth and varying opinions as to when growth may level out have produced a wide range of estimates for future population.

During the past two decades, planners, consultants and governmental agencies have made projections of the growth in population for Clark County. For the year 2,000, these estimates vary from a low of 500,000 people in the Valley to a high of 1,500,000 people. Of these projections, only the report entitled "Population Projections, Clark County,

HISTORICAL AND PROJECTED POPULATIONS OF THE LAS VEGAS VALLEY AND CLARK COUNTY, NEVADA

YEAR	CLARK COUNTY	LAS VEGAS VALLEY	POPULATION COMPONENT OF LAS VEGAS VALLEY			
			LAS VEGAS	UNINCORP-ORATED AREA	NORTH LAS VEGAS	HENDERSON
HISTORY*						
1920	4,859					
1930	8,532					
1940	16,414					
1950	48,289					
1960	127,016	122,957	64,405	27,605	18,422	12,525
1970	273,288	268,065	125,787	89,667	35,216	16,395
PROJECTIONS**						
1973	331,700	316,725	135,355	122,320	41,400	17,650
1980						
Minimum	420,000	403,000	185,000	144,000	55,000	19,000
Medium	435,000	421,000	190,000	152,000	58,000	21,000
Maximum	460,000	446,000	202,000	159,000	61,000	24,000
1990						
Minimum	560,000	530,000	244,000	187,000	76,000	23,000
Medium	600,000	565,000	262,000	196,000	82,000	25,000
Maximum	650,000	621,000	284,000	214,000	91,000	32,000
2000						
Minimum	700,000	661,000	275,000	274,000	86,000	26,000
Medium	750,000	700,000	295,000	284,000	91,000	30,000
Maximum	850,000	805,000	335,000	309,000	111,000	50,000

*Bureau of the Census, Department of Commerce
** Clark County Regional Planning Council projection with modification to North Las Vegas and unincorporated areas made by NECON.

table 14

Nevada 1980-2000" prepared by the Clark County Regional Planning Council (CCRPC) has been approved and adopted for utilization among the local governments within the regional planning jurisdiction. The distribution of population within the County by the year 2000 is still open to question. The CCRPC has calculated that if the median projection of 750,000 people were to inhabit Clark County in 2000, 93% (700,000) of the population would be in the Las Vegas Valley. Extrapolating these population components for the Las Vegas Valley out, 295,000 people would be in the City of Las Vegas, 284,000 would be in the unincorporated areas, 91,000 would be in North Las Vegas and 30,000 would be in Henderson.

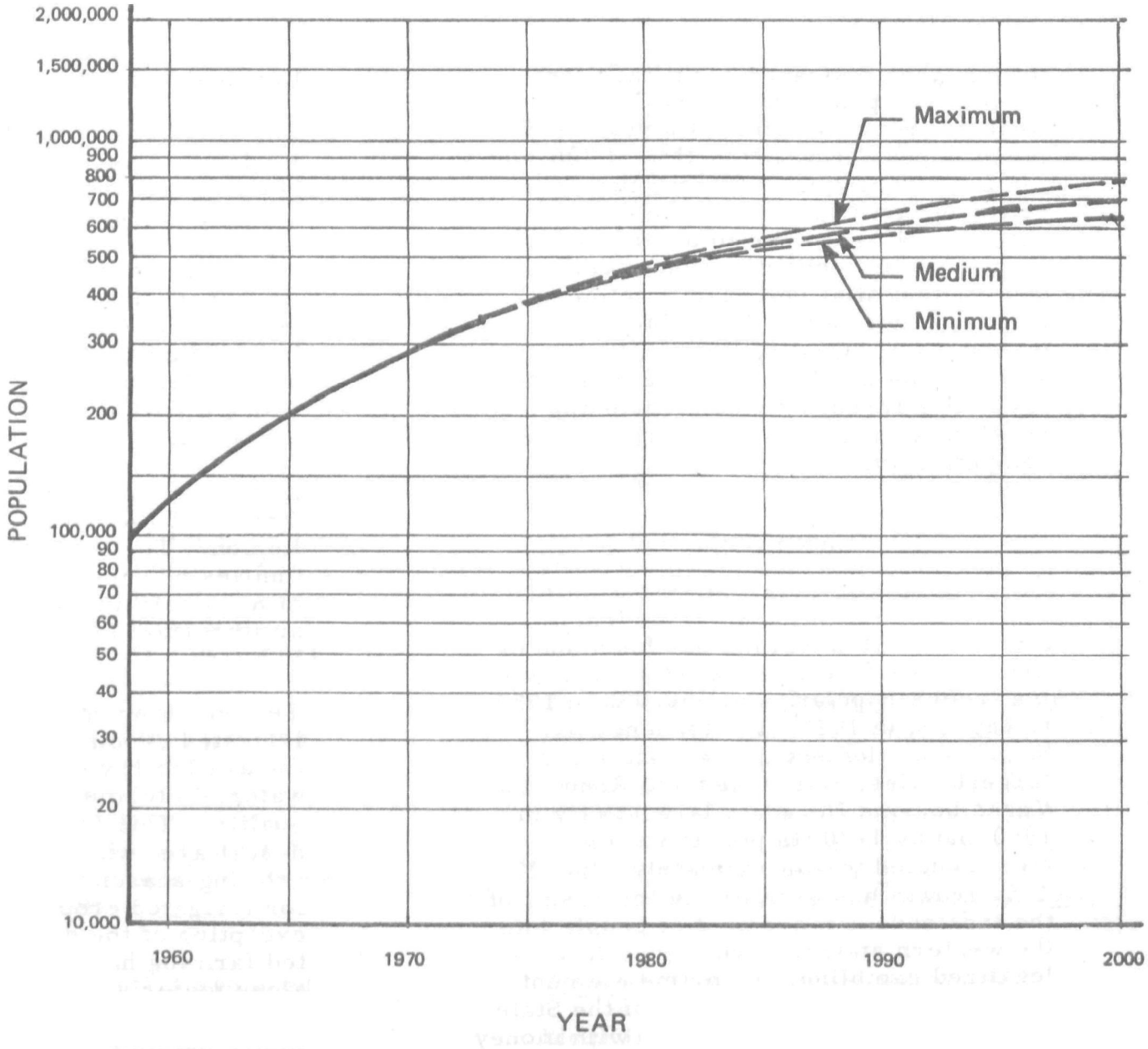
The distribution of permanent population within Las Vegas Valley is based on CCRPC staff estimates with some modifications by the engineering consultants, Nevada Environmental Consultants (NECON), to reflect changes in population distribution between the City of North Las Vegas and the unincorporated area. This modification is made to adjust for a recent annexation annulment.

Annexations, governmental consolidations or the development of totally planned communities, similar to that currently being considered in Henderson, could materially affect the distribution of population among the various governmental jurisdictions. Recent demographic projections for the City of Henderson suggest that the city population could approach 44,000 people by the year 2000, and that the new planned communities of Green Valley and Lake Adair could increase the population of the Henderson area to 159,280 by 2000. Henderson presently represents approximately 5.4% of the total Las Vegas Valley population, and is projected to maintain 4.3% of the Valley population in the year 2000 based on CCRPC figures. If future populations shifted to the Henderson area, this distribution percent could change significantly.

In addition to the permanent population, there is present in the Las Vegas Valley a large transient population. A substantial portion of demand placed on public services comes from this tourist and transient segment. Transient population for 1973 showed a winter low of about 29,000 people, a summer high of about 57,000 people and a daily average transient population of about 45,400 people.

Limited data on transient population suggests that the total population in Las Vegas Valley at any one time will be about 109% of the permanent population during winter months, about 118% during summer months and, on the average, about 114% of the permanent population. Generally speaking, each unit of government believes it will attract a somewhat larger portion of the total growth than has been shown by the distribution on Table 14.

Throughout the formulation of the 1974 Wastewater Management Project sub-



SOURCES:
1. Bureau of the Census, Department of Commerce
2. Clark County Regional Planning Council
3. NECON

figure 24

HISTORICAL AND PROJECTED POPULATION CURVE FOR LAS VEGAS VALLEY, NEVADA

mittal, the applicant has utilized for planning purposes the Clark County Regional Planning Council's year 2000 medium population projection of 700,000 for Las Vegas Valley. Since the ultimate sizing of facilities may not necessarily reflect this figure due to other environmental quality considerations (i.e., air quality assimilative capacity to meet standards within the Clark-Mojave-Yuma Interstate Air Quality Control Region), EPA will be continually reevaluating this projection through its other planning and regulatory programs for environmental compatibility.

LAND USE

Since the 1950's Nevada has been one of the Nation's fastest growing states, moving from a population of 160,000 in 1950 to 489,000 in 1970. The tendency has been for settlement in the State's two largest cities, Las Vegas and Reno. Las Vegas became Nevada's largest city in 1960 and by 1970 its population had almost doubled to approximately 126,000. This growth has been partly the result of the tremendous movement of people into the western states. Ever since Nevada legalized gambling, the prime element in the economic development of the State was established. Americans, with money and free time, have made the Las Vegas area of Clark County principally a recreation center and use of the land has been to satisfy the needs of recreational pursuits. With tourism as the main industry, mining and agriculture have become secondary.

Regional Land Use

The land area of the Lower Colorado Region is classified as cropland, rangeland, forest and woodland, urban, and a small acreage is for miscellaneous use. Land ownership within the Region is unique in that more than half is in public ownership and only a small percentage is private. About half the private land is in Indian trust. The bulk of the land in this Region is in pasture and range with a small percentage in urban, transportation, utilities, etc.

Recreation and tourism have grown into a multimillion dollar industry in the Region. The outdoor recreation opportunities provided by the forest, mountain, desert and water areas have been an important factor in this expanding industry.

The location and amount of the Region's irrigated cropland area is determined by the availability of suitable irrigation water, in terms of both quantity and quality. This is especially true in the desert area where the nearly year-long growing season makes this area ideal for irrigated crop production. With the exception of the desert areas, irrigated farming has developed primarily along major streams where soils are productive, have uniform slopes, and where suitable water is available.

The range resource contributes substantially to livestock production, long one of the major industries, within this Region. Two broad types of rangeland are used for grazing: ephemeral and perennial.

The ephemeral rangeland is in the desert below the elevation of 3,000 feet. The average annual precipitation is less than 8 inches; however, precipitation varies widely from year to year. Large volumes of annual grasses and forbs, which provide good livestock forage, are produced during above-normal spring and summer rains. The perennial-type rangeland provides a more dependable, perennial-type forage. More precipitation at higher elevations increases forage quantity and quality in these areas above 3,000 feet elevation.

Timberlands can be found on national forests, on Indian reservations, on land owned by states and counties, by farmers and ranchers, or owned by timber companies and other private operators. Growing stock suitable for saw timber, paper pulp, poles, fuel, and other forest products are the main timber products. The commercial forest lands provide some of the better livestock ranges. They provide important habitat for wildlife and coldwater fisheries. The commercial forest areas are popular for recreation, and their natural beauty has important scenic value.

Lands within the Region that are used for military and related purposes, consist of 0.5 million acres in Nevada. A small percentage of these lands is in areas suitable for urban expansion and/or surrounded by intensively used agricultural land. The majority of these lands are barren desert or semi-arid mountainous terrain.

Urban and industrial developments occupy a small percentage of land in the Region. Individual developments range in size from the acreage of Las Vegas to small unincorporated towns of less than a square mile. In general, these lands are not compatible with other uses; with the exception of recreation use. The larger urban developments have recreation areas reserved within their boundaries.

Although low-grade mineral deposits occur over large areas, a very small percentage of the Region's lands are actually used for mineral production. While small in size, these lands are intensively used. Their economic importance is great; their compatibility with other uses is small; and they are, almost entirely, in private ownership.

Transportation and utilities have kept pace with the rapid regional growth. Land used for roads, railroads, and airports is generally excluded from other land uses, but telephone, canal, electric power, and pipeline rights-of-way often modify existing uses and may produce benefits not previously present.

Watershed Management Problems

More intensive use of the land resources has created a multitude of watershed management problems including: increased soil erosion, accelerated sediment production, reduced productivity, increased flood damage, and degraded water quality. High yielding

mountain watershed lands more and more are regulated for water yield in order to help fulfill the ever-increasing water requirements of the Region.

Sixty percent of the land needs land treatment and management for erosion control and sediment yield reduction. Danger from wildfire on the forest and rangelands usually is present some place in the Region during every month of the year. Problems and responsibilities for wildfire protection and control are multiplying due to the development of small communities, expanding urban, and public use developments scattered throughout the forest and rangelands.

LAND USE IN THE LAS VEGAS VALLEY - 1972

Use	Acres
Single family	16,310
Multiple family	2,820
Commercial	3,570
Industrial	2,080
Public	15,170
Quasi-public	2,650
Parks	2,390
Total	44,990 acres

Source: NECON - Water Quality Management Plan, Draft (March 1973).

Area Land Use

Within the Las Vegas Valley the three major urbanized areas consist of the Cities of Las Vegas , North Las Vegas and Henderson. These cities encompass approximately 162.2 square miles of the 1,800 square miles in the Las Vegas Valley.

In 1968 the Clark County Regional Planning Council adopted the "Coordinated General Plan for the Las Vegas Valley", and a "Land-Use Element - Coordinated General Plan" in 1971. In the Coordinated Plan, future land uses in the Las Vegas Valley were projected from 1975 to 2000 at five year intervals, with the 2000 figures based on an estimated population of 700,000 people.

The City of North Las Vegas is essentially a "bedroom" community to Las Vegas, and also satisfies the urban needs of personnel at Nellis Air Force Base. Nellis Air Force Base is primarily a pilot training facility whose population and growth depend upon the United States Air Force.

Boulder City began as a housing facility for construction workers building Hoover Dam. Incorporated in 1960, Boulder City is unique to this area in that it does not allow gambling. The main "industry" is recreation, Boulder City being five miles from Lake Mead.

PROJECTED LAND USES IN THE LAS VEGAS VALLEY - 2000

Use	Acreage
Low density residential	56,700
High density residential	13,045
Commercial/industrial	30,275
Parks and recreation	9,430
Agricultural	2,000
Total	111,450 acres

Source: Clark County Regional Planning Council, 1973

Henderson began as a housing facility for Basic Magnesium, Inc. during World War II, and is still an industry-based city also providing some tourism and recreational facilities. The Basic Management, Inc. complex, adjacent to Henderson, now houses Stauffer Chemical Company, the Flintkote Company, Titanium Metals Corporation of America, Kerr-McGee Chemical Corporation, Montrose Chemical Corporation of California, State Stove Company and Jones Chemicals.

Since the development of the Las Vegas Valley and portions of the Eldorado Valley, man has ranged into the other valleys of the study area. There has been an attitude of "no value" toward areas of the region not yet developed. Dry Lake, Hidden Valley and Jean Lake and those portions of Las Vegas and Eldorado Valleys not yet developed, have numerous trails cut by car or motorcycle for convenience or sport with no regard for the desert environment. Trash is found piled along many dirt roads. Dry Lake Valley has been used for cattle grazing and contains one small railroad maintenance settlement. Hidden Valley and Jean Lake are also used for cattle grazing, but have very low carrying capacity.

Use of Las Vegas Wash is high and diversified. According to the U.S. Bureau of Fish and Wildlife, there were an estimated 50,000 visits last year, the Wash being used for: motor vehicle recreation, educational field trips, bird watching, hunting, hiking, horseback riding, and dumping. When flying into Las Vegas, the Wash is an immediate focus point for the whole area. From the ground the dense vegetation and vivid green are offset somewhat by the piles of trash and abandoned cars along the periphery of the Wash.

Site Land Use

Ground-water Recharge Well Field and Pilot Desalination Plant

At the present time, there is considerable open space around the Injection Well Field, but it is rapidly disappearing on the eastern boundary. Between Sahara Avenue and Flamingo Road, west of Rainbow Road, is a newly-built housing development. North of Charleston Boulevard, extending to the eastern boundary of the site, is a residential area completely built and occupied. The site is presently bordered by a gravel company to the south and west, the northern border showing no signs of development. Also located on the eastern boundary is a Nevada Power Company substation. Present land use appears to be primarily for scenic, travel and dumping purposes. Charleston Boulevard passes through the study area, leading to the Toiyabe National Forest Area. Large piles of trash are observed in this area along many dirt roads. Much of Section 1 (640 acres) at the experimental recharge well site, has low density housing with a population of approximately 60,000 people. There is some limited commercial development on Sahara Avenue and Decatur Boulevard and an elementary school on West Oakey Boulevard. The alternative sections (2,560 acres) are extensively developed with single and multiple family dwellings, commercial enterprises, schools, and recreation areas. The population approximates 22,000 people.

Much of the land bordering the proposed desalination plant site is presently owned and maintained by the Las Vegas Valley Water District. Numerous groundwater wells are scattered throughout the area. Two 10,000 gallon storage tanks are located at the north end of the site while an electrical substation borders the area on the west. The area has been substantially disturbed in the past and has numerous roads criss-crossing the site. A disjunct wash crosses the site from west to east. Due to an extensive development of the area in the past, storm flows are now diverted to a concrete channel at the west of the site and therefore no longer enter the site.

Waste-water Collection System, Treatment Plant, Deep Disposal Well Field Areas and Sludge Disposal Site

Along much of the route for the collection system the land has been disturbed by man's activities in varying degrees. The proposed route will follow existing highways, dirt roads or rights-of-way along most of the distance. It will also follow a border of agricultural lands.

The site of the reservoir and treatment facilities for Alternatives 1, 4, 6, 7 and 8 is scarred by dirt roads, litter and motor-vehicle tracks. For Alternatives 2, 3 and 5 the site is approximate to a major highway, the Las Vegas Stadium, and a gravel pit operation. Much of the area for the treatment plant in Alternative 10 has been extensively disturbed

or altered by construction activities and cattle and horse grazing. Portions of the area are disturbed by a heavy equipment yarding and other activities.

At the present time there is considerable open space around the site of the sludge disposal ponds. To the east the land rises toward the rugged and colorful Rainbow Garden and Lava Butte area. In areas adjacent to the site, numerous jeep trails and a recent pipeline excavation crisscross and mar the area. The site is bordered to the west and south by Hollywood Boulevard and Telephone Line Road. The Las Vegas Wash is located immediately to the south and west of these roadways.

Lands to be Irrigated

Major lands to be irrigated are existing irrigation lands in the Valley, i.e., parks, golf courses, and greenbelt areas. The irrigation pipeline parallels existing boulevards and avenues and roads. The reservoir and pumping station have four alternate sites with the land being used in a variety of ways. The first location is adjacent to two busy streets. A gas station is across the street with a restaurant located on the diagonal corner. The second is in the parking lot of the Cashman Field and Elks Stadium. Development surrounding this site is residential on the south, the temporary City Hall on the west, the Field and Stadium on the east, and a commercial area on the north. The third site is bounded on two sides by a golf course, and on the third by the Department of the Interior's National Bighorn Sheep Headquarters. A residential area is located across Decatur Boulevard. Across from McCarran International Airport is the site for the fourth reservoir. McCarran is the only development near this site, and it is very scarred and littered. Refer to Figure 6 and Figures 28 through 36 in Chapter 2.

Dry Lake Valley

Located at Dry Lake, in the northeastern portion of the Valley, directly west of the Union Pacific Railroad, is a small occupied settlement, with between 10 and 16 residents. Also located on the eastern side of the Valley is a power line trending northeast to southwest. A major portion of this Valley is publicly owned land, with small scattered areas of privately owned land on the east side of the Valley. The present use of this Valley is for dumping, off-road motor vehicle recreation, enjoyment of scenery and travel. Numerous car and motorcycle tracks are seen crisscrossing the Valley. The immediate environment of dirt roads off the frontage road paralleling the Valley is littered with abandoned cars, washing machines and other assorted trash. Cutting through the easternmost portion of the Valley, running north-south, is Interstate 15, the freeway from Salt Lake City, Utah, Las Vegas and Barstow, California. Travel along this route is moderate. Paralleling this freeway is the main line of the Union Pacific

Railroad. Crossing the south end of the Valley is Highway 93, a sparsely traveled road, leading to Ely. Also located in this Valley are powerlines leading to Las Vegas and to Los Angeles.

There is an existing Desert National Wildlife Range located just west of Highway 93. This area is primarily a refuge for Desert Bighorn Sheep. It is presently proposed to include this area in the National Wilderness Preservation System. The area comes within several miles of the Dry Lake evaporation ponds and the proposed Allen Power Plant.

Eldorado Valley

Located in the northern portion of this Valley, adjacent to Highway 95, is a single ranch and mining operation. The northeastern portion of the Valley which could be affected by an alternative is owned by the City of Boulder City. The remaining lands in the Valley are under the jurisdiction of the Bureau of Land Management. There is little evidence of motor vehicle recreation or dumping in this Valley. The Valley's main use is for power line maintenance, scenic and travel. Highway 95 to Searchlight, Nevada crosses through the middle of this Valley. Located to the northeast side of this Highway is a large pet cemetary which evidences a great amount of use. There are three sets of power lines crossing the Valley, trending east-west, and a power relay station located in the southeastern portion of the Valley.

Jean Lake

All the lands that could be affected in this Valley are under the jurisdiction of the Federal Bureau of Land Management. There are two cattle impoundments with wells located in the study area. The present use of this Valley is for grazing cattle, limited dumping and motor vehicle recreation. Little regard for the desert environment has been demonstrated in this Valley, evidenced by the large amount of overgrazed land, the motorcycle tracks crisscrossing the whole Valley and numerous car tracks. Abandoned cars and some trash are found along the dirt roads at the northern end of the Valley. Highway 91 passes by the extreme northern portion of the Jean Lake area with Interstate 15 directly west of Highway 91.

Hidden Valley

This whole Valley is publicly owned land. Motor vehicle trails crosscross the whole Valley, and it has been heavily overgrazed. There are two cattle impoundments with wells. The Valley is not visible from any road.

HOUSING

According to the U.S. Census figures of 1970, housing in the Standard Metropolitan Statistical Area (SMSA) of Las Vegas, consists of 92,815 year-round units. The construction boom during the last few years has begun to slow although the rise in vacancy factors

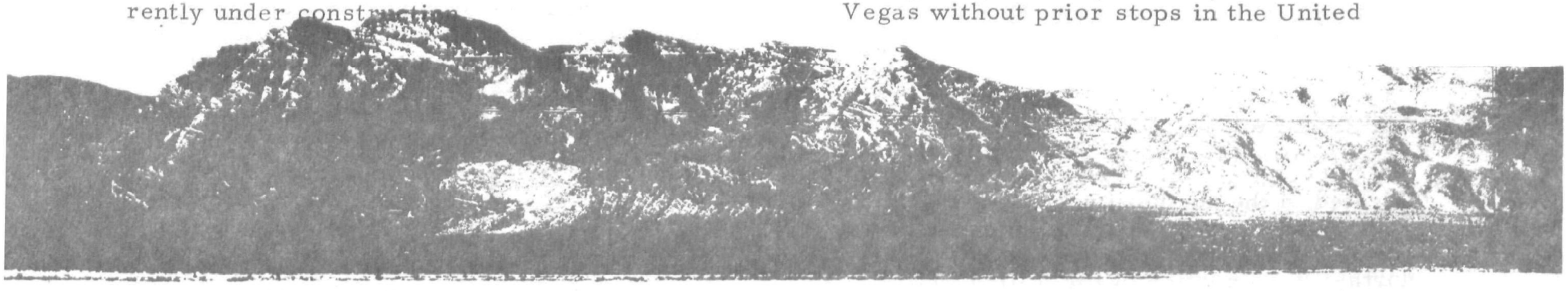
indicates that residential units already available, are enough to fulfill the area's short-term needs. Apartments in the Las Vegas area have climbed to more than 7% vacancy factor. Residential permits for new construction have declined 42.9% in the first quarter of 1974.

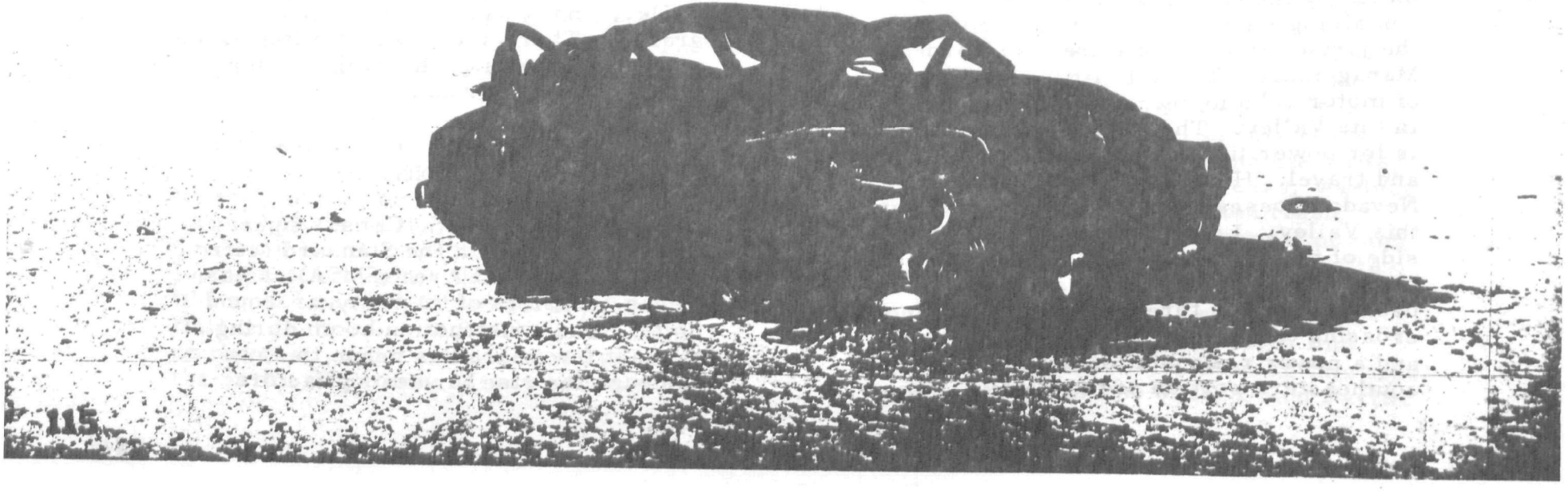
Dollar volume for construction county-wide has shown an increase primarily due to the expansion of tourist-oriented facilities. According to statistics for 1974, the Las Vegas expansion continues with 3,330 hotel and motel rooms currently under construction.

TRANSPORTATION

Excellent transportation facilities service the Las Vegas Valley. Passenger transportation in all forms has been emphasized in recognition of the many available tourist and recreational attractions.

Most of the major airlines serving the West have flights to Las Vegas, including nonstop flights from the east coast and the mid-west. McCarran Field is an "international" airport which permits foreign flights to fly directly to Las Vegas without prior stops in the United





States for customs and immigration control. More than 30% of Las Vegas' eight-and-a-half million annual visitors arrive at the airport, which is served by seven major airlines and various supplemental carriers. McCarran's constant growth relates directly to the rapid population increase and the ever-increasing number of visitors. A thirty million dollar uplift program is due for completion in the immediate future.

Las Vegas is on the main line of the Union Pacific Railroad between Los Angeles and Salt Lake City and offers excellent trans-continental freight service. Community leaders and AMTRAK officials are attempting to revitalize railroad service to Las Vegas. The biggest problem at the present time is the scarcity of operable equipment. This mode of transportation could be a great asset in servicing the Southern California influx as each trip could handle between 600 and 800 passengers.

Bisecting Las Vegas from the north by northeast, is Interstate 15, an extensively controlled network (freeway) that connects Southern Nevada to the rest of the United States. This freeway system extends in the southerly direction through San Bernardino, California where its number changes to I-10 and connects to all points in Southern California. This freeway system accounts for the majority of truck lines and auto traffic into the City. Bisecting Las Vegas from north to south, is the twin system of U.S. 95 and U.S. 93.

An inner city shuttle for the visitor is being contemplated. Moving people on an overhead tram above the congested traffic, it would, if approved, be the only system of its kind in the world. Its sinewy rail would follow a route from McCarran International Airport, along the Strip, to a central point in down-town Casino Center. Stops are proposed at each major resort hotel on the Strip and the Las Vegas Convention Center.

EMPLOYMENT

The U.S. Department of Commerce has prepared employment projections, by industry, for the Las Vegas Valley for the period 1970 to 2020. These projections indicate an anticipated population of 588,200 by the year 2000. The regionally adopted medium population planning projection for Las Vegas Valley is 700,000 by year 2000. Accordingly, the Department of Commerce employment projections have been adjusted to coincide with regionally adopted population projections for the years 1980, 1990 and 2000. Adjusted employment projections are shown on Table 15.

The importance of tourism is underscored by the 1970 employment statistics which show the service industry, consisting principally of hotels, gaming and recreation, to be the top area employer, accounting for 42% of total employment. The next largest employers in 1970 were whole-

table 15

EMPLOYMENT

HISTORY AND PROJECTIONS

LAS VEGAS VALLEY

	HISTORY ① **		PROJECTIONS ② **		
	1960	1970	1980	1990	2000
POPULATION: (Thousands)	123.0	268.1	421.0	565.0	700.0
PARTICIPATION RATIO **	.44	.45	.41	.42	.41
TOTAL EMPLOYMENT: (Thousands)	53.7	121.1	173.5	239.0	287.6
MINING	0.4	0.1	0.1	0.1	0.1
CONTRACT CONSTRUCTION	3.7	7.4	14.1	17.9	21.5
MANUFACTURING	2.6	4.3	11.1	14.7	17.8
TRANSPORTATION AND PUBLIC UTILITIES	3.8	7.3	9.9	13.7	14.2
TOTAL TRADE	8.4	20.7	30.4	43.8	51.4
FINANCE, INSURANCE AND REAL ESTATE	1.4	4.2	7.3	10.8	14.9
SERVICE INDUSTRIES	20.9	51.0	81.2	112.1	137.9
GOVERNMENT	6.2	16.2	19.2	25.7	29.6
OTHER NON-AGRICULTURAL	5.8	9.6	*	*	*
AGRICULTURAL	0.5	0.3	0.2	0.2	0.2

* Included in other numbers on this table.

** All numbers except Participation Ratio are given in thousands; Participation Ratio is the ratio of total employment to total permanent population.

SOURCES: ① Nevada Employment Security Department.

② NECON adjustments to U.S. Department of Commerce projections.

GROSS GAMING RECEIPTS
HISTORY AND PROJECTIONS
CLARK COUNTY

table 16

FISCAL YEAR	CURRENT DOLLARS	CONSTANT 1959 DOLLARS
HISTORY ①		
1959	91,033,938	91,033,938
1960	106,503,378	104,795,216
1961	108,478,255	105,421,045
1962	122,633,158	117,803,226
1963	137,291,416	130,257,510
1964	152,350,481	142,250,068
1965	163,209,101	150,008,365
1966	179,018,338	159,695,217
1967	199,056,250	172,045,160
1968	227,437,087	189,058,260
1969	287,642,376	228,287,602
1970	352,552,000	267,085,000
1971	373,242,526	272,439,800
1972	417,662,387	292,071,595
1973	502,500,000	339,756,590
Average Annual Compound Interest Growth	12.5%	9.5%
PROJECTIONS ②		
1980		365,000,000
1990		545,000,000
2000		715,000,000

SOURCES: ① Nevada Gaming Commission.

② Current Population and Economic Statistics, 1973 by Clark County Regional Planning Council.

sale and retail trade at 17% and government at 13% of total employment.

Gross gaming receipts provide a growth index for the service industry and for the entire metropolitan area. Historic and projected gross gaming receipts for the year 2000 are expected to be 2.68 times that received in 1970. It is anticipated that population during the same period of time is expected to increase by a factor of 2.61. Thus, it is concluded that the services industry will maintain its dominant role through the year 2000. (See Table 16).

In addition to growth precipitated by the service industry, very favorable tax laws are in effect in Nevada which benefit commerce and industry. The "Free Port" law encourages the warehousing and manufacturing of goods "in transit" by granting a tax-exempt status to such goods. This and other favorable tax laws are an inducement to many potential employers and manufacturers.

The Federal government has a number of programs which are quite significant to the economy of Southern Nevada. Most important of these are:

(1) Nellis Air Force Base, a training and development center for military aircraft.

(2) The Atomic Energy Commission's Nevada Test Site, which operates with a large budget. The Atomic Energy Commission operations in Southern Nevada include research and development on nuclear explosives, both war and peace oriented. Among other facilities, the AEC operates the evaporation station near Lake Mead. The Radiological Health Laboratory studies the physiological effects of radiological exposure.

(3) The Lake Mead National Recreational Area.

As of September 1973 total employment was 145,600, only 200 fewer than the all-time record high set the previous month. In September 1972, total employment stood at 132,500. Unemployment totaled about 8,000 persons or a rate just under 6% during September 1973. The rate is down 1% from 1972 figures.

HISTORICAL SITES

Las Vegas was a part of the Arizona Territory when Nevada was admitted to the Union. While it had been a watering place for south-bound emigrants who traveled the Old Spanish Trail, it never distinguished itself except as an outpost of the Mormon colonization movement in 1885. Within the Las Vegas city limits may be found the Mormon Mission on Washington Avenue and the original Springs on Fremont Street. The site of the Old Spanish Trail follows Las Vegas Wash. Much of the area's history is stored in its "ghost towns." They were creations and victims of the mining and railroad industries. A number of old mine shafts are located in Eldorado Valley, among them, the "Goodsprings Mine" of 2899 and the "Nelson Mine" of

1857. The ghost town of Aliunite is between Henderson and Boulder City, while the site of the Potosi is in the Blue Diamond area southwest of Las Vegas. Other ghost towns are in Eldorado Valley but their remains have virtually vanished. Other historical sites in the Las Vegas region consist, for the most part, of old mines and ranches. An example of the latter is the Kyle Ranch, established in the 1880's and located in North Las Vegas on Losie and Carey Streets, (communication with Dr. Roske of the Southern Nevada Historical Society). Throughout the Region, artifacts are found of the area's past Indian culture.

The archaeology of the Las Vegas Valley and surrounding areas is little known. No major archaeological investigation has been undertaken within this area for more than five decades. (The one exception to this is the Tule Springs expedition, which was uniquely unsuccessful in finding archaeological remains, probably due to the locality of the major excavations.) Archaeological investigations in neighboring areas, and unpublished investigations undertaken in the general area of Las Vegas Valley indicate that archaeological resources may be plentiful and important in the areas to be affected by any one of the alternate plans. There were at least five periods of occupation in the Mojave Desert, all with distinct cultural expression and all are probably represented in archaeological remains in Las Vegas Valley and adjacent areas. These periods are briefly discussed below:

Period 1. Early Man

These cultural remains are represented by finds at Tule Springs, where a few artifacts were recovered by excavators from deposits dated between 10,000 and 12,000 years ago. Elsewhere in the Mojave Desert cultural remains from this period are found on the margins of dry lake beds similar to Jean, Hidden, Eldorado, and Dry Lake beds. Occupation also believed to date from this period is often found on higher level surfaces and is known from Whitney Mesa and margins of Las Vegas Wash.

Period 2. Pinto Culture

This culture apparently dates between 9,000 and 4,000 years ago, and is represented by surface finds at Tule Springs and at Corn Creek Dunes. Remains of the Pinto Culture are found along extinct water courses and less often around dry lakes, springs, and occasionally elsewhere in what now appear to be places that are unlikely to be occupied by man lacking highly developed technology.

Period 3. Gypsum Culture

Gypsum culture dates from 4,000 to 1,500 years ago. This culture is known from Gypsum Cave and a number of sites elsewhere in the Mojave. These are mostly rock shelters or middens near springs and streams that were flowing during

historic times. Some materials resembling those of this period have been reported by amateurs and recently by college students from Eldorado Lake and Paradise Valley.

Period 4. Pueblo Occupation

This occupation dates from 1,500 to 800 years ago and it characterized by Pueblo remains in the Las Vegas Valley. Sites dating from this period are known to be located near historically flowing springs such as Big Springs. They are found in Paradise Valley and in rock shelters at higher elevations around the valley.

Period 5. Paiute Culture

Paiute culture dates from about 800 years ago to the time of European settlement. The Paiute utilized both the valleys and mountains of this area, and their remains are known from Duck Creek and Paradise Valley, near Tule Springs, Bird Springs, and numerous small sites at higher elevations.

It is likely that most, if not all, of these cultural periods known for the Mojave Desert and Las Vegas Valley would be represented by sites on the alternate routes proposed by the Las Vegas Valley Water District. The archaeological remains are nonrenewable resources.

RECREATION

All within 100 miles of Las Vegas, are more than 48 public and private campgrounds, totaling 3,588 individual campsites. These are operated by the U.S. Forest Service, National Park Service or the Nevada Park System.

Lake Mead National Recreation Area, fourth largest in the National Park System, with the biggest accommodation of campsites, is just a half-hour drive from the casinos. Formed by monolithic Hoover Dam and fed by the Colorado River, the lake's 550 miles of shoreline enjoys a twelve-month season. The area encompasses over 3,000 square miles of lake area and surrounding desert environment, and provides both local and out-of-state visitors with fishing, boating, swimming, and other forms of recreation. Nearly 3-1/2 million persons spent one or more days in the Lake Mead area in 1973. As of June 1974, visitors to Lake Mead totaled 326,412 for the month and 1,612,096 for the year to date.

Toward the north end of the lake is the Valley of Fire State Park, a 55,000-acre ecological "museum" and recreation area. Nature began work on the valley sometime around the "Ice Age", when the terrain was still lush green and well-watered. Rock carvings found in the vicinity date Indian civilization as far back as 1,500 B.C. Camping and picnicking sites, like the roads, are designed, located, and oriented to offer both intimacy and a panoramic view of the valley.

Away from the desert terrain, and jutting skyward from the floor of the arid Amargosa Desert, stands 12,000-foot Mt. Charleston, only an hour's drive from downtown Las Vegas. In the winter time the verdant slopes become a playground for skiers. New facilities in the area have made it the fastest growing recreation outlet in Southern Nevada.

Nearly every major hotel boasts championship tennis courts and/or golf courses. Spectators are treated to major golf and tennis tournaments, most having celebrity rounds. With the almost constant sunshine, swimming and sunning around the hotel pools are an intricate part of Las Vegas by day.

Visitor and Visitor Use - 1973

Lake Mead Recreation Area - 5,534,515
Hoover Dam Guided Tours - 638,315
Mount Charleston - 459,600
Valley of Fire - 232,000
Valley of Fire Visitor Center - 60,000
Lost City Museum - 181,000

In addition, the Bureau of Land Management (BLM) administers over 3 million acres of public lands (greater than 51% of the land in the County) within Clark County. Approximately 183,250 acres of this BLM land has been classified as having recreational, protective or scenic qualities.

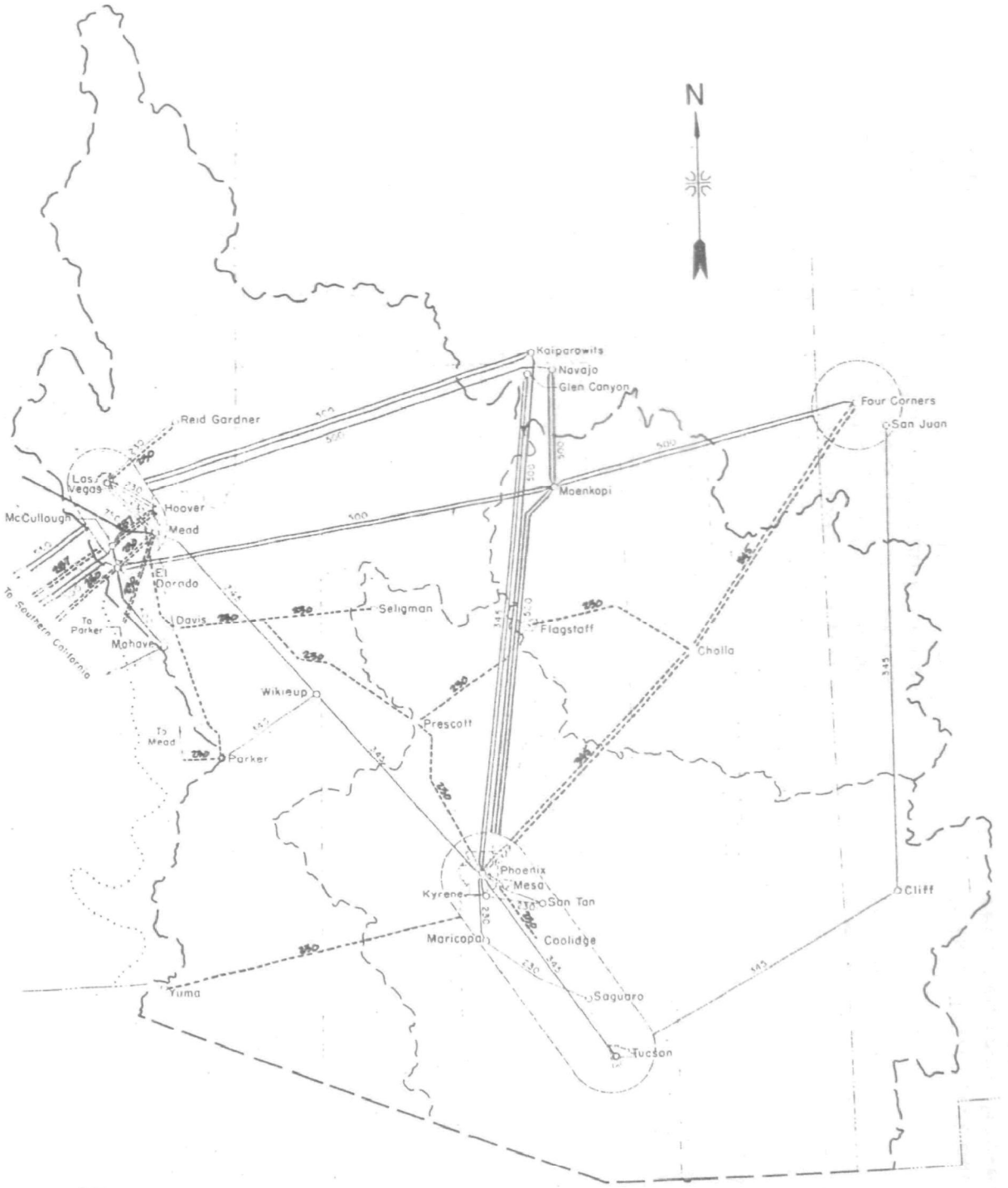
UTILITIES

The Southwest Gas Corporation, a Las Vegas-based natural gas utility which serves Nevada, California, and Arizona, increased its revenues during 1973 by 11% over the previous year. The 1974 customer growth pattern is expected to continue with the addition of nearly 8,000 residential and commercial customers with most of the increases in the utility's Southern Nevada Division. Natural gas usage during the year 1973 for gas sales (1,000 cu. ft.) was 40,681,508, and customer accounts totaled 48,328.

The Nevada Power Company is an investor owned utility development. In 1929 the Consolidated Power and Telephone Company became known as the Southern Nevada Power Company. The name was subsequently changed to Nevada Power Company in 1961.

The directors of the old company were instrumental in adding the "Nevada Amendments" to the Swing-Johnson Act which gave Nevada the right to share in the water, power and revenue from Hoover (Boulder) dam. This source of 263 million kilowatt-hours and 87,375 kilowatts served the electric needs of Las Vegas for the next 16 years.

It is well to point out that the energy received from Hoover Dam, which represented 100 percent of the requirement in 1953, represented in 1970 only about 11 percent of the company's total needs.



Notes

1. No attempt has been made to forecast either additions or deletions of transmission facilities of less than 230 KV.
2. Transmission lines simplified in congested areas.

LEGEND

TRANSMISSION LINES	PROJECTED AS OF 1980	AS OF JUNE 30, 1965
750 KV		
500 KV		
345 KV		
287 KV		
230 KV		
CONNECTING LINES		
CROSSOVER LINES		

PRINCIPAL TRANSMISSION LINES
YEAR 1980

20 0 20 40 60 80
SCALE OF MILES

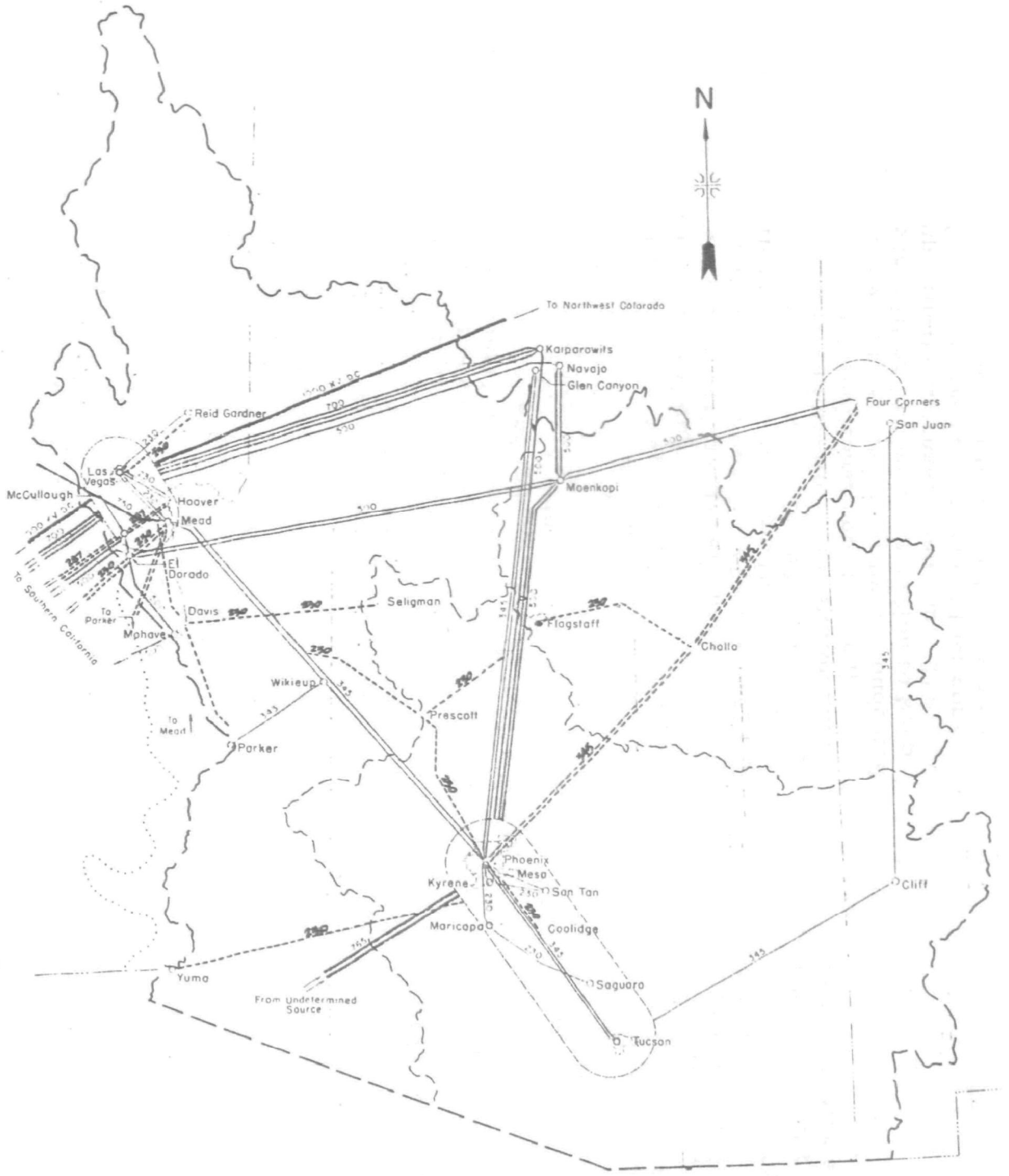
figure 25

In 1955 the company added its first gas-fired steam electric generating unit and plant of 50,000 kw. At the end of 1965 the company was operating a total of three steam generating stations and a diesel peaking plant to serve customers within the Las Vegas area.

The Las Vegas Division of the Company shows an 11% electric energy use increase in 1973 over the previous year and its growth plans go well into the 1980's to keep up with the demand of electrical energy usage. The electric utility has already added to its producing capabilities once in '74, as a participant in the Navajo Power Project in Northeastern Arizona, as it will also do in 1975. Electric energy during the year 1973 for sales (1,000 Kilowatt-Hours) for residential was 1,792,688, commercial and industrial 1,983,701 and other 290,422. Customer accounts totaled 108,088.

The Southern Nevada Division of Central Telephone Company is kept in a constant state of growth as its telephone in service increased nearly 12% over 1972 (this figure includes four smaller companies in outlying areas). In 1974 Central Telephone is anticipating main station gains of 23,000 additional units; in conjunction with this, the company has budgeted $28 million in new construction to keep up with the increased demand. The five-year forecast indicates that construction expenditures will remain on the same yearly level. In 1974 the downtown office cut in a 10,000-line electronic switching systemto provide for anticipated growth in the downtown area. Telephones in service during the year 1973 for the Southern Nevada Division of the Central Telephone Company was 254,978, and for the Continental Telephone Company of Nevada (Henderson) the total was 7,818.

The Las Vegas Valley Water District expects to spend $29 million in the next four years in order to keep pace with the anticipated growth of the community. Land acquisitions will cost about $1.3 million, and reservoir additions are estimated around $8.8 million. Well field expansion will cost approximately $1.9 million and pump station installation costs are estimated to be $2.7 million. A projected $14.3 million will be required over the next four years to install pipelines necessary to adequately serve population increases. If projected population increases materialize, the second phase of the Southern Nevada Water Project will be constructed by early 1980. This phase will double the capacity and will ultimately enable the Las Vegas Valley to recieve full allocation of Lake Mead water. Water during the year 1973 for consumption (thousands of gallons) totaled 26,911,366 and customer accounts totaled 54,013.



LEGEND

TRANSMISSION LINES

	PROJECTED AS OF 2000	AS OF JUNE 30, 1965
1000 KV D.C.	———	
765 KV	———	
700 KV	———	
500 KV	———	
345 KV	———	- - - - - -
287 KV	———	- - - - - -
230 KV	———	- - - - - -
CONNECTING LINES		- - - - - -
CROSSOVER LINES	———	- - - - - -

Notes:

1. No attempt has been made to forecast either additions or deletions of transmission facilities of less than 230 KV
2. Transmission lines simplified in congested areas

PRINCIPAL TRANSMISSION LINES
YEAR 2000

20 0 20 40 60 80
SCALE OF MILES

figure 26

WATER USE

Nevada has little usable surface water; its primary sources of water being ground-water reserves and the Southern Nevada Water Project. The first phase of the Water Project, nearing completion, will provide 132,000 acre-feet annually by pumping Colorado River water from Lake Mead for municipal and industrial uses in the Las Vegas area. Completion of the second stage construction should occur before year 2000 and would utilize most of the remainder of Nevada's 300,000 acre-feet per year share of Colorado River water.

