FINAL
ENVIRONMENTAL IMPACT STATEMENT
FOR
ALBUQUERQUE
WASTEWATER TREATMENT FACILITIES

Project No. C-35-1020-01
Albuquerque, New Mexico

ENVIRONMENTAL PROTECTION AGENCY

REGION VI

DALLAS, TEXAS

APPROVED BY

John C. White

John C. White
Regional Administrator

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AUGUST, 1977

ENVIRONMENTAL PROTECTION AGENCY

REGION VI

DALLAS, TEXAS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FIRST INTERNATIONAL BUILDING

1201 ELM STREET

DALLAS, TEXAS 75270

August 23, 1977

TO ALL INTERESTED AGENCIES, PUBLIC GROUPS AND OFFICIALS:

To comply with the provisions of the National Environmental Policy Act of 1969, the Environmental Protection Agency (EPA) has prepared a Final Environmental Impact Statement (EIS) for a proposal by the City of Albuquerque, Bernalillo County, New Mexico, to expand and upgrade the wastewater treatment facilities of the city under EPA grant C-35-1020-01.

A Technical Reference Document containing detailed environmental data and analyses compiled during the preparation of this EIS is available for review. The enclosed list indicates the locations where this material may be reviewed.

The final statement is being sent to agencies, officials and interested persons upon request and to those who made substantive comments on the draft. If additional information is needed, please contact Mr. Clinton B. Spotts, Regional EIS Coordinator, EPA, Region VI, First International Building, 1201 Elm Street, Dallas, Texas 75270, (214) 749-1236.

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Albuquerque, New Mexico

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Reserve Desk - Main Lobby
University of New Mexico
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EXECUTIVE SUMMARY

( ) Draft Environmental Statement
(xx) Final Environmental Statement

City of Albuquerque Wastewater Treatment Facilities
Environmental Protection Agency, Region VI, Dallas, Texas

1. Type of Action. (xx) Administrative ( ) Legislative

2. Environmental Setting and Existing Problems.

General setting. Albuquerque lies along the Rio Grande in a broad river valley flanked on either side by gentle mesa uplands, backed on the east by the rugged Sandia Mountains. The valley, mesa and mountain regions represent the basic environmental units of the planning area, which encompasses the City of Albuquerque, major populated portions of Bernalillo County and the incorporated villages of Corrales, Los Ranchos de Albuquerque and Tijeras. This area had a population of about 375,000 in 1975, four-fifths within the City. Albuquerque is actively growing, and is expected to reach a population of between 590,000 and 687,000 by the year 2000. For environmental analyses the planning area extends downstream to Elephant Butte Dam and Reservoir, the southern limit of the Middle Rio Grande Basin.

Albuquerque is above an elevation of 5000 feet and has a mild, sunny, arid climate. Air pollution problems are serious and worsening due to emissions from vehicular traffic aggravated by natural pollutants and climatic conditions. Geologically, most of the area is characterized by a thick basin-fill of alluvial sediments which is an excellent aquifer; however, the mountains are underlain by consolidated rocks with poor water-bearing properties. No unusual geologic resources or hazards have been identified. Soils tend to be loamy along the valley bottom, sandy on the mesas and rocky in the mountains and in the volcanoes area west of the City.

The Rio Grande is a perennial stream with a median discharge of 600 cubic-feet per second. Flow is erratic from year to year and season to season, and much of the discharge is carried outside the channel in irrigation ditches. Prolonged periods of no-flow have been observed in the river as it passes through Albuquerque. In the Middle Rio Grande Basin surface water resources are scarce, and demands are high for downstream irrigation, recreation and support of fisheries and wildlife habitat. Extensive governmental modification programs have been undertaken to maximize the surface water supply and to obtain flood control. River flooding has largely been controlled by structural modifications, and damage from mountain and mesa arroyo floods is gradually being reduced. Over the next few decades the programs will tend to stabilize the river flow regime somewhat, and will slightly increase total discharge.

Ground water resources are excellent in the area of basin-fill, where an almost unlimited fresh water supply is available. City wells tap this resource and divert approximately 80,000 acre-feet per year at present, causing river flows to be reduced by about 50,000 acre-feet. The water table tends to slope south and west toward and along the axis of the valley. Beneath the river floodplain ground water is normally within 5-20 feet of the surface throughout the year. In the mountain area ground water conditions are varied, and supplies are limited or locally unavailable.

Forested areas support good wildlife habitat in the mountains, while the mesas are characterized by generally poor grass and shrublands of much lower wildlife value. Along the river are found woodlands and wetlands of considerable significance to waterfowl and other wildlife. In downstream areas these habitats

support valuable wildlife refuges which are frequented by several endangered and threatened bird species. Elephant Butte Reservoir is the only significant aquatic ecosystem and fishery in the Basin; productivity is limited by physical factors such as high natural turbidity.

Land use is characterized by urban sprawl in much of the valley and mesa area, with semi-rural, rural, open and vacant lands elsewhere. Federal, Indian and State lands abut the planning area on three sides. Large portions of the valley remain in irrigated agriculture, especially south of the City and east of the river. Beyond the City limits much of the mesa is grazing land awaiting development. Most of the mountain area is within Cibola National Forest; semi-rural development occurs in lower-lying sections.

The City/County Comprehensive Plan forcefully states long-term planning goals, which are to support growth through infill of the already urbanized area, with some extension of development onto the adjacent mesas. The remaining rural portions of the valley, mesa and mountains are to be protected for low-density or open space uses. Historically, market forces have tended to lead to development of these rural lands, despite zoning, taxation and other measures which are used to implement the Comprehensive Plan.

Albuquerque has a relatively healthy economy, but with a high incidence of low-income families, especially in the valley. The population is ethnically diverse with a large Spanish-surnamed component. Government facilities and services are well developed within the City limits, but much less available outside. For example, densely populated unincorporated areas in Bernalillo County normally rely on household wells for water, and septic tanks for waste disposal.

Archeological sites are abundant throughout the area, especially near existing and former water bodies. Remains of the Pueblo and early Spanish cultures are especially significant, but much of the resource has been destroyed by development and agriculture. Recreation is focused on developed parks, the National Forest, and at Elephant Butte Reservoir. Increasing interest is being shown toward use of the river environs within Albuquerque for recreational pursuits, including direct use for swimming and boating. Many irrigation drains are stocked for fishing purposes.

Wastewater facilities. Municipal sewers extend throughout the City and collect domestic and industrial liquid wastes which are then treated at one or both of two central treatment plants. The plants are south of the City center, adjacent to the Rio Grande. Plant #1 is in an industrial/commercial neighborhood, while #2 is in a rural setting near the community of Mountainview. The two facilities use trickling filters to provide initial treatment; all wastewater is then pumped to brand-new activated sludge units at Plant #2, and further treated until effluent quality meets the standards now required by Federal regulations. In mid-1976 the total wastewater treated was about 36 million gallons per day (mgd). All effluent was discharged to the Rio Grande. This discharge provided the City with a water rights credit of 40,000 acre-feet/year, offsetting most of the pumping effects of City wells. The new activated sludge facilities are now operating at near-capacity and will be expanded to process about 47 mgd by late 1979 or early 1980. The expansion, which is funded largely by grants outside the scope of this EIS, is known as Phase IA.

Sludge handling facilities which digest and dewater the solids produced by wastewater treatment are deficient at Plant #2, and will be expanded during Phase IA. Digested sludge is used as a soil conditioner at City parks. Sludge gas is burned to generate electricity. Chlorination is used on some sewer lines and at the treatment works in order to control odors and kill off disease-causing bacteria.

Outside the City limits, the common practice is to dispose of wastewater via on-site systems (OSS) such as cesspools and septic tanks: about 20,000 such systems occur in the planning area. The OSS discharge about 6 mgd of wastewater into area soils. Sewer extensions have been approved for a portion of the South Valley, and will replace about one-third of the OSS. A small independent treatment plant serves the needs of Sandia Heights. Separate facilities also serve parts of Kirtland Base which is outside the jurisdiction of the Albuquerque planning study.

Problems related to wastewater management. Many significant existing and potential future environmental problems are related to wastewater management in the Albuquerque area, including: growth and land use; surface water quality; ground water quality; operation and maintenance; odors; and resource management.

Growth projections in accordance with the Comprehensive Plan indicate that present treatment capacity will become inadequate shortly after 1980. The Comprehensive Plan requires that any expansion in capacity, and especially extensions of sewer lines, be carefully coordinated with land use policies. In particular it is considered critical that sewer service not be provided in rural or open areas unless such areas are urbanizing in accordance with established policies, or unless the sewers are essential for environmental protection.

No major adverse water quality impacts can be reasonably attributed to the discharge of contaminants in City wastewater. At present only the stream standard for fecal coliform bacteria is widely violated in the Middle Rio Grande Basin; Albuquerque effluent is considered to be a minor source of this problem. Albuquerque's wastewater will be required to meet secondary treatment standards set forth in a NPDES permit. The potential exists that additional treatment might eventually be needed to control possible pollution related to the discharge of nutrients, salts and/or metals. However the need for such treatment before the year 2000 cannot be demonstrated at this time. Reports prepared by the New Mexico Water Quality Control Commission indicate that non-point sources, including natural runoff, are the most significant origin of contaminants which may interfere with beneficial water uses. The Commission has also found that water quality per se is not the crucial factor limiting aquatic productivity and recreation potential in the Basin. Physical factors such as water supply fluctuations and the impact of hydrologic modification projects severely restrict aquatic ecosystems and flat-water recreation in the river system, and to a lesser extent adversely effect the value of Elephant Butte Reservoir for these uses.

The massive reliance on on-site systems for waste disposal in unincorporated areas appears to have contributed to widespread degradation of ground water in the shallow aquifer beneath the Rio Grande floodplain. Agricultural practices and animal confinement facilities are also thought to contribute to this pollution, which is characterized by elevated levels of dissolved solids and hardness, excess concentrations of iron and manganese, and higher-than-background amounts of nitrate-nitrogen. The contamination impairs some domestic water supplies, leads to surface water pollution, and is a long-term threat to the deeper aquifers which are used as the municipal water source. Regional problems of bacteria contamination and adverse public health impacts have not been identified, but local problems may occur due to site-specific unsanitary conditions. Such conditions stem primarily from the widespread use of on-site systems in close conjunction with household wells on small lots where the water table is shallow or where flooding or soil percolation limitations exist. An extreme

nitrate contamination problem has been observed in the Tijeras and Mountainview areas, where many water supplies do not meet health standards. The best evidence now available suggests that natural sources are probably responsible; on-site systems are only a minor cause of the problem.

Odors have been and remain the most significant adverse impact on the environment from Albuquerque wastewater facilities. Both treatment plants, portions of the sewerage system, and areas of high density OSS use have been sources of chronic odors. These problems are especially severe in the South Valley where they combine with odors from animal confinement facilities to significantly degrade the quality of life. The odors at the treatment plants reflect physical limitations of the facilities inadequate operation and maintenance, inadequate budgets and inadequate levels of staffing. In 1973 a legal document known as the Stipulation resolved a lawsuit which was partly related to odor problems and required the City to implement Best Practicable Control Technology for odor control. Progress on such control has been slow and has elicited extensive adverse public comment. In 1976 when the activated sludge units at Plant #2 were brought into operation, the lack of adequate sludge-handling facilities resulted in critical operational deficiencies and severe odors. The City proposes to solve these problems with emergency operational procedures coupled with capacity and sludge-handling improvements constructed during the Phase IA expansion of Plant #2. Upon completion of Phase IA some odor sources will remain; the large-scale use of drying beds for sludge dewatering will probably be most significant.

A general concern has been expressed that wastewater management should promote resource recycling and conservation. Exploration of effluent reuse for agriculture and aquaculture is specifically mandated by the Stipulation. The present discharge of effluent to the Rio Grande results in complete reuse downstream, with no evident major adverse impacts. The present sludge recycling practices also do not appear to adversely impact the environment. The recycling of sludge gas is presently impaired by insufficient capacity, and some gas is flared. Scum material is not recycled, and contributes to the overloading of sludge-handling facilities. Resource consumption of the treatment works is not unusually high, although energy and chemical demands are significant.

Other problems related to wastewater management in Albuquerque include: safety hazards associated with chlorine use; the need for renovations at both treatment plants and at most lift and chlorination stations; the presence of some interceptor sewers which will soon become overloaded; the discharge of heavy metals by some industries in amounts which violate the City Liquid Waste Ordinance; high noise levels at both treatment plants, and especially near the new pump station at Plant #2.

3. Alternatives Evaluated.

Alternatives have been developed for all aspects of wastewater management including the collection system (and on-site systems); sites and processes for wastewater treatment; solids handling; disinfection and chemical odor control; and others. The general alternative of taking no action is unacceptable because without improvements to wastewater facilities existing problems such as ground water contamination and odors would remain, and Albuquerque would not be able to develop in the orderly manner set forth in the Comprehensive Plan.

Collection system. For settled or developing areas not now served by the City sewerage system the two major collection alternatives are to construct sewers or to retain the use of on-site systems (OSS) such as septic tanks and drainfields. Major factors to be considered in evaluating these alternatives include:

- sewers (coupled with central treatment) provide a high degree of environmental protection, especially to ground water quality and public health;

- areas with small lots and/or adverse soil and water table conditions may not be suited for OSS;
- sewers tend to support high-density land use and may conflict with the Comprehensive Plan in areas designated as rural and semi-rural;
- sewers generally are a higher dollar cost option than on-site systems, especially in low-density areas;
- sewer construction causes significant short-term impacts, especially in areas with a shallow water table or shallow bedrock.

When these factors are assessed for each portion of the planning area it is evident that no significant obstacles exist to extending sewer service to urban and urbanizing neighborhoods (where lots are normally smaller than one-acre). Conversely, in semi-rural settings OSS appear preferrable, in order to protect the goals of the Comprehensive Plan and reduce direct dollar costs, even though some ground water contamination and sanitation problems may result. As most of the rural areas are characterized by shallow water table or shallow bedrock, the use of OSS also avoids substantial construction impacts.

Because the use of OSS in rural areas has adverse environmental effects, the no action alternative with regard to OSS management is undesirable. The simplest and least costly alternative is to upgrade government regulation of on-site systems, by requiring the use of advanced units such as aerobic tanks and evapotranspiration fields on sites with adverse soil or water table conditions, and by requiring frequent inspection and upgrading of existing cesspools and septic tanks. A greater degree of environmental protection would be obtained by alternatives which would provide for the strong centralized management and/or public ownership of OSS, treating the installation and operation of septic tanks as a public utility. However, such alternatives are not yet proven and cannot be implemented at this time.

A number of collection system alternatives relate to design or upgrading of facilities. The lowest cost options in general are also those with the least impact. These alternatives include: sizing and phasing of sewer lines in accordance with population projections; selection of routes to minimize environmental and other problems; use of permanent pipe materials to minimize leakage and the need for replacement; renovations and improvements to lift and odor control stations to provide for proper operation; construction of parallel lines to relieve overloaded interceptors.

Treatment system: plant sites. Alternatives exist to concentrate all facilities at Plant #2, or to provide some facilities elsewhere. Centralization at #2 has advantages of lower treatment cost and increased reliability and ease of operation. It also limits adverse land use impacts to a single site, and avoids construction impacts which would occur if new facilities were constructed elsewhere. Alternative sites include continued use of Plant #1, construction of a major plant west of the river, and construction of a plant on the Southeast Mesa as part of an irrigation project.

Abandonment of Plant #1 would reduce long-term dollar costs, would permit the City to concentrate its management efforts at #2, would remove a source of odors in the Barelas neighborhood, and would permit conversion on the plant site to industrial, commercial or recreational use. Continued operation of the Plant has no evident environmental benefits. Construction of a Westside plant built in the Far South Valley would eliminate the need to pump sewage across the river to #2, but would be costly and would mandate construction of large interceptor sewers through rural areas in conflict with the Comprehensive Plan. No significant environmental benefits would be obtained from a Westside facility.

The alternative of building a new plant on the Southeast Mesa is attractive if irrigation is to be used to provide advanced treatment of wastewater. However, development of an entirely new irrigated farm on the mesa would be expensive in terms of both dollar and resource costs, especially as it would add a major new source of water depletion to the already water-short Rio Grande Basin. Construction impacts would also be very significant, and long-term air pollution problems related to wind erosion could result. Irrigation sites other than the Southeast Mesa all have similar or greater drawbacks.

Alternatives were evaluated with regard to small treatment plants to serve Sandia Heights (existing), Corrales, Tijeras, the Far South Valley and the Far North Valley. At this time a need can be demonstrated only for the Sandia Heights facility; its continued use would conform to the Comprehensive Plan.

Treatment system: process. The primary alternative for meeting NPDES requirements is to expand the activated sludge facilities at Plant #2 as needed to provide adequate capacity. Advantages of this course of action include: low dollar costs compared to other options; significant removal of nutrients and metals; ability to be modified through add-on of advanced treatment processes to achieve any degree of nutrient or toxic substance removal which might reasonably be expected to be required in the future; minimal land requirements; potential for nearly complete odor control. Disadvantages include significant energy use, and the large sludge volumes produced by the process.

The alternative of developing a large-scale irrigation program to provide secondary treatment is not cost effective because of high dollar and resource costs and potential impacts related to clearing of highly erodible soils. More favorable cost factors are associated with the option of constructing primary clarifiers at Plant #2, and then disposing of the effluent by infiltration/percolation through seepage ponds east of Mountainview. Potential benefits ascribed to this alternative are small and include: some reduction in energy use; some increase in nutrient and metals removal; and possible increased ground water supplies. Drawbacks are significant: a large land requirement; increased water depletions; no agricultural or other productive use of the water depleted; potential for major odor problems.

Given existing effluent regulations and quality there is no evidence to indicate that special nutrient or metals removal processes are needed. In fact, as such processes are expensive and involve considerable resource use, they should be undertaken only when benefits can be clearly demonstrated. Of the available options for nitrogen removal those involving land application have already been discussed; a number of others would be feasible only if implemented as part of the next plant expansion, which will probably occur before any new standards are adopted. The most reliable alternative which could be added on to activated sludge units at any time is a three-stage nitrification-denitrification process; the process could be sized to provide as much N-removal as required. Phosphorus removal by chemical precipitation could also be added, if and when needed; it would greatly increase sludge handling problems. One alternative to expensive advanced treatment processes is expected to be studied further during the next several years--land application on existing irrigated fields of the Middle Rio Grande Conservancy District.

Solids handling. A number of alternatives are available to improve solids handling capabilities at Plant #2, including: mechanical thickening instead of gravity thickening; mechanical dewatering instead of sand-bed dewatering; and use of aerobic digesters for waste activated sludge, instead of anaerobic digesters. While these new processes would increase energy consumption by a small amount, they

would considerably improve odor control and thus have substantial environmental benefits. Continued use of sludge as a fertilizer/dressing for City parks is not expected to lead to environmental problems. Alternatives include: sale for rangeland use; disposal by landfill; use of thermoradiated sludge as an animal feed supplement. The latter has the most potential for fully utilizing the resource value of sludge, but has not yet been demonstrated to be safe and economically feasible. Disposal by landfill is acceptable if sludge volume exceeds the demand for park fertilizer.

Disinfection and chemical odor controls. Chlorine use to control odors along the sewer system and to disinfect treated effluent has many environmental drawbacks: chlorine is a hazardous substance which may be released accidently in toxic quantities; its use results in chlorine residuals and chloramines which adversely affect aquatic life; its use may result in production of chlorinated hydrocarbons suspected of being carcinogenic; it does not kill off all disease-causing organisms, especially virus materials.

For odor control along the sewer lines an alternative with many environmental advantages exists--use of hydrogen peroxide. Benefits include minimal safety hazards, no adverse water quality effects and increased dissolved oxygen levels in raw wastewater reaching the treatment plant. The cost of replacing chlorination units by hydrogen peroxide is only slightly higher than the cost of upgrading the units. For disinfection at Plant #2 the only alternative which would substantially reduce water quality impacts is the use of ozone; this option has the added advantage that virus control is relatively effective. At present, ozone use is not yet well enough established at a reasonable cost to make it preferable over chlorine use, especially as its production would require considerable energy resources. Alternatives for other aspects of solids handling include collection and recycling of scum and recycling of all digester gas to generate electricity for plant operations. These options promote resource reuse without having significant adverse impacts on the environment.

Other. The present practice of discharging effluent to the Rio Grande benefits the water resources of the Middle Rio Grande Basin; all City wastewater is used for beneficial purposes downstream. Alternatives which could provide more direct reuse benefits include: irrigation; aquaculture; silviculture; cooling water; recreation. Only one cost-effective option can now be identified, sale of 1 mgd of effluent to Public Service Company of New Mexico for use as boiler cooling water at a power plant. Of the remaining alternatives, irrigation reuse and aquaculture are not now practicable, but are worth consideration in the future. In particular, it may prove feasible to discharge effluent directly to downstream irrigation systems to increase nutrient recycling.

Management alternatives available to the City include: progressive enforcement of the Liquid Waste Ordinance to reduce metals levels; operation of a toxic metals disposal facility; promotion of water conservation programs to reduce wastewater flows; energy conservation at treatment facilities; use of solar energy where feasible; noise controls at Plant #2. These alternatives generally have environmental and other benefits, and no significant adverse impacts.

4. Proposed Actions.

It is proposed to construct 105 miles of new interceptor and collector sewer lines within the planning area by 1995 to serve the following areas:

Arenal District, South Valley; south and eastern part of the North Valley; portions of the Southeast Valley near Treatment Plant #2, including Mountainview; developing portions of the West Mesa; developed and developing portions of the Candelaria and North Industrial Parks and North Albuquerque Acres; Four Hills and other parts of the Northeast Heights. Also, relief interceptors will be constructed parallel to overloaded lines and lift and odor control stations will be upgraded. Permanent pipe will be used for all facilities; each line will be designed and placed in accordance with population projections based on the Comprehensive Plan. Chlorination control stations will be changed over to utilize hydrogen peroxide. The total cost of the sewerage system improvements is estimated at $25,000,000.

New requirements are proposed for the on-site systems which will be utilized elsewhere in the planning area. Regulations will be modified to require the use of advanced aerated or evapotranspiration units at sites not suited for the conventional septic tank and drainfield. More frequent inspections of existing units, to detect sanitation problems, are also proposed.

It is proposed that the activated sludge facilities at Plant #2 be expanded to accommodate projected population growth and wastewater flow increases as follows: Phase IA, 47 mgd capacity by 1979 (already approved); Phase II, 59 mgd capacity by 1983; and Phase III, 76 mgd capacity by about 1990. All facilities would be designed to meet NPDES permit requirements. For emergency odor control purposes it is proposed that thickener units be included in Phase IA. Phase II will involve elimination of Plant #1 and a number of modifications and improvements to Plant #2. Mechanical sludge dewatering will replace sandbed drying; preliminary treatment facilities will be provided for the activated sludge units; scum handling and improved gas recycling facilities will be constructed; an administration/laboratory building and a rail line for chlorine delivery will be built; aerobic digesters are tentatively to be used for waste activated sludge; existing trickling filter facilities will be renovated. The completion of the measures set forth in Phase II is expected to achieve Best Practicable Control Technology for odors. However, the most serious existing odor problems will be solved earlier, upon completion of Phase IA in 1978 and 1979. The total cost of the treatment plant actions will be $18,000,000.

It is proposed that 1 mgd of effluent be sold to Public Service Company of New Mexico for use as cooling water. All other effluent will be discharged to the Rio Grande as at present. Sludge will be used as fertilizer/dressing on City parks. Scum and digester gas will also be recycled. Grit will be disposed of by sanitary landfill. Progressive enforcement of the Liquid Waste Ordinance will reduce industrial metals discharges to the collection system. If necessary, the City will construct a toxic waste facility for processing of industrial sludges. Over time, energy and water conservation programs will be implemented.

It is proposed that additional actions be reevaluated during the next 20 years, and that they be implemented if changing factors lead to a favorable cost-effective analysis. These actions include: construction of sewers in presently rural areas, should the areas urbanize despite implementation of the Comprehensive Plan; centralized management of on-site systems; land application of effluent, especially on existing farms in the Middle Rio Grande Basin; advanced treatment of effluent, in the event a nitrogen or phosphorus effluent standard is established; use of ozone for wastewater disinfection; thermoradiation of sludge.

The City is committed to measures which include improved operation and maintenance of all facilities, through necessary repairs and rehabilitation, reorganization and increased staffing, and improved process control. EPA will assure the proper operation and maintenance of the facilities by requirements for a Plan of Operation, operation and maintenance manuals, enforcement

of the NPDES permit, requirements for an adequate users fee, and requirements for State inspections. EPA will assure the adequate design and construction of major facilities by requirements for a value engineering analysis, and by use of construction inspection services under contract to the U. S. Army Corps of Engineers.

5. Environmental Impacts

The proposed actions will accommodate the orderly growth of the Albuquerque area; protect and improve water quality and water supply conditions in Albuquerque and downstream; implement Best Practicable Technology for odor control; conform to the Albuquerque/Bernalillo Comprehensive Plan; and benefit long-term productivity. Unavoidable adverse impacts include those related to project construction and operation, and are considered minor. No alternatives exist which would increase benefits and reduce adverse effects. The actions conform to requirements set forth in the NPDES permit, Basin Plan and Stipulation.

Short-term impacts. Existing odor problems and contamination caused by on-site systems in densely settled valley areas will remain until appropriate portions of the project are completed. In the case of odors, serious potential problems will remain until 1978-1980, and some odors may be of concern until 1983. The major adverse impact of the proposed actions is the short-term effect of construction, especially for interceptor sewers built in the valley or in undeveloped portions of the mesas. The adverse effects may include: dust, erosion, noise, vehicle emissions, disruption of traffic and utility service, disturbance or loss of unregistered archeological and historical sites, and water-table drawdown caused by dewatering. The City will develop a specific environmental protection program to mitigate site-specific impacts of each project. An archeological survey will be part of the design phase of each project, and archeological clearance will be required as a grant condition.

Long-term impacts. The proposed actions have substantial beneficial long-term effects, including: protection of water quality in the Middle Rio Grande Basin for all existing beneficial water uses; reduction of contamination associated with extensive use of on-site systems and a corresponding reduction in sanitation and health problems; augmentation of flows in the Rio Grande, especially during drought periods; provision of a water supply to support downstream irrigation, wetland habitats, aquatic ecosystems and flat-water recreation; protection of a substantial water rights credit; elimination of significant odor problems; elimination of safety hazards associated with chlorine use at odor control stations; recycling of waste materials such as sludge, sludge gas and scum; availability of 25 acres at Plant #1 for an alternative use. It is probable that fecal coliform contamination will be reduced as the result of elimination of on-site systems; however, stream standards may not be met because of the influence of other non-point sources. The projected improvement in ground water quality will occur only over a prolonged period, and will not necessarily lead to drinking water standards being met in the shallow aquifer.

The proposed actions also have some adverse long-term impacts, including: consumption of energy, materials, chemicals and financial resources; generation of small amounts of non-recycled wastes and pollutants, such as grit and emissions from sludge gas burning; reduction in recharge in valley areas, due to elimination of on-site systems; continued discharge of pollutants from the on-site systems which remain in the area; commitment of 25 acres of farm land at Plant #2. It is likely that the actions will cause substantial increases in sewer fees charged to all customers. It will be necessary to continue to monitor potential adverse long-term impacts such as increased salinity, impairment of water use for irrigation, and excess nutrient loadings at Elephant Butte Reservoir. The proposed actions do not foreclose any decisions which might be needed should such impacts be observed.

Secondary impacts. The proposed actions conform to the policies and goals of the City/County Comprehensive Plan. In so doing they minimize adverse secondary effects, help restrict development in environmentally sensitive areas, and promote a more efficient urban form which in turn will help minimize problems such as vehicle travel, air pollution and energy use. However, in some areas sewer construction will remove a constraint to development, requiring other measures to be used to implement the Comprehensive Plan. The substantial investment in construction projects and operation of facilities will provide jobs and stimulate the local and regional economy. Adverse economic effects will be felt by the on-site systems industry.

Persons who now use on-site systems, and who will obtain access to sewers, should experience an increase in property values and property taxes, increased access to financial institutions, reduced sanitation-related health problems, and lower total costs for liquid waste disposal. Overall these effects will improve the economic condition of many residents, especially in neighborhoods now marked by a high frequency of low-income families.

The quality of life in the vicinity of Plant #1 and #2 should be substantially improved. Areas which retain the use of on-site systems will be affected by an increased degree of government regulation.

6. Coordination and Review.

The City of Albuquerque held four public hearings and numerous informal open meetings in 1975 and 1976 to discuss alternative wastewater management actions.

The draft environmental statement was distributed on June 14, 1977 to agencies, organizations and individuals who are identified on the attached distribution list. A public hearing on the draft statement was held in Albuquerque on July 20, 1977. Comments on the draft were received through August 8, 1977. No testimony or comments were received which indicated significant objections to the proposed actions. Testimony and comments indicated matters requiring clarification or restatement, and expressed concerns that some alternatives should be reevaluated at appropriate points in the future. The most common point made in the testimony and comments was that assurances were needed that the design, construction and operation of the proposed facilities would in fact achieve the recognized planning goals.