Present depletion requirements for the Subregion total nearly 1.29 million acre-feet annually. Water withdrawal requirements total about 2.98 million acre-feet of which some 90% is for irrigated agriculture. About 19% of these requirements occur in Nevada. Future water requirements in the Subregion show depletion requirements increasing by about a million acre-feet between 1965 and 2020, the largest increases occurring in agriculture and municipal and industrial demands. Significant increases also occur in electric power and fish and wildlife needs. By 2020, Nevada's requirements are projected to rise from 251,000 acre-feet per year to over 715,000 acre-feet, a threefold increase, due primarily to a rapidly growing population.

Present demands on the supply of the Colorado River below Lee Ferry, in addition to the 1.3 million acre-feet of present water requirements within the Subregion, are for main stem reservoir evaporation, channel losses, system spills, exports to the California Region, and Mexican Treaty obligations. The future water supply available to the subregion, without augmentation, is almost entirely dependent on the depletions caused by water resource development in the Upper Colorado River Basin.

Water withdrawals in the lower main stem Subregion show, for the 1965 level of development, gross diversions of about 2.42 million acre-feet annually, including more than a half-million acre-feet from ground-water pumpage. Seventy percent of these diversions were made below Imperial Dam. About 6% of the total withdrawals were identified with uses other than irrigation. The average annual irrigation diversion in Nevada is estimated at about four acre-feet per irrigated acre. Much of the diversion is returned to the River for reuse downstream. Nearly all of the present diversions of surface water from the mainstream of the Colorado River are measured. Off-stream diversions, principally from the Virgin, Muddy, and White Rivers, and Kanab Creek, are minimal. Surface water diversions to the Las Vegas-Henderson-Boulder City area and to the City of Yuma, Arizona represent the bulk of uses for municipal and industrial purposes. Current ground-water pumpage in the Subregion is estimated at about 525,000 acre-feet annually of which about 80,000 acre-feet are pum-

WATER RESOURCE UTILIZATION
1969–1973
LAS VEGAS VALLEY

YEAR	GROUNDWATER (1)*		COLORADO RIVER (2)		WASTEWATER (1)		TOTALS	
	BILLION GALLONS	ACRE FEET	BILLION GALLONS	ACRE FEET	BILLION GALLONS	ACRE FEET	BILLION GALLONS	ACRE FEET
1969	28.26	86,717	10.99	33,731	2.84	8,717	42.09	129,165
1970	27.88	85,555	11.16	34,250	3.07	9,431	42.11	129,236
1971	27.84	85,436	13.39	41,089	3.41	10,454	44.64	136,979
1972	22.84	70,086	21.25	65,208	3.15	9,663	47.24	144,957
1973	22.73	70,063	24.43	74,988	3.07	9,427	50.23	154,478

SOURCES: (1) State Engineer's Office, Division of Water Resources - Las Vegas Valley Water Inventory (Annual Reports, 1969-1973).

(2) Bureau of Reclamation - Compilation of Records in Accordance with Article V of the Decree of the Supreme Court of the United States in Arizona v. California Dated March 9, 1964 (Annual Report thru 1972 and provisional records of the Colorado River Commission for 1973).

* Total amount of water pumped from the Las Vegas artesian basin.

table 17

ped for municipal and industrial use. 72,000 acre-feet is pumped in the Las Vegas Valley.in Nevada, where pumpage exceeds the probable recharge of 25,000 to 35,000 acre-feet annually. Other areas of localized overdraft also exist.

Existing Water Uses and Distribution

Records of 1973 water consumption and waste-water generation were compared with the CCRPC 1973 population estimates to obtain current water use factors. The results of this comparison indicated that the assumptions made for per capita water and waste-water generation used in the 1969 Boyle CH2M Phase II report were sufficiently accurate for the comparisons in which they were used. For the purposes of this study, a more current set of per capita factors were developed for various categories of water usage based upon 1973 flow data and the CCRPC population estimates. Specific categories described are as follows:

Residential and Transient

Parks and Public Facilities

Golf Courses

Agriculture

Heavy Industry

Commercial and Light Industry

Military

Power

WASTE-WATER FLOWS

Waste-water flows for 1973 are shown on Table 20 for each of the more highly developed areas of Las Vegas Valley. The 1973 flows are based upon the measured flows into the City of Las Vegas and the Sanitation District waste-water treatment plants. Flows for the City of Henderson are as estimated by the Henderson Public Works Department and represent the sum of the flows entering Henderson Plants Nos. 1 and 2.

During 1973, the City of Las Vegas waste-water plant treated an average of 31.8 mgd (35,600 acre-ft/yr). This average flow included the 23.1 mgd (25,900 acre-ft/yr) shown for the City of Las Vegas, 4.4 mgd (4,900 acre-ft/yr) from north Las Vegas and 4.3 mgd (4,800 acre-ft/yr) diverted from the unincorporated area. The Clark County Sanitation District treated an average of 13.2 mgd (14,800 acre-ft/yr) which is the balance of the flow from the unincorporated area.

A long term contract between the City of Las Vegas and the City of North Las Vegas calls for the continued treatment by Las Vegas of waste water from North Las Vegas. Diversion of waste-water flows from the unincorporated area to the City of Las Vegas plant is a temporary condition which will be discontinued upon completion of expansions now (1974) underway at the Sanitation District's waste-water treatment plant.

YEAR 1973
WATER USES
AND
SUPPLY DISTRIBUTIONS
LAS VEGAS VALLEY

PARAMETERS	HISTORY FOR YEAR 1973 WITH ESTIMATED JULY 1, 1973 POPULATION OF 316,725 PEOPLE (1)	
	ACRE FEET (2)*	BILLION GALLONS
WATER USED:		
POTABLE WATER USED:		
RESIDENTIAL AND TRANSIENT	90,000	29.32
PARKS AND PUBLIC FACILITIES	9,200	3.00
GOLF COURSES	6,100	1.99
AGRICULTURE	3,000	0.98
HEAVY INDUSTRY	13,600	4.43
COMMERCIAL AND LIGHT INDUSTRY	20,000	6.52
MILITARY	3,200	1.04
TOTAL POTABLE WATER USED:	145,100	47.28
RECLAIMED WASTEWATER USED:		
PARKS AND PUBLIC FACILITIES	-0-	-0-
GOLF COURSES	1,200	0.39
AGRICULTURE	4,500	1.47
POWER	3,700	1.20
TOTAL RECLAIMED WASTEWATER USED:	9,400	3.06
TOTAL WATER USED:	154,500	50.34
WATER SUPPLIED:		
GROUNDWATER WITHDRAWALS	70,100	22.84
COLORADO RIVER DIVERSIONS	75,000	24.44
RECLAIMED WASTEWATER	9,400	3.06
TOTAL WATER SUPPLIED:	154,500	50.34
COLORADO RIVER DEPLETIONS: (Las Vegas Valley only)		
NET DIVERSIONS	75,000	24.44
WASTEWATER RETURNED	-43,000	-14.01
NET DEPLETION:	32,000	10.43

SOURCES: (1) Current Population and Economic Statistics 1973, by Clark County Regional Planning Council. *Rounded to nearest 100 acre feet.

(2) Provisional 1973 records of the Colorado River Commission; Las Vegas Valley Water Inventory, 1973 by the State Engineer's Office; 1973 records of the Las Vegas Valley Water District.

YEAR 2000
WATER NEEDS
AND
SUPPLY DISTRIBUTIONS
LAS VEGAS VALLEY

PARAMETERS	PROJECTIONS FOR YEAR 2000 (1)			
	FOR MEDIUM POPULATION OF 700,000 (2)		FOR MAXIMUM POPULATION OF 805,000 (2)	
	ACRE FEET*	BILLION GALLONS	ACRE FEET*	BILLION GALLONS
WATER NEEDS:				
POTABLE WATER NEEDS:				
RESIDENTIAL AND TRANSIENT	212,800	69.34	244,700	79.74
PARKS AND PUBLIC FACILITIES	10,000	3.26	13,200	4.30
GOLF COURSES	6,000	1.96	6,100	1.98
AGRICULTURE	3,000	0.98	4,000	1.31
HEAVY INDUSTRY	32,200	10.49	32,600	10.62
COMMERCIAL AND LIGHT INDUSTRY	46,900	15.28	53,900	17.56
MILITARY	7,700	2.50	8,900	2.90
TOTAL POTABLE WATER NEEDS:	318,600	103.81	363,400	118.41
RECLAIMED WASTEWATER NEEDS:				
PARK AND PUBLIC FACILITIES	11,000	3.58	11,000	3.58
GOLF COURSES	9,800	3.20	11,800	3.85
AGRICULTURE	8,500	2.77	8,500	2.77
POWER	39,500	12.87	39,500	12.87
HEAVY INDUSTRY	-0-	-0-	4,400	1.43
TOTAL RECLAIMED WASTEWATER NEEDS:	68,800	22.42	75,200	24.50
TOTAL WATER NEEDED:	387,400	126.23	438,600	142.91
WATER SUPPLIES:				
GROUNDWATER WITHDRAWALS	50,000	16.29	50,000	16.29
COLORADO RIVER DIVERSIONS	268,600	87.52	313,400	102.12
RECLAIMED WASTEWATER	68,800	22.42	75,200	24.50
TOTAL WATER TO BE SUPPLIED:	387,400	126.23	438,600	142.91
COLORADO RIVER DEPLETIONS: (Las Vegas Valley only)				
NET DIVERSIONS	268,600	87.52	313,400	102.12
WASTEWATER RETURNED	-54,400	-17.72	-65,700	-21.42
NET DEPLETION	214,200	69.80	247,700	80.70

SOURCES: (1) Projections by NECON Staff.

(2) Population estimates by Clark County Regional Planning Council Staff.

* Rounded to nearest 100 acre feet.

table 19

DOMESTIC AND COMMERCIAL AVERAGE DAY WASTEWATER FLOWS PRESENT AND PROJECTIONS

YEAR	LAS VEGAS VALLEY	WASTEWATER FLOW COMPONENTS OF LAS VEGAS VALLEY			
		LAS VEGAS	UNINCORP-ORATED AREA	NORTH LAS VEGAS	HENDERSON
PRESENT (1)					
1973					
Per Capita Flow(gpcd)	144	171	133	106	100
Actual Flow (mgd)	46.8	23.1	17.5	4.4	1.8
PROJECTIONS (2)					
1980					
Per Capita Flow(gpcd)	150	175	140	110	105
Minimum Flow(mgd)	60.6	32.4	20.2	6.0	2.0
Medium Flow(mgd)	63.1	33.2	21.3	6.4	2.2
Maximum Flow(mgd)	66.9	35.4	22.3	6.7	2.5
1990					
Per Capita Flow(gpcd)	154	178	145	115	110
Minimum Flow(mgd)	81.7	43.4	27.1	8.7	2.5
Medium Flow (mgd)	87.2	46.6	28.4	9.4	2.8
Maximum Flow (mgd)	95.6	50.6	31.0	10.5	3.5
2000					
Per Capita Flow(gpcd)	157	180	150	120	115
Minimum Flow(mgd)	103.9	49.5	41.1	10.3	3.0
Medium Flow (mgd)	110.0	53.1	42.6	10.9	3.4
Maximum Flow (mgd)	125.8	60.3	46.4	13.3	5.8

SOURCES: (1) Based on Wastewater plant records for 1973 and CCRPC Staff estimates of Population for 1973.

(2) Based on Projected Per Capita Flows by NECON and Permanent Population Projections shown on TABLE

table 20

EXISTING SANITARY FACILITIES

Service Areas

Waste-water collection systems and associated treatment plants serve the majority of the urbanized area of the Las Vegas Valley. Major waste-water systems are operated by the Cities of Las Vegas, North Las Vegas, Clark County Sanitation District, and Henderson.

City of Las Vegas (Including North Las Vegas)

The present waste-water systems of the Cities of Las Vegas and North Las Vegas are considered a combined system because they utilize some common major interceptors and treatment facilities belonging to the City of Las Vegas. The combined systems, now treating the largest amount of sewage in the valley, presently serve nearly all the population of both cities. The treatment facility receives municipal wastes from the sewered portions of the incorporated areas of Las Vegas and North Las Vegas. The undeveloped areas lying within both cities are subject to future development. The extension of waste-water collection facilities to serve this development will be necessary. The areas of present service and proposed future service are shown on Figure 27.

Collection System

The major portion of the sewer system has been installed within the last 20 years. The older sections of the collection system may be experiencing some ground-water infiltration. Most of this can be attributed to poured joint connections for clay pipe. With receding water tables, the effect of infiltration may not be extensive, although perched water from irrigation will undoubtedly continue to infiltrate these older lines.

Population estimates suggest a population approaching or exceeding 400,000 persons by the year 2000. This would require a little over two times the present number of service connections. The system will probably require some future paralleling of major interceptors or the construction of relief sewers.

There are several existing problem areas in the collection system within the city limits. Some of these have been corrected and a number are in process of being resolved by relief connections, a sewer relayment to appropriate depth, etc. At present, additional sewerage facilities are needed in the downtown area due to the construction of high-rise hotels in the past ten years. All of the new high-rise office buildings also have been built since 1964 and current planning includes a downtown convention center. This construction and its related developments require additional, and larger capacity, trunk sewers to handle the expanded uses of the downtown area.

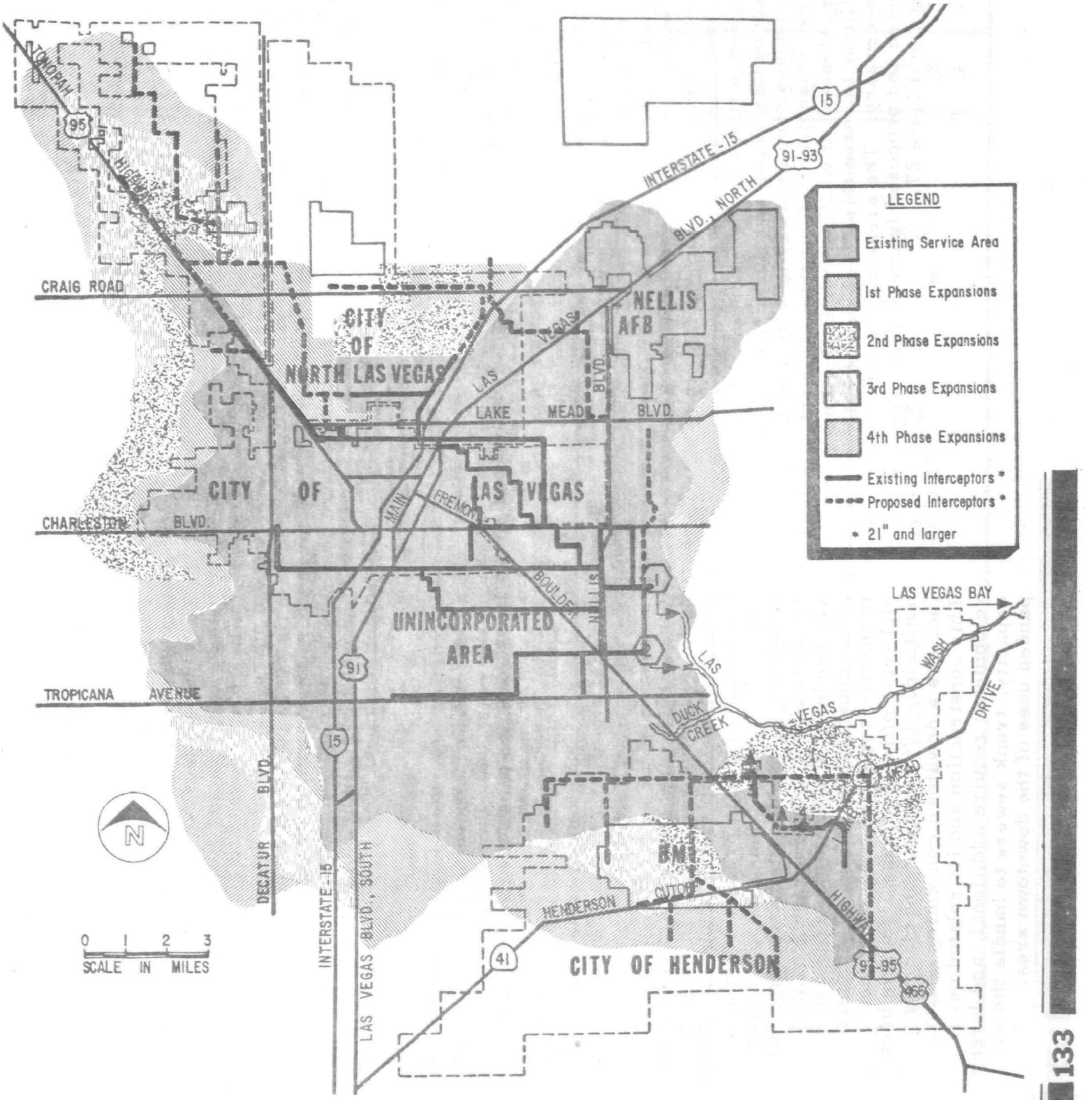

LEGEND
Existing Service Area
1st Phase Expansions
2nd Phase Expansions
3rd Phase Expansions
4th Phase Expansions
Existing Interceptors *
Proposed Interceptors *
* 21" and larger
CRAIG ROAD
CHARLESTON BLVD.
TROPICANA AVENUE
CITY OF NORTH LAS VEGAS
CITY OF LAS VEGAS
NELLIS AFB
UNINCORPORATED AREA
CITY OF HENDERSON
BM
INTERSTATE-15
LAS VEGAS BLVD., NORTH
LAS VEGAS BLVD., SOUTH
DECATUR BLVD.
LAKE MEAD BLVD.
MAIN
FREMONT
BOULDER
NELLIS
LAS VEGAS BAY
DUCK CREEK
WASH
DRIVE
HENDERSON CUTOFF
HIGHWAY
TONOPAH
95
15
91-93
91
41
466
N
0 1 2 3
SCALE IN MILES

figure 27

While infiltration is not a problem, inflow illustrates the result of a problem peculiar to desert construction. Flash floods damage or wash out portions of the local sewer system. However, this type of in flow is extremely intermittent in nature and is not significant to the overall condition of the collection system. Also, the treatment facility is of sufficient capacity to accommodate the increase in flows occurring because of unusual and/or extraneous conditions. Undesirable in flows can be readily eliminated by the replacement of curb inlets with properly designed dry wells. This would mean an annual decrease of flow into the treatment plant of approximately 5.0 million gallons per inlet and would result in a savings in plant operations.

Treatment Facilities

The City of Las Vegas' waste-water treatment plant consists of two, essentially similar, high-rate trickling filter plants, operating at a nominal design capacity of 30 million gallons per day, (mgd). In 1973, the daily flow rates averaged 31.8 mgd. This included 4.3 mgd which was diverted from the Clark County Sanitation District's waste-water collection system. The County's waste-water plant expansion should discontinue this flow diversion. Even so, it is anticipated that the City's plant will reach its design capacity before the end of year 1975. A study on recommended expansion of the City's plant and a collection system infiltration-inflow analysis is underway.

Waste-water discharges from this plant may be described as high-quality secondary effluent. Removal of biochemical oxygen demand (BOD_5) for 1973 ranged from 90% to 96%, with an annual average removal of 93%. Removal of suspended solids (SS) for 1973 ranged from 87% to 94%, with an annual average removal of 91%. A detailed description of the effluent characteristics was presented in Table 2 in the section entitled WATER QUALITY. A small portion of the treated effluent is used for cooling water for the Nevada Power Company's Sunrise Generating Station and for irrigation. The remaining effluent is discharged directly into the Las Vegas Wash.

System Administration

The Sanitation Division of the City of Las Vegas' Department of Public Works is responsible for the administration, maintenance and operation of the City's waste-water collection and treatment facilities. The Department of Public Works' budget is subject to the approval of the City Commissioners. The Sanitation Division includes the Waste-water Treatment Section responsible for maintenance and operation of the City's Waste-water Plant, which is manned round-the-clock, and the Sewer Maintenance Section, responsible for the waste-water collection facilities

City of North Las Vegas

The City of North Las Vegas operates

and maintains the waste-water collection facilities within its corporate boundaries and discharges its collected waste water to the City of Las Vegas' waste-water system. North Las Vegas is giving serious consideration to the construction of a 3 to 4 mgd waste-water reclamation plant. The plant as presently conceived, would be an extended aeration activated sludge plant. The area to be served by this plant lies generally west of Interstate 15 and north of Carey Avenue. Chlorinated effluent from the reclamation plant would be used for irrigation of upwards to 1,600 acres of parks and golf courses, some planned unit developments and Craig Ranch Country Club. One of the larger areas proposed for irrigation is the North Las Vegas Regional Park where reclaimed waste water will also be used to maintain a 40 acre lake. Solids processing facilities would not be included with the reclamation plant. The City of North Las Vegas proposes to discharge solids back to the interceptor system for subsequent treatment at the City of Las Vegas' waste-water treatment plant. This approach to solids handling may be accomplished by mutual agreement with the City of Las Vegas with appropriate amendments to the existing sewer service contract. Irrigation with reclaimed waste water from this plant would require some modifications to the in-valley irrigation system described in Chapter 2.

Clark County Sanitation District

The Clark County Sanitation District provides waste-water and collection and treatment facilities which serve the developed but unincorporated areas within the Las Vegas metropolitan area, plus the recent addition of Nellis Air Force Base.

Collection System

The Sanitation District's existing and projected waste-water collection system is shown on Figure 27. The collection lines generally extend from Nellis Air Force Base on the north to Sunset Road on the south and from Decatur Boulevard on the west to the waste-water treatment plant on the east. The major trunk and interceptors shown on Figure 27 are the backbone of the Sanitation District's System. Pipe sizes range from 4-inch single residential laterals to 51-inch interceptors.

The District treats the second largest amount of sewage in the valley. Population projections indicate that by the year 2000, the area served by the District may grow to over 300,000 persons and may generate average daily waste-water flows in excess of 40 mgd. This will require enlargement or paralleling of some existing interceptor lines. Assuming development proceeds in an orderly manner and large areas of developable land are not bypassed, it should be possible to expand the collection system as required to meet future demands at reasonable cost. There are still many septic tanks in the Las Vegas Valley.

Treatment Facilities

The Clark County Sanitation District's waste-water treatment plant is of the high-rate trickling filter type with a nominal capacity of 12 mgd.

A 20 mgd expansion of this plant has been undertaken by the applicant. The waste-water treatment processes employed in the plant expansion are the same as those of the original plant. The solids handling facilities are, however, different. When the plant expansion is completed, all solids will receive thickening, heat treatment, vacuum filtration, and incineration. The waste-water stream from the solids handling process will be treated in an activated sludge basin and returned to the plant inlet structure.

This plant is operating under overloaded conditions. The 1973 average daily flow from the collection system was 17.5 mgd of which 4.3 mgd was diverted to the City's plant for treatment, leaving 13.2 mgd to be treated. Removal of BOD_5 for 1973 averaged 83%. Removal of SS for 1973 averaged 84%. With the expansion now under construction, effluent quality should improve and the facilities should have adequate capacity to meet projected needs through the early 1990's. A detailed description of the effluent characteristics is contained in Table 4 . Portions of the effluent are used for cooling water for the Nevada Power Company's Clark Generating Station and for irrigation. The remaining effluent is discharged directly into Las Vegas Wash.

System Administration

The Board of Trustees for the Sanitation District establishes policy. The Board of Trustees consists of the seven members of the Board of County Commissioners for Clark County, Nevada. The Sanitation District staff is divided into four departments (1) administration, (2) general offices, (3) waste-water collection system operations and (4) waste-water treatment plant operations. The plant is manned round-the-clock.

City of Henderson

The City of Henderson operates a waste-water collection system and two waste-water treatment plants. These facilities provide service to virtually all of the people residing in Henderson.

Collection System

The City of Henderson's waste-water collection system is intermingled with small portions of the BMI system from which it originated. All the waste water collected south of the BMI plant and northeast of the Boulder Highway, plus that carried in the Center Street trunk, is diverted to the Henderson waste-water plant No. 2 purchased in 1973 from BMI. The remaining waste-water flows are treated

VARIATIONS
WASTEWATER FLOW
LAS VEGAS VALLEY

TYPICAL MONTHLY VARIATIONS IN WASTEWATER FLOW (1)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
% AVERAGE MONTH	93.4	93.6	95.0	96.5	99.0	102.8	107.2	108.0	104.1	100.9	99.9	99.6

TYPICAL HOURLY WASTEWATER FLOWS (1)

HOUR (A.M.)	1	2	3	4	5	6	7	8	9	10	11	12
% AVERAGE HOUR	100.9	90.5	78.9	70.1	63.7	60.2	61.4	67.9	76.9	89.1	104.2	121.2
HOUR (P.M.)	1	2	3	4	5	6	7	8	9	10	11	12
% AVERAGE HOUR	130.3	129.2	123.4	118.0	114.9	113.9	114.4	115.8	116.9	116.1	113.4	108.7

DAILY AND PEAK HOUR FLOW FACTORS (2)

	YEAR	AVERAGE DAILY FLOW-mgd	MAXIMUM DAY		PEAK HOUR		
			FLOW-mg	Ratio to Average Day	RATE-mgd	Ratio to Average Day	Ratio to Maximum Day
CITY WWTP	1969	22.5	29.5	1.31	37.0	1.64	1.25
	1970	24.5	32.0	1.31	38.0	1.55	1.19
	1971	25.4	29.1	1.15	37.5	1.50	1.29
COUNTY WWTP	1969	10.1	13.0	1.29	16.0	1.58	1.23
	1970	10.6	13.6	1.28	17.0	1.60	1.25
	1971	12.5	14.9	1.19	19.5	1.56	1.31
RECOMMENDED FACTORS FOR DESIGN							
	1980			1.35		1.75	1.35
	1990			1.30		1.65	1.30
	2000			1.25		1.55	1.25

SOURCES: (1) A Comprehensive Water Quality Control Program for the Las Vegas Drainage Basin-Phase II, December 1969 by Boyle Engineering and CH_2M.

(2) Design Appendix to the November Project Report - Las Vegas Wash Pollution Abatement Project, November 1, 1972 by NECON.

table 21

DOMESTIC AND COMMERCIAL MAXIMUM DAY WASTEWATER FLOWS PRESENT AND PROJECTIONS

YEAR	LAS VEGAS VALLEY (mgd)	WASTEWATER FLOW COMPONENTS OF LAS VEGAS VALLEY			
		LAS VEGAS (mgd)	UNINCORPORATED AREA (mgd)	NORTH LAS VEGAS (mgd)	HENDERSON (mgd)
PRESENT (1)					
1973	51.3	24.4	20.2	4.7	2.0
PROJECTIONS (2)					
1980					
Population Level					
Minimum	81.9	43.8	27.3	8.1	2.7
Medium	85.2	44.8	28.7	8.7	3.0
Maximum	90.4	47.8	30.1	9.1	3.4
1990					
Population Level					
Minimum	106.2	56.4	35.2	11.3	3.3
Medium	113.4	60.6	36.9	12.2	3.7
Maximum	124.3	65.8	40.3	13.7	4.5
2000					
Population Level					
Minimum	129.7	61.8	51.3	12.9	3.7
Medium	137.5	66.3	53.3	13.7	4.2
Maximum	157.2	75.4	58.0	16.6	7.2

SOURCES: (1) Based on 1973 Wastewater Plant Records for CCSD and CLV and Estimates for Henderson Plants. CLV WWTP Flows have been prorated between the Cities of Las Vegas and North Las Vegas.

(2) Based on Average Wastewater Flows shown on TABLE 21 multiplied by Recommended Factors for Design shown on TABLE 20

table 22

at the Henderson No. 1 city-built treatment plant. Records on the portion of total flows treated at each plant and the basis for proportioning are not available. The waste-water system also collects the waste water of the East Las Vegas area and portions of the City located northerly of BMI. Prior to anticipated future development, interceptor trunk and main collection lines will need to be extended into presently undeveloped areas. The existing service area and the interceptor system together with proposed system expansions are shown on Figure 27.

Treatment Facilities

Henderson treatment plant No. 1 is of the Imhoff tank-oxidation pond type. Plant No. 1 was designed for an average daily flow of 1.5 mgd. Present daily flow rates are estimated to be about 0.7 mgd to 0.9 mgd. Effluent from the plant is piped to unlined holding ponds, from which the effluent is disposed of by evaporation and seepage to the near-surface ground-water zone. The treatment effectiveness is difficult to evaluate because of the diffuse nature of the seepage portion of the disposal system. Influent and effluent are not routinely sampled, and no definitive past records are available. The limited available data is shown in Table 5.

The remaining portion of the City is served by Henderson's treatment plant No. 2. The BMI industrial complex sanitary sewerage system, that portion of Henderson lying east of the Boulder Highway, a portion of central Henderson and the small residential area west of the Henderson High School are all tributary to plant No. 2. Plant No. 2 is a two-stage trickling filter plant designed to provide treatment of domestic waste water from the BMI complex. Certain industrial wastes, characterized by a very low pH, occasionally are received at the plant and have pronounced detrimental effects on plant operation. Flow measurement equipment at Plant No. 2 is reported to be inoperative. Estimates of flow reaching the filter are 0.9 to 1.1 mgd, which is about the original design capacity of this plant.

Both plants No. 1 and No. 2 discharge their sanitary and industrial effluents into unlined ponds constructed of native material. The native soil is at least semi-permeable, and infiltration into the ground from these ponds is known to occur. Such treatment as occurs may be classified as similar in nature to that from a combination waste stabilization pond and infiltration gallery. The infiltration of large quantities of basically untreated industrial waste and lesser amounts of domestic waste water into the near surface ground-water zone has had a detrimental effect upon quality of ground water entering the Las Vegas Wash.

Since accurate measurements of surface and subsurface flow from the BMI and Henderson pond systems are not available, it is not possible to accurately characterize these discharges to Las

Vegas Wash. It seems probable that waste waters which percolate through the pond bottoms are the worse for their passage through the surrounding soil, at least from a TDS standpoint. A previous study indicates the probability that, while high TDS water may enter the Wash from the BMI ponds, these ponds do not contribute any significant pollution in terms of phosphorus or uncombined nitrogen.

The limited data available indicates that Henderson's waste-water plants are probably not producing a good quality secondary effluent. If Henderson is to grow and prosper in a healthy climate, waste-water treatment facilities must be upgraded and expanded. Currently, the city of Henderson is considering a proposal to modify its existing means of treatment. The proposal is for developing four separate secondary treatment facilities which provide a trickling filter plant with evaporation ponds for the Henderson Core area, two trickling filter plants with irrigation for the Green Valley area and a trickling filter plant with lime addition for phosphorus removal for the Lake Adair area.

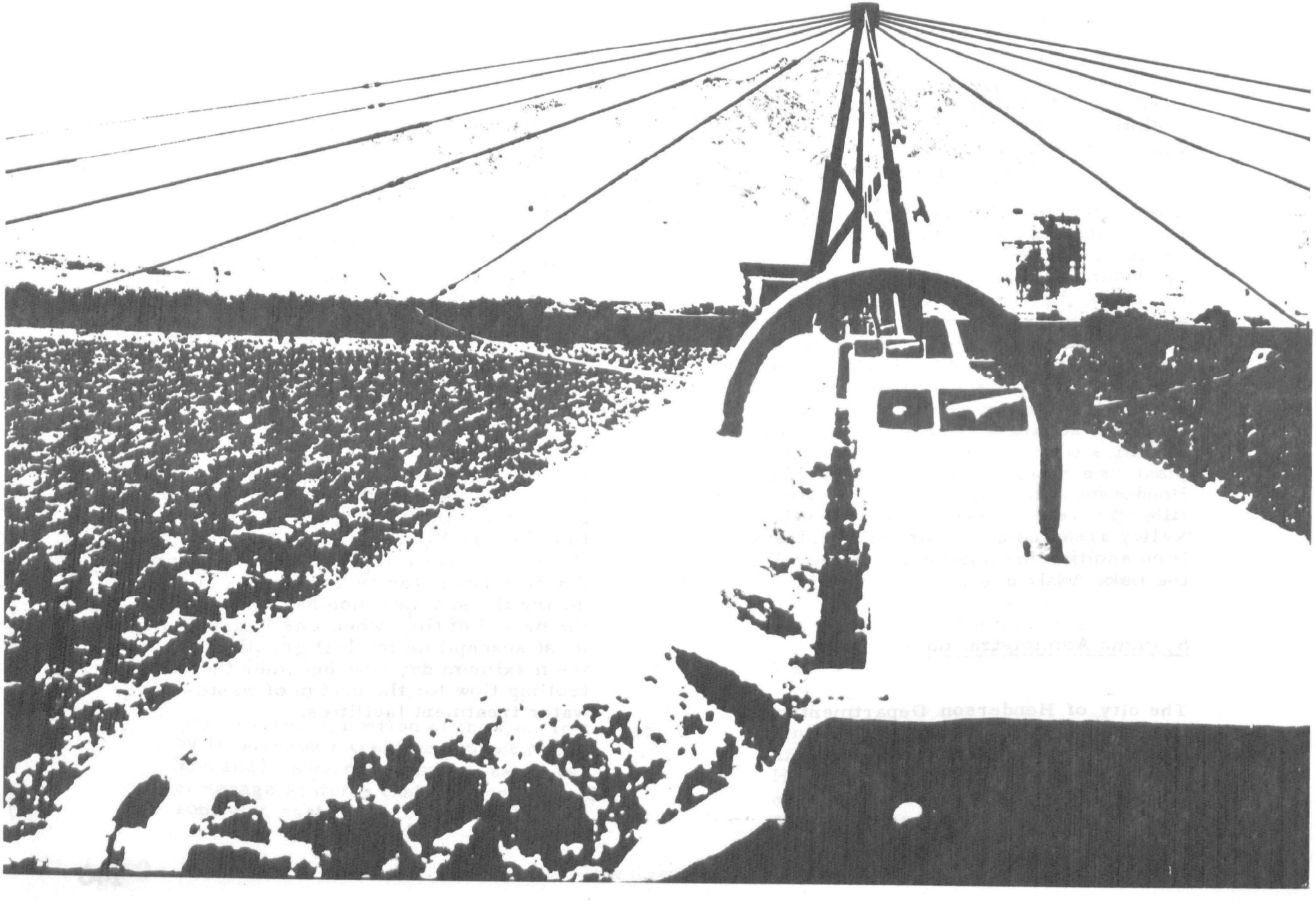
Systems Administration

The city of Henderson Department of Public Works is responsible for the administration, maintenance and operation of the City's waste-water collection and treatment facilities. The plants are normally staffed seven days a week during an eight hour work day and as needed in case of emergency.

Variation in Waste Flows

Variations in waste-water flow rates have been studied utilizing the records of the City of Las Vegas and Clark County waste-water treatment plants. These variations are shown on Table 21 together with recommended factors for design. The recommended design factors have been applied to the average day flows shown on Table 20 to derive the projected maximum day waste-water flows shown on Table 22.

It should be noted that the maximum day flow occurs during the summer months and is a result of the influx of tourists into the Las Vegas Valley. Furthermore, flows equal to or approaching the maximum day flow occur for several weeks at a time during the summer months. This is also the period of time when Las Vegas Bay is most susceptible to algal growth, thus, the maximum day flow becomes the controlling flow for the design of waste-water treatment facilities.



selection of alternatives

Ten possible alternatives have been considered for implementation to meet the water resource management goals and water quality objectives.

Of the alternatives to be discussed 4 of the alternatives have discharges into the receiving water as their method of disposal. These alternatives are: Alternatives 2-Complete Treatment; 3-Advance Waste Water Treatment and Return to Lake Mead; 7-Combination Alternative Export to Dry Lake and 10-Amended Combination Alternative. The advantages of discharging into the Las Vegas Wash are that the greenbelt will be maintained and effluent returned to Lake Mead and to the Colorado River could be credited up to the amount of Colorado River water allocated to Nevada.

Another method of discharge investigated in the alternatives is export with land disposal. Alternatives 4-Dry Lake Export; 5-Export to Eldorado Valley; 6-Export to Hidden Balley-Jean Lake Area and 7-Combination Alternative-Export to Dry Lake all use this method. Other methods of discharges were Alternative 1-Groundwater Recharge and Alternative 8-Deep Well Disposal.

DESCRIPTION OF ALTERNATIVES

Alternative 1 - Ground Water Recharge (subsurface disposal)

Waste water at the central collection point will be given complete waste water treatment for the purpose of improving the physical, biological, chemical and biochemical characteristics sufficiently to preclude degradation of the existing ground water supply. The majority of the effluent from the complete treatment plant would be injected into the valley's water-bearing aquifers through a network of injection wells. The water could be retrieved through a system of wells for delivery to the portable water system. Effluent from the advanced waste-water treatment plant phase of the process would be used for in-valley irrigation and maintenance of a greenbelt in Las Vegas Wash. Brine waste resulting from the desalination process would be exported out of the Las Vegas Valley for disposal by

evaporation.

To meet the existing ground water quality condition, a reduction in concentration of total dissolved solids (TDS), phosphorus, nitrogen, biochemical oxygen demand (BOD), chemical oxygen demand (COD) and suspended solids would be required and bacteria and viruses should be eliminated. If these constituents are reduced in concentration sufficient to preclude degradation of ground water quality, the effluent from the plant would exceed water quality standards that have been established for the Las Vegas Wash.

Unfortunately, present knowledge of the physical hydraulic, or water quality characteristics of the ground water basin beneath Las Vegas Valley is insufficient to assure the viability of this alternative. Before major financial commitments are made for a recharge program, it will be necessary to first define the physical characteristics of the basin through a program of exploration, data collection, and data analysis. It would then be necessary to demonstrate the feasibility of ground water recharge utilizing a pilot operation through the physical chemical and biological practicability as well as financial feasibility of such a program.

Due to the large number of technical unknowns which exist for this alternative with regard to the degree of pretreatment and with regard to the ground water basin, this alternative does not provide a readily implementable solution to the existing pollution problems. Further, lack of sufficient design data precludes the possibility of a meaningful cost-effective analysis. This alternative is not presently considered viable and is eliminated from further evaluation.

Alternative 2 - Complete Treatment (receiving water discharge and direct reuse)

Wastewater, at a central collection point, will be given AWT and desalination for the purpose of improving physical, biological, chemical and biochemical characteristics sufficiently to meet U.S. Department of Public Health drinking water standards. Effluent from the plant could be used for (1) agricultural irrigation, (2) a pilot ground water recharge program, (3) discharge to Las Vegas Bay or Lake Mead for return flow credit and (4) blending with the domestic water supply for direct reuses.

Complete treatment, including the reduction in concentration of nitrogen, phosphorus, TDS, BOD_5, COD and SS, with disinfection, will produce an effluent which will meet and exceed the water quality standard for Las Vegas Wash. The effluent from this process should be usable for any water demand in the Las Vegas Valley. This alternative has the disadvantage of high-unit processing cost due to the high energy consumption of the desalination facility and has some

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technical problems in as much as facilities of the size required have not yet been constructed. Furthermore, the control of bacteria and viruses in a direct reuse application is not known to have been demonstrated to the satisfaction of the nation's health authorities. Future technical advances to make complete treatment more feasible. Complete treatment is considered to be one of the more viable and desirable alternatives.

Alternative 3 - Advance Waste Water Treatment and Return to Lake Mead (receiving water disposal)

Alternative 3 provides for waste water collection at a central point, provision of AWT to improve physical, biological, chemical and biochemical characteristics to a level that will meet the existing water quality standards for discharge to the wash.

The AWT plant would be designed to reduce the concentration of phosphorus SS, BOD_5 and COD. The water will be disinfected prior to discharge. The effluent from this plant would meet the water quality standards now set for Las Vegas Wash, but may complicate meeting the proposed one million pounds TDS Load recommended by EPA.

The advantage of returning adequately treated waste water to Lake Mead is that effluent returns to the Colorado River which may subsequently be beneficially reused downstream.

The technical feasibility of the proposed AWT plant and the beneficial usage of the effluent for In-Valley irrigation; maintenance of a green belt in the Las Vegas Wash and as credit for allocated Colorado River withdrawals makes this alternative viable.

Alternative 4 - Dry Lake Export (land disposal)

Secondary treated waste water, collected at a central point, would be exported by pipeline to Dry Lake Valley for disposal by evaporation. In the time period of 1990 to 2000, depending upon population growth and water usage, AWT and desalination of required waste water quantities to meet potable usage would be initiated. Brine wastes from the desalination process would be exported to Dry Lake Valley for disposal by evaporation. In the same pipeline originally constructed for the export of waste, waste water of good quality exported to Dry Lake Valley would be segregated through the use of a flood control principle of waste water of poorer quality. At Dry Lake Valley, a portion of the good quality waste water could be diverted for use by the proposed Allen Power Project, and, if proven feasible, portions of the waste water could be used for irrigation in the Dry Lake Valley.

This alternative does not provide for maintenance of a green belt area in Las Vegas Wash. This alternative has been eliminated as a viable alternative because it does not meet the basic project objective of preserving the Las Vegas Wash environment.

Alternative 5 - Export to Eldorado Valley (land disposal)

Waste water, collected at a central collection point, would be pumped and transported by pipelines to Eldorado Valley for disposal by evaporation. A portion of the waste water exported to Eldorado Valley would be used for irrigation of agricultural land. A small portion of the waste water at the central collection point would be given AWT. The effluent of the AWT plant would be used for a pilot desalination plant, pilot ground water recharge program and for In-Valley irrigation.

Waste water treatment plant effluent, be it secondary or AWT effluent or a blend, would be available for the maintenance of a green belt in the Las Vegas Wash. The waste water to be exported to Eldorado Valley would not receive AWT.

The pilot scale AWT near the Las Vegas Wash would be designed to reduce the concentration of phophorus, BOD_5, SS, and COD. Effluent would be disinfected to produce a water that would preclude degradation of the existing ground water supply beneath the valley.

Investigation into the surface soils and shallow geology of the Eldorado Valley indicates that it may not be possible to avoid pollution of the regional ground waters without extensive evaporation pond lining. Also, there would not be any provision in the Eldorado export alternative for diverting water to the Allen Power Project for beneficial reuse. Due to the similarity of the Eldorado export alternative and the Dry Lake export alternative except for additional costs of the evaporation pond lining and a loss of a possible beneficial reuse of the waste water as power plant cooling water, the Eldorado export alternative has been eliminated as a viable alternative.

Alternative 6 - Export to Hidden Valley - Jean Lake Area (land disposal)

Waste water collected at a central collection point would be pumped and transported by pipeline to the Hidden Valley-Jean Lake Area for disposal by evaporation. All elements of this program are similar to those outlined by the Eldorado Valley alternative including the loss of a possible beneficial waste water reuse and a necessity of lining the evaporation pond. For these reasons the export to Hidden Valley-Jean Lake area has been eliminated as a viable alternative.

Alternative 7 - Combination Alternative - Dry Lake Export (receiving water discharge, reuse, land and subsurface disposal)

Waste water, collected at a central collection point, would be pumped and transported by pipeline to Dry Lake Valley for disposal by evaporation. At Dry Lake Valley, portions of the waste water would be diverted for use by the proposed Allen Power Project. If proven feasible, portions of the waste water could be used for

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limited agricultural irrigation at the Dry Lake disposal site. About one (1) mgd of the waste water at the essential collection point would be given AWT. The effluent of the AWT plant would be used for a pilot desalination plant and pilot ground water recharge program. Effluent would be avilable for the maintenance of the green belt in the Las Vegas Wash. The waste water could be exported to Dry Lake Valley and would not receive AWT. The pilot scale AWT plant would be designed to produce the concentration of phosphorus, BOD_5, SS, and COD. Effluent would then be disinfected to produce a water that would preclude degradation of the existing ground water supply.

The possible beneficial uses of the waste water in the vicinity of the Dry Lake Valley, abatement of pollution, and maintenance of a green belt in the Las Vegas Wash make this alternative viable.

Alternative No. 8 - Deep Well Disposal (subsurface disposal)

Waste water, from a central collection point, would receive AWT to remove SS and biologically active components to preclude the possibility of plugging the injection well and surrounding aquifers. The majority of the effluent from this plant would be injected into confined aquifers through a network of deep wells for ultimate disposal. The remainder of the effluent from the AWT plant will be available for the maintenance of a green belt in the Las Vegas Wash. The effluent to be discharged to the Las Vegas Wash would receive additional treatment as necessary to meet the water quality standards set for the Las Vegas Wash. The AWT plant would be designed for removal of SS and biologically active compound in the waste water that would foster the growth of biological slimes. The removal of these constituents is essential to prevent flooding of the receiving aquifers serving as the ultimate disposal sites of the waste water. AWT effluent used to maintain a green belt in Las Vegas Wash would be treated to the level necessary to meet water quality standards for the Wash.

There is insufficient data available at the present time about the geological and hydraulic characteristics of the aquifers underlying the Las Vegas Valley. Without this information it is not practical to evaluate the feasibility of deep well disposal of large quantities of waste water. Before a program of disposal by deep well injection could be implemented, a program of exploration, data collection and analysis would have to be undertaken to determine if a confined aquifer exists that could be used for the ultimate disposal of the waste water. Another geological consideration that would have to be analyzed would be the effect of seismic activity caused by deep well injection.

Due to the time and expense that would be required to determine these geological characteristics of the basin underlying the

Las Vegas Valley and the potential for polluting the potable water aquifers through possible aquifer inter-connection, this alternative is not considered to be viable for implementation.

Alternative 9 - No Action

The no action alternative will permit existing methods of waste water treatment and disposal to continue. No improvements or upgrading of treatment processes would be made to improve the water quality of the Las Vegas Wash.

This alternative is not being considered as being viable. It violates EPA's and Nevada's water quality standards for Las Vegas Wash and results in the continued pollution of Las Vegas Bay and Lake Mead.

Alternative 10 - Amended Combination Alternative (receiving water discharge, reuse, land and subsurface disposal)

Waste water, at a central collection point, would be given AWT for the purpose of removing physical, biological, chemical and biochemical constituents to meet water quality standards. Effluent from this plant would be available for such beneficial reuses as: (1) cooling water for the proposed Allen Power Project, (2) an In-Valley irrigation program, (3) as a water source for a pilot desalination plant, (4) as a water source for a pilot ground water recharge program, (5) maintenance of a green belt in Las Vegas Wash and (6) as a water supply for return flow credit from the Colorado River when returned to Lake Mead. This alternative is the same as Alternative No. 3, AWT and return to Lake Mead, with the addition of the above-mentioned reuse programs, and reduced volumes of water being discharged to Las Vegas Wash.

The plant would be designed to reduce the concentration of phosphorus SS, BOD_5, and COD. Effluent would then be disinfected. Plant dischargers would meet water quality standards and effluent limitations set for Las Vegas Wash. The advantages of having effluent available for use by the Allen Power Project facility is that the water used by the facility would be purchased by the Nevada Power Company, thus becoming a source of revenue for the community. Also, the technological feasibility of the proposed AWT plant and the beneficial uses of the effluent for In-Valley irrigation, maintenance of a green belt in Las Vegas Wash, the potential for an additional potable water supply and a possible credit against withdrawals from the Colorado River make this alternative viable.

SCREENING OF ALTERNATIVES

All the treatment alternatives were evaluated using eight qualitative parameters. They were presented in the facilities plan Annex A, and we concur with their determination. The evaluations of the alternatives are listed in Table 23 in matrix form with the relative variance of each alternative listed. The numerical values

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of 1, 2 and 3, representing, yes, questionable, and no, respectively, are assigned to determine the relative adequacy or inadequacy of each individual alternative to each parameter. The overall relative merit of each alternative is then determined by totaling each vertical column. The lowest total is representative of the alternative with the highest overall merit and the highest total is representative of the alternative with the lowest overall merit.

Reviewing the individual qualitative description of each alternative and determination of the overall relative merits of each alternative using the matrix indicates that the following four (4) alternatives are most viable.

Alternative No. 2 - Complete Treatment

Alternative No. 3 - Advanced Waste Water Treatment and Return to Lake Mead

Alternative No. 7 - Combination Alternative

Alternative No. 10 - Amended Combination Alternative.

These four alternatives will be analyzed in more detail.

Alternative No. 2 - Complete Treatment

The Complete Treatment Alternative is designed to collect and treat secondary effluent from the existing Clark County waste-water treatment plant, the existing City of Las Vegas waste-water treatment plant and the existing City of Henderson waste-water treatment plants. The treatment process would produce a water which should exceed discharge requirements for Las Vegas Wash. Because of the high quality of the effluent produced by this alternative, it is planned that it would be blended with Lake Mead water just ahead of the water treatment plant of the Southern Nevada Water Project (SNWP). Thus, the primary objective of the Complete Treatment Alternative is indirect reuse of reclaimed waste water for potable purposes.

This alternative involves construction of a complete waste-water reclamation plant utilizing phosphorus removal by chemical coagulation, ammonia stripping and filtration. Carbon absorption and desalination would be applied to a portion of the total flow. The desalinated water would be blended with the remainder of the flow from the AWT plant. The blended effluent would be disinfected with chlorine and aerated. An export pipe would be required with this alternative for disposal of brine generated in the desalination process. The high quality of this effluent would economically preclude discharge into Las Vegas Wash where it could be contaminated by high salinity ground-

PRELIMINARY SCREENING OF ALTERNATIVES

table 23

ALTERNATIVE NO.	1 GROUNDWATER RECHARGE	2 COMPLETE TREATMENT	3 AWT AND RETURN TO LAKE MEAD	4 EXPORT TO DRY LAKE VALLEY	5 EXPORT TO ELDORADO VALLEY	6 EXPORT TO HIDDEN VALLEY-JEAN LAKE AREA	7 COMBINATION ALTERNATIVE	8 DEEP WELL DISPOSAL	9 NO ACTION	10 AMENDED COMBINATION ALTERNATIVE
Meets Federal and State Standards	2	1	1	1	1	1	1	2	3	1
Provides Immediate Pollution Abatement	2	1	1	1	1	1	1	2	3	1
Technically Feasible Today	2	2	1	1	1	1	1	2	1	1
Protects Water Resource	2	1	1	1	2	2	1	2	3	1
Augments Water Resource	1	1	1	3	3	3	2	3	3	1
Enhances Water Quality	3	1	1	3	3	3	3	3	3	1
Potential for Agriculture	3	1	1	1	1	1	1	3	3	1
Environmental Enhancement	1	1	1	1	1	1	1	1	3	1
TOTAL	16	9	8	12	13	13	11	18	22	8
ORDER OF PREFERENCE	6	2	1	4	5	5	3	7	8	1

LEGEND

(1 = Yes) (2 = Questionable) (3 = No)

water discharges. The benefits of desalination could be lost by adding the treated water to the water in Las Vegas Wash which has a high level of TDS. Therefore, conveyance of the plant effluent to the SNWP would be via lined canal and pipelines.

Special provisions for maintaining the Wash will be required with this alternative. This will basically consist of diverting a small flow of water to sustain vegetation and wildlife. This water will be diverted prior to desalination and may be blended with secondary treatment plant effluent in order to provide nutrients necessary to sustain vegetation along the Wash.

This alternative provides an immediate solution to the problem of the discharge of pollutants (including TDS) to Las Vegas Bay. In addition to water reclamation for indirect potable reuse, this alternative also includes an in-valley irrigation system.

The Complete Treatment Alternative will meet the recommended water quality objectives developed for potable water supply, that is, U.S. Public Health Service Drinking Water Standards. The process as described will incorporate sophisticated unit processes, however, there are some questions regarding the technical feasibility of operating a desalination process on the large scale necessary to meet the requirements of this project.

This alternative would not degrade water quality in Las Vegas Wash. While most of the reclaimed water from this treatment plant would be diverted to the existing SNWP for reuse, some of the water would be diverted, prior to the desalination process, for reuse in the in-valley irrigation system and for a Las Vegas Wash maintenance program. Brine wastes would be exported out of the Valley.

There is no Federal effluent requirement and no National Pollution Discharge Elimination System (NPDES) permit at the present time for this proposed system. Preliminary discussions have indicated that an effluent quality equal to or better than the water quality standards for Las Vegas Wash would be acceptable.

This alternative meets the criteria for a Best Practicable Waste Treatment Technology (BPWTT) treatment and reuse alternative.

Alternative No. 3 (Modified) - Advanced Waste-water Treatment and Return to Lake Mead

The AWT and Return to Lake Mead Alternative is designed to collect and treat secondary effluent from the existing Clark County waste-water treatment plant, the existing City of Las Vegas waste-water treatment plant and the existing City of Henderson waste-water treatment plants. The treatment process employed is designed to produce an effluent which will meet anticipated

effluent discharge limitations. The primary objective of this alternative is to treat the waste water and discharge it to the receiving water. As in all plans, a portion of effluent from this system would be utilized for future in-valley irrigation. In addition, this alternative would maintain vegetation in Las Vegas Wash.

This plan includes initial construction of an AWT plant to provide reduction in BOD5, SS and COD levels by post aeration prior to discharge to Las Vegas Wash.

This alternative does not presently include any experimental pilot programs to determine feasibility of more sophisticated processes that might be required to meet future water quality standards.

A comparison of the effluent characteristic for AWT and Return to Lake Mead with the water quality standards for Las Vegas Wash indicates that the water quality standards for the Wash would be met excepting the proposed salt load criterion.

There are no Federal effluent requirements and no NPDES permit at the present time for this proposed plan. Preliminary discussions have indicated that an effluent quality equal to the water quality standards for Las Vegas Wash would not be possible, if the proposed salt load criterion is enforced.

This alternative meets the BPWTT requirements for a waste treatment and discharge alternative.

Alternative Number 7 - Combination Alternative

The Combination Alternative provides an immediate solution to the problem of the discharge of pollutants (including TDS) to Las Vegas Bay and also provides a facility which would make secondary effluent available to the Allen Power Project station for power cooling water. It provides a pipeline for conveying future brines from desalination installations when such installations are required. A future in-valley irrigation systen would be structured to deliver secondary effluent for beneficial reuse within the Valley. This irrigation system can be expanded and extended as the demands develop. The pilot programs involving AWT and desalination are included to provide the information necessary to determine the economics and quality of water required for proposed programs of desalination, ground-water recharge, and potable water use. The program of ground-water basin definition and pilot recharge operation will offer the opportunity to define and hopefully make use of the ground-water basin for the storing of reclaimed waste water. The ground-water basin will be evaluated as a vehicle for water distribution within the valley and for water "banking" against future needs. The element of the system provides for the

maintenance of Las Vegas Wash and the export of saline ground waters now entering the Colorado River system via Las Vegas Wash. Thus, the program will meet the objectives desired of the pollution abatement program.

The export system includes: (1) collection facilities to carry waste waters from secondary treatment plants, (2) collection and conveyance of industrial waste discharges and intercepted flows from the Las Vegas Wash to flow regulating reservoirs, (3) compartmentalized reservoirs for high and low quality waste waters and (4) an export pipeline with pumping stations including surge protection and forebays. Flows will be conveyed to a disposal area in Dry Lake Valley which includes irrigation and the utilization of the main playa of Dry Lake to evaporate the waste water not used for other purposes.

In addition to the main export system, this alternative also proposes several subsystems; (1) future in-valley irrigation system, (2) pilot plant development, (3) pilot desalination and recharge facilities and (4) Las Vegas Wash maintenance. These subsystems, except the Wash maintenance subsystem, are identical to the subsystems proposed in Alternative Number 10.

The Las Vegas Wash maintenance program proposes the release of secondary treated waste water in controlled amounts so as to maintain a permanent greenbelt in the Wash. This is desired because of the great concern and high value placed on the Wash by a substantial segment of the local community.

Recent investigations have indicated that for Wash maintenance, nutrient bearing waste-water flows to the Wash should vary from 3 mgd in the winter to 19 mgd in the summer. This water would flow down the Wash and then would be collected at a natural barrier in the Wash and pumped back to the collection system to be exported with the other waste water to Dry Lake Valley. This program would permit retention of the majority of the Wash in its present vegetative state, collect and dispose of undesirable poor quality ground waters and result in the substantial elimination of TDS and nutrient pollution in Las Vegas Bay.

Export to Dry Lake Valley will meet the proposed water quality standards by diverting the combined waste-water flow to Dry Lake Valley, thus, eliminating all discharges of pollutants to Lake Mead. The diversion system, as previously described, would export waste water out of the Las Vegas Valley for ultimate disposal by evaporation. The effluents from the existing secondary plants would not require any further treatment prior to exportation.

There are no Federal effluent requirements and no NPDES permit requirements if there is no discharge to the surface waters of the State. Since this alternative

proposes to export the flow, there will be no discharge to the surface waters other than that for the Wash maintenance program. The water which is discharged to the Wash will be pumped out of the Wash before reaching the North Shore Road sampling point. Thus, this alternative will meet proposed water quality for Las Vegas Wash and probably would not meet "effluent limitations."

Effluent limitations have not been established as of this writing. However, preliminary discussions have indicated that an effluent quality equal to the water quality standards for Las Vegas Wash (as measured at North Shore Road) should be assumed. This alternative meets the BPWTT requirements for a land application alternative. Effluent exported to the Dry Lake Valley will not degrade either surface or ground-water resources. The ground water below Dry Lake is protected from the waste water by the impervious geologic formations within the Dry Lake Basin.

Alternative Number 10 - Amended Combination Alternative

The Amended Combination Alternative is designed to collect, treat, and reclaim waste water from the existing Clark Count, City of Las Vegas, and Henderson wastewater treatment plants. The objectives of this alternative include a high degree of treatment and several reuse systems. Reuse systems include: (1) industrial reuse, primarily as power plant cooling water, (2) in-valley irrigation, (3) pilot scale desalination plant, (4) pilot scale ground-water recharge program and (5) receiving water discharge for return flow credit.

AWT processes would include lime coagulation, single stage recarbonation, filtration, chlorination of effluent for disinfection, and post aeration. The plan includes lime reclamation facilities to minimize chemical requirements for lime coagulation, minimize the amount of reject solids to be disposed of and to supply needed carbon dioxide for recarbonation.

The Nevada Power Company presently uses lime coagulated secondary effluent water for cooling purposes. Present reuse of treated effluent by the Power Company occurs at its Clark Station and Sunrise Station. This alternative anticipates that AWT effluent will be purchased by Nevada Power Company for use at the proposed Allen Power Project near Dry Lake.

The utilization of AWT effluent for irrigation of agricultural lands, landscaping of parks and public facilities, golf courses and greenbelt areas within Las Vegas Valley offers an opportunity for the beneficial reuse of these highly treated waste waters.

Operation of an in-valley irrigation system utilizing AWT effluent would have all the benefits of the irrigation system proposed in the export alternative. It would also

provide additional benefits due to the higher quality of the water. The health hazards associated with irrigation using secondary effluent would be substantially reduced; in fact, use of AWT effluent should not impose any undue risks to health because of the high level of treatment and reliabilitiy that exists with this process.

Secondary effluent is presently used at two Las Vegas golf courses for irrigation. This practice has resulted in both odor problems and soil plugging. It is anticipated that effluent from the AWT plant would significantly reduce these problems. Further, because of the high quality of this effluent, it is anticipated that it can also be used for additional park and greenbelt areas.

A pilot desalination program is proposed in conjunction with this alternative to accomplish the following objectives:

Determine the feasibility of desalting AWT effluent

Evaluate specific desalination pretreatment requirements

Evaluate operation techniques

Investigate health hazards

Investigate environmental impacts of a desalination operation

This plant would produce about 1.0 mgd of high quality reclaimed waste water. This will provide sufficient capacity for the proposed ground-water pilot recharge program.

A pilot ground-water recharge program is also proposed as an integral part of this alternative. This program is proposed to accomplish the following objectives:

Determine the feasibility of recharging high quality reclaimed waste water into the Valley's ground-water formations.

Formulate recharge methods of injecting effluent water for future use as a supplemental water supply

Determine water quality requirements for recharging water.

The balance of the water will be discharged to Las Vegas Wash. This flow would maintain a permanent greenbelt along the Wash; however, there is some question as to the ability of the AWT effluent to supply sufficient nutrients to support present vegetation.

There is no NPDES permit at the present time for the proposed discharge and there are no official effluent limitations; however, an effluent quality equal to the water quality standards for Las Vegas Wash would be acceptable.

This alternative meets the BPWTT requirements for treatment and reuse of waste water. In this alternative, heavy emphasis has been placed on reclamation and multiple beneficial reuse of the waste-water resource.

ENERGY CONSUMPTION OF THE VIABLE ALTERNATIVES

The four most viable alternatives each consume significant amounts of energy. Electric power would be purchased from Nevada Power Company. The estimated energy required for each alternative is shown in Table 24. Electrical power would be purchased monthly at an April 1974 cost of 1.033¢ per kwh, plus a monthly demand charge of $1.75 per kw. It is probable that the price of electrical power will increase significantly during the life of this project. Alternatives 2 and 7 will be subject to larger changes in total yearly costs as the power rate increases when compared with Alternatives 3 and 10.

The analysis uses maximum day running horsepower as a basis of comparison. This is the amount of power that would be used when process flow is equal to the maximum day flow.

Existing and projected power generation capacity available to Las Vegas Valley is summarized in Table 25.

When the total power required by the different alternatives is compared to the total power available in the Las Vegas Valley, it may be seen that the highest maximum day demand is only about 1% or less of available generating capacity. Thus, the impact of any one of the four most viable alternatives on the Las Vegas Valley power supply is small.

Fuel sources that would be used in the alternatives are natural gas and fuel oil. Despite the anticipated shortage of these two items, local suppliers have indicated that adequate supplies should be available in the future.

RELATED CONSTRUCTION

Allen Power Project

The Nevada Power Company has proposed the construction of a coal-fired steam electrical generating plant to be located in the Arrow Canyon Mountains, twenty miles northeast of Las Vegas. The plant would ultimately generate 2000 megawatts of power, and is estimated to cost $600,000,000.

It is presently proposed that the project would be constructed in four equal stages: 500 megawatts becoming operational in each year for 1979, 1980, 1981, and 1982. Power would be sold to Southern California

Edison Company (SCE) to supply the Los Angeles area: 70% of the total from 1979 to 1983, 50% of the total from 1984 to 1990, and then cutting off all sales to SCE by 1994. The remaining 30% would be consumed in the Las Vegas area, and be increased in proportion to the decreases noted above. This arrangement would allow the total capacity of the Allen Power Project to ultimately be recaptured and used in Southern Nevada.

When in full operation, the plant would burn about 16,000 tons of coal each day, using oxygen from the air in the combustion process, and producing carbon dioxide, water vapor, 34.5 tons of sulfur dioxide (SO_2), 14.4 tons of particulate matter, and other gaseous by-products each day. It would also produce heat necessary to drive steam turbines and turn the generators which produce the electricity.

Cooling water would be required to remove waste heat energy by condensing steam used in the boilers and turbines. This cooling water would be used over and over again by having its waste heat removed to the atmosphere through evaporation. Large cooling towers are usually constructed for this purpose, with the water cascading down a series of short drops to allow maximum exposure to the air. Fresh water is added as evaporation occurs, but eventually the salts become so concentrated in this water that they begin to precipitate (come out of solution), coating the cooling tower surfaces, a problem called "scaling". To prevent this from occurring, water (called "blowdown", and comprising only about 20% of the volume flowing into the towers) must be removed and replaced with fresh water. Nevada Power Company representatives state that they would use part of the blowdown water to "scrub" the gases from the combustion of the coal, removing particulate matter, and then either evaporate the water in sealed ponds or reclaim it by a desalinization process. High quality product water would then be used as boiler water, with the brine being evaporated at the site. Estimates of make-up cooling water requirements are as follows:

RECLAIMED WASTEWATER DELIVERIES
ALLEN POWER PROJECT

Peak Demand (MGD)	Average Demand (MGD)	To Be Delivered After
12	8	June 1, 1979
24	16	June 1, 1980
36	24	June 1, 1981
48	32	June 1, 1982

A four-party contract has been drafted which would provide waste water to meet the cooling water requirements of the Allen Power Project. The draft contract calls for the sale of effluent from the proposed County AWT plant. If, however, for some reason, the recommended AWT plant were not constructed, then

ESTIMATED ELECTRIC POWER CONSUMPTION (2)

Alt. No.	Description	1978 Max. Day Running HP	1978 Max. Energy Use kwh/day(1)	1985 Max. Day Running HP	1985 Max. Energy Use kwh/day(1)	1990 Max. Day Running HP	1990 Max. Energy Use kwh/day(1)	2000 Max. Day Running HP	2000 Max. Energy Use kwh/day(1)
2	Complete Treatment	26,000	468,000	32,700	589,000	38,000	684,000	48,100	866,000
3	AWT and Return to Lake Mead	4,800	86,000	6,000	108,000	7,000	126,000	8,800	158,000
7	Combination Alternative	10,000	180,000	13,500	243,000	16,700	301,000	22,300	401,000
10	Amended Combination Alternative	6,000	108,000	7,500	135,000	8,700	157,000	11,000	198,000

(1) kwh/day = HP x .75 x 24

(2) Power consumption is assumed to be proportional to flow

table 24

POWER GENERATING PLANTS FOR LAS VEGAS VALLEY

	Name of Plant and Location	Megawatts Presently Available	Megawatts Available to Nevada by year 2000	Type of Plant and Purpose
1.	Clark Station Las Vegas Valley	195	195	Steam Electric Main Load (nat. gas & fuel oil)
2.	Sunrise Station Las Vegas Valley	85	85	Steam Electric Main Load (nat. gas & fuel oil)
3.	Mohave Station near Davis Dam	211	211	Steam Electric Main Load (coal)
4.	Westside Las Vegas Valley	30	30	Diesel Electric Peak, Emerg.
5.	Gas Turbines Las Vegas Valley	58 + 67 (May 1974)	125	Gas Turbines Peak, Emerg.
6.	Hoover Dam at the Dam	100	100	Hydroelectric Main Load
7.	Navajo Station near Page, Arizona	261 (June 1974)	261	Steam Electric Main Load (coal)
8.	Reid Gardner Moapa Valley	234 + 112 (June 1975)	448 (1977)	Steam Electric Main Load (coal)
9.	Allen Power Project (Proposed)		2,000 *	Steam Electric Main Load (coal)
	Total Nominal Generating Capacity in Megawatts	1,241 mid 1974 1,353 mid 1975	3,455	

Source: Nevada Division of Water Resources

* 500 Megawatts proposed to be available in 1979 with proposed expansion to 2,000 Megawatts by 1983

table 25

Nevada Power Company would purchase secondary waste water for the Allen Power Project and provide their own AWT facilities.

It is estimated that Nevada Power Company will purchase AWT plant effluent from the County for about 31¢ per thousand gallons ($308 per million gallons). Thus, the estimated annual revenue to be realized by the community (after 1982) would be about $3,500,000 per year. This revenue is to be applied to the costs of providing the AWT required to meet the water quality standards for Las Vegas Wash. The anticipated revenues from the sale of reclaimed waste water to the Allen Power Project should reduce the costs to the community of the recommended project by about 25-30%.

Coal for the plant would reportedly be low sulfur coal to be mined in Utah. It would be transported to the site either by railroad of by pipeline, or a combination. Additional transmission lines would have to be built to convey electrical power to substations for distribution. They would follow the existing lines from the Reid Gardner Plant to Las Vegas.

A separate environmental impact statement for this plant and power transmission facilities would have to be prepared prior to construction.

EVALUATION OF THE VIABLE ALTERNATIVES

Each of the four viable alternatives meets or exceeds the October 1973 water quality standards for Las Vegas Wash set by the State of Nevada and approved by the EPA. In addition, each alternative meets the project objectives and, in varying degrees, the water management goals and water quality objectives. The degree to which each alternative meets the project objective, water management goals and water quality objectives is discussed in the paragraphs which follow.

Engineering

Alternative 2, Complete Treatment, would treat the waste water to a degree which will allow direct reuse of the effluent. It would provide a flow of effluent to Las Vegas Wash which would be of a quality that would meet and exceed the effluent limitations. This high degree of treatment, however, would not be without certain liabilities. This alternative would use large quantities of electric power when compared to the other viable alternatives. In addition, it would use large quantities of chemicals which are expensive, and in some cases, in short supply. Finally, with the direct reuse of reclaimed waste water for domestic water supply purposes, there exists a potential health hazard. To date, the nation's health authorities have not approved any technique of direct reuse of reclaimed waste water for domestic water supply.

MONETARY COST EFFECTIVENESS OF FOUR MOST VIABLE ALTERNATIVES

Alternative	Description	Present[1] Worth of Capital Costs	Costs Per Million Gallons Treated: Capital[2] Cost	M&O[3] Cost	Total Annual Cost	Direct[4] Annual Revenues	Net Annual Costs
2	Complete Treatment	$155,216,000	$446	$446	$912	unknown	$912
3*	AWT & Return to Lake Mead	$ 87,288,000	$248	$128	$376	unknown	$376
7**	Combination Alternative				$467**		$437**
	(Export to Dry Lake Valley)	87,293,000	$248	$ 91	$339	($ 30)	$309
10**	Amended Combination				$438**		$322**
	Alternative	$ 89,373,000	$254	$130	$384	($116)	$268

1/ Includes the present worth value of all elements to be constructed between now and the year 2000. The in-valley irrigation system is common to all four alternatives shown in this table. In-valley irrigation represents a present worth capital cost of $13,377,000 and is included in the cost shown above.

2/ Derived by computing the annual capital cost using the "capital recovery factor" for 22 years at 7% and dividing the annual cost by the average annual flow for the period 1978 to 2000 which is estimated to be 31,025 mgy. In-valley irrigation is equal to $33 per million gallons for all four alternatives.

3/ Includes $13 per million gallons for in-valley irrigation for all four alternatives.

4/ Based on average annual flow delivered to the proposed Allen Power Project of 11,680 mgy and rates as described in the "draft" 4-party contract. (Calculation: $11{,}680 \text{ mgy} \times \frac{\$308}{\text{mg}} \div 31{,}025 \text{ mgy} = \$116$)

* Modified from Phase III Report; see discussion page VI-4.

** See Dr. Thorne Butler's comments in Appendix H.

table 26

Alternative 3 (Modified), AWT and Return to Lake Mead, will remove sufficient pollutants to meet the effluent requirements for discharge to Las Vegas Wash and, thus, will meet the water quality standards, for Las Vegas Wash. This alternative will have the lowest first cost of the four viable alternatives as well as the next to lowest operation and maintenance cost. It also has the lowest energy consumption. Reuse in this alternative discharge is limited to golf course irrigation which is presently practiced with secondary effluent and agricultural reuses. Industrial reuse is limited to the two power plants which are presently using secondary effluent. No new industrial reuses are scheduled with this alternative.

Alternative 7, the Combination Alternative, provides for exportation of secondary effluent. This alternative has a first cost about equal to Alternatives 3 and 10 and a low maintenance and operation cost. Power consumption is higher than with Alternatives 3 and 10. This alternative provides for some beneficial reuse, both for industrial and agricultural uses. The quality of this water would limit its use for irrigation purposes. The secondary effluent would be available for delivery to the Allen Power Project located near the final disposal site at Dry Lake.

During the public hearings held in August of 1972, there were objections to the concept of exporting and evaporating water from a desert community. This alternative does include a maintenance program for Las Vegas Wash; however, the water used for this purpose will not meet the effluent limitations for discharge into the Wash. The water quality standards for Las Vegas Wash could be met by the removal of water from the Wash by the proposed Wash ground-water collection system and pumping station. The Wash pumping station is located upstream of the sampling station at North Shore Road, thus, water discharged to the Wash for greenbelt maintenance is withdrawn and returned to export system for exportation to Dry Lake Valley. This alternative includes pilot scale AWT and desalination plants as well as a pilot ground-water recharge program. Information obtained from these pilot facilities would be used to design future facilities for expanded waste-water reclamation.

Alternative 10, the Amended Combination Alternative, provides AWT prior to discharge to Las Vegas Wash. The treatment process proposed would produce an effluent which would meet or exceed effluent limitations, thus, meeting water quality standards for Las Vegas Wash. This alternative emphasizes beneficial reuse including continuation and expansion of irrigation in the Valley and the providing of industrial cooling water. Also included is a pilot desalination and pilot ground-water recharge program. This alternative has the second lowest first cost and the third lowest annual operation and maintenance cost. This alternative has the lowest net cost after deducting revenues from the sale of reclaimed waste water to the Allen Power

Project. Energy consumption is comparatively low and this alternative offers great flexibility for future waste-water management programs.

Economic

Cost estimates and economic analysis were prepared for each of the viable alternatives in accordance with established criteria. Cost estimates were prepared for initial construction costs and planned future expansions. The Combination Alternative (No. 7) and the Amended Combination Alternative (No. 10 both have direct income benefits from the sale of waste water for use as power plant cooling water. These revenues are included in the monetary portion of the cost-effective analysis.

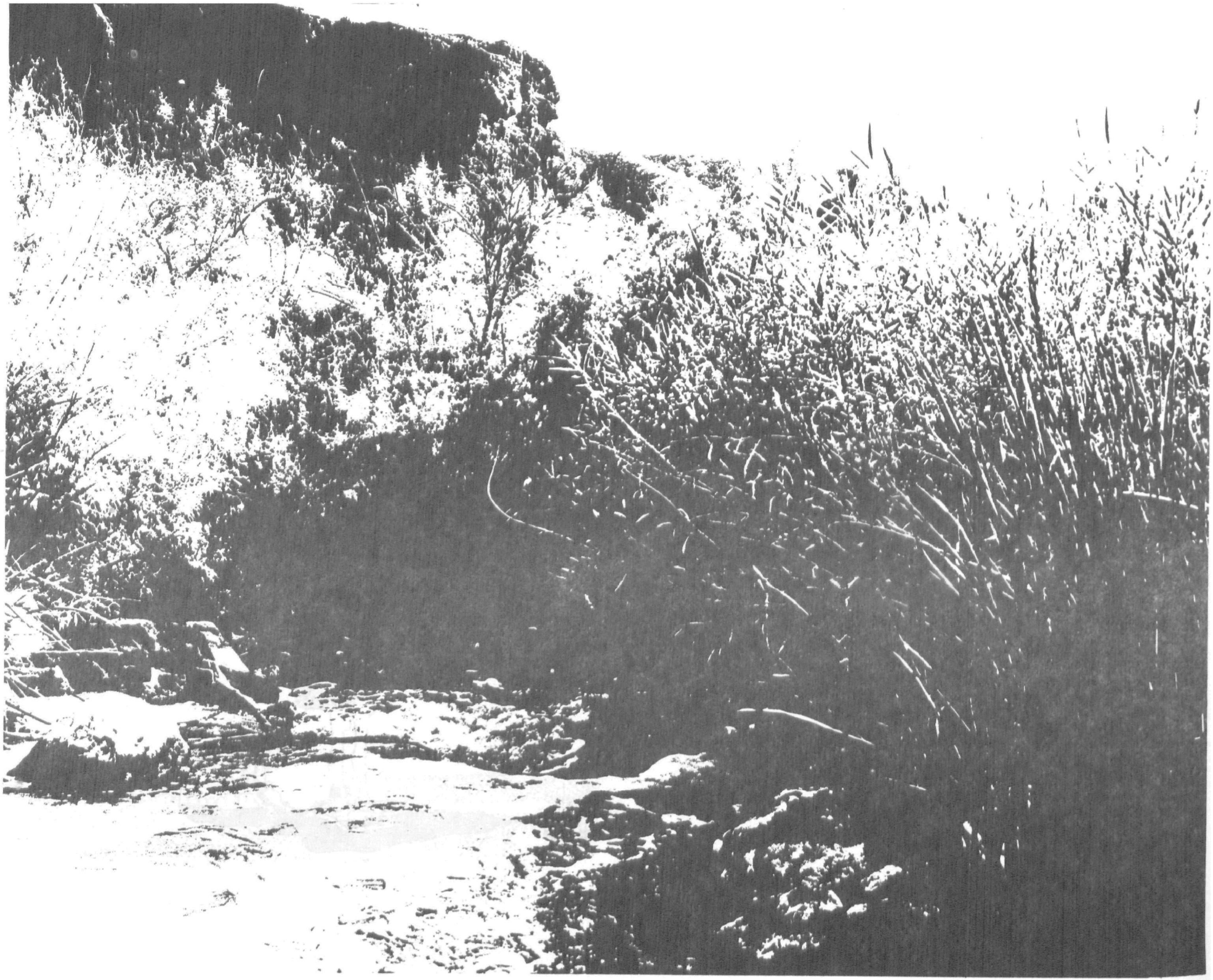
A summary of the monetary costs of the viable alternatives is shown in Table 26. This Table lists present worth of project costs as well as costs per million gallons (mil gal) of waste water treated. The capital cost per mil gal is developed by calculating the equivalent annual costs of initial construction and future project expansion then deducting salvage value. The equivalent annual cost is then divided by the average annual waste water flow over the planning period to derive cost per mil gal. The same approach is used to obtain maintenance and operation costs per mil gal of waste water. The total equivalent annual costs per mil gal is the sum of the annual capital cost and the annual maintenance and operation cost. The direct annual benefits or revenus are developed from the terms of the April 1974 draft of the proposed contract for the sale of AWT effluent to Nevada Power Company. The net annual costs are the difference between the total annual costs less the direct annual revenues.

THE NPDES PERMIT PROGRAM

The Federal Water Pollution Control Act Amendments of 1972 established the National Pollutant Discharge Elimination System (NPDES), a national permit program. Section 402 of the Act requires that municipal, industrial and other point source discharges obtain permits from EPA or its designated State agency for the discharge of any pollutant into the waters of the United States. The Act also requires that standards be established for discharges from most pipe sources, including publicly-owned treatment works. In the event that the effluent standards are not sufficiently stringent to provide for attainment of established water quality standards in the receiving waters, effluent limitations necessary to achieve compliance with water quality standards must be met. The date specified for achievement of secondary treatment, as defined in regulations published pursuant to the Act, or the treatment necessary to provide compliance with water quality standards, is July 1, 1977.

Since the flow in Las Vegas Wash will be almost exclusively effluent from the Clark County AWT Plant, and since

water quality standards for Las Vegas Wash are more stringent than secondary treatment effluent standards, the plant effluent characteristics will be limited by the NPDES permit to the level specified by the water quality standards. Other conditions of the permit will require: monitoring of the discharge on a daily basis, with reporting of results to EPA and the State Bureau of Environmental Health; provision of safeguards against electric power failure; and action to assure compliance with industrial pretreatment regulations published by EPA pursuant to the Act.



environmental impacts

Central to the evaluation of the viable alternatives proposed in the previous chapter is the varying environmental impacts that will result. Within this evaluation, both beneficial and adverse impacts will be identified. Adverse impacts which cannot be avoided will be highlighted in Chapter 4.

For organizational purposes, the primary impacts of the alternatives will be discussed first. Primary impacts are those impacts which have a more immediate affect on the environment as the result of an activity and are of a comparatively shorter duration than, let's say, subsequent ramifications of that primary impact. For example, noise of construction is a primary impact where the resultant disturbance to wildlife may be of a temporary nature. Both the primary impact and immediately identifiable impact subsequent to that primary impact will be discussed in this section.

Secondary impacts will be discussed next. A working definition of secondary impacts, as opposed to primary impacts, would be those impacts that are directly related to primary impacts but may not be readily apparent as impacts. To expand on the previous example of construction noises disturbing wildlife, a secondary impact may be a change in the balance of wildlife. In a long-term analysis, more adaptive species would possibly return to the impacted area and less adaptive species would seek new habitats. In such instances, the need for human intervention to mitigate and maintain balances within whatever wildlife habitat remains would have to be considered.

In addition to the adverse impact mitigation measures discussed in this chapter, measures designed to mitigate the adverse impacts will be considered in the next chapter as well. This will facilitate isolation of those impacts remaining even after all available mitigation measures have been undertaken.

PRIMARY IMPACTS

Impacts of Construction

Construction of waste water management

facilities in developed areas causes noise, dust, and inconvenience. These three impacts can be minimized by careful scheduling of work so designed to affect a minimum of people, watering to control dust, and requiring mufflers on construction equipment. Other construction practices which can avoid adverse impacts are: Providing adequate safety protection for motorists, cyclists, and pedestrians; disposal of spoil in a beneficial manner; and an enlightening education program to acquaint residents with the necessity and value of the project.

Construction in deserts and marsh areas causes noise, dust, erosion, spoil, loss of vegetation and disturbance of wildlife. These impacts can be minimized by restricting the area of facilities under construction at any one time, watering to control dust, requiring mufflers on construction equipment, restricting construction areas to minimize loss of vegetation, and restricting disturbance of areas subject to erosion. Other practices which can avoid these impacts include scarifying and watering compacted soil to encourage new plant growth; restricting equipment cleaning and maintenance to construction yards equipped to dispose of oils, fuels, and other substances harmful to vegetation, and wildlife; and locating construction stockpile areas to avoid areas of more valuable vegetation. The impacts of soil disposal can be eliminated or reduced by carefully locating such areas for beneficial uses or locating these disposal sites where minimal impact would occur. Soil could be used to construct pond dikes if the haul distance is not prohibitive. Where water tables must be lowered to bury pipelines, the time should be minimized so as to cause as little damage as possible to vegetation surrounding the area of construction.

The following impacts of construction could result from any construction associated with any of the proposed viable alternatives. The applicant's consultants have recommended that the mitigation measures that are discussed below be implemented.

Temporary roads, equipment storage sites, corporation yards, and construction sites cause the loss of vegetation. Temporary construction of this nature will destroy the native vegetation, compact the soil, and remove the top layer of soil. Regrowth and revegetation is retarded and can be further retarded by the dumping of equipment fuels, cleaning fluids and excess construction materials.

To minimize the impacts, all temporary construction of access roads, equipment storage sites, corporation yards, and construction sites should be restricted to the smallest compatible area. They should be located in areas where the least destruction of native vegetation occurs. Disposal of all construction wastes, equipment fuels, cleaning fluids, and broken machinery parts should be made at proper off-site disposal areas. After these temporary construction areas have served their purpose, they should be restored to

their original condition, or at least blended into the adjacent land form. Vegetation to be preserved adjacent to temporary construction areas should be identified and marked with measures taken to protect it.

The impacts from temporary access routes, equipment storage sites, corporation yards, and construction sites could cause the loss of wildlife. Vegetation provides food and cover for animals. The clearing of vegetation from construction work areas removes habitats, therefore removing both food and cover.

In order to minimize the impact upon wildlife from temporary access routes, equipment storage sites, corporation yards, and construction sites, all temporary construction should be restricted to the smallest compatible area. These temporary areas should be located where there will be the least destruction to wildlife habitat. The disposal of all construction spoils, equipment fuels, fluids, and scrap machinery parts should be done at proper off-site disposal areas. After temporary access routes, equipment storage sites, corporation yards, and construction sites have served their purpose, they should be restored to their original condition or at least blended into the adjacent land form. All wildlife habitats adjacent to temporary access routes, equipment storage sites, corporation yards, and construction sites should be identified and marked with measures taken to protect them.

The deposition of construction spoils on vegetation in undoubtedly destructive. The spoils "pile" in itself can be aesthetically undesirable, especially when spoils are a poor quality soil and natural vegetation regrowth is virtually not occurring.

The location of spoil areas is critical. A site should be chosen that covers the least amount of vegetation, particularly the vegetation used by animals for food and cover. The location of the spoil should not increase local land erosion or contribute to erosion in itself. Spoil areas should be molded to blend with local topography and be seeded or planted with localized native plants to blend with existing native plant material. Plant species chosen for revegetation should be from those native species which will flourish in the area and provide food and cover for wildlife. Fertilization and treatment of spoils may be needed to ensure adequate revegetation.

Dust created by construction activity can blanket adjacent vegetation and kill or injure the plants, thereby reducing habitat (food, cover) for wildlife.

Layers of dust on leaves reduce gas exchange and photosynthesis in plants. Plant survival potential is reduced, as well as food and palatability to wildlife. All construction sites, roads, and corporation yards where dust is created should be watered down as often as ne-

cessary to keep fugitive dust to a minimum.

Increased traffic on present roads and on roads under construction could result in the destruction or displacement of wildlife.

Increased traffic could increase the number of road kills of animals. A traffic accident involving a large animal such as a Desert Bighorn Sheep can also result in human injury. The activities of construction. . . human activity, heavy construction movement (subsurface vibration), noise, etc. . . . will disturb resident animals causing them to move out of the construction area. If the adjacent area into which the animals move is already at its carrying capacity for that species the population of the species will be reduced. For each species displaced, the adjacent population of that species will be affected. To minimize the impact of increased traffic upon wildlife, construction crews and other project-related personnel should be made aware of road-kill hazards. Roads in construction areas should be posted with warning signs for animal crossings. Noise and construction activities should be kept to a minimum needed to perform the work. Temporary access routes, equipment storage sites, and corporation yards should be located in areas of low wildlife density. Temporary fencing or barriers should be placed at heavily used wildlife crossings.

Construction activities such as movement of diesel-powered trucks, earth movers and associated equipment would create short-term noise impacts on the area. These noise impacts would last from the time of construction commencement to its completion. Wildlife would be affected by noise from these trucks adjacent to the areas of construction. Feeding bird species and mammals close to construction roads would likely be displaced and may feed elsewhere or return to the area after the noise ceases. Sustained high noise levels may affect animals that rely on the use of auditory signals to detect and locate prey, evade predators or stake out territories.

Proper use of muffling equipment and noise baffles on construction equipment would aid in reducing some noise emission. In addition, the timing of construction activities in relation to the seasonal abundance and critical use of the area by wildlife would also reduce the impact. In general, the time of greatest impact would occur during the spring breeding season.

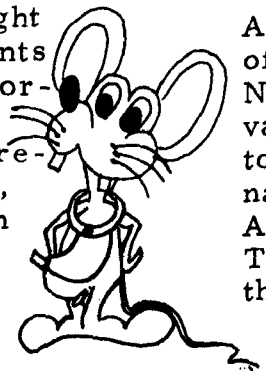
Construction equipment used on a project would be operated with the standards expressed in the Occupational Safety and Health Act (OSHA) which stipulates permissible levels of sound and duration of exposure to construction workers. Additionally, construction activities should only proceed during a 12-hour work period

day during the normal week, thus eliminating the noise exposure to weekend recreation and to local residents after the daylight hours.

Air quality changes related to construction activities are not expected to be significant on the study area. In areas where motorized equipment would be used, a modification in particulate and oxidant levels may occur. Any burning of brush and waste material would create localized, periodic area quality changes.

In order to minimize effects of construction efforts on local air quality, burning activities should be limited to times when atmospheric conditions are suitable and when the practice is absolutely necessary and material cannot be disposed of by alternative means such as shredding. The operation of diesel-fueled heavy equipment will not result in any significant air quality degradation.

The increase in human activity could cause an increase of litter in the project and adjacent areas. Construction personnel, if careless, can significantly add to the accumulation of refuse on the project site. Bizzare occurrences such as birds caught in plastic six-pack holders, small rodents and reptiles with aluminum pull tabs adorning their bodies, along with the refuse littered road sides are indicators of carelessness. If trash is allowed to collect, an increase in flies, rats, and mice can be expected.



To minimize the impact from increased human activity in the project area and adjacent areas, refuse containers should be readily available at all project construction sites. Refuse containers should be placed at all temporary observation areas. Frequent collection and disposal of refuse should be practices. All construction crews should use trash disposal facilities and encourage visitors to use the facilities provided.

Associated with the increased human activities is the degradation of the environment by human wastes. All of the remedial, protective, and mitigation measures discussed for increased human activities should be applied, along with the provision for adequately and conveniently located sanitation facilities for use by construction crews and visitors at construction sites and temporary visitor facilities. Human traffic may result in some destruction of the existing vegetative cover. All vegetative spoil which is removed will be chipped and spread in a manner which will not present a future fire hazard. No spoil will be burned.

Impacts Of Project Features in Common

As was discussed in the previous chapter, of the ten alternatives, four alternatives -- No. 2 - Complete Treatment; No. 3 - Advanced Waste Water Treatment and Return to Lake Mead; No. 7 - Combination Alternative and; No. 10 - Amended Combination Alternative -- were considered viable. The criteria for selection and screening of the alternatives that was done by the Appli-

cant and presented in Table VI-I of the Facilities Plan Annex A submitted to EPA in July of 1974 is reproduced in Table 23 and is concurred in by EPA. In addition, EPA's evaluation of the alternatives appears in Chapter 2.

Therefore, the impacts of the viable alternatives will only be discussed, as well as the alternative of "no action" in keeping with the letter and intent of the National Environmental Policy Act of 1969. Due to the need of the community to comply with the overriding immediacy of the EPA Pollution Abatement Notice to clean up the discrete pollutant contributions to Las Vegas Bay, as well as maximize the reuse and beneficial return of waste water within the hydrologic system, it would be extraneous to discuss the entire range of alternatives when certain alternatives would not be capable of satisfying these basic requirements.

Common to all of the viable alternatives that have been selected in the previous chapter are the impacts relating to the (1) collection system conveying wastes from the existing sanitary systems to the AWT Plant, (2) the advanced waste treatment plant itself and (3) the in-valley irrigation system. These impacts on the environment are discussed below, with modifications peculiar to each alternative presented in the discussion of each alternative. In addition, the impacts associated with pilot desalination and ground water recharge (Alternatives 7 and 10) and export to Dry Lake (Alternatives 2 and 7) are discussed herein.

Waste Water Collection System Impacts

Since the waste water collection pipelines will all be buried underground, the long-term surface and visual impacts will be minor. The pipeline alignment will be in such a manner to minimize disturbance to native plant communities.

The Henderson Pump Station and the AWT Surge Pond will create some visual impacts. These visual effects can be reduced by providing attractive design in landscaping.

The surge pond will permanently remove approximate 8 acres of vegetation and wildlife habitat.

The ponds, pump stations and treatment facilities will increase the ambient noise level in the area. The pump stations should generate noise only noticeable up to 300 feet from each station. The AWT and desalination plant would create a smaller amount of noise.

The pump stations to be constructed at the Henderson Treatment Plant and the Las Vegas Wash subsurface drain will increase the ambient noise levels of these two areas to a small degree.

These facilities would create some amount of odor. Odor created is dependent on many factors, mainly the degree of treatment, the quality water received before entering the reservoir.

A noticeable odor immediately around the surge pond is expected. If the reservoir becomes odorous, aeration may solve the problem. Aeration may also create some odors if there is a great amount of organic material in the waste water. Chlorination and reduced aeration would reduce odors to the greatest extent.

Periodic pond cleaning should be practiced to remove accumulated solids and algae. These solids should then be transported to a designated sanitary landfill or to the sludge disposal pond. Furthermore, design of the surge pond should specify that the pond be deep enough to prevent substantial algal growth on the bottom Algae growth can be effectively controlled by using short retention time in the pond.

The asphalt lined ponds will prevent waste water high in salts and nutrients from percolating into the ground-water system at this site.

If a power shortage longer than 24 hours were to occur, spillage into the Wash and then into Lake Mead would occur.

Impacts From the Advanced Waste Water Treatment Plant

The addition of an advanced waste water treatment facility to the existing secondary systems of the City of Las Vegas, Clark County and Henderson, will aid greatly in reducing water pollution to the Las Vegas Wash and Bay. This is considered to be a long-term beneficial impact. In addition, by providing a centralized AWT facility, the effluent quality can be more carefully controlled as compared to the higher variable quality of effluent produced from the three existing systems. Instead of having three separate points of discharge as with the existing system, the proposed system will have only one.

The AWT system will provide for a substantial flexibility in the treatment and management of waste water in the Las Vegas area. The modular design of the plant will ensure that proper sewage disposal is maintained as the population of the Las Vegas Wash increases by allowing for both expansion of capacity and the addition of new treatment devices as required.

Construction of the AWT Plant will necessitate the conversion of 80 acres of irrigated pasture and adjoining salt bush, seep-weed and bassia close to the Wash. This land use change will result in a displacement of grazing practices and the wildlife species associates with the agricultural practices and the adjacent natural vegetation.

The AWT Plant processes may create some unpleasant odors which will have impact upon the surrounding area. The generation of odoriferous gases is likely to be minor and difficult to assess due to the close proximity of the existing secondary treatment facility (trickling filters) which at the present time create offensive

odors to adjacent residents. Any odors that are created can be alleviated by the use of sanitary operational techniques, chlorination and injection of deodorizing chemicals into the air, and fuel air collection and treatment.

The expected impact from noise created by AWT operations is expected to be slight. The only noise sources will be from pumps, fans and motorized vehicles. All equipment concerned with the operation and treatment that would generate noise will be located within buildings insulated or baffled to reduce noise.

In the advanced waste water treatment plant, the calcining furnace for Alternatives 3 and 10 is the greatest source of uncontrolled particulate emissions. A multiple-hearth furnace is to be used and the emissions from it are characterized as moderate to heavy. The calcining temperature is sufficiently high to cause the discharge of a high proportion of submicron particulates which makes the control problem difficult. In the process it is intended to recycle the CO_2-content gas stream from the calciner. However, there will be periods, during initial startup, shut-down, for equipment malfunctions, etc. when the gases will be discharged to the atmosphere. Therefore, the particulate emissions control equipment must be designed for such periods.

The processing rates, discharged loading and gas flow rates of the calcining furnace are not yet finalized. However, with the addition of a refractary lined cyclone followed by a wet scrubber, the most stringent emission regulations of Clark County (Ringlemann No. 1) should be satisfied.

A properly.designed wet scrubber would ensure collection of the submicron particulate. The liquid effluent from the scrubber can be recycled to the process.

The lime feeding, transfer, and flaking operations could be particulate emission sources if conventional control equipment were not provided. Through the use of fabric filters for the feeder and pneumatic and/or mechanical transfer equipment practically "zero" emissions can be achieved.

Truck delivery and make-up lime to the calcining systems can pose a serious particulate emission problem, depending on the truck type. If a fully-enclosed back vented pneumatic delivery type of vehicle is used, then the emissions will be negligible. However, a dump-truck will require an effective shrouding and ventilation system to minimize the escape of the very fine calcium oxide (CaO) particulates during the unloading operation. This material poses a health hazard and an air pollution potential so that its control will probably fall under OSHA jurisdiction. With an effective hood and ventilation system, the material can be easily collected in a fabric filter.

The presence of the AWT plant will create a visual impact on the area; however, since the facility will be adjacent to an existing treatment plant, the visual effect will be reduced substantially by using proper architectural design and landscaping. Where possible, the structures should conform to the surrounding desert environment. An attempt should be made to use local native vegetation in landscaping.

There is no NPDES permit at the present time for the proposed discharge and there are no official effluent limitations; however, an effluent quality equal to the water quality standards of the Las Vegas Wash would be acceptable for meeting any permit requirements.

All alternatives meet the Best Practical Waste Water Treatment Technology (BPWWT) requirements for treatment and reuse of waste water. In this alternative, heavy emphasis has been placed on reclamation and multiple beneficial reuse of the waste water resource.

Post aeration with chlorination will be used after advanced waste treatment to destroy pathogenic organisms and to remove nitrogen in its ammonia form. Residual chlorine can cause toxic effects on fish in Las Vegas Bay, however this can be minimized by ensuring that the chlorine addition is carefully controlled and that maximum mixing occurs with the Bay. EPA has recommended that post dechlorination prior to discharge of the AWT effluent to the Wash, be instituted, for all of the viable alternatives.

Impact on Las Vegas Lands to be Irrigated

Operation of an in-valley irrigation system utilizing AWT effluent would have all the benefits of the irrigation system proposed in the other alternatives. It would provide the same benefits as 2 and 3, and additional benefits to those of Alternative 7 due to the higher quality of the water. The health hazards associated with irrigation using secondary effluent would be substantially reduced; in fact, use of AWT effluent should not impose any undue risks to health because of the high level of treatment and reliability that exists with this process.

Increased irrigation of lands in the Las Vegas Valley will create new surface impacts. Those that do occur will be either beneficial or subtle.

Perhaps the most prominent impact will be the increase in green areas throughout the City. To many people, the presence of green belts are an amenity and a definite asset to the populace since they provide areas for recreation and a visual relief from the surrounding city or the starkness of the desert.

The application of additional water in

a normally dry, hot climate may produce subtle, microclimatic changes, particularly in terms of the humidity and temperature in the area where water is applied. This will constitute a minor impact; however, in an area of extensive irrigation the effects could be monitoried.

Ground water flowing toward the Las Vegas Wash as a result of irrigation could result in some changes in vegetation wherever more water becomes available to plants. This could likely occur in areas downslope and adjacent to lands to be irrigated. These changes may occur subtly or where there is substantial irrigation runoff, the vegetation changes may be substantial.

Some areas presently irrigated with secondary treated waste water may be converted to AWT water as it becomes available. This conversion will create some beneficial impacts, one of which will be a significant reduction in the presence of odor now created by application of secondary water. Also, the elimination of soil clogging by nutrients and suspended solids may be realized. Of principal importance is the reduced health hazard in irrigating with a highly treated waste water.

Irrespective of what alternative is selected as the proposed project, pipelines will be constructed to deliver reclaimed waters.

By the year 2000 the theoretical requirements of the In-Valley irrigation system could surpass 70,000 acre-feet per year. Expansion of neighborhood and regional parks within the Valley could add as much as 9,000 acres of grass and greenbelt to the existing system.

More realistic projections of the anticipated new irrigable acreage which could easily be served by AWT plant effluent, indicates that a maximum of 25,000 acre-feet per year of reclaimed waste water could be disposed of within the Valley by 2000. On completion of all stages of In-Valley irrigation an annual supply of about 20,000 acre feet, is anticipated. The main factors discouraging a more extensive irrigation system include:

- Sites which are too remote from the effluent sources
- Small size of many of the new sites will make the service costs prohibitively high.

The most beneficial aspects of In-Valley irrigation are from water conservation benefits. Every acre-foot of reclaimed waste water which is used for irrigation purposes is one less acre-foot which will have to be taken from the potable water supply. In-Valley irrigation is beneficial because it is a recycling process of a scarce resource.

From the adverse side, any increase

in the irrigated acreages within the Valley will be ultimately reflected in poorer water quality of the waters within Las Vegas Wash. In previous sections it has been shown that the soil column within the basin is vulnerable to salt leaching to the environment from surface irrigation.

Due to the geology of the Valley, it is believed that some of the near surface groundwater will ultimately migrate down gradient and discharge into Las Vegas Wash. The increased salts which are added to the system due to the initiation of irrigation practices will contribute greater TDS concentrations to the near surface groundwater.

Much of the groundwater within the near-surface aquifer system is located in areas physically remote to the Las Vegas Wash, and the fact that these shallow aquifers are often made up of sediment with low permeability will tend to offset the near-future salinity impact. There are sectors of the Valley where it might take hundreds of years for the salt (within the near-surface aquifer) to migrate to the Wash.

Therefore, any effort to increase the irrigated acreage within the Valley can only move in the direction of greater degradation of the waters in the near surface aquifer system. This is the case whether the irrigation water supply is potable water or reclaimed waste water. If the piezometric levels of the potable aquifers continue to drop, there is also the possibility of the near-surface aquifer recharging the deeper zones due to the shift in potentials.

Prior to the implementation of any of the proposed projects, it is recommended that a network of observation wells be constructed adjacent to selected In-Valley irrigation sites. This network should be designed to monitor the near-surface and a shallow aquifer system contiguous to the irrigated areas. Several monitoring well nests should also be constructed adjacent to Las Vegas Wash down gradient from the irrigated areas so that the movement and quality of the return flows can be traced.

Construction of a minimum network of wells will provide the County with the necessary baseline data (both water table elevation and water quality measurements) prior to initiation of the In-Valley irrigation element.

A tentative water quality sampling procedure should be adopted to ensure that the representative data is collected from each observation well. These procedures along with the location of sampling stations, frequency of sampling, and constituents to be monitored should be delineated in the plans and specifications submitted to EPA.

Impacts of the Pilot Desalination Program

A pilot desalination program is proposed

in conjunction with this alternative to accomplish the following objectives: 1) Determine the feasibility of desalting AWT effluent; 2) Evaluate the specific desalination pretreatment requirements; 4) Investigate health hazards and; 5) Investigate environmental impacts of a desalination operation.

The plant would produce about 1.0 mgd of high quality reclaimed waste water. This would provide sufficient capacity for the proposed pilot ground-water recharge program.

The pilot desalination plant would cover approximately two acres of land. This would represent a permanent commitment of land resources and the elimination of existing vegetation and wildlife species.

The operation and maintenance of the pilot plant facility would produce increased noise levels in the area. The source of this noise will include feed pumps, degasifier blowers and numerous other equipment such as the pumps necessary for the flushing, cleaning, chlorine booster and waste-brine processes. The estimated noise emissions of the desalination equipment should be determined and plans developed to reduce the noise levels by use of housing and baffles.

Operation of the pilot desalination facility would require additional electrical power. Estimates of electrical needs are 13 KWH per 1,000 gallons of desalinized water produced. Expected production of desalted water would be 1 mgd which will require approximately 13,000 kilowatts per hour of electricity per day.

The desalination facility would produce a highly concentrated waste brine which could be disposed of in one of three ways: 1) Lined evaporation ponds near the desalt plant, 2) Removal to AWT sludge disposal ponds and; 3) Discharge to the City waste water collection system. The brine waste would include concentrated salts, heavy metals and possibly small amounts of chemicals and resins. If a brine evaporation pond facility is used, the water would be evaporated with the brine residues left behind. These deposits would have to be periodically removed and disposed of at a selected land fill.