Federal Offices (other than EPA).
Council on Environmental Quality, Washington, D.C.
U.S. Department of Interior, Washington, D. C.
Bureau of Reclamation, Albuquerque, New Mexico
Bureau of Reclamation, Amarillo, Texas
Bureau of Indian Affairs, Albuquerque, New Mexico
Bureau of Land Management, Santa Fe, New Mexico
U.S. Fish and Wildlife Service, Albuquerque, New Mexico
Bureau of Outdoor Recreation, Albuquerque, New Mexico
National Park Service, Santa Fe, New Mexico
Army Corps of Engineers, Albuquerque, New Mexico
Kirtland Air Force Base, Albuquerque, New Mexico
U.S. Department of Agriculture, Washington, D. C.
Farmers Home Administration, Albuquerque, New Mexico
Farmers Home Administration, Washington, D.C.
Soil Conservation Service, Albuquerque, New Mexico
U.S. Forest Service, Albuquerque, New Mexico
Cibola National Forest, Albuquerque, New Mexico

Four Corners Regional Commission, Albuquerque, New Mexico
Federal Energy Administration, Washington, D.C.
Energy Research and Development Administration, Albuquerque, New Mexico
Department of Transportation, Albuquerque, New Mexico
Department of Transportation, Washington, D.C.
Department of Housing and Urban Development, Albuquerque, New Mexico
Department of Health, Education and Welfare, Albuquerque, New Mexico
Department of Commerce, Washington, D.C.
Advisory Council on Historic Preservation, Washington, D.C.
Federal Commissioner and Chairman, Rio Grande Compact Commission, Denver, Colorado
Honorable Pete Domenici, U.S. Senate
Honorable Harrison J. Schmitt, U.S. Senate
Honorable Manuel Lujan,Jr..U.S., House of Representatives

State Agencies (all Santa Fe, New Mexico)
State Planning Office (A-95 Clearinghouse)
State Historical Preservation Officer
Environmental Improvement Agency
State Engineer Office
Department of Fish and Game
Department of Parks and Recreation
Museum of New Mexico
Governor's Office
Legislative Council

Other Agencies
City of Albuquerque
Museum of Albuquerque
Environmental Planning Commission, Albuquerque, New Mexico
Bernalillo County
Village of Corrales
Village of Los Ranchos de Albuquerque
Village of Tijeras
Middle Rio Grande Council of Governments, Albuquerque, New Mexico
Southern Rio Grande Council of Governments, Las Cruces, New Mexico
Albuquerque Metropolitan Arroyo and Flood Control Authority
Middle Rio Grande Conservancy District, Albuquerque, New Mexico
Elephant Butte Irrigation District, Las Cruces, New Mexico
El Paso County Water Improvement District, El Paso, Texas
International Boundary and Water Commission, El Paso, Texas
Governor, Isleta Pueblo
Governor, Sandia Pueblo
Irrigation Committee, Middle Rio Grande Pueblos, Albuquerque, New Mexico
Water Resources Research Institute, Las Cruces, New Mexico

Environmental Organizations; Individuals*
Southwest Research and Information Center, Albuquerque, New Mexico
New Mexico Citizens for Clean Air and Water, Albuquerque, New Mexico
Sierra Club Albuquerque Chapter, Albuquerque, New Mexico
Sierra Club Rio Grande Chapter, Santa Fe, New Mexico
Central New Mexico Audubon Society, Albuquerque, New Mexico
Southwest New Mexico Audubon Society, Albuquerque, New Mexico
National Wildlife Federation, Albuquerque, New Mexico
Albuquerque Wildlife Federation
League of Woman Voters, Albuquerque, New Mexico
Central Clearing House, Santa Fe, New Mexico
New Mexico Ornithological Society, Albuquerque, New Mexico

*includes all parties to the Stipulation

National Audubon Society, New York, New York
Environmental Defense Foundation, East Setauket, New York
Conservation Action League, Albuquerque, New Mexico
Council of Garden Clubs, Albuquerque, New Mexico
New Mexico Conservation Coordination Council, Albuquerque, New Mexico
Izaak Walton League of America, Albuquerque, New Mexico
Trout Unlimited - Rio Grande Chapter, Albuquerque, New Mexico
Bosque del Rio Grande Nature Preserve Society, Albuquerque, New Mexico
Southwest Valley Area Council, Albuquerque, New Mexico
Mountainview Community Improvement Association, Albuquerque, New Mexico
Natural Resource Defense Council, Washington, D.C.
Regional Environmental, Education, Research and Improvement Organization, Las Cruces, New Mexico
New Mexico Public Interest Research Group, Albuquerque, New Mexico
Charles Hyder, Albuquerque, New Mexico
Don Bartholomey, Albuquerque, New Mexico
John Wainwright Evans, Jr., Sunspot, New Mexico
Gloria Noland, Albuquerque, New Mexico
Joseph Green, Sr., Albuquerque, New Mexico
Hazel E. Snyder, Albuquerque, New Mexico
Stanley and Betty Read, Albuquerque, New Mexico
G. Stanley Smith, Las Cruces, New Mexico
Al Church, Albuquerque, New Mexico
H. Donald Sivinski, Albuquerque, New Mexico
Rick Stewart, Albuquerque, New Mexico
James Kunkel, Denver, Colorado
Sandra Simons, Bluewater, New Mexico

Other Organizations

Public Service Company of New Mexico, Albuquerque, New Mexico
Sandia Peak Tramway Company, Albuquerque, New Mexico
Hygea Septic Tank Inc., Albuquerque, New Mexico

1. INTRODUCTION

1.0 BACKGROUND

Albuquerque lies along the Rio Grande Valley at the foot of the Sandia Mountains in north-central New Mexico (Figures 1-1 and 1-2). For 200 centuries or longer people have been attracted to the area by a healthful climate, by striking scenery, and especially by the presence of a river which provided ample water and which created an oasis of fertile green bottom land amid the surrounding desert. Until late in the 1800's the population was small, agrarian and dispersed in Indian and Spanish villages. Within the past century the urban complex of Albuquerque began to develop, first as the transportation and commercial hub of New Mexico, and more recently as the State's employment center, reflecting Federal investments at defense establishments as well as expanded manufacturing and trade activity. Rapid growth since 1950 has brought the metropolitan population to about 375,000 in early 1976, making Albuquerque by far the largest urban center in New Mexico, and one of the major cities of the southwestern U.S. Although the rate of growth has slowed, forecasts suggest that the population could increase by 50% or more in the next 20 years.

One major factor affecting environmental quality in the area is the management of municipal wastewater - domestic and industrial sewage. The proper collection, treatment and ultimate disposal of these liquid wastes is essential for reasons which include: 1) protection of ground water resources which provide the regional supply of drinking water; 2) protection of the scarce supply of surface water which supports extensive agricultural activity, water-based recreation, and valuable wildlife habitat; 3) coordination of sewer system planning with overall goals of comprehensive local and regional planning; 4) control of environmental hazards and nuisances such as toxic substances and odors.

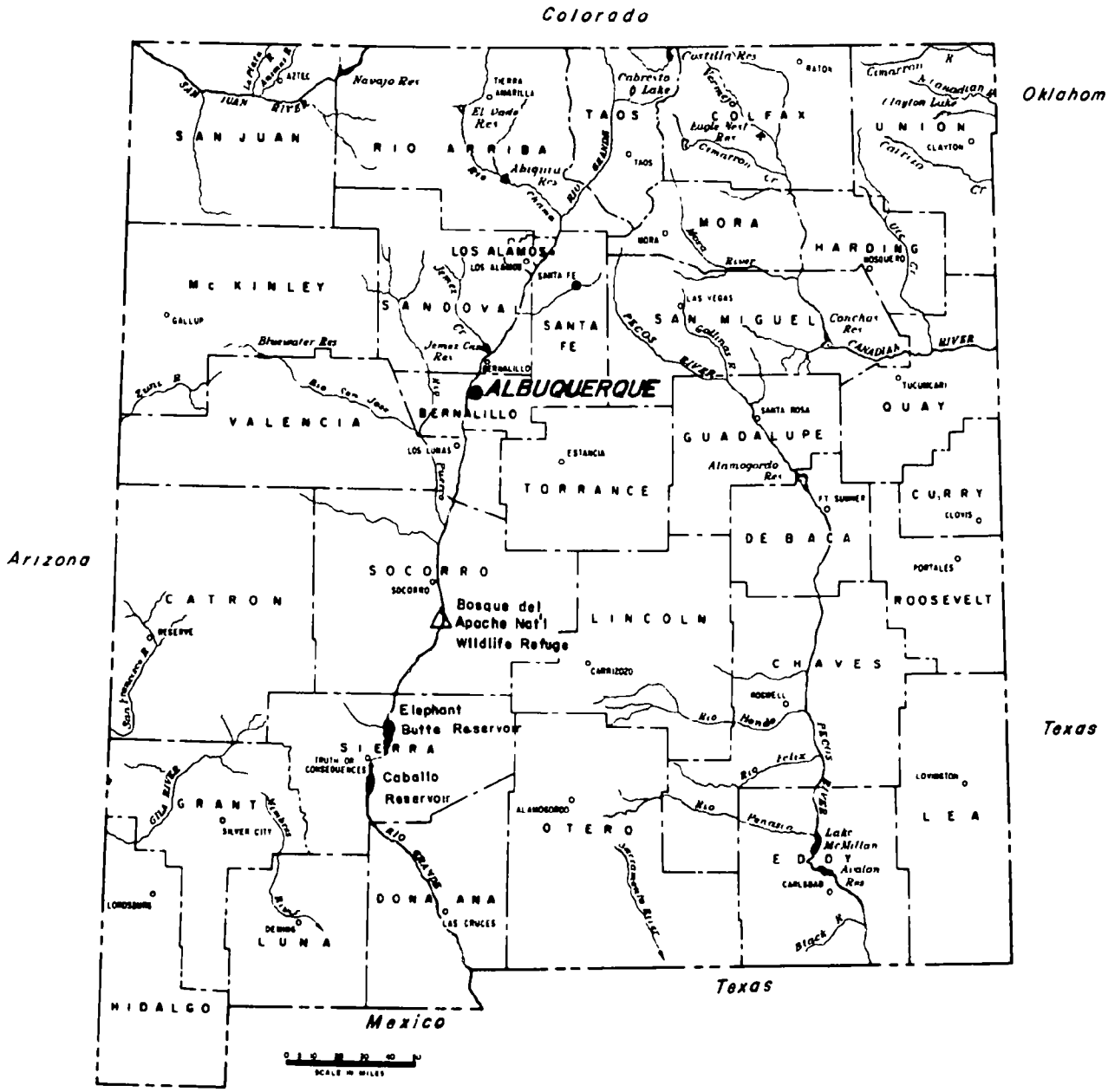
Clearly, part of any effort to enhance Albuquerque's environment will be a plan to provide adequate wastewater management. Stimulus to prepare such a plan has been provided by laws and decisions of the Federal government, as described below.

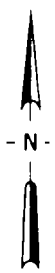
1.1 THE FEDERAL ROLE

In 1972 Congress enacted Public Law 92-500, Amendments to the Federal Water Pollution Control Act, in order to establish a comprehensive set of laws which would "restore and maintain the chemical, physical and biological integrity of the Nation's waters". Because municipal sewage is one of the major sources of water pollution in the U.S., Title II of the new law provided for an expanded program of Federal assistance in the construction of sewage treatment facilities, and gave the Environmental Protection Agency (EPA) authority to fund such activities provided that State and local governments supply 25% of the necessary financial support. The EPA grants are normally given in three steps or phases: 1) initial planning; 2) detailed design; 3) actual construction. Under the law

photo by Dick Kent Photography

FIGURE 1-1. AERIAL VIEW OF ALBUQUERQUE, NEW MEXICO. This oblique photo was taken from directly above the Rio Grande near the southern end of the planning area in June, 1976, and looks NNE. Treatment Plant #2 is in the foreground; #1 is in the middle distance on the left. The fertile Valley is clearly seen, and includes downtown Albuquerque just north of Plant #1. The Heights area occupies the Mesa lands to the east in the middle distance, with the Sandia Mountains dominating the eastern skyline. The Jemez and Sangre de Cristo Mountains are faintly seen on the western skyline; the volcanoes and west mesa areas are not shown in this photo.





CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

LOCATION MAP
STATE OF NEW MEXICO

FIGURE 1-2

USGS BASE MAP

the initial planning phase is emphasized, and must involve a long-range look at the many options available to a city for collection, treatment, and ultimate disposal or reuse of water-borne wastes.

The City of Albuquerque, New Mexico has received Federal Grant C-35-1020-01 (as amended), the purpose of which is to plan for an area-wide wastewater collection and treatment system. Such a plan could lead to decisions which would have significant environmental effects. Whenever Federal funds are involved in a proposed action which would have such an effect, the law requires that the funding agency prepare an environmental impact statement (EIS). As provided in Section 102(2)(c) of the National Environmental Policy Act of 1969, the statement must consider:

a) the environmental impact of the proposed action;
b) any adverse environmental effects which cannot be avoided should the project be implemented;
c) alternatives to the proposed action;
d) the relationship between local short-term effects on man's environment and the maintenance and enhancement of long-term productivity; and
e) any irreversible and irretrievable commitments of resources which would be involved due to the implementation of the proposed action.

In addition to providing grant funds, EPA has specified discharge standards to be met by effluent from Albuquerque's facilities. These standards are discussed in Section 2.4.1.

1.2 THE STIPULATION

This EIS has been written with special consideration given to fulfilling obligations set forth in a legal document which is commonly known as "the Stipulation". The Stipulation represents the settlement of a 1973 lawsuit (Mt. View et al. vs. Fri et al.) in which several citizen groups protested the use of Federal funds to support construction of wastewater facilities in Albuquerque, on the basis that no environmental impact statement was prepared prior to issuance of the construction grant monies. The Stipulation, which was agreed to by the City, EPA and the New Mexico Environmental Improvement Agency, mandates that a number of specific steps be taken with regard to the City's wastewater management program. These steps are referred to in appropriate sections of the EIS; for example, the control of odors and heavy metals is discussed in Section 2.1.3.

The Stipulation also requires that this EIS must provide:

"An adequate analysis of alternative practical methods of utilizing, as nutrients, phosphorus and/or nitrogen in the wastewater of the City, including, but not necessarily limited to:

(1) cropland spray irrigation and other agricultural use of the effluent of the wastewater plants; and

(2) aquacultural use of the effluent;

and an analysis of these and other alternatives to increasing the activated sludge capacity (of existing treatment plants)."

1.3 STANDARDS AND GOALS

A number of criteria are important for use in evaluating alternative programs to manage Albuquerque's wastewater. These criteria include standards and goals which relate to water quality, land use planning, air quality and odor control, and other aspects of environmental quality. A compilation of such criteria was prepared by Wilson (1976). Important standards and goals are discussed in appropriate sections of this EIS, including:

- chemical and bacteriological standards which apply to wastewater discharges (Section 2.4.1);
- chemical and bacteriological standards which apply to surface and ground water in the Rio Grande Basin (Section 2.4.1);
- land use planning goals set forth in the Albuquerque/Bernalillo County Comprehensive Plan (Section 2.6.2);
- odor control objectives (Section 2.2.4); and others.

General goals of wastewater management in the Albuquerque area are discussed in Section 1.4.

In evaluating alternative actions the technique of cost-effective analysis is used. The analysis involves comparing all alternatives in a logical, objective and systematic manner in order to identify their merits and deficiencies. Where practical the comparisons are made in a quantitative way; in many cases they involve use of monetary values. The goal of the analysis is to identify the most cost-effective alternative, which is the option that:

- achieves all the specified standards and goals, and
- does so with the minimum long-term cost to society, that is with the least realistic combination of dollar expenditures, environmental sacrifices and social burdens.

While quantitative and monetary terms are used in the analysis, cost-effective evaluations do not require translation of all environmental values and concerns into numbers. Qualitative and subjective judgements are invariably involved. Consequently the results are neither absolute nor fixed.

1.4 SUMMARY OF WASTEWATER MANAGEMENT ISSUES

In the public meetings held during the planning process, a number of issues have been discussed. The major ones are summarized below.

i) Existing collection and treatment facilities are not adequate to serve anticipated growth; new construction is therefore necessary. The phasing of construction is important, in order to provide sufficient capacity to handle projected waste loads without incurring unnecessary or premature costs.

ii) Effluent discharged by the City treatment works may potentially harm water uses in the Rio Grande Basin and in Elephant Butte Reservoir. It has been suggested that treatment may be needed to remove toxic metals, nutrients, or other contaminants which might adversely affect fish, wildlife, recreation or diversion of river water for irrigation. The need for such treatment must be assessed, and alternate treatment programs evaluated.

iii) Effluent reuse is considered very desirable in an arid region. Reuse for agriculture is of special interest because it would provide for beneficial use of nutrients in the municipal wastewater. Other reclamation options such as ground water recharge should also be investigated. Management of water rights must be considered in evaluating reuse alternatives.

iv) Odors from the treatment plants and portions of the sewer network have provoked many public complaints. Selection of cost-effective odor control alternatives is thus a major concern of the planning effort.

v) On-site waste disposal in semi-rural and semi-urban areas needs to be improved, or replaced by public sewers. The Comprehensive Plan stresses the need to extend sewers only where necessary, and to design them in a manner which will minimize the potential for urbanization.

vi) Alternate sites for new treatment plants must be considered, whether for major facilities or for satellite units which would operate in conjunction with some or all of the existing system. Satellite plants are of special interest where they would promote effluent reuse, reduce odor problems, or minimize the need for sewer extensions.

vii) Projected increases in sludge production will require that alternatives for sludge disposal or reuse be considered in detail.

viii) There is a growing public concern to minimize costs and promote efficient use of resources. Alternatives which would minimize use of energy or chemicals, or promote reuse of substances normally considered waste will be of particular interest.

1.5 SCOPE OF THIS DOCUMENT

This EIS is the result of a joint effort between EPA and the City of Albuquerque, and is intended to provide essential information regarding the options available for collection, treatment and disposal/reuse of Albuquerque's liquid wastes over the next 20 years. The focus is on problems which can be solved through local changes in policies and operations or through construction of new or modified facilities. This focus is intended to permit citizens and government officials to make an informed choice among the available alternates, so that the decisions made will lead directly to actions which will enhance environmental quality.

Not every wastewater problem can be solved directly by construction or through local policy changes. Some environmental concerns require a regional or long-term solution. Many of these larger resource management issues cannot be completely resolved until two other on-going research programs are completed. One of these programs involves analysis of regional water resource management issues in the greater Albuquerque area and is being conducted by the District Office of the Army Corps of Engineers. This study will consider water supply, flood control and water-based recreation. The second program is being conducted by the New Mexico Water Quality Control Commission and the New Mexico Environmental Improvement Agency under Section 208 of P.L. 92-500. Section 208 is concerned with areawide wastewater treatment needs and non-point sources of pollution, such as storm runoff and agricultural return flows. The State plan for implementing Section 208 has specified the Albuquerque Metropolitan Area for intensive wastewater management planning (NMWQCC, 1976). The 208 program will include many work elements which will develop important water quality data and interpretations for the Middle Rio Grande Basin including: the impact of irrigated agriculture on water quality; the characteristics of the nitrogen cycle; the biological availability of nitrogen and phosphorus; nutrient inflows and outflows for Elephant Butte Reservoir; and the significance of toxic substances.

The EIS contains, by reference, extensive technical information which is available from other sources. Such sources are cited throughout the EIS and include published reports, scientific journals and the files of government agencies and private organizations. Two particular documents have provided the greatest amount of information.

a) The Facility Plan contains the overall analysis of alternatives which were studied as part of the City's wastewater management plan. It is the primary source of economic and engineering data on existing and possible future facilities. The document is referenced as MMC (1977). Part C-1 of the Facility Plan contains a discussion of the standards, goals and selection criteria which are outlined in Section 1.3 above.

b) The Technical Reference Document contains environmental data and analyses compiled during preparation of the Environmental Impact Statement. All pertinent information in the document has been summarized in the EIS or Facility Plan, and thus the referenced report is primarily for the use of those who have an interest in the detailed technical documentation of environmental conditions in the planning area. The document is cited as EPA (1977).

2. ENVIRONMENTAL SETTING

2.0 INTRODUCTION

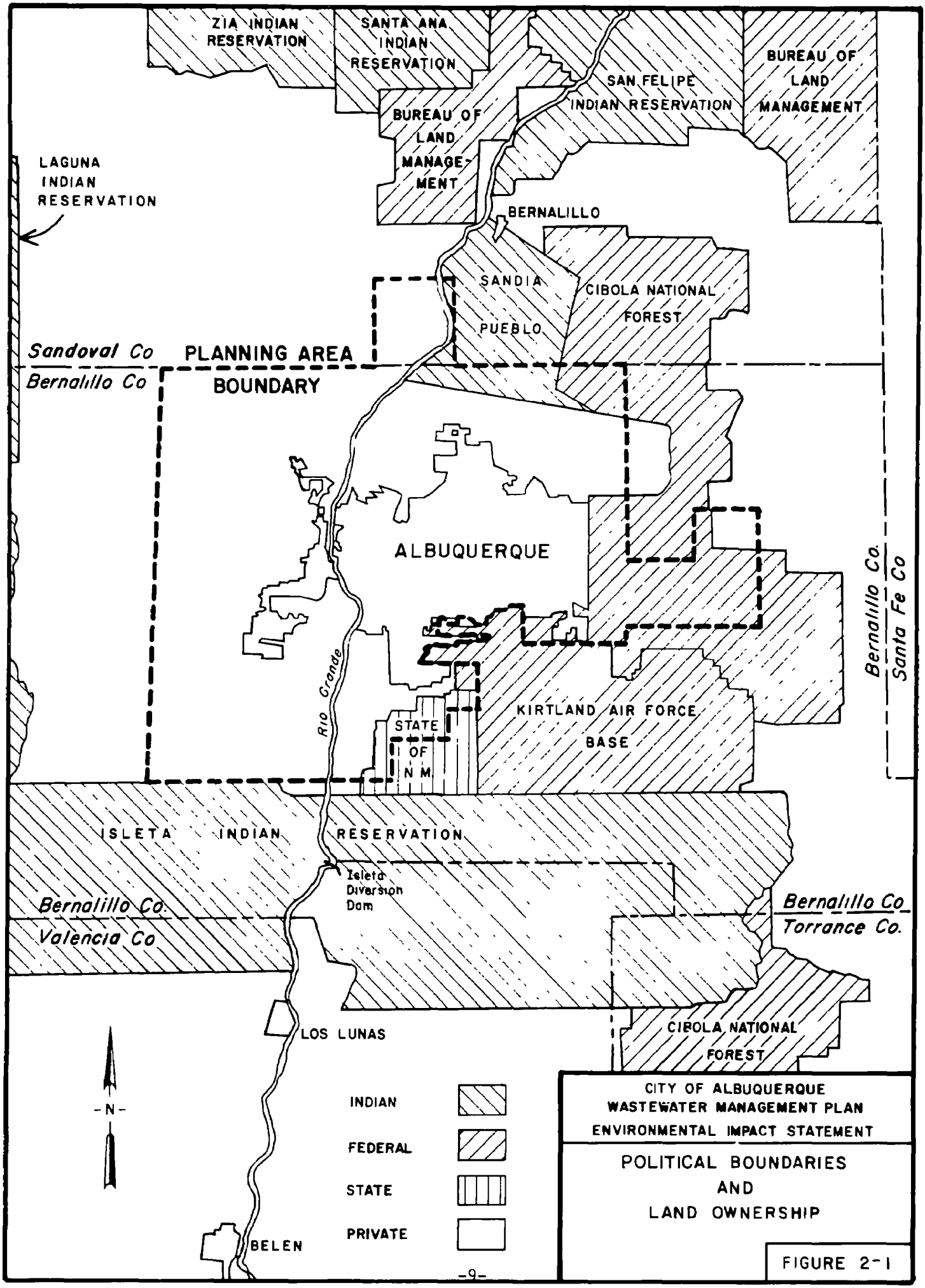
Albuquerque is wholly within Bernalillo County and contains about 300,000 people within an extremely irregular corporate limit. Another 10,000 people live in three small nearby incorporated villages: Ranchos de Albuquerque is just north, Corrales is west of the Rio Grande in Sandoval County, and Tijeras is in the mountains to the east. Most of the remaining population (about 65,000) lives in unincorporated areas which border the City, especially in the area near the Rio Grande. The entire urban area is surrounded and confined on the north, east and south by land in Federal, Indian and State ownership, including Sandia Laboratories (Energy Research and Development Administration), Kirtland Air Force Base, Cibola National Forest and the Sandia and Isleta Pueblos. Scattered parcels of public land are found west of the City. Figure 2-1 shows political boundaries and land ownership patterns near Albuquerque. The figure also shows the boundary of the planning area designated for detailed study as part of this Environmental Impact Statement. The complex boundaries of the planning area reflect the political jurisdictions noted above; most Federal, Indian and State land is excluded even though it is an integral part of the Albuquerque environment. The three incorporated villages have formally agreed to be included within the planning area; Bernalillo County similarly agreed on behalf of the unincorporated sectors.

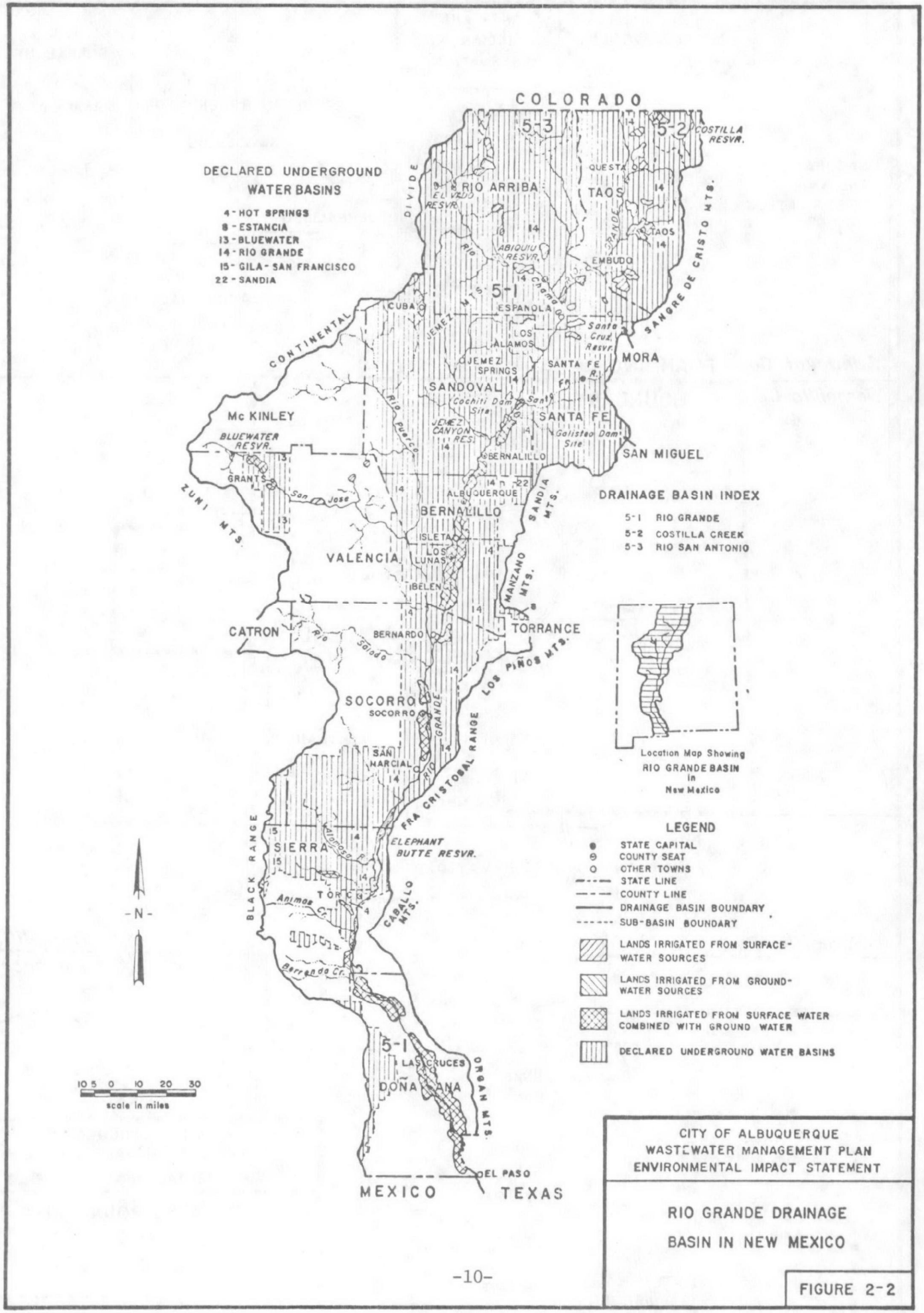
For some purposes, especially water quality evaluations, it is necessary to consider the environment of the entire Rio Grande drainage basin in New Mexico; Figure 2-2 shows the boundaries and major features of this basin. The area most directly affected by decisions made in Albuquerque is the reach of the Rio Grande immediately downstream to the first major dam and reservoir at Elephant Butte. As shown on the map, this reach contains many settlements, extensive agricultural acreage, and major wildlife refuges.

2.0.1 Natural Regions

The landscape of the planning area can be divided into three distinctive natural regions: mountain, mesa, and valley. Each region has its own characteristic set of environmental resources and problems, and each can be divided further into smaller units. The distribution of the regions and their units is shown on Figure 2-3. Table 2-1 provides an extensive summary of the natural and cultural features associated with the units. Because this table includes much background material of interest to this study, it will be referred to often in the sections which follow.

The Mountain region lies above 6000 feet elevation in the eastern part of the planning area, and includes an upland unit--the Sandia Mountains--and a lowland unit--Tijeras Canyon. The region is characterized by: a relatively cool, moist climate; rugged terrain; thin rocky loam soils; small mountain springs and streams which may flow year-round and which discharge considerable runoff to the adjacent mesa; relatively scarce ground water resources; and a forest or woodland vegetation which supports a diverse wildlife population including many species of large mammals. The lowland unit contains many


ZIA INDIAN RESERVATION
SANTA ANA INDIAN RESERVATION
BUREAU OF LAND MANAGEMENT
SAN FELIPE INDIAN RESERVATION
BUREAU OF LAND MANAGE-MENT
LAGUNA INDIAN RESERVATION
BERNALILLO
SANDIA PUEBLO
CIBOLA NATIONAL FOREST
Sandoval Co
Bernalillo Co
PLANNING AREA BOUNDARY
ALBUQUERQUE
Bernalillo Co.
Santa Fe Co
Rio Grande
STATE OF N M
KIRTLAND AIR FORCE BASE
ISLETA INDIAN RESERVATION
Isleta Diversion Dam
Bernalillo Co.
Valencia Co
Bernalillo Co
Torrance Co.
LOS LUNAS
CIBOLA NATIONAL FOREST
-N-
INDIAN
FEDERAL
STATE
PRIVATE
BELEN
CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT
POLITICAL BOUNDARIES
AND
LAND OWNERSHIP
FIGURE 2-1



CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

RIO GRANDE DRAINAGE BASIN IN NEW MEXICO

FIGURE 2-2

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TABLE 2-1. NATURAL REGIONS OF THE ALBUQUERQUE AREA. TERRAIN; CLIMATE AND AIR QUALITY; GEOLOGY; SOILS; HYDROLOGY; VEGETATION; WILDLIFE; ARCHEOLOGY; LAND USE.