Since the specific characteristics of the waste brine are not yet known, a continuous monitoring program would have to be conducted to measure heavy metals, total dissolved solids and other water quality parameters during the pilot plant operation. If heavy metal concentrations are found to be excessively high, removal by precipitation or other processes may be necessary.

The pilot desalination plant would likely emit small amounts of water vapor from the degasifier unit and blowers. This constitutes a minor impact.

As a result of construction of the pilot plant, some long-term visual changes

in the area would occur. The area is presently a well field with a power substation and water tank. Landscaping and architectural design of the structure would minimize any undesirable appearance features of the plant.

Impacts of the Pilot Ground-water Recharge Program

A pilot ground-water recharge program is also proposed as an integral part of this alternative. This alternative is proposed to accomplish the following objectives: 1) Determine the feasibility of recharging high quality reclaimed waste water into the Valley's ground water formation; 2) Formulate recharge methods of injecting effluent water for future use as a supplemental water supply and; 3) Determine water quality requirements for recharging water.

The experimental recharge well site and related facilities would permanently eliminate approximately two acres of wildlife habitat in vegetation. Since much of the area has been significantly disturbed, this impact would not be significant.

The recharge well and facilities would cause a permanent change in the visual environment of the area. In order to minimize the impact of the well housing structure on the surrounding environment, the facilities should be designed to conform with the desert environment and to be as unobtrusive as possible. The area should be landscaped to include shrubs and trees that would aid in shielding the structure from adjacent residential areas.

Pumps and related equipment may create noise levels that would adversely affect adjacent residents. In order to properly determine the expected noise levels of the equipment, noise sources should be identified and the estimate noise output determined. It would then be possible to determine methods such as enclosing pumps or providing baffles to reduce noise levels that are above ambient and considered to have an adverse effect.

Subsurface impacts due to operation of the injection wells for Alternatives 7 and 10 are largely problematical. Injected water may cause some changes. The two waters may be chemically incompatible and may dissolve additional minerals from the aquifer; or they could react to form a precipitate that would cause clogging of the injection wells. Testing of the two waters and additional treatment of the waste water, if necessary, would eliminate this impact. Contamination of subsurface waters can be avoided by injecting water of at least equal quality to that of the selected aquifer.

Injected water will be warmer than that of the middle aquifer. The impact of this is not known. Recharge of the middle aquifer utilizes short-term storage of water to be withdrawn and beneficially used by man; it provides some biological treatment, reducing bacteria, viruses, and remaining organic material; slows

the rate of subsidence in the ground caused by continual depressurization from pumping out of the middle aquifer, if injected near production wells; and moves towards offsetting the trend of depleting ground-water resources.

A comprehensive monitoring program, if implemented, will identify any impact which may occur.

The experimental recharge well would be drilled into the middle aquifer (500 to 700 feet below ground surface), and sized to recharge 1.0 mgd of desalted effluent. It is estimated that the product water from the desalination plant would have a TDS concentration in the range of 300 mg/l. This is close to the background level of potable ground water of the middle zone in this sector of the Valley. A series of ground water observation wells would be installed in the vicinity of the recharge wells to monitor the effects of the injection operation on the ground-water system. This monitoring would permit identification of any potential degradation of the potable water supply.

Implacement of renovated waste waters by well injection into the middle zone of aquifers could enhance the environment by conserving reusable waters that normally would have been discharged out of the Basin. A continuous discharge of 1 mgd would add 1,120 acre-feet per year of potable water into the basin water supply. Since the product water utilized for injection is close to the background TDS level of the middle zone, there would be no adverse salt balance effects due to this operation.

During the initial stages of the experimental recharge operation, the recharge well would be supplied with ground water. A system of observation wells should be provided to evaluate the response of the ground-water systems to the recharge operation. This system of monitoring wells could permit termination of operation in the event that undesirable effects or problems develop.

Impacts of Dry Lake Disposal

The following discussion concerns the impacts of Alternatives 2 and 7 in using the Dry Lake area, a closed basin sink to the northwest of Las Vegas, for waste water and/or brine disposal.

Ponds located on the alluvium above the lake beds will have pervious dikes and pervious bottoms. Evaporation will increase salt concentration somewhat, but continual percolation will prevent significant salinity buildup. Water which percolates in Dry Lake, will reach a clay lens and flow underground towards the center of the lake bed (or if there is no clay layer, as in Jean, Hidden, and Eldorado, will percolate downwards to join the deep ground-water system). Where good clays exist in the lake bed (Dry Lake and Eldorado Lake), water logs will occur by evaporation, allowing salts to continuously build up in the lake waters. The salinity in the evaporation ponds will

gradually change from relatively low in the higher pond, to relatively high in the lower pond. Storm flows may occasionally dilute concentrations in the lake beds, but presumably storm runoff will be kept out of the ponds.

Of special interest to the ecology of the treatment ponds are toxicity, nutrients, dissolved solids, and temperature. Acute toxicity from waste water is not expected to occur in the ponds if they are operated to make use of the volume of dilution made available through long detention and detoxification with time.

Several physical factors peculiar to this situation will affect the functioning of the pond. Among the most significant are solar radiation, wind speed and duration, soil type, and the actual configuration of the pond. The sun shines 86% of the time during the year with average air temperatures ranging from below 45° to over 100° Fahrenheit. Insofar as sunlight and temperature are concerned, biological systems may function at high rates throughout the year. Water temperature in the pond is expected to vary seasonally from 50° to 90° Fahrenheit. However, pond temperature will be influenced by wind behavior and water depth. Conceivably, water temperatures in shallow portions of the pond may at times exceed 90°. Prevailing winds in the 7-10 miles per hour range are expected to cause daily mixing of pond waters. Winds in the Las Vegas area may rise to 40-50 miles per hour, and on these occasions bottom sediment may be resuspended and cause increased levels of turbidity.

In cross-section, the ponds on the alluvium will be shaped like a wedge. The shallow water portion of the pond will influence its physical and biological nature. Heat adsorption and the stirring of bottom sediments will be greater in the shallow end of the ponds.

Depending on the degree of light penetration, mats of blue-green algae and colonies of sulfur bacteria may grow in the bottom. Plants which grow up and out of the water, such as cattail, tule, and cane, may also occupy shallow portions of the pond. Both the growths of bottom dwelling blue-green algae in marsh plants will have adverse impacts on the evaporative purposes of the ponds, and the dissolving of oxygen in the pond water.

Mats of blue-green algae may break loose from the bottom and float on the surface where they give off a foul odor. They also die and become resuspended in the water where they decay, consuming oxygen in the process. This decay, when combined with other factors, may cause the pond to go anerobic (stagnant).

Upright growing plants contribute to the filling of the pond with sediment, by producing and holding suspended material. During the winter, these plants die and contribute decomposable organic matter to the system. However, such plants

provide food, cover, and nesting habitats to aquatic wildlife. Biological productivity of higher plants and animals in the lower level ponds and lake bed is likely to be restricted by the level of total dissolved solids (TDS) which is expected to be 5,000 mg/l when operation begins.

Over the next five-years, it may build up to 45,000 mg/l in the lake bed. A TDS of 5,000 mg/l is expected to sustain plant growth and to provide drinking water for birds and terrestrial animals. It is not expected to provide habitat for common species of game fish. Certain fish which are able to tolerate wide ranges of salinities may be introduced in the Lake to control insects and other aquatic vertebrates, but they will not provide recreational use. Research would be needed to find game fish species such as the Corvina of the Salton Sea that could survive in the pond.

A rise in salinity from 5,000 to 45,000 mg/l is expected to reduce and eventually eliminate vascular plants from the lake bed and lower pond. As was predicted for the Salton Sea in California, a TDS of 45,000 mg/l is the upper limit for marine fish that may live in such highly enriched waters. Consequently, at a TDS of 45,000 mg/l, biological communities in the Lake would be reduced to simple communities of salt-tolerant algae and invertebrate animals.

During the biologically productive life of the ponds (long-term for higher ponds, five years for lower ponds), water fowl and native wildlife are expected to use the ponds as a habitat. A potential for water fowl botulism (a disease caused by bacterial toxins) exists in warm shallow enriched ponds of this type. However, this type of botulism may be prevented by the proper design and operation of the pond.

A riparian type of habitat (typical of stream banks) consisting of salt cedar and cat claw mesquite is expected to develop near the ponds. This vegetation will provide habitat for native animals and increase their density in the vicinity of the project. Irrigation streams would have to be implemented to provide controlled plant growth.

Recreational uses of the pond area are expected to be limited to viewing the scenery, birds, and terrestrial wildlife that will be associated with the pond. A study should be implemented at the time of construction and initial operation to determine the design and operating conditions that will provide optimum recreational benefits.

Because of the shallow depth and the prevailing winds, the lake beds would be turbid and the level of biological productivity is uncertain. With salt concentratiaons reaching high levels, greater than 45,000 mg/l, the Lake would become biologically of little value after about five years.

After desalination is added to the treatment process, slug flows of brine and some waste water will be pumped to the playa lake. This water is not expected to support life. Because of mixing by wind, it is likely to appear as a lake of muddy water surrounded by a white band of salt crystals. Some water fowl may use the lake surface for a resting area.

Water Quality

The elimination of secondary waste-water discharges to Las Vegas Wash will have a number of beneficial impacts on Las Vegas Bay, all of them related primarily to the quality of the advanced treated effluent.

The higher quality characteristics of waste water entering the Las Vegas Wash are expected to change significantly the character of the Wash. Initial changes will likely be minor since the water quality in the Wash is determined, in part, by ground-water inflows from a number of sources. The residual effect of the poor quality water will be slowly eliminated over time as the AWT water has a diluting effect.

Perhaps the most significant change will be the reduction in amounts of phosphorus entering the Bay. According to Deacon and Tews (1973), approximately 814 pounds of phosphorus enters Las Vegas Bay daily from the Wash. This amount would be significantly greater if it were not for the the vegetation in the Wash which assimilates a large portion of the phosphorus.

Existing phosphorus discharges from the City of Las Vegas and Clark county treatment plant are from 9 to 11 mg/l. Future discharges will be 0.5 mg/l or less.

Other water quality parameters will include suspended solids, biochemical oxygen demand, chemical oxygen demand and total dissolved solids; however, the reduction of TDS is likely to be minor in comparison to the total quantity reaching Las Vegas Bay daily. The amount of nitrogen entering the Bay has been estimated at 3,234 lbs. per day according to Deacon and Tews. Some reduction will likely occur as a result of AWT discharge; however, a significant portion of that amount is known to come from a non-point source near the BMI evaporation ponds. The effects of changes in water quality will, therefore, constitute beneficial impacts on Las Vegas Bay.

In addition to the expected changes in discharges to the Wash, the quality of the effluent will differ significantly from existing effluent characteristics. Table 27 lists the quality of the effluent from the treatment plants to be centralized and the effluent quality expected from advanced waste water treatment. As previously mentioned, one important characteristic will be the reduction in the amount of phosphorus in the effluent from the existing 9-10 milligrams per liter (mg/l) to approximately 0.5 mg/l.

EXISTING AND FUTURE WASTEWATER CHARACTERISTICS
OF CITY OF LAS VEGAS, CLARK COUNTY SANITATION DISTRICT,
HENDERSON, AND ADVANCED WASTEWATER TREATMENT PLANTS

Effluent Parameter	Unit	Clark Co.	City of Las Vegas	Henderson #1	Henderson #2	Future AWT (average monthly mean)
Suspended Solids	mg/l	38	18.4	NA	NA	2.0
BOD Biochemical oxygen demand	mg/l	30.5	14.7	NA	NA	10.0
COD Chemical oxygen demand	mg/l	128	NA	NA	NA	40
PO as P	mg/l	10.7	9	NA	NA	0.5
NH as N	mg/l	16	18	NA	NA	-
TDS Total dissolved solids	mg/l	1831	1058	2293	1000	1425-1725
Alkalinity as CaCO	mg/l	236	247	319	240	-
Hardness as CaCO	mg/l	546	413	825	270	-
Calcium as Ca	mg/l	124	80	305	100	-
Temperature (influent)	°C	25.2	22.7	NA	NA	27.0
pH		7.5	7.6	7.2	7.4	6.5-8.5
Chlorine residual	mg/l	2.4	1.0	NA	NA	-
LAS	mg/l	2.3	NA	NA	NA	-
Coliform		-	-	-		200/100
Dissolved oxygen	mg/l	-	-	-		5.0

table 27

This is evident by the low phosphorus levels at North Shore Road. The most likely affect of phosphorus reduction would be the loss of vigorous vegetative growth and possibly some die-off and composition changes. Because the definite effect of reduction of phosphorus levels to 0.5 mg/l cannot be determined without monitoring of vegetative trends, this will constitute a problematical impact.

When possible means of mitigating the effects of phosphorus reduction, if it was found to be a problem, would be the periodic discharge of controlled quantities of secondary waste water from the City of Las Vegas Treatment Plant. These releases would have to be made to provide the necessary nutrients to maintain vigorous vegetative growth without exceeding the water quality standards for Las Vegas Wash.

The discharge of AWT water in place of the secondary treated water will improve the desirability of the Wash in terms of aesthetic quality. This will constitute a beneficial impact. The presence of odoriferous and unpleasant looking waste water reduces the desirability of the area at the present time. Advanced waste water treatment will greatly reduce both of these unpleasant features.

The availability of good quality water will enhance the recreational and educational opportunities in the Wash. This is considered a beneficial impact. The Wash Development Committee, in a recent report outlined the educational and recreational development goals for the Wash based on the identified qualities of the area and the desires of the population.

The improvement of water quality in the Wash will reduce the health hazards potential. Advanced waste water treatment will significantly reduce biochemical oxygen demand and bacteria that was present in the secondary effluent. By decreasing the nutrient discharges, the likelihood of bacterial growth will be diminished. This will constitute a long-term beneficial impact.

Total dissolved solids or salinity realized through the advanced treatment of waste water discharge to Las Vegas Wash will result in a TDS reduction of 150 mg/l and have a beneficial impact on the Colorado River. The importance of controlling salinity throughout the Colorado River Basin goes without saying as borne out by the discussion in Chapter 1. It is estimated that the present economic impact of salinity for each milligram per liter increase in salinity at Imperial Dam may be as much as $160,000. Las Vegas Wash presently contributes an increase in salinity at Imperial Dam of 17-18 milligrams per liter.

In addition to the reduced salinity of advanced treated waste water discharge to Las Vegas Wash, export and beneficial reuse of waste water as envisioned in proposed alternatives 7 and 10 will divert

additional salts from the Colorado River. The reuse of waste water for cooling in the Allen Power Generating Facility will divert over 60,000 tons per year of salt from the river. In-Valley irrigation will divert over 235,000 pounds of salt per day; however, some portion of this diversion may return to Las Vegas Wash as diffuse subsurface flows.

Water Quantity

Any substantial increase in water volume entering the Wash would change the width of the stream and velocity of the flow. This increase in water will also create changes in the vegetative composition of the Wash. Areas now supporting the more arid plant species will likely shift to more moisture dependent species. The provision of a greater quantity of water in the Wash would allow for a greater variety of usage for wildlife and recreational enhancement in the Wash. There would be considerable beneficial impacts.

The substantial reduction or elimination of the flows into Las Vegas Bay from Las Vegas Wash will change the present characteristics of the Bay. Acute die-off of algae in Las Vegas Bay could occur, but will depend on the time of year that the flow is eliminated. A die-off would be most likely to occur if the flow is eliminated during the summer months. Such a die-off would be of a temporary duration lasting from two weeks to a month. Odorous die-off could be avoided by eliminating the flow in the Wash during the winter months.

Under modified Alternative No. 3, significantly more AWT water than provided for in the other alternatives would flow down Las Vegas Wash to Lake Mead. This is because there would be less provisions for beneficial reuse of water in modified Alternative 3 than in Alternative 2, 7 or 10, and no export out of the basin.

During the initial phase of operation, the amount of AWT water to be discharged to the Wash and ultimately to the Bay, will be greater than existing releases of secondary treated water. This waste water return to Lake Mead may be credited to the amount of water diverted to the Las Vegas Valley from the Colorado River. This water will also contribute a slight amount to the generation of power at Hoover Dam. These will both be beneficial impacts.

Due to alternations in the points of waste water effluent discharge and quality and quantities of discharge, changes in the Las Vegas Wash are likely.

It has been well established that monthly and annual fluctuations in waste water flows to the Wash have occurred in the past and will continue to change with the increase in water demand, reduction of non-point discharges to the Wash and greater demand for waste water reuse in the Las Vegas Valley. Table 29 shows

COMPARITIVE DISCHARGE SCHEDULES- 1979-2000

Year	Projected Wastewater Flow (AF/yr)	Projected Discharge to Las Vegas Wash (AF/yr)	
		Modified Alternative No. 3	Alternative No. 10
1979	68,000	68,000	63,520
1980	70,700	70,700	57,260
1981	73,400	64,120	40,264
1982	76,100	65,230	32,404
1983	78,800	63,810	26,506
1985	84,200	64,530	27,226
2000	123,200	103,530	67,117

table 28

the changes in flows to Las Vegas Wash for the years in 1971 through 1973. These flows are expected to continue to increase as the population in the Valley grows.

One of the most important aspects of the Las Vegas Wash is the relationship between average monthly waste water flows in Las Vegas and the amount of water measured at the U.S.G.S. Gauging Station at North Shore Road at the lower end of of the Wash. Figure 36 shows that although the peak discharges to the Wash (in terms of waste water flows) occur during the summer months, the lowest flows in the Wash also occur during that time period. This is undoubtedly due to the high rate of evapotranspiration in the upper Wash. In terms of continued maintenance of vegetation and water conditions in the Wash, this means that any future discharge programs related to the project will require determination of water requirements in the Wash on a month-to-month basis and water releases according to that schedule.

The reuse of waste water in Las Vegas Valley will reduce the demands for withdrawal on the Colorado River. Return of acceptable quality water to the river would go as a credit to Nevada's allotment of 300,000 acre-feet per year, thus adding to the amount of this valuable resource.

Water is not the only factor necessary for the maintenance of Las Vegas Wash. The majority of the Wash is on privately owned land. The long-term maintenance of the Wash is also dependent on some kind of public ownership of the Wash, be it buying the land the Wash is located on or acquiring a flow easement.

Flexibility in the system is one of the features that should be a major consideration in any proposed project. Waste water demand will fluctuate considerably from one month to the next and one season to the next. Any excess water will be released to Las Vegas Wash. The projected in-valley irrigation for 1982 will amount to 9.4 mgd; however, this amount may never be used for that purpose. Any amount not used will be discharged to Las Vegas Wash. With additional In-Valley irrigation, more water is expected to return to the Wash as underflow from the alluvial fan.

Vegetation and Wildlife

One of the features of all the proposed alternatives is the change in the point of waste water discharge to the Wash. Centralization of the City of Las Vegas, Clark County Sanitation District and Henderson Secondary Waste Water flows for advanced waste water treatment will eliminate existing discharges to the Wash from the City of Las Vegas and the Henderson Treatment Plant.

The effects of the elimination of discharge from the City of Las Vegas Plant will have the greatest impact on (1) vegetation

ESTIMATE OF ANNUAL FLOWS TO LAS VEGAS WASH AND LAKE MEAD FOR THE YEARS 1971 TO 1973

	Source of Discharge to Las Vegas Wash	1971 mgd	1972 mgd	1973 mgd
1.	City L.V. WWTP	20.99	22.00	27.60
2.	Clark Co. San. Dist. WWTP	7.90	10.00	9.00
3.	NPC - Sunrise Power Plant	0.20	0.20	0.20
4.	NPC - Clark Power Plant	0.94	0.70	0.70
5.	Nevada Rock & Sand near Sunrise	0.50	0.50	-0-
6.	BMI Pond Seepage	3.87	3.87	6.50
7.	Undescribed Sources	7.11	7.11	3.6
8.	From Las Vegas Valley	2.95	2.95	4.20
	TOTAL OF IDENTIFIABLE SOURCES	44.46	47.33	51.8
	Less evaporation & transpiration	-13.10*	-13.10*	-9.80
	Computed discharge to Lake	31.36	34.23	42.0

*Includes 3.3 MGD evapotranspiration below the geologic barrier.

Sources: NECON, 1971 and 1973; 1972 Environmental Assessment

table 29

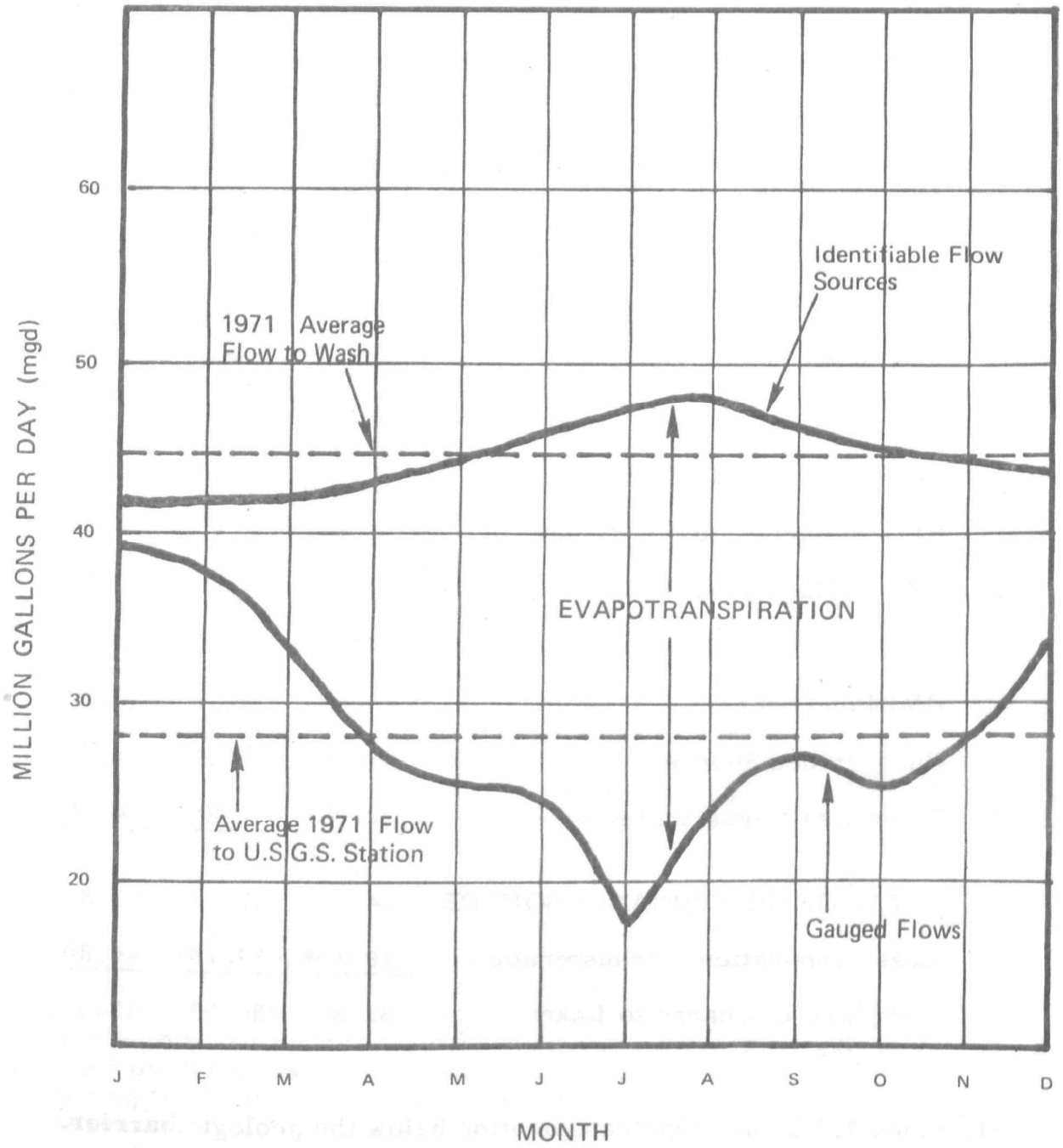


Figure 37

RELATIONSHIP OF AVERAGE DISCHARGES TO LAS VEGAS WASH PER MONTH (IDENTIFIABLE FLOWS) AND AVERAGE FLOWS AT THE U.S.G.S. GAUGING STATION AT NORTH SHORE ROAD FOR 1971

composition, (2) the amount and location of vegetative communities and (3) the wildlife use and species composition as a result of the floristic changes. Existing discharges above the Clark County discharge point, amount to approximately 27.8 mgd (City of Las Vegas Treatment Plant and Sunrise Power Plant).

According to Bradley and Niles (1973), the primary plant community above the Clark County Sanitation Plant is the salt cedar biotic community. With the reduced flows, the salt cedar community is likely to change into more arid and drought tolerant communities. Tolerant plants such as those characteristic of the mesquite or salt bush communities may be the replacement community. The total area to be impacted would amount to approximately 400 acres. Historically, this upper Wash area contained dense areas of mesquite which were maintained, in part, by the Las Vegas Springs which flow to Las Vegas Creek, so it seems likely that the mesquite community would again become dominant unless management measures are taken.

In the recent "Report to the Board of County Commissioners" by the Las Vegas Wash Development Community, recommendations for educational and recreational use of the area included maintenance of the salt cedar forest in the area of the Wash above the Clark County Treatment Plant. In order to accomplish this recommendation, changes in the proposed discharge regime will be necessary.

Any of the proposed methods would reduce the impact on upper Wash vegetation and wildlife.

In addition to vegetative changes above the Clark County Treatment Plant as a result of effluent discharge relocation, vegetation downstream is also expected to be altered. From the present until 1978 when the first phase of project operations began, the amount of water to be discharged to the Wash can be expected to follow the general upward trend as experienced in the past.

During the first two years of project operation, brine from the desalination plant proposed in Alternatives 7 and 10 may be discharged into the Las Vegas City sewerage system. This will amount to approximately 0.27 mgd of brine which will add approximately 15,500 lbs. of salt per day to the Wash. The result in change in TDS will affect those plant species of the Wash which are intolerant to higher salt levels. Consequently, there will be a transformation of some vegetative types with more salt tolerant species such as pickleweed, salt cedar, desert salt bush or four-winged salt bush. After the initial two years of the pilot program, brine will likely be disposed of by evaporation either at Dry Lake or at permanent evaporation ponds near the plant.

The more water released to the Wash, the area and the vegetative species composition are expected to change to more shrub and woodland and marsh vegetation types. In addition, the amount of surface water will likely increase.

This, in turn, will provide additional habitat for water-dependent wildlife species.

Beneficial reuse of AWT water, as in Alternatives 7 and 10, will require a reduction of discharges to the Wash as these reuse programs are initiated. This action would cause changes in downstream biotic communities and a reversion from moist to more arid condition.

In order to minimize the effect of flow reduction on Wash, vegetation and wildlife, recommendations have been made by Bradley and Niles (1973) and the Las Vegas Development Committee (1974) to: 1) Establish a management plan for the Wash to include such things as a levee system, check dam, etc.; 2) Release of at least 19 mgd of water during the critical summer months, 3 mgd during the winter and an annual 10 mgd; 3) A monitoring system in the Wash to determine changes in biotic communities as a result of changes in discharge regime and to determine if the above recommended releases are adequate or if additional flows are needed to maintain the Wash in a viable state. In order to ensure the perpetuation of Las Vegas Wash, these recommendations should be implemented.

Eliminating all direct discharges but allowing groundwater to continue flowing, will have an unknown impact on vegetation and wildlife. The quality of the groundwater will be worse than that of the present flows. Some areas may slowly die and, unless they burn, will remain as dead standing areas for many years. A slow succession of salt cedar will take place. If these areas are cleared off or burned, during times of heavy precipitation there will be no vegetation to hold the soil or catch water, resulting in erosion of nutrient-rich soil which then flows to Lake Mead.

The extent of the loss of vegetation and wildlife is directly related to the reduction of recreational use. Las Vegas, in its present environment, is not as productive as it could be. With less water than is now flowing in the Wash and the management program, the recreational value of the Wash can be enhanced.

The loss of marsh vegetation and habitat would be a long term adverse impact. Smaller wildlife such as amphibians would probably be lost. Birds and mammals of the lower Wash would be displaced. It is doubtful that this portion of the Wash is a major habitat area. Dr. Bradley and Dr. Niles give insight into the diversity and amount of use this area supports. The major impact of wildlife displacement will occur if surrounding areas are at their carrying capacity. If these areas, such as the upper marsh are at carrying capacity, then some wildlife will die, proportional to the amount of habitat loss, or reproductive rates could be reduced. The ef-

fect on terrestrial birds will be of small magnitude if salt cedar or mesquite are growing in the Wash. The displacement of wildlife is an adverse impact. If salt cedar continues to grow and replace the marsh vegetation, a beneficial impact could result.

Another potential impact that could result from the elimination of direct discharges to the lower marsh, is the impact on Las Vegas Bay caused by storm runoff. If the marsh vegetation dies, and the ridge no longer holds the soil, a large storm could cause silt to be carried into Las Vegas Bay. This addition of silt to the Bay would result in increased turbidity and nutrient concentrations.

Impacts of No-Action

The alternative of no-action would perpetuate the deteriorating water quality conditions now apparent in Las Vegas Bay. Municipal and industrial waste waters from the Las Vegas Valley along with highly saline subsurface flows which are discharged into Las Vegas Wash are the main sources contributing to this degradation. The principal effects of pollution have been algal blooms in the Las Vegas Bay of Lake Mead, and increases to the salt load of the Colorado River. Foreseeably, no action would allow gradually increasing, but uncontrolled amounts of water to flow down Las Vegas Wash, maintaining the riparian habitat.

It is a matter of conjecture whether or not the quality of water entering Lake Mead might increase or decrease. However, the total nutrients in salt loading would probably increase.

Algae blooms would continue producing odors, and eventually harming fish in the Bay. The increase flow would add some small values to the power generated at Hoover Dam, but would continue losses to downstream water users due to increased salt loading decreasing the quality of water in the Lower Colorado River System.

Ignoring the EPA enforcement action may precipitate court action by the U.S. Attorney General. A court order to cease polluting Lake Mead might be issued. The violators, including the City of Las Vegas and the Clark County Sanitation District, could be found guilty of contempt of court if present discharges continue. Fines and prison sentences could result. An injunction to prevent further connections to sewage systems in Las Vegas Valley could also be sought by the Attorney General.

Failure to meet July 1973, Nevada Water Quality Standards may result in the inability to obtain approval for subdivisions unless their sewage is treated to meet the standards. This is a result of a Nevada State law effective July 1972, requiring certification that sewage effluent meets discharge standards. A development could probably obtain approval if it were to treat its own wastes.

A No-Action alternative will not interfere with the construction of the proposed Allen Power Plant. Intentions of the Nevada Power Company to continue negotiations for the purchase of waste water for plant cooling will not be impeded. Purchase of secondary effluents from existing municipal discharges in the Valley would be capable of meeting cooling water demands. Therefore construction of the proposed power plant could proceed according to plan.

SECONDARY IMPACTS

Sewerage facilities, as do most public works projects, initiate and accommodate community growth by subsidizing resource development. This investment in waste water treatment provides for population growth by sizing the capacity of a treatment facility so that a community infrastructure, or interdependency of service and support subsystems will ultimately develop to an equal population equivalent. For example, services such as police, schools, fire, electricity, water, and roads will have to provide for the population capacity accommodated within the sewage treatment facility.

Therefore, the sizing of facilities can create or hinder an urban capacity, which in itself can be environmentally beneficial or adverse. In the previous section on Primary Impacts, many specific causes and effects were identified. In Chapter 1, a population base for the year 2000 was established at 700,000 in the Las Vegas Valley. The accommodation of this population given the environmental constraints identified in the INTRODUCTION, is more dependent on planning and regulation of development to delineate an adaptable urban form but there is an ever growing dependency on modern technology to achieve and maintain the quality of life for those future populations.

To the extent that the capital cost of sewerage facilities is very high and public grant assistance is used in construction, the subsidizing of facilities provides the community with the capability it would not necessarily have within its own financial resources. Hopefully the following discussion of secondary impacts provides the reader with a better understanding of such implications.

Economic Implications

The project costs of the waste water treatment system are expected to be based on a cost sharing formula consisting of a 75% contribution by the Federal Government and a 25% contribution from local governments. This is based on the stipulation that the treatment system protects the natural environmental and the overall long-term productivity of the area.

Local funds will be raised by the sale of revenue bonds. The bonds would be paid back by increasing the cost of sewer

service, water, or both. When the project reclaims waste water to provide a quality equal to that of domestic water, it is proper to increase the cost to reflect the added cost of providing water.

This project will require the acquisition of private land for a number of facilities. These include lands for the waste water collection system, In-Valley irrigation pipelines and reservoirs, the sludge disposal ponds, and whatever other facilities depending upon what the selected alternative projects will be. Cost of this land will vary according to the site, however, since many of the facilities are located in or adjacent to residential and commercial areas, the cost of acquisition of land, right-of-ways and severance fees will be substantial. These costs are contained in the main body and appendices of the applicant's facilities plan.

Construction and operation of the pollution abatement facilities will provide part-time and permanent jobs for contractors, laborers, engineers and personnel to man the new facilities. A significant portion of their earnings would be spent in the Las Vegas Valley.

Growth Accommodations

Nine of the 10 project alternatives (see 'no action') and all four of the viable alternatives enable growth by providing waste water management facilities. Some growth is going to take place in the Las Vegas Valley, but how much growth and the rate at which it occurs depend on what the people of the Las Vegas Valley desire. Through planning, regulation of development activities, and the continued application of modern technology, any eventual urban form will have to be within the environmental constraints of the Valley. The responsibility for growth rests with the County and local government bodies. Utilities will continue to provide power, water, proper waste disposal, and treatment if growth is to continue with a minimum of adverse impacts and as long as means are available. This requires planning by the utility agencies so that pollution of the environment does not take place.

Growth results in increased construction, increased power demands, increased transportation demands, increased support services demands, and increased water demands. All of these increased needs result in a greater commitment of resources, a reduction of air quality, and increased noise levels to perpetuate the lifestyle as it is known to exist.

Alternative 9 (the no-action alternative) would have the practical effect of preventing growth. However, no action does not resolve the continuing water quality degradation of Las Vegas Bay and therefore is not a viable strategy for regulating or stopping growth. Due to the nature of the study area, tourist visitations are expected to increase, limited by hotel capacities and available service employees. The result would be a slowed

rate of increase in power, transportation, and water demands. Construction and growth would be limited to those developments providing their own waste water disposal to be able to meet water quality standards. Unless planned, the regulation of growth can be economically detrimental, yet environmentally beneficial.

The consolidation, expansion and upgrading of waste water treatment can be viewed as accommodating further population and economic growth in the Las Vegas Valley rather than inducing development. The first modular phase of the AWT plant would begin operation in 1978 and would have a capacity of 90 mgd. With the projected maximum day waste water production of 85.2 mgd by 1980, the initial AWT plant will have a reserve capacity of 4.8 mgd. The second stage of AWT would be on line by 1982 and would provide for a maximum AWT capacity of 112.5 mgd (90 mgd + 22.5 mgd). This capacity will be sufficient until 1990. The construction of the third AWT stage will provide an additional 22.5 mgd capacity which would be sufficient to treat the waste water flows until year 2000.

A major question to consider when evaluating the role of the waste water treatment system as a growth inducing factor, is whether or not the projected population figures for the area appear reasonable and particularly if the area can adequately support that population environmentally. For the Las Vegas region, the environmental constraints that might well dictate future population growth may be the maintenance of air quality, the maintenance of water quality, and the availability of future potable water in the Las Vegas Valley. The latter questions are considered in succeeding portions of this impact section. The question of the relationship between the Allen Power facility and the availability of AWT is considered next.

The Environmental Impacts of the Allen Power Generating Facility

Regardless of the alternative selected, the Allen Power Plant may or may not be constructed. This plant is dependent upon a water supply of 36 to 38 mgd. According to the Nevada Power Company, the only source of cooling water for the plant is effluent from Las Vegas Valley. Although a separate impact statement is required before the plant can be built, the impacts are considered here on general terms.

The Allen Power Plant will provide power for use by man for light, heat, and energy for a variety of uses. Air conditioning currently consumes over half of the power used in Las Vegas, and enables life in the desert on a comfortable basis. Power is also required for pumping and treating waste water, especially in desalination processes. The various electric consumptive rates for the viable alternatives are indicated in Table 24. Nevada Power Company's projections show that 70% of the power will be used by the customers of Southern California Edison Company

and 30% will go to the customers of Nevada Power Company from 1977 to 1983.

From 1984 to 1990, there will be a 50-50 benefit split, and between 1990 and 1994, Nevada customers will regain 100% of the power. The plant will enable growth in electrical consumption by providing power for increased populations.

Through sale of power to Southern California Edison, it can be expected that demand will justify development of replacement generation facilities to the SCE service area once the Allen plant output is no longer available. Therefore, the Allen Power Plant will accommodate continued growth and consumptive use of power in the Southern California service area.

The plant will discharge large quantities of waste gases into the atmosphere. Operating at 80% of capacity, the plant will burn about 16,000 tons of coal per day, producing 34.5 tons of sulfur dioxide (SO_2), 150 tons of nitrogen oxides (NOX), 14.4 tons of particulate matter, and unknown quantities of other gases. Quantities are based on maximum allowable emissions under Clark County and EPA Standards in the assumption that these standards can be met. Gas emissions may be confined in Dry Lake Valley by inversion layers, or may be conveyed by winds to the populated areas of Las Vegas Valley on occasion, causing a decrease in visibility and a degradation in present air quality. Wind direction data for Las Vegas (HEW, June 1970) indicated that this could occur perhaps 10% of the time in winter and perhaps 6% of the time in summer. No climatological work has been done to verify wind directions at the plant site, and therefore these projections are speculative.

Plant emissions will occasionally be carried by wind into the Desert Bighorn Sheep refuge presently being considered by Congress as a part of the National Wilderness Preservation System. Desert Bighorn Sheep are a fragile species for which hunting is restricted by law. The percentage of time that winds will blow in this direction is unknown, and the effects are unknown, although the presence of man interferes with the sheeps' normal behavior.

Plant emissions may be reduced through sophisticated control devices. The efficiency of these has been questioned in conjunction with existing power plants, particularly the Mohave plant in Clark County. Complete elimination of the waste gases would occur if a nuclear plant were constructed instead. However, there is no need to expand on the environmental risks of such a trade-off.

The Allen Power Plant will require a long-term commitment of water for cooling. When water is used in the generation of power, it is by definition a beneficial use. If that water could be

put to a more beneficial use, and the commitment of its use for power generation prevents that, then an adverse impact results. Nuclear power also requires cooling water usually in increased amounts.

The agreement between the Nevada Power Company, Clark County, and the City of Las Vegas provides that in the event AWT effluent is not available by 1979, the Nevada Power Company may elect to purchase secondary effluent from the City and District.

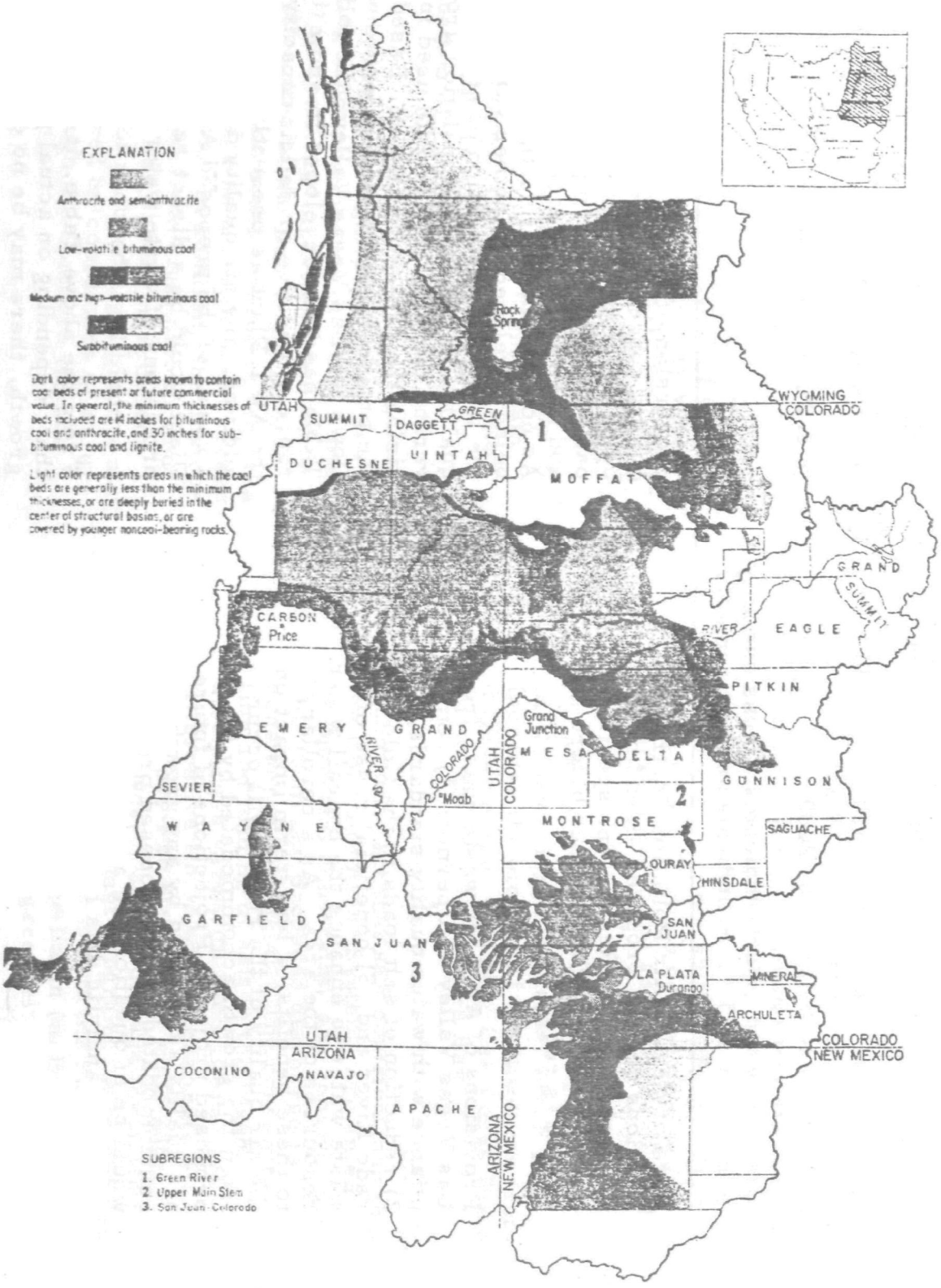
Operation of the Plant will require the burning of 5.5 million tons of coal per year. The Nevada Power Company will purchase coal mined for the specific purpose of supplying the Allen Power Facility. Strip-mined coal will be transported by a slurry pipeline some 175 miles south to Las Vegas. Coal field locations in Utah are identified in Figure 37. At the time of the writing of the Impact Statement for the Allen Power Facility, EPA requests the priviledge of commenting on the potential impact to water quality resources that may result from the mining operation. Of further interest is the fact that an additional coal-fired power facility located in St. George, Utah will supply Las Vegas with an additional 500 megawatts and is scheduled for first unit completion in 1978. Coal is a limited irreplaceable resource. Commitment of such a resource reduces reserves for future generations. The Power Plant and associated transmission lines will change the desert scenery and add noise.

Operation of the Plant provides solid wastes which must be disposed of. Based on Southern Nevada Power Company statements that all wastes will be reduced to solid form, the impacts of disposal are related to the use of the wastes. If it is used beneficially for man, it would be considered a beneficial impact. If it were piled on mounds in the desert, it would constitute an adverse impact.

Implications on Regional Air Quality

The major air pollution sources considered for the proposed project are construction activities, motor vehicles, and the advanced waste treatment plant. A discussion of the impact on air quality from construction activities and emissions from the advanced waste treatment plant were presented in the preceding section of this chapter. The following discussion considers the impact of the proposed project on a broader frame of regional air quality.

Motor vehicle emissions immediately related to the AWT Plant are induced by the vehicle volumes generated by operating and maintenance personnel. It is assumed that neither facility will constitute a significant tourist attraction. It is estimated that the AWT Plant will require from 25 to 30 men per shift. Thus, a maximum of about 40 spaces for parking will have to be provided. The emissions associated with this number of parking spaces would be negligible. In addition, the existing



Coal deposits in the Upper Colorado Region.

figure 38

PROJECTED AWT PLANT
RESERVE CAPACITY

Year	AWT Cap. (MGD)	Range of Excess or Deficit Capacity
1980	90	+ 9% to - 0.4%
1990	112.5	+ 5.6% to - 10.5%
2000	135	+ 3.9% to - 16.4%

\+ indicates excess capacity
\- indicates deficit capacity

State of Nevada Air Pollution Control Regulations and the proposed amendments to Clark County's Regulations specify a cut-off of 500 parking spaces before a review is required

Provisions of AWT for waste water from Las Vegas Valley will permit: 1) compliance with water quality standards, 2) reduction of salt loads to the Colorado River and, 3) beneficial reuse of waste water to enhance the overall water resources of the area. As a corollary to these benefits, a long-term impact on the air quality of the region will occur from the growth accommodated by the proposed project. Projections of future air quality as affected by any growth accommodated by the proposed project would be of questionable accuracy since the basic analytic data has yet to be developed.

Additional meterological data for the Region is specifically patterned for the conversion of source emissions to air quality concentrations. This data is now being developed. Knowledge on wind patterns, vertical temperature structure, and inversion incidence will be monitored. As noted in Chapter 1, these data are being developed. Another variable in the long-term projection of regional air quality, is the actual population growth versus the projected growth used in sizing the project facilities. Based on the projected maximum day waste water flows for Las Vegas Valley, the following Table has been developed to show the range of reserve or deficit capacity of the AWT Plant as presently planned. In addition, any air quality degradation as a result of the proposed Allen Power Plant would be a direct result of the provisions of waste water facilities.

From the above Table, it can be seen that, depending on actual population growth, there may be no excess plant

capacity at some time in the future. However, the time spans considered over the life of the Project will permit interim actions to be responsive to: 1) actual needs, 2) changing regulations, and, 3) advances in technology. The potential impact on regional air quality in quantified terms is problematic.

Water Quality Implications

Since all of the viable alternatives, in part, provide for the AWT of waste water and return in part to Las Vegas Wash, varying solutions will have varying consequences on water quality. All of these alternatives will meet the Nevada State and Federal Water Quality Standards and the salinity reduction objectives of the Colorado River Basin Salinity Control Act, as adopted. No action would result in the further degradation of Las Vegas Bay.

Any decrease in algal populations resulting from phosphorus decreases may have a beneficial impact on the quality of recreation in the Las Vegas area. Maintenance on boats moored in the area should decrease as a result of decreases in algal growth. In addition, the noxious odors produced from algal blooms and die-off in the Bay should be reduced. The benefits of reduced algal blooms may also be realized by consumers of water supplied through the Southern Nevada Water Project.

Some shifting in the distribution of biota may occur as result of any changes in algal populations. According to Deacon and Tews, thread fin shad, characteristically concentrate at the thermocline of Las Vegas Bay, probably due to the presence of large amounts of organic debris from which they feed. Much of this organic debris is provided by flows from the Wash and from algal production. Reduction and dispersion of organic matter and algae may cause these fish to eventually redistribute, however, this appears problematic. This may consequently result in a shift in the carniverous game fish which depend on thread fin shad populations as a source of food.

All alternatives will provide for an In-Valley irrigation system which will increase the amount of constitutents from diffuse sources reaching Las Vegas Wash and ultimately Las Vegas Bay.

Due to the fact that salt contributions to the Colorado River Systems are an environmental constraint, any removal of salt from any proposed discharge is considered beneficial. The concentration and loading of salt in the Wash, discharges vary with each alternative. Alternative No. 2 would desalinate effluent prior to discharge, while Alternative Nos. 7 and 10 provide for a pilot desalination plant program. Alternatives No 2 and 7 would export the majority of effluent out of the Basin (to Dry Lake) and only have a greenbelt maintenance

discharge to the Wash. Alternatives 7 and 10 provide for the sale of 36-38 mgd of AWT effluent for beneficial reuse by a proposed power plant, prior to its disposal outside of the Basin (Dry Lake). Alternative No. 3 has no program of export, therefore would contribute increased loadings of salt due to increased AWT flows over and above those of the other alternatives.

If increased population growth and subsequent urbanization continue, increased surface flows and flood flows can be expected to eventually reach Las Vegas Wash and ultimately Las Vegas Bay. As land is converted from its natural condition to housing subdivisions, commercial centers, roads and recreational areas, soil systems are disturbed and impervious surfaces are imposed on the natural terrain. Accelerated surface run-off from impervious surfaces increases the erosion potential downstream. The process of erosion normally results in increased sedimentation and siltation of the surface water streams. (See Figure 9). The Environmental Protection Agency, in a study entitled Control of Sediments Resulting from Highway Construction and Land Development, estimated that sediments from urbanizing areas varies from 1,000 to 100,000 tons per square mile per year, while sediments from urbanized areas varies from 200 to 500 tons per square mile per year. Sediments deposited in lakes and streams may decrease water clarity and interfere with biological life cycles which depend on clear bottom conditions.

Soil sediments also contain various nutrients which may accelerate the process of eutropication in lakes, and increase the biological productivity of streams.

The impact of road construction, one of the first manifestations of urbanization, can hardly be over-emphasized. Roadway run-off often contains chemical constituents and solid waste materials that may seriously degrade water quality and surface water regimes. Such constituents include asbestos from automobile brake linings, oils and greases, rubber, ferrocyanide, sodium ferrocyanide, chromate and phosphate.. These roadway pollutants may also cause serious damage to vegetative communities adjacent to the roadways.

Water Quantity Impacts

Each viable alternative and the No-Action alternative will provide for different volumes of water being released down Las Vegas Wash, as well as for other uses. Alternative 3 will result in all water receiving advanced waste treatment prior to its discharge to Las Vegas Wash and diversion downstream for in-valley irrigation. Alternatives Nos. 7 and 10 provide for other beneficial uses after advanced waste treatment either inside the Valley and export for disposal (with a pipeline to tap secondary effluent) for beneficial reuse (7) or export for beneficial reuse as well as recharge to Las Vegas Wash (10). No action would still result in the continuation of nutrient rich discharges to the Wash from the existing

secondary treated municipal discharges.

With the different volumes of AWT water being released down the Wash, it can be expected that Wash vegetation will be impacted in terms of its distribution, density, and quality; and concurrently the distribution and density of wildlife dependent on that cover. As was mentioned in Primary Impacts, flows down Las Vegas Wash would be diverted prior to entering Lake Mead for beneficial reuse, thereby eliminating this augmentation flow. Certain vegetative habitats may be impacted by the loss of nutrients more than by the change in available flow. Flow variances that would be experienced with the various alternatives would not appreciably impact flow in the Lower Colorado River, since quality is a more significant constraint; however, the impact of particular constituent loadings is directly related to the volume and quality of the waters receiving the discharge.