	MOUNTAIN		MESA			VALLEY	
	Uplands	Lowlands	Volcanic	Alluvial Fans	Sand Plains	Sides and Terraces	Floodplains
TERRAIN	Extremely steep west-facing slopes, averaging 25% or more Varied relief, locally exceeding 1000 feet Marked by cliffs, pinnacles, canyons Gentle east-facing slope in not in planning area	Nearly level, but often rugged canyon floors with steep sides (to 80% slope). Tijeras Canyon grades SW at 1-2% and locally broadens to an inter-montane basin.	Aligned small volcanic cones surrounded by nearly level or eastward sloping lava flows which commonly end abruptly in cliffs up to 100 feet high Surface slope is toward Rio Grande at 1%-15%	Smooth but fairly steep slopes (to 10% and above) near mountain front, grading westward to a gently undulating surface with slopes of 3-5%, and relief of tens of feet near arroyos	High, flat to slightly concave surfaces often enclosed by low, broad ridges Local slopes may exceed 3%, regional gradient is to S at 1% or less.	Moderately to steeply sloping area grading from Mesa to Floodplain or river Upper boundary marked by sharp break in slope, local relief of 50 feet plus, and slopes often 10% Lower areas gentler, smoother except below terraces.	Broad flat valley bottom, grading southward parallel to Rio Grande at about 0.1%. Natural slopes do not exceed 1%, minor local relief between old terraces, swamps. Man-made relief features (streets, canals) are dominant
CLIMATE AND AIR QUALITY	Description Relatively moist, cool subhumid climate Mean annual precipitation is 18 to 25 inches, mean annual air temperature 44°F, frost-free season 60 to 100 days, average snowfall 60 to 100 inches Comments. One of the highest incidences of thunderstorms in contiguous U S. Considerable freeze-thaw effect, rapid snowmelts and runoff on west faces.	Description Climate is transitional from subhumid to semi-arid 12-18 inches of precipitation per year, mean annual air temperature 43-55°F, frost-free season 130 to 160 days. Comments Valley areas subject to cold air drainage, heavy snow drifts	Description Moderate semi-arid climate, warm and dry. Mean annual precipitation from 7 to 10 inches, mean annual air temperature 58-60°F, 170-195 day frost-free season Comments Snowfall less than 10 inches per year, few relative extremes of any type, high incidence of solar insolation Best represented by main Albuquerque weather station	Description See above description of volcanic unit Comments Like volcanic unit, except that urbanized areas have major hydrocarbon, carbon monoxide, and photochemical oxidant air quality problems	Description See Volcanic Unit for description Comments See Volcanic Unit for comments	Description· Warm, dry, semi-arid climate like that of mesa units, except that extremes are somewhat greater Comments Susceptible to erosion from flash flooding and wind. Air quality problems in urbanized areas	Description Semi-arid bordering on arid climatic conditions Mean annual precipitation 7-8 inches, mean annual air temperature 53-54°F, frost free season 165-185 days. Comments Extreme temperature ranges, greatest evapotranspiration rate, high incidence of cold air drainage and local inversions. An air quality problem area.
GEOLOGY	Cap of several hundred feet of Pennsylvanian limestone layers alternating with shale Remaining material is a light colored Precambrian granite with gneiss, quartzite, greenstone and schist Resources or hazards· Resources are limited and access restricted Principal hazard is landslides	West face is nearly all granite, south slopes show various metamorphics, eastern lowlands covered with limestone, shale. Numerous limestone outcrops. Resources and hazards limestone (for a cement plant), shale (for a brick company), gold, flourspar and galena mined in past Hazards include landslides and flash flooding	Consists of lava and cinders extruded from five distinct cones and eight very small ones Activity was relatively recent (Pleistocene) in time and centered upon the west side of the Rio Grande rift Resources and hazards principle resource is scoria for cinder blocks, possible earthquake hazards.	A series of coalescing alluvial fans (Bajada) composed of sands and gravels and younger formations, deposited in a down-dropped block (the Rio Grande rift) Resources and hazards resources are limited to sand and gravel, hazards are flash flooding, mud flows, potential earth movements along fault scarps, and in places poor compaction.	See description of "alluvial fans". Upper fill is less well consolidated and reworked by wind in active and fossil dunes Resources and hazards· some potential for deep geo-thermal wells, no other significant resources or hazards known.	River-cut cliffs and valley sides in older river-laid terraces Cut and fill material is composed of reworked sands and gravels of the Santa Fe group Resources and hazards· principal resource consists of extensive deposits of sand and gravel, common hazards such as sloughing, slides, and flash flooding in numerous arroyos	The top 75 feet of the flood plain consists of recent alluvial fill from the Rio Grande, below that is much older fill of the Santa Fe group Resources and hazards principal resources are ground water, adobe soil, and farmland Main hazard is flooding
SOILS	Association· Kolab-Rock Outcrop Description dark, well-drained clay loams on steep slopes, parent material usually limestone, sandstone or granite Rock outcrop accounts for 30% of association. Notable characteristics permeability slow, slope severely limits nearly all man-related activity, useful for watershed, wildlife, nature study	Association· Seis-Orthids Description· well drained stony loams over clayey subsoil, forming from bedrock on nearly level to steep slopes. Notable characteristics· severe restrictions to engineering activities due to slope and bedrock on steepar slopes; moderate limitations where grade is less than 15% (Trees usually are existing slopes)	Association Alemeda-Akela Description· generally shallow, well drained sandy loam, with cinders, on moderately sloping, irregular basalt flows, 17% exposed basalt Notable characteristics moderate to severe limitations to overcome for most engineering activities, septic tanks, foundations, underground utilities Basalt cobbles, shallow bedrock and excess slope are problems	Association Tijeras-Embudo Description deep, well drained gravelly sandy loams of alluvial fans, some clay in subsoil Notable characteristics rapid percolation rate and moderate shrink-swell, otherwise few engineering problems, generally suitable for urban development	Association· Madurez-Wink Description well drained fine sandy loam over sandy clay loam, formed from unconsolidated alluvial material Notable characteristics moderate shrink-swell, sloughing, and permeability; may be highly corrosive, fair suitability for most activities if used with care	Associations Bluepoint-Kokan, Madurez-Wink Description Madurez-Wink soils on isolated river-cut terraces, see Sand Plains for description and characteristics Bluepoint-Kokan soils are excessively drained loamy and/or gravelly sandy soils found as slopewash over terraces Notable characteristics locally severe water erosion, sedimentation, sloughing, corrosivity and slope problems. Otherwise use potential is moderate overall on slopes less than 15%	Association Gila-Vinton-Brazito Description. level to gently sloping, well-drained loams of the Rio Grande floodplain Notable characteristics. principle hazards are shallow water table, flooding, and ditchback sloughing Good to excellent development potential for all categories. 20% is saline or alkaline
HYDROLOGY	Parallel canyons (located along joints, faults) cut in steep mountain front, fed by short, intermittent channels Runoff from snowmelt, thunderstorms, and from springs fed by ground water Ground water otherwise available in small quantities; quality generally good Little water use in area. This is important source of water used elsewhere	Structurally controlled trellis-drainage pattern; larger flat-bottomed canyons fed by steep, parallel canyons, in turn fed by small coalescing gullies Streams carry snowmelt, spring-flow, storm runoff; larger water courses such as Tijeras River are virtually perennial Most flow infiltrates to stream alluvium or limestone aquifers Some local water use from shallow wells, water is available in sufficient quantities for domestic purposes in most areas, but is hard and has high iron content in Tijeras area	Irregular arroyos and small depressions, normally dry, usually incised into lavas and grade parallel toward Rio Grande All major flows are in direct response to summer thunderstorms Some runoff percolates into channel bottoms, the rest flows to the river, locally causing flood problems. Ground water is found at considerable depth, little information as to quantity, quality available.	Mountain channels feed into many arroyos which spread out over the fan surface Mountain runoff which reaches generally percolates into the porous material, this is a major source of recharge to the regional ground water supply Summer storms here or in mountains may cause flash floods, now partly controlled by diversion ditches Ground water found 300-1000 feet beneath the surface, generally in considerable amounts in sediments of Santa Fe Group, many municipal wells found here and obtain water of acceptable to good quality	Relatively small number of broad valleys and ponding areas, almost always dry Some local runoff following summer storms, most percolates into ground or is lost by evaporation Ground water is found at considerable depth (and mainly results from inflow from mountain areas to the north) Use limited at present, local quality problems, and generally available in quantities which are less than east of the river, due to lower transmissivity	Upper areas have closely spaced subparallel gullies which join to form arroyos, in lower areas the arroyos diffuse to broad, poorly defined drainageways or sheet flow areas, and can cause widespread shallow flooding Flows occur in response to summer storms here or on mesa Ground water depth varies, aquifer is Santa Fe Group Quality is generally good, some municipal wells are in this unit	Rio Grande is a braided, slightly meandering river which flows at an elevation above the flood plain Drainage in the latter is largely internal, or by man-made ditches The river is fed mainly by meltwater from the northern New Mexico mountains The flood plain proper receives flow from local arroyos, flooding now being brought under control by diversions and holding ponds in the Valley sides unit Ground water is very shallow, fed by river seepage and percolation of irrigation water, the latter is diverted in large amounts from the Rio Grande River alluvium forms an upper aquifer up to 120 feet thick, water is hard and frequently polluted City wells in the Santa Fe Group below obtain abundant water of good quality, numerous domestic, commercial and irrigation wells also occur and local drawdown effects are pronounced

TABLE 2-1, Continued

	MOUNTAIN			MESA		VALLEY	
	Uplands	Lowlands	Volcanic	Alluvial Fans	Sand Plains	Sides and Terraces	Floodplains
VEGETATION	Zone Upper Sonoran foothills to Canadian and Hudsonian on peaks Indicator species ponderosa pine, white fir, Douglas-fir, Cambel oak, Pinyon-Juniper association below 8,000 feet Productivity, sensitivity Upper reaches serve as good grazing and cover areas for wildlife, some wood cutting, gathering of fruits and nuts and recreation occurs in lower areas Vegetation is somewhat sensitive to over-browsing and intrusion by man.	Zone Transition (plateau lands) Indicator species some ponderosa pine but mainly pinon pine, juniper, mountain mahogany, sumac, and mid and short grasses, also cholla and prickly pear cactus Productivity, sensitivity Less moist than upland areas and therefore productivy is limited Some browsing, grazing, and fruit and nut picking occurs, area is easily disturbed and recovers slowly	Zone Upper Sonoran Indicator species mid and short grasses, shrubs and annuals, such as black grama grass, snakeweed, winter fat, much cacti Productivity, sensitivity only marginal productivity for grazing or browsing animals Sensitive to overgrazing, prolonged drought or intrusion by men as collector of cacti, shrubs	Zone Upper Sonoran Indicator species mostly mid and short grasses, some little soapweed (yucca), almost no native species in urbanized areas Productivity, sensitivity moderate grazing capacity, most disturbance, other than directly man-related, results from overgrazing or drought Otherwise, fans are not overly sensitive to disturbance	Zone Upper Sonoran Indicator species mostly short grasses including black grama, sand dropseed, Indian ricegrass, some sand sagebrush, snakeweed and winter fat Productivity, sensitivity Moderate grazing capacity, good habitat for semi-desert and grassland species Very sensitive to overgrazing	Zone Upper Sonoran Indicator species Sea Sand Plains unit for terrace areas, snakeweed, Russian thistle and other species indicating disturbance inhabit valley sides, along with grasses Productivity, sensitivity only marginally productive except along water courses, which are good wildlife habitats Relatively insensitive to human activities because already severely disturbed	Zone Upper Sonoran grading slightly into Lower Sonoran; Basque along water courses Indicator Species alkali sacaton, inland saltgrass, four-wing salt bush, trees include cottonwoods, Russian olive, and salt cedar Productivity, sensitivity Good natural and agricultural productivity, average alfalfa yield, the main crop, is 4 7 tons per acre Highest natural productivity occurs in woodlands and marshes
WILDLIFE	Indicator Species bighorn sheep, mountain lion, mule deer, turkey, bobcat, Stellar's jay, broad-tailed hummingbird, ground squirrel, porcupine Value Breeding areas for bighorn sheep, mountain lion and other large animals.	Indicator Species mule deer, rock squirrel, pinyon mouse, pinyon jay, skunks, rattlesnakes, fence lizards Value Important wintering area for mule deer and mountain birds, provides food and cover for some prairie animals.	Indicator Species antelope, squirrel, coyote, skunk, many lizard snakes and predatory birds Value Excellent habitat for semi-desert species, good cover for burrowing animals, great variety Provides home for relatively rare rock pocket mouse, which is endemic to lava flows	Indicator Species many burrowing animals such as ground squirrel, prairie dog, field mice Also hawks, quail, roadrunner and numerous lizards Value Undisturbed areas provide food and cover for grassland rodents and reptiles Disturbed areas are of little value More moist arroyos are prized habitat for all	Indicator Species jackrabbit, kangaroo rat, coyote, and western diamondback rattlesnake, scorpions, and others as noted under "Alluvial Fans " Value slightly less moist environment, but contains broader range of species because is generally less disturbed	Indicator Species burrowing rodents, owls, or other animals which "adopt" burrows in valley sides, including rattlesnakes and many feral dogs from urban areas Value Arroyo sides provide moist inner-city habitats for burrowing owls, ground squirrel, field mice and the like Generally, less rich fauna than in other units.	Indicator Species ducks, shorebirds, muskrat, beaver, skunk, roadrunner, norway rat Also, some fish and many reptiles and amphibians are common Value used as flyway for migratory birds, provides breeding sites, feed and cover for grassland and aquatic species, locally rare wetland habitats for riparian woodland creatures
ARCHEOLOGY	Site frequency and types: No known sites within planning area limits, but numerous small Anasazi settlement mounds (post-1000 A D) nearby to north; ceramic fragments probable Typical locations Relatively level sites in canyons where water is accessible, Sandia Cave found several miles north, and potential exists for more such valuable finds.	Site frequency and types: Very high density of sites, reflecting primary settlement pattern (large pueblos) of Anasazi and associated outlying farming hamlets and fields. Most remains consist of ceramics, some masonry rubble Typical locations Locations relate directly to drainage, such as arroyo heads, and reflect prehistoric adaptation to the mostly perennial water supply	Site frequency and types Moderate number of rock art (petroglyph) sites some archaic campsites (7000-2000 B C) likely with lithic surface scatters Typical locations All exposures of basalt are potential rock art sites small caves or rock-shelters are potential archaic era sites	Site frequency and types No sites on file, but archaic campsites likely, with associated small lithic scatters Typical locations Site probability increases along major arroyo banks, in sandy areas, and along the juniper transition zone near the Sandia Mountains	Site frequency and types No official sites recorded, but numerous finds exist including Paleo-Indian and archaic campsites Some Anasazi or Mogollon farm sites with small pit-houses expected, evidenced by circular surface depressions and/or sherd scatters Some larger villages possible from period 950-1000 A D Typical locations Favored sites are near stabilized dune concentrations	Site frequency and type: Many sites representing Paleo-Indian, archaic, Anasazi, and Mogollon sites Some historic structures remain near the edge of the floodplain Typical locations Older sites are back from terrace edges near level, sandy areas, pueblo remains are near stabilized dunes, arroyos, and on edge of flood plain	Site frequency and type Most prehistoric sites destroyed by flooding, farming, and/or urban expansion Many historic features are present Typical locations For subsurface remains, older neighborhoods such as Old Town present a high potential
LAND USE	Description National Forest land except near boundary with alluvial fans Condition is semi-primitive, rugged, with no roads (in planning area section of forest) and few trails Problems Heavy use, including history of Off-Road Vehicle (ORV) use in lower forest lands, encroaching urbanization in Embudo Canyon area	Description Roughly half National Forest land and half private land - latter is on relatively level plateaus or valleys Private lands in Tijeras and Cedar Crest are developed as semi-rural, but are approaching capacity for settlement Problems General Off-Road Vehicle (ORV) use of forest lands, encroaching urbanization; use of septic tanks on shallow rocky soils	Description Present land use is mostly as range or open space, several volcanoes purchased by city for preservation Some urbanization occurring along northwest fringes Problems Basically related to nearby urban activities such as scavenging for plants, lava rock, archeologic artifacts	Description About half of unit is suburban or developing and remaining north half has been platted for future development, including both urban and commercial-industrial along Interstate 25 Problems Relate to questions of urban design more than to impacts on natural environmental quality	Description Sand Plain areas west of the Rio Grande are presently used only for light grazing of cattle One section located east of the river is used as an airport Some land held for speculation Problems Easily damaged by overgrazing or other activities which disturb surface Few problems presently because of little development pressure	Description Land use is highly varied, from dense urban to open space Miscellaneous uses include dumping and landfill sites, Off-Road Vehicle (ORV) tracts, sand and gravel works, and new subdivisions Problems Gullying and wind erosion in moderate to steeply sloping areas can be caused by ORV use, housing developments, dirt roads, dumping	Description Has passed from marshy to agricultural to urban setting in many areas Main uses at present are for central office district, dense urban, commercial-industrial development, and semi-rural areas River edges preserved as bosque Several feedlots and dairies Problems Major conflict relates to use of prime agricultural land for urbanization Many unsewered areas feedlots and the like contribute to ground water pollution Almost entire floodplain is or was potential flood hazard area See also section on Environmental Quality

archeological sites, is generally rural but has been settled in places to near its capacity, and is the site of one large cement plant. The upland unit is prime recreation land.

The Mesa region lies on either side of the Rio Grande Valley and is a dry, relatively flat desert upland between 5200 and 6000 feet elevation. It includes three units: Alluvial Fan, Sand Plains, and Volcanic. Most of the area east of the river is in the Alluvial Fan unit and is characterized as follows: smooth, steeper slopes at the mountain front; gentler, but more dissected slopes near the valley; deep, well-drained sandy loam soils which, except along the flood-prone arroyos, are well-suited for most types of development; abundant good quality ground water at depth; the potential to support a stable grassland and desert wildlife; and a history of progressive urbanization which at present dominates the area, and which has led to some environmental problems such as traffic-generated air pollution.

A small part of the eastern mesa and most of the mesa west of the Rio Grande is in the Sand Plains unit, which can be characterized as follows: a relatively flat surface marked by sandy soils, some closed basins, and many stabilized dunes; diverse wildlife habitat on a moderate to good quality grassland; abundant open space (mostly grazing land) with a fair potential for urban land uses when care is taken to avoid problems such as erosion. The Volcanic unit is an area of volcano hills and adjacent lava flows which end in steep cliffs. Shallow, rocky soils severely limit development, but the area is suited for desert wildlife and for uses such as low intensity grazing or recreation. The area also contains valued archeologic resources in the form of rock art (petroglyphs). Throughout the Mesa region the arroyos are the key to environmental patterns, providing much of the scenic and biological diversity as well as presenting flood hazards and providing ground water recharge.

The Valley region lies along the Rio Grande between the mesas; it includes a rather flat Flood Plain unit near the river, at elevation 5000 feet and below, as well as an adjacent steeper unit known as the Valley Sides and Terraces, which locally rises to above 5500 feet. This latter unit is transitional between the adjacent mesa uplands and the main river valley. It generally has a steep upper slope, sometimes with a badland character; lower slopes are gentler, though locally broken by one or more level terraces bounded by steep bluffs. The unit has sand and gravel resources and a diversity of archeological sites. Soils are somewhat fragile, and arroyo flood hazards are widespread. Uses include both urban development and open space; the former is somewhat limited by the erosion-prone soils, the latter by the low-quality of the existing grassland.

The Flood Plain unit is the nearly level bottom land adjacent to and including the river. It has been extensively modified by agricultural and urban development. These factors along with the generally fertile loamy soils have made this the major greenbelt area in the city landscape, even though the area includes the central business district. Ground water is

abundant near the surface, but deep wells often are needed to obtain water which is free from contamination problems. Air pollution is a major concern, caused in part by the micro-climate associated with a valley location. Along the river a narrow bosque (woodland) provides important habitat for wildlife, especially migratory birds. The area's rich archeological heritage is largely destroyed but important historic sites remain, and cultural diversity is more pronounced than elsewhere in Albuquerque.

The basic natural patterns noted above--mountain, mesa, valley--are repeated down the Rio Grande basin to Elephant Butte. Descriptions of specific environmental resources and constraints are presented elsewhere in this document. However, for general planning purposes it is the composite of features in each unit which is of interest, not the individual environmental components. For example, the overall character of the alluvial fan unit makes it more easily developed for urban purposes than other units--wastewater planning actions which support development there are less likely to have adverse impacts than those taken in a more sensitive area such as the mountain lowland. The unit with the most complex environmental conditions is the valley flood plain. Wastewater management systems in this unit must be planned with special care to ensure that they solve the existing problems without leading to new ones.

2.0.2 Urban Features

Figure 2-4 shows the location of major urban features in and near Albuquerque. It indicates the common names used to refer to different areas, and shows the relationship of neighborhoods to one another, as well as indicating the sites of regionally important facilities such as the two universities, several large shopping centers, major industrial parks, fairgrounds, and the two sewage treatment plants.

2.1 EXISTING WASTEWATER MANAGEMENT SYSTEM

Background information regarding wastewater management in the Albuquerque area is presented in the Technical Reference Document (EPA, 1977, Part A). There are four major categories of wastewater in the area, as listed below and described in the sections which follow.

a. Within the City limits most domestic and industrial wastes are discharged to the municipal sanitary sewers, treated at a central plant, and then discharged to the Rio Grande. This discharge is the largest municipal point source affecting water quality in the State of New Mexico and is a major focus of the analysis presented here. (See Sections 2.1.1, 2.1.2 and 2.1.3 below).

b. Wastewater from some industries, animal confinement facilities, subdivisions and other point sources is treated and discharged separately, in accordance with Federal controls set forth in NPDES permits. Compared to the City discharge these sources are probably minor. (Section 2.1.4).

c. Nearly 20% of the population in the planning area utilizes individual on-site disposal systems such as septic tanks. These are con-

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centrated in the unincorporated sections of the Valley Floodplain unit, and serve commercial establishments as well as households. The systems are under limited government control and have been associated locally with ground water contamination problems. They represent the non-point source of pollution which is of most concern to this study. A recently approved sewer construction project will reduce the number of on-site systems somewhat, and will increase the amount of sewage treated at the City's central facilities. (Section 2.1.5).

d. Other possible non-point sources of pollution occur in the area, including storm water runoff and return flows in irrigation drains. There is very little information concerning these sources, and they are now uncontrolled. (Section 2.1.6).

2.1.1 Municipal Sanitary Sewers

Albuquerque's sanitary sewerage system has several components: small collection lines which serve homes, businesses, and industry; larger mains and interceptor sewers to which the small lines discharge; lift stations which are located where pumping is needed to maintain or replace gravity flow; and chlorination stations which are used to control odors. Figure 2-5 is a map showing the location of the lift and chlorination stations; it also shows which parts of the planning area have sewer service, and which rely on septic tanks or other household units. Further information is provided in the Technical Reference Document (EPA, 1977, Part A-1).

In recent years system expansion has been guided by a master plan (Turney, 1963), with service being extended as needed to developing areas within the City limits. In contrast the unincorporated portions of the planning area are not served, including most of the North and South Valleys, and the mountain area to the east. Figure 2-5 identifies a part of the South Valley which will receive sewers following completion of construction projects which are scheduled to begin in July, 1977. Additional extensions are expected to take place as provided for in the Facility Plan. As of May, 1977, the City had advanced plans to implement some construction of interceptors prior to the approval of the Facility Plan by EPA and EIA, and without assurance of Federal or State funding. This construction is intended primarily to serve rapidly growing areas of the City, such as the Northeast Heights.

The collection lines and interceptors appear to function properly, although relatively minor local problems occur with regard to odors, backups and overloading. According to the Facility Plan, overloading will be of increasing concern in the next 5-25 years in areas where population growth leads to flows which exceed system capacity.

Lift and chlorination station problems are significant. Desired preventative maintenance is neither scheduled nor performed to the extent necessary, and maintenance records are lacking. Some safety hazards identified in a 1974 survey have not yet been corrected; in a few cases these hazards can prevent complete cleaning and repair of equipment. Other problems include station security (especially at some chlorination units), the need for standby power, and the need for an effective monitoring and alarm system. To a considerable extent these deficiencies persist because of budget restrictions and resulting staff limitations.

2.1.2 Municipal Treatment Plants

Albuquerque operates wastewater treatment facilities at two sites, both located near the Rio Grande south of the City center (see Figure 2-5). Technical data on these facilities are provided in Part A-2 of EPA (1977), and in the Facility Plan (MMC, 1977). The treatment system involves a combination of physical and biological processes plus chlorination. These processes are designed to remove most of the organic and solid material present in raw sewage and to eliminate almost all the disease-causing bacteria. Three distinct treatment facilities exist. Two use trickling filters and are referred to here as Plant #1 and Plant #2A. Plant #1 can handle 22 million gallons of wastewater per day (22 mgd), which is the approximate load generated by a population of 200,000. The facilities at #1 are old, in poor condition, and comparatively expensive to operate. Plant #2A can also handle 22 mgd, giving the City a total of 44 mgd capacity through the trickling filter process. Plant #2A is newer, in fair condition, and provides better treatment than Plant #1. However, even with renovations, neither of the trickling filter facilities can meet the treatment standards imposed by Public Law 92-500. Both plants are affected adversely by operation and maintenance problems (see discussion later in this section).

In response to the law the City has built a third facility to obtain secondary treatment. This facility uses the activated sludge process. It occupies the same site as #2A but is physically separate, and is referred to here as Plant #2B. The activated sludge units are brand-new and have a capacity of about 39 mgd, slightly less than the trickling filter capacity; they are adequate to serve about 355,000 persons. New and improved chlorination facilities have also been constructed. As explained subsequently, treatment units at Plant #2 are not operating effectively.

Prior to construction of Plant #2B all trickling filter effluent was discharged directly to the Rio Grande. During the dry summer of 1972 wastewater was also discharged to the Riverside Drain at the request of the Middle Rio Grande Conservancy District. The activated sludge units of Plant #2B were completed in early 1976, although minor aspects of the plant remain unfinished in early 1977. As of March 31, 1976, Plant #2B was put into full operation, and since that date the facility has been used to provide for additional treatment of trickling filter effluent, as well as to provide treatment of some raw sewage. Approximate flows as of April 1976 were:

Treated at Plant #1	18 mgd
Treated at Plant #2A	15 mgd
Total trickling filter effluent	33 mgd
Raw sewage to Plant #2B	3 mgd
Total wastewater flow, Plant #2B	36 mgd

The discharge to the Rio Grande of 36 million gallons per day equals about 40,350 acre-feet per year. Because of operational problems the flow pattern noted above is not typical of 1977 conditions (refer to the discussion of operation and maintenance on pages 23-24 for further details).

In 1977 construction will begin at Plant #2B to increase the treatment capacity to 47 mgd. The construction is known as "Phase IA" and represents completion of the plant as it was originally designed. Phase IA, which is scheduled for completion in late 1979 or early 1980, is considered as being already in existence for purposes of evaluations in the Facility Plan and EIS.

PAGE NOT

AVAILABLE

DIGITALLY

The sludge produced in the treatment process is digested, dried, ground and then used as fertilizer on City parks. Most of the sludge digester gas is burned on-site to power electric generators which supply some of the energy needs at the plants. Coarse solids such as grit are disposed of by landfill. An important support facility is the laboratory at Plant #2, which provides an extensive capability to monitor the performance of the treatment works.

The combined treatment and collection facilities cost about $1.5 million to operate in fiscal year 1976, an amount which is distributed rather evenly into five categories: Plant #1; Plant #2A; Plant #2B; collection lines; and the remainder for the lift and chlorination stations and the lab. Wages account for more than half the expenditure, and utility charges (mostly electricity) are responsible for nearly one-quarter of the costs. As with the collection system, staffing and budget at the treatment plants are not adequate for performance of needed preventative maintenance and repairs; system operation suffers as a result. Staffing at the lab is also inadequate to perform necessary duties.

Performance Problems at Plant #2. Prior to detailing operation and maintenance problems in the treatment system it is necessary to review the present performance characteristics of Plant #2. Funding limitations during the period when Plant #2B was planned and designed led to the facility being smaller and less complete than originally intended. In particular, thickener units for handling waste-activated sludge were postponed because of cost considerations, and have not yet been built. The lack of adequate sludge-handling facilities has led to critical operating conditions throughout Plant #2. The facility is now overloaded with dilute, highly organic solids which interfere with the treatment and digestion processes, give rise to severe odors, and lead to discharge of effluent of substandard quality. The plant does not and cannot function as intended without provision of the necessary thickening facilities, or an equivalent action.

CDM (1977, 1977a) described the sludge-handling problems in detail. They also identified a performance problem related to relative inefficiencies in the new aeration system at Plant #2B. An insufficient air supply has been observed in the aeration basins, due to causes which may include leaks in the air supply manifold, use of an inefficient diffusion system or insufficient blower capacity.

Operation and Maintenance Problems. The fundamental physical conditions which contribute to operation and maintenance problems in Albuquerque include the lack of adequate sludge-handling facilities at Plant #2B and the great age of most facilities at Plant #1. These problems preclude effective operation of the plants without extensive construction projects. However additional operational problems occur and in some cases make a significant contribution to the observed poor quality of effluent and the significant plant odors. Many of these operational difficulties are aggravated by the physical conditions noted above. The following list of operation and maintenance problems reflects discussions in CDM (1977a) and the results of the most recent annual inspection of the facilities by the New Mexico Environmental Improvement Agency (file record dated April 7, 1977). Except as noted the problems apply to both Plant #1 and Plant #2; in almost all cases they are more severe at Plant #1.

- Sludge digestors have not been cleaned, are in poor repair and suffer from inadequate mixing, temperature problems and (in the case of Plant #]) excess acidity.

- Preventative maintenance actions are not performed routinely, and housekeeping (cleanliness has had a low priority.

- Many facilities are in a state of disrepair, especially at Plant #1; gas recycling units are prominent in this respect.

- Many minor sources of odors are poorly controlled; for example screenings are often exposed, boxes and pits are uncovered, pumps valves and pipes lead to leakage or spraying of sewage or sludge.

- Record keeping, parts inventories, and reporting activities are not always adequate.

- Despite excellent laboratory facilities, and good data on effluent quality, data pertinent to process control and plant operation have not been adequately developed.

Directly causing many of these conditions is the historical lack of adequate budget and manpower resources. Staffing deficiencies also reflect difficulties in attracting and retaining good personnel; over 10% of the authorized positions are now vacant. In 1976 the City management of liquid waste facilities was reorganized. As noted in the next paragraph, since that reorganization many steps have been taken to overcome the performance and operational problems. However, CDM (1977a) notes that the organization of liquid waste management remains inefficient, especially at lower levels.

One consequence of the performance and operational problems is that EIA's 1977 inspection rating of Plant #1 was "conditionally acceptable", while Plant #2 was "unacceptable", and was characterized as "quite sick".

Recent Operational Changes. The fundamental performance deficiencies of Plant #2 led to severe odor problems in 1976 (and continuing); the City has responded by instituting a number of new procedures to improve plant operation. The two most important changes have been implemented on an emergency basis:

- to prevent the build-up of solids caused by the lack of adequate sludge-handling facilities liquid sludge is now hauled from the plant at a rate normally exceeding 50,000 gallons/day, and disposed of at a sanitary landfill;

- during critical operational periods when excess hydraulic and organic loadings have occured at Plant #2B, the trickling filter effluent from Plant #2A has been discharged directly to the Rio Grande, as it was prior to 1976.

A number of other emergency measures have been implemented or considered. For example temporary sludge drying beds have been added to provide additional sludge holding capacity, one secondary clarifier has been used unsuccessfully to try to thicken waste-activated sludge, and expensive polymer chemicals have been added on an experimental basis to improve sludge settling and drying. Some modifications to the operational processes within the plant have also been made, such as changing the rates at which different processes or actions take place; these are discussed in CDM (1977a).

These emergency measures have had a positive effect in stabilizing plant operation and preventing critical upsets. For example, EIA revisited Plant #2 on June 6, 1977, as a followup to the April annual inspection, and found performance much improved, although still characterized by substantial problems and deficiencies. Continued improvement has occured since that date, primarily due to the handling of liquid sludge which in effect substitutes for the missing thickener equipment.

On an emergency or high priority basis the City has begun to undertake measures of the type which would normally be considered routine. These include:

- embarking on a program to clean and repair digesters;
- increasing the number of staff positions;
- replacement of chlorinators;
- increased operator training;
- rehabilitation measures, especially at Plant #1.

These and other actions are described further in Exhibit Number 1 which was presented at the Public Hearing held on the Draft Environmental Statement; the hearing transcript and exhibit can be found in Appendix B of this document.

Emergency Construction. As originally defined, the already approved Phase IA expansion of Plant #2 did not include mechanical thickeners. Because such facilities are essential to the proper operation of the Plant, the City decided to contract for the design and construction of a dissolved air flotation thickening unit on a prepayment basis, that is using City funds without a grant commitment from EPA. The thickener units are expected to be completed by late spring, 1978.

2.1.3 Environmental Effects of the Treatment System

Albuquerque's wastewater treatment system impacts the environment through discharge of effluent, disposal of sludge, emission of offensive odors, emissions from sludge gas burning, consumption of energy and chemicals, noise, and production of non-recycled solid wastes. Data on the amount and character of these impacts are provided in EPA (1977), Part A-3.

Influent Character. The quality of raw sewage received by the treatment plants has a direct influence on the quality of discharge. Available data on influent quality are given in Table 2-2 and indicate that the sewage is not substantially different from that found in other non-industrialized U. S. cities. A number of sources have been identified which discharge substantial quantities of heavy metals to the sewerage system. These include industries or institutions concerned with:

- metal finishing and plating (nickel, chromium, cadmium, lead, mercury)
- manufacture of electronics equipment or jewelry (lead, boron, copper)
- laboratory research and medical care (copper, lead, mercury, molybdenum, silver).

These industries and institutions account for between 10% and 40% of the different metals found in the influent. Many of the sources discharge one or more metals in an amount which exceeds levels permitted by the City's Liquid Waste Ordinance. It is possible that a more detailed industrial survey would show additional industrial contributions, but it also appears that a substantial portion of the influent metals comes from residential and commercial neighborhoods. The leaching of plumbing fixtures and the discharge of cleaning

TABLE 2-2. CHARACTERISTICS OF INFLUENT AND EFFLUENT. All values in Mg/l unless otherwise indicated.

	Treatment Plant #1				Treatment Plant #2A				Treatment Plant #2B
	Influent	Effluent			Influent	Effluent			Effluent
	Average	Low	High	Average	Average	Low	High	Average	Average
BOD_5	218	35	148	86	194	23	140	62	17
COD	471	81	318	211	466	95	261	180	57
Settleable Solids	6.2	0	1.0	<0.05	7.0	<0 05	0.20	<0.12	<0.05
Suspended Solids	184	28	106	56	183	27	88	56	13.7
Fecal Coliforms/100 ml	-	<100	>50,000		-	<100	>50,000		-
pH (units)	7.5	7.0	7.8	7.4	7 45	7.15	7 9	7.6	7.75
Chlorine Residual	-	0	>2.0	<0.81	-	0	0.50	0.22	-
Nitrate (as No_3)	0.01	0	0.04	<0.01	<0 01	0	<0 01	<0.01	0.124
Ammonia-Nitrogen (as N)	17.9	11.0	28.0	19.9	20.0	19 8	31.0	24.0	17.3
Organic-Nitrogen (as N)	12.5	6.3	12.8	7.9	11.7	1.8	12.8	7.3	3.8
Total Kjeldahl Nitrogen	30.7	17.0	35.0	27.5	31.8	17.0	38.5	30.9	21.1
Ortho-Phosphorus (as P)	7.3	5.9	14.3	9.7	8.2	4.6	15 0	9.0	7.4
Total Phosphorus (as P)	11.9	6.7	17.4	11.6	11.2	7.5	14.6	10.8	8.3
Aluminum, Al	0.38	0.02	0.55	0.26	0 42	0 06	0.38	0.21	0.06
Antimony, Sb	*	<0.05	<0.25	*	*	<0 05	<0.25	*	*
Arsenic, As	*	<0.01	<0.03	*	*	<0.01	<0.03	*	<0.01
Barium, Ba	0.29	0.16	0.37	0.26	0.22	0 11	0.31	0.21	0.09
Beryllium, Be	*	<0.005	<0.01	*	*	<0.005	<0.01	*	<0.002
Boron, B	0.51	0.08	0.81	0.54	0.57	0 11	0.88	0.62	0.6
Cadmium, Cd	0.006	<0.001	0.17	0.005	0.004	<0 001	0.50	0.003	<0.002
Chromium, Cr	0 049	<0.01	0.09	0.03	0.07	<0 01	2.00	0.047	0.01
Cobalt, Co	*	<0.01	<0.02	*	*	<0.01	<0.02	*	<0.01
Copper, Cu	0.175	0 03	0 75	0.10	0.22	0 03	0.90	0.139	023
Iron, Fe	1.0	0.21	0 81	0.53	0.93	0.2	0.62	0.46	.126
Lead, Pb	0.096	<0.02	0.15	0.064	0.08	0.01	0.50	0.049	023
Manganese, Mn	0.057	0.02	0.12	0.045	0 05	0 02	0.11	0.043	.024
Mercury, Hg	0.003	<0.001	0.004	0.001	0.003	<0.001	0.005	0.001	<0.001
Molybdenum, Mo	*	<0.005	0.02	*	*	<0 005	0 02	*	<0.01
Nickel, Ni	0 043	<0.01	0.24	0.032	0.045	<0 01	0 19	0.036	.031
Silver, Ag	0.01	<0.001	0.10	0.01	0.009	<0 002	0.10	0.008	< .005
Selenium, Se	*	<0.001	0.05	*	*	<0 001	<0.005	*	<0.005
Silicon, Si	29	23	35	29	25	17	32	25	34
Tellurium, Te	*	<0.02	<0.1	*	*	<0 02	<0.1	*	*
Thallium, Tl	*	<0.015	<0.10	*	*	<0 015	<0.10	*	< .002
Vanadium, V	*	<0.05	<0.10	*	*	<0 05	<0.10	*	<0.05
Zinc, Zn	0.249	0.03	1.3	0.15	0.22	0 03	2.90	0.152	091
Dissolved Oxygen	0.32	0.15	3.72	1.46	1.90	0 30	4.80	2.40	-

* Nearly all values reported as "less than" the detection limit, so that a valid average cannot be calculated.

chemicals, cosmetics, medicines and other substances are presumed to be significant metals sources in these areas. Because of the relative importance of non-industrial metals sources the Facility Plan concluded that strict enforcement of the Liquid Waste Ordinance would have only a marginal effect on the discharge of metals from the treatment works.

It should be noted that past enforcement of the ordinance by the City has not been all encompassing. Data provided by the City indicate the following.

- At least 25 sources exist which have violated ordinance standards (although some violations are very minor).

- The City has corresponded with about half of the sources in order to move toward compliance.

- In many cases the problems have not been resolved, although a few complete successes are on record, and some sources have accomplished some (but not all) of the ordinance requirements.

The lack of enforcement appears to reflect the organizational and staffing problems noted in the discussion of operation and maintenance (2.1.2).

Effluent Character. Table 2-2 provides data on the quality of effluent discharged from the two trickling plants and the new activated facility. The trickling filter data represent normal conditions and show that the effluent is of fair to poor quality with regard to organic and solid contaminants and contains a large nutrient load. The effluent sometimes has contained levels of metals such as cadmium, chromium, copper, lead, mercury, nickel, and zinc, which were excessive when measured against standards set forth in the Stipulation (see Table 2-8). The effluent from Plant #1 is of poorer quality than that from #2A; neither facility achieves secondary treatment standards of 30 mg/l BOD and 30 mg/l suspended solids.

The data for Plant #2B represents relatively rare conditions of normal operation and proper performance which occured prior to the build-up of sludge to critical levels. These data show that the activated sludge process is capable of producing effluent of good to excellent quality, with contaminants reduced to below permitted levels. The data further indicate that the combined effect of activated sludge and trickling filter treatment can be to remove more than 90% of the influent organic and solid load, between 35% and 50% of the influent nitrogen and as much as 25% of the influent phosphorus. Substantial quantities of metals can be removed, sufficient to product effluent which meets all standards in the Stipulation.

Data for Plant #2B for periods of poor performance give quite different results which, presumably, reflect short-term conditions caused by inadequate facilities. The poor performance is reflected by an organic load slightly above, and a solids load well above, permitted levels; nitrogen and phosphorus contents are higher than indicated in the last column of Table 2-2. Because the chlorination contact tank is not operational, levels of coliform bacteria are also excessive. A compliance monitoring survey performed by the New Mexico Environmental Improvement Agency on May 3-5, 1977, also indicated that effluent quality did not meet Stipulation standards for several metals. The survey was performed during the period of worst performance of the plant, prior to initiation of the most effective emergency measures described previously. Even so the results of the survey conflict with data collected by the City Wastewater Laboratory. The

only metal which certainly occurs in excess amounts in the poor-quality activated sludge effluent is copper. For most other metals EIA data show higher levels than indicated by the City lab, and a conclusion regarding actual discharge amounts is difficult to reach.

It will be impossible to project the long-term impact of activated sludge treatment on effluent quality until Plant #2B is operating as designed. However, the data so far available suggest that the total mass discharge of pollutants by Albuquerque may be less in the near future than in the recent past, once Plant #2B is operating as intended. Moreover the improvement in effluent quality will at least partly offset projected increases in total wastewater flow. For example, in 1975 the discharge of 36 mgd of trickling filter effluent, containing 30 mg/l nitrogen, was responsible for the release of 1645 tons/year of nitrogen to the Rio Grande. If activated sludge is effective in achieving 50% removal of nitrogen, then the N-discharge in 1985 would only be 1165 tons/year, even though the effluent would have increased to 51 mgd.

Pilot studies predicted that activated sludge effluent would contain as much as 5 mg/l of nitrogen in the bioavailable nitrate form. In practice nitrate levels in the effluent averaged only about 0.1 mg/l, according to the data of Table 2-2. The high rate of nitrogen removal by the plant, and the absence of nitrate in the effluent, indicates that both nitrification and denitrification are occurring in the aeration basins of Plant #2B. It should be noted that data obtained by EIA during the compliance monitoring show much higher nitrate levels than indicated by Table 2-2. However some of the EIA data are not consistent internally, and they conflict with measurements made by the City laboratory. In any case, until Plant #2B achieves a sustained period of normal operation it will be difficult to confidently project the long-term reliability of N-removal processes, and the probable level of effluent nitrate.

Sludge Disposal. Sludge production from the two trickling filter plants has averaged more than 4400 tons/year in the recent past, and is expected to double as the result of adding activated sludge to the treatment process. In the past a substantial portion of the sludge has been ground and spread on City parks, where it has served as a fertilizer and soil conditioner. However, the increased rate of sludge production could exceed the demand for parks usage and require alternative means for sludge reuse or disposal.

Sludge contains a significant quantity of heavy metals. When the weight of metals in sludge is compared to that in effluent on an annual basis for the past years, the two sources are roughly equal in importance. Since data of Table 2-2 indicate that activated sludge treatment will lead to a decrease of metals levels in effluent, it is reasonable to expect that the removed metals will show up in sludge deposits. Thus it is likely that in the future it will be sludge, not effluent, which contains most of the mass of metals discharged to the environment from the treatment works.

Odors. Odor problems have received more adverse public comment than any other aspect of wastewater management in Albuquerque (see Section 2.2.4). The Stipulation set forth as the basic goal of odor control the use of "Best Practicable Control Technology". To date this goal has not been met. A number of chronic odor sources have been responsible for most of the past problems at both treatment plants. Some of the problems have been corrected through actions taken in response to the Stipulation, while others remain unabated. Figure 2-5 shows the location of odor sources in the wastewater system; Figure 2-6 shows the regional extent of odor problems.

In 1976 a severe new odor problem developed with the completion and initial operation of Plant #2B. This problem was caused by the operating difficulties noted previously. The emergency operating and construction measures described above have been implemented in large part to try to reduce the odor problems. They have been successful on a relative basis, though severe problems remain. The Phase IA expansion of Plant #2 is expected to provide some further odor control, primarily by increasing treatment capacity and by providing more solids-handling facilities. However odor control will not conform to the standard of Best Practicable Control Technology set by the Stipulation, and thus such control is to be evaluated by the Facility Plan and this EIS. Based on CDM (1977a) additional control measures should address the use of sludge drying beds at both plants, and the disrepair of treatment of units at Plant #1.

A further discussion of the proposed odor control actions is given in the Technical Reference Document (EPA, 1977, Section A-3, part g).

Other Effects. In addition to sludge, about 6 cubic yards per day of coarse solid waste are produced at the two plants, and disposed of by hauling to the County landfill. Noise levels within each plant can exceed 70 dBA near some equipment, with extremes of 90 dBA and above; noise within the new activated sludge lift station has been measured at above 115 dBA. Noise levels at the plant property lines are commonly 45 dBA or less but approach 60 dBA at some locations.

The annual production of sludge digester gas from all facilities exceeds 200 million cubic feet. Much of this is burned to generate electricity for use within the plants, and the rest is disposed of by burning a flare at Plant #2. Gas combustion may produce up to 100 tons of air pollutants per year, 75% of which consists of nitrogen oxides. About 25 million cubic feet of gas is purchased yearly to provide for heating of digesters. The electricity generated by gas combustion amounts to 7800 kilowatt hours per day, or more than 40% of the need. Purchases of electricity average 10,500 kwh/day, but at times Plant #1 produces an excess supply, and sells a small amount of power back to the electric company. Chlorine usage averages about 2750 pounds per day, divided about equally into thirds for use at Plant #1, Plant #2 and collection system chlorination stations.

2.1.4 Other Point Sources

Treatment Plant #2 is the only major point source of wastewater discharge in the Albuquerque area. Other sources are of four types: municipal, industrial, agricultural, and collected storm runoff. The municipal and industrial sources within and adjacent to the planning area discharge no more than 1 mgd of good quality effluent. Another 3 mgd of poorly treated municipal effluent is discharged from other towns in the Middle Rio Grande Basin - such as Bernalillo, Los Lunas, Belen and Socorro. Agricultural sources include at least 25 dairies and feedlots within the planning area. Limited information on these sources suggest they probably affect ground water more than surface water, and may be associated with organic and nutrient-rich wastewaters containing a high content of bacteria. Six points of storm runoff collection have been identified, but no data are available which permit these to be evaluated. Refer to Part A-4 of the Technical Reference Document (EPA, 1977) for more information.

2.1.5 On-Site Systems

Individual liquid waste disposal systems are the major non-point source of water pollution in the Albuquerque area and are discussed in detail in Part A-5 of the Technical Reference Document. As many as 20,000 such systems exist, about half in the South Valley, one-third in the North Valley, and the remainder in Corrales, the Sandia foothills, the Tijeras-Cedar Crest area, and on the lower West Mesa. The distribution of the systems tends to correlate positively with the existence of below-average income levels. About five million gallons per day of residential wastewater is discharged to the soil from the on-site units of the area, and another one mgd is discharged from larger systems which serve trailer parks, schools, business and industry. This total discharge of 6 mgd is one-sixth of the City's treatment plant discharge. Population and increased per capita water use (following extension of City water lines) would be expected to increase this wasteload in the future, but this growth should be balanced by already approved sewer construction into the near South Valley. Thus 6 mgd is a reasonable estimate of future on-site effluent discharge unless additional sewers are constructed.

Three reliable disposal methods are generally used for on-site systems, in addition to the extra-legal use of cesspools and seepage pits.

- Septic tanks (with one or two chambers) and buried drainfields are the dominant method of on-site disposal because of low initial costs. These units provide limited wastewater treatment when compared to a central plant, and are especially limited by conditions such as slow soil percolation, shallow bedrock or water table, or small lot size.
- Aerated tanks and drainfields are used in approximately 5% of all new installations in the planning area, primarily to overcome poor soil or drainage problems. Effluent quality is better than for septic systems, but the units are initially expensive, have a significant energy demand, and require better than average maintenance in order to function properly.
- Septic tanks with plastic-lined evapotranspiration fields are in limited use to date. These units discharge no effluent to the soil and so cause no water contamination; they are also relatively maintenance-free. Disadvantages include high cost, complete consumption of the wastewater resource, and possible risks of liner failure and/or flooding.

The installation of new on-site systems is subject to regulations which specify matters such as setbacks (e.g. a minimum distance of 100 feet between wells and drainfields) and lot sizes (larger lots for sites with impaired soil or drainage conditions). Despite these regulations, the majority of already constructed systems occur in valley locations adversely affected by a shallow water table; poor soil permeability and/or small lot sizes are also common. Many of the existing systems do not meet modern sanitation and lot size standards; the regulations do not affect such systems retroactively.

Even when properly designed, installed and maintained, common on-site systems such as septic tanks and drainfields can cause water pollution problems. The effluent from these units is normally rich in organic load, nutrients, metals and bacteria. Normally the effluent does not meet the secondary standards which are enforced at central treatment plants. Under ideal conditions most of the pollutant load is treated as the wastewater

passes through the soil. However, nitrate removal in the soil is limited, and ample evidence exists in the technical literature that nitrate contamination of ground water is common where septic tanks or cesspools are numerous. Section 2.4.4 discusses nitrate problems in the planning area, in relation to the possible contributions of on-site liquid waste disposal.

2.1.6 Other Non-Point Sources

The Middle Rio Grande Basin Plan (NMWQCC, 1976a) recognizes several non-point sources of water pollution in addition to on-site systems, including sediment, irrigation return flows, runoff from animal confinement facilities, and salinity sources such as salt-water intrusions. To this list should be added storm water runoff from urban streets, storm sewers and flood control ditches. There is little information on the effects of these sources on water quality in the Rio Grande; studies being undertaken pursuant to Section 208 of P.L. 92-500 are expected to clarify the significance of such sources. Until these studies have been concluded, it will be difficult to fully determine the benefits of point source controls, especially as "in New Mexico, non-point sources are responsible for a greater amount of water quality degradation than are point sources when sediment and salinity problems...are included in water quality assessments"(NMWQCC, 1975, p.8).

2.2 THE PHYSICAL ENVIRONMENT

2.2.1 Terrain

Albuquerque lies within a basin and mountain landscape which is typical of the desert Southwest. Each of the natural regions identified in Section 2.0.1 has a distinctive terrain, as described in Table 2-1. The following features occur:

- the Sandia and Manzano Mountains east of the City which form a rugged area with elevations locally above 10,000 feet;
- a broad flat-bottomed valley along the Rio Grande at an elevation of about 5,000 feet;
- broad upland surfaces on either side of the valley which generally slope toward the river; the eastern upland is a dissected alluvial fan while the west is marked by a large area of relatively young volcanoes and lava cliffs and by a relatively flat surface capped by stabilized sand dunes.

The City's landscape is a major asset, offering attractive diversity and a bold eastern skyline. In some areas steep slopes present a serious limitation to urbanization, especially in the mountain uplands and in parts of the volcanic unit, valley sides, and mountain lowland. Elsewhere the terrain is gentle and comparatively featureless--with a man-made landscape predominating. In the floodplain almost all the relief consists of man-made features such as levees, irrigation canals and drains, and streets.

2.2.2 Climate

Because Albuquerque is located in desert country, far from any oceanic source of moisture, its climate is arid and continental. The weather is usually dry and sunny, with an average temperature of about 57°F (14°C) and an average precipitation of less than 8 inches (20mm) per year. Cool winters with occasional snow are invariably followed by windy, dusty, dry springs. Early summer may be hot, but this is moderated by frequent thunderstorms from July through September, which supply most of the annual rainfall. Autumn is warm and pleasant, and is typical of a climate which is one of Albuquerque's outstanding assets, benefiting outdoor recreational and economic activities.

Detailed information on the Albuquerque climate is provided in EPA (1977), Section C-1, and includes weather data, information on the local water budget, and a narrative analysis of climatic variables. Factors which could have a direct bearing on wastewater management planning are listed below.

i) The overall aridity means that there is a high demand for water, especially for purposes such as agriculture, landscaping and recreation. In the absence of irrigation or watering, the natural vegetation tends to be sparse and the soil is very vulnerable to erosion.

ii) The erosion potential is made more severe by the high intensity of frequent summer rainstorms, and by the numerous windstorms in spring.

iii) Atmospheric temperature inversions caused by winter air masses and by cold air drainage into the valleys have a potentially serious effect on the dispersion of air pollutants.

iv) The frost-free season lasts about six months in the valleys and slightly longer on the mesas; valley locations may be adversely affected by the cold air drainage noted above. The climate tends to favor crops such as native hay, alfalfa, chile, corn and to a lesser extent, orchard fruits.

v) Solar radiation is abundantly available, and is used as an alternative energy source for many purposes.

Each of the natural regions recognized in Section 2.0.1 of this report has its own micro-climate. The mountains tend to be cooler and wetter than the rest of the area. The valley receives the least precipitation, and in effect is a desert oasis with water supplied by the Rio Grande. Variations in temperature and humidity are marked, and inversions are common. The mesas have the mildest climate overall, and receive the greatest influx of solar radiation. For further information, refer to Table 2-1.

2.2.3 Air Quality

Albuquerque experiences significant air pollution problems which have worsened in recent years due to population growth and an associated rise in vehicle traffic and emissions. Six pollutants have been the focus of regulatory efforts to date: total suspended particulates (TSP), photochemical

oxidants (O_x), carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x) and sulfur dioxide (SO_2). Table 2-3 lists the standards for these pollutants and summarizes data from monitoring stations in the area.

The Albuquerque Air Quality Control Region has been designated Priority I by the New Mexico Environmental Improvement Agency for reduction of TSP, O_x and CO because the air quality standards for these pollutants are frequently violated under present conditions. Studies indicate that motor vehicles are the major source of CO and O_x emissions in Albuquerque (TRW, 1973), and that natural erosion along with fugitive dust from unpaved roads are important particulate sources (Wilson, 1974). The area has been designated Priority III for HC, NO_x and SO_2, indicating that no violation of standards occurs at present. A discussion of the observed patterns in the pollutants is given below. Figure 2-6 illustrates the location of air pollution problems in the area.

Total Suspended Particulates. TSP readings averaged 80 ug/m^3 in 1969-1973 when data from all area stations were combined; this exceeded both the Federal and State standards. In a typical year about fifty 24-hour observations exceed the State standard; about 5 exceed the Federal standard. The highest readings are observed in spring time and are associated with natural duststorms. High readings also occur in winter, especially in the Valley area, and may reflect dust from unpaved roads. The trend in TSP data is stable; no increases over time have been observed. The strategy to control particulates includes paving of dirt roads and restrictions on open burning (ABC, 1975). However, due to the significance of natural sources, it may not be possible to consistently meet the standards, especially during periods when soil erosion is significant (Wilson, 1974).

Photochemical Oxidants. Natural background levels of ozone are high, generally about 0.05 ppm. Only rather minor contributions from sources such as vehicle exhaust are needed to cause standards to be violated, especially as abundant sunlight is available to drive photochemical reactions. Thus violations are common, especially in summer; readings greater than 0.1 ppm are frequently recorded. The highest concentrations have been observed at sites with a high traffic count but problems are observed throughout the area. The trend in O_x readings is markedly upward, as reflected by an increase in smog conditions in Albuquerque. The proposed control strategy involves improvements in vehicle exhaust controls, less reliance on automobiles for travel, and improved traffic flows. Other possible control actions include regular vehicle inspections and retrofit of pollution control devices.

Carbon Monoxide. CO pollution is probably Albuquerque's most significant air quality problem. A marked upward trend in CO readings has been observed in the 1970's, with the worst problems being observed in areas of high traffic density such as the Winrock-Coronado shopping center, where the 8-hour standard was violated nearly 100 times in 1975. Violations of this standard occurred 5-20 times at many other Northeast Heights and Downtown stations in 1975. The highest readings occur in winter, due primarily to the poor air circulation problems which exist during that season. The upward trend in CO data has lead

TABLE 2-3 AIR QUALITY IN THE ALBUQUERQUE AREA

AIR QUALITY STANDARDS. ug/m^3 = micrograms/cubic meter ppm = parts per million

Pollutant	National Primary Standards	New Mexico Standards
Total suspended particulates	75 ug/m^3 annual geometric mean 260 ug/m^3 max. 24-hr arith. mean	60 ug/m^3 annual geometric mean 150 ug/m^3 max 24-hr. arith mean
Photochemical oxidants (ozone)	0.080 ppm 1-hour average	0 060 ppm 1-hour average
Carbon monoxide	35.0 ppm 1-hour average 9 0 ppm 8-hour average	13 1 ppm 1-hour average 8.7 ppm 8-hour average
Hydrocarbons	0 24 ppm 3-hour average	0.19 ppm 3-hour average
Nitrogen oxides	0 05 ppm annual arith. mean	0.05 ppm annual arith. mean 0.10 ppm max. 24-hour average
Sulfur dioxide	0.03 ppm annual arith. mean 0 14 ppm max. 24-hr. average	0.02 ppm annual arith. mean 0 10 ppm max. 24-hour average

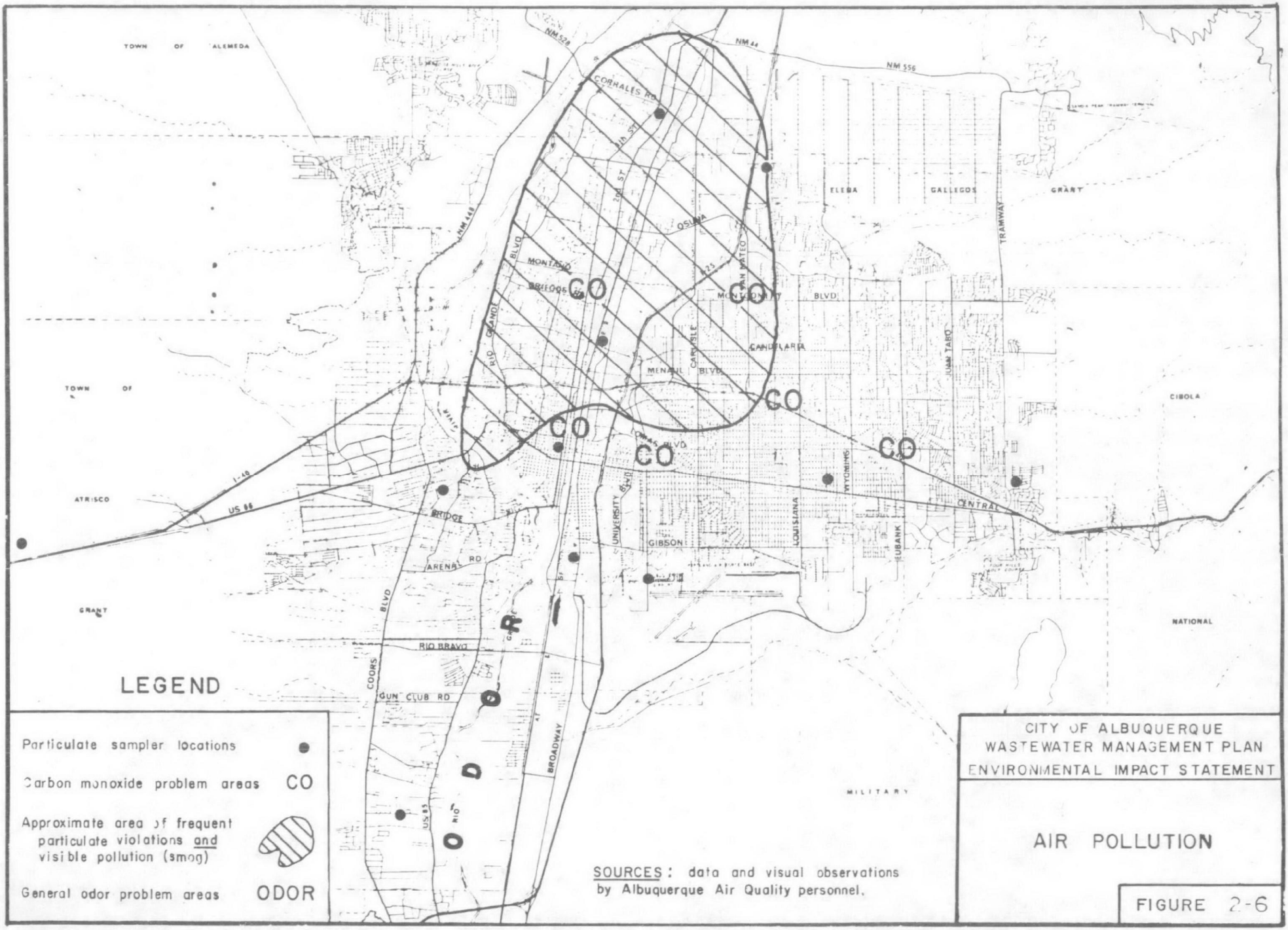
AIR QUALITY DATA, ALBUQUERQUE, NEW MEXICO

SITE	YR	POLLUTANT	HIGH[1]	SECOND[1] HIGH	MEAN[2]
320040002H01	75	TSP (24-hr)	250	230	*78
400 Marquette Ave. N W.	76	TSP (24-hr)	132	125	56
	75	CO (8-hr)	*23.2	*21.4	3 9
	76	CO (8-hr)		NOT AVAILABLE	
	75	CO (1-hr)	*40.0	*35.0	5.0
	76	CO (1-hr)	27.0	25.0	N/A
	75	SO_2 (24-hr)	0.001	0.001	
	76	SO_2 (24-hr)	0.011	0.011	
	76	NO_2 (24-hr)	0.055	0.023	
320040003H01	75	TSP (24-hr)	*333	209	*97
Candelaria Rd. & Edith N.E. (Water Tank)	76	TSP (24-hr)	*560	*379	*142
	75	SO_2 (24-hr)	0 001	0.001	N/A
	76	SO_2 (24-hr)	0.016	0.012	0.005
	76	NO_2 (24-hr)	0 044	0.037	0.018
320040004H01	75	TSP (24-hr)	*425	154	N/A
Chico Rd. & Dallas St. N.E (Fire Station)	76	TSP (24-hr)	197	169	*80
	76	NO_2 (24-hr)	0.029	0.024	
320040005H01	75	TSP (24-hr)	133	133	68
400 San Jose S.E. (City Water Tank)	76	TSP (24-hr)	215	207	74
320040007H01	75	TSP (24-hr)	172	125	49
(International Airport)	76	TSP (24-hr)	188	142	67
320040008H02	75	TSP (24-hr)	194	176	*86
5501 Pino N.E. (City Yards)	76	TSP (24-hr)	198	196	*103
	75	Ozone	*0 087	*0.080	
	76	Ozone	*0.115	*0.110	
320040009H01	75	TSP (24-hr)	*434	219	*124
	75	CO (8-hr)	*30.0	*27 0	10 0
	75	CO (1-hr)	*45.0	*45 0	11.0
	76	CO (1-hr)	*52 0	*44.0	
320040006H01	75	TSP (24-hr)	254	198	40
N of Encantado Rd N.E. and Monte Alto (Water Tank)	76	TSP (24-hr)	90	89	45
320040015H02	75	CO (8-hr)	*25 3	*19.4	4 9
Montgomery & San Mateo N.E. (Volandis #4 Water Pump Station)	75	CO (1-hr)	33.0	28.0	
	76	CO (1-hr)	12	10	
320040016H01	75	CO (8-hr)	*21.2	*19 5	8.1
University & Central Ave. (UNM, Hodgin Hall)	75	CO (1-hr)	33 0	26.0	9.0
	76	CO (1-hr)	21.0	19.0	
320040017H01	76	Ozone	*0.105	*0.100	
Montgomery & Juan Tabo (Ponderosa Pump Station)					
320040018H01	76	CO (1-hr)	34.0	32.0	
1700 Pennsylvania N.E. (Inez Elem. Sch.)					
320040001P01(H01)	75	TSP (24-hr)	85	70	N/A
Broadway & Grand N E. (HASH Site)	76	TSP (24-hr)	231	220	*111
	75	NO_2 (24-hr)	0.027	0.026	
	76	NO_2 (24-hr)	0.072	0.047	
	75	SO_2 (24-hr)	0.002	0 001	
	76	SO_2 (24-hr)	0.014	0.011	
320140001H01	75	TSP (24-hr)	*434	*423	
701 Atrisco Dr & Eucaris (Water Tank)	76	TSP (24-hr)	228	209	*97
320140002H01	75	TSP (24-hr)	*375	255	*98
Raynac & August S.W. (Polk Jr High Sch.)	76	TSP (24-hr)	*463	*267	*96
	75	SO_2 (24-hr)	0 001	0 001	
320140011H01	75	TSP (24-hr)	222	220	*96
St. Francis & 4th St N W (Alemeda Cnty Fire House)	76	TSP (24-hr)	*273	244	*114
320140031H03	75	TSP (24-hr)	*443	122	
(West Mesa Radar Station)	76	TSP (24-hr)	238	236	37

NOTES:

1. All units are ppm, except for TSP values which are given in micrograms per cubic meter (ug/m^3)
2. Mean indicates Annual Geometric Mean for TSP
   Annual Arithmetic Mean for SO_2 and NO_2
   90th percentile for CO

* indicates that value exceeds National Primary Standard


TOWN OF ALEMEDA
NM 528
NM 44
NM 556
CORRALES RD
ELENA GALLEGOS
GRANT
TRAMWAY
OSUNA
MONTAÑO BLVD
MONTGOMERY BLVD
CANDELARIA
MENAUL BLVD
CARLISLE
RIO GRANDE BLVD
JUAN TABO
CIBOLA
TOWN OF ATRISCO
I-40
US 66
BRIDGE
ARENAL RD
GIBSON
UNIVERSITY BLVD
LOUISIANA
WYOMING
EUBANK
CENTRAL
GRANT
RIO BRAVO
COORS BLVD
GUN CLUB RD
BROADWAY
US 85
NATIONAL
MILITARY
CO
ODOR
LEGEND
Particulate sampler locations
Carbon monoxide problem areas CO
Approximate area of frequent particulate violations and visible pollution (smog)
General odor problem areas ODOR
SOURCES: data and visual observations by Albuquerque Air Quality personnel.
CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT
AIR POLLUTION
FIGURE 2-6

to an increased frequency of pollution alerts in recent years; more violations of standards occurred in 1975 than in the previous two years combined. The control strategy for CO is similar to that for O_x. In extreme cases, streets in congested areas will be closed. One obstacle to CO control is the inherent operational inefficiency of internal combustion engines at high altitude.