Fish and Wildlife Impacts

As has already been discussed, the accommodation of continued urbanization will have a beneficial and adverse impact on fish and wildlife.

Increased power generation by the Allen Power Facilities may result in carrying air borne pollutants into the Desert Big Horn Sheep Refuge, thereby resulting in impacts of unknown consequence and magnitude.

Reduction in the nutrient concentration of flows reaching Las Vegas Bay may result in impacting the treadfin shad which depend on algae populations for food, and consequently on any predators of the treadfin shad.

With the change in density, distribution, and quality of vegetative habitats in and adjacent to the Wash, various wildlife species will be affected. Birds, water fowl, mammals, reptiles and invertebrates that are impacted will not be irreperably impacted due to the abundant replacement habitat, whether Wash related or desert, to mitigate such impact. However, brackish water habitats may decline.

adverse impacts which cannot be avoided

It is anticipated that all of the viable alternatives will have impacts of a similar nature only varying in magnitude from alternative to alternative. To prepare the reader, the following discussion will not be site-specific nor will the no-action alternative be considered since no action would be the perpetuation of an already recognized adverse environmental dilemma. The generic impact common to each alternative along with the means to mitigate its impact will be considered.

PRIMARY IMPACTS

Since the proposed alternatives are a long-term community investment to improve an existing adverse condition, the removal of property from the tax rolls to accomodate facilities and the increased cost of sewer service are a given consequence of such an investment. However, since 75% of the initial cost for planning, design and construction is reimbursable by the Federal Government, the severity of that initial capital investment is mitigated.

The normal construction-related impacts of increased noise, dust, soil disturbance, disruption of traffic flow are generally unavoidable. They can be mitigated by construction specifications delineating dust suppression measures, construction during daylight hours, minimizing the movement of earth to accomodate structures, and keeping construction-related equipment and vehicles off or from crossing traffic-bearing surface roads.

The removal of vegetation and the excavation, removal, and compaction of soil are generic to construction of the collection system, AWT plant, and export lines. Again these can be minimized through construction specifications directing the contractor to limit the construction area to the smallest possible area. Restoration of areas where removal of vegetation was necessary or where soil disturbance occurred will be the responsibility of the contractor. In addition, conveyance line alignments that do not disturb natural habitats which support abundant vegetative cover and wildlife should be encouraged. Some erosion will occur with a potential for increased nutrient-bearing silts reaching Las Vegas Wash and eventually Las Vegas Bay.

The actual operation of facilities after construction will result in additional noise from pumps and the treatment plant. This can be mitigated by housing of these facilities and baffling or insulating them for sound.

Deposition of waste sludges and brines will result in some loss of land committed to these purposes. Sludges will be disposed of at a land fill site classified to accept these wastes.

Salt accumulation in the Colorado River system is an adverse impact whose control is dependent on engineering means to initially control the magnitude which would vary from alternative to alternative. Alternative 3 would result in greater salt loadings through increased discharge volumes of effluent reaching Las Vegas Bay while Alternatives 2, 7 and 10 would export and/or beneficially reuse waste water, but would return smaller flows to Las Vegas Wash. Salt accumulation within a waste water management system has recognized environmental and economic costs.

Beneficial reuse of waste water for in-valley irrigation will create new diffuse sources of water pollution reaching Las Vegas Wash. However, the benefits derived would greatly outweigh the minimal water quality detriments anticipated.

The disposal of any effluent will be governed by where the costs are incurred. Alternative 2's complete treatment with maintenance disposal to the Wash potentially provides the highest water quality benefit to the receiving water. Alternative 3's AWT with no export and return to Lake Mead, has the highest receiving water quality impact, providing a greater volume of effluent resulting in greater salt loadings than that of Alternatives 2, 7, or 10. Alternative 10 meets the water quality standards of Lake Mead and provides for beneficial reuse and a reduced salt contribution to that of 3. Since Alternative 7 provides only AWT of flows necessary to maintain the existing riparian recreational environment of Las Vegas Wash and not violate Federal-State standards in Las Vegas Bay, the return flow benefits from this alternative would be minimal.

Changes in the environment at Dry Lake, such as increased salinity concentrations at Dry Lake and surrounding wells near the site; increased temperature and humidity near Dry Lake; and loss to the present use of Dry Lake all characterize the nature of export called for in Alternative 7.

All alternatives will require electrical power in varying magnitude. Refer to Table 24.

SECONDARY IMPACT

The secondary impacts as discussed in the previous chapter cannot be avoided altogether. To a great extent those impacts that would specifically pertain to the accommodation of a potential future population (changes in land use, expansion in public services, air quality de-

gradation, increased resource exploitation, etc.) are unavoidable. However, the magnitude of those impacts are subject to some control, either through technological, statutory, or regulatory means. Nonetheless, growth is anticipated to create these impacts which are unavoidable.

The various viable alternatives allow for varying volumes of water returning to Las Vegas Bay via Las Vegas Wash. Dependent on these releases, the increase in water volume will change the width of the stream and velocity of flow. These changes could result in changes to the vegetative composition of the Wash. Another consideration would be the loss or displacement of wildlife depending on that vegetative cover for food or shelter. Since each alternative will result in this type of impact, it is unavoidable yet within mitigation capabilities of the applicant to reduce the magnitude of any extreme impact. In addition, any waste of water in this watershort environment is an adverse impact on the human environment which is not in the best interest of sound water management. All viable alternatives to some degree provide for beneficial reuse of the AWT water, with Alternative 10 identifying several reuse programs for AWT water beyond any identified in the other viable alternatives.

Any increase in the amount of high quality effluent discharges to Las Vegas Wash will offset any existing adverse water quality problem in Las Vegas Bay. However, as was mentioned in the section on secondary impacts in Chapter 3 with the improvement in water quality, loss in algae populations may result in a reduction or displacement of threadfin shad and their attendant predators, but to what extent is unknown. Also vegetation which is dependent on a certain concentration of nutrients being present in Las Vegas Wash flows to maintain certain vegetative habitat is a concern. Due to the impending enforcement action if nutrients are not largely eliminated from the waste water discharged, this loss is the trade-off for attainment of clean water objectives. Worthy of consideration would be a scheduled release of secondary effluent that could be discharged to the Wash to mitigate this loss. This release arrangement would require a new permit for the existing secondary dischargers delineating a schedule of allowable quality ranges within which such discharges could be made.

With the construction of Alternative 7 or 10 the supply of cooling water to the proposed Allen Power Plant raises some long-term environmental questions which will be explored in the following chapters.

Any salinity contributions that continue to increase TDS levels in the receiving water require a greater attention to controlling source contributions. Another consideration is the relationship of TDS concentration within a certain volume of flow. In other words, dilution capability in any case would be a water quality plus; Alternatives 3 and 10 provide the largest amount of dilution capability. Alternative 2 has the highest degree of desalination

but only a maintenance discharge to the Wash of minimal proportion. Alternative 3 would result in the greatest volume of AWT discharge to the Wash and hence the highest dilution capability. Alternative 10 provides for pilot desalination and pilot ground-water augmentation with a more generous Wash maintenance program than 2 or 7. Eventually the augmentation of ground water may increase as feasibility dictates and as consumption increases. Alternative 7 would return the least volume of water, but would result in export that would remove volumes of salt from the Colorado River system along with the exported effluent. It is expected that with the removal of industrial contributions to the Wash, salts (TDS) would be stabilized in their concentration, and over a period of time would eventually be reduced in Las Vegas Bay.

The means by which salt loading is controlled is technologically moot, with economic and environmental balance suggesting 2, 3, 7 and 10 to be a toss up, other economic and environmental concerns would leave Alternative 2 as too expensive, Alternative 7 as being less beneficial to other downstream uses, and 3 and 10 worthy of further consideration.

relationship between local short-term uses versus long-term productivity

In this chapter of the environmental impact statement, the short-term objective of improving the community capability to meet Federal-State standards in order to abate pollution in Lake Mead, versus the maintenance and enhancement of long-term community productivity is explored.

Through the supplementing of County financial resources by Federal grant assistance, this combined investment provides the Valley Community with a new lease to expand urban growth and to continue the quality of life.

The short-term technological mastery of the very environmental constraints that limit man's long-term adaptability to the desert environment is made possible but with some acknowledged environmental detriments. These detriments are explored further in Chapter 6. The facilities' consumption of electrical power, use of materials in its construction, and the loss of undeveloped lands are recognized expenditures worth the investment when weighed against the benefits returned. The increased capacity to treat and dispose of waste waters within Federal-State water quality standards prior to their return to the Colorado River; the crediting of return flows to compensate for withdrawals of surface water allocations and; the beneficial reuse of other flows for in-valley irrigation, or as identified in Alternatives 7 and 10 for cooling water in the proposed Allen Power Plant of the Nevada Power Company, add up to short-term actions of long-term magnitude. Guaranteed water quality maintenance, the means to augmenting potable water withdrawals from the Colorado River, and the accommodation of additional electrical power generation, sets into motion for the communities of Las Vegas Valley the necessary measures to solidify a multiplicity of future planning scenarios.

No doubt the allowance for continued degradation of downstream water supplies by waste water flows would be severely damaging to the long-term productivity and maintenance of man's presence in the Lower Colorado River Basin. However, sustaining man's productivity in an extreme desert clime is a long-term commitment of resource exploitation that goes far beyond the Valley community into areas yet untouched by man's heavy

hand. The conversion of raw resources into fuels and hardware grant technological reprieves to sustaining a lifestyle where the balance between resources availability and resource consumption is finite. Therefore, any decision regarding a major short-term monetary investment is an investment in the continued maintenance of a consumptive trend which will have to escalate to sustain the long-term community productivity.

It goes without saying that the present means of discharging waste water to the environment can be considered an unacceptable short-term use that, with proper waste water treatment, can become a long-term benefit to the environment. In terms previously set forth in Chapter 3, the maintenance and enhancement of wildlife in Las Vegas Wash and the provision of waste water for beneficial reuse can definitely be a long-term deposit which will appreciate for generations to come.

As of this writing, the City of Las Vegas and Clark County have entered an agreement with the Nevada Power Company for the sale of AWT water for use in the proposed Allen Power Plant. Waste water is the only source of cooling water available to the plant. The plant is expected to be in operation within the next six years, but will not be generating power initially for the exclusive use of In-Valley communities, and will be transmitting major portions of its output at a declining rate to the Southern California Edison service area of Los Angeles through 1994.

EPA has yet to assess how demand for power in the Southern California Edison service area would be affected with this diminishing supply arrangement. Nor what pressures would be brought to supply new power generation sources and at what environmental cost. Also unassessed is the economic effect when marginal power supplied at a reduced cost creates a demand related to a surplus supply in the Los Angeles area.

Since growth is so intricately linked with any waste water management scheme within the Valley, considerations of its contribution to air quality made by increased populations were identified in Chapter 1. A 1973 emissions inventory found that State Ambient Air Quality Standards were exceeded for photochemical oxidants and particulates when monitored in downtown Las Vegas. Similar data for CO and HC were unavailable. It is hoped that the current emissions' inventory update will provide additional air quality information on concentrations of CO and oxidants to facilitate their translation into remedial actions. Therefore, the information relating to the long-term air quality dynamics resulting from increased population is still under development and any population increases may complicate the clean-up effort.

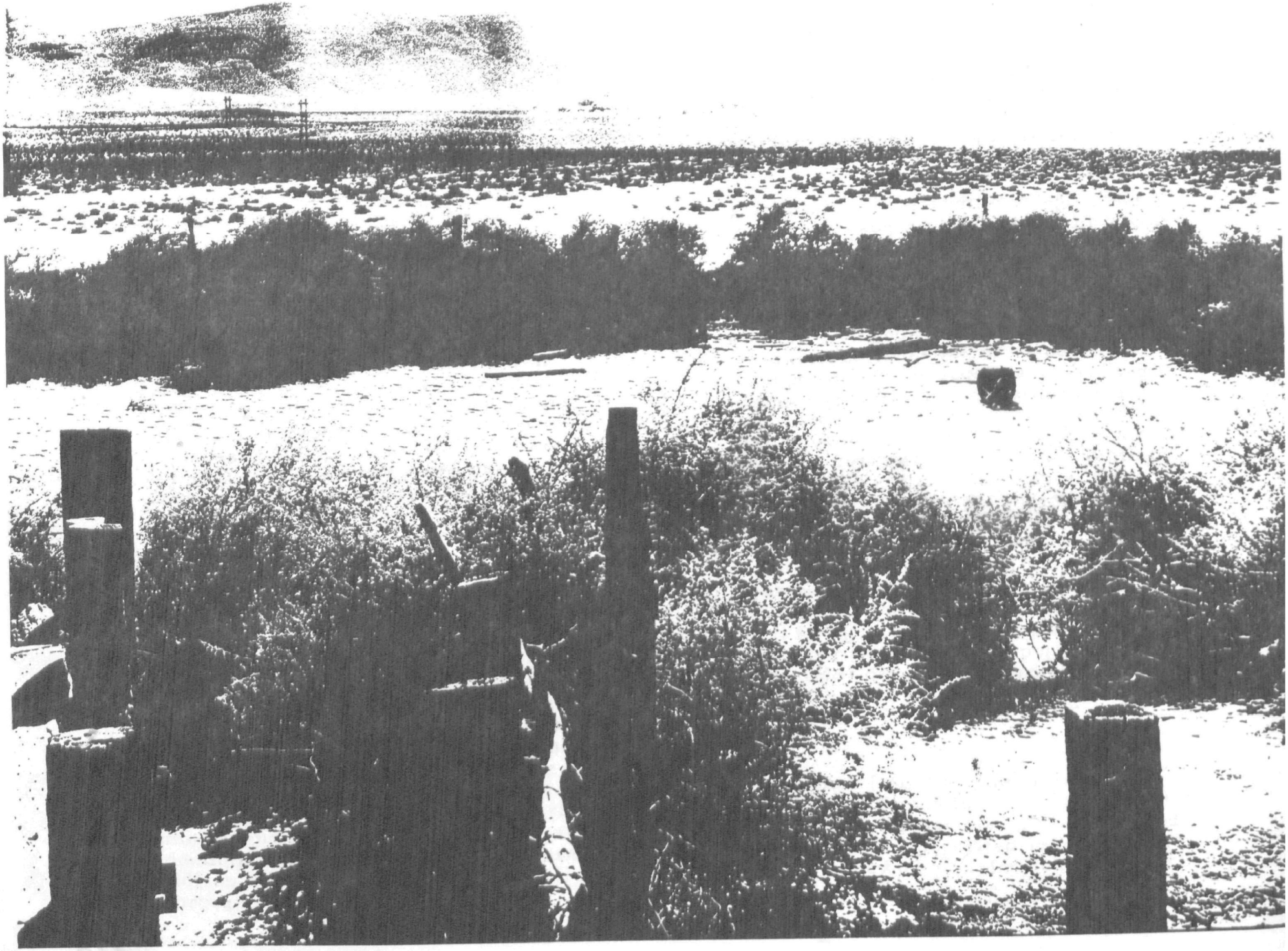
Emissions from the Allen Power Plant will mostly be confined to the Dry Lake Valley by inversion layers, or conveyed by winds to the populated areas of Las Vegas Valley on occasion, causing a

decreased visibility and degradation of the present air quality. Since wind data is still being developed, how often this will occur and for what duration is unknown. What long-term impact degradation of the exterior air quality will have on a tourist industry mainly oriented to recreating indoors is undeterminable.

The long-term impacts of strip mining of coal in Utah and its proposed conveyance to the Allen Power Plant site by a pipeline as a slurry, go unaccessed since waste water resources development directly accommodates such activities. However, these questions no doubt will be addressed in any environmental impact reports prepared prior to that project initiation by the Power Company.

It is the opinion of the Environmental Protection Agency that the short-term uses of the environment resulting from the decision to construct waste water facilities will have a profound effect on the growth capability of the Las Vegas Valley communities, while improving and maintaining the water quality of Lake Mead. However, of the alternatives considered as viable, only Alternative 3 does not provide for AWT export to the Allen Power facility and its yet unknown attendant long-term secondary impacts.

The unknown extent to which the configuration of urbanization will play on the maintenance of air quality is dependent upon strategies implemented and maintenance measures instituted by this Agency and its state and local counterparts. These strategies hopefully will bring about a long-term resolution of many of the recognized air quality problems.



irreversible & irretrievable commitment of resources

The commitment of any resources to the implementation of a long-term waste water resource management and development program obligates the immediate community to an upwardly spiraling course of expenditure and consumption. This commitment implicates a network of communities from which raw resources will be drawn, investments of capital and manpower made, to convert these raw resources into products for consumption. Foreseeably, all of this activity will result in an escalation in the expenditure of energy.

Since it is anticipated that no matter what viable alternative is selected, the same projected base population will occur, this discussion will focus on the irreversible and irretrievable events that will occur as a result of this waste water resource development project.

The conversion of raw sewage effluent to a marginally useable resource (secondary treatment) and then into a high quality, highly usable resource (AWT) is the establishment of that AWT resource as the integral component in the maintenance of an ecological machine where the continued use of water by man is essential to that machine's existence. The establishment of such a machine is not only an economic asset to the community, but with a guaranteed volume of flow and quality returning to the Colorado River System, water quality in the receiving waters will improve. Wildlife and vegetative habitats will proliferate providing greater recreational opportunities. As long as the quality requirements for each habitat are met and maintained, the irreversibility and irretrievability of these flows is established. Community water consumption may emphasize a heavy dependence on the insurance provided by the return flow credit arrangement as a guarantee against overdraft of In-Valley resources. The successful banking of AWT waters in the groundwateraquifer may be of equal importance. Both arrangements may establish an irreversible and irretrievable commitment of resources to future consumptive patterns.

The commitment of money to construct facilities, and the materials and manpower committed to that end are irreversible and irretrievable. The commitment of land for facilities is irreversible and

irretrievable, unless in the future the location and means of waste water management are changed, then the return of the land to its former appearance and use would be possible.

Another facet of the irreversibility and irretrievability of resource consumption arrangements, especially those that involved a dependency on water, is the sale of water for cooling the proposed Allen Power Plant. This arrangement may result in maintenance of an upward consumption of water in order to maintain the power plant so that an upward consumption of electricity can continue. This arrangement may be of questionable benefit.

As identified in Table 25, revenues returned from the sale of AWT to the Allen Power Plant per million gallons treated are shown. Of interest is the fact that Alternative 7, when examined over the long-term repayment period, results in annual revenues of $30 per million gallons treated. However, it costs the service area consumer from $339 to $467 to treat that same million gallons. With Alternative 10, returns from direct annual revenues from sale of cooling water would only be $116 per million gallons treated against it, costing the service area consumer from $384 to $434 to treat. With Alternative 3, no AWT reclamation for the power plant is involved and would result in greater volumes of water being discharged beyond the volume flows needed to maintain water quality standards in Las Vegas Bay and the Wash habitat. However, the volume of TDS in the Alternative 3 discharge may jeopardize the attainment of the loads proposed by EPA. Alternative 2 would produce an effluent of a quality higher than the quality of the receiving water and comparable to that of U.S. drinking water standards, but at an enormous expense, too prohibitive for any feasible consideration.

However, if, with any of the Alternatives the cost of treatment to continue supplying the water to the power plant can be avoided, it would seem more economic to sell the power plant secondary effluent, with the necessary treatment being done at the power facility. In fact, with the power plant tapping 38 mgd in secondary effluent, the ultimate size of the AWT plants for any of the Alternatives could be smaller, and therefore a greater capital cost to the Federal Government and the applicant would be avoided. Another consideration is that the cost of treatment hardware would be passed on by the Power Company to the consumer if the Power Company had to treat cooling waters prior to use. However, this consumer cost would be mitigated by the consumers in Los Angeles.

The irreversibility of an investment in hardware, especially when that hardware has to do with water quality or supply in this water quality and quantity short region, is an expensive one. Therefore, it would seem in the best interests of all parties concerned to construct a pro-

ject that would treat and dispose of waste water in the most economic means. If a sizedown of the ultimate treatment facility is possible, as previously mentioned, further consideration of the economics of AWT capacity vs. Power Company treatment is necessary.

The air quality implications from urban growth of any oversizing of facilities or a combination of electrical power generation will result in the degradation of that air quality resource. Such degradation is irreversible and irretrievable if maintenance of air quality standards through regulatory or technical strategies is incapable of mitigating any of the degradation that occurs.

In consideration of all documents submitted by the Board of County Commissioners, the Environmental Protection Agency agrees that Alternative 10 is the alternative achieving the project objectives and the alternative which is consistent with the determination of the local populace. Throughout this impact statement, several questions have been raised with regard to attainment and maintenance of water quality and air quality standards. Since this statement was written to evaluate a planning document, information is still being developed to perfect decisions as this "facilities plan" evolves.

Therefore, the following discussion will serve to highlight certain outstanding concerns that are within EPA's regulatory authority. Recognizably, many of these decisions may impact the proposed program of reclamation/reuse, AWT effluent export for power plant cooling. However, until further information concerning this proposal becomes available, EPA is unable to evaluate the full environmental bearing of this proposed power facility. Therefore, the Agency will reserve judgement until such opportunities are afforded us. Some of these opportunities are identified below.

This Agency recognizes that there is a water quality advantage in reducing the introduction of dissolved solids (salts) along with the other pollutants discharged to the Colorado River system; however, this does not preclude controlling increased solids contributions at their source. It is for this very reason that a salinity investigation specified by EPA in a letter of May 3, 1974 to the Waste-water Management Agency be initiated by the applicant to:

A. Identify and quantify all addition of dissolved salts into the sewerage systems.

B. Recommend methods for reducing and where practicable eliminating the salts.

C. Recommend a control program including ordinances where practicable.

D. Determine the salinity values of the incoming secondary effluent from Clark County Sanitation District and the City of Las Vegas' treatment plant to the advanced waste-water treatment plant if all the recommended corrections are instituted.

Conceivably export, as would be achieved by the applicant's proposed method of reclamation/reuse would contribute to the attainment of an acceptable dissolved solids loading limitation. However, removing water from the Colorado River system will impact downstream water quality. Therefore, the results of the salinity source investigation may provide Clark County with a better understanding of how to control salts prior to their entry into the waste-water system. With this knowledge, and with this Agency's co-operation with the Colorado River Basin Salinity Control Forum, better strategies for benefiting downstream water quality in the Colorado and the Las Vegas Valley's contribution to that end, can be realized.

This Agency requests further examination of the sale of secondary effluent over the sale of AWT effluent to the proposed power facility, in the event that opportunity occurs. Foreseeably if secondary effluent is diverted from the AWT collection system prior to its delivery to the AWT facility, this arrangement would not necessitate extensive expansion of AWT facilities to meet 1980 and 1990 AWT needs. Therefore a substantial capital investment, which is now forecasted at $22,200,000 (July 1974 dollars) would not be necessary. Revenues from sale of secondary effluent would still be obtainable, even though they may not be as high as those possible with AWT. Therefore, EPA wishes to reserve judgment on the proposed 1980 and 1990 expansions pending presentation by the applicant of further information regarding this issue.

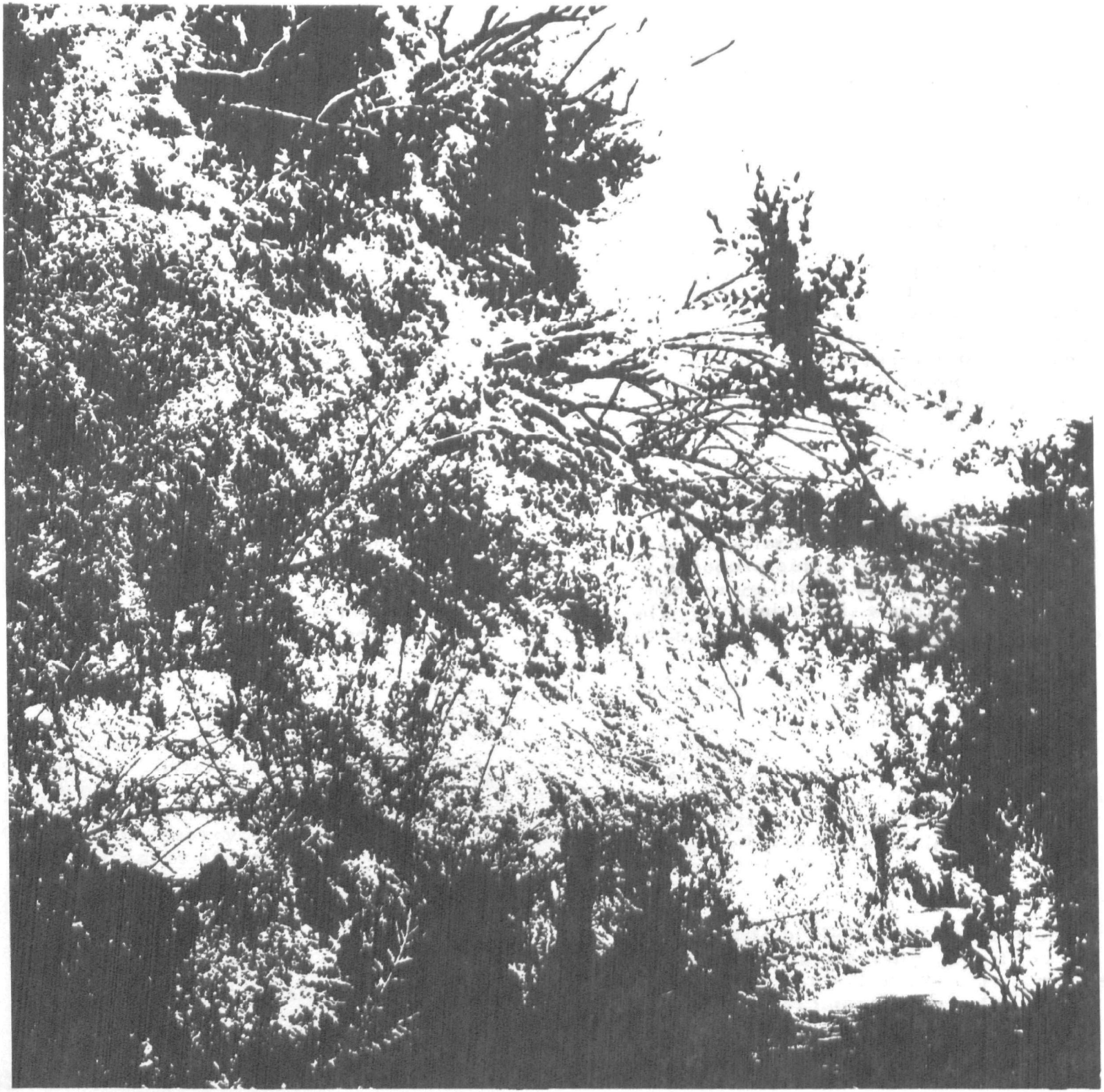
Throughout this impact statement, the growth inducing impact of the various alternatives has been addressed. The combination of the abilities to reimburse additional potable water withdrawals from the Colorado River through return flow credits; to supply waste water for power plant cooling, accommodating increased electric power generation and; to increase the capability of the community to treat and dispose of waste water to comply with Federal-State water quality standards, add up to providing the Las Vegas Valley communities with the tools necessary for continued residential, commercial, and industrial growth in a relatively short period of time.

In an air quality sense this kind of community growth in itself is not necessarily adverse, but the rate, distribution, and density of that growth may be. The Environmental Protection Agency is currently providing contract assistance to Nevada to prepare emission control strategies to reduce the contributions from mobile and stationary sources in the Clark County Metropolitan area, and it would be inopportune to initiate a program which may pre-empt or overwhelm effective implementation and maintenance of those planning and enforcement strategies. Therefore we acknowledge this relationship and foresee further air quality input.

The State of Nevada in conjunction with EPA through provisions specified in the Clean Air Act of 1970, require the submittal of information sufficient

to enable determination whether such a facility will not violate "applicable portions of the control strategy or will not interfere with attainment or maintenance of a national standard either directly because of emissions from it, or indirectly because of emissions resulting from mobile source activities associated with it." Since the decision to proceed with Alternative 10 has been made, EPA does not want to obviate the objective analysis of this proposed power facility by the State. Therefore our reservations with respect to the power plant as the major form of reclamation/reuse extend into these regulatory and planning responsibilities.

Above all, the abatement of pollution from municipal and industrial sources is the main objective of this proposed project. Alternative 10 will more than adequately facilitate this objective. The recommended objective is designed to collect and treat secondary effluent from the existing Clark County waste-water treatment plant, the existing Las Vegas waste-water treatment plant, and the existing City of Henderson waste-water treatment plants. The treatment processes employed are designed to produce an effluent which will meet anticipated effluent discharge limitations. The primary objective of this alternative is to treat waste water and discharge it to Las Vegas Wash for maintenance of existing beneficial uses or make AWT effluent available for beneficial reuse. As in all alternatives, a portion of the effluent would be available for in-valley irrigation in the future. The increased quality of flows provides for increased pollutant reduction capability in the receiving water, and the effluent characteristics of Alternative 10 compared to the water quality standards for Las Vegas Wash and Lake Mead indicate that these standards would be more than met by discharges from this process.



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federal register

WEDNESDAY, JULY 17, 1974

WASHINGTON, D.C.

Volume 39 ■ Number 138

PART III

ENVIRONMENTAL PROTECTION AGENCY

■

PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS

Notice of Proposed Rulemaking

No. 138—Pt. II—1

appendix A

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 6]

PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS

Notice of Proposed Rulemaking

The National Environmental Policy Act of 1969 (NEPA), implemented by Executive Order 11514 of March 5, 1970, and the Council on Environmental Quality's (CEQ's) Guidelines of August 1, 1973, requires that all agencies of the Federal Government prepare detailed environmental statements on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The objective of the Act is build into the agency decision-making process an appropriate and careful consideration of all environmental aspects of proposed actions.

On January 17, 1973, the Environmental Protection Agency (EPA) published a new Part 6 in interim form, establishing Agency (EPA) policy and procedures for the identification and analysis of the environmental impact of Agency (EPA) actions, and the preparation and processing of environmental impact statements when significant impacts on the environment are anticipated.

As a result of public comment on the interim regulation and the new requirements in the Council on Environmental Quality's Guidelines of August 1, 1973, the Agency has revised its procedures and is now publishing them again for public review and comment. They are being published as proposed rulemaking because of the substantial changes that have been made in the regulation. A final regulation will be published after receipt and consideration of the comments.

The proposed regulation provides detailed procedures for applying NEPA to EPA's nonregulatory programs only. The new source permit program has not been included in this revision because the procedures for applying NEPA to this program have not yet been completed. Procedures for preparing impact statements on environmentally protective regulatory actions will be described in a notice of administrative procedure to be published in the FEDERAL REGISTER.

The Environmental Protection Agency invites all interested persons who desire to submit written comments or suggestions concerning the preparation of final regulations to do so in triplicate to the Office of Federal Activities, Environmental Protection Agency, Washington, D.C. 20460. Such submissions should be received by August 31, 1974, to allow time for appropriate consideration and possible inclusion in the final regulations. Copies of the submissions will be available for examination by interested persons in the Public Information Office, Room W329, Waterside Mall, Fourth and M Streets, SW., Washington, D.C.

Dated: July 3, 1974.

JOHN QUARLES,
Acting Administrator.

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EXHIBITS

1. Flowchart.
2. (page 1.) Notice of Intent Transmittal Memorandum—Suggested Format.
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3. News Release—Suggested Format.
4. Negative Declaration—Suggested Format.
5. Environmental Impact Appraisal—Suggested Format.
6. Cover Sheet Format for Environmental Impact Statements.
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8. Flowchart for ORD.
9. Flowchart for OSWMP.

AUTHORITY: Secs. 102, 103, 83 Stat. 854.

Subpart A—General

§ 6.100 Purpose and policy.

(a) The National Environmental Policy Act of 1969, implemented by Executive Order 11514 and the Council on Environmental Quality's Guidelines of August 1, 1973 (38 FR 20550), requires that all agencies of the Federal Government prepare detailed environmental statements on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The objective of the Act is to build into the agency decision-making process an appropriate and careful consideration of all environmental aspects of proposed actions.

(b) This part establishes Environmental Protection Agency policy and procedures for the identification and analysis of the environmental impact of Agency actions, and the preparation and processing of environmental impact statements when significant impacts on the environment are anticipated.

§ 6.102 Definitions.

(a) "Environmental assessment" is a written analysis submitted to the Agency by its grantees or contractors describing the environmental impacts of proposed actions undertaken with the financial support of the Agency. For plans, the assessment must be an integral part of the plan submitted to the Agency for review. In other cases, the assessment will be a separate document.

(b) "Environmental review" is a formal evaluation undertaken by the Agency to determine whether a proposed Agency action may have a significant impact on the environment. The assessment is one of the major sources of information used in this review.

(c) "Notice of intent" is a memorandum announcing to Federal, State, and local agencies, and to interested persons, that a draft environmental impact statement will be prepared and processed.

(d) "Environmental impact statement" is a report, prepared by the Agency, which identifies and analyzes in detail the environmental impacts of a proposed Agency action.

(e) "Negative declaration" is a written announcement, prepared subsequent to the environmental review, which states that the Agency has decided not to prepare an environmental impact statement.

(f) "Environmental impact appraisal" is an abbreviated document, based on an environmental review, which supports a negative declaration. It describes a proposed Agency action, its expected environmental impact, and the basis for the conclusion that no significant impact is anticipated.

(g) "Responsible official" will usually be either a Regional Administrator or a Deputy Assistant Administrator. He is responsible, for assuring that environmental impact statements and other associated documents are prepared. Responsible officials are identified for the various Agency program offices in the subparts following Subpart D.

(h) "Interested persons" are individuals, groups, organizations, corporations, or other nongovernmental units, including an applicant for an Agency contract or grant and conservation groups, who may be interested in, affected by, or technically competent to comment on the environmental impact of the proposed Agency action.

§ 6.104 Summary of procedures for implementing the NEPA.

(a) *Environmental assessment.* Environmental assessments must be submitted to the Agency by its grantees and contractors, as specified in the subparts following Subpart D of this part. The assessment is used by the Agency in deciding if an impact statement is required and in preparing a statement if it decides to prepare one.

(b) *Environmental review.* Environmental reviews shall be made of proposed and certain ongoing actions (as required in § 6.106(c)) of the Environmental Protection Agency. This process shall consist of a study of the program or project, including a review of any environmental assessment received, to identify and evaluate the expected and potential environmental impacts of the action. The purpose of this review is to determine whether any significant impacts are anticipated, whether any changes can be made in the project to eliminate or mitigate these impacts, and whether an environmental impact statement is required. The Agency has overall responsibility for this review, although its grantees and contractors will contribute to the review through environmental assessments they have submitted. (Types of grants, contracts, and other actions requiring such assessments are specified in the subparts following Subpart D.)

(c) *Notice of intent and impact statements.* When an environmental review indicates that a significant environmental impact may occur and the impact cannot be eliminated by making appropriate changes in the project, a notice of intent shall be published, and a draft environmental impact statement shall be prepared and distributed. After external coordination and evaluation of the comments received, a final environmental impact statement shall be prepared and distributed.

(d) *Negative declaration and environmental impact appraisal.* When the environmental review does not indicate any significant impacts, or when the project is changed to eliminate the significant impacts, a negative declaration to this effect shall be issued. For the cases specified in the subparts following Subpart D of this part, an environmental impact appraisal shall be prepared, which summarizes the impacts, alternatives, and the reasons an impact statement was not prepared. It shall remain on file and shall be available for public inspection.

(e) The general procedures for complying with NEPA are shown graphically in Exhibit 1.

§ 6.106 Applicability.

(a) Administrative actions covered. This part applies to the administrative actions listed below. The subpart referenced with each action specifies the detailed NEPA procedures associated with the action.

(1) Development of Agency legislative proposals (see paragraph (d) of this section);

(2) Development of favorable reports on legislation (see paragraph (d) of this section) initiated elsewhere and not accompanied by an impact statement, provided it relates to or affects matters within EPA's primary areas of responsibility;

(3) For the construction grants program under Title II of the FWPCA Amendments of 1972, those administrative actions specified in § 6.504;

(4) For the Office of Research and Development, those administrative actions specified in § 6.604;

(5) For other programs, the award of a grant or contract (see Subparts G and H) except for those cases listed in paragraph (b) of this section;

(6) For other programs, actual physical commencement of a project or activity undertaken with inhouse funds (intramural project). See Subparts G and H.

(b) The requirements of this part do not apply to environmentally protective regulatory activities undertaken by the Agency.

(c) Application to ongoing actions. This regulation shall apply to uncompleted and continuing Agency actions initiated prior to the promulgation of these procedures when substantial funds have not been released and modifications of or alternatives to the Agency action are still available. An environmental impact statement shall be prepared for each project found to have significant environmental consequences, as determined in accordance with § 6.200.

(d) Application to legislative proposals. (1) As noted in paragraphs (a) (1) and (2) of this section, environmental impact statements shall be prepared for legislative proposals or favorable reports relating to legislation. Because of the nature of the legislative process, impact statements for legislation must be prepared and reviewed in accordance with the procedures followed in the development and review of the legislative matter. These procedures are described in Office of Management and Budget Circular No. A-19.

(2) A working draft impact statement shall be prepared by the Agency office responsible for preparing the legislative proposal or report on legislation. It shall be prepared concurrently with the development of the legislative proposal or report and shall contain, where appropriate, the information required in § 6.304. The statement shall be circulated for internal Agency review with the legislative proposal or report and other supporting documentation. The working draft statement shall be modified in accordance with changes made in the proposal or report during the internal review. All major alternatives developed during the formulation and review of the proposal or report should be retained in the working draft statement.

(i) The working draft impact statement shall accompany the legislative proposal or report to OMB. The Agency shall revise the working draft statement, as necessary, to respond to comments made by OMB and Federal agencies.

(ii) Upon transmittal of the legislative proposal or report to Congress, the working draft impact statement will be forwarded to CEQ and the Congress as a formal legislative impact statement. Copies will be distributed in accordance with § 6.208(b) (2) (i), (ii), (iv) (d), and (iv) (e). At the same time copies are sent to the Council on Environmental Quality, two (2) copies shall be sent to the Office of Federal Activities and the originating office.

(iii) Comments received on the legislative impact statement by the Agency shall be forwarded to the appropriate Congressional Committees. If appropriate, the Agency may wish to respond to specific comments and forward those with the comments. Because legislation undergoes continuous changes in Congress, no final impact statement need be prepared by the Agency.

§ 6.108 Completion of NEPA procedures before commencement of administrative action.

(a) When an impact statement will be prepared. Except when requested by the responsible official in writing and approved by the Council on Environmental Quality, no administrative action shall be taken sooner than ninety (90) calendar days after a draft statement has been distributed or sooner than thirty (30) calendar days after the final statement has been circulated and made public, the thirty (30) day period and ninety (90) day period may run concurrently to the extent that they overlap. In addition, the proposed action should be modified to conform with any changes the Agency deems necessary.

(b) When an impact statement will not be prepared. If the Agency decides not to prepare a statement on any action on which a negative declaration with environmental appraisal is required (as specified in the subparts following Subpart D), no administrative action shall be taken sooner than fifteen (15) days after issuance of the negative declaration.

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§ 6.110 General responsibilities.

(a) *Responsible official.* (1) Requires contractors and grantees to submit environmental assessments and related documents needed to comply with NEPA, and assures environmental reviews are conducted on proposed Agency projects at the earliest practicable point in the Agency's project formulation process.

(2) When required, assures that draft statements are prepared and distributed at the earliest practicable point in the Agency's project formulation process, their internal and external review is coordinated, and final statements are prepared and distributed.

(3) When an impact statement is not prepared, assures that negative declarations and environmental appraisals are prepared and distributed for those actions requiring them.

(4) Consults with the Office of Federal Activities on actions involving unresolved conflicts with other Federal agencies.

(b) *Office of Federal Activities.* (1) Provides Agency wide policy guidance and assures that Agency components establish and maintain adequate administrative procedures to comply with this part.

(2) Monitors the overall timeliness and quality of the Agency effort to comply with this part.

(3) Provides assistance to responsible officials as required.

(4) Coordinates the training of personnel involved in the review and preparation of environmental impact statements and other associated documents.

(5) Acts as Agency liaison with the Council on Environmental Quality and other Federal and State entities on matters of Agency policy and administrative mechanisms to facilitate external review of Agency environmental impact statements, to determine lead Agency, and to improve the uniformity of the NEPA procedures of Federal agencies.

(6) Advises the Administrator and Deputy Administrator on projects which involve more than one Agency component, are highly controversial, are nationally significant, or "pioneer" Agency policy, when these projects have had or should have an environmental impact statement prepared on them.

(c) *Office of Public Affairs.* (1) Assists the Office of Federal Activities and responsible officials by answering the public's queries on the impact statement process and on specific impact statements, and by directing requests for copies of specific documents to the appropriate regional office or program.

(2) Analyzes the present procedures for public participation, and develops and recommends to the Office of Federal Activities a program to improve those procedures and increase public participation.

(d) *Regional Office Division of Public Affairs.* (1) Assists the responsible official or his designee on matters pertaining to negative declarations, notices of intent, press releases, and other public notification procedures.

(2) Assists the responsible official or his designee by answering the public's queries on the impact statement process and on specific impact statements, and by filling requests for copies of specific documents.

(e) *Office of the Assistant Administrators and Regional Administrators.* (1) Provides specific policy guidance to their respective offices and assures that those offices establish and maintain adequate administrative procedures to comply with this part.

(2) Monitor the overall timeliness and quality of their respective component's efforts to comply with this part.

(3) Act as liaison between their components and the Office of Federal Activities and between their components and other Assistant Administrators or Regional Administrators on matters of agencywide policy and procedures.

(4) Advise the Administrator and Deputy Administrator through the Office of Federal Activities, on projects or activities within their respective areas of responsibilities which involve more than one Agency component, are highly controversial, are nationally significant or "pioneer" Agency policy, when these projects have had or should have an environmental impact statement prepared on them.

(f) *The Office of Legislation.* The Office of Legislation provides the necessary liaison with Congress and coordinates the preparation of impact statements required on reports on legislation originating outside the Agency (see § 6.106(d)).

(g) *The Office of Planning and Evaluation.* The Office of Planning and Evaluation coordinates the preparation of impact statements required on Agency legislative proposals (see § 6.106(d)).

Subpart B—Procedures

§ 6.200 Guidelines for determining when to prepare an impact statement.

The following general guidelines shall be used when reviewing an Agency action to determine if it will have a significant impact on the environment and therefore require an impact statement:

(a) *Significant environmental effects.* (1) Actions having both beneficial and detrimental effects may be classified as having significant effects on the environment even if, on balance, the Agency believes that the net effect will be beneficial. Impact statements should be prepared first on those proposed actions with the most adverse effects, and in accordance with the Agency's schedule to implement the action.

(2) Significant effects should include both primary and secondary consequences of short term and long term duration. Secondary consequences result from activities encouraged or induced by the Agency action. Long term effects should be given particular attention in the determination of significant effects.

(3) The total expected environmental impact of precedent-setting actions and individually small but cumulatively large actions shall be identified and considered fully. If the Agency is taking a number of minor, environmentally insignificant actions that are similar in execution and purpose, especially when they are taken during a limited time span and in the same general geographic area, the cumulative environmental impact of all of these actions may be significant.

(4) In making a determination of significant impact, the unique characteristics of the area should be carefully considered. For example, proximity to wetlands may make the impact significant.

(b) *Controversial actions.* An environmental impact statement shall be prepared and processed when the environmental impact of an Agency action is likely to be highly controversial.

(c) *Historic sites.* An environmental statement shall be prepared and processed when the Agency action will adversely affect a property listed in or eligible for listing in the National Register of Historic Places, and a joint memorandum of agreement has not been agreed to by the appropriate parties acknowledging removal of mitigation of the adverse impact. See § 6.214(a) for the detailed procedures.

§ 6.202 Environmental assessment.

Environmental assessments must be submitted to the Agency by its grantees and contractors, as specified in the subparts following Subpart D of this part. The purpose of the assessment is to ensure that the applicant builds into his project formulation process at the earliest possible point, an appropriate and careful consideration of the environmental impacts of the proposed action. The assessment, along with other relevant information, is used by the Agency in deciding if an impact statement is required and in preparing a statement if one is prepared. While the Agency must be responsible for the impact statements it prepares, it expects grantees and contractors to ensure that the assessments and any other data they submit to the Agency are accurate. The responsible official may request additional data and analyses at any time if he determines that it is needed to adequately comply with NEPA.

§ 6.204 Environmental review.

(a) Proposed and certain ongoing Agency actions as specified in § 6.106(c) shall be subjected to an environmental review. This review shall be a continuing one and should commence at the earliest possible point in the development of the project. It shall consist of a study of the proposed program or project, including a review of any environmental assessments received, to identify and evaluate the expected and potential environmental impacts of the action and alternatives to it. It will determine whether a significant impact is anticipated from the proposed action, whether any changes can be made in the project to eliminate or mitigate these impacts, and whether an environmental impact statement is required.

(b) The responsible official shall determine the proper scope of the environmental review. If a plan covering proposed actions is available, it should be reviewed before making this determination (see § 6.208(a)(2)).

§ 6.206 Notice of intent.

(a) *General.* (1) When an environmental review indicates a significant impact may occur and that impact cannot be eliminated by making appropriate changes in the project, a notice of intent, announcing the preparation of a draft impact statement, shall be issued by the responsible official. The notice shall briefly describe the Agency action, its location and the issues involved (see Exhibit 2).

(2) The purpose of a notice of intent is to involve other Government agencies and interested persons as early as possible in the planning and evaluation of Agency actions which embody significant environmental impacts. This device should facilitate coordination during the preparation of a draft impact statement and assure that environmental values will be identified and weighed from the outset, rather that accommodated by adjustments at the end of the decision-making process.

(3) If the project involves a grant applicant or potential contractor, he must submit any data which the Agency requests for preparation of the statement.

(b) *Specific actions.* The specific actions that should be taken with respect to notices of intent are as follows:

(1) When the review process indicates there will be a significant impact, prepare a notice of intent immediately after the review.

(2) Forward copies of the notice of intent to:

(i) The appropriate State and local agencies and to the appropriate State, regional, and metropolitan clearinghouses.

(ii) Potentially interested persons.

(iii) The Office of Federal Activities and the Office of Public Affairs.

(iv) The Headquarters impact statement coordinator for the program office originating the statement. When the originating office is a regional office and the action is related to water quality management, the copies should be forwarded to the Oil and Special Materials Control Division, Office of Water Program Operations.

(v) The Office of Legislation so they will be able to answer any queries from Congress on the matter.

(3) Submit to a local newspaper, which has adequate circulation to cover the area that will be affected by the project, a brief news release (see Exhibit 3) informing the public that an impact statement will be prepared on a particular project. News releases may be submitted to other media as appropriate.

(c) *Regional office assistance to program offices.* Regional offices will provide assistance to program offices in taking these specific actions when the statement originates in a program office.

§ 6.208 Draft impact statements.

(a) *General.* (1) The responsible official shall assure that a draft environmental impact statement is prepared as soon as practicable after the release of the notice of intent. Prior to release to the Council on Environmental Quality (CEQ), a preliminary version of the draft statement may be circulated for review to other offices within the Agency with collateral interest in or technical expertise related to the action. Thereafter, the draft statement shall be sent to CEQ and circulated to Federal, State, and local agencies with special expertise or jurisdiction by law, and to interested persons. If the responsible official determines that a public hearing on the project is warranted, the hearing will be held after preparation of the draft statement and in accordance with the requirements of § 6.402.

(2) Draft impact statements should be prepared at the earliest practicable point in the project development. Where a plan or program has been developed by the Agency or submitted to the Agency for approval, the relationship between the plan and the subsequent projects encompassed by it shall be evaluated to determine the preferable and most meaningful point in time for preparing an impact statement. Where practicable, an environmental impact statement will be drafted for the total program at the overall planning stage. Subsequently, component projects included in the plan will not require individual statements unless they deviate substantially from prior plans, or unless the plans do not provide sufficient detail to fully assess significant impacts of individual projects. Plans shall be reevaluated by the responsible official to monitor the cumulative impact of the component projects and to preclude the plans' obsolescence.

(b) *Specific actions.* The specific actions that should be taken with respect to draft impact statements are as follows:

(1) Before transmitting the draft statement to the Council on Environmental Quality, the responsible official shall:

(i) Notify by phone the Office of Federal Activities and the headquarters impact statement coordinator for the program office originating the statement that a draft impact statement has been prepared. When the originating office is a regional office and the project is related to water quality management, the Regional Administrator will notify by phone the Office of Federal Activities and the Oil and Special Materials Control Division, Office of Water Program Operations, that the draft impact statement has been prepared.

(ii) Send two (2) copies of the draft statement to each of the appropriate offices in paragraph (b)(1)(i) of this section.

(2) If neither of the above offices requests any changes within a ten (10) working day period after notification the responsible official shall:

(i) Send five (5) copies of the draft environmental impact statement to the Council on Environmental Quality.

(ii) Inform the Office of Public Affairs of the transmittal to the Council on Environmental Quality and the plans for local press release.

(iii) Notify the Office of Legislation of the transmittal so they will be able to answer any queries from Congress on the matter.

(iv) Provide copies of the draft statement to:

(a) The Office of Legislation if they request copies.

(b) The Office of Public Affairs. Provide two (2) copies.

(c) The appropriate offices of reviewing Federal agencies that have special expertise or jurisdiction by law with respect to any impacts involved. The Council on Environmental Quality's Guidelines (40 CFR 1500.9 and Appendixes II–III thereof) specify those agencies to which draft statements will be sent for official review and comment. Two (2) copies of the impact statement should be provided each agency unless they have made a specific request for more copies. The agencies are expected to reply directly to the originating EPA office. Commenting agencies shall have at least forty-five (45) calendar days to reply (the reply period shall commence from the date of publication in the FEDERAL REGISTER of lists of statements received by the Council on Environmental Quality); thereafter, it shall be presumed that, unless a time extension has been requested, the agency has no comment to make. EPA may grant extensions where practical of fifteen (15) or more calendar days.

(d) The appropriate State and local agencies and to the appropriate State and metropolitan clearinghouses. The time limits for review and extensions shall be the same as those available to Federal agencies.

(e) Interested persons. The time limits for review and extensions shall be the same as those available to Federal agencies.

(v) Submit to the local newspaper and other appropriate media a news release (see Exhibit 3 of this part) that the draft statement is available for comment and where copies may be obtained.

(vi) Send two (2) copies of the summary sheet (see § 6.302) to the Office of Management and Budget, Organization and Management Systems Division.

(c) *Regional office assistance to program office.* If requested, regional offices will provide assistance to program offices in taking these specific actions when the impact statement originates in a program office.

§ 6.210 Final impact statements.