Hydrocarbons. Limited data regarding hydrocarbon levels do not indicate that any problems occur in the Albuquerque area, although an upward trend in HC is evident. A major program to control HC emissions has been implemented by requiring vapor recovery systems at gas stations and gasoline tank farms.

Nitrogen Oxides. Nitrogen oxides in the Albuquerque area seldom exceed 0.05 ppm. The maximum values are normally recorded in winter, near traffic centers and power plants, both of which are significant NO_x sources. An upward trend in concentrations has been observed, indicating that potential problems may occur in the future. It is expected that the vehicle control strategies being implemented to reduce O_x and CO pollution will also affect NO_x readings. Further reductions should occur as local power plants shift away from use of natural gas.

Sulfur Dioxide. This pollutant is observed in trace amounts in the area, normally about 0.001 ppm. The recent decision to permit coal-burning at the Ideal Cement Plant in Tijeras Canyon could cause standards to be exceeded in that area.

Air pollution problems in Albuquerque are aggravated by adverse natural conditions including:

- air drainage patterns which tend to concentrate pollutants into the Valley area;
- frequent low-level temperature inversions which tend to trap pollutants near the ground, especially in winter, leading to a build-up of contaminants to hazardous levels;
- infrequent precipitation capable of cleansing the atmosphere.

Partly offsetting these conditions is the high frequency of winds which are capable of dispersing pollutants.

The most serious pollution episodes occur in winter, when a dome of brownish-yellow smog often hangs over the Valley during the cool-season months. The smog is held at a low level by temperature inversions, which are intensified by the night time air drainage when cool air flows into low spots. As the thin air has little capacity to absorb pollutants, hazardous levels are quickly reached and relief must await windy conditions. All analyses of this problem forecast continued pollution which at best will be slowly abated by control programs.

2.2.4 Odors

Odors are a special air quality problem which represent one of the most serious environmental concerns in the planning area. The bulk of public input to the wastewater facility plan has dealt with the need for truly effective odor control, especially at Plant No. 2. The controversial nature of debate on this issue makes it of special importance in the evaluation of treatment alternatives.

Within the planning area some odor problems are localized, others are widespread. Sources of odors include: open burning, food processing, paint and other industries, roofing and paving, horse pens and corrals, truck terminals and sewage. Sewage odors are both local and regional in extent. Local odor problems may reflect: flat collection lines, unsatisfactory conditions at a lift station, sludge applications to City parks, seepage from cesspools and septic tank drainfields.

Regional odor problems are concentrated along the valley - especially the South Valley - and result from two major sources: wastewater treatment plants and animal confinement/meat processing facilities. Although some observers can distinguish between the two sources, the odors are somewhat similar and often occur together. Thus, it is difficult to evaluate the separate significance of the two sources. However, it is certain that treatment plant odors have had a significant long-term impact on immediate neighborhoods and areas downwind, and that on occasions when the treatment process has turned septic, odor pollution has become a gross problem with widespread public impact (See Figure 2-6).

Information on the nature of odor sources at the treatment plants was presented in 2.1.3 and in Part A-4 of the Technical Reference Document. The most severe problems have occurred at Plant #2. In 1964 fourteen South Valley residents brought suit against the City to obtain compensation for odor damages from Plant #2. In 1966, it was ruled that compensation was proper, and the "odor rights" of the individuals were purchased by the City. In 1973 odor was a major cause for the lawsuit and stipulation discussed in 1.2. In 1976, the plant suffered a severe odorous upset, resulting in a petition of protest signed by more than 120 persons.

Testimony at public hearings conducted during preparation of the Facility Plan indicate the scope of the odor problem. Impacts attributed to odors include: interference with sleep; upsetting of appetites; restraint of outdoor activity, especially for children and the elderly; interference with summer cooling by use of air conditioners or open-window ventilation; decreased property values; and, by implication, mental depression.

Discussions with City personnel and members of a special odor committee indicate that the most serious problems occur from May to August, especially in June and July. Winds vary during this period, exposing persons in all quadrants to the odors. The Mountainview community is especially impacted because of the year-round occurrence of winds from the north-northwest. However, impacts over an area of many square miles have been reported. The odors tend to be worse, or reportedly most noticed, in the evening.

At the public meetings considerable dissatisfaction has surfaced regarding the rate at which odor control is being accomplished by the City. While this attitude partly reflects nearly 15 years of problems at Plant #2, it is more particularly a response to the fact that legal action in 1973, which required the City to use Best Practicable Odor Control Technology to achieve reasonably odor-free operations, has not actually led to an improvement in the quality of life for those who reside near the Plant.

As indicated in 2.1.3, the City has taken or will begin a number of measures to reduce odor problems from Plant #2. These steps, which will take place independent of actions set forth in the Facility Plan, are expected to reduce critical odor problems in 1977 and to eliminate them by 1978. Relatively odor-free operation is expected by about 1980. However, complete implementation of Best Practicable Odor Control Technology, and an operation which is free from odors except under extremely unusual conditions, remains an objective to be accomplished by the Facility Plan.

Plant #1 appears to cause fewer odor problems than #2, perhaps because much of the surrounding land is in industrial/commercial use. However, the Plant is certainly a significant odor source and causes frequent discomfort among those who work or live in the area. These odors were a factor in the decision to redevelop part of the residential South Barelas neighborhood into an industrial park. Some odor control measures at Plant #1 have been proposed by the City (see Part A-3 of EPA, 1977). Elimination of significant odors is an objective to be accomplished by the alternatives evaluated in Facility Plan.

One special problem related to odors is that no standards exist concerning odor polution, and citizen recourse is limited. However, under the terms of the Stipulation a committee will be formed to determine if the City is properly in compliance with wastewater-related odor control requirements. This committee, which will gain authority upon completion of the Phase I construction at Plant #2, can determine if violations occur from the Plants. The City is obligated to investigate and remedy odor problems which occur. When odors at the treatment plants are controlled, problems would still occur in the South Valley due to the feedlots, stockyards and packing/rendering plants of the area. Many of the animal-confinement and processing facilities occur in immediate proximity to populated areas and have occasioned frequent citizen complaints.

To summarize, the treatment plants have been and remain major sources of odor, particularly during the hot summer months. With construction and implementation of proper facilities, the City proposes that the odor will be greatly reduced. However, even should the treatment plants become 100% odor-free, the South Valley would not be totally relieved of nuisance odors due to the existence of animal confinement/meat processing operations in that area.

2.2.5 Noise

As indicated in technical references (EPA, 1971; EPA, 1974) average noise levels in typical urban settings should not exceed 50-55 dBA in order to minimize psychological stress and interference with speech and sleep; noise levels below 50 dBA are especially desirable at night. Noise above 80-90 dBA can lead to hearing and other health problems if experienced over prolonged periods. There are no data which permit a comprehensive evaluation of noise problems in the Albuquerque area, but information which is available indicates that ranges reported as typical of most communities (EPA, 1971a) are also typical of Albuquerque.

residential areas	- 40-60 dBA daytime; 30-50 dBA night
commercial areas	- 5-15 dBA higher than residential
near highways	- 60-80 dBA; peak to 90 dBA or above
near airports	- 90 dBA or higher peaks in flight paths.

Based on EHD records, complaints regarding community noise problems focus on localized sources: loud music, motorcycles, specific commercial/industrial locations.

Noise levels within the two treatment plants generally do not exceed 45 dBA at property lines except near generator and lift station facilities, where they may approach 60 dBA. Table 2-4 provides noise data for the neighborhoods near the plants. The data indicate that there is an increase in noise because of the treatment facilities, and that this increase may be as much as 7 dBA above the nighttime background noise level. Peaks above 50 dBA have been recorded near Plant #1 and also near Plant #2 prior to recent construction of a noise barrier. Technically the plants are not violating the City noise ordinance; however, as noted by a memo in the City files, the situation is approaching the borderline of violating the ordinance (Caraveo, 1976). Although the noise barrier at #2 has reduced the impact on surrounding residences, complaints regarding noise from the facility have been voiced during the public hearing process.

Noise levels near one typical lift station are also presented in Table 2-4. These indicate that a lift station may violate the City ordinance. No data are available which would indicate that actual problems exist in the City; no complaints about lift station noise are on file with the City.

A particular noise problem associated with wastewater facilities is that of construction equipment. Levels of 85-90 dBA are commonly experienced during excavation and other stages of sewer construction (EPA, 1971). The impact of the noise is reduced substantially away from the source, decreasing 6 dBA for each doubling of distance. Where hilly terrain or extensive vegetation exists, a greater decrease with distance is observed. Thus, the major impact of construction is within several hundred feet of the source. The principal concern regarding this noise is its effect on those who are asleep or ill; thus, the most severe problems occur at night or near hospitals.

Actual measurements of sewer construction noise in Albuquerque, made as part of this EIS, indicate that typical levels are less than those indicated above. In general activities such as trenching, scraping and filling produce noise levels of only 65-75 dBA, measured at a distance of 50 feet from the

TABLE 2-4. NOISE LEVELS OBSERVED IN NEIGHBORHOOD OF WASTEWATER FACILITIES, ALBUQUERQUE, N M dBA = decibels (A-scale) Except as noted, all data were obtained by Lee Wilson & Associates, Inc

Survey information	Ambient levels (background noise)	Levels near facility
Treatment Plant 1 August 26, 1976 11 00-11 30 p m	45-48 dBA (recorded near Barelas Bridge, traffic noise)	52-55 dBA (recorded in S Barelas along Kathrin, motor noises/pumps)
Treatment Plant 2 August 26, 1976 11 30-midnight	40-42 dBA (several locations, crickets)	46-50 dBA* (highest near Barr Canal & Prospertt, motor rumbling; pump whine)
Lift Station (Four Hills) April 16, 1976 10 00 a m	35-40 dBA (children playing)	50 dBA (pump)
Subdivision sewer laying City View Acres August 26, 1976 10 30 a m.	36-40 dBA (traffic noise)	54-77 dBA (backhoe, construction shovel, concrete truck, small plow)
Septic tank installation 8905 Rio Grande N W August 23, 1976 1-4 p m	35-40 dBA (traffic noise, children playing)	49-78 dBA (backhoe, dumping gravel, installation vehicle)

* Data obtained by City EHD January 27, 1976, indicate value as high as 54 dBA were measured reflecting screw pump noise, this was prior to construction of a noise barrier berm near the pump house; data reported above post-date barrier construction

construction equipment; peaks to 80 dBA can be expected. Many of the observed noises are extremely annoying - grinding, squeaking or hissing in character. Noise measurements made during the installation of a septic tank system indicate similar levels occur, though obviously on a more localized scale. The measured levels were mostly between 62-70 dBA with peaks to 78 dBA.

2.2.6 Geology

Most of the planning area lies within the Rio Grande Depression, a series of structural basins which have a north-south alignment and which lie between uplifted fault blocks on either side. Figure 2-7 is a three-dimensional diagram showing the major geologic features of the area. Descriptions of the stratigraphy and structures associated with each of the natural regions previously identified are provided in Table 2-1. A geologic map and stratigraphic column for the Albuquerque area are presented in Part C-3 of the Technical Reference Document.

Two major types of rock are found near Albuquerque. Relatively hard rocks (Precambrian, Paleozoic, and Mesozoic crystalline and sedimentary units) are found to the east in the Sandia-Manzano Mountains and to the west in the Rio Puerco region. These occur within upfaulted blocks which began to develop more than 20 million years ago, and reflect a long and varied geologic history extending back hundreds of millions of years (see Kelley, 1974). Between the blocks lies a basin filled with debris which has been eroded from higher areas to the east, north and west. This basin fill is a one to two mile thick sequence of sand, gravel, silt and clay and is locally interbedded with lava and other volcanic rocks; the Mesozoic and older rocks underlie the fill at depth. This fill is known to geologists as the Santa Fe Group, and is extremely variable in composition from place to place.

Overlying the Santa Fe Group in most locations is a thin cover of younger sediments, including: valley alluvium up to 100-200 feet thick along the Rio Grande; terrace material along the valley sides; alluvial fan sands and gravels along the mountain front; sand dune deposits on the west mesa; and thin valley alluvium in Tijeras Canyon and its tributary arroyos. For many practical purposes, these sediments can be grouped with the Santa Fe

2.2.7 Geologic Resources

An extensive discussion of mineral resources in the planning area is given in Elston (1967) and is summarized for each natural unit in Table 2-1; that table also includes more recent information regarding energy resources, (e.g. from Foster and Grant, 1974). The geologic map in EPA (1977) indicates the location of major mineral deposits.

Sand and gravels used for construction materials represent the most important local resource; they are obtained from pits in terrace deposits near the Rio Grande, and from scattered deposits elsewhere. Limestones and shales in the mountains are valued for cement-making purposes, and support the largest single mineral processing operation in the area, the Ideal Cement Plant near Tijeras. Minor deposits of gypsum, brick-clay, volanic scoria, and building stone have been identified, and small metal deposits (lead,

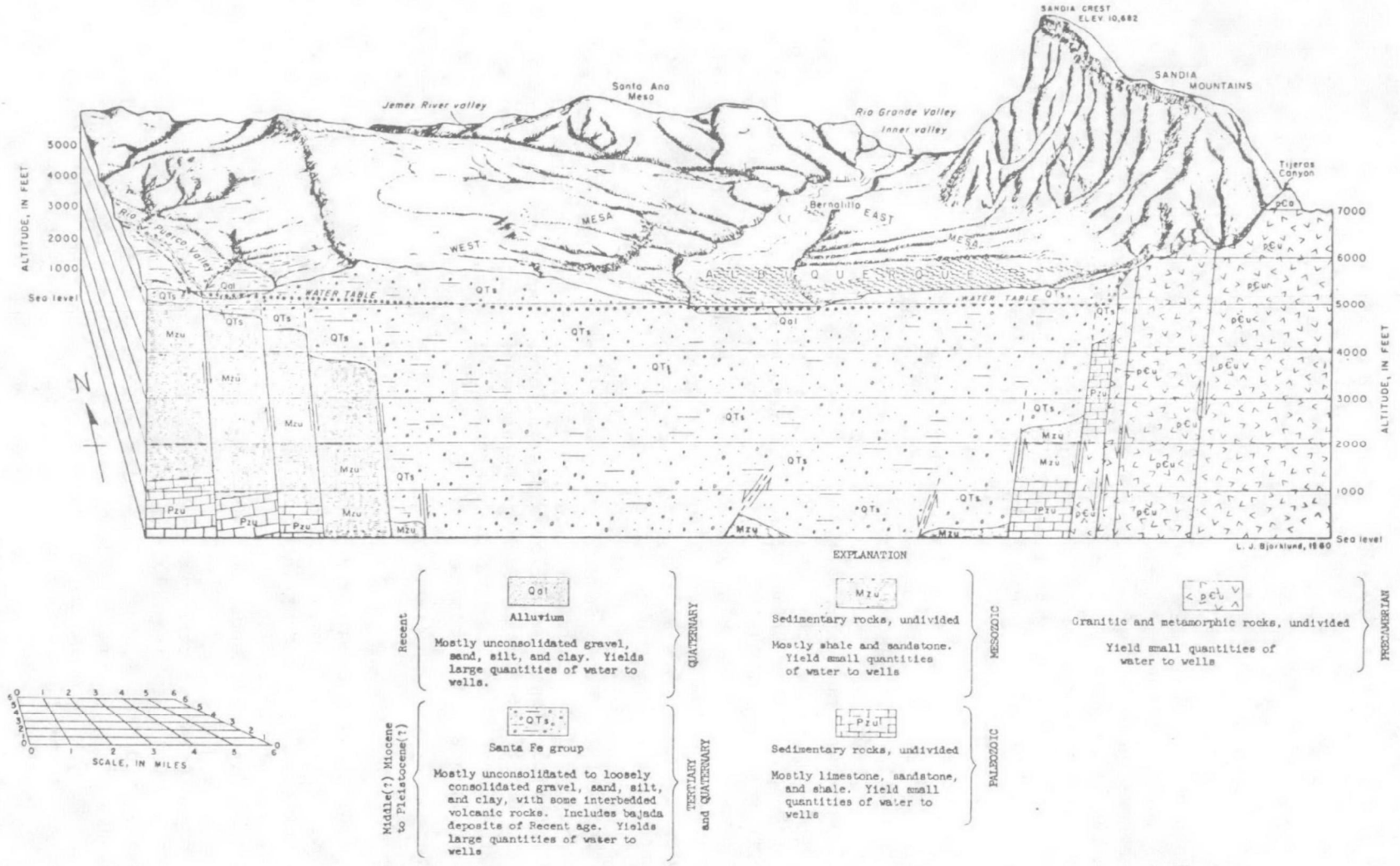


FIGURE 2-7. BLOCK DIAGRAM OF ALBUQUERQUE AREA (from Bjorklund and Maxwell, 1961). The diagram clearly shows the structural trough along the Rio Grande, filled with sediments of the Santa Fe Group, and bordered by upfaulted older rocks on either side. This trough extends at least 450 miles from southern Colorado to the El Paso, Texas area and averages 25-30 miles wide; it is thus a major crustal feature of the western U.S. Total structural displacement near Albuquerque is at least four vertical miles. Diagram does not show the limestone cap of the Sandia Mountains (although it is suggested by the drawing), nor the complex folded and faulted sequence of Paleozoic and Mesozoic sandstones and shales near Tijeras.

silver, gold and copper) have been mined near Tijeras; none of these are considered to have a significant potential for future development, given deposit quality and/or present economic conditions.

There is growing interest in energy resources near Albuquerque. Coal reserves of bituminous and sub-bituminous rank are found near Tijeras and in the far northwestern part of the area. Oil and gas exploration is presently occurring in scattered locations north, west and south of the area, and the region is not far from zones of uranium and geothermal resources.

Collecting sites for mineral and fossil prospectors occur in the area (see for example, Northrop, 1961); however, no individual sites of more than routine interest have been identified in this study.

2.2.8 Geologic Hazards

Small earthquakes are not uncommon in the Albuquerque area; they occur up and down the Rio Grande Valley, and especially south toward Socorro. Sanford and others (1974) have provided the most detailed analysis of seismic risk in the area, based on historical quakes, instrument recordings and analysis of relatively young faults. They conservatively estimate that the largest shock which would be expected to occur in the area during a 100-year period would be about 5 to 6 on the Modified Mercalli Scale. Such a seismic event would be widely felt, but cause slight damage. More recently Algermissen and Perkins (1976) have estimated that the maximum level of shaking of solid ground which would occur during a 50-year period would be 8% of the force of gravity; this is a small value compared to more active areas such as Southern California or even Socorro.

The Albuquerque area is marked by many volcanic eruption centers; one of the world's largest explosion craters occurs to the north in the Jemez Mountains. However, most of the major volcanic activity in the area occurred more than one million years ago; the nearby Albuquerque volcanoes were formed about 190,000 years ago. Eruption hazards are thus remote.

Because the underlying geologic material of the Albuquerque area is normally coarse sediment or fairly massive hard rock, mass movements such as landslides are comparatively minor in the area, especially in settled sectors. However, flash flooding is common and can produce considerable erosion as well as mudflows, especially when originating in the canyons draining the Sandia Mountains. Further information on flood hazards is presented in Section 2.3.3. Erosion is probably one of the more prevalent problems near Albuquerque. The Valley Sides natural unit and dissected portions of the Alluvial Fan are major sediment sources, contributing in excess of 1 acre-foot of material each year per square mile of area (SCS, 1973). Elsewhere erosion rates are low because of hard bedrock (Mountains, Volcanoes), coarse sediments (Alluvial Fan unit), or gentle slopes (Flood Plain and Sand Plains).

Subsidence because of water table lowering is probably not a major hazard because; a) the rate of regional water table lowering is small; b) the sediments being dewatered are coarse and unlikely to undergo major compaction or settling (see Beckel, 1970).

2.2.9 Soils

Three references provide extensive information on the soils of the Albuquerque area:

a) A map of general soil associations for Bernalillo County has been prepared by the Soil Conservation Service (SCS, 1973) and shows that the distribution of major soil units is very similar to the distribution of the natural regions mapped in Figure 2-3.

b) Maps of detailed soil units related to the associations are presently being prepared by SCS; while the maps are not yet available, specific descriptions of all the soil units are available in an unpublished manuscript (SCS, undated).

c) Prior to this most recent mapping effort, which is part of a Statewide program to provide uniform detailed soils data, SCS and the Middle Rio Grande Council of Governments (MRGCOG) had gathered, mapped and interpreted soils data for the Albuquerque area, with particular reference to the effects of soils characteristics on land use planning (MRGCOG, 1974).

The appropriate soil association identifications have been included on the natural regions map (Figure 2-3), which thus also serves as the soils map for this EIS. The more detailed MRGCOG maps have been utilized where site-specific soils information was needed for the purposes of wastewater management planning, but have not been reproduced in this Statement. The essential data on soil characteristics - physical properties, limitations, and potential uses - have been compliled in Table 2-5 and are summarized as part of Table 2-1.

Generally the soils of the planning area can be classified into three groups.

a) Rocky, comparatively shallow soils occur in the mountains and on the volcanic basalt flows. These are generally formed in place from weathered bedrock; forest litter is important in the mountains, where the soils are often dark and loamy.

b) Coarse soils occur on the mesas and valley sides and are developed on sands and gravels eroded from nearby highlands. These soils are commonly deep and well-drained.

c) Highly variable soils occur in the valley flood plain; these include fine clays, loams, silts and sands developed on deposits laid down by the Rio Grande. Frequently the surface soil is underlain by a deep sand horizon; the water table commonly is within 5-10 feet of the ground surface.

Soil interpretations regarding urban and agricultural land uses are useful inputs to wastewater management planning. The soils of the Alluvial Fan natural unit are the best suited for urban development in the area; appropriately, newer Albuquerque is built on these soils. In contrast, the rocky soils of the mountain upland and volcanic units can be developed only at great cost, if

TABLE 2-5 SOILS OF THE NATURAL UNITS, ALBUQUERQUE, N M
(Source SCS 1973, MRGCOG, 1974, SCS undated)

General soil description	Engineering characteristics	Limitations[4] for septic tanks and drainfields, low building foundations, and underground utilities	Potential use
Mountain uplands unit			
Kolab-Rock Outcrop association well drained stony to very stony dark clay loams, or rock outcrops Parent material is often limestone but may be sandstone, granite, gneiss, or schist Soils form on moderately steep to very steep slopes from 25% to 80% Soil depths are up to 60 inches, but rock outcrop accounts for 30% of association	Unified[1] CL (CH below 13 inches) Surface permeability[2] slow AWHC[3] 1-6 inches Problems slope creates severe difficulties for any engineering activities	Septic tanks severe, due to depth to bedrock and slow percolation rate Foundations severe due to slope, small stones Utilities moderate to severe due to shrink swell potential, corrosivity of uncoated steel and slope	Recreation excellent for climbing, nature study, etc , but otherwise limited by slope Agriculture none Other timberland, watershed, wildlife habitat
Mountain lowlands unit			
Seis-Orthids soil association well drained cobbly or stony loams over clayey subsoils level areas are often underlain by limestone, and canyon and mountain sides by metamorphosed material or limestone, sandstone Form on nearly level to steep slopes from 0% to 80% Soil depth is about 30 inches, with some rock outcroppings	Unified CH (CL-ML or ML below 7 inches) Surface permeability moderate AWHC 1-6 inches Problems slope and depth to bedrock limit nearly all engineering activities, often highly corrosive	Septic tanks severe, due to depth to bedrock and slope Foundations severe, due to depth to bedrock and slope, moderate where slopes <15% Utilities moderate to severe due to slope and high corrosivity of uncoated steel	Recreation generally unsuitable due to slope, bare rock, but only moderate limitations in level areas for camps, picnic grounds, trails, and paths Agriculture extremely limited, levelest areas may be suitable for gardening, raising trees Other wildlife habitat, watershed, range, limestone quarrys
Mesa volcanic unit			
Alemeda-Akela association moderately deep to very shallow gravelly, well drained sandy loam and cobbly soils on gently sloping to very steep basalt flows, slopes from 1% to 15% Exposed basalt accounts for 17% of this association, also are inclusions of dune sand and non-volcanic subsurface	Unified SM, SC, SC-SM, GM Surface permeability moderate AWHC 1 to 1 5 inches Problems severe limitations[4] for most engineering uses due to depth to berrock, basalt cobble and stone, or steepness of slope	Septic tanks severe, due to depth to bedrock Foundations severe, where bedrock near surface Utilities severe where bedrock near surface, otherwise moderate	Recreation few limits to any type of recreation, except in areas of small stones and exposed or very shallow basalt Agriculture practically no potential due to slope, shallowness, stones and low AWHC Other watershed, wildlife habitat, range, community development, source of basalt and cinder
Mesa alluvial fans unit			
Tijeras-Embudo association well drained, gravelly sandy loam formed from decomposed granitic alluvium on very deep, old alluvial fans, some clay in subsoil Slopes are from 0 to 9%	Unified SM, MC-CL, (CL below 19 inches) Surface permeability moderate AWHC 5 0 to 6 5 inches Problems severe limitations to sewage lagoons and sanitary landfills due to rapid percolation rate, moderate shrink swell potential in Tijeras series Otherwise few engineering problems	Septic tanks slight Foundations slight to moderate due to shrink swell and consolidation upon loading Utilities slight to moderate due to shrink swell	Recreation suitable for most uses except where slope >6% moderate potential for dust Agriculture generally unsuitable for intensive use due to rapid percolation rate and low organic content Other lessening potential for range, watershed, and wildlife habitat due to extensive community development

See next page for footnotes

TABLE 2-5 (Continued)

General soil description	Engineering characteristics	Limitations[4] for septic tanks and drainfields, low building foundations, and underground utilities	Potential use
Mesa: sand plains unit Madurez-Wink association. well drained fine sandy loam over sandy clay loam subsoil, formed on gently sloping, slightly convex mesas, from old unconsolidated alluvial material. Material may be modified by wind; some dune sand; weakly cemented caliche at 3 to 5 feet in places. Slopes are 1% to 7%	Unified[1]: SC-SM, SC, CL, SM, SM below 2 to 3 feet Surface permeability[2]: moderate to rapid AWHC[3] 6 to 9 inches Problems: moderate shrink swell potential and cave-in of cutbanks, high potential for corrosion of untreated steel. Moderate limitations[4] to sewage lagoons and sanitary landfills where percolation rate is rapid.	Septic tanks: slight Foundations slight to moderate shrink swell Utilities moderate to high due to cutbank cave-ins, shrink swell, and corrosivity	Recreation good except in areas of excess sand or slope Agriculture best in sandy loam areas but generally unsuitable for intensive agriculture due to rapid permeability and low organic content Other. range, watershed, wildlife habitat, community development; has been used for cut and fill operations and is fair material for road fill
Valley sides and terraces unit Bluepoint-Kokan association: somewhat excessively to excessively drained loamy sandy (Bluepoint) and gravelly sandy (Kokan) soils on dissected terraces, formed from materials of the Santa Fe formation. Slopes are from 1% to 45%, with Kokan soils on the steepest slopes. Madurez-Wink association: as described under sand plains unit, these soils are formed on the more level, less dissected terraces.	Unified SP-SM, SM (Bluepoint GP, GP-GM, GM (Kokan) Surface Permeability rapid to very rapid AWHC: 2.0 to 5.5 inches Problems severe water erosion and sedimentation problems; severe limitations to sewage lagoons due to rapid perc rate, sloughing and corrosivity (Kokan) potential high Otherwise moderate to slight limitations where slope is <15%	Septic tanks slight where slopes <8%, severe if slopes greater than 15% Foundations. same Utilities: severe due to cutbank cave-ins, small stones, corrosivity of Kokan soils	Recreation fair to poor potential due to slope, dust and sand Agriculture poor due to sand, small stones, slope, limited topsoil Other: range, wildlife habitat, where not used for community development. Also used for cut and fill and for a source of sand and gravel; some Indian artifacts
lley: floodplain unit ola-Vinton Brazito association: well drained but shallow loams, clay loams, and sandy loams over a very deep substratum of fine to coarse sand Slopes from 0 to 3%. Soils formed from alluvial materials deposited by the Rio Grande	Unified: SM, ML, CL-ML, CL at surface; SM, SP-SM, SP for subsurface sands Surface permeability: moderate to rapid AWHC: 1.5 to 8.5 inches Problems: shallow to very shallow water table; flood hazards from both the river and mesa runoff; easily erodable materials; severe sloughing hazard; moderate shrink swell and corrosivity in places nearest the river. Severe limitations to sewage lagoons and sanitary landfills where percolation rate is rapid.	Septic tanks: moderate to severe due to flooding potential, high water table, or slow percolation rate Foundations: slight Utilities: moderate to severe because of sloughing, corrosion, shrink-swell, and shallow water table	Recreation: excellent except in areas prone to flooding or excessive dust, sand or clay Agriculture: very good, except where limited by sand or rapid percolation Other: pasture, wildlife habitat, community development; good source for roadfill and fair for sand except where fines excessive

[1]Unified: a visual soil classification, based on texture and plasticity, used for embankment, foundation, and roadway construction.

GW-well graded gravels	SM-silty sands
GP-poorly graded gravels	SC-clayey sands
GM-silty gravels	ML-silts of low plasticity
GC-clayey gravels	MH-silts of high plasticity
SW-well graded sands	CL-clays of low plasticity
SP-poorly graded sands	CH-clays of high plasticity

[2]Surface permeability classes and approximate rates (inches/hour) slow, 0.2-0.6, moderate, 0.6-2.0, rapid, 2.0-6.0 very rapid, over 6.0

[3]AWHC: abbreviation for available water holding capacity:

AWHC	Inches in 5 feet
very low	<3 3/4
low	3 3/4 - 5
moderate	5 - 7.5
high	>7.5

[4]Limitations slight, moderate, severe Expressed in terms of difficulty (time, expense) in overcoming natural limitations of soils for specific uses.

at all. The other units have some limitations to urbanization, but can be utilized in many places if care is taken.

Irrigation, whether by river water, ground water, or treated sewage, is physically practical on the soils of the Flood Plain unit. Elsewhere it is generally impractical, although the Sand Plains unit can be farmed if enough water and fertilizer are available to overcome the naturally rapid permeability and low organic content of the soil.

A special problem associated with area soils is that many are poorly suited for use of septic tanks and drainfields. The Mountain Upland and Volcanic soils are too shallow to be suitable for such disposal systems, while in the Flood Plain the soils are locally either too fine (low permeability) or too coarse (high permeability with shallow water table) for conventional on-site disposal to function adequately. Conditions are more varied along the Valley Sides and in the Mountain Lowland; locally soils are deep enough and of adequate permeability to permit on-site disposal for low-density development. Elsewhere problems such as slope and shallow bedrock make such disposal undesirable. Conditions are best in the Alluvial Fan and Sand Plains units, where soil conditions are favorable almost everywhere to low-density development using on-site waste disposal.

2.2.10 Present Impact of Sludge Reuse and Disposal

The present practice of using ground, dried sludge as a fertilizer-dressing on City parks provides a positive reuse of the nutrients in Albuquerque sludge, and a method of sludge disposal which generally follows official guidelines (e.g. as published in the Federal Register, 41 CRF 108). A major benefit of this program is that the need for commercial inorganic fertilizers is reduced, although potassium supplements may be needed (Dean & Smith, 1973). Based on a sludge production rate of 4900 dry tons/year; nitrogen and phosphorus contents in the 2-3% range; and a value of 20¢ per pound nitrogen or phosphorus; the dollar value of the sludge fertilizer is approximately $100,000/year under present conditions. An advantage of sludge over commercial fertilizer is that a high percentage of the nitrogen is in the organic form and is released slowly by mineralization over the year, thus providing a steady nutrient supply. Another benefit of sludge application to park soils is that the overall condition of these soils should be improved (e.g. Epstein, 1973; Miller, 1973). For example, sludge applications generally increase soil properties such as humus and organic content, fertility, water-holding capacity, cation exchange capacity and soil aggregation (hence resistance to erosion).

There could also be adverse impacts from sludge application on City parks, related primarily to water pollution by nitrogen and/or metals. An additional problem, pathogens, is probably minimized by the long storage of sludge prior to application and the action of soil processes to filter out disease-causing organisms. However, survival of some organisms is likely (Fair and Geyer, 1965). The present rate of nitrogen-loading at a park where sludge is used can be calculated to be between 200 and 400 pounds/acre/year. The lower estimate (representing a one-eighth inch application each year) is probably close to the value which can be taken up by park grasses; it would be acceptable under the proposed State ground water quality regulations. The upper value would undoubtedly exceed plant uptakes, especially considering

that grass clippings are not removed from parks, but allowed to decay, so that nutrients are returned to the soil. Where the loading rate substantially exceeds 200 tons/acre/year, the prospect exists that some nitrate is leached to ground water. The amount of nitrate which is leached probably is small, since evidence exists that processes of nitrogen loss (nitrification-denitrification, ammonia volatilization) are extremely important in sludge-treated soils (Larson et al., 1975).

While metals in sludge may be useful as plant micronutrients, they may also accumulate in the soil or build up in the food chain to potentially toxic levels. Chaney (1973) identified boron, cadmium, cobalt, chromium, copper, mercury, nickel, lead and zinc as metals which present "the long term environmental hazard in land application" of sludges and effluents. Based on his data, Albuquerque sludge contains higher levels of copper, nickel, and zinc than would be advisable for use on agricultural lands. These metals present no direct health hazard on park soils which are not used for crop cultivation; however, their presence provides a source of metals which might ultimately be leached out and cause water pollution.

The best available information suggests that the potential for metals leaching is small. Dean and Smith (1973) observe that the organics in sludge will normally complex out most metals and make them unavailable. Similarly, the Federal guidelines (41 CFR 108) state that "maintaining (soil-sludge) pH above 6.5 will prevent solubilization and migration of most metal ions". Soils in the Albuquerque area commonly have a pH of 7 or above.

In order to determine if metals in Albuquerque sludge remain in park soils, samples were taken at three park sites and a control site, and tested for copper, zinc, cadmium, chromium, lead and arsenic. The results are given in Table 2-6. As indicated in the table, the results are consistent with the hypothesis that virtually all metals introduced to the soil by sludge have remained in the soil, and have not been leached to ground water or lost to erosion. Since there are no firm data for the total length of sludge application at each park, nor the metals content in sludge in past years, it is not possible to state with certainty that an absolute metals balance exists. Nonetheless, the data do not suggest any problems exist.

2.3 HYDROLOGIC ENVIRONMENT

Good quality water is one of Albuquerque's most valued resources. Extensive information related to this resource has been compiled in EPA (1977) as follows: D-1 provides background information on the physical characteristics of the drainage system and history of water management; D-2 presents data on surface water hydrology of the Rio Grande, and the comparative significance of Albuquerque's wastewater discharges; D-3 presents data on ground water hydrology; D-4 provides information on matters such as flooding and water rights.

2.3.1 General Setting

Albuquerque is located in the Middle Rio Grande Basin, 158 miles above

TABLE 2-6. HEAVY METALS CONCENTRATIONS IN ALBUQUERQUE SOILS TREATED WITH DIGESTED SLUDGE. Samples taken by Lee Wilson & Associates, Inc , Santa Fe, from upper 18 inches of soil (mixed), and analyzed by State Scientific Laboratory, Albuquerque. All values as ug/g or parts per million

Site	Rio Grande Park	Los Altos Golf Course	Matheson Park	Menaul High School
Soils	Loam	Sandy loam (over caliche)	Sandy loam (over caliche)	Loam
Other Conditions	Shallow water table	Freeway nearby	Arroyo area	Freeway and main artery nearby
Sludge History	More than 16 years application	Irregular and rather minimal use	12 years application	Fertilizer and manure only: no sludge (20 years +)
Metals (all values ug/g)				
Copper	46.7	14.7	26.7	10 6
Zinc	59.7	29.9	32.4	30.6
Cadmium	1.7	0.1	0.7	0 2
Chromium	13.6	6.1	8.2	4.6
Lead	52.3	7 9	15.7	26.8
Arsenic	6.0	3.2	4.5	3.3

Metals balance. Sludge applied at 1/8 inch/year is applied at the rate of 7260 pounds/acre/year If copper is 900 ppm of sludge, and all copper accumulates in the upper foot of soil, then the increase in copper levels would be 1.3 ug/g where sludge is applied. Similar estimates can be made for zinc (1200 ppm), cadmium (30 ppm), chromium (300 ppm), lead (1000 ppm), and arsenic (100 ppm). If sludge were applied at Rio Grande Park for 40 years, the predicted metals concentration would be Cu-48 ug/g, Zn-64 ug/g, Cd-1.6 ug/g, Cr-16 ug/g; Pb-53 ug/g, As 5-ug/g. These values are almost identical to those observed. This does not mean that all the above assumptions are correct, but does indicate that the observed data are internally consistent, and in accordance with a hypothesis that metal buildups are a function of sludge disposal, with no major effect from leaching or erosion

Elephant Butte Dam and downstream of a 14,500 square mile drainage area (Figure 2-8). The Middle Rio Grande flows through a series of sub-basins, divided by natural narrows at San Felipe, Isleta, San Acacia and San Marcial. Between the narrows each sub-basin has the same general characteristics as described for the Albuquerque area in Section 2.0.1. The river itself occupies a wide sandy meandering channel and has a grade of 4-5 feet/mile. Because of aggradation, the channel is often several feet above the adjacent, wide flood plain. Tributaries are few, and in this desert region invariably ephemeral. The most significant are the Jemez River north of Albuquerque, and the Rio Puerco and Rio Salado to the south. Tijeras Arroyo is the largest tributary within the planning region, but is too small to have significant effect on regional hydrologic patterns.

More than most rivers, the character of the Rio Grande reflects historic patterns of water use and intensive man-made modifications aimed at providing a controlled hydrologic regime. Major elements in this history can be summarized as follows:

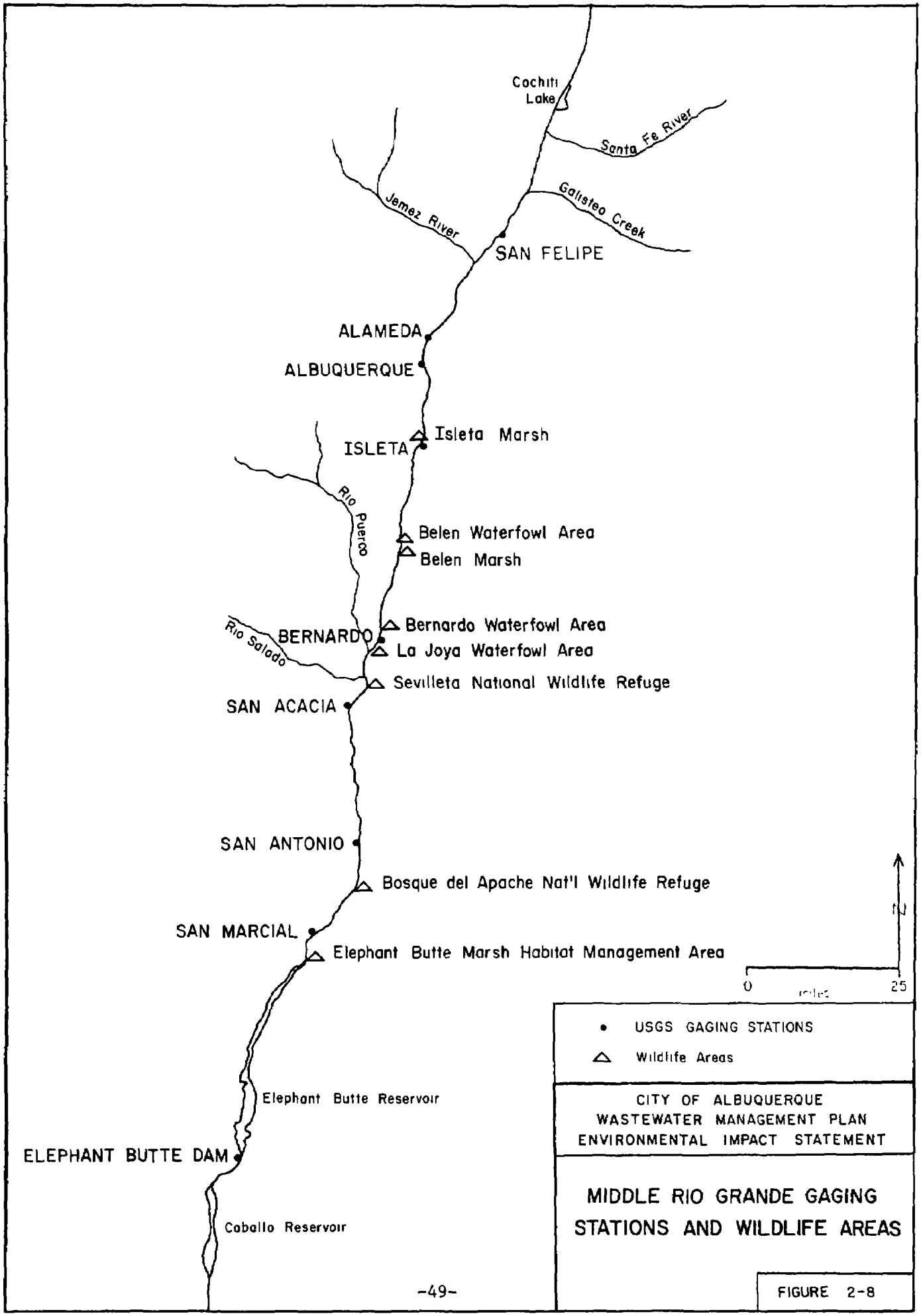
i) Prior to 1850 the Middle Basin river flows were used for irrigation of Indian and Spanish colonial lands totalling 125,000 acres.

ii) From about 1850 to about 1900, the effects of upstream irrigation development and overgrazing combined with climate change to create severe sedimentation problems and extreme water shortages, reducing irrigated acreage in the Middle Basin to about 50,000 acres, just less than the present amount.

iii) From the late 1800's to about 1940 many actions were taken to solve the sediment and water supply problems and to reduce flooding hazards. For example, Elephant Butte Dam was constructed downstream, and State control was exercised over appropriation of surface and ground water. For Albuquerque the most significant action was formation of the Middle Rio Grande Conservancy District (MRGCD), which consolidated and improved the network of irrigation dams and canals, and which constructed irrigation drains to lower the water table.

iv) More recently the Federal government has implemented a number of major public works programs which have resulted in construction of flood and sediment control reservoirs upstream, construction of a major project for transferring Colorado River water into the Basin, straightening and channelization of the Rio Grande, and construction of flood control structures on tributary arroyos. In addition the MRGCD canals and drains have been rehabilitated, and efforts have been undertaken to salvage water by clearing of phreatophytes.

Within the past decade or so the emphasis has begun to change from concern over irrigation water supplies to concern for municipal water supplies and water for recreation purposes. One consequence is that the value of the Rio Grande is no longer measured only in terms of agricultural use; the worth of river water in supporting fish, wildlife and boating is of comparable importance in the public view. Another consequence is that ground water, the source of municipal supplies, is receiving increasing attention.


Cochiti Lake
Santa Fe River
Jemez River
Galisteo Creek
SAN FELIPE
ALAMEDA
ALBUQUERQUE
Isleta Marsh
ISLETA
Rio Puerco
Belen Waterfowl Area
Belen Marsh
Bernardo Waterfowl Area
BERNARDO
Rio Salado
La Joya Waterfowl Area
Sevilleta National Wildlife Refuge
SAN ACACIA
SAN ANTONIO
Bosque del Apache Nat'l Wildlife Refuge
SAN MARCIAL
Elephant Butte Marsh Habitat Management Area
Elephant Butte Reservoir
ELEPHANT BUTTE DAM
Caballo Reservoir
N
0
25
• USGS GAGING STATIONS
△ Wildlife Areas
CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT
MIDDLE RIO GRANDE GAGING STATIONS AND WILDLIFE AREAS
FIGURE 2-8

What emerges from the above summary is that there is severe competition for a limited surface water supply. One recent study concluded that "the problems of the Rio Grande ... are as severe and complicated as any in the entire West" (USDI, 1975, p. 71). Increasingly, ground water is being used as an alternate supply, but its use is restricted by water rights considerations (see Section 2.3.4). Water quality as such has only recently become an issue in the area.

The historical summary also highlights the variety of projects and programs which influence decisions regarding water resource management in the Albuquerque area. Major projects and programs are listed in Table 2-7. Of these the irrigation and drainage works of the MRGCD most directly interact with wastewater management in the planning area. For example, while most city wastewater is discharged directly to the Rio Grande, the Riverside Drain which passes Plant #2 has on occasion received treated wastewater; the Drain returns to the River about six miles downstream. About seven miles downstream is a diversion dam at Isleta Pueblo. This structure diverts almost all of the Rio Grande flow during most months of the irrigation season, March-October. The diverted water supplies farms in the Peralta-Belen area, and in effect is a mixture of normal river water and the effluent discharged by the City. Also included in this water supply is return flow from MRGCD drains which serve irrigated areas throughout the South and North Valleys. These drains intercept shallow ground water which is affected by discharges from cesspools and septic tanks.

2.3.2 Surface Water

Flow Patterns. Snowmelt from northern New Mexico mountains contributes a sizeable flow to the Rio Grande in most years, creating a perennial water source for Albuquerque despite the aridity of the local climate. Figure 2-9 illustrates flow data for the river as measured at the Central Avenue Bridge. The average discharge shown for the period 1955-1974 was 819,000 acre-feet/year, of which 87% occurred in the river channel and the remainder was bypass flow distributed in adjacent MRGCD irrigation canals and the Riverside Drain. About half the annual discharge occurred during the meltwater season (March-June); conversely very low flows were observed late in the irrigation season (July-October).

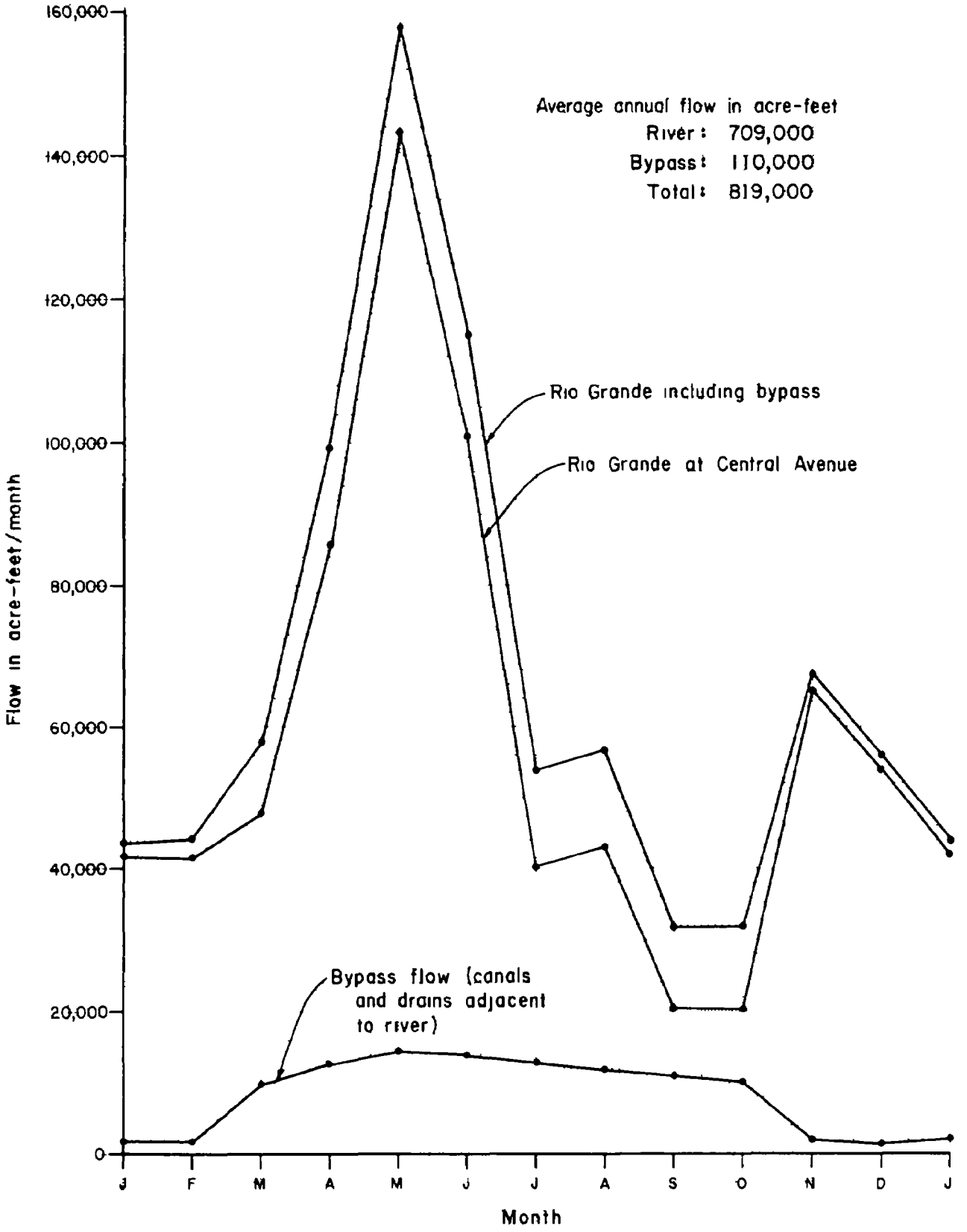
Great variability exists in the flow regime from year to year. While in some years more than two million acre-feet of flow have been recorded, more commonly the river is drier than indicated by the average values illustrated in Figure 2-9. An analysis of median flow conditions provides data representative of "normal" hydrologic patterns. Median discharge in the past few decades has been about 550,000 acre-feet/year, of which 79% was in the river channel and 21% was bypass. The median river flow has been about 600 cubic feet per second since 1943. With an average wastewater discharge of just under 60 cfs (in 1976), the mean dilution ratio of river to wastewater is about 10:1 for present circumstances.

By definition, flows less than the median occur half the time so that the river normally has a comparatively small discharge. In recent years it has become increasingly common for the river at Central Avenue Bridge to

TABLE 2-7. PROJECTS AFFECTING WATER RESOURCES IN THE MIDDLE RIO GRANDE BASIN
COE=Corps of Engineers. BOR=Bureau of Reclamation. MRGCD=Middle Rio Grande Conservancy District.

Upstream from Albuquerque	Flood and sediment control dams and reservoirs (COE): Abiquiu (Rio Chama); Cochiti (Rio Grande); Galisteo (Rio Galisteo); Jemez Canyon (Jemez River).
	Water supply storage reservoirs: El Vado (MRGCD, on Rio Chama); Heron (BOR, on Willow Creek).
	Interbasin diversion works (BOR): San Juan-Chama Project to import 110,000 acre-feet/year from Upper Colorado Basin, for municipal and irrigation use in Rio Grande of New Mexico.
Downstream from Albuquerque	Elephant Butte Dam and Reservoir, 40-mile long lake used for irrigation storage, hydroelectric power, and recreation (fishery, boating). Storage capacity = 2.1 million acre-feet, but storage is normally 300,000-700,000 AF
	Caballo Reservoir, used for flow regulation and other purposes.
	Phreatophyte clearing (BOR): eradication of salt cedar and other riparian vegetation which consume water for "non-beneficial purposes." Controversies have arisen over effectiveness of project, impact on wildlife.
Middle Rio Grande Basin (general)	Channelization, straightening of Rio Grande (BOR): includes development of confined, partly cleared floodway (bordered by levees, jetty fields), and in some reaches construction of low-flow conveyance channels to carry most river flows.
	Irrigation works (MRGCD): includes small diversion dams on river, network of large and small canals for delivery of irrigation supply to farms, network of drains to intercept seepage water from river, canals, farms, and thus maintain water table at an acceptable depth below ground surface.
Albuquerque Area	Irrigation works (MRGCD): as above, described in detail for planning area in Table D 3 of EPA (1977).
	Tributary flood control projects, including dams, diversion channels (COE, others).

FIGURE 2-9. SEASONAL DISTRIBUTION OF RIO GRANDE FLOWS AT ALBUQUERQUE, NEW MEXICO, 1955-1974



contain no discharge for several days to several weeks at a time, although the bypass flow has remained substantial. Thus, during the late irrigation season the City's wastewater may be discharged to a dry riverbed, and no dilution takes place. In hydrologic terms, the week-long flow expected in a ten-year interval is zero cubic feet per second. One consequence of flow variability, and frequent low flows, is that water levels at Elephant Butte Reservoir tend to be low, and tend to widely fluctuate from year to year and month to month, resulting in impaired value for recreation and fishery purposes.

Fate of Wastewater. As noted previously, wastewater discharged by the City to the Rio Grande can be diverted at Isleta Dam to the canals of the Belen Division, MRGCD. Section D-2 of EPA (1977) contains an extensive analysis to determine how much effluent is diverted at Isleta and how much may actually be used for farm irrigation in the Belen region. Many factors must be considered in evaluating the effect of City wastewater on the river and on MRGCD irrigation. For example, flows at Central Avenue Bridge are probably greater than those reaching Isleta Dam because some of the bypass at the Bridge does not return to the river, and because City well pumpage causes river seepage to occur in the Central Avenue-Isleta reach. Another factor is that during winter months no flow is diverted at Isleta; in spring a portion of the flow is diverted, but an excess exists and passes over the dam; in the late irrigation season in most years all the river flow at Isleta is diverted. Thus the seasonal pattern of river discharge as compared to effluent discharge must be evaluated to determine just how much wastewater is diverted to irrigated lands. Finally, it is necessary to analyze water use patterns in the Belen Division, since much of the diverted flow does not reach farm land, but instead is lost as direct return flow or as canal seepage.

When all the variables are considered, it appears that under present conditions 14,900 acre-feet of wastewater are diverted at Isleta Dam each year, and that 6,600 acre-feet of this wastewater are delivered to farms in the Belen Division and used for irrigation purposes. Of the total irrigation water supply in the Division, 8% is effluent on the average. During spring months the effluent may be only 3% of the supply, whereas by late in the irrigation season it is 16% of the supply. Of course, during dry years the percentage values would probably be much higher. For the year as a whole, the average acre of irrigated land in the Belen Division receives 2.4 inches of wastewater. Under present conditions, one-third of all Albuquerque's wastewater is diverted at Isleta Dam, and one-sixth is utilized on the farms of Valencia County.

Wastewater not used in the Peralta-Belen area may be consumed further downstream in the Socorro Division of the MRGCD or in areas of wetland and phreatophyte vegetation. Simplified water budget calculations indicate that about one-third of all Albuquerque's wastewater is consumed above Elephant Butte Reservoir. The remaining two-thirds would be expected eventually to reach the Reservoir, and to be consumed there or used by irrigation further downstream.

Flood Hazards. In the Albuquerque area floods arise from two sources: overflow of the Rio Grande, most often during spring or early summer; and flash floods from local arroyos in response to intense, localized summer thunderstorms.

The combined effect of upstream flood control dams and riverside levees has greatly reduced the hazard of Rio Grande floods in the Albuquerque area. At present most of the valley is not subject to a 100-year flood; this includes the area of the two treatment plants. However, in some locations the levees are low or in poor repair, and a severe flood hazard exists. Such a situation occurs in the area from the University of Albuquerque north to Corrales, and in the Southeast and Southwest Valleys, south of Tijeras Arroyo.

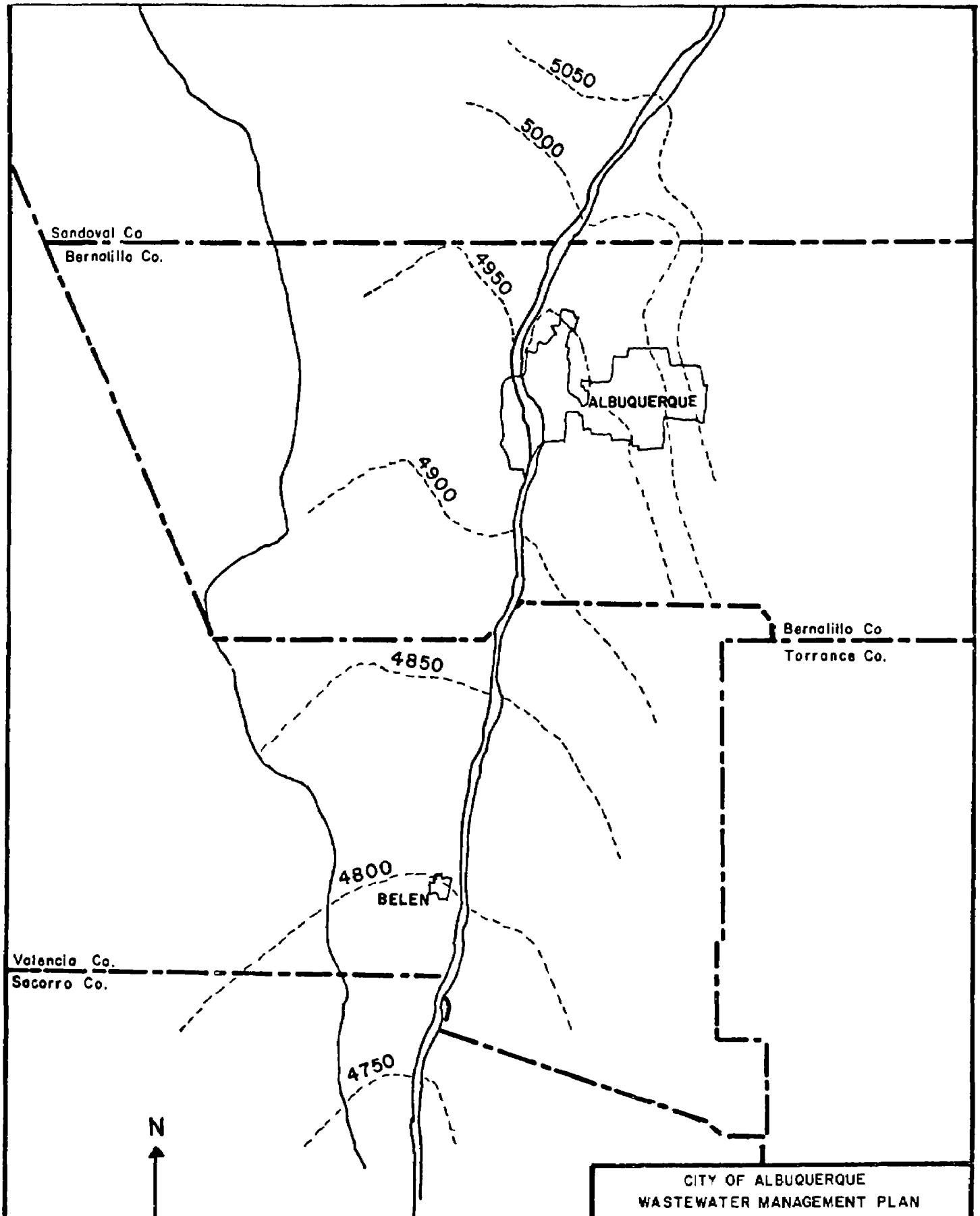
Arroyo floods affect not only their channel and adjacent terrace areas, but also the Rio Grande flood plain, because most arroyos empty to the poorly drained valley and lead to widespread shallow ponding of the flood waters. This flooding has caused health problems in the past, as it has caused flushing of liquid wastes from cesspools and septic tank drainfields. Section D-4 of EPA (1977) contains a map indicating where the greatest hazards exist. Some local flooding has been controlled by construction of the North and South Diversion Channels, and some is soon to be managed by new structures being built by the Albuquerque Metropolitan Arroyo and Flood Control Authority. Although these measures limit the potential for major flood damage in the area, the prospect of localized flooding on the valley floor remains, caused by runoff of the remaining uncontrolled arroyos and/or by intense localized precipitation. Thus, for purposes of evaluating on-site systems, all of the poorly drained valley area can be considered as vulnerable to flooding.

2.3.3 Ground Water

The basin fill sediments of the Rio Grande trough provide a thick, relatively permeable aquifer which stores a large supply of good quality ground water. Properly developed wells should reliably produce yields of several hundred gallons per minute or greater from this aquifer or the closely related overlying alluvium of the Rio Grande flood plain. West and Broadhurst (1976) indicated that the total recoverable water stored in the Albuquerque basin averages about 460,000 acre-feet per square mile, or 2.3 billion acre-feet beneath a 5,000 square mile area. This is equivalent to the median Rio Grande flow for about 4,000 years.

The ground water supply is much less favorable in the Sandia Mountain area, where geologic conditions are variable. Some geologic units yield little water while others locally provide an adequate supply for limited development. According to Titus (1974) limitations on the availability of ground water represent a major obstacle to development in the East Mountain area.

In most of the planning area the water table slopes west and south, toward and along the Rio Grande (Figure 2-10). However, the lowest point in the water table occurs beneath the West Mesa, several miles from Albuquerque. The area of greatest interest with regard to ground water is the river valley where the water table normally lies within 20 feet of the ground surface, and often occurs within five feet. This level is fairly stable because of the regular or controlled patterns of recharge and discharge. Recharge occurs through river seepage, canal seepage, percolation from irrigated



CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

WATER TABLE CONTOURS
1968

FIGURE 2-10

Source: LANSFORD, et al., 1973

fields, and effluent from on-site systems. Discharge occurs to the MRGCD drains, and to City and private wells. Prior to construction of the drains, most valley soils were waterlogged. After the drains were built the water table lowered an average of three feet throughout the area.

Because the valley ground water is shallow, and because the alluvium is highly permeable, the flood plain aquifer is very vulnerable to pollution. The aquifer is also interconnected with the underlying Santa Fe Group and with surface flows in the Rio Grande, so that locally contaminated ground water has the potential of causing regional problems.

At present a large volume of ground water is pumped each year in the Albuquerque area--probably about 120,000 AF/year. The large amount of inflow from the north (coupled with local recharge) has offset most of the pumpage, and drawdown of the water table is limited to comparatively small cones of depression near major well fields, and a larger cone near downtown.

2.3.4 Water Rights

Ground and surface water in the Albuquerque area is publicly owned and can be used only by those holding a legal water right. The use of such rights is governed by the regulations of the New Mexico State Engineer, whose policies are designed to protect and stabilize flows in the Rio Grande. The City of Albuquerque holds water rights in the amount of approximately 65,000 acre-feet/year; it can deplete the flows of the river by this amount, provided it does so without impairing senior water rights. The City's holdings include about 18,672 acre-feet of vested well rights, and an allocation of San Juan-Chama Project water in the amount of 46,300 acre-feet (after delivery losses). The City has an active policy of acquiring additional rights. For example households with private wells are required to turn over a portion of their domestic water right in return for hookup to the City water system.

The City's present use of water rights is calculated following complex procedures of the State Engineer. Presently nearly 80,000 acre-feet of ground water are pumped from municipal wells each year. However, a portion of this (more than one-fourth) is calculated to come from ground water storage, or to come from wells far from the river. Water rights are not required to offset this supply because there is no present effect on river flows. For the water in storage there will never be such an effect.

The remaining pumpage is calculated to reduce stream discharge by nearly 50,000 acre-feet/year. However, the State Engineer credits the City for the wastewater which is returned to the river, since that water replenishes stream flow. The credit is calculated as equal to 50% of the water pumped; in practice, wastewater discharge is slightly greater than half the pumpage. The net result of this credit, which currently is nearly 40,000 acre-feet per year, is that the City is charged with depleting river flows by less than 10,000 acre-feet per year under present conditions. The water right requirement is thus less than 25% of the total holding. As the City grows and uses more and more ground water, the water right requirement will increase, even though the 50% credit for wastewater return would remain a major factor keeping that requirement to a minimum.