(a) Final statements shall respond to all substantive comments raised through the review of the draft impact statement. Special care should be taken to respond fully to comments that are at variance with the Agency's position (see also § 6.304(g)).

(b) Distribution and other specific actions will be as specified for draft statements in § 6.208 (b) and (c), in the case of Federal and State agencies and

interested persons, only those who made substantive comments on the draft statement or request a copy of the final statement shall be sent a copy. If there is an applicant, he shall be sent a copy. Where the number of comments on the draft statement is such that distribution of the final statement to all commenting entities appears impracticable, the program or regional office preparing the statement shall consult with the OFA, who will discuss with the Council on Environmental Quality alternative arrangements for distribution of the statement.

§ 6.212 Negative declaration and environmental impact appraisals.

(a) *General.* When an environmental review indicates no significant impact, a negative declaration shall be prepared prior to taking action (see Exhibit 4). The negative declaration and news release must contain a statement that persons disagreeing with the decision may submit comments for consideration by the Agency. In most cases the Agency should not take an administrative action on the project for at least fifteen (15) days after release of the negative declaration. An environmental impact appraisal supporting the negative declaration shall be prepared at the same time for those cases specified in the subparts following Subpart D of this part, as determined by the responsible official. The appraisal (see Exhibit 5) describes the proposed activity and its effects, and documents the reasons for concluding that there will be no significant impact. This appraisal shall remain with internal records for the activity or action, and shall be available for public inspection.

(b) *Specific actions.* The following specific actions should be taken on those projects on which both a negative declaration and appraisal were prepared. Circulation of a negative declaration on a project for which no appraisal is required is unnecessary.

(1) *Negative declaration.* (i) When the review process indicated that there will not be a significant impact, or when the project is changed to eliminate the significant impacts, prepare a negative declaration immediately after the review.

(ii) The negative declaration shall be distributed in the same fashion as the notice of intent, except that copies shall be sent only when practicable to interested persons.

(iii) If it is not practicable to send copies to all interested persons, attempt to make the negative declaration available through local libraries or post offices. In addition, when practicable submit to local newspapers and other appropriate media a brief news release (see Exhibit 3) informing the public that an impact statement will not be prepared on a particular project.

(2) *Environmental impact appraisal.* (i) Have the appraisal available when the negative declaration is distributed.

(ii) Forward a copy to the Headquarters impact statement coordinator for the program office originating the statement. (Not applicable to regional offices.)

(iii) Have copies on file in the originating office for public inspection upon request.

§ 6.214 Additional procedures.

(a) *Historic sites.* The Agency is subject to the requirements of section 106 of the National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq. The following procedures shall be applied to all administrative actions described in § 6.106(a):

(1) If an Agency action may affect a property listed in or eligible for listing in the National Register of Historic Places (published in the FEDERAL REGISTER each year in February with supplements on the first Tuesday of each month), the responsible official, during the environmental review, will consult with the State Historic Preservation Officer to determine if the effect will be adverse. If the effect will be adverse, the responsible official shall consult with the Executive Director of the Advisory Council as well as the State Officer, and attempt to develop alternatives to remove the adverse impact so a joint memorandum of agreement can be issued acknowledging removal of the impact. If a joint memorandum cannot be agreed to, the responsible official shall prepare an impact statement as required by § 6.200(c) that includes a complete discussion of the impacts of the action on the property in question. Copies of the draft and final statement should be sent to the above officials for their comment in accordance with the procedures of the Advisory Council on Historic Preservation. See also § 6.512(c)(2) of this part for additional procedures for the construction grant program under Title II of the FWPCA Amendments of 1972.

(b) *Wetlands.* The following procedure shall be applied to all Agency administrative actions covered by this part that may impact wetlands:

(1) If an action may affect wetlands, the responsible official shall consult, during the environmental review of the action, with the appropriate offices of both the Department of the Interior and Department of Commerce to aid in the determination of the probable impact of the action on the pertinent fish and wildlife resources of the wetlands. Requests for consultation and the results of such consultation shall be documented in writing. The agencies should be given thirty (30) days to comment as measured from the date of the written request. In all cases where consultation has occurred, the agencies consulted should receive copies of either the notice of intent and impact statement or negative declaration and appraisal prepared on the action.

(2) If an impact statement is to be prepared on a project and wetlands may be affected, the required consultation may be deferred until the preparation of the draft statement.

(c) *Fish and wildlife.* The Agency is subject to the requirements of the Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq. The following procedures shall be applied to all administrative actions covered by this part:

(1) Whenever an Agency action will result in the control or modification of any stream or other body of water, for any purpose whatever, including navigation and drainage, the Agency shall consult with the United States Fish and Wildlife Service, Department of the Interior, and the head of the agency exercising administration over the wildlife resources of the particular State in which the action will take place with a view to the conservation of wildlife resources. Such consultation shall take place during the environmental review of an action. Requests for consultation and the results of such consultation shall be documented in writing. The agencies should be given thirty (30) days to comment as measured from the date of the written request. The Agency should employ the results of such consultation in determining if an impact statement is needed. In all cases where consultation has occurred, the agencies consulted should receive copies of either the notice of intent and impact statement or negative declaration and appraisal prepared on the action.

(2) If an impact statement is to be prepared on a project which may result in the control or modification of a stream or body of water, the required consultation may be deferred until the preparation of the draft statement.

Subpart C—Content of Environmental Impact Statements

§ 6.300 Cover sheet.

The cover sheet shall indicate the type of statement (draft or final), the official project name, the responsible Agency office, the date, and the signature of the responsible official. The format is shown in Exhibit 6.

§ 6.302 Summary sheet.

The summary sheet shall conform to the format prescribed in Appendix I of the August 1, 1973, Council on Environmental Quality's Guidelines. The format is shown in Exhibit 7.

§ 6.304 Body of statement.

The body of the impact statement shall identify, develop, and analyze the pertinent issues included in the seven sections below. Each section need not be a separate chapter in the statement. Impact statements shall not be justification documents for proposed Agency funding or actions. Rather, they shall be objective evaluations of actions and their alternatives in light of all environmental considerations. Environmental impact statements shall be prepared using a systematic, interdisciplinary approach. Statements shall incorporate all relevant analytical disciplines and shall provide meaningful and factual data, information, and analyses. The presentation should be simple and concise, yet include all facts necessary to permit independent evaluation and appraisal of the beneficial and adverse environmental effects of alternative actions. The amount of detail provided should be commensurate with the extent and expected impact of the actions, and the amount of information required at the particular level of decision making. To the extent possible, statements shall not be drafted in a style which requires extensive scientific or technical expertise to comprehend and evaluate the environmental impact of an Agency action.

(a) *Background and description of the proposed action.* Describe the recommended or proposed action, its purpose, where it is located and its time setting. To prevent piecemeal decision making, the project shall be described in as broad a context as necessary. The relationship to other projects and proposals directly affected by or stemming from the proposed project shall be discussed, including not only other Agency activities, but also those of other Governmental and private organizations. Development and population trends in the project area and the assumptions on which they are based shall also be included. Maps, photos, and artist sketches should be incorporated if available when they help depict the environmental setting. If not enclosed, supporting documents should be referenced.

(b) *Alternatives to the proposed action.* Develop, describe, and objectively weigh alternatives to any proposed action. The analysis should be sufficiently detailed to reveal the Agency's comparative evaluation of the environmental effects, costs, and risks of the proposed action and each reasonable alternative. The analysis of alternatives should include the alternative of taking no action or of postponing action, as well as alternatives having different environmental impacts. On projects involving construction, alternative sites must be considered. This analysis shall evaluate alternatives in such a manner that reviewers independently can judge their relative desirability. If a cost-benefit analysis is prepared, it should be appended to the statement. In addition, the reasons why the proposed action is believed by the Agency to be the best course of action shall be explained.

(c) *Environmental impact of the proposed action.* (1) Describe the primary and secondary environmental impacts, both beneficial and adverse, anticipated from the action. The scope of the description shall include both short- and long-term impacts. Attention should be given to discussing those factors most directly impacted by the proposed action.

(2) Primary impacts are those that can be attributed directly to the action or project. For example, if the action is a field experiment, materials introduced into the environment may damage certain flora or fauna. If the action involves construction of a facility, construction activities may damage certain aspects of the environment. In addition, operation of the facility may have continuing environmental effects, both beneficial and adverse.

(3) Secondary impacts are indirect or induced impacts. If the action involves construction of a facility, such as a wastewater treatment system or an office building or laboratory, it may stimulate or induce secondary effects in the form of associated investments and changed patterns of social and economic activities. Particular attention should be paid to changes in population patterns or growth. When such changes are significant, their effect on the resource base, including land use, water quality and quantity, air quality, and public services, should be determined. A discussion of how these impacts conform or conflict with the objectives and specific terms of approved or proposed Federal, State, and local land use plans, policies, and controls for the area should be included. If a conflict exists, the Agency should give the reasons why it has decided to proceed notwithstanding the absence of full reconciliation.

(4) The following sections discuss in more detail some of the items that shall be considered in describing the impact of the proposed action.

(d) *Adverse impacts which cannot be avoided should the proposal be implemented.* Describe the kinds and magnitudes of adverse impacts which cannot be reduced in severity or which can be reduced to an acceptable level but not eliminated. These may include water or air pollution, undesirable land use patterns, damage to ecological systems, urban congestion, threats to health or other consequences adverse to the environmental goals set out in section 101(b) of the National Environmental Policy Act. Remedial, protective, and mitigative measures which will be taken as part of the proposed action shall be identified. These measures to prevent, eliminate, reduce, or compensate for any environmentally detrimental aspect of the proposed action shall include those of the Agency and others; e.g., its contractors and grantees.

(e) *Relationship between local short term uses of man's environment and the maintenance and enhancement of long term productivity.* Describe the extent to which the proposed action involves tradeoffs between short term environmental gains at the expense of long term losses or vice-versa and the extent to which the proposed action forecloses future options. Special attention shall be given to effects which narrow the range of beneficial uses of the environment or pose long term risks to health or safety. Those who may reap windfall gains or suffer significant decrease in current property value from the prepared project shall be identified. In addition, the reason the proposed action is believed by the Agency to be justified now, rather than reserving a long term option for other alternatives, including no use, shall be explained.

(f) *Irreversible and irretrievable comments of resources which would be involved in the proposed action should it be implemented.* Describe the extent to which the proposed action curtails the diversity and range of beneficial uses of the environment. For example, a decision to dispose of the treated effluent from a wastewater treatment system rather than reclaim it will result in the irretrievable loss of that water, including nutrient constituents. Secondary impacts, such as induced growth in undeveloped areas, may make alternative uses of that land impossible. Also, irreversible damage can result from environmental accidents associated with the action. Any irretrievable and significant commitments of resources shall be evaluated to assure that such current consumption is justified.

(g) *A discussion of problems and objections raised by other Federal, State, and local agencies and by interested persons in this review process.* Final statements (and draft statements if appropriate) shall summarize the comments and suggestions made by reviewing organizations and shall describe the disposition of issues surfaced (e.g., revisions to the proposed action to mitigate anticipated impacts or objections). In particular, they shall address the major issues raised when the Agency position is at variance with recommendations and objections (e.g., reasons why specific comments and suggestions could not be adopted, and factors of overriding importance prohibiting the incorporation of suggestions). Reviewer's statements should be set forth in a "comment" and discussed in a "response." In addition, the source of all comments should be clearly identified and copies of the comments (or summaries where a response has been exceptionally voluminous) should be attached to the final statement.

Subpart D—Public Participation

§ 6.400 General.

Public participation is an integral part of the Agency planning process. It consists of continuous, two-way communication keeping the public fully informed about the status and progress of studies and findings, and actively soliciting comments from all concerned and affected groups and individuals.

§ 6.402 Public hearings.

(a) Public hearings on draft impact statements shall be held when the responsible official determines that a public hearing would facilitate the resolution of conflict or significant public controversy.

(b) When public hearings are to be held, the Agency must notify the public of the hearing in the draft statement or immediately after distribution of the draft statement. If a notice is included in the statement, it must follow the summary sheet at the beginning of the statement. This public notification must include at least fifteen (15) days prior to the date of such hearing:

(1) Notification to the public by adequate advertisement identifying the project, announcing the date, time, and place of such hearing, and announcing the availability of detailed information on

the proposed project for public inspection at one or more locations in the area in which the project will be located. "Detailed information" shall include a copy of the project application and the draft environmental impact statement.

(2) Notification to the appropriate State and local agencies and to the appropriate State and metropolitan clearinghouses.

(3) Notification to interested persons.

(c) A written record of the hearing shall be made. As a minimum, the record shall contain a list of witnesses together with the text of each presentation. Generally, a stenographer should be used. A summary of the record, including the issues raised, conflicts resolved and unresolved, and any other significant portions of the record, shall be appended to the final impact statement.

(d) When a public hearing has been held by another Federal, State, or local agency on an Agency action, additional hearings need not necessarily ensure. The responsible official shall decide if additional hearings are required.

(e) When a program office is the originating office, the appropriate regional office will provide assistance to the originating office in holding any public hearing if assistance is requested.

§ 6.404 Comments on the draft and final statements.

(a) Draft impact statements and negative declarations shall be made available to the public to assure the fullest practical provision of timely public information and understanding of Federal plans and programs. In addition, public hearings, notices of intent, and press releases will be employed by the Agency to ensure adequate public involvement.

(b) Final environmental impact statements shall be furnished to all interested persons who submitted written comments on the draft impact statement. This is to enable public organizations to comment on the final statement to the Agency or the Council on Environmental Quality, if they so desire, within the thirty (30) calendar day period prior to Agency administrative action on the proposal.

§ 6.406 Availability of documents.

(a) Draft and final environmental impact statements, negative declarations, and environmental impact appraisals shall be made available for public review at the following locations:

(1) The originating office.

(2) The Office of Public Affairs for draft and final impact statements only.

(b) The Agency will endeavor to print sufficient copies of draft and final environmental impact statements to meet anticipated demand. A nominal fee may be charged for copies requested by the public.

(c) Lists of impact statements prepared or under preparation and lists of negative declarations prepared will be available at both the regional and headquarters Offices of Public Affairs.

Subpart E—Guidelines for Compliance With NEPA in the Title II Wastewater Treatment Works Construction Grants Program

§ 6.500 Purpose.

This subpart amplifies the general EPA polices and procedures described in Subpart A through D by providing detailed procedures for compliance with NEPA in the wastewater treatment works construction grant program.

§ 6.502 Definitions.

(a) "Responsible official." The responsible official for Agency actions covered by this subpart is the Regional Administrator.

(b) "NEPA-associated documents." Notices of intent, negative declarations, environmental appraisals, news releases, impact statements, and assessments.

(c) "Section 208 plan." An areawide waste treatment management plan prepared pursuant to section 208 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA). A section 208 plan normally includes most of the material required in a facilities plan (see paragraph (d) of this section) as well as material on land use planning and controls, control of non-point sources, and a comprehensive regulatory process adopted by the jurisdictions in the planning area. Section 208 plans will generally be developed in metropolitan areas with critical water quality conditions.

(d) "Facilities plan." A preliminary plan other than a section 208 plan, prepared as the basis for construction of publicly owned waste treatment works pursuant to Title II of the FWPCA. The purpose of a facilities plan is to determine the cost effectiveness of alternative waste treatment works, provide for a defined planning area, and present the preliminary design for the selected treatment works.

(e) "Step 1 grant." A grant for preparation of a facilities plan.

(f) "Step 2 grant." A grant for preparation of construction drawings and specifications. An approved facilities plan is required before a step 2 grant can be awarded.

(g) "Step 3 grant." A grant for fabrication and building of a treatment works. Both an approved facilities plan and construction drawings and specifications are required before a step 3 grant can be awarded.

(h) "Step 2 and 3 grant." A combination of design (step 2) and construction (step 3) grants. Requirements are the same as those for step 2 and step 3 grants.

(i) "Step 2/3 grants." A combination of design (step 2) and construction (step 3) grants, except that proposed performance specifications and other relevant design/construct criteria for the project must be submitted in lieu of construction drawings and specifications. A single firm would do both design and construction for a step 2/3 grant.

§ 6.504 Applicability.

(a) *Administrative actions covered.* This subpart applies to the administrative actions listed below:

(1) Approval of all § 208 plans;

(2) Approval of all facilities plans except as provided in paragraph (a)(5) of this section;

(3) Award of a step 2, 3, 2 and 3, and 2/3 grant, if an approved facilities plan was not required (during the transition from the present planning requirements to the new ones [see § 6.512(f)]); however, when a step 2 grant is to be awarded, the NEPA procedures must be completed prior to the award of the step 2 grant except as provided in paragraph (a)(5) of this section, and once the NEPA procedures have been completed at step 2 they need not be applied again at step 3 except as specified in paragraph (a)(4) of this section;

(4) Award of a step 2, 3, 2 and 3, and 2/3 grant when either the project or its impact has changed significantly from that specified in the approved facilities plan, except as provided in paragraph (a)(5) of this section;

(5) A facilities plan may be approved and a step 2 grant awarded prior to completion of an impact statement when the Regional Administrator determines that excessive costs would be incurred if award of a step 2 grant were delayed pending completion of the impact statement, provided the Regional Administrator also determines that there is no substantial risk that preparation of plans and specifications under step 2 will foreclose options that must be considered in the impact statement. The Regional Administrator shall document each such decision in writing.

(b) *Administrative actions excluded.* The Agency actions listed below are not subject to the requirements of this part.

(1) Approval of State priority lists;

(2) Award of a step 1 grant;

(3) Award of a section 208 planning grant;

(4) Approval of engineering plans and specifications;

(5) Issuance of an invitation for bid;

(6) Actual physical commencement of building or fabrication;

(7) Award of a section 206 grant for reimbursement;

(8) Award of grant increases *provided, however,* That § 6.504(a)(4) does not apply;

(9) Program grant awards to State and interstate agencies;

(10) Training grants and contracts.

(c) *Retroactive application.* (1) This subpart shall be applied to ongoing wastewater treatment works for which grant awards were made prior to the promulgation of these guidelines when substantial funds have not been released and modifications or alternatives to the project are still available. The Regional Administrator shall ensure that an environmental impact statement shall be prepared for each such works found to have a significant impact in accordance with § 6.510. The grantee must be promptly notified in writing of the decision to prepare an impact statement.

(2) On such works, either all or a portion of the project work may be stopped by the Regional Administrator pending completion of the statement, if he determines that a work stoppage is warranted, to reduce the risk of incurring substantial additional costs for work which the impact statement may indicate will have to be abandoned or substantially changed. The Regional Administrator may request a written statement from the grantee to assist him in making this decision. The statement should include: A list of what work should and should not continue; a discussion of potential changes the impact statement might recommend in the work discussed in the above list; and the reasons why the work in question should or should not continue. Upon a determination of partial or complete work stoppage by the Regional Administrator, the appropriate grant action would be the issuance of a stop-work order to suspend work or a bilateral agreement to suspend project work, effected through a grant amendment, or in some cases, the issuance of a termination notice.

§ 6.506 Completion of NEPA procedures before commencement of administrative actions.

No administrative action can be taken until an impact statement or negative declaration with appraisal has been prepared in accordance with § 6.108.

§ 6.508 Responsibilities.

(a) *Responsible official.* The responsible official for Agency actions covered by this subpart is the Regional Administrator. The responsibilities of the Regional Administrator in addition to those in § 6.110(a) are to:

(1) Assist the Office of Federal Activities in coordinating the training of personnel involved in the review and preparation of NEPA-associated documents.

(2) Require of grant applicants and those who have submitted plans for approval, the information the regional office requires to comply with these guidelines.

(3) Consult with the Office of Federal Activities concerning works or plans which significantly affect more than one regional office, are highly controversial, are of national significant or "pioneer" Agency policy when these works have had or should have had an environmental impact statement prepared on them.

(b) *Assistant Administrator.* The responsibilities of the Office of the Assistant Administrator, as described in § 6.110(e), shall be assumed by the Assistant Administrator for Water and Hazardous Materials for Agency actions covered by this subpart.

(c) *Oil and Hazardous Materials Division, Office of Water Program Operations.* Coordinates all activities and responsibilities of the Office of Water Program Operations concerned with preparation and review of environmental impact statements. This includes providing technical assistance to the Regional Administrators on impact statements and assisting the Office of Federal Activities in coordinating the training of personnel involved in the review and preparation of NEPA-associated documents.

(d) *Public Affairs Division, Regional Offices.* The responsibilities of the regions' Public Affairs Divisions in addition to those in § 6.110(d) are to:

(1) Assist the Regional Administrator in the preparation and dissemination of NEPA-associated documents.

(2) Collaborate with the Headquarters Office of Public Affairs to analyze procedures in the regions for public participation and to develop and recommend to the Office of Federal Activities a program to improve those procedures.

§ 6.510 Criteria for preparation of environmental impact statements.

The Regional Administrator shall assure that an impact statement will be prepared on a treatment works facilities plan, 208 plan or other appropriate water quality management plan when any of the criteria in § 6.200 apply or when:

(a) The treatment works or plan will induce or encourage significant changes in industrial, commercial, or residential concentrations or distributions, the effects of which have not been adequately reflected in a previous impact statement on either the facility, the section 208 plan, or other water quality management plans encompassing the works. Factors that must be considered in determining if induced changes are significant include but are not limited to: the land area subject to increased development as a result of the treatment works; the increases in absolute population which may be induced; the increase in the rate of change of population; changes in density; the potential for overloading sewage facilities; the extent to which landowners may benefit from the areas subject to increased development; and the nature of land use regulations in the affected area and their potential effects on the development.

(b) Any major part of the treatment system will be located on wetlands or parklands, or in some other way will significantly affect wetlands or parklands.

(c) The proposed treatment plant site, effluent disposal site, or sludge disposal site is located on or adjacent to a habitat of species listed on the Department of Interior's list of endangered species.

(d) The works or plan will result in a significant displacement of population.

(e) The works or plan will have significant adverse impacts on areas of recognized scenic, recreational, or archeological value.

(f) The works will affect properties listed in or eligible for listing in the National Register of Historical Places, only when a memorandum of agreement showing removal of adverse effects cannot be agreed to by the Agency, the State Historic Preservation Officer, and the Executive Director of the Advisory Council on Historic Preservation.

(g) The works or plan will significantly deface an existing residential area.

(h) The works or plan may directly or through induced development have a significant adverse effect upon local ambient air quality, local ambient noise levels, surface or groundwater quality, fish, wildlife, their natural habitats, or other natural elements.

(i) The works or plan may significantly and adversely affect the quality or quantity of either surface or groundwater in a basin.

(j) The treated effluent is being discharged into a body of water where the present classification is being challenged as too low to protect present uses, and the effluent will not be of sufficient quality to meet the requirements of such uses.

(k) The environmental impact of the works or plan is highly controversial based on environmental issues raised by a concerned party or parties.

§ 6.512 Procedures for implementing the NEPA.

(a) *Environmental assessment.* An adequate environmental assessment must be an integral part of any facilities or section 208 plan submitted to the Agency. The analyses that constitute an adequate environmental assessment shall include:

(1) *Description of the environment without the project.* This shall include for the delineated planning area a description of the present environmental conditions when they are relevant to the analysis of alternatives or determinations of the environmental impacts of the proposed action. In addition, the future environmental conditions, assuming no project, shall be described. The description shall include but not be limited to a discussion of water quality, water supply and needs, air quality, land use trends, population projections, wetlands and other environmentally sensitive areas, historic sites, other related projects in the area, and where relevant a description of plant and animal communities that may be affected, especially rare and endangered species.

(2) *Analysis of alternatives.* This shall include a comparative analysis of options and a systematic development of wastewater treatment alternatives. The reasons for rejecting an option shall be presented in addition to any significant environmental benefit forgone by rejection of the option. The preliminary alternatives shall be screened with respect to goal attainment, approximate monetary costs, significant environmental effects, and physical, legal or institutional constraints. The reasons for rejecting a preliminary alternative shall be summarized. The alternatives remaining after screening shall be compared on the basis of detailed capital and operating costs, contributions to water quality goals, reliability and flexibility, and environmental impacts, giving special attention to long-term impacts, irreversible impacts

and induced impacts such as development. The options that shall be considered in the development of alternatives shall include:

(i) Flow and waste reduction measures, including infiltration/inflow reduction, land use and development regulations, and industrial reuse and recycling;

(ii) Sewers including alternative locations, sizes, and construction phasing;

(iii) Treatment and discharge, including wastewater reuse (industrial, groundwater recharge, or surface water supply enhancement), land application (irrigation, overland flow, or percolation), and treatment processes compatible with such discharge techniques;

(iv) Disposal of sludge and other residual waste, including process options and final disposal options such as land application, incineration, and landfill disposal;

(v) Siting of facilities;

(vi) Degree of regionalization;

(vii) Improving effluent quality through more efficient operation and maintenance;

(viii) For assessments associated with § 208 plans, the analysis of options shall include in addition:

(a) Land use controls, non-point source controls, and institutional arrangements; and

(b) Land management practices.

(3) *Environmental impacts of the proposed alternative.* This shall include a complete description of the environmental impacts the proposed alternative will have on the area's present environment. Impacts shall be identified as primary or secondary, beneficial or adverse, short or long term, avoidable or unavoidable, and reversible or irreversible. See § 6.304 (c), (d), (e), and (f) for an explanation of these terms and examples. Special attention should be paid to induce changes in population patterns and growth.

In addition to these items, the Regional Administrator may require that other analyses and data, which he determines are needed to comply with NEPA, be included with the facilities or section 208 plan. Such requirements will normally be discussed during preapplication conferences. The Regional Administrator may also require the submittal of supplementary information either before or after a step 2, 3, 2 and 3, or 2/3 grant if he determines it is needed for compliance with NEPA. Requests for supplementary information shall be made in writing.

(b) *Public hearing.* Unless waived by the Regional Administrator, at least one public hearing must be held in conjunction with the preparation of facilities and section 208 plans by the entity responsible for preparing the plan. Normally the hearings held on the plan will adequately surface the environmental issues associated with the facility and other aspects of the water quality management strategy. A Regional Administrator may elect to hold an Agency hearing if he determines it is warranted. Agency hearings shall be held in accordance with § 6.402.

(c) *Environmental review.*—(1) *General.* All facility and section 208 plans submitted to the Agency will be reviewed to determine the adequacy of the integral environmental assessment and to determine if the plan will have any significant environmental impacts, if any changes can be made in the project to eliminate or mitigate their impacts, and if an impact statement is required.

(i) If the integral assessment does not meet the requirements of § 6.512(a), the plan shall not be approved. If deficiencies exist, they shall be identified in writing by the Regional Administrator and must be corrected before the plan can be approved.

(ii) To determine if the plan will have any significant environmental impacts requiring an impact statement, the plan shall be reviewed in accordance with the criteria in § 6.200 and § 6.510. Either a notice of intent and impact statement or a negative declaration and environmental appraisal must be prepared on each facilities and section 208 plan.

(2) *Historic sites.* If a facilities or section 208 plan may affect a property listed in or eligible for listing in the National Register of Historic Places, the submitter of the plan shall consult with the State Historic Preservation Officer to determine if the effect will be adverse. A no-effect determination shall be documented in a memorandum to be submitted with the facilities or section 208 plan. If the project will have an adverse effect, the submitter of the plan shall attempt to develop alternatives with the State Officer to remove or mitigate the adversity, and prepare a proposal for a memorandum of agreement. The memorandum shall be included with the facilities or section 208 plan submitted for approval. If a proposal for a memorandum of agreement cannot be developed, the reasons shall be explained in a memorandum to be submitted with the facilities or section 208 plan. In such cases, the Regional Administrator shall commence consultation with the same officials in accordance with § 6.214(a) in an attempt to come to an agreement. If this consultation is unsuccessful, the Regional Administrator shall prepare an impact statement as required by § 6.510(g).

(3) *Wetlands.* If the facilities or section 208 plan may affect wetlands, the Regional Administrator shall follow the procedures described in § 6.214(b).

(4) *Fish and wildlife.* If the facilities or section 208 plan may result in the control or modification of any stream or other body of water, the Regional Administrator shall follow the procedures described in § 6.214(c).

(5) *Scope of review.* It is the Regional Administrator's responsibility to determine the proper scope of the environmental review. If a number of related facilities plans are submitted to the Agency in conjunction with applications for grants, the Regional Administrator may delay approval of these plans and award of a grant until the plans can be reviewed together to allow the Agency to properly evaluate their cumulative impact.

(d) *Notice of intent and impact statement.*—(1) *General.* If the environmental review of the facilities or section 208 plan indicates a significant impact on the environment, and that impact cannot be eliminated by making appropriate changes in the project, the Regional Administrator shall issue a notice of intent and prepare an impact statement on the plan in accordance with the procedures in Subpart B of this part.

(2) *Scope of impact statement.* It is the Regional Administrator's responsibility to determine the most appropriate scope of the impact statement. He should determine if the statement should be prepared on a facilities plan(s) or section 208 plan. Once an impact statement has been prepared for a given area, another need not be prepared unless the significant impacts of individual facilities were not adequately treated in the statement.

(e) *Negative declaration.* If the Regional Administrator, after completion of the environmental review of the facilities or section 208 plan, determines that the plan will not have any of the significant impacts listed in § 6.510, or determines that the project has been changed to eliminate the significant impacts, a negative declaration shall be prepared in accordance with the procedures in Subpart B of this part. Once a negative declaration and appraisal have been prepared for the facilities plan for a certain area, grant awards may proceed without preparation of additional negative declarations, provided the project has not changed significantly from that specified in the facilities plan.

(f) *Interim procedures.*—(1) *General.* Until facilities plans are required, an environmental assessment meeting the requirements of § 6.512(a) shall be submitted with the application for each step 2, 3, 2 and 3, and 2/3 grant. However, when a step 2 grant application is received the NEPA procedures must always be completed before awarding the step 2 grant except as provided in § 6.504(a)(5). In such cases, an assessment is not required with the step 3 grant application and the NEPA decision need not be made again. The assesment should be reviewed in accordance with § 6.512(c) to determine if it is adequate and whether an impact statement should be prepared. If the assessment is not adequate, the deficiencies shall be identified in writing by the Regional Administrator and must be corrected by the grant applicant before the Regional Administrator can act on his application. The Regional Administrator is responsible for determining the proper scope of the review to ensure that the cumulative impact of individual works is properly evaluated. If any water quality management plans are available for the area, they should be considered in determining the proper scope of the review. If an impact statement is to be prepared, a notice of intent will be prepared as described in § 6.512(d). If appropriate, the Regional Administrator may prepare an impact statement on a number of related grants or an available water quality management plan. If no impact statement need be prepared, a negative declaration should be prepared in accordance with § 6.512(e). Commencement of administration action must be in accordance with § 6,506.

(2) *Public hearing.*—(i) *General.* Until facilities plans and their associated public hearings are required, the applicant must submit a record of a public hearing with his grant application, unless the requirement for such a hearing is waived by the Regional Administrator. The record must be received before the Regional Administrator can act on the application. The record shall contain as a minimum a list of witnesses together with the text of each presentation and a statement that the participants at the hearing were informed that one of the purposes of the hearing is to discuss the environmental effects of the proposed treatment works and alternatives to it as required by the Environmental Protection Agency.

(ii) *Public notice.* (a) The potential grantee must provide adequate notice to the public of the hearing. Adequate notice shall generally be considered to include, at least thirty (30) days prior to the date of such hearing:

(1) Notice given to the public by adequate advertisement identifying the works, announcing the date, time, and place of such hearing, and announcing the availability of detailed information on the proposed works for public inspection at one or more locations in the area in which the works will be located. Detailed information shall generally include, as a minimum, a complete description of the works, cost and financing information, alternatives to the proposed works, a detailed description of the effects of the works on land use, and a statement that one of the purposes of the hearing is to discuss the potential environmental impacts of the works and alternatives to it.

(2) Notification to the appropriate State and local agencies, to the appropriate State and metropolitan clearinghouses, and the appropriate regional office of EPA.

(3) Notification to interested environmental and conservation action groups.

(4) The Regional Administrator may permit a shorter notice period if he determines the notification is adequate.

(b) The potential grantee shall submit with the record of the public hearing: (1) A copy of any advertisement published, broadcast, or otherwise issued pursuant to this section; (2) a list of those notified; and (3) a certification that the hearing was held in accordance with the notification requirements of this section.

(iii) Waiver of hearing on grant applications. A request to waive the hearing on a grant application for a wastewater treatment works must be submitted in writing prior to submission of the grant application. Such requests will be acted upon promptly by the Regional Administrator. Requests must include a description of the works, the estimated cost of the works, the area that will be serviced, and the reasons the grantee feels a public hearing would not serve the public interest. Waivers will, in general, only be granted for minor works such as small additions, minor modifications to existing works, or cases where a previous hearing was sufficiently comprehensive to cover the environmental issues in detail.

(3) *Additional procedures.* During the interim period, the Regional Administrator shall also apply the procedures detailed in § 6.214.

§ 6.514 Content and format of environmental impact statements.

Environmental impact statements for treatment works or plans shall be prepared in accordance with § 6.304.

Subpart F—Guidelines for Compliance With NEPA in Research and Development Programs and Activities

§ 6.600 Purpose.

This subpart amplifies the general Agency policies and procedures described in Subparts A through D by providing detailed procedures for the preparation of impact statements on programs and projects of the Office of Research and Development (ORD).

§ 6.602 Definitions.

(a) *"Program."* A significant, mission oriented Agency endeavor which fulfills executive or statutory requirements and which includes the principal actions to achieve a desired objective.

(b) *"Project or task."* A planned unit of effort fulfilling a portion of a Research Objective Achievement Plan (see § 6.602 (d)), having a defined output and delivery date; consisting of a single intramural, extramural or demonstration project. This term will be used collectively for the three project types below.

(1) "Intramural (in-house) project." A project or task undertaken by EPA personnel.

(2) "Extramural project." A project undertaken with a grant, contract, or interagency agreement.

(3) "Demonstration project." A project which shows the applicability of a piece of developed technology. It is a project which is carried out at or near full-scale and has a high probability of success. A demonstration project is usually an extramural project.

(c) *"Program Area Plan"* (PAP). An ORD planning document which details objectives, outputs, scheduling, and resources necessary to the achievement of objectives within a major area of ORD responsibility.

(d) *"Research Objective Achievement Plan"* (ROAP). A planning document defining all tasks (projects) and resources required to attain an objective as defined in a PAP.

(e) *"Appropriate program official."* The official within the ORD to whom the responsible official delegates most of the work related to compliance with NEPA.

(f) *"Decision official."* The individual responsible for determining if a proposal for conducting a specific project will be funded. The assignment of this role will vary according to cost and subject matter.

(g) *"NEPA-associated documents."* Notice of intent, negative declarations, environmental appraisals, news releases, impact statements, and assessments.

§ 6.604 Applicability.

(a) *Administrative actions covered.* This subpart applies to the administrative actions listed below:

(1) Approval of PAP's, except for those PAP's excluded in paragraph (b)(1) of this section;

(2) Approval of ROAP's, except for those ROAP's excluded in paragraph (b)(2) of this section;

(3) Award of a contract or grant on projects (tasks), except for those excluded in paragraph (b)(3) of this section;

(b) *Administrative actions excluded.* The Agency actions listed below are not subject to the requirements of this part. However, none of these actions are excluded from the procedures on historic sites, wetlands, or fish and wildlife detailed in § 6.214.

(1) Approval of PAP's developed pursuant to the Federal Water Pollution Control Act (FWPCA) Amendments of 1972;

(2) Approval of ROAP's developed pursuant to the FWPCA Amendments of 1972;

(3) Award of a contract or grant on tasks undertaken pursuant to the FWPCA Amendments of 1972.

These exclusions are consistent with section 511(c)(1) of the FWPCA Amendments of 1972.

§ 6.606 Responsibilities.

(a) *Responsible official.* The responsible official for Agency actions covered by this subpart is the Assistant Administrator for Research and Development. The Assistant Administrator will delegate most of the work to the appropriate program official. The responsibilities of the responsible official, in addition to those in § 6.110(a), are:

(1) Ensures that environmental assessments are submitted and the appropriate program officials conduct environmental reviews, prepare impact statements and other NEPA-associated documents, and take such subsequent actions as are delegated to them by the responsible official.

(2) When projects significantly affect more than one regional office, are highly controversial, are of national significance, or "pioneer" Agency policy, the appropriate program official shall coordinate the project with the Office of Program Integration, Assistant Administrator for Research and Development.

(b) *Assistant Administrator.* The responsibilities of the Office of the Assistant Administrator as described in § 6.110 (e) shall be assumed by the Assistant

Administrator for Research and Development for Agency actions covered by this subpart.

(c) *Office of Program Integration, Assistant Administrator for Research and Development.* Advises the Assistant Administrator for Research and Development, concerning projects which significantly affect more than one regional office, are highly controversial, are of national significance, or "pioneer" Agency policy, when these projects have had or should have had an environmental impact statement prepared on them.

(d) *Regional Administrators.* The responsibilities of the Regional Administrator with regard to projects of the Office of Research and Development which affect his region will be to:

(1) Provide technical and administrative assistance in environmental reviews and in the preparation of impact statements.

(2) Advise the appropriate program officials and the Office of Program Integration of any projects which will significantly affect more than one regional office, are highly controversial, are of national significance, or "pioneer" Agency policy, when these projects have had or should have had an environmental impact statement prepared on them.

§ 6.608 Criteria for the preparation of environmental impact statements.

(a) An impact statement shall be prepared and processed by the Office of Research and Development when:

(1) The action will have significant adverse impacts on public parks, wetlands, wildlife habitats, or areas of recognized scenic or recreational value.

(2) The action will have significant adverse impacts on areas of recognized archeological value.

(3) The action will adversely affect properties listed in or eligible for listing in the National Register of Historical Places, only when a memorandum of agreement showing removal of such effects cannot be agreed to by the Agency, the State Historic Preservation Officer, and the Executive Director of the Advisory Council on Historic Preservation.

(4) The action will significantly deface an existing residential area.

(5) The action may directly or through induced development have a significant adverse effect upon local ambient air quality, local ambient noise levels, surface or groundwater quality, fish, wildlife, their natural habitats, or other natural elements.

(6) When the treated effluent is being discharged into a body of water where the present classification is being challenged as too low to protect present uses, and the effluent will not be of sufficient quality to meet the requirements of such uses.

(7) The project consists of field tests involving the introduction of agricultural chemicals, animal wastes, pesticides, radioactive materials, or other hazardous substances into the environment by the Office of Research and Development, its grantee, or its contractor.

(8) There is a high probability of an action ultimately being implemented on a large scale and the broad scale application may result in significant impacts on the immediate area in which it will be located.

(9) The commitment to a new technology is relatively significant and may restrict future viable alternatives.

(10) The environmental impact of a project is highly controversial based on environmental issues raised by a concerned party or parties.

(b) An impact statement will normally not be necessary when:

(1) The project is conducted completely within a laboratory or other facility, and external environmental effects have been minimized by providing effective methods for disposal of laboratory wastes and effective safeguards to prevent accidental introductions of hazardous materials into the environment; or

(2) The project is a relatively small experiment or investigation that is part of the private sector, and the project makes no significant new or additional contribution to the existing pollution.

§ 6.610 Procedures for compliance with NEPA.

EIS related activities shall be integrated into ORD's formal research planning system. The planning system ensures management control of all research and development actions assigned to the ORD. In this planning system, all increments of work are interrelated by means of a hierarchical system of planning documentation (tasks, ROAP's, and PAP's). The PAP is the highest level plan whose output synthesizes a subordinate set of ROAP's. A ROAP includes and amalgamates a group of tasks and represents a multiple-year effort. The task or project is a manageable unit of research activity directly supervised by a single project individual. The ROAP's and PAP's are available to all management levels and can only be modified by formal change procedures. These plans are reviewed by ORD management on an annual basis as a minimum. At this time all subordinate plans are reevaluated, new R&D initiatives considered and priorities and resources recommended to the Agency.

(a) *Environmental assessment.* (1) Environmental assessments shall be submitted to the Agency on certain extramural projects (tasks), including all grant applications and proposals for sole-source contracts. In the case of competitive proposals, assessments need not be submitted by potential contractors because the NEPA procedures will be completed before a request for proposal (RFP) is issued. If there is a question concerning the need for an assessment, the potential contractor or grantee should consult with the appropriate official responsible for the grant or contract.

(2) The assessment shall contain the same sections specified for impact statements in § 6.304. Copies of § 6.304 (or more detailed guidance when available) and a notice alerting potential grantees and contractors of the assessment requirements shall be included in all grant application kits, attached to letters concerning the submission of unsolicited proposals, and included with all requests for sole-source proposals.

(b) *Environmental review.*—(1) *PAP's.* An environmental review shall be conducted for all PAP's that are not listed in § 6.604(b), prior to their incorporation into the ORD annual program plan. This review will consist of an evaluation of the potential environmental effects of the efforts proposed within the PAP's. The criteria in § 6.608 shall be used to determine if these effects may be significant.

(i) The environmental reviews for continuing programs will be reevaluated annually to coincide with the ORD planning cycle and at any other time when a major change in objectives is officially incorporated.

(ii) Current PAP's, less budgetary data, will be filed with the Office of Public Affairs (OPA). Negative declarations, associated appraisals and certificates stating the action is exempt from NEPA will also be filed with OPA.

(2) *ROAP's.* As part of the environmental review of PAP's, all ROAP's identified in the PAP's will be briefly reviewed by the appropriate program official for future potential adverse impacts. The criteria of § 6.608 shall be used in conducting this review. A formal environmental review will be conducted for those ROAP's that are deemed to have significant adverse impacts. The remainder of the ROAP's will be covered by a simple blanket negative declaration.

(i) The environmental reviews for continuing ROAP's will be reevaluated annually to coincide with the ORD planning cycle and at any other time when a major change in mission objectives is officially incorporated.

(ii) Current ROAP's less budgetary data, will be filed with OPA. Negative declarations and associated appraisals will also be filed with OPA.

(3) *Projects.* As part of the environmental review of ROAP's, all projects identified in the ROAP's will be briefly reviewed by the appropriate program official for future potential adverse impact. The criteria in § 6.608 shall be used in conducting this review. If an individual project may have a significant adverse impact when it is actually implemented, it will be identified in the documentation associated with the ROAP and will be filed with the OPA. Lists of such research projects will be available at the OPA. The remainder of the projects, which will not have any adverse impact when implemented, will be covered by a single blanket negative declaration.

(i) The projects (tasks) identified in a ROAP will be reevaluated annually to coincide with ORD's planning cycle and at any other time that a major redirection of the parent ROAP or PAP is undertaken. All associated documentation will be updated as appropriate.

(ii) As those projects identified as having potentially significant impacts near implementation, detailed environmental reviews shall be performed on each. The review shall be programmed just prior to the planned initiation of the project, leaving sufficient lead time to ensure the review will affect the project.

(iii) A project level environmental review shall also be conducted for any projects which could not be predicted and scheduled within a ROAP, and whose environmental assessment indicates there may be adverse impacts.

(c) *Notice of intent and environmental impact statement.* (1) If any of the actions discussed in paragraph (b) (1), (2), or (3) of this section will have a significant effect on the environment, the appropriate program official will prepare a notice to the appropriate decision official for a determination on whether the project will be funded. If the action is to be approved and funded, the appropriate program official will commence preparation of the draft impact statement. The appropriate program official, through his National Environmental Research Center Director or Headquarters Division Director, shall request the Regional Administrator to assist him in the preparation and distribution of the statement as specified in Subpart B of this part.

(2) Before release to the Council on Environmental Quality, all draft and final impact statements must be forwarded through the appropriate National Environmental Research Center Director or Headquarters Division Director to the Office of Program Management, Assistant Administrator for Research and Development, for approval.

(d) *Negative declaration and environmental impact appraisal.* If the environmental review indicates that an action discussed in paragrapahs (b) (1), (2), or (3) of this section will not have any significant environmental impacts, the appropriate program official shall prepare a negative declaration and environmental impact appraisal and forward them to the appropriate decision official. If the project is to be funded, the appropriate program official will distribute the negative declaration where practical as described in § 6.212, in addition to making copies of the negative declaration and appraisal available in the OPA.

(e) *Project commencement.* As required by § 6.108, a contract or grant will not be awarded for an extramural project, nor an intramural project begun, until fifteen (15) days after a negative declaration has been issued or the thirty (30) day waiting period after forwarding the final impact statement to the Council on Environmental Quality has expired.

(f) The environmental impact statement process for the Office of Research and Development is shown graphically in Exhibit 8.

Subpart G—Guidelines for Compliance with NEPA in Solid Waste Management Activities

§ 6.700 Purpose.

This subpart amplifies the general Agency policies and procedures described in Subparts A through D by providing additional procedures for compliance with NEPA on actions undertaken by the Office of Solid Waste Management Programs.

§ 6.702 Definitions.

(a) *"Project."* A discernible effort or activity to accomplish a specific objective or end result.

(1) "Intramural (in-house) project." A project undertaken with resources other than grant or contract funds.

(2) "Extramural project." A project undertaken with grant or contract funds.

(b) *"Project officer."* The individual responsible for the technical direction and evaluation of a grantee's or contractor's performance.

(c) *"NEPA-associated documents."* Notices of intent, negative declarations, environmental appraisals, news releases, impact statements, and assessments.

§ 6.704 Applicability.

This subpart applies to those actions specified in § 6.106(a) (5) and (6) that are undertaken by the Office of Solid Waste Management Programs. The specific procedures to be followed for various project types are set forth in § 6.710.

§ 6.706 Responsibilities.

(a) *Responsible official.* The responsible official for Agency actions covered by this subpart is the Deputy Assistant Administrator for Solid Waste Management Programs. The responsibilities of this responsible official, in addition to those in § 6.110(a) are:

(1) Insure that environmental assessments are submitted by appropriate grant and contract applicants, and that project officers conduct environmental reviews on all projects and take such subsequent actions as are delegated to them by the "responsible official."

(2) Assist the Office of Federal Activities in coordinating the training of personnel involved in the review and preparation of all NEPA-associated documents.

(3) Advise the Assistant Administrator for Air and Waste Management concerning projects which significantly affect more than one regional office, are highly controversial, are nationally significant, or "pioneer" Agency policy.

(b) *Assistant Administrator.* The responsibilities of the Office of the Assistant Administrator as described in § 6.110 (e) shall be assumed by the Assistant Administrator for Air and Waste Management for Agency actions covered by this subpart.

(c) *Regional Administrator.* The responsibilities of the Regional Administrator with regard to projects of the Office of Solid Waste Management Programs which affect his region will be to:

(1) Assist the responsible official in the project review by commenting on the project, the project application and the applicant's environmental assessment. Among other things, the comments should identify those projects which will significantly affect more than one regional office, are highly controversial, nationally significant, or "pioneer" Agency policy.

(2) Assist the responsible official in the preparation and distribution of NEPA-associated documents.

§ 6.708 Criteria for the preparation of environmental assessments and impact statements.

(a) *Assessment preparation criteria.* Environmental assessment need not be submitted with all grant applications and contract proposals. Studies and investigations do not require assessments. The following sections describe for other actions when an assessment is or is not required:

(1) *Grants.*—(i) *Demonstration projects.* Environmental assessments must be submitted with all applications for demonstration grants that will involve construction, land use (temporary or permanent), transport, sea disposal, any discharges into the air or water, or any other activity having any direct or indirect effects on the environment external to the facility in which the work will be conducted. Preapplication proposals for such grants will not require environmental assessments.

(ii) *Training.* Grant applications for training of personnel will not require assessments.

(iii) *Plans.* Grant applications for the development of comprehensive State, interstate, or local solid waste management plans will not require environmental assessments. A detailed analysis of environmental problems and effects should be part of the planning process, however.

(2) *Contracts.*—(i) *Sole-source contract proposals.* Before a sole-source contract can be awarded, an environmental assessment must be submitted with a bid proposal for a contract which will involve construction, land use (temporary or permanent), sea disposal, any discharges into the air or water, or any other activity that will directly or indirectly affect the environment external to the facility in which the work will be performed.

(ii) *Competitive contract proposals.* Assessments will not generally be required on competitive contract proposals.

(b) *Impact statement preparation criteria.* An environmental review shall be performed on those projects of the Office of Solid Waste Management Programs on which an assessment is required or which may have effects on the environmental external to the facility in which the work will be performed. The criteria in § 6.200 shall be utilized in determining whether an impact statement need be prepared.

§ 6.710 Procedures for compliance with NEPA.

(a) *Environmental assessment.* (1) Environmental assessments shall be submitted to the Agency as specified in § 6.708. If there is a question concerning the need for an assessment, the potential contractor or grantee should consult with the appropriate project officer for the grant or contract.

(2) The assessment shall contain the same sections specified for impact statements in § 6.304. Copies of § 6.304 (or more detailed guidance when available) and a notice alerting potential grantees and contractors of the assessment requirements in § 6.708 shall be included in all grant application kits, attached to letters concerning the submission of unsolicited proposals, and included with all requests for proposals (RFP's).

(b) *Environmental review.* An environmental review will be conducted on all projects which require assessments or which will affect the environment external to the facility in which the work will be performed. This review must be conducted before a grant or contract award is made on extramural projects or before project commencement on intramural projects. The guidelines in § 6.200 will be utilized in determining if the project will have any significant environmental effects. This review will include an evaluation of the assessment by both the responsible official and the appropriate Regional Administrator. The Regional Administrator's comments will include his recommendations on the need for an environmental impact statement. No detailed review or documentation is required on projects for which assessments are not required and which will not affect the environment external to a facility.

(c) *Notice of intent and environmental impact statement.* If any of the criteria in § 6.200 apply, the responsible official will assure that a notice of intent and a draft impact statement are prepared. The responsible official shall request the appropriate Regional Administrator to assist him in the distribution of the NEPA-associated documents as may be required. Distribution will be as specified in Subpart B.

(d) *Negative declaration and environmental impact appraisal.* If the environmental review indicated that there will not be any significant environmental impacts, the responsible official will assure that a negative declaration and environmental appraisal are prepared. These documents need not be prepared for projects not requiring an environmental review.

(e) *Project commencement.* As required by § 6.108, a contract or grant shall not be awarded on an extramural project, nor an intramural project begun, until fifteen (15) days after release of a negative declaration (if one is required), or until thirty (30) days after forwarding the final impact statement to the Council on Environmental Quality has expired.

(f) The environmental impact statement process for the Office of Solid Waste Management Programs is shown graphically in Exhibit 9.

Subpart H—Guidelines for Compliance with NEPA in Construction of Special Purpose Facilities and Facility Renovations

§ 6.800 Purpose.

This subpart amplifies the general Agency policies and procedures described in Subparts A through D by providing detailed procedures for the preparation of impact statements on construction and renovation of special purpose facilities.

§ 6.802 Definitions.

(a) *"Special purpose facility."* A building or space, including land incidental to the use thereof, which is wholly or predominantly utilized for the special purpose of an agency and not generally suitable for use for other purposes, as determined by the General Services Administration.

(b) *"Program of requirements."* A comprehensive document (booklet) describing program activities to be accomplished in the new special purpose facility or improvement. It includes architectural, mechanical, structural, and space requirements.

(c) *"Scope of work."* A document similar in content to the program of requirements but substantially abbreviated. It is usually prepared for small-scale projects.

§ 6.804 Applicability.

(a) *Actions covered.* These guidelines apply to all new special purpose facility construction, activities related to such construction (e.g., site acquisition and clearing), and any improvements or modifications to such facilities having potential environmental effects external to the facility. This includes new construction and improvements undertaken and funded by the Facilities Management Branch, Facilities and Support Services Division, Office of Administration; by a regional office; or by a National Environmental Research Center.

(b) *Actions excluded.* This subpart does not apply to those activities of the Facilities Management Branch, Facilities and Support Services Division, for which the branch does not have full fiscal responsibility for the entire project. This includes pilot plant construction, land acquisition, site clearing and access road construction where the Facilities Management Branch's activity is only supporting a project financed by a program office. Responsibility for considering the environmental impacts of such projects rests with the office managing and funding the entire project. Other subparts of this regulation would apply depending on the nature of the project.

§ 6.806 Responsibilities.

(a) *Responsible official.* The responsible official for new construction and modification of special purpose facilities is as follows:

(1) The Chief, Facilities Management Branch, Data and Support Systems Division, shall be the responsible official on all new construction of special purpose facilities and on all improvement and modification projects for which the Facilities Management Branch has received a funding allowance.

(2) The Regional Administrator shall be the responsible official on all improvement and modification projects for which the regional office has received the funding allowance.

(3) The Center Director shall be the responsible official on all improvement and modification projects for which the National Environmental Research Centers have received the funding allowance.

(b) The responsibilities of the responsible officials specified above, in addition to those in § 6.110(a), are as follows:

(1) Ensure that environmental assessments are submitted when requested, that environmental reviews are conducted on all projects, and impact statements are prepared and circulated when there will be significant impacts.

(2) Assist the Office of Federal Activities in coordinating the training of personnel involved in the review and preparation of NEPA-associated documents.

§ 6.808 Criteria for the preparation of environmental assessments and impact statements.

(a) *Assessment preparation criteria.* An environmental assessment may be requested of a construction contractor or consulting architect/engineer employed by the Agency if they are involved in the planning or construction of special purpose facilities or in modifications to such facilities having potential environmental effects external to the facility. Such modifications include but are not limited to: facility additions, changes in central heating systems or wastewater treatment systems, and land clearing for access roads and parking lots.

(b) *Impact statement preparation criteria.* An environmental review shall be performed on all actions involving construction of special purpose facilities and on improvements to such facilities. The guidelines set forth in § 6.200 shall be utilized to determine whether an impact statement shall be prepared.

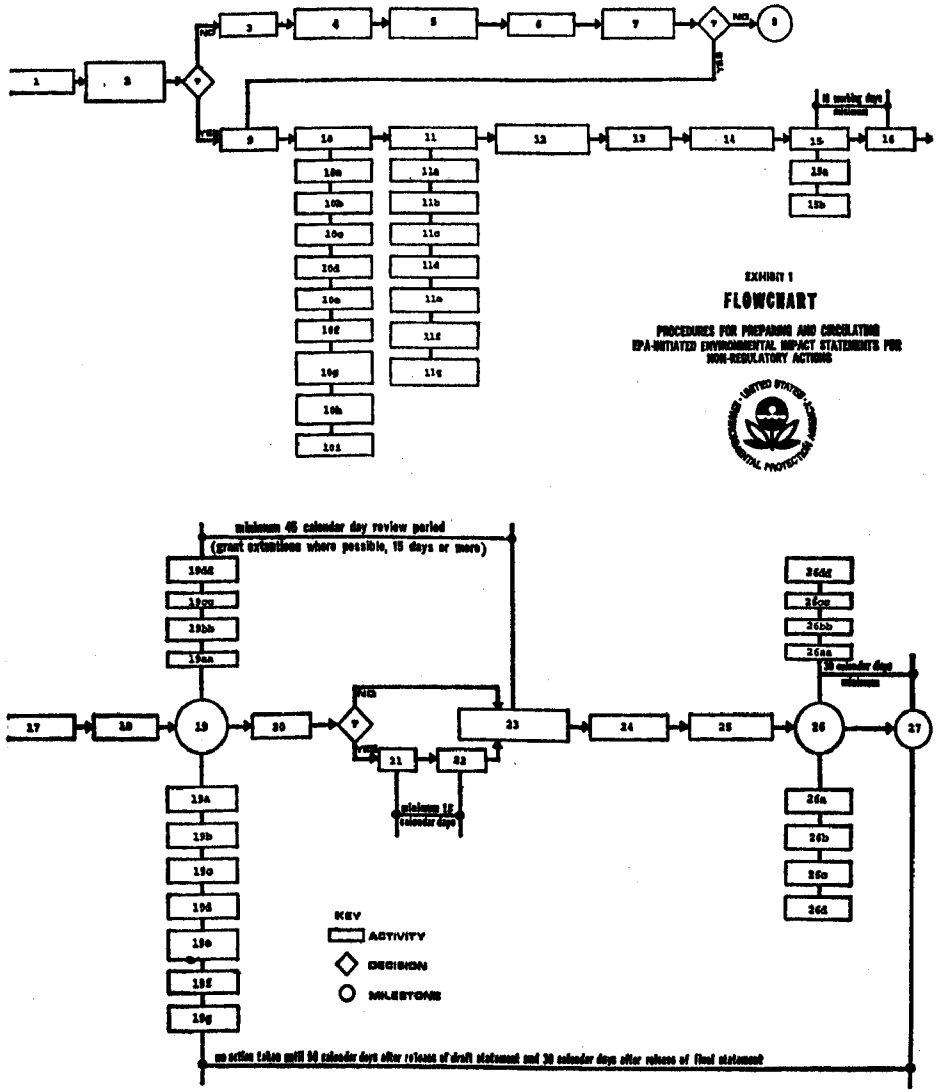
§ 6.810 Procedures for compliance with NEPA.

(a) *Environmental review and assessment.* (1) An environmental review shall be conducted when the program of requirements or scope of work has been completed for the construction, improvement, or modification of special purpose facilities. For special purpose facility construction, the Chief, Facilities Management Branch, shall request the assistance of the appropriate program office and Regional Administrator in the review. For modifications and improvements, the appropriate responsible official shall request assistance in making the review from other cognizant Agency components.

(2) Any assessments requested shall contain the same sections specified for impact statement in § 6.304. Contractors and consultants shall be notified in the appropriate contractual documents of this possibility.

(b) *Notice of intent, environmental impact statement, and negative declaration.* The responsible official shall decide at the completion of the environmental review whether there will be any significant environmental impacts. If there will be significant environmental impacts, a notice of intent and an environmental impact statement shall be prepared in accordance with the procedures outlined in § 6.206. If there will not be any significant environmental impacts, a negative declaration and environmental impact appraisal shall be prepared in accordance with the procedures outlined in § 6.212.

(c) *Project commencement.* As required by § 6.108, a contract shall not be awarded or construction-related activities begun until fifteen (15) days after release of a negative declaration, or until thirty (30) days after forwarding the final impact statement to the Council on Environmental Quality.



1. Applicant submits environmental assessment and other available data.
2. Agency performs environmental review at the earliest possible point in the development of the proposed action, decides if an EIS is required, prepares an EIS if the project will have a significant impact or if the project's impact is likely to be highly controversial.
3. Where required, prepare environmental impact appraisal.
4. Prepare and circulate negative declaration to Federal, State, and local agencies, and where practicable to interested persons, local newspapers, and other media. This may be supplemented by making it available through local libraries or post offices.
5. File impact appraisal, negative declaration, and other supportive documents in-house. (Available for public inspection.)
6. Receive and evaluate comments.
7. Change decision, if necessary.
8. Administrative action.
9. Prepare notice of intent.
10. Circulate notices of intent.
a. Regional staff.
b. Office of Federal Activities.
c. Appropriate headquarters program office EIS Coordinator.
d. Office of Public Affairs.
e. Office of Legislation.
f. Federal agencies.
g. State and local agencies, appropriate State, regional and metropolitan clearinghouses.
h. Interested persons.
i. Newspapers and other media as appropriate.
11. Prepare preliminary draft environmental impact statement and summary sheet.
a. Description of the proposed action.
b. Environmental impact of the proposed action.
c. Adverse effects which cannot be avoided should the proposal be implemented.
d. Alternatives to the proposed action.
e. Relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.
f. Irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.
g. A discussion of problems and objections raised by other Federal, State, and local agencies, and by private organizations and individuals to date.
12. Coordinate internally for review and comment with appropriate regional and headquarters (optional) elements.
13. Evaluate comments and revise preliminary draft accordingly.
14. Notify OFA and appropriate headquarters program office EIS coordinator of intent to release draft.
15. Submit draft for review.
a. OFA (2 copies).
b. Appropriate headquarters program office EIS coordinator (2 copies).
16. Consider comments and revise draft accordingly.
17. Prepare transmittal letter with responsible official's signature.
18. Submit news release to local newspapers and other media (one copy).
19. Distribute draft and transmittal letter externally for review and comments.
a. Council on Environmental Quality (5 copies).
b. Notify Office of Legislation of release (copies as needed).
c. Notify Office of Public Affairs of release (two copies).
d. Offices of appropriate Federal agencies (two copies unless more are requested).
e. Appropriate State and local agencies, appropriate State, regional and metropolitan clearinghouses (two copies).
f. Interested persons (one copy).
g. Forward summary sheet to OMB–OMSC (two copies).
aa. Regional staff.
bb. Public Affairs Division if prepared in region (copies as needed).
cc. OFA (two copies).
dd. Appropriate headquarters program office EIS coordinator (two copies).
20. Determine need for public hearing.
21. Circulate public notice.
22. Conduct public hearing.
23. Review and evaluate suggestions, criticisms and comments received and reexamine the proposed course of action and alternatives. Include evaluation of comments generated at public hearings (if held).
24. Prepare final environmental impact statement.
25. Submit news release to local newspapers and other media (one copy).
26. Distribute final to interests submitting comments on draft (one copy).
a. Council on Environmental Quality (5 copies).
b. Notify Office of Legislation of release (copies as needed).
c. Notify Office of Public Affairs of release (two copies).
d. Forward summary to OMB–OMSC (two copies).
aa. Regional staff.
bb. Public Affairs Division if prepared in region (copies as needed).
cc. OFA (two copies).
dd. Appropriate headquarters program office EIS coordinator (two copies).
27. Administrative action.

EXHIBIT 2

NOTICE OF INTENT TRANSMITTAL MEMORANDUM SUGGESTED FORMAT

(Date)

ENVIRONMENTAL PROTECTION AGENCY,

(Appropriate office)

(Address, City, State, Zip Code)

To All Interested Government Agencies and Public Groups.

Gentlemen: In accordance with the guidelines for the preparation of environmental impact statements, attached is a notice of intent to prepare such a statement for the proposed Agency action specified below:

(Official Project Name)

(City, State)

(Impact Statement No.)

If your organization needs additional information or wishes to participate in the preparation of the draft environmental impact statement, please advise the (appropriate office, city, State).

Very truly yours,

(Appropriate EPA Office)

(List Federal, State, and local agencies to be solicited for comment.)

(List public action groups to be solicited for comment.)

NOTICE OF INTENT—SUGGESTED FORMAT

NOTICE OF INTENT—ENVIRONMENTAL PROTECTION AGENCY

1. Project location:
City
County
State
2. Estimated project costs:
Federal Share (total) $
Contract $ Grant $ Other $
Applicant share (if any):
(Name) $
Other (specify) $
Total $
3. Period covered by project:
Beginning date
(Original date, if project covers more than one year)
Dates of different project phases
Approximate ending date
4. Estimated application filing date

EXHIBIT 3

NEWS RELEASE SUGGESTED FORMAT

NOTICE TO THE PUBLIC FROM THE ENVIRONMENTAL PROTECTION AGENCY

This announcement is to inform the public that the Environmental Protection Agency (originating office, address) (will prepare, will not prepare, has prepared) a (draft, final) environmental impact statement on the following project:

(Official Project Name)

(Purpose of Project)

(Project Location, City, County, State)

(Where statement can be obtained if one is prepared)

This notice is to implement the Agency's policy to inform the public to the maximum possible extent of environmental actions it is taking.

EXHIBIT 4

NEGATIVE DECLARATION SUGGESTED FORMAT

(Date)

ENVIRONMENTAL PROTECTION AGENCY,

(Appropriate Office)

(Address, City, State, Zip Code)

To All Interested Government Agencies and Public Groups.

Gentlemen: In accord with the procedures for the preparation of environmental impact statements, an environmental review has been performed on the proposed Agency action below:

(Official Project Name)

(Purpose of Project)

(Project Originator)

(General Project Location, City, County, State)

(Specific Project Location—provide either a map or description)

(Potential Agency Financial Share)

(Other Funds Included)

After making an environmental review of the project, this Agency has decided not to prepare an environmental impact statement.

An environmental impact appraisal, which summarizes the review and the reasons why a statement is not required, is on file at the above office and will be available for public scrutiny upon request.

Persons disagreeing with this decision may submit comments for consideration by the Agency. The Agency will not take any administrative action on the project for at least fifteen (15) days after release of this negative declaration.

Sincerely,

(Appropriate EPA Official)

EXHIBIT 5

ENVIRONMENTAL IMPACT APPRAISAL SUGGESTED FORMAT

A. Identify Project
Name of Applicant:
Address:
Project Number (if assigned):
B. Summarize Assessment.
1. Brief description of project:
2. Probable impact of the project on the environment:
3. Any probable adverse environmental effects which cannot be avoided:
4. Alternatives considered with evaluation of each:
5. Relationship between local short-term uses of environment and maintenance and enhancement of long-term productivity:
6. Any irreversible and irretrievable commitment of resources:
7. Public objections to project, if any, and their resolution:
8. Agencies consulted about the project:
State representative's name:
Local representative's name:
OTHER:
C. Reasons for concluding there will be no significant impacts.

(Discuss topics 2, 3, 5, 6, and 7 above, and how the alternative (topic 4) selected will avoid any major public objections or significant impacts, thereby making an impact statement unnecessary.)

(Signature of appropriate official)

(Date)

EXHIBIT 6

COVER SHEET FORMAT FOR ENVIRONMENTAL IMPACT STATEMENTS

(Draft, Final)

Environmental Impact Statement

(Describe title of project or plan)

Prepared by

(Responsible Agency Office)

Approved by

(Responsible Agency Official)

(Date)

EXHIBIT 7

SUMMARY SHEET FORMAT FOR ENVIRONMENTAL IMPACT STATEMENTS

(Check One)
( ) Draft
( ) Final Environmental Statement.

ENVIRONMENTAL PROTECTION AGENCY

(Responsible Agency Office)

1. Name of action. (Check one)
( ) Administrative action.
( ) Legislative action.
2. Brief description of action indicating what States (and counties) are particularly affected.
3. Summary of environmental impact and adverse environmental effects.
4. List alternatives considered.
5. a. (For draft statements) List all Federal, State, and local agencies from which comments have been requested.
b. (For final statements) List all Federal, State, and local agencies and other sources from which written comments have been received.
6. Dates draft statement and final statement made available to Council on Environmental Quality and public.

EXHIBIT 8
FLOWCHART FOR OR & D

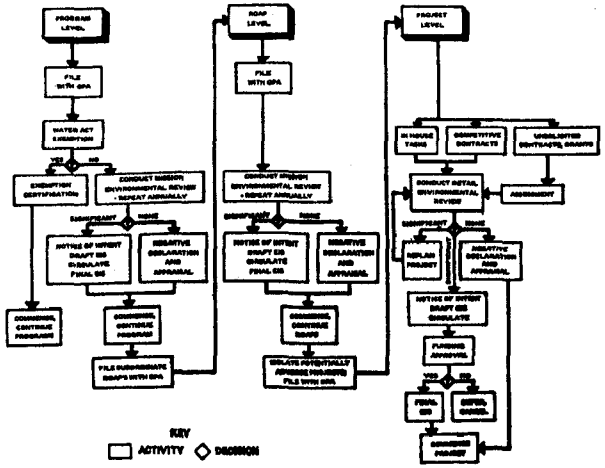
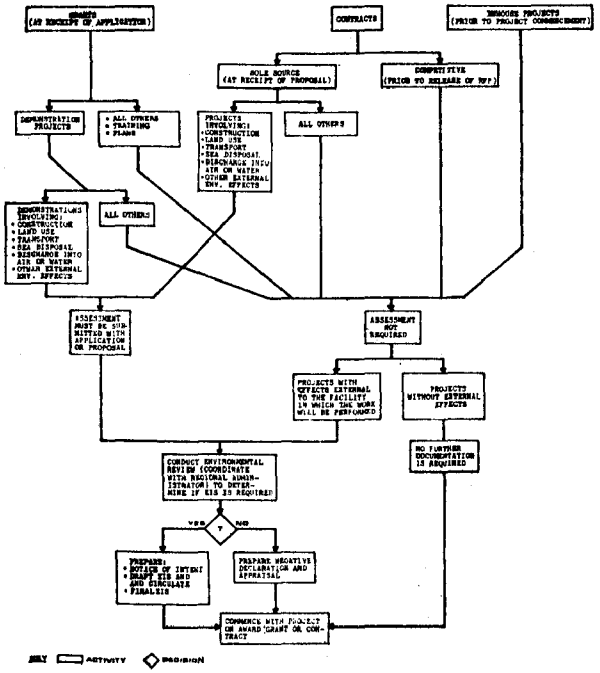


EXHIBIT 9

FLOWCHART FOR OSWMP

PROCEDURES FOR DETERMINING IF AN EIS IS REQUIRED ON OSWMP PROJECTS



[FR Doc.74-16128 Filed 7-16-74;8:45 am]

TERRESTRIAL WILDLIFE OF THE REGIONAL AREA

Fauna

The discussion that follows is based on the checklists of amphibians, reptiles and mammals given by W. G. Bradley and J. E. Deacon (1967). Species discussed by Bradley and Deacon were crosschecked with R. C. Stebbins (1966) and Burt and Grossenheider (1964) to verify that their range includes the study area. All scientific names are based on Stebbins (1966) and Burt and Grossenheider (1964).

Common Name	Scientific Name	Biotic Community: Creosote	Saltbrush	Desert Riparian	Las Vegas Wash	Other
Amphibians						
Great plains toad	Bufo cognatus				Tom Harper	
Red-spotted toad	Bufo punctatus				Tom Harper	
Southwestern toad	Bufo microscaphus				Tom Harper	
Woodhouses's toad	Bufo woodhousei				B & N, 1972	
Canyon tree frog	Hyla arenicolor				Tom Harper	
Pacific tree frog	Hyla regilla				B & N, 1972	
Bullfrog	Rana catesbeiana				Record	
* Vegas Valley leopard frog	Rana fisheri				Undocumented record	
Leopard frog	Rana pipiens				B & N, 1972	
Grear basin spadefoot	Scaphiopus intermontanus					
Reptiles						
* Desert tortoise	Gopherus agassizi	Uncommon				
Soft-shell turtle	Trionyx ferox				Record	
Banded gecko	Coleonyx variegatus	Uncommon	Record	Record	B & N, 1972	
Zebra-tailed lizard	Callisaurus draconoides	Abundant		Abundant	B & N, 1972	
Collared lizard	Crotaphytus collaris	Common		Abundant		
Leopard lizard	Crotaphytus wislizeni	Common	Record	Record	B & N, 1972	
Desert iguana	Dipsosaurus dorsalis	Common		Common		
Desert horned lizard	Phrynosoma platyrhinos	Abundant	Record	Record		
Chuchawalla	Sauromalus obesus	Common		Record		

Common Name	Scientific Name	Biotic Community: Creosote	Saltbrush	Desert Riparian	Las Vegas Wash	Other
Sagebrush lizard	Sceloporus graciosus					X
Desert spiny lizard	Sceloporus magister	Common		Record		
Western fence lizard	Sceloporus occidentalis					X
Western brush lizard	Urosaurus g. graciosus	Common	Record	Record		
Tree lizard	Urosaurus ornatus	Uncommon		Record	Common	
Side-blotched lizard	Uta stansburiana	Abundant	Record	Common	B & N, 1972	
Desert night lizard	Xantusia vigilis	Common		Record		
Western whiptail	Cnemidophorus tigris	Abundant	Record	Common	B & N, 1972	
* Gila monster	Heloderma suspectum	Uncommon				
Western blind snake	Leptotyphiops humilis					X
Glossy snake	Arizona elegans	Uncommon				
Night snake	Hypsiglena torquata	Rare				
Common king snake	Lampropeltis getulus	Rare				
Western shovel-nosed snake	Chionoctis occipitalis					X
Coachwhip	Masticophis flagellum					X
Stripped whip-snake	Masticophis taeniatus	Record		Rare		
Spotted leaf-nosed snake	Phyllorhynchus decuratus	Record		Rare		
Pacific gopher snake	Pituophis m. catenifer	Record		Record		
Western patched-nosed snake	Salvadora hexalepis	Rare		Record		
Western ground snake	Sonara semiannulata	Record		Record		

Common Name	Scientific Name	Bictic Community: Creosote	Saltbrush	Desert Riparian	Las Vegas Wash	Other
Sonora lyre snake	Trimorphodon lambda	Record		Record		
Western diamond-back snake	Crotalus atrox	Record				
Sidewinder	Crotalus cerastes	Common		Common		
Speckled rattle-snake	Crotalus mitchelli	Common		Rare		
Mojave rattle-snake	Crotalus scutulatus	Common				
Mammals						
Desert shrew	Notiosorex crawfordi				B & N, 1972	
California leaf-nosed bat	Macrotus californicus	Abundant	Record			
Pillid bat	Antrozous pallidus	Common	Record		B & N, 1972	
Townsend's big-eared bat	Corynorhinus town-sendii	Common	Record	Common		
Big brown bat	Eptesicus fuscus	Uncommon	Record	Record		
* Spotted bat	Euderma maculata	Rare				
Silver-haired bat	Lasionycteris noctivagans	Rare				
Red bat	Lasiurus borealis	Rare				
Hoary bat	Lasiurus cinercus	Rare				
California myotis bat	Myotis californicus	Abundant	Record	Record	B & N, 1972	
Long-eared myotis bat	Myotis evotis	Rare	Rare	Rare		
Small-footed myotis bat	Myotis subulatus	Rare	Rare	Rare		
Fringe-tailed myotis bat	Myotis thysanodes	Rare				
Cave myotis bat	Myotis velifer	Uncommon				
Long-legged myotis bat	Myotis volans	Rare	Rare	Rare		
Yuma myotis bat	Myotis yumanensis	Rare				

Common Name	Scientific Name	Biotic Community: Creosote	Saltbrush	Desert Riparian	Las Vegas Wash	Other
Western pipistrell	Pipistrellus hesperus	Abundant	Record	Record	B & N, 1972	
Western big-eared bat	Plecotus townsendii	Common	Record			
Mexican freetail bat	Tadarida brasiliensis	Common	Record	Record		
Big freetail bat	Tadarida molossa	Common	Record	Record		
Gold-mantled ground squirrel	Citellus lateralis					X
White-tailed antelope squirrel	Citellus leucurus	Common	Common	Common	B & N, 1972	
Round-tailed ground squirrel	Citellus tereticaudus	Common				
Rock squirrel	Citellus variegatus			Uncommon		X
Cliff chipmunk	Eutamias dorsalis					X
Charleston mountain chipmunk	Eutamias palmeri					X
Uinta chipmunk	Eutamias umbrinus					X
Valley pocket gopher	Thomomys bottae			Record		X
Desert kangaroo rat	Dipodomys deserti	Common		Record		
Merriam's kangaroo rat	Dipodomys merriami	Abundant	Common	Common	B & N, 1972	
Great Basin kangaroo bat	Dipodomys microps	Rare	Record	Rare		
Long-tail pocket mouse	Perognathus formosus	Abundant	Record	Common		
Great Basin pocket mouse	Perognathus parvus					X
Bushy-tailed wood rat	Neotoma cinerea					X
Desert wood rat	Neotoma lepida	Common	Record	Abundant	B & N, 1972	
Muskrat	Ondatra zibethicus				B & N, 1972	
Southern grasshoper mouse	Onychomys torridus	Uncommon	Uncommon	Uncommon		
Little pocket mouse	Perognathus longimembris	Abundant	Record	Common	B & N, 1972	

Common Name	Scientific Name	Biotic Community: Creosote	Saltbrush	Desert Riparian	Las Vegas Wash	Other
Brush mouse	Peromyscus boylei					X
Canyon mouse	Peromyscus crinitus	Common	Record	Abundant		
Cactus mouse	Peromyscus eremicus	Common	Record	Common	B & N, 1972	
Deer mouse	Peromyscus maniculatus	Rare	Record	Common		
Pinyon mouse	Peromyscus truei					X
Western Harvest mouse	Reithrodontomys megalotis			Common	B & N, 1972	
House mouse	Mus musculus	Rare			B & N, 1972	
Porcupine	Erethizon dorsatum			Uncommon		X
Beaver	Castor canadensis				Tom Harper 1972	
Black-tailed Jack Rabbit	Lepus californicus	Common	Record	Common	B & N, 1972	
Desert cotton-tail	Sylvilagus auduboni	Common	Record	Common	B & N, 1972	
Nuttall's cotton-tail	Sylvilagus nuttalli			Record		
Coyote	Conis latrans	Common	Common	Common	B & N, 1972	
Gray Fox	Urocyon cinereoargenteus	Uncommon	Uncommon	Common		
Kit Fox	Vulpes macrotis	Common	Common	Common	B & N, 1972	
Racoon	Procyon lotor	Uncommon			B & N, 1972	
Ring-tailed cat	Bassariscus astutus	Uncommon		Uncommon		
Stripped skunk	Mephitis mephitis	Uncommon			B & N, 1972	
Spotted skunk	Spilogale putorius	Uncommon		Uncommon	B & N, 1972	
Long-tailed Weasel	Mustela frenata					X
Badger	Taxidea taxus	Common	Record	Common		
Mountain Lion	Felis concolor		Rare in Study area			
Bobcat	Lynx ratus	Uncommon	Uncommon	Uncommon	B & N, 1972	
Pronghorn antelope	Antilocapra americana		Recorded throughout Study area			
Mule deer	Odocoileus hemionus					X
Big-horn sheep	Ovis canadesis	Rare	Common	Abundant		

B & N = Bradley and Niles - 1972
* = See Rare or Endangered Species list.

Fauna Expected at Specific Sites

Fauna	Dry Lake	Eldorado Valley	Jean Lake	Hidden Valley	Las Vegas Wash
Great Plains toad					x
Red-spotted toad					x
Southwestern toad					x
Woodhouse's toad					x
Canyon tree frog					x
Pacific tree frog					x
Bull frog					x
Vegas Valley leopard frog					Undocumented
Leopard frog					x sighting
Great Basin spadefoot					x
Desert tortoise	x	x	x	x	
Soft-shell turtle					x
Banded gecko	x	x	x	x	
Zebra-tailed lizard	x	x	x	x	
Collared lizard	x	x	x	x	
Leopard lizard	x	x	x	x	
Desert iguana	x	x	x	x	
Desert horned lizard	x	x	x	x	
Chunchawalla	x	x	x	x	
Sagebrush lizard					
Desert spiny lizard	x	x	x	x	
Western fence lizard					
Western brush lizard	x	x	x	x	
Tree lizard	x	x	x	x	
Slide-blotched lizard	x	x	x	x	
Desert night lizard	x	x	x	x	
Western whiptail	x	x	x	x	
Gila monster	x	x	x	x	
Western blind snake					
Glossy snake	x	x	x	x	

	Dry Lake	Eldorado Valley	Jean Lake	Hidden Valley	Las Vegas Wash
Night snake	R	R	R	R	
Common king snake	R	R	R	R	R
Western shovel-nosed					
Coachwhip					
Stripped whipsnake	R	R	R	R	
Spotted leaf-nosed	R	R	R	R	
Pacific gopher snake	R	R	R	R	
Western patched-nosed	R	R	R	R	
Western ground snake	R	R	R	R	
Sonora Lyre snake	R	R	R	R	
Western diamond back	R	R	R	R	
Sidwinder	x	x	x	x	
Speckled rattle snake	x	x	x	x	
Mojave rattlesnake	x	x	x	x	
Desert shrew					x
California leaf-nosed	x	x	x	x	x
Pallid bat	x	x	x	x	x
Townsend's big-eared	x	x	x	x	
Big brown bat	x	x	x	x	x
Spotted bat	R	R	R	R	x
Silver-haired bat	R	R	R	R	
Red bat	R	R	R	R	
Hoary bat	R	R	R	R	
California myotis	x	x	x	x	x
Long-eared myotis	R	R	R	R	x
Small footed myotis	R	R	R	R	
Fringe-legged myotis	R	R	R	R	
Cave myotis bat	x	x	x	x	
Long-legged myotis	R	R	R	R	
Yuma myotis	x	x	x	x	
Western pipistrell	x	x	x	x	x
Western big-eared	x	x	x	x	x
Mexican freetail	x	x	x	x	
Big freetail bat	x	x	x	x	x

	Dry Lake	Eldorado Valley	Jean Lake	Hidden Valley	Las Vegas Wash
Goldmantled ground squirrel					
White-tailed antelope sq.	x	x	x	x	x
Round-tailed ground sq.	x	x	x	x	
Rock squirrel	R	R	R	R	
Cliff chipmunk					
Charleston mountain chipmunk					
Unita chipmunk					
Valley pocket gopher	R	R	R	R	
Desert kangaroo rat	x	x	x	x	
Merriam's kangaroo rat	x	x	x	x	x
Great Basin kangaroo rat	x	x	x	x	
Long-tail pocket mouse	x	x	x	x	
Little pocket mouse	x	x	x	x	x
Great Basin pocket mouse					
Bushy tailed wood rat					
Desert wood rat	x	x	x	x	x
Muskrat					x
Southern grasshoper mouse	R	R	R	R	
Brush mouse					
Canyon mouse	x	x	x	x	
Cactus mouse	x	x	x	x	x
Deer mouse	x	x	x	x	
Pinyon mouse					
Western harvest mouse	x	x	x	x	x
House mouse	R	R	R	R	x
Porcupine	R	R	R	R	
Beaver	x	x	x	x	x
Black-tailed jack rabbit	x	x	x	x	
Desert cottontail	x	x	x	x	
Nuttall's cottontail	R	R	R	R	
Coyote	x	x	x	x	
Gray fox	x	x	x	x	

	Dry Lake	Eldorado Valley	Jean Lake	Hidden Valley	Las Vegas Wash
Kit fox	x	x	x	x	
Racoon	R	R	R	R	x
Stripped skunk	R	R	R	R	
Spotted skunk	x	x	x	x	
Long-tailed weasel					
Badger	x	x	x	x	
Mountain lion	R	R	R	R	
Bobcat	x	x	x	x	
Pronghorn antelope	R	R	R	R	
Mule deer					
Big-horn sheep	x	x	x	x	
Ring tailed cat	R	R	R	R	

x = expected at this site based on biotic community distribution

R = recorded occurrence in a biotic community. Rare for the regional area. Uncommon to one or all biotic communities.

BIRDS OF THE REGIONAL AREA
NOT FOUND IN LAS VEGAS WASH OR BAY

The following list of birds for the regional area was compiled by use of the State of Nevada check list, and "The Biotic Communities of Southern Nevada", W. G. Bradley and J. E. Deacon, and a list provided by Mr. Charles Lawson.

Artic Loon
(Gavia artica)

Brown Booby
(Sula leucogaster)

Magnificent Frigatebird
(Fregata magnificens)

Louisiana Heron
*Hydranassa tricolor)

Least Bittern
(Ixobrychus exilis)

Black Brant
(Branta nigricans)

White-fronted Goose
(Anser albifrons)

Ross' Goose
(Chen rossii)

Fulvous Tree Duck
(Dendrocygna bicolor)

Surf Scoter
(Melanitta perspicillata)

Harris' Hawk
(Parabuteo unicinctus)

Bald Eagle
(Haliaeetus leucocephalus)

Purple Gallinule
(Porphyrula martinica)

Ruddy Turnstone
(Arenaria interpres)

Sanderling
(Crocethia alba)

Band-tailed Pigeon
(Columba fasciata)

Rock Dove
(Columba livia)

Inca Dove
(Scardafella inca)

Yellow-billed Cuckoo
(Coccyzus americanus)

Groove-billed Ani
(Crotophaga sulcirostris)

Screech Owl
(Otus asio)

Snowy Owl
(Nyctea scandiaca)

Flammulated Owl
(Otus flammeolus)

Pygmy Owl
(Glaucidium gnoma)

Pigeon Hawk
(Falco columbarius)

Ring-necked Pheasant
(Phasianus colchicus)

Chukar
(Alectoris graeca)

Turkey
(Meleagris gallopavo)

Sandhill Crane
(Grus canadensis)

Gilded Flicker
(Colaptes chrysoides)

Gila Woodpecker
(Centurus uropygialis)

Acorn Woodpecker
(Melanerpes formicivorus)

Williamson's Sapsucker
(Sphyrapicus throideus)

Hairy Woodpecker
(Dendrocopos villosus)

Downy Woodpecker
(Dendrocopos pubscens)

Wied's Crested Flycatcher
(Myiarchus tyrannulus)

Olivaceous Flycatcher
(Myiarchus tuberculifer)

Least Flycatcher
(Empidonax minimus)

Saw-whet Owl
(Aegolius acadicus)

Whip-poor-will
(Caprimulgus vociferus)

Anna's Hummingbird
(Calypte anna)

Allen's Hummingbird
(Selasphorus sasin)

Calliope Hummingbird
(Stellula calliope)

Yellow-shafted Flicker
(Colaptes auratus)

Dipper
(Cinclus mexicanus)

Canon Wren
(Catherpes mexicanus)

Catbird
(Dumetella carolinensis)

Brown Thrasher
(Toxostoma rufum)

Bendire's Thrasher
(Toxostoma bendirei)

Curve-billed Thrasher
(Toxostoma curvirostre)

Varied Thrush
(Ixoreus naevius)

Wood Thrush
(Hylocichla mustelina)

Gray-cheeked Thrush
(Hylocichla minima)

Hammond's Flycatcher
(Empidonax hammondii)

Gray Jay
(Perisoreus canadensis)

Steller's Jay
(Cyanocitta stelleri)

Black-billed Magpie
(Pica pica)

Clark's Nutcracker
(Nucifraga columbiana)

Mountain Chickadee
(Parus gambeli)

Plain Titmouse
(Parus inornatus)

Pygmy Nuthatch
(Sitta pygmaea)

Hermit Warbler
(Dendroica occidentalis)

Cerulean Warbler
(Dendroica cerulea)

Grace's Warbler
(Dendroica graciae)

Blackpoll Warbler
(Dendroica striata)

Ovenbird
(Seiurus aurocapillus)

Northern Waterthrush
(Seriurus noveboracensis)

Veery
(Hylocichla fuscescens)

Gray Viero
(Vireo vicinior)

Yellow-throated Vireo
(Vireo flavifrons)

Black-and-white Warbler
(Mniotilta varia)

Worm-eating Warbler
(Helmitheros vermivorus)

Tennessee Warbler
(Vermivora peregrina)

Parula Warbler
(Parula americana)

Black-throated Blue Warbler
(Dendroica caerulescens)

Rose-breasted Grosbeak
(Pheucticus ludovicianus)

Dickeissel
(Spiza americana)

Evening Grosbeak
(Hesperiphona vespertina)

Purple Finch
(Carpodacus purpureus)

Cassin's Finch
(Carpodacus cassinii)

Lawrence's Goldfinch
(Spinus lawrencei)

Hooded Warbler
(Wilsonia citrina)

Painted Redstart
(Setophaga picta)

Orchard Oriole
(Icterus spurius)

Rusty Blackbird
(Euphagus carolinus)

Hepatic Tanager
(Piranga flava)

Cardinal
(Richmondena cardinalis)

Red Crossbill
(Loxia curvirostra)

Rufous-crowned Sparrow
(Aimophila ruficeps)

Cassin's Sparrow
(Aimophila cassinii)

Clay-colored Sparrow
(Spizella pallida)

Black-chinned Sparrow
(Spizella atrogularis)

Chestnut-collared longspur
(Calcarius ornatus)

BIRDS OF LAS VEGAS WASH

The following list of birds for the Las Vegas Wash and Las Vegas Bay was complied by Mr. Charles S. Lawson. Mr. Lawson has been identifying birds for 27 years and is currently submitting manuscripts of birds, new or unusual, to Nevada, to Condor and collaborating with Fred Ryser, Ph.D., Department of Biology, University of Nevada, Reno in the preparation of a manuscript for a book on the birds of Nevada. Mr. Lawson's full report is unpublished at this time and can be found in the Las Vegas Valley Water District Library and the Clark County Library.

This list words 251 species that can be found using Las Vegas Wash and Las Vegas Bay. This represents 65% of the species known to have occured in Nevada. To date, 346 species of birds have been seen in the regional area. 72% of the birds found in Southern Nevada are found in the Las Vegas Wash-Bay area. There are five birds on this list which appear on the rare and endangered species list; Golden Eagle, Prairie Falcon, and Peregrine Falcon. Many of the birds found on Mr. Lawson's list are also found in other areas of the regional environment.

BIRDS OF LAS VEGAS WASH AND LAS VEGAS BAY

Definitions of Symbols Used in Table

Species - Nomemclature, both common and scientific, follow the American Ornithologists' Union Check-list of North American Birds (1957). *indicates a rare or endangered species. See the Rare and Endangered Species list.

Column A - Relative Abundance - The symbols used to indicate abundance follow Alden (1969). Those symbols are:

A Abundantly encountered	Seen on 75-100% of the trips there
C Commonly encountered	Seen on 50-75% of the trips there
O Occasionally encountered	Seen on 25-50% of the trips there
R Rarely encountered	Seen on 1-25% of the trips there
X Accidential	A unique sighting, needs further explanation

These symbols of abundance refer only to the normal seasonal occurrence.

Column B - Seasonal Distribution - These symbols refer to the normal season of occurrence for each species. Symbols used are:

PR - Permanent Resident
SR - Summer Resident
WR - Winter Resident
TV - Transient Visitor - is migrant through the area both spring and fall
Acc - Of accidental occurrence in this area

Column C - Breeding species - indicated by an x

Column D - Found in Las Vegas Wash - indicated by an x

Column E - Found in Las Vegas Bay, Lake Mead - indicated by an x

Column F - Species most affected by loss of water - indicated by an x

Column G - Species least affected by loss of water - indicated by an x
(Columns F and G indicate a personal opinion of the author, based on twenty-seven years field experience)

Column H - Rare and/or endangered species - indicated by an x

Species List with Data for Each

Species	A	B	C	D	E	F	G	H
Common Loon (Gavia immer)	O	TV, WR			x		x	
Red-throated Loon (Gavia stellata)	R	WR			x		x	
Horned Grebe (Podiceps auritus)	O	TV, WR		x	x		x	
Eared Grebe (Podiceps caspicus)	A	TV, WR		x	x		x	
Western Grebe (Aechmophorus occidentalis)	A	TV, WR		x	x		x	
Pied-billed Grebe (Podilymbus podiceps)	C	PR	x	x	x	x		
White Pelican (Pelecanus erythrorhynchos)	R	TV		x	x		x	
Brown Pelican * (Pelecanus occidentalis)	X	Acc			x		x	x
Blue-booted Bobby (Sula nebouxii)	X	Acc			x		x	x
Double-crested Cormorant (Phalacrocorax auritus)	A	PR		x	x		x	
Great Blue Heron (Ardea herodias)	C	PR		x	x		x	
Green Heron (Butorides virescens)	O	TV, SR		x	x	x		
Little Blue Heron (Florida caerulea)	X	Acc		x		x		
Common Egret (Casmerodius albus)	O	TV		x	x			
Snowy Egret (Leucophoyx thula)	O	TV		x	x			
Black-crowned Night Heron (Nycticorax nycticorax)	O	PR		x	x			
American Bittern (Botaurus lentiginosus)	O	TV		x	x			
Wood Ibis (Mycteria americana)	X	Acc			x		x	
White-faced Ibis (Plegadis chihi)	C	TV		x	x	x		

Whistling Swan (Olor columbianus)	R	TV, WR		x	x	x	
Canada Goose (Branta canadensis)	O	TV, WR		x	x		x
Snow Goose (Chen hyperborea)	R	TV, WR		x	x		
Mallard (Anas platyrhynchos)	C	TV, WR		x	x	x	
Gadwall (Anas strepera)	O	TV, WR		x	x	x	
Pintail (Anas acuta)	A	TV, WR		x	x	x	
Green-winged Teal (Anas carolinensis)	A	TV, WR		x	x	x	
Blue-winged Teal (Anas discors)	O	TV, SR		x	x		
Cinnamon Teal (Anas cyanoptera)	A	PR	x	x	x	x	
American Widgeon (Mareca americana)	O	TV, WR		x	x	x	
Shoveler (Spatula clypeata)	C	TV, WR		x	x	x	
Wood Duck (Aix sponsa)	R	WR		x	x		
Redhead (Aythya americana)	C	TV, WR	x	x	x		
Ring-necked Duck (Aythya collaris)	R	TV, WR		x	x		x
Canvasback (Aythya valisineria)	O	TV, WR		x	x		x
Greater Scaup (Aythya marila)	R	WR			x		x
Lesser Scaup (Aythya affinis)	C	TV, WR		x	x		x
Common Goldeneye (Bucephala clangula)	O	TV, WR		x	x		x
Bufflehead (Bucephala albeola)	C	TV, WR		x	x		x
White-winged Scoter (Melanitta deglandi)	X	Acc		x	x		x
Ruddy Duck (Oxyura jamaicensis)	A	PR	x	x	x	x	

Hooded Merganser (Lophodytes cucullatus)	R	TV		x	x		x	
Common Merganser (Mergus merganser)	C	WR		x	x		x	
Red-breasted Merganser (Mergus serrator)	A	WR		x	x		x	
Turkey Vulture (Cathartes aura)	O	TV		x		x		
Goshawk (Accipiter gentilis)	R	TV		x		x		
Sharp-shinned Hawk (Accipiter striatus)	O	TV, WR		x	x		x	
Cooper's Hawk (Accipiter cooperii)	O	TV, WR		x	x		x	
Red-tailed Hawk (Buteo jamaicensis)	C	PR		x	x		x	
Red-shouldered Hawk (Buteo lineatus)	X	Acc		x			x	
Swainson's Hawk (Buteo swainsoni)	C	TV		x	x			
Rough-legged Hawk (Buteo lagopus)	R	WR		x	x			
Ferruginous Hawk* (Buteo regalis)	R	WR		x		x		
Golden Eagle (Aquila chrysaetos)	R	WR		x		x	x	
Marsh Hawk (Circus cyaneus)	C	WR		x		x		
Osprey * (Pandion haliaetus)	O	TV	x	x	x	x		
Prairie Falcon* (Falco mexicanus)	O	WR		x	x		x	
Peregrine Falcon* (Falco peregrinus)	R	WR		x	x		x	x
Sparrow Hawk (Falco sparverius)	A	PR		x	x		x	
Gambel's Quail (Lophortyx gambelii)	A	PR	x	x	x	x		
Virginia Rail (Rallus limicola)	A	WR		x	x			
Sora (Porzana carolina)	A	WR		x	x			

Common Gallinule (Gallinula choropus)	A	PR	x	x	x		
American Coot (Fulica americana)	A	PR	x	x	x	x	
Semi-palmated Plover (Charadrius semipalmatus)	O	TV		x	x		
Snowy Plover (Charadrius alexandrinus)	O	TV		x	x		
Killdeer (Charadrius vociferus)	A	PR	x	x	x		x
Mountain Plover* (Eupoda montana)	X	Acc		x	x		
American Golden Plover (Pluvialis dominica)	X	Acc		x	x		
Black-bellied Plover (Squatarola squatarola)	O	TV		x	x	x	
Common Snipe (Capella gallinago)	C	TV, WR		x	x	x	
Long-billed Curlew (Numenius americanus)	O	TV		x	x	x	
Whimbrel (Numenius phaeopus)	X	Acc		x		x	
Upland Plover (Bartramia longicauda)	X	Acc		x		x	
Spotted Sandpiper (Actitis macularia)	C	TV, SR		x	x	x	
Solitary Sandpiper (Tringa solitaria)	R	TV		x	x	x	
Willet (Catoptrophorus semipalmatus)	C	TV, WR		x	x		
Greater Yellowlegs (Totanus melanoleucus)	C	TV		x	x		
Lesser Yellowlegs (Totanus flavipes)	X	Acc		x	x		
Knot (Calidris canutus)	O	TV, WR		x	x		
Pectoral Sandpiper (Erolia bairdii)	C	TV, WR		x	x		
Least Sandpiper (Erolia minutilla)	O	TV		x	x		
Dunlin (Erolia alpina)							

Short-billed Dowitcher (Limnodromus griseus)	O	TV		x	x		
Long-billed Dowitcher (Limnodromus scolopaceus)	A	TV		x	x		
Stilt Sandpiper (Micropalama himantopus)	X	Acc		x	x		
Semi-palmated Sandpiper (Ereunetes pusillus)	X	Acc		x	x		
Western Sandpiper (Ereunetes mauri)	C	TV		x	x		
Marbled Godwit (Limosa fedoa)	O	TV		x	x	x	
American Avocet (Recurvirostra americana)	A	TV		x	x	x	
Black-necked Stilt (Himantopus mexicanus)	C	TV, SR	x	x	x		
Red Phalarope (Phalaropus fulicarius)	X	Acc		x		x	
Wilson's Phalarope (Steganopus tricolor)	C	TV		x	x		x
Northern Phalarope (Lobipes lobatus)	O	TV		x	x		x
Glaucous-winged Gull (Larus glaucescens)	X	Acc			x		x
Herring Gull (Larus argentatus)	C	WR		x	x		x
California Gull (Larus californicus)	A	WR		x	x		x
Ring-billed Gull (Larus delawarensis)	A	WR		x	x		x
Mew Gull (Larus canus)	X	Acc			x		x
Franklin's Gull (Larus pipixcan)	O	TV			x		x
Bonaparte's Gull (Larus philadelphia)	R	TV		x	x		x
Forster's Tern (Sterna forsteri)	O	TV		x	x		x
Common Tern (Sterna hirundo)	R	TV		x	x		x
Least Tern (Sterna albifrons)	X	Acc			x		x

Caspian Tern (Hydroprogne caspia)	O	TV		x	x		x
Black Tern (Chlidonias niger)	O	TV		x	x		x
White-winged Dove (Zenaida asiatica)	R	SR		x		x	
Mourning Dove (Zenaidura macroura)	A	TV, SR	x	x	x		x
Ground Dove (Columbigallina passerina)	X	Acc		x		x	
Roadrunner (Geococcyx californianus)	A	PR	x	x	x		x
Barn Owl (Tyto alba)	R	TV		x		x	
Great Horned Owl (Bubo virginianus)	R	PR		x		x	
Burrowing Owl (Speotyto cunicularia)	O	PR	x	x		x	
Long-eared Owl (Asio otus)	X	Acc		x			
Short-eared Owl (Asio flammeus)	X	Acc		x		x	
Poor-will (Phalaenoptilus nuttallii)	X	Acc		x			x
Common Nighthawk (Chordeiles minor)	C	TV		x		x	
Lesser Nighthawk (Chordeiles acutipennis)	C	TV, SR	x	x		x	
Vaux's Swift (Chaetura vauxii)	O	TV		x		x	
White-throated Swift (Aeronautes sexatalis)	C	TV, SR		x	x		x
Black-chinned Hummingbird (Archilochus alexandri)	R	TV		x		x	
Costa's Hummingbird (Calypte costae)	R	TV		x		x	
Broad-tailed Hummingbird (Selasphorus platycercus)	R	TV		x		x	
Rufous Hummingbird (Selasphorus rufus)	R	TV		x		x	
Belted Kingfisher (Megaceryle alcyon)	O	TV, WR		x	x		x

Red-shafter Flicker (Colaptes cafer)	A	WR		x		x	
Lewis Woodpecker (Asyndesmus lewis)	R	TV		x		x	
Yellow-bellied Sapsucker (Sphyrapicus varius)	O	WR		x		x	
Ladder-backed Woodpecker (Dendrocopos scalaris)	O	TV, WR		x		x	
Eastern Kingbird (Tyrannus tyrannus)	X	Acc		x		x	
Western Kingbird (Tyrannus verticalis)	A	SR	x	x		x	
Cassin's Kingbird (Tyrannus vociferans)	O	TV		x		x	
Scissor-tailed Flycatcher (Muscivora forficata)	X	Acc		x		x	
Ash-throated Flycatcher (Myiarchus cinerascens)	C	SR	x	x	x		
Black Phoebe (Sayornis nigricans)	C	PR		x	x		
Say's Phoebe (Sayornis saya)	C	PR	x	x	x	x	
Traill's Flycatcher (Empidonaz traillii)	A	TV		x	x		x
Dusky Flycatcher (Empidonax oberholseri)	O	TV		x		x	
Gray Flycatcher (Empiodnax wrightii)	A	TV		x		x	
Western Flycatcher (Empidonax difficilis)	C	TV		x		x	
Western Wood Pewee (Contopus sordidulus)	O	TV		x		x	
Olive-sided Flycatcher (Nuttallornis borealis)	O	TV		x		x	
Vermilion Flycatcher (Pyrocephalus rubinus)	O	SR		x	x		
Horned Lark (Eremophila alpestris)	A	PR	x	x		x	
Violet-green Swallow (Tachycineta thalassina)	A	TV		x	x		x
Tree Swallow (Iridoprocne bicolor)	A	TV		x	x		x

Bank Swallow (Riparia riparia)	A	TV		x		x	
Rough-winged Swallow (Stelgidopteryx ruficollis)	A	TV		x	x		x
Barn Swallow (Hirundo rustica)	A	TV		x	x		x
Cliff Swallow (Petrochelidon pyrrhonota)	A	SR	x	x	x		x
Purple Martin (Progne subis)	X	Acc		x		x	
Scrub Jay (Aphelocoma coerulescens)	X	Acc		x		x	
Common Raven (Corvus corax)	A	PR		x	x		x
Common Crow (Corvus brachyrhynchos)	O	TV, WR		x	x		x
Pinon Jay (Gymnorhinus cyanocephala)	R	TV		x		x	
Verdin (Auriparus flaviceps)	A	PR	x	x	x	x	
Common Bushtit (Psaltriparus minimus)	C	WR		x		x	
White-breasted Nuthatch (Sitta carolinensis)	R	TV		x		x	
Red-breasted Nuthatch (Sitta canadensis)	R	TV		x		x	
Brown Creeper (Certhia familaris)	R	TV		x		x	
House Wren (Troglodytes aedon)	C	WR		x		x	
Winter Wren (Troglodytes Troglodytes)	R	WR		x			x
Bewick's Wren (Thryomanes bewickii)	C	PR		x			x
Cactus Wren (Campylorhynchus brunneicapillum)	C	PR		x			x
Long-billed Marsh Wren (Telematodytes palustris)	A	PR	x	x	x	x	
Rock Wren (Salpinctes obsoletus)	C	PR	x		x		x
Mockingbird (Mimus polyglottos)	C	PR		x			x