The vested well rights will be fully used within the next 5-6 years, after which the City's San Juan-Chama allocation is to be utilized to provide water rights in support of future growth. The allocation will be fully committed for municipal and industrial purposes early in the next century. In the meantime, the City must pay an annual charge for the allocation, a charge which will eventually exceed $1.5 million per year. The City has explored many interim uses for the allocation, especially related to creation of recreational water bodies in or near the metropolitan area. No such local use has been found feasible so far. The City is actively exploring the possibility of storing some water for recreational and other purposes in Abiquiu Reservoir, north of Espanola.

2.4 WATER QUALITY

Data on water quality in the Middle Rio Grande Basin are not yet adequate to permit a thorough evaluation of present or possible future pollution problems. On-going monitoring and research programs are expected to improve the data base in the next several years. Pending such improvements it is practicable only to discuss preliminary and general conclusions which appear valid given existing information. A detailed discussion of water quality in the Basin, and the effect of wastewater management in Albuquerque is presented in Section D-5 of the Technical Reference Document (EPA, 1977). Section D-5 includes: extensive data summaries and references to the literature; evaluation of all major parameters of concern in protection of surface and ground water; detailed review of available information regarding the effects of wastewater nutrients on Elephant Butte Reservoir. Additional analyses which relate wastewater management in Albuquerque to water quality in the Middle Rio Grande Basin include: Clayton (1966); Patterson (1970); Anderson (1972); NMWQCC (1976a); EIA (1976).

2.4.1 Water Quality Goals and Standards

The pollution control program established by P.L. 92-500 includes Federal standards for industrial and municipal waste treatment and provisions for Federal enforcement; a permit and license system entitled National Pollutant Discharge Elimination System (NPDES), which governs the discharge of pollutants into navigable waters; and a massive grant-in-aid program for the construction of publicly owned treatment works. The basic objective of the law is to eliminate the discharge of pollutants into waters of the United States by 1985. The feasibility or environmental acceptability of meeting the "zero discharge" goal by 1985 has not been established by EPA. However, the less stringent interim goals for discharges from municipal sewage treatment plants will be enforced.

By 1977 discharges from facilities such as Plant #2B are to meet a standard associated with "secondary" treatment technology, as follows:

- BOD_5 removal shall be at least 85% of that found in the influent wastewater, and effluent shall not average more than 30 mg/l BOD_5 over a 30 day period nor more than 45 mg/l over a 7-day period;
- the standard for suspended solids reads the same as for BOD_5;
- effluent pH shall be in the range 6.0-9.0.

These standards have been incorporated into the City's NPDES permit along with a requirement regarding fecal coliform levels (Table 2-8). By 1983 the standards would be based on the "Best Practicable Control Technology", which is defined as the average of the best performance at well-operated plants. The 1983 effluent standards have not yet been established but it is expected that they will relate to the control of toxic substances and nutrients. It is possible that adequately sized activated sludge treatment would meet such standards.

The State of New Mexico has specified discharge requirements to be included in the City's NPDES permit, including more stringent limits for BOD_5 and pH, and standards for COD and settleable solids (Table 2-8). The State has also designated beneficial water uses in the Middle Rio Grande Basin and Elephant Butte Reservoir which must be protected by wastewater management actions. The Middle Rio Grande is designated for irrigation use, limited warmwater fishery, livestock and wildlife watering, and secondary contact recreation. Elephant Butte and/or Caballo Reservoir are designated for the same uses plus primary contact recreation, fish culture and marginal cold-water fishery. The ground water which is recharged by the Rio Grande is also designated for use as a drinking water source. To protect the surface and ground waters of the Basin, the State has set specific stream standards and ground water quality standards (Table 2-8). As will be described in 2.4.2, the stream standard for fecal coliform bacteria is frequently violated within the Basin. In accordance with P.L. 92-500 the stream therefore is classified as "water quality limited", which means that water quality standards are not now met, nor are they expected to be met after application of the above-cited effluent standards.

The New Mexico Water Quality Control Commission has identified two water quality issues of prime importance in areawide planning for Albuquerque (NMWQCC, 1976, page 13):

> "The determination of the movement or potential for movement through the aquatic and terrestrial ecosystem of those toxic substances associated with the municipal/industrial complex's discharges into the river system" and "the determination of the relative importance of nutrient loadings (nitrogen and phosphorus) to Elephant Butte Reservoir from municipal, agricultural and storm water discharges."

In the Basin Plan, the Commission has provided a specific mandate to the Facility Plan and this EIS (NMWQCC, 1976, p. I-5):

> "Alternatives to the production of highly oxidized nitrogenous effluent from the Albuquerque sewage treatment plant shall be realistically evaluated in the Section 201 Facilities Plan and where cost-effective, such an alternative shall be implemented".

In addition to Federal and State criteria, the City is obligated to meet standards set forth in the Stipulation regarding the discharge of 14 heavy metals.

TABLE 2-8. WATER QUALITY STANDARDS AND CRITERIA PERTINENT TO MANAGEMENT OF CITY OF ALBUQUERQUE WASTEWATER

Source of Standard, Criteria	Parameter & Measurement Period	Maximum Acceptable Value
1. NPDES Permit #NM02250 as proposed May 1, 1976. An asterisk (*) indicates standards set by State of New Mexico, others are Federal	BOD_5 (30-day average)	30 mg/l
	BOD_5 (7-day average)	45 mg/l
	*BOD_5 (2 consecutive samples, and 10% of all samples)	30 mg/l
	Suspended solids (30-day average)	30 mg/l
	Suspended solids (7-day average)	45 mg/l
	pH (acceptable range at all times)	6 0-9.0
	*pH (2 consecutive samples and 10% of all samples, acceptable limits)	6.6-8.6
	*COD (not to be exceeded more than once per month)	80 mg/l
	Fecal coliform (30-day average)	200 organisms/100 ml
	Fecal coliform (7-day average)	400 organisms/100 ml
	*Fecal coliform (2 consecutive samples, 10% all samples)	500 organisms/100 ml
	*Settleable solids (2 consecutive samples, 10% of all samples)	0.1 mg/l
	Floating solids	none
2 Stream standards set by New Mexico Water Quality Control Commission for Rio Grande between Angostura Diversion (N. of Albuquerque) to headwaters of Elephant Butte Reservoir	Dissolved oxygen (any sample)	Must exceed 4 0 mg/l
	pH (acceptable range, any sample)	6 0-9 0
	Temperature (any sample)	32.2 °C
	Fecal coliform (monthly logarithmic mean)	1000 organisms/100 ml
	Fecal coliform (10% all samples)	2000 organisms/100 ml
	Total dissolved solids (monthly average when flows exceed 100 cfs)	1500 mg/l
	Chloride (same as above)	250 mg/l
	Sulfate (same as above)	500 mg/l
3 Ground water standards as adopted by New Mexico Water Quality Control Commission, January 11, 1977 An asterisk (*) denotes a standard which applies to aesthetic conditions, or to irrigation water, all others are health standards for drinking water.	*Aluminum	5 0 mg/l
	Arsenic	0 1 mg/l
	Barium	1 0 mg/l
	*Boron	0.75 mg/l
	Cadmium	0 01 mg/l
	*Chloride	250. mg/l
	Chromium	0 05 mg/l
	Cobalt	0.05 mg/l
	*Copper	1 0 mg/l
	Cyanide	0.2 mg/l
	Fluoride	1.6 mg/l
	*Iron	1 0 mg/l
	Lead	0 05 mg/l
	*Manganese	0 2 mg/l
	Mercury (total)	0 002mg/l
	*Molybdenum	1 0 mg/l
	*Nickel	0 2 mg/l
	Nitrate (NO_3 as N)	10 0 mg/l
	*Phenols	0 005mg/l
	Selenium	0 05 mg/l
	Silver	0 05 mg/l
	*Sulfate	600. mg/l
	*Total dissolved solids	1000 mg/l
	Uranium	5 0 mg/l
	*Zinc	10 0 mg/l
	Radioactivity combined Radium 226 and Radium 228	30 0 picocuries/l
	pH	between 6 and 9
4 Heavy metal standards set forth in Stipulation. All are maxima and apply to effluent when natural backgrounds are not high. Other standards may apply to industrial discharges and to effluent when backgrounds are high (see Wilson, 1976).	Arsenic	0 05
	Barium	1.0
	Boron	0 75
	Cadmium	0.01
	Chromium	0 01
	Copper	0.1
	Lead	0 05
	Manganese	0 1
	Mercury	0.001
	Molybdenum	0 01
	Nickel	0 1
	Selenium	0 01
	Silver	0 05
	Zinc	0 5

It is the objective of the City of Albuquerque to participate in the Federal pollution control program to achieve current and future water quality goals and to provide for anticipated growth in a manner which prevents future violations of water quality standards. To this end the treatment of wastewater to the levels listed in Table 2-8 represents a minimum standard to be achieved by any acceptable alternative, unless data are available to indicate that other effluent criteria are more appropriate.

2.4.2 Surface Water: the Rio Grande

Data regarding water quality in the Middle Rio Grande Basin are provided in EPA (1977, Table D.20 et seq.) and summarized here in Table 2-9. The major parameters of interest are: salinity and major salts; sediment and turbidity; temperature, pH, hardness and alkalinity; organic load and dissolved oxygen; pathogens such as coliform bacteria; metals. Information on nutrients is presented in Section 2.4.3. Except as noted the evaluations of water quality given here reflect data collected prior to operation of activated sludge facilities at Plant #2B.

Salinity. Total dissolved solids, especially salts such as sodium chloride and calcium sulfate, are of concern because they may interfere with the use of river water for irrigation. The available data demonstrate a considerable increase in dissolved solids in a downstream direction as the Rio Grande passes through New Mexico. This increase in salinity is due primarily to the addition of salts from natural weathering processes and to the normal concentrating effects of beneficial water use. Stream standards for total dissolved solids, sulfate and chloride are not violated along the main stem of the Rio Grande in the Middle Basin except during low flow conditions; the standards specifically exempt such conditions. Nonetheless in the reaches below Elephant Butte Reservoir salinity reaches a high enough level to present problems in irrigation use during some periods.

Under 1976 conditions Albuquerque's effluent contributes approximately 6% of the total dissolved solids measured at the San Marcial gaging station. At Albuquerque the effluent contains more dissolved solids than river water, although detailed data on effluent salinity are limited and were not included in Table 2-2. The effluent would be expected to increase the salt concentration in the river at Albuquerque by less than 10%. This effect is shown in Table 2-9 by the increase in conductivity (a measure of dissolved solids) between the Barelas and Isleta measuring points. Despite this increase, Patterson (1970) noted that under some conditions the mixing of effluent and river water may result in chemical reactions which actually result in an observed decrease in dissolved solids downstream from the effluent outfall.

Chlorination of wastewater is not considered to have a significant effect on salinity (NMWQCC, 1976a).

TABLE 2-9. WATER QUALITY OF THE RIO GRANDE BASIN. All data represent long-term averages for varying record lengths, as given in EPA (1977), Section D-5, and are expressed in mg/l except: pH (pH units); conductivity (micromhos/cm), fecal coliform level (colonies/100 ml), and turbidity (Jackson Turbidity Units) Dashes (--) indicate that less than 10 data points are available for a particular parameter at a particular sampling point, too few to summarize here. Data sources: Otowi Bridge and San Marcial Conveyance Channel - USGS, Barelas Bridge and Isleta Dam - EIA (non-metals), and City of Albuquerque (metals), San Acacia Conveyance Channel - EIA The City treatment plant outfall is between Barelas Bridge and Isleta Dam.

Parameter	Otowi Bridge	Barelas Bridge	Isleta Dam	San Acacia CC	San Marcial CC
Dissolved oxygen	9 2	8.7	7.7	7 4	8.6
pH	7.9	7 9	7.9	8.1	7.8
Total alkalinity	112	183	169	--	167
Total Kjeldahl nitrogen	0.58	1.38	1.54	1 07	2.39
Nitrate nitrogen	0 20	0 20	0.23	0.46	0.48
Total phosphorus	0.20	0.56	1.41	1.68	1.03
Sulfate	77	76	78	143	183
Fecal coliform	871	2,135	11,228	1,585	4,801
Conductivity	397	381	411	734	907
Turbidity	62	215	189	369	2,454
Cadmium	0.009	0 002	0 002	--	--
Chromium	0.008	0.017	0.016	--	--
Copper	0.014	0.022	0.025	--	--
Lead	0.010	0.030	0 033	--	0.080
Manganese	0.263	0.558	0.529	--	--
Nickel	--	0 023	0.022	--	--
Silver	--	0.004	0 003	--	--
Zinc	0.033	0.075	0 069	--	--

Sediment. Sediment is the most abundant pollutant in the Middle Rio Grande Basin and causes the river to be highly turbid. As shown in Table 2-9 turbidity is especially great in the downstream reaches of the Middle Basin, below the confluence with the Rio Puerco and Rio Salado. The sediment load of the river causes numerous problems, especially siltation of irrigation works and interference with aquatic ecosystems. The combination of high turbidity and variable flows is responsible for the virtual absence of a productive ecosystem within the river itself; the same combination is a major factor reducing the productivity of Elephant Butte Reservoir. The observed sediment problems are largely natural in origin and not readily subject to human control.

The direct effect of wastewater discharges is to reduce stream turbidity, since effluent contains much less solids than natural stream flows. A more significant relationship is that pollutants contained in the wastewater may interact with sediment; for example the sediment may serve to adsorb and transport nutrients and metals downstream. The role of sediment in water quality dynamics in the Middle Rio Grande Basin is demonstrably significant, but very poorly defined. Until this role is known in detail it will be very difficult to trace the specific effects of Albuquerque's wastewater discharge and relate it to particular downstream water quality problems.

Temperature, pH, Hardness, Alkalinity. Water in the Middle Rio Grande tends to have a high pH and to be warm, moderately hard and alkaline. Occasional violations of stream standards for temperature and pH have been reported, but variations in these parameters appear to relate to natural causes; pollution is not indicated by the violations. The direct effect of Albuquerque's wastewater on river water quality is small; for example river water temperatures may increase by 1°C or so below the treatment plant outfall. The chemical reaction which occurs when effluent and river water mix results in a small increase in river pH and a decrease in alkalinity; this was taken by Patterson (1970) to indicate that the reaction involved precipitation of a substance such as calcium carbonate.

The main significance of temperature with regard to wastewater management is that the naturally warm waters inhibit many forms of aquatic life, limiting the potential for ecologic benefits associated with improved effluent quality. Factors such as pH, hardness and alkalinity are important because they markedly affect the impact of pollutants on aquatic life. For example, heavy metals of the type found in Albuquerque's effluent would be expected to have less biologic impact in the Middle Rio Grande than would occur if the discharge were to a stream with a lower hardness and alkalinity. On the other hand, the relatively high pH increases the potential for problems such as ammonia toxicity.

Organic Load; Dissolved Oxygen. Organic pollutants and depletion of dissolved oxygen are among the most typical problems which occur when inadequately treated wastewater is discharged to a stream. These problems are not major in the Middle Rio Grande, primarily because the wide, shallow nature of river flows promotes extensive aeration of the water and rapid degradation of the organic load.

The discharge of wastewater from Albuquerque's two trickling filter plants has in the past caused some depletion of dissolved oxygen in the Rio Grande.

The stream standard for dissolved oxygen was violated at Isleta in 3% of all measurements taken from 1970 through 1975. The data are not taken to indicate a significant problem because: a) the aquatic ecosystem in the impacted area is essentially nonexistent; b) it is expected that the small percentage of violations will be eliminated by operation of the new activated sludge facilities at Treatment Plant #2.

Pathogens. Fecal coliform bacteria are widely used as an indicator of the presence of pathogens or disease-causing organisms. The available data show that fecal coliform levels increase in the Rio Grande as the river passes through Albuquerque and that the stream standards are exceeded throughout most of the Middle Basin. The highest levels have been observed at Isleta Dam and clearly relate at least in part to the City's wastewater discharge. However in recent years a decline in coliform levels has been reported in the Albuquerque area, especially at Isleta; this improvement may reflect better chlorination practices at the treatment plants. No data are available to reflect the eventual operation of the brand-new chlorination contact tank at Plant #2B; presumably this facility should further reduce the bacteria impact of City effluent.

The pervasive nature of bacteria problems indicates that non-point sources are significant. Such sources are also suggested by high readings upstream of the treatment plants and by the fact that the greatest contamination occurs in summer when urban and feedlot runoff would be important. It is likely that on-site systems are also a significant bacteria source. According to the Basin Plan, coliform contamination is the major water quality problem in the Middle Rio Grande, but because of the importance of non-point sources "the fecal coliform (stream) standard is not expected to be met even after point sources meet applicable secondary treatment requirements of effluent regulations" (NMWQCC, 1976a, p. I-2).

Information on other pathogens, such as viruses, is generally insufficient to permit an evaluation of existing or potential problems.

Metals. No stream standards for metals exist, but when concentrations in the Rio Grande are compared to those set forth in criteria documents (e.g. EPA, 1973) it is apparent that constituents such as lead, cadmium, chromium, copper, mercury, molybdenum and zinc may be present in elevated amounts, and that aesthetically undesirable metals such as manganese and iron are definitely present at excessive levels. There is no information to indicate that the heavy metals have toxic effects on aquatic ecosystems, or other adverse impacts. The lack of any reported effects may be due to: a) the high hardness and alkalinity of Rio Grande water, which tends to diminish metal toxicity; b) the fact that much of the metal contamination occurs in the particulate form, and thus the metals are not readily bioavailable. Algal assay experiments made using Albuquerque's effluent indicated that City wastewater is not toxic to aquatic life in a laboratory environment (EPA, 1977).

The observed high concentrations of metals in the Rio Grande do not relate to City wastewater discharges or to any other identified point source. No more than 10% of most metals measured at Isleta in recent years can be attributed to the City effluent; the remainder were already in the river above the treatment plant outfalls. The data in Table 2-9 demonstrate the small impact of

City wastewater by showing that there is little difference in metals levels between Barelas Bridge and Isleta Dam. Since the new activated sludge units at Plant #2B appear to be effective in removing metals from effluent, even smaller impacts would be expected in the immediate future.

There is little information available to pinpoint the source of metals in the Middle Rio Grande Basin. The most comprehensive data base has been collected by the City. Analysis of the City data (EPA, 1977) indicates that urban storm runoff is likely to be a significant metals source, especially for substances such as lead. The very high levels of iron and manganese may reflect contributions from ground water, as described in Section 2.4.4.

On-going studies under the 208 program are expected to improve the understanding of metals pollution in the Albuquerque area and downstream. An important factor in such an understanding is the role of sediment in absorbing, transporting and re-releasing metals, especially during storm runoff events. The importance of this factor was highlighted in a study by Dauchy (1976) who found that the elements zinc, lead, manganese, chromium, barium, molybdenum and copper are found in the Middle Rio Grande at much higher levels in sediment than in dissolved form.

Other Toxic Substances. The limited data base does not demonstrate any elevated levels of toxic substances such as pesticides or polychlorinated biphenyls (EPA, 1977). Chlorine residuals in wastewater discharged by the City may have exceeded recommended levels in the past. No problems have been reported to result from such discharges, probably because of the lack of an aquatic ecosystem in the discharge area. With recent construction of a chlorine contact tank the high effluent residuals should cease.

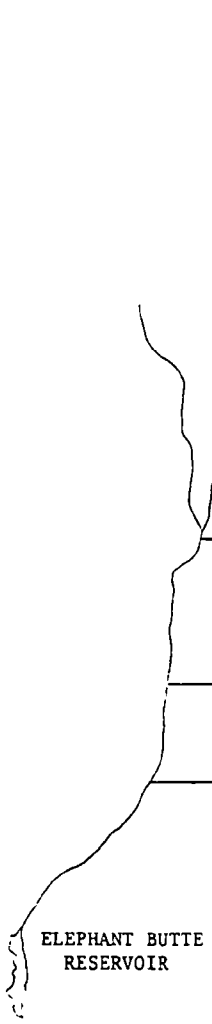
2.4.3 Surface Water: Nutrients; Elephant Butte Reservoir

A major public concern regarding Albuquerque wastewater is that nutrient discharges may lead to overfertilization of Elephant Butte Reservoir and loss of fishery and recreation resources. This potential problem has been evaluated in a number of studies, most recently EIA (1976) and EPA (1977, D-5, parts i and j). Table 2-10 indicates variations in nitrogen and phosphorus levels along the Rio Grande, as determined by the EIA study. A number of observations can be made based on these data, and on other information cited in the Technical Reference Document.

- City wastewater discharges have caused increased levels of ammonia-nitrogen, organic-nitrogen, ortho-phosphate and total phosphorus to be measured at Isleta, compared to upstream points. However, elevated levels of nutrients, especially organic-nitrogen, are observed throughout the Albuquerque reach of the Rio Grande, indicating sources other than City wastewater are also significant.

- Below Isleta nutrient levels have shown a tendency to decrease downstream. In particular, the relatively high ammonia concentrations observed at Isleta virtually disappear and there has been a marked reduction in organic and total-nitrogen as well as in orthophosphate and total phosphorus. However, most data sets show that nitrate-nitrogen tends to remain rather steady throughout the reaches south of Albuquerque.

TABLE 2-10. FLOW-WEIGHTED MEAN CONCENTRATIONS OF MAJOR PHOSPHORUS AND NITROGEN FORMS IN THE MIDDLE RIO GRANDE (EIA, 1976).



Station	PO_4-P	Total P	NO_3-N	Kjel N	NH_3-N
Alameda	0.06	0.09	0.09	0.41	0.06
Bridge Ave.	0.15	0.33	0.08	1.34	0.29
Isleta	0.58	0.83	0.28	1.80	0.86
Bernardo	0.21	0.34	0.25	0.70	0.08
San Acacia	0.35	0.56	0.36	0.65	0.07
San Antonio	0.33	0.46	0.32	0.60	0.09
San Marcial	0.23	0.64	0.31	1.23	0.08

- Nutrient levels observed at San Marcial, above the headwaters of Elephant Butte Reservoir, are often greater than observed at stations which are above the tributary inflows of the Rio Puerco and Rio Salado. Organic-nitrogen concentrations at San Marcial average higher than at Isleta.

- Overall, the data indicate that nutrient concentrations at Isleta vary inversely with river flows, being highest during low flow conditions. This relationship would be expected if the nutrient concentrations reflect a steady point source discharge (City wastewater) mixing with varied river flows.

- Nutrient concentrations at San Marcial tend to vary proportionally with river flows, being highest during storm runoff events. This relationship would be expected if runoff-related non-point sources are responsible for the observed nutrient loads.

The technical literature (see EPA, 1977) indicates that the entire subject of nutrient cycling and impact in any water body is complex and not well understood. The observations summarized above demonstrate the complexity of nutrient water quality in the Middle Rio Grande. Clearly, only tentative evaluations of eutrophication problems can be made until more nutrient data are available, and the Basin nutrient cycle is better understood.

Simplified mass balance studies and modeling can be performed to develop a gross nutrient budget for the Middle Rio Grande Basin. For 1976 conditions, and assuming considerable nutrient-removal by activated sludge treatment, Albuquerque's effluent can be identified as accounting for approximately 50% of all the nitrogen and phosphorus introduced to the Basin each year, and one-third of all the nutrients measured at San Marcial, above the headwaters of Elephant Butte Reservoir.

Many studies, including algal assays made as part of this EIS, identify nitrogen as the critical nutrient limiting aquatic productivity in the Basin under most circumstances. Phosphorus is far more abundant in the Rio Grande than in most river systems, and the nitrogen-phosphorus ratio is unusually low, about 2:1. This is one reason why EIA (1976) indicated that wastewater treatment to remove phosphorus from Albuquerque effluent would have little if any beneficial effect on Elephant Butte water quality.

The mass balance and algal assay data indicate that nitrogen discharges from Albuquerque's treatment plants should be an important factor in determining the nutrient status of Elephant Butte Reservoir. However, it is difficult to trace nitrogen discharges from the City treatment works and relate them to changes in water quality at San Marcial or in the reservoir. Processes such as nitrification-denitrification, ammonia volatilization, sediment sorption, and biological uptake (by crops, phreatophytes) appear to be active within the river system, and probably account for a considerable removal of nitrogen from river water. High nitrogen concentrations observed at San Marcial appear to relate in part to movement of sediment-borne organic-N during flood cycles; the ultimate source of this organic-N could be Albuquerque wastewater, agricultural return flow or tributary inflow from the Rio Puerco and Rio Salado.

Regardless of uncertainties as to the origin and fate of nutrients in the Middle Rio Grande Basin, there appears to be a consensus among investigators that Elephant Butte Reservoir does not now exhibit serious nutrient-related water quality problems such as blooms of blue-green algae or fish kills related to turnover of oxygen depleted water. In short, the lake is not eutrophic. It appears that factors such as turbidity (which blocks sunlight and reduces photosynthesis) and fluctuations in lake level (which interfere with spawning) limit aquatic productivity despite the presence of relatively abundant nutrients. Other factors of possible importance include: the role of sediment as a nutrient sink; the influence of parameters such as alkalinity, manganese and trace metals, which may inhibit algal productivity; and the relative scarcity of nutrients in readily bioavailable forms.

It is uncertain if increased nutrient supplies to the reservoir would benefit or harm the value of the lake for recreation purposes. Jester (1971) indicated that more nutrients could be beneficial, and would improve the fishery potential of the water body. Certainly the control of nutrients in the reservoir would not overcome fundamental problems which already determine recreation values, such as the natural high turbidity of lake water, the variability of water levels, and the frequent occurence of undesirably low water levels.

Reflecting all the factors noted above, the State has established the policy that "the need to remove algal nutrients such as nitrogen and phosphorus from municipal wastewaters in order to protect reservoirs in lower stream reaches has not been established" (NMWQCC, 1975, p. 5). This statement was reaffirmed by the 1976 study of Elephant Butte (EIA, 1976, p. 55). The specific reasoning stated was as follows:

- phosphorus removal is not justified because it is unlikely that the reservoir can be made phosphorus-limited;
- biologically available nitrogen from Albuquerque's wastewater is being effectively removed by natural processes in the river, such that increased N-loadings from the City will not necessarily result in increased nitrogen reaching the reservoir headwaters;
- increased nutrients in the reservoir may not lead to increased productivity, especially if light is the principle factor limiting algal production in the turbid lake water;
- undesirable water quality trends are not detectable at Elephant Butte;
- even if remedial action (e.g. nutrient removal at Albuquerque) were undertaken only after the onset of nuisance algal conditions, the characteristics of the reservoir are such that recovery time would be short.

2.4.4 Ground Water Quality in the Albuquerque Area

Ground water in the planning area is generally of quality suitable for use as a drinking water supply. Relatively poor quality water occurs in three locations, as shown on Figure 2-11: the far West Mesa; Tijeras; and the Valley. Table 2-11 provides representative data for City drinking water and for samples taken in the Tijeras and Valley areas.

West Mesa. Deeper portions of the Santa Fe Group aquifer, including areas beneath the far West Mesa, have been known to yield naturally mineralized ground water and possibly to contain excess heavy metals. At present this water

TABLE 2-11 REPRESENTATIVE RANGES OF DATA ON GROUND WATER QUALITY IN THE ALBUQUERQUE AREA.
All data given as mg/l ND = No Data.

Parameter	City wells (EIA, 1974) Represents water quality of deeper wells.	Domestic wells, valley area (Clayton, 1966)	Tijeras Canyon area (Caprio, 1960) [1]
Total Dissolved Solids	160 - 480	213 - 1852	204 - 594
Hardness as $CaCO_3$	18 - 273	187 - 1380	ND
Alkalinity as $CaCo_3$	97 - 181	ND	112 - 310
Sulfate	17 - 180	35 - 959	18 - 221
Nitrate (NO_3)	0 - 8.0	0.9 - 1255 [2]	0 - 91
Iron	0 - 0.77	0 - 2.2	0 - 7.5
Manganese	0 - 0.50	0 - 4.0	ND

[1] Data from Coyote and Embudo Canyon Springs not included.

[2] Data from survey performed by Lee Wilson & Associates, 1976 (see EPA, 1977).

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is not used and causes no significant problems. However, the remote potential exists that overdevelopment of fresh ground water in the shallower part of the aquifer could lead to upward migration of the saline water, contaminating the regional water supply.

Tijeras. Ground water in the Tijeras Canyon area contains nitrate-nitrogen in excess amounts, with many wells tapping water which is unsuitable for domestic use. As shown on Figure 2-11, the contamination extends down Tijeras Arroyo to the Mountainview area. Titus (1974) concluded that the nitrate levels result from sewage discharges from septic tanks and cesspools. However, the available data demonstrate that such discharges are far too small and localized to account for such a large problem, especially since the contamination predates much of the development of the area (see discussion in EPA, 1977, Section D-5, part p). It is conceivable that the contamination could be largely of natural origin, since studies in other areas have determined that nitrate pollution can occur naturally in areas of limestone and evaporite deposits of the type underlying the Sandia-Manzano Mountains. It is also possible that an as yet unidentified man-made problem is the source of the pollution.

Valley. The third problem, and the one of greatest significance to wastewater management, is that alluvial ground water at shallow depths beneath the Rio Grande flood plain is consistently of much poorer quality than water found at greater depths in the same aquifer (Clayton, 1966). The contaminated shallow water, which extends to a depth of 50 to 100 feet, differs from the deeper water in the following ways: more dissolved solids; more sulfate; greater hardness; nitrates are present in small but significant amounts; bacterial contamination occurs locally; iron and manganese are often found at levels far above the drinking water standards; and some problems occur of bad odor, color, and taste, as well as laxative effects.

At least three sources can be identified to account for the observed contamination: a) percolation of excess irrigation water, which is generally more saline than the receiving ground water; b) animal wastes, fertilizers, soil amendments and other pollutant sources associated with agricultural activity; and c) domestic, commercial and industrial sewage and other wastes discharged by the approximately 18,000 on-site systems which occur in the valley area. These sources cumulatively would be expected to cause the observed mineralization (dissolved solids, sulfates, hardness). The specific causes of the other problems require more discussion.

With two exceptions, nitrates in the valley are found at comparatively low concentrations, usually less than 1 mg/l (as N). However, this low-level contamination is widespread, occurring throughout the area where the water table is shallow. It appears that the nitrates represent a chronic, low-level degradation of ground water related to sources such as domestic sewage and animal wastes. Indeed, such sources are sufficiently large that higher nitrate levels than those observed might be expected. Two explanations could account for the relatively modest amount of pollution. First, the nitrate may be quickly flushed through the relatively permeable aquifer to irrigation drains and then to the Rio Grande, preventing any marked build-up in concentrations. This would also explain the observed increase in nitrates in the Rio Grande which occurs as the river passes through Albuquerque. Second, most sewage and animal waste discharges occur as ammonia and organic nitrogen, that is in forms which may be temporarily stored in the soil. Conversion of these

forms to nitrate, through nitrification, could be inhibited by the high water table and general prevalence of anaerobic conditions in the soil. If this is true, the possibility exists that much nitrate may be released to ground water as the water table is lowered in the future by increased pumping for municipal water supplies.

The two exceptions noted above occur where nitrates are present at levels much above the low-level degradation found elsewhere (see Figure 2-11). In the case of Mountainview the nitrates appear to be derived from the Tijeras Canyon area, discussed previously, although local sources cannot be completely ruled out. The other problem area, Pajarito, occurs in an area which is hydrologically down-gradient from the large concentration of septic tanks and cesspools found in the Atrisco and Armijo neighborhoods. Highly permeable deposits in a prehistoric channel of the Rio Grande may play a role in transmitting sewage-related pollution from those neighborhoods to the Pajarito area. Again, local sources cannot be completely eliminated as a contributory cause of the problem.