LeConte's Thrasher (Toxostoma lecontei)	O	PR	x			x
Crissal Thrasher (Toxostoma dorsale)	A	PR	x	x		x
Sage Thrasher (Oreoscoptes montanus)	O	TV	x			x
Robin (Turdue migratorius)	A	TV, WR	x	x		x
Hermit Thrush (Hylocichla guttata)	O	TV	x			x
Swainson's Thrush (Hylocichla ustulata)	O	TV	x			x
Western Bluebird (Sialia mexicana)	C	WR	x			x
Mountain Bluebird (Sialia currucoides)	C	WR	x			x
Townsend's Solitaire (Myadestes townsendi)	O	WR	x			x
Blue-gray Gnatcatcher (Polioptila caerulea)	C	PR	x			x
Black-tailed Gnatchatcher (Polioptila melanura)	o	PR	x			x
Golden-crowned Kinglet (Regulus satrapa)	X	Acc	x			x
Ruby-crowned Kinglet (Regulus calendula)	A	TV, WR	x	x		x
Water Pipit (Anthus spinoletta)	A	TV, WR	x	x	x	
Bohemian Waxwing (Bombycilla garrula)	X	Acc	x			x
Cedar Waxwing (Bombycilla cedrorum)	O	WR	x			x
Phainopepla (Phainopepla nitens)	O	PR	x			x
Northern Shrike (Lanius excubitor)	X	Acc	x			x
Loggerhead Shrike (Lanius ludovicianus)	C	PR	x	x		x
Starling (Sturnus vulgaris)	A	PR	x	x		x
Hutton's Vireo (Vireo huttoni)	O	TV	x			x

Bell's Vireo (Vireo bellii)	O	SR		x	x		x
Solitary Vireo (Vireo solitarius)	O	TV		x	x		x
Red-eyed Vireo (Vireo olivaceus)	R	SR		x			x
Warbling Vireo (Vireo gilvus)	C	TV		x	x		x
Orange-growned Warbler (Vermivora celata)	C	TV, WR		x	x		x
Nashville Warbler (Vermivora ruficapilla)	O	TV		x			x
Virignia's Warbler (Vermivora virginiae)	o	TV		x			x
Lucy's Warbler (Vermivora luciae)	O	TV, SR		x			x
Yellow Warbler (Dendroica petechia)	C	TV		x	x		x
Myrtle Warbler (Dendroica coronata)	O	TV		x			x
Audubon's Warbler (Dendroica auduboni)	A	TV, WR		x	x		x
Black-throated Gray Warbler (Dendroica nigrescens)	O	TV		x			x
Townsend's Warbler (Dendroica townsendi)	O	TV		x			x
MacGillivray's Warbler (Oporornis tolmiei)	O	TV		x			x
Yellowthroat (Geothlypis trichas)	A	SR	x	x	x	x	
Yellow-breasted Chat (Icteria virens)	C	SR		x	x		x
Wilson's Warbler (Wilsonia pusilla)	A	TV		x	x		x
American Redstart (Setophaga ruticilla)	O	TV		x			x
House Sparrow (Passer domesticus)	A	PR	x	x			x
Bobolink (Dolichonyx oryzicorus)	X	Acc		x			x
Western Meadowlark (Sturnella neglecta)	A	PR	x	x			x

Yellow-headed Blackbird (Xanthocephalus xanthocephalus)	C	SR	x	x	x	x	
Red-winged Blackbird (Agelaius phoeniceus)	A	PR	x	x	x	x	
Hooded Oriole (Icterus cucullatus)	O	SR	x	x	x		x
Scott's Oriole (Icterus parisorum)	O	TV		x			x
Bullock's Oriole (Icterus bullockii)	C	SR	x	x			x
Brewer's Blackbird (Euphagus cyanocephalus)	A	TV, WR		x	x		x
Boat-tailed Grackle (Cassidix mexicanus)	R	SR		x		x	
Brown-headed Cowbird (Molothrus ater)	A	PR	x	x	x		x
Western Tanager (Piranga ludoviciana)	C	TV		x			x
Summer Tanager (Piranga rubra)	R	SR		x		x	
Black-headed Grosbeak (Pheucticus melanocephalus)	O	TV		x			x
Blue Grosbeak (Guiraca caerulea)	A	SR	x	x	x	x	
Lazuli Bunting (Passerina amoena)	O	TV		x	x		x
Indigo Bunting (Passerina cyanea)	R	SR		x			x
House Finch (Carpodacus mexicanus)	C	PR	x	x			x
Pine Siskin (Spinus pinus)	O	WR		x			x
American Goldfinch (Spinus tristis)	O	TV, WR		x			x
Lesser Goldfinch (Spinus psaltria)	C	PR		x	x		x
Green-tailed Towhee (Chlorura chlorura)	C	TV		x			x
Rufous-sided Towhee (Pipilo erythrophthalmus)	O	TV, WR		x			x
Abert's Towhee (Pipilo aberti)	A	PR	x	x	x	x	

Lark Bunting (Calamospiza melanocorys)	X	Acc		x			x
Savannah Sparrow (Passerculus sandwichensis)	A	TV, WR					
Grasshopper Sparrow (Ammodramus savannarum)	X	Acc		x			x
Vesper Sparrow (Pooecetes gramineus)	O	WR		x			x
Lark Sparrow (Chondestes grammacus)	C	TV		x			x
Black-throated Sparrow (Amphispiza bilineata)	C	TV		x			x
Sage Sparrow (Amphispiza belli)	A	WR		x			x
Slate-colored Junco (Junco hyemalis)	O	WR		x			x
Oregon Junco (Junco oreganus)	O	WR		x			x
Gray-headed Junco (Junco caniceps)	O	WR		x			x
Tree Sparrow (Spizella arborea)	R	WR		x			x
Chipping Sparrow (Spizella passerina)	C	TV, WR		x			x
Brewer's Sparrow (Spizella breweri)	C	TV		x			x
Harris' Sparrow (Zonotrichia querula)	R	WR		x			x
White-crowned Sparrow (Zonotrichia leucophrys)	A	TV, WR		x	x		x
Golden-crowned Sparrow (Zontrichia atricapilla)	R	WR		x	x		x
White-throated Sparrow (Zonotrichia albicollis)	X	WR		x			x
Fox Sparrow (Passerella iliaca)	O	WR			x		x
Lincoln's Sparrow (Melospiza lincolnii)	C	WR		x	x		x
Swamp Sparrow (Melospiza georgiana)	X	Acc		x		x	
Song Sparrow	A	PR	x	x	x		x
Lapland Longspur (Calcarius lapponicus)	X	WR		x			x

The following species of fish are presently found in Las Vegas Bay:

*Largemouth black bass	(Micropterus salmoides)	Abundant
*Channel catfish	(Ictalurus punctatus)	Abundant
*Black crappie	(Pomoxis nigromaculatus)	Abundant
Carp	(Cyprimus carpio)	Abundant
*Bluegill sunfish	(Lepomis macrochirus)	Common
*Rainbow trout	(Salmo gairdneri)	Common
Green sunfish	(Lepomis cyanellus)	Common
+Humpback sucker	(Xyrauchen texanus)	Common
Western golden shiner	(Notemigonus crypolencas)	Common
German brown trout	(Salmo trutto)	Rare
Black bullhead	(Ictalurus melas)	Rare
+Bonytail chub	(Gila robusta)	Rare
Mosquito fish	(Gambrusia affinis)	Rare
+Colorado River Squaw fish	(Ptychocheilus lucius)	Rare
*Cutthroat trout	(Salmo clarkii)	Common
*Silver salmon	(Oncorhynchus kisutheh)	Common
*Striped bass	(Morone saxatilis)	Common
Threadfin shad	(Dorosoma petenense)	Abundant
Walleye	(Stizostedion vitreum)	Rare

Basic Biota of the Site Environments

Biota	Scientific Name	1. Recharge Well Site*	2. Wastewater Collection	3. AWT Plant	4. Sludge Disposal Site	5. Pilot Desalination Plan	6. Brine Disposal*	7. Irrigated Lands
Flora								
Creosote Bush Community								
Creosote bush	Larrea divaricata		X		X	X		
Mormon tea	Ephedra torreyanna				X	X		
Ratney	Krameria parvifolia							
Niggerheads	Echinocactus polycephalus							
Cholla	Opuntia begelovii							
Prickley pear cactus	O. erinacea							
Mojave yucca	Yucca schidigera							
Burro bush	Franseria dumosa				X			
Desert Riparian Community								
Desert wash willow	Chilopis linearis				X	X		
Indigo bush	Dalea fremonti							
Cat claw	Acacia greggii							
Snakeweed	Gutierrezia sarothrae							
Salt cedar	Tamarix gallica		X	X		X		
Cheese weed	Hymenoclea salsola		X	X				
Bassia	Bassia hyssopilolia		X	X				
Quail brush	Atriplex lentiformis		X	X				
Saltbush Community								
Shadscale	Atriplex confertifolia					X		
Hop sage	Grayia spinosa					X		
Agricultural Crops								X

Common Name	Scientific Name	1. Recharge Well Site*	2. Wastewater Collection	3. AWT Plant	4. Sludge Disposal Site	5. Pilot Desalination Plant	6. Brine Disposal*	7. Irrigated Lands
Grazing lands								
Bermuda grass	Cynodon dactylon		X	X				
Golf Courses and Parks								X
'auna								
Mammals								
California leaf-nosed bat	Macrotis californicus		X	X	X	X		X
California myotis (bat)	Myotis californicus		X	X	X	X		X
Western pipistrell (bat)	Pipistrellus hesperus		X	X	X	X		X
White-tailed antelope ground squirrel	Citellus leucurus		X	X	X	X		X
Round-tailed ground squirrel	C. tereticaudus		X	X				
Merriams kangaroo rat	Dipodomys merriami		X		X			
Desert kangaroo rat	D. deserti				X			
Black-tailed jackrabbit	Lepus californicus		X	X	X			X
Coyote	Canis latrans		X		X			X
Deer mouse	Peromyscus eremicus		X	X	X	X		X
Birds								
Gambel's quail	Lophortyx gambelii		X	X				
Cactus wren	Campylorhynchus brunneicapillum		X		X			
Raven	Corvus corax		X	X	X	X		X
Horned lark	Eremophila alpestris			X				X

Common Name	Scientific Name	1. Recharge Well Site*	2. Wastewater Collection	3. AWT Plant	4. Sludge Disposal Site	5. Pilot Desalination Plan	6. Brine Disposal*	7. Irrigation Lands
Abert's towhee	Pipilo aberti		X	X				X
House finch	Carpodacus mexicanus		X	X				X
Red-tailed hawk	Buteo jamaicensis		X	X	X			
Verdin	Auriparus flaviceps		X	X				
Mourning dove	Zenaidura macroura		X	X				X
Starling	Sturnus vulgaris		X	X	X	X		X
Song sparrow	Melospiza melodia		X	X				X
Brown-headed cowbird	Molothrus ater		X	X				
Mockingbird	Mimus polyglottos		X	X				
Bewick's wren	Thryomanes bewickii		X					
Reptiles								
Side-blotched lizard	Uta stansburiana		X		X	X		
Western whiptail	Cnemidophorus Tigris		X		X	X		X
Zebra-tailed lizard	Callisaura draconoides		X		X	X		
Desert Iguana	Dipsosaurus dorsalis		X		X			
Leopard lizard	Cnotaphytus wislizeni		X	X	X	X		X
Pacific gopher snake	Pituophis catenifer		X	X	X	X		X
Coachwhip	Masticophis flagellum		X		X			
Sidewinder	Crotalus cerastes		X		X			

*Information as to the exact location of this element is insufficient to determine existing biota.

STATE OF NEVADA

WATER POLLUTION CONTROL REGULATIONS

ADOPTED BY THE STATE ENVIRONMENTAL COMMISSION

OCTOBER 24, 1973

DEPARTMENT OF HUMAN RESOURCES
BUREAU OF ENVIRONMENTAL HEALTH
CARSON CITY, NEVADA 89701

WATER QUALITY STANDARDS
Las Vegas Wash

Control Point
North Shore Road (No sampling will be required upstream of the control point if the regulations are satisfied at the control point.)

Temperature °C

Monthly Mean	Less than 32
Single Value in 90% of samples	Less than 35

pH Units

Monthly Median	Within range 6.5 - 8.5
Single Value in 90% of samples	Within range 6.5 - 8.5

Dissolved Oxygen - mg/l

Monthly Mean	Not less than 5.0
Single Value in 90% of samples	Not less than 4.0

BOD_5 - mg/l

Monthly Mean	Not more than 10.0
Single Value in 90% of samples	Not more than 15.0

COD - mg/l

Monthly Mean	Not more than 40.0
Single Value in 90% of samples	Not more than 50.0

SS - mg/l

Monthly Mean	Not more than 2.0
Single Value in 90% of samples	Not more than 5.0

MBAS - mg/l

Monthly Mean	Not more than 0.8
Single Value in 90% of samples	Not more than 1.0

Phosphorus as P - mg/l

Monthly Mean	Not more than 0.5*
Single Value in 90% of samples	Not more than 1.0*

*But not to exceed 400 pounds/day during April through October

Turbidity - JTU

Monthly Mean	Not more than 5.0
Single Value in 90% of samples	Not more than 10.0

Fecal Coliform - The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100 milliliters.

The beneficial uses to be protected in the Las Vegas Wash are as follows: Fish and wildlife, esthetics, irrigation and stock watering and recreation.

WATER QUALITY STANDARDS
Colorado River

Control Point
One mile below Willow Beach Resort and various points in Lake Mead

Temperature °C

Average (June through September)	Not more than 14
Summer Single Value	Not more than 15
Winter Single Value	Not more than 14
Allowable temperature increase above natural receiving water temperatures	None when water temperature is greater than or equal 14°C. 1° when water temperature less than or equal to 13°

pH Units

Annual Median	Within range 7.5 - 8.2
Single Value	Within range 7.0 - 8.5

Dissolved Oxygen - mg/l

Average (June through September)	Not less than 6.0
Single Value	Not less than 5.0

BOD - mg/l

Single Value	Not more than 2

Phosphates (PO_4)
(Pending further analysis)

Nitrates (NO_3) - mg/l

Single Value	Not more than 7
Annual Average	Not more than 4

MF Coliforms/100 ml (Average of the last five samples)
Maximum value of 1000 if MF Fecal Streptococci are less than 100.
Maximum value of 500 if MF Fecal Streptococci are less than 20.
To apply to all swimming areas of the Colorado River within Nevada.

The "Guidelines for Formulating Water Quality Standards for the Interstate Waters of the Colorado River System" as adopted January 13, 1967, are incorporated as a supplement to the standards for this stream (Appendix A).

WATER QUALITY STANDARDS
Colorado River

Control Point
Cage Station located half a mile downstream from Davis Dam

Temperature °C
Average (June through September). . . . . Not more than 20
Summer Single Value . . . . . Not more than 25
Winter Single Value . . . . . Not more than 16
Allowable temperature increase above natural receiving water temperatures. . . . . Not more than 1

pH Units
Annual Median . . . . . Within range 7.5 - 8.0
Single Value. . . . . Within range 6.5 - 8.5

Dissolved Oxygen - mg/l
Average (June through September). . . . . Not less than 6.0
Single Value. . . . . Not less than 5.0

BOD - mg/l
Single Value. . . . . Not more than 3

Phosphates (PO_4) - mg/l
(Pending further analysis)

Nitrates (NO_3) - mg/l (tentative)
Single Value. . . . . Not more than 7.0
Annual Average. . . . . Not more than 5.0

The "Guidelines for Formulating Water Quality Standards for the Interstate Waters of the Colorado River System" as adopted January 13, 1967, are incorporated as a supplement to the standards for this stream (Appendix A).

AMENDMENTS TO NEVADA'S
WATER POLLUTION CONTROL REGULATIONS

APR 9 1974

I. Amend Article 3.2.2 to read:

The duration of permits may be variable, but shall not exceed 5 years. The expiration date shall be recorded on each permit issued. A new application must be filed with the Department to obtain renewal or modification of a permit. Applications for renewal shall be filed at least 180 days prior to expiration of permit.

II. Amend Article 3.3.2 to read:

Authorized representatives of the Bureau of Environmental Health shall be permitted access to the premises of all facilities owned or operated by the permittee at all reasonable times for the purpose of making inspections, surveys, collecting samples, obtaining data, and carrying out other necessary functions related to the permit.

III. Amend Article 3.4.1 by adding the following sentence after the fifth sentence of Article 3.4.1: "In the case of a municipal, State, or other public facility the application must be signed by either a principal executive officer, ranking elected official, or other duly authorized employee."

IV. Add the following section to Article 3:

3.9 Emergency Powers

In accordance with the powers granted in subsections 1, 9 and 12 of NRS 445.214 and NRS 445.317, 445.321, 445.324, 445.327, 445.331, 445.334 and 33.010, the Director may take any appropriate action authorized under the Nevada Water Pollution Control Law against a pollution source or any combination of sources which the Director has evidence is presenting an imminent and substantial endangerment to the health or welfare of persons, where such endangerment is to the livelihood of such persons.

V. Amend 4.1.2(d) by adding the following paragraph:

The presence of toxic materials in a water shall be evaluated by use of a 96-hour bioassay. Survival of test organisms shall not be less than that in control tests which utilize appropriate experimental water. Experimental water shall be obtained from the most upstream control point in the stream system, or laboratory water with quality closely approximating that of the most upstream control point, or other appropriate experimental water defined by the State and concurred in by EPA. Failure to determine presence of toxic substances by this method shall not preclude determination of excessive levels of toxic substances on the basis of other criteria or methods.

VI. Amend Table 22 (Virgin River) and Table 23 (Beaver Dam Wash) in Article 4.2.5 by adding:

Color

Color shall not exceed that characteristic of natural conditions by more than 10 units Platinum Cobalt Scale.

Turbidity

Turbidity shall not exceed that characteristic of natural conditions by more than 10 Jackson Units.

VII. Amend Table 44 (Lake Tahoe) in Article 4.2.5 by adding:

Turbidity

In order to minimize turbidity levels in the Lake and tributary streams and control erosion:

1. The discharge of solid or liquid waste materials including soil, silt, clay, sand, and other organic and earthen materials to Lake Tahoe or any tributary thereto, is prohibited.

2. The discharge of solid or liquid waste materials including soil, silt, clay, sand, and other organic and earthen materials to lands below the high water rim of Lake Tahoe or along any tributary to Lake Tahoe in a manner which will cause the discharge of such waste materials to Lake Tahoe or any tributary thereto, is prohibited.

3. The placement of material below the high water rim of Lake Tahoe or along any tributaries to Lake Tahoe, in a manner which will cause the discharge of solid or liquid waste materials including soil, silt, clay, sand and other organic and earthen materials to Lake Tahoe or any tributary thereto, is prohibited.

VIII. Amend Table 45 (Willow Beach Colorado River) in Article 4.2.5 by replacing the coliform standard and adding color, turbidity and phosphate standards by adding:

Phosphates (PO_4) - mg/1

Annual Average.....not more than 0.040
Maximum value in 90% of samples.....not more than 0.060

Color

Color shall not exceed that characteristic of natural conditions by more than 10 units Platinum Cobalt Scale.

Turbidity

Turbidity shall not exceed that characteristic of natural conditions by more than 10 Jackson Units.

Fecal Coliform

The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100 milliliters.

IX. Amend Table 46 (Colorado River below Davis Dam) in Article 4.2.5 by replacing the coliform standard and adding color, turbidity and phosphate standards by adding:

Phosphates (PO_4) - mg/l

Annual Average.....not more than 0.060
Maximum value in 90% of samples.....not more than 0.100

Color

Color shall not exceed that characteristic of natural conditions by more than 10 units Platinum Cobalt Scale.

Turbidity

Turbidity shall not exceed that characteristic of natural conditions by more than 10 Jackson Units.

Fecal Coliform

The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100 milliliters.

X. Amend the temperature standard in Table 47 (Las Vegas Wash) in Article 4.2.5 to read:

Temperature - °C

Monthly mean - June 1 to September 30.....not more than 27°
October 1 to May 31.....not more than 23°

Single value in 90 percent of samples:
June 1 to September 30.....not more than 31°
October 1 to May 31.....not more than 27°

XI. Amend Article 4.2.5 by adding the following table:

TABLE 48
WATER QUALITY STANDARDS
Pyramid Lake

Control Point - Various Points

Temperature - °C

Permissible temperature increase above natural receiving water temperature.....not more than 2

pH Units

Single value.....6.5 - 9.0

Dissolved Oxygen - mg/l

Single value.....not less than 6

Fecal Coliform

The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100 milliliters.

XII. Amend Article 4.2.5 by adding the following table:

TABLE 49
WATER QUALITY STANDARDS
Walker Lake

Control Point - Various points

Temperature - °C

Permissible temperature increase above natural water temperature.....not more than 2

Dissolved Oxygen - mg/l

Single value.....not less than 6.0

Fecal Coliform

The fecal coliform concentration, based on a minimum of five samples during any 30-day period, shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100 milliliters.

XIII. Add the following as a footnote to the phosphate standard in Tables 45 and 46:

> Interpretation of this standard shall not be construed to restrict the phosphorus passing the North Shore Road control point as defined in Table 47, i.e., monthly mean of not more than 0.5 mg/l as P and single value in 90% of samples of not more than 1.0 mg/l as P but not to exceed 400 pounds/day during April through October.

ADOPTION: NOW, THEREFORE, by affirmative vote of the Nevada State Environmental Commission, these Water Pollution Control Regulations are hereby revised and compliance therewith ordered.

To become effective _____, 1974.

_____

Norman Glaser, Chairman
Environmental Commission

1.59 Complex source. Any property or facility that has or solicits secondary or adjunctive activity which emits or may emit any air contaminant for which there is an ambient air quality standard, notwithstanding that such property or facility may not itself possess the capability of emitting such air contaminants. Complex sources include, but are not limited to:

a. Shopping centers;
b. Sports complexes;
c. Drive-in theaters;
d. Parking lots and garages;
e. Residential, commercial, industrial or institutional developments;
f. Amusement parks and recreational areas;
g. Highways;
h. Sewer, water, power and gas lines;

and other such property or facilities which will result in increased air contaminant emissions from motor vehicles.

1.44 Registration certificate. A document issued and signed by the Director certifying adequate empirical data for the single or complex source has been received and shall constitute approval of location.

1.60 Vehicle trip. A single movement by a motor vehicle which originates or terminates at the single or complex source.

1.61 Contiguous Property. Any property which is in physical contact, touching, near or adjoining. Public property or public right-of-way shall not be deemed as a break in any contiguous property.

3.1.9 Registration certificates for single and complex sources and operating permits for single sources may be issued through an approved local air pollution control program.

3.2.4 Within 5 days after receiving an application for registration, the Director shall determine what, if any, additional information is needed. Within 15 days after receiving adequate information the Director shall make a preliminary determination to issue or deny issuance of a registration certificate. Within 75 days after receiving adequate information, pursuant to Article 13, the Director shall issue or deny issuance of a registration certificate.

3.2.5 A registration certificate shall only expire if construction of a new or modified source, including a complex source, is not commenced within one year from the date of issuance thereof or construction of the facility is delayed for one year after initiated.

3.3.2 A stop order can be issued at any time before the operating permit is granted, except that a stop order for a source shall not be issued after construction or modification has commenced if the construction is in accordance with the provisions of the registration certificate as submitted and approved by the Director under Article 13 hereof.

13.1 General provisions for the review of new sources.

13.1.1 Prior to the issuance of any registration certificates in accordance with this Article the applicant shall submit to the Director an environmental evaluation and any other information the Director may deem necessary to make an independent air quality impact assessment.

13.1.2 The preliminary intent to issue or deny issuance of a registration certificate for a complex source shall be made within 15 days after receiving adequate information for reviewing the registration application. The application, the Director's review and preliminary intent to issue or deny shall be made public and maintained on file with the Director during normal business hours at 201 South Fall Street, Carson City, Nevada and in the Air Quality Region where the source is located, at a site specified in a public announcement by the Director for thirty (30) days to enable public participation and comment. All comments on the Director's review and preliminary intent for issuance or denial shall be submitted in writing to the Director within 30 days after the public announcement. Within the time period prescribed by Article 3.2.4, the Director shall make his decision, taking into account written public comments on the Director's review and preliminary intent for issuing or denial, project proponent submittal and the effect of such a facility on the maintenance of the ambient air quality standards as contained in Article 12 and the control strategy contained in the Air Quality Implementation Plan.

13.1.3 The Director shall not issue a registration certificate for any source if the environmental evaluation submitted by the applicant, or if the Director determines, in accordance with the provisions of this Article, that the source will prevent the attainment and maintenance of the State Ambient Air Quality Standards or will cause a violation of the applicable control strategy contained in the approved Air Quality Implementation Plan.

13.1.4 The Director may impose any reasonable conditions on his approval, including conditions requiring the source owner or operator to conduct ambient air quality monitoring at the facility site for a reasonable period prior to commencement of construction or modification, and for any specified period after the source has commenced operation.

13.1.5 Where a proposed source located on contiguous property is constructed or modified in increments which individually are not subject to review as provided in this Article, all such increments occurring since the effective date of this Article shall be added together for determining the applicability of this Article.

13.1.6 Approval and issuance of a registration certificate to any source construction or modification shall not affect the responsibilities of the owner or owners to comply with any other portion of the control strategy.

13.1.7 Any source or proposed facility shall, upon written application to the Director, receive within thirty (30) days a written notice of his determination, either requiring the submittal of an environmental evaluation or exempting the source from such requirement.

13.4 *Environmental Evaluation*

13.4.1 The environmental evaluation required for new or modified single or complex sources, as determined by this Article or as required by the Director, shall include the following:

13.4.1.1 An environmental evaluation shall be a careful and detailed assessment of the environmental aspects of a proposed action.

13.4.1.2 An environmental evaluation shall contain adequate environmental safeguards to be implemented by the applicant to provide for the maintenance of acceptable air quality and shall consider:

a. Ambient air concentrations before, during and after construction, empirically calculated with recognized methods as approved by the Director; or, in the case of existing ambient air concentrations, they may be measured with approved methods at approved site locations for not less than one year. Estimates shall be empirically determined for ambient air concentration immediately contiguous to the facility and at the point of predicted maximum concentration within the surrounding region.

b. Diffusion models used to determine the location and estimated value of highest air contaminant concentration shall contain:

1. Assumptions and premises.
2. Evaluation at the recorded most adverse meteorological conditions in the last 100 years
3. Evaluation at the recorded most adverse meteorological conditions in the last year.
4. Geographic area considered in the evaluation.
5. Dispersion equations.
6. Predicted contaminant buildup.
7. Location, type and amount of emissions.
8. Meteorological information

c. Alternate proposals which could be implemented as conditions of approval.

d. Other probable environmental effects, before, during and after construction shall be considered in the narrative portion of the evaluation.

13.5 The following are exempt from Article 13.2:

1. Complex source or single sources existing prior to February 25, 1974 and remaining unmodified thereafter or those facilities which have received local approval and necessary building or construction permits by April 1, 1974, and commence a continuous program of construction before July 1, 1974

2. Those complex sources or single sources obtaining an exemption granted by the President under section 118 of the Clean Air Act of 1970.

SECTION 26. FUEL BURNING EQUIPMENT

2. b. Maximum allowable emission rates of particulate matter for heat input greater than 10 million but less than 4000 million BTU per hour shall be determined by using the equation

$Y = 1.02 \times ^{-0.231}$. Maximum allowable emission rates of particulate matter for heat inputs equal to or greater than 4000 million BTU per hour shall be determined by using the equation

$Y = 17.0 \times ^{-0.568}$ where Y = allowable rate of emission in pounds per million BTU and X = maximum heat input in millions of BTU per hour.

c. No person shall cause or permit the emission of sulfur dioxide from any fuel-burning equipment in excess of the quantity set forth in the following table:

Heat input, millions of British thermal units per hour	Maximum allowable rate of emission of sulfur dioxide, pounds per hour
1,000	150
5,000	750
10,000	1,500
15,000	2,250
20,000	3,000
25,000	3,750
30,000	4,500
35,000	5,250
40,000	6,000
45,000	6,750
50,000	7,500

d. Maximum allowable emission rate of sulfur dioxide shall be determined by using the equation $Z = 0.15 X$ where Z = allowable rate of sulfur dioxide emission in pounds per hour and X = maximum heat input in millions of BTU per hour.

SECTION 27. PROVISIONS OF REGULATIONS SEVERABLE

If any provision of these Regulations or the application thereof to any person or circumstances is held invalid or unconstitutional, such invalidity or unconstitutionality

SECTION 35. COMPLIANCE SCHEDULES

4. Compliance schedules shall contain as a minimum:

   a. Appropriate increments of progress.

   b. Final date of compliance with the appropriate emission limitations.

SECTION 36. AMBIENT AIR QUALITY STANDARDS

1. The following concentrations of air contaminants shall not be exceeded at any single point in the ambient air:

   a. Sulfur oxides as sulfur dioxide:

Annual arithmetic mean	60 ug/M^3 (0.02 ppm)
Maximum 24 hr. concentration	260 ug/M^3 (0.1 ppm)
Maximum 3 hr. concentration	1300 ug/M^3 (0.5 ppm)

   b. Suspended particulate matter:

Annual geometric mean	60 ug/M^3
Maximum 24 hr. concentration	150 ug/M^3

   c. Carbon monoxide:

Maximum 3 hr. concentration	10 mg/M^3 (9.0 ppm)
Maximum 1 hr. concentration	40 mg/M^3 (35.0 ppm)

d. Photochemical oxidant:

Maximum 1 hr. concentration 160 ug/M^3 (0.08 ppm)

e. Non-methane hydrocarbons:

Maximum 1 hr. concentration 160 ug/M^3 (0.24 ppm)

f. Nitrogen dioxide:

Annual arithmetic mean 100 ug/M^3 (0.05 ppm)

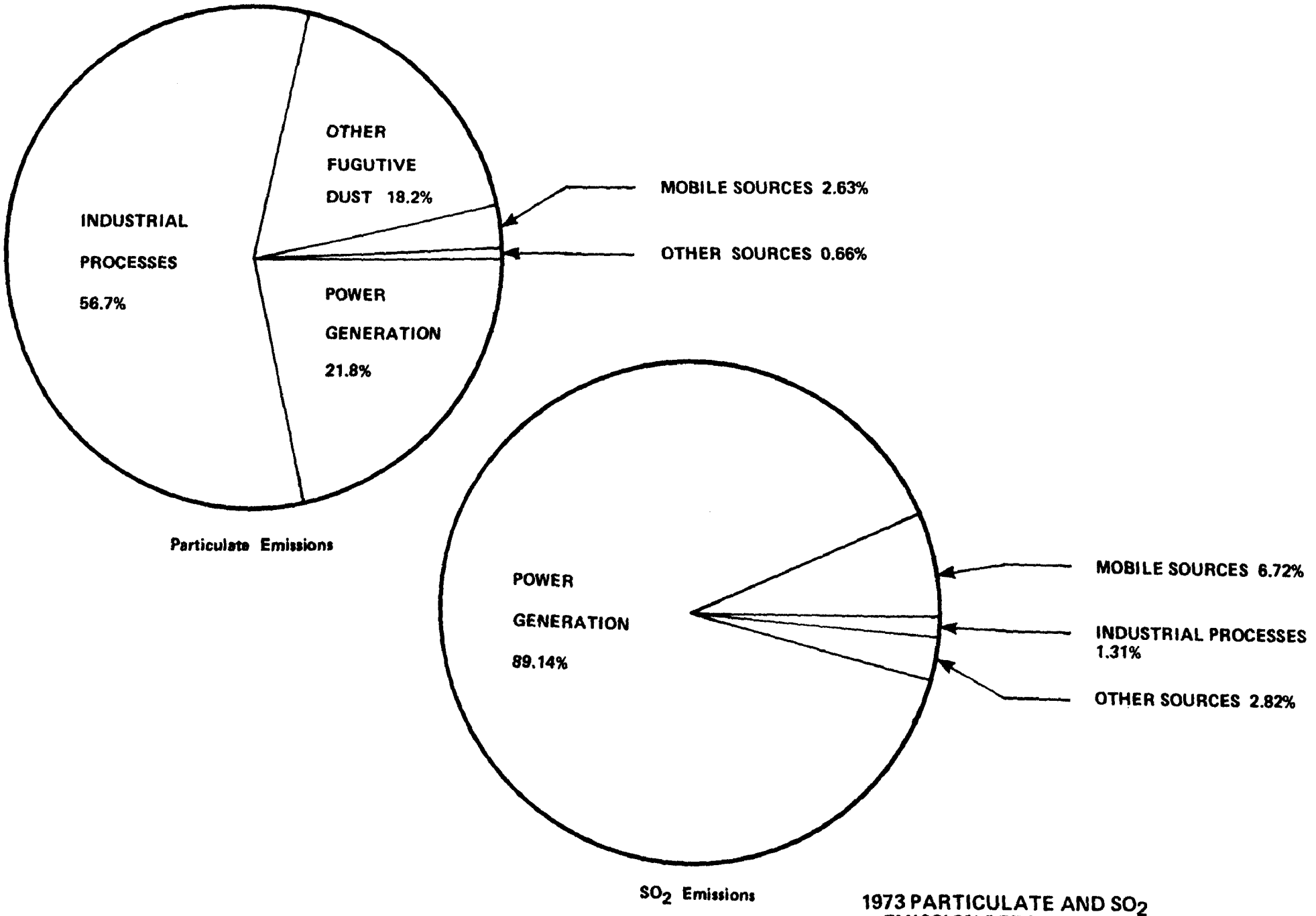
2. ug/M^3 means micrograms of air contaminant per cubic meter of air.

mg/M^3 means milligrams of air contaminant per cubic meter of air.

ppm means parts of air contaminant by volume per million parts of air by volume.

3. The methods of measurement shall be those precribed in Appendices A through F, inclusive, of § 410 of Chapter IV, Title 42, Code of Federal Regulation, published in the Federal Register on April 30, 1971. These may change from time to time.

4. Adoption of these Ambient Air Quality Standards shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of Clark County.



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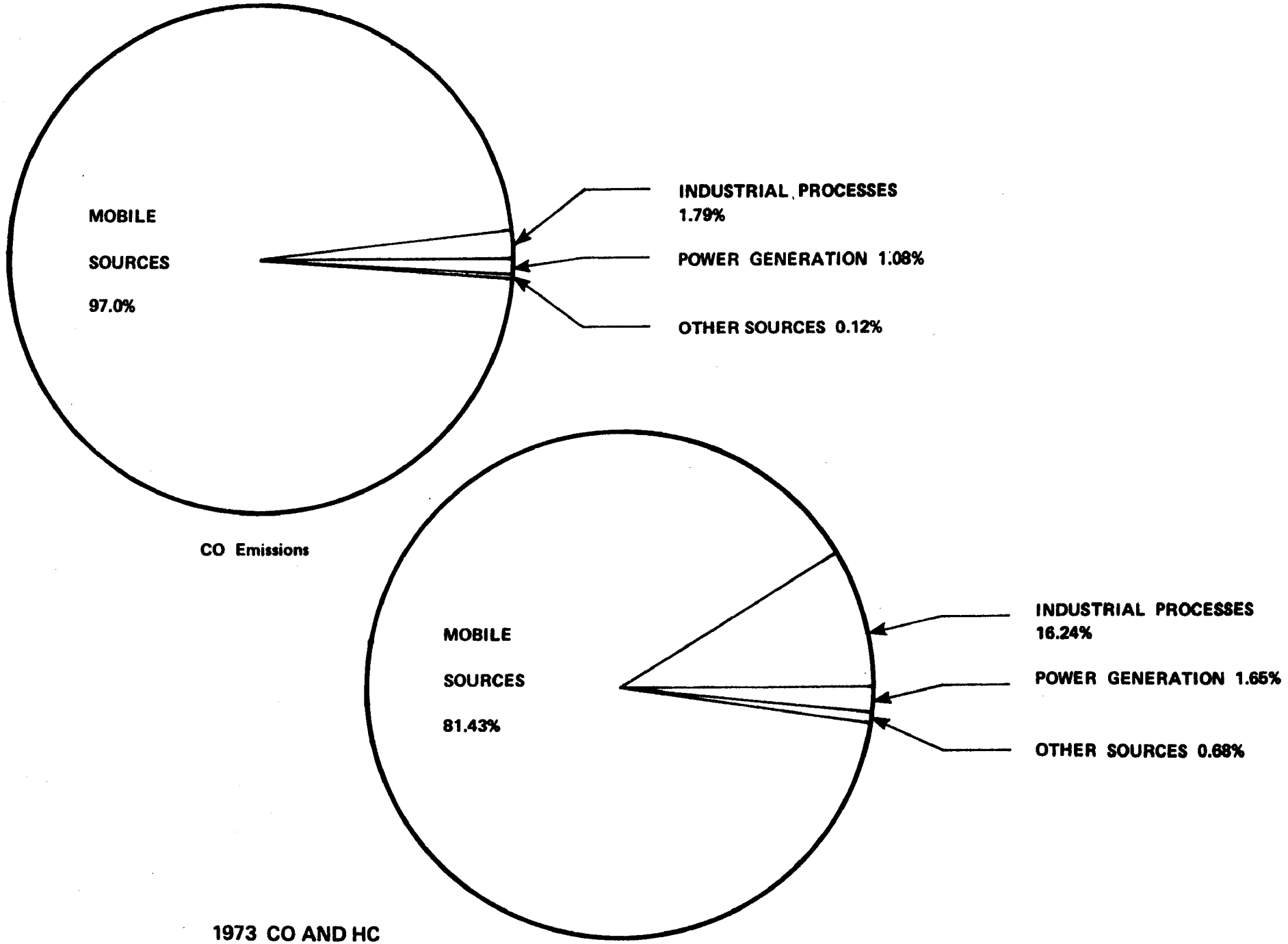
AQCR 013



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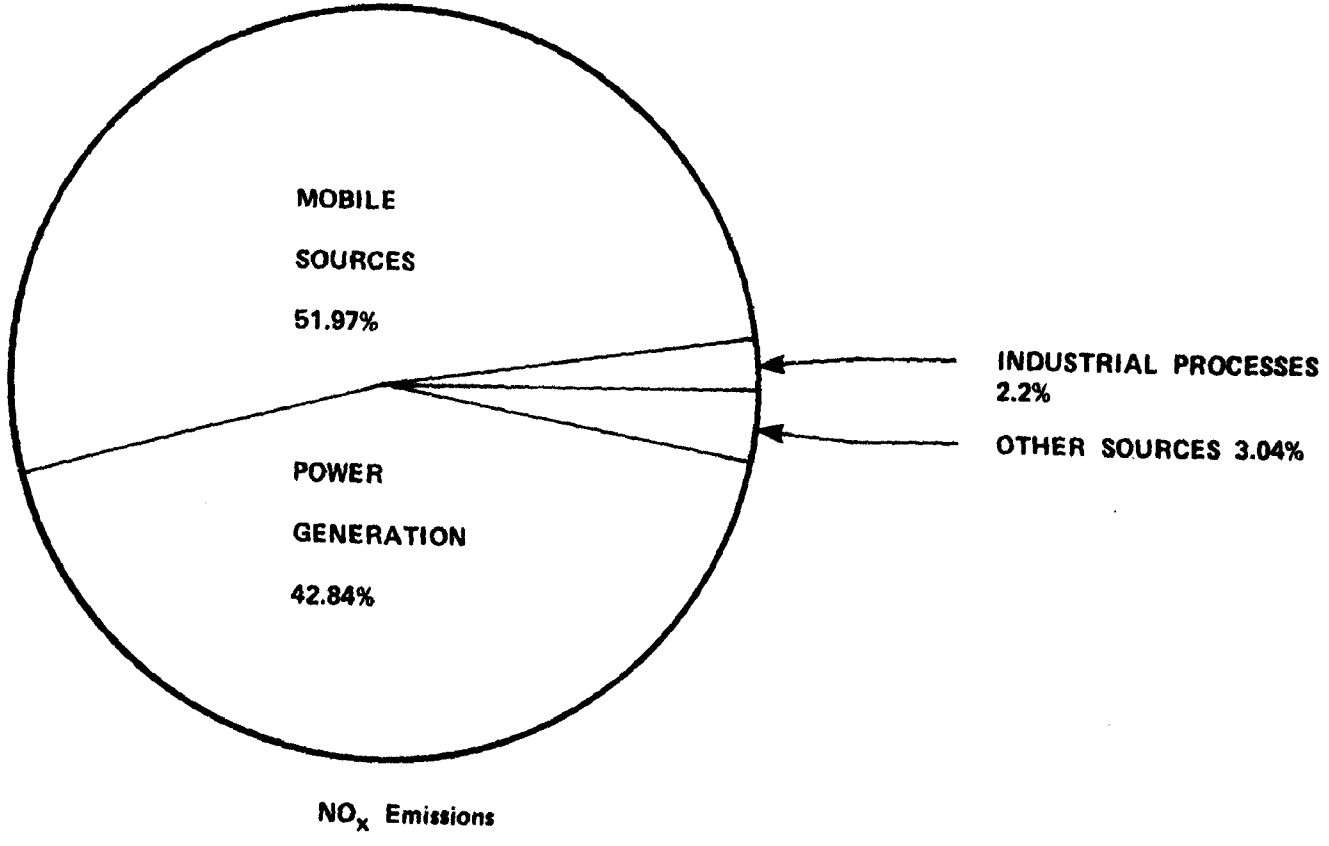

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RECEIVED
☐ A.M. ☐ ☑ P.M.
JUN 12 1974
WASTEWATER MANAGEMENT
AGENCY

June 12, 1974

Mr. Tom Wiesner
Chairman, Board of Clark County Commissioners
Clark County Courthouse
Las Vegas, Nevada 89101

Dear Mr. Wiesner:

Enclosed is my statement on the Facilities Report and Environmental Assessment being submitted for review and/or approval by the Commission.

Because I have been closely associated for several years with the Pollution Abatement Program for Lake Mead and serve as President of the Las Vegas Valley Water District, I am submitting this brief introductory cover letter to avoid any confusion as to the District's position in this matter.

Naturally, the District has actively participated in the Sewage and Waste Water Advisory Committee (SWAC) and supplied technical data to the consultants preparing the reports now under consideration.

I want to clearly state that the ideas, recommendations, and comments in my statement do not reflect any official positions of the District's staff or Board of Directors. The submitted statements are derived from my analysis of the reports.

Yours sincerely,

Thorne J. Butler, M. D.
President, Las Vegas Valley Water District

TJB:gcs

STATEMENT FROM THORNE J. BUTLER
on
FACILITIES REPORT AND ENVIRONMENTAL ASSESSMENT
to
THE CLARK COUNTY COMMISSIONERS

Both the amended facilities plan and its attached environmental assessment are directed to accomplishing two goals.

1. The elimination of pollution of Lake Mead by flows from the Las Vegas Wash. This objective was established by the 1971 Nevada State Legislature and has been endorsed as being still valid by both of the consultants who prepared these reports. The bulk of the facilities report is devoted to accomplishing this end.

2. The conservation of the potable water supplies available to the Las Vegas community. This goal is to be met by the substitution of properly treated waste waters for potable water.

My comments to the first of these objectives are very limited and brief. I would like to concentrate my comments on the in-valley irrigation, desalinization and ground water recharge programs. As a member of the Board of Directors of the Las Vegas Valley Water District I believe that this program is of paramount importance to the District's goal of continuing to supply adequate potable water to this area.

With respect to the pollution abatement phase of the project, Table VII-3, entitled "Monetary Cost Effectiveness", needs to be corrected. In the column "Total Annual Cost", the Alternatives 7 and 10 are not evenly stated. The reason being that, in Alternative 10 one of the factors for the determination of net annual cost is based upon the development of the Allen Power Project which will utilize approximately 37% of the annual average flows through the year 2000. Therefore, to Alternative 10 should be added the cost of piping and pumping the AWT water to the power project. To balance the total costs, to Alternative 7 must be added the cost of treating the secondary effluent to make it acceptable as an industrial cooling water. Computing these additional costs, I calculate for Alternative 7, $467.00 per million gallons treated and for Alternative 10, $438.00 per million gallons treated. Alternative 7 may be higher in total costs because included is the pickup and disposal of the ground water discharges. Naturally, the net annual cost to the Las Vegas community depends on variable factors such as the amount of federal participation, revenues derived from the Allen Power Project and possible other minor revenues from the sale of AWT water.

In the same sense, Table VIII-4 should be corrected to include power requirements for pumping water to the Allen Power Project in Alternative 10 and for the AWT process in Alternative 7. When these two alternatives are balanced in the terms of cost and energy consumption, both programs are equal.

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I would like to make recommendations on the proposed in-valley irrigation, desalinization and ground water recharge programs as outlined in Sections 8.4 through 8.6. There is little doubt that the accomplishing of an in-valley irrigation system to utilize reclaimed waters for irrigation as a substitute for pumping large amounts of high grade ground water is a goal that has both short-term and long-term benefits to this community. For that reason, I feel strongly that the in-valley irrigation program, as part of the overall Pollution Abatement Program, should go ahead with all due speed. With respect to these programs, I would like to recommend that the in-valley irrigation phase and desalinization aspects be coupled together, and furthermore, the ground water recharge program be conducted independently. The reason for these recommended changes in the program are outlined below.

One of the major problems involving the use of reclaimed waste water for agricultural irrigation use is the build-up of salt concentrations in the superficial soil layers. As indicated in this facilities report and in the Phase III report, the application of large quantities of AWT water to the soil for agricultural uses will require periodic leaching with better grade water to assure continuation of plant growth. The actual percentage of better grade water necessary to accomplish this leaching varies from 10% to almost 30% of the total volume of reclaimed water applied. Therefore, periodically, all of the land area receiving reclaimed waste water from the AWT process will have to be permitted to apply high grade water, either from wells, Lake Mead water, or the product of a desalinization operation.

The second element in this interrelated area is the program to develop ground water recharge. The objective behind ground water recharge, of course, is to bank in the groundwater aquifer, properly treated waste water. Everyone who has been involved over any period of time with the pollution abatement problem in the Las Vegas area, has been interested in the possibilities of recharging the ground water. It is an accepted fact that a requirement for the quality of recharged water is that it be of quality equal to, if not better than, the water existing in the underground aquifer. For that reason, AWT water would necessarily have to be subject to a desalinization process to bring it to such a quality. In this proposal, the pilot desalinization plant product water would have a TDS of 150 mg/L. Since the ground water currently being pumped from the western areas of the valley has an average TDS of approximately 250 mg/L, it seems that desalinated water would be perfectly adequate to accomplish ground water recharge. Unfortunately, there are many other complicating problems associated with ground water recharge. The report identifies them and rightfully takes the position that a pilot recharge program using well water should be undertaken to evaluate the feasibility of such a project. My comment, with respect to the pilot recharge phase, is that a two-year time plan may be too short to appropriately evaluate the success of a recharge program. I believe that many consultants recommend that a time period of from 5 to 8 years is required to appropriately evaluate the possibilities of accomplishing ground water recharge.

As previously stated, the purpose for ground water recharge is to bank water in the ground water aquifer. Therefore, you have to not only pump the water down into the aquifer, but later, when you decide to recover it, you have to pump it back out. Both of these efforts increase the cost of that recoverable ground water.

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Because this plan more carefully coupled the in-valley irrigation program to desalinization and ground water recharge, I believe that a less expensive approach would be to utilize the desalinated water within the in-valley irrigation system. Since there is evidence that all in-valley irrigated areas receiving AWT water will have to be periodically leached with a higher grade water, then desalinated water would be ideal for that purpose. Again, our objective of reducing withdrawals from the ground water aquifer would be maintained. Whether we add to the ground water volume by recharge, or we reduce withdrawal by substituting desalinated water, the net effect is to increase the available ground water. Furthermore, the desalinated water would be appropriately utilized at a far less cost than pumping it into the aquifer and pumping it out at a later date. As the desalinization program increased in size, producing greater volumes of water per day, it could be mixed with AWT water to, in a sense, sweeten it for various uses.

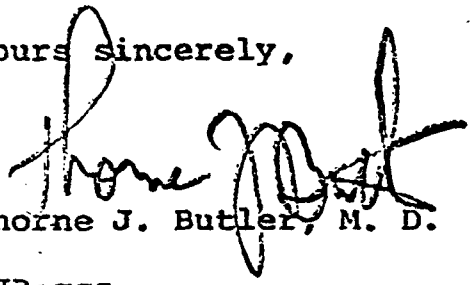
I would recommend that the location for a desalinization plant be adjacent to the AWT plant. The report suggests that a desalinization plant be located on the property of the Las Vegas Valley Water District. I believe that the construction of a factory-like building in that area would meet with substantial citizen objections. Might it not be simpler to construct it near the AWT plant being proposed? The product water could then be added into the in-valley irrigation pipeline system and be delivered to appropriate sites to be used either for mixing with AWT water or for the purposes of leaching. Assuming that the various health arguments which currently prevent the use of desalinated water for potable purposes are finally solved to everyone's satisfaction, then excess desalinated waters (when available) could be directly added into the main transmission line running near the Clark County Sanitation District from the Southern Nevada Water Project. Furthermore, the brine produced by such a desalinization program could be pumped into the export line which will be part of the Allen Power Project.

While I do not want to totally throw cold water on the concept of ground water recharge, I think that this report permits one to put it into a different perspective. Ground water recharge has a large number of unknown factors associated with it and may require a very long time frame to properly evaluate its success or failure. But, with a large-scale, in-valley irrigation system on line, it would be possible to make direct use of desalinated water without the additional cost of pumping it into the underground and then pumping it back later. For every gallon that we can apply to the surface it means that we save and conserve another gallon in our valuable underground aquifer.

A final recommendation on saline control is less detailed, but does apply to the overall project philosophy. Since the saline control program for the Colorado River is receiving strong federal support, I believe we will see an active program undertaken within the next five years. For that portion of the saline program which applies to the Las Vegas Wash discharges, I recommend the Commission adopt the position that the saline control program planned by the Bureau of Reclamation be integrated into the pollution project now being considered.

I appreciate the opportunity of presenting these comments and recommendations to the Commission. I would recommend that the Commission adopt both the facilities report and its environmental assessment as a course of action to solve the pollution of Lake Mead.

Yours sincerely,



Thorne J. Butler, M. D.

TJB:gcs

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