The data on bacterial contamination are extremely limited. However, as discussed in EPA (1977), there appears to be no question that problems can and do occur in areas where on-site water supply and waste disposal systems do not meet sanitary standards. Most cases of drinking water contamination recorded in the North and South Valleys seem to relate to site-specific sanitation conditions. The data do not demonstrate that a regional pollution problem exists, since many wells obtain a bacteria-free water supply. The only evidence suggesting such a regional problem is the observed increase of bacteria levels in the Rio Grande as the river passes through the planning area. Studies made elsewhere (e.g. Socorro) indicate that discharges from on-site systems can lead to increased bacteria levels in nearby surface waters. Thus, it is reasonable to infer that on-site disposal of domestic and commercial sewage to the shallow water table beneath the Rio Grande Valley can and probably does lead to some degree of bacterial pollution throughout the valley area. However, this does not necessarily mean that regional health problems result. Moreover, other sources such as animal confinement facilities and urban storm runoff also are presumably responsible for a portion of the surface water problem.

Most public complaints about the shallow alluvial ground water center on the problem of iron and manganese pollution which results in a supply which is extremely undesirable for household use because of odor, color and taste. Youngblood (1974) indicates that the problem relates to the large amount of organic material which moves through the soil to the ground water as the result of agricultural practices (animal wastes, fertilizer) and sewage discharges (on-site systems). This results in a high oxygen demand and anaerobic conditions in the soil and ground water. The oxygen-depleted water is readily able to move iron and manganese from the soil into solution.

The above discussion clearly indicates that ground water pollution is a major problem along the Rio Grande Valley in the Albuquerque area, and that sewage disposal by on-site systems plays a significant role in creating the problem. As will be discussed in Section 2.4.5, it is not certain if this pollution is associated with regional health problems; however, local unsanitary conditions and a regional impairment of the aesthetic quality of drinking water both occur.

It should be noted that elimination or upgrading of on-site waste disposal systems in the valley area would not guarantee an immediate improvement in water quality. This is true because other sources (agriculture, percolating flood waters from urban runoff) are also significant, and because at best ground water recovers from pollution only over a period of many years. One implication is that over the short-term, problems of drinking water contamination in the valley area would require solutions such as deep wells, hookup to a public water supply of good quality, use of treatment units, or water hauling.

2.4.5 On-Site Liquid Waste Disposal and Water-Borne Diseases

The primary goal of regulations which govern the use of on-site systems (OSS) is to prevent sewage contamination of water supplies, or seepage of sewage to the ground surface, and thus eliminate one major source for transmission of diseases. To determine if the 20,000 or so existing septic tanks and cesspools in the area cause public health problems it is appropriate to determine if the existing systems conform to the regulations, and if disease patterns exist which may be attributed to on-site liquid waste disposal.

Suitability of OSS. For common soil and water table conditions in the Albuquerque area current regulations require that OSS be used only on lots of 1.25 acres or larger, in order to allow for adequate separation of a drainfield from a household well. Where public water supplies are available the lot size may be somewhat smaller, and where soil conditions are particularly favorable it may be possible to install a conventional septic tank and drainfield on a lot as small as 0.5 acres. Conventional OSS are not permitted where the water table or bedrock is within four feet of the surface, where soil percolation rates are very slow, where flooding occurs at least once per 25 years, or where slopes exceed 25%.

Figure 2-12 is a map displaying the environmental conditions appropriate for determining if existing OSS conform to the above regulations. The map indicates areas where:

- lot sizes are generally less than 0.5 acres (OSS not suitable);
- lot sizes are generally from 0.5 to 1.25 acres (OSS suitable unless soils are adverse);
- soil limitations are so severe that the use of conventional OSS are not generally acceptable;
- the water table is within 12 feet of the surface (OSS permitted only on lots 1.25 acres or larger under normal circumstances).

The map does not show areas where the slope exceeds 25% or where flooding occurs at least once per 25 years; in general all such areas are characterized by soils which have severe limitations to OSS use.

OSS can be considered to be well suited for waste disposal only where soil conditions are favorable, flood and water table problems are absent, and lots are large. As shown on Figure 2-12, such conditions occur throughout those parts of the West and East Mesas where development is incomplete or open (except the Volcanoes).

All other locations have some limitations to OSS, due either to soil conditions or lot sizes. Soils are acceptable but lots are often smaller than allowed in the following areas: East North Valley below Homeland Road, Mountainview, and Alameda. Soils are unacceptable in the Southeast Valley area, but densities are extremely low to the point that no major problems would be expected. East Mountain area soils are generally limited due to slope, shallow soils over fractured bedrock, and/or a few high density situations; many localized exceptions occur though.

There are also locations where densities consist of clusters mixed with open space, such as the Arenal district of the Southwest Valley, the Southwest Valley below Gun Club Road, Corrales, Los Ranchos de Albuquerque, and Los Duranes. High water table in some of these locations creates a potentially serious OSS problem.

As indicated by the map and the above discussion, the greatest health dangers should occur in the Valley natural unit, which is generally unsuited for use of conventional OSS because of problems such as high water table, fine-grained soils and/or flood hazards. Densities range from urban to completely rural, and problems exhibit the same range--that is complaints about water quality are more frequent in the more densely populated areas. It is readily evident from the map that if existing regulations had been in force over the past 50 years, development in the Valley would have been much less extensive than has actually occurred. In effect the regulations protect the OSS in the valley because no retroactive provisions apply. If the grandfather clause protection were removed it is likely that most of the valley OSS would have to be replaced.

To summarize: there is a mismatch between actual waste disposal practices and environmental conditions adverse to such practices, primarily occurring in the unincorporated portions of the North and South Valley. The most evident result of this situation was discussed in 2.4.4 and is the wide-spread occurrence of ground water contamination in the shallow valley aquifer. This contamination is evidenced by excess iron and manganese levels, high dissolved solids and hardness, frequent odor problems, and widespread low-level degradation by nitrates. Another result is discussed in 2.6.3 and relates to the reduced land values where OSS are used, and the problems citizens experience in obtaining Federal loans to buy or improve homes in areas where OSS do not meet the standards.

Health Effects. Available information is conflicting regarding health problems which might be associated with unsanitary liquid waste disposal practices in the planning area. Data on enteric diseases indicate that Shigella, Salmonella and infectious hepatitis are reported to occur more frequently in areas such as the South Valley, where OSS are the rule, than elsewhere in the Albuquerque region (Table 2-12). Since these diseases may be water-borne, the data suggest that the existing waste disposal practices could be responsible for a public health problem. Further, John Zonski of the City Environmental Health Department reports having obtained positive tests for coliform bacteria in the large majority of private water systems he has sampled (see letter, Section D-6 of EPA (1977)).

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TABLE 2-12 INFORMATION RELATED TO WATER-BORNE DISEASES

1. Enteric Disease Rates (per 100,000 population)

		South Valley	Bernalillo County	State	National
Hepatitis -	1971	262	89	59	28
	1972.	112	72	-	-
Shigella -	1971	282	72	25	10
	1972.	109	73	-	-
Salmonella-	1971	24	20	9	0
	1972.	35	31	-	-

Source BCHD (undated) Sherman (1973)

2. Southwest Valley Shigella Cases, 1972, by Data Analysis Zone

DAZ	#Cases	Pop	Rate/100,000
553	0	184	0
540	0	1,214	0
543	1	199	500
550	2	516	390
551*	0	3,580	0
552	0	2,029	0
553	3	2,832	106
560*	9	2,716	330
561*	6	4,341	138
562*	4	5,027	80
563*	9	10,356	87
564*	3	3,011	100
571	0	669	0
Unkn.	0		
Total	40	36,674	109

Source Sherman (1973)

*DAZ's comprising Southwest Valley.

3 Age and Sex of 1972 Southwest Valley Shigella Cases.

Age	Male	Female
0-4	11	9
5-9	2	5
10-14	2	2
15-19	2	1
20-24	0	2
25-29	1	0
30-34	0	2

Source Sherman (1973).

4. Southwest Valley Well Survey, 8-7-73*

Coliform Colonies per 100 ML	Number of Wells
0	33
1-10	7
11-20	5
21-100	3
over 100	8

*Taken during a period of local flooding

Source Albuquerque Environmental Health Department files.

However, a number of factors must be considered in interpreting the available information.

- Contamination of raw drinking water is just one pathway for transmission of enteric diseases; personal hygiene is equally if not more important.

- Reporting procedures for enteric diseases are better from public hospitals than from private doctors, so that disease rates from comparatively affluent neighborhoods are probably underestimated.

- Many of the private water systems in unsewered areas do not meet modern standards for construction, and may be contaminated because of site-specific unsanitary conditions rather than because of a regional problem related to on-site waste disposal. For example, a specific survey of 56 OSS in the Arenal area in 1973 indicated that 95% of the systems substantially violated sanitary standards (Matotan, 1975).

It is also worth noting that the data in Table 2-12 reflect conditions in 1972. Data from 1973-1975 show a gradual reduction in enteric diseases in Bernalillo County. In 1975 the County, which contains nearly 40% of the State population, reported only 29% of the State's Shigella cases. Salmonella rates declined by nearly half from 1972 to 1975. Infectious hepatitis (Type A) declined slightly, though viral hepatitis increased statewide. Moreover, the fact that enteric disease rates drop off markedly with increased age suggests that poor hygiene practices among children is a significant factor accounting for the occurrence of enteric diseases.

Certainly, numerous unsanitary waste disposal and water systems exist in the area. These represent a source of site-specific health problems worthy of immediate attention. However, it appears from the data that public health problems in areas which utilize OSS relate to a number of causes, all of which must be corrected if community health is to be brought up to modern standards. Beyond individual cases, the disease statistics do not provide conclusive evidence of health problems resulting from improper on-site waste disposal. Given the variations in data associated with reporting procedures, it is unlikely that any correlation will be found between regional health problems and ground water contamination resulting from liquid waste disposal. Rather the problems which do relate to OSS will occur mostly where the site-specific problems occur.

The high incidence of diseases which may be partly water-borne can be expected to continue as long as some citizens receive any part of their water supply from shallow and poorly constructed wells, and as long as septic sytems malfunction so that effluent reaches the surface and has potential contact with children, domestic animals, garden vegetables or other environmental receptors. With disease comes missed school and work days, reduced educational and employment opportunity, and continued deficits in local income. This in turn means a continued inability to maintain proper wells and septic systems, and thereby a continued unnecessary exposure to disease. Thus, water pollution is part of an unfortunate cycle in which social inequities persist unbroken. Good hygiene alone cannot correct these problems if unsanitary waste disposal practices continue.

Summary. Albuquerque suffers from an abundance of on-site liquid waste disposal systems, most of which occur in areas of bad soils and/or on small lots. Disposal relies on dilution of wastes by ground water, and not on adequate treatment. Regional health problems cannot be attributed with certainty to the disposal practices, but some widespread low-level degradation of water quality has occurred and site-specific sanitation problems are not uncommon. Increasingly stringent regulation of OSS will probably keep the problem from getting much worse, but unless existing inadequate systems are replaced, conditions will not improve.

2.4.6 Summary of Water Quality Conditions

The following conclusions regarding water quality in the Middle Rio Grande Basin are based on relatively poor data, but appear valid as to basic findings.

- Historically water scarcity has been considered a greater problem than water quality in the Basin.
- Natural and non-point sources are responsible for a greater total amount of water quality degradation in the Basin than are point sources.
- No pollution problems exist which interfere with the beneficial use of water and which are directly attributable to wastewater management practices.
- The most significant surface water quality problem in the Basin which may relate partly to wastewater management is the frequent violation of bacteria standards at numerous locations. According to the Basin Plan (NMWQCC, 1976a) non-point sources are a significant cause of the observed problem, such that control of point sources would not lead to standards being met.
- The most significant ground water quality problem in the Basin which may be attributed to wastewater management is the degradation of drinking water supplies in the shallow aquifer beneath the Rio Grande flood plain in the Valley region. Wastewater discharges from septic tanks and cesspools are only a partial cause of the problem, and do not cause a regional health hazard, although they may cause local health problems.
- Public concerns have been expressed regarding many other water quality issues -- especially those related to nutrient enrichment of Elephant Butte Reservoir, discharge of toxic chemicals, and nitrate pollution in the Tijeras area. The Tijeras nitrates appear to be natural in origin, and almost certainly do not result from wastewater discharges. Nutrient and toxic metal problems are as yet poorly defined; if such problems were to exist it is not certain that they could be alleviated by changes in wastewater management practices in Albuquerque.

Despite the finding that Albuquerque's wastewater does not now appear to be a major source of pollution problems, the prospect exists that such problems may occur in the future. For example, agricultural water use south of Isleta may be impaired during low flow periods within the next few decades, as wastewater discharges increase. This problem is discussed further in Section 3.1.2.

2.5 THE BIOLOGICAL ENVIRONMENT

In deserts the availability of moisture is often the most important ecological variable. This is true in the Albuquerque area, where plant and animal communities near the Rio Grande are much more productive and diverse than those which occur in the drier parts of the region. There are two important riverside habitats: a) wetlands which are found where the water table is at or very near the ground surface; and b) bosque, or woodlands, which occurs where the water table is deeper.

The discussion which follows emphasizes the riverside habitats because: the habitats are rare, and in the case of wetlands, endangered; the riverside areas are the most likely to be impacted by wastewater management; the habitats are critical to maintaining a diverse array of wildlife in the Middle Rio Grande Basin; the wetland and bosque areas are particularly important to migratory birds and waterfowl, including a number of endangered or threatened species. The most valuable habitat areas occur downstream of Albuquerque, in a number of wildlife refuges. Also downstream is the major aquatic habitat of the Basin, Elephant Butte Reservoir, which supports a widely used fishery.

2.5.1 Communities in the Albuquerque Area

The distribution of natural biological communities in the Albuquerque area corresponds approximately to the natural regions discussed in Section 2.0.1. and graphically depicted on Figure 2-3. Detailed information on these communities is presented in Section E-1 of EPA (1977).

- The mountain area contains pinon-juniper woodlands at lower elevations and pine-fir forest above 8,000 feet, with a varied wildlife including larger mammals and birds.
- Grasslands occur on the mesas where grazing and subdivision development have generally disturbed the native species (black grama, Indian rice-grass and others); wildlife tends to be concentrated near arroyos and includes varied insects, reptiles, rodents and birds adapted to a desert environment.
- An agricultural/residential community occurs in the valley and is characterized by irrigated fields, lawns, vacant lots, and a civilization-adapted wildlife.
- A riverside woodland or bosque occurs near the river where trees such as cottonwoods, willows and Russian olive have replaced the marsh and meadow vegetation which once occupied the area. A varied wildlife utilizes the area, including amphibians, reptiles, small mammals and numerous migratory waterfowl.

Aquatic and wetland environments are very limited in the planning area, and include the Rio Grande channel (which is rather sterile), moderately productive drains and canals, and the one extant marshland, a 37-acre tract near the University of Albuquerque. Wetlands were formerly much more extensive, but have been eliminated by irrigation drainage and channelization projects which have lowered the water table and altered the physical environment (BOR, 1975, p.B-100).

2.5.2 Downstream Habitats

Aquatic and wetland habitats are very important downstream of Albuquerque and include the river channel, canals and drains, marsh and woodland areas and Elephant Butte Lake. These environments are described in Section E-2 of EPA (1977). The river channel is characterized by a shifting sand bottom, highly turbid flows, and seasonal dryness. The resulting habitat is quite sterile and is incapable of supporting a productive aquatic community without radical modifications. Similar problems restrict the ecologic value of irrigation canals. In contrast riverside and irrigation drains normally have year-round flow and comparatively clear water. Modestly productive fishery resources occur in some drains, primarily where State fish (trout) stocking programs are employed. However, periodic maintenance actions such as dredging disrupt the habitat on a long-term basis.

The riverside bosque and wetlands are distributed as a function of water table depth, with the woodlands being dominant where drainage has lowered the water table and led to a dominance of deep-rooted phreatophyte vegetation, especially salt cedar. These woodlands consume a significant portion of the Basin's water resources and provide habitat for some game and song birds. However, they lack the wildlife diversity characteristic of the open water, marsh and swamp communities they replaced. Because wetland habitats have declined, those areas which remain are extremely significant and valuable to the ecology of the Rio Grande Basin; they represent, in effect, rare and endangered habitats. Figure 2-8 indicates the location of the significant wetlands, most of which are special refuges administered by State or Federal agencies which supervise their use as hunting or wildlife observation sites.

The high value of river-related wetland was indicated by BOR (1975, B-134), which noted that, "the combination of open water, shallow marsh areas, irrigated cropland bordering the river, and the absence of other waters make the Rio Grande system one of the most important waterfowl areas in New Mexico". The most important refuge is Bosque del Apache, which includes 7,000 wetland acres. A total of 268 bird species have been identified within the refuge; thousands of sandhill cranes, ducks and geese utilize the area each year. Endangered or threatened species present include Mexican duck, peregrine falcon, southern bald eagle, Mississippi kite, osprey, and whooping crane. Mammals, amphibians and reptiles abound, including deer, muskrat and coyote. The Bosque del Apache was projected to receive 60,000 or more visitor-use days in 1976. Studies to investigate the habitat value of river-related wetlands have been initiated by the New Mexico Department of Fish and Game and are expected to lead to improved management of the habitats over the next several years.

Elephant Butte Reservoir is a popular fishing area. Dominant game fish include walleye and bass; these introduced predators are at the top of a food chain which has phytoplankton (algae) and detritus at its base. Forage fish, especially gizzard shad, are the dominant food source for the game fish and are a major consumer of the standing plankton crop. Rough fish such as carp and carpsucker are important in terms of biomass, and successfully compete with the other species. Populations of the rough species have been controlled in recent years through measures such as commercial fishing. Overall the fish resource is somewhat limited because lake productivity is limited. Factors such as water turbidity and extreme fluctuations in surface elevation appear to be responsible for restrictions of the fishery potential of the reservoir. To promote game fish populations, reservoir management practices now attempt to stabilize the lake level during critical spawning periods (primarily May).

2.5.3 Endangered Species

Lists of endangered mammals, birds and fish which might be affected by wastewater management in Albuquerque are given in the Technical Reference Document (EPA, 1977, Section E-3) and the Basin Plan (NMWQCC, 1976a).

The majority of these species are dependent on aquatic habitats. Fish species include the shovelnose sturgeon, prosperine shiner, and bluntnose shiner. Both shiners are likely to be extinct in New Mexico at this time (BOR, 1975a), or at least restricted to areas below Elephant Butte Dam. The only confirmed record of the shovelnose sturgeon was a specimen collected at Albuquerque in 1875.

Four endangered bird species regularly frequent the Middle Rio Grande. The whooping crane has used the Rio Grande flyway enroute to wildlife refuges to the south (Bosque del Apache, Belen, Bernardo). Formerly a more common winter resident, the whooping crane was eliminated in New Mexico through loss of its wetland habitats and by overhunting. A "foster parent" program involving sandhill cranes has allowed reintroduction of the whooping crane to Bosque del Apache National Wildlife Refuge (4 in 1975-76), and numbers are expected to rise in the future. The southern bald eagle and American peregrine falcon also use the flyway in migration. The former winters irregularly at Bosque del Apache and Elephant Butte Reservoir. The peregrine falcon has been known to nest in cliffs on the west side of the Sandia Mountains. In both cases breeding has been adversely affected by persistent pesticides, and because some young falcons are taken illegally by falconers. The Mexican duck breeds on the lower Rio Grande but has been observed as far north as Albuquerque. Protected marshland refuges have been established for it at Elephant Butte Marsh (north end of reservoir), Bosque del Apache, and San Simon Cienega. It is felt that as yet undetermined changes in habitat have favored the common mallard duck, and resulted in hydridization and thus reduction of pure strains of the Mexican duck.

Two endangered mammals are listed for New Mexico. The spotted bat, residing in high cliffs and canyons, is listed only as "restricted" by the New Mexico Department of Game and Fish, due to its relative abundance locally. The black-footed ferret is a rare animal, so reclusive that after first being described in 1851. no specimens were reported by U.S. naturalists until the turn of the century. A decline in numbers is apparently due to secondary poisoning from programs to eradicate the prairie dog, which is the ferret's preferred food source. Principally a grassland dweller, its range is all of central and northern New Mexico.

Threatened mammal and bird species (in less serious danger of extinction than endangered) which may be found in the Middle Rio Grande Valley are the black-tailed prairie dog, olivaceous cormorant, Mississippi kite, grey hawk, black hawk and osprey. The cormorant is at its northern limits in New Mexico, and deterioration of habitat could wipe out the only breeding colony in the state at Elephant Butte Reservoir. Both hawks and the kite are very rare, at best, and destruction of riparian habitat and shooting are major problems. The osprey (fish hawk) is a rare breeder in the State, almost totally dependent on fish for food.

No endangered or threatened invertebrates have been identified which would be impacted by any wastewater-related actions. One threatened plant (Pediocactus papyracanthus, a cactus) and one proposed endangered plant (Petalostemum scariosum, a member of the pea family) occur in habitats of the type which are found on the mesas and the Sandia Mountain foothills. Any construction projects on previously undisturbed mesa or foothill lands could adversely affect these species.

2.5.4 Vectors

Vector organisms, such as rats, mosquitoes and flies, have not been reported as occurring in significant numbers in association with any of the City's wastewater facilities. According to the records of the City Environmental Health Department, significant problems occur with the many cesspools and septic tanks which occur throughout the planning area. Wherever such on-site systems are not sealed, mosquitoe breeding commonly occurs. This is considered by the Department to be by far the most significant concern regarding wastewater management and vector control.

2.6 SOCIO-ECONOMIC ENVIRONMENT

Major socio-economic aspects of the Albuquerque environment include: population size, characteristics and distribution; land use patterns and projected changes resulting from the Comprehensive Plan; economic conditions, including the extent and location of major private investments; the existing infrastructure of the urban complex, especially utilities which can be supportive of future growth; and capital improvements intended to expand the infrastructure.

2.6.1 Population

Albuquerque's most explosive period of growth occurred during World War II and the following decade. The 1940 population of about 35,500 increased more than five-fold by 1960, when it exceeded 201,000. More recently growth has been slower but relatively steady, to the point that the present population of the planning area (which excludes those living on Federal land) is 358,150.

Detailed population projections have been made as part of the Facility Plan (MMC, 1977), based on a study by BBER (1976) and additional work by the City/County Planning Department. A population of between 590,000 and 687,000 is projected in the year 2000 for the planning area. Table 2-13 summarizes the projections for the major political subdivisions of the area. As with any such forecast, the estimates could be significantly high or low. For comparison, the Basin Plan forecasts a population of only about 630,000 in the year 2000 for an area which includes not only Albuquerque but Bernalillo, Peralta, Los Lunas, Belen, Socorro, and vicinities (NMWQCC, 1976). The ultimate population of the area, based on environmental carrying capacity, could approach 2,000,000 (ABCPD, 1972).

Ethnic minorities comprise nearly half the population (BOR, 1975, p. B-180). For Bernalillo County in 1970, 39.2% of the population was Spanish-surnamed, 2.1% was classified as Negro, and 1.8% were Indian. Half the citizens were born in New Mexico. The median age, 24.4 years, is similar to that for the State as a whole.

2.6.2 Land Use

Land use in the planning area reflects a pattern of urban development which has gradually expanded at the expense of agricultural, rural and vacant land. As a result much of the area is now a sprawling urban/suburban complex. Some cropland remains, mixed with urban/rural development in parts of the North and South Valleys. Several large parcels of vacant grazing land occur on the mesas; most of these are being held for eventual subdivision or commercial development. Much of the other rural or open land is publicly owned.

TABLE 2-13. PLANNING AREA POPULATION PROJECTIONS. Source: MMC, (1977)

		1970	1975	1980	1985	2000
Total Planning Area:	low	-	-	393,200	434,000	590,000
	medium	304,695	358,150	398,200	443,000	-
	high	-	-	401,200	471,000	687,000
City of Albuquerque.	low	-	-	340,383	393,201	-
	medium	243,420	303,100	349,321	397,486	-
	high	-	-	355,395	427,618	-
Los Ranchos de Albuquerque		2,200	2,400	2,600	3,000	-
Corrales (Sandoval County)		2,000	3,150	4,200	5,000	6,000
East Mountain Area		1,550	1,600	2,280	2,700	3,750
North Valley (north of Osuna Road, east of river)		9,393	12,973*	13,500	14,900	18,500
South Valley (south of Bridge Blvd. to Isleta Reservation)		29,185	31,787*	34,800	36,500	45,000

* 1973 estimates

Within the metropolitan area most land is used for single-family residences. Multi-family dwellings and retail outlets tend to occur along major streets, while manufacturing and wholesaling activities are scattered, though most often found near the north-south railroad line or near one of the major interstate highways/freeways. Offices are concentrated in the Central Business District, and along both freeways. Data on land use and ownership in the study area are given in Section F-1 of EPA (1977).

During the past decade there has been increasing public concern that the existing urban development pattern is inefficient and undesirable. In 1975 the City and County adopted a new Comprehensive Plan (CP) in order to accomplish development in a more orderly fashion (ABC, 1975). The heart of the CP is a set of land use, environmental and economic policies and goals which are intended to produce an attractive, diverse and efficient metropolis. Conformance to the principals of the CP is one of the prime objectives of the wastewater management planning process. Indeed, once adopted, the Facility Plan will become an official part of the CP.

Figure 2-13 illustrates the major land use policies of the CP. New development is to be accommodated to a large extent within the already existing urban and urbanizing areas, and on suitable portions of the adjacent mesas. Development is discouraged or prohibited in most rural and open areas, especially where land has aesthetic or recreational value or is unsuited for construction. Particularly designated for protection are the Bosque, the Sandia Foothills and the Volcanoes.

Figure 2-13 differs from the plan published in 1975 in that it has been expanded to include areas such as Corrales and Tijeras. Corrales is shown as maintaining a rural character, based on the official village zoning policy. The East Mountain area is similarly designated rural, reflecting goals of the Plan for that region (ABC, 1975d). In both cases, as elsewhere in the rural areas, denser development, including commercial activity, may occur in clusters.

Extensive consideration of economic and environmental impacts went into the establishment of the land use policies discussed above. For example, the promotion of a compact urban form is expected to reduce total development costs, and the limitation of development in the valley areas is expected to help control air pollution problems, reduce flood damage risks and have other advantages. Therefore, unless special circumstances are present, it is reasonable to expect that any wastewater management alternative proposed in agreement with the Comprehensive Plan should have beneficial secondary impacts.

Enforcement of the CP is to be achieved by measures such as zoning, control of services and utilities, and use of taxation policies. For example, the basic approaches toward maintaining rural areas in the Valley include large-lot and agricultural zoning, a general policy against provision of urban-scale services and utilities to lightly settled areas, and the greenbelt taxation program. The latter was begun in 1967 and reduces the tax burden on those who maintain irrigated or grazing lands in urbanizing areas. None of these enforcement measures have been completely successful in preventing conversion of rural lands to more intensive development. For example, within Bernalillo County there has been a loss of Class-A* irrigated

*Class A parcels are those 5-acres in size and larger.

land amounting to 200 acres per year in recent years (Herkenhoff, 1973). If this rate of conversion were to continue, no sizable irrigated parcels would remain after the year 2015. This trend reflects the fact that farming on small parcels is economically marginal, while sale of land for subdivision purposes is generally profitable in the rural Valley areas. Thus, to achieve the goals of the CP additional measures may be required, such as public purchase of farms (with leaseback to operators), establishment of land trusts, and use of transferable development rights. These measures and others are under consideration by local planning agencies.

Provision of city utilities can play a role in accomplishing the goals of the Comprehensive Plan, since development is more likely to occur where municipal services are available than where they are absent. However, as discussed in 2.6.4, the lack of such services does not by itself prevent considerable growth from occurring in areas which are designated as rural or open. Thus, the future land use of the area depends primarily on the extent to which zoning and other measures are utilized to enforce the plan. Based on historical patterns, at least some departures from the planned land use must be expected.

Land Use Near Treatment Plants. The neighborhood near Plant #1 is dominated by industrial/commercial uses. Most of the former residential area immediately to the north has been razed and will be developed as an industrial park. This park will be managed to attract tenants of the light manufacturing and warehouse type. Vacant industrial commercial sites are also available south of the plant. Plant #2 is located in an area of mixed urban/agricultural land use. The low-density Mountainview Community occurs to the south and the riverside bosque lies on the west. Farms bound both the north and south property lines.

The general area of the two treatment plants includes a number of animal confinement and processing facilities such as feedlots and packing and rendering plants. These facilities represent significant odor sources (see 2.2.4). Although planning efforts have attempted to remove the operations to unpopulated areas (e.g. a mesa industrial park), present County policy is to allow existing facilities to continue, provided they obtain a special use permit.

PAGE NOT

AVAILABLE

DIGITALLY

2.6.3 Economic Conditions

The planning area has a relatively healthy economy compared to much of New Mexico, which reflects Albuquerque's role as the trade and service center of the State. Employment and income data as of 1975, and projected through 1985, are presented in Table 2-14. These data indicate that the largest economic sectors are: wholesale and retail trade, personal and professional services, government administration and services, and education/medical services. Together these four groups account for 75% of all jobs and 68% of the gross dollar output in Bernalillo County. Light manufacturing and construction are also significant. Government employment, in both the downtown area and at the Air Force/ERDA complex of Kirtland/Sandia, is a mainstay of the economy, directly accounting for nearly 20% of all jobs.

At present there is about one job per three persons, with an unadjusted unemployment rate in June, 1976 of 7.7%. This compares to an 8.0% unemployment rate nationwide, and to a 7.9% rate in Bernalillo County a year earlier. According to Table 2-14, unemployment should decrease slightly in the next decade. Employment opportunities are better than elsewhere in the State, as illustrated by the fact that Bernalillo County contains 55% of all businesses in the State which employ more than 250 persons, though it contains only 31% of the State's population (NMU, 1974). However, Albuquerque's role as the State's economic center could be in decline. For although the City has 41% of all New Mexico bank deposits, in 1975 bank deposits grew only 7.2%, whereas statewide the growth factor was 12.7% (NMU, 1974). This reflects a shift in economic activity toward smaller cities, especially those in energy boom areas.

Despite Albuquerque's relatively good employment situation, the population as a whole is not affluent. Median family income (1970 census) was $7,371, about 10% less than the national average; the gap is estimated to have widened since then. There are also more families with sub-poverty level incomes in the area (16.3%) than nationwide (14.0%); however, the City compares favorably to New Mexico as a whole (22.0%). Incomes are unevenly distributed within the area. For example in 1970 family incomes were more than $1,000/year higher within the City than in adjacent unincorporated areas. As suggested by the income figures, poverty pockets are concentrated in some valley locations, especially in the South Valley where the percentage is 25-30% in some census districts. Similar percentages occur in other parts of the City, such as in the valley neighborhoods of Martineztown, Barelas and South Broadway. In contrast only about 5% of the income levels in the Northeast Heights were below poverty level in 1970.

Projections in Table 2-14 indicate that the New Mexico economy will not markedly improve in the decade ahead. Although personal income is projected to increase faster than the national average, it will remain well below that average. Confidence in the local economy is reflected by the large scale of private investments in recent years. Building permits exceed $10,000,000 per month, and the City was rated 16th among the nation's 200 largest cities in terms of permits issued during the first quarter of 1976. Section F-2 of EPA (1977) indicates the types and locations of $51.5 billion worth of public and private investments announced in the period January 1975 to May 1976; industrial parks are also listed and mapped. The reference provides an indication of areas where major development is occurring and growth pressures are most intense. Many of the areas are within the existing urbanized sectors of Albuquerque, or immediately adjacent in the Northeast Heights and West Mesa. The largest investments are by the Federal Government in the Kirtland/Sandia complex.

TABLE 2-14. PRESENT AND PROJECTED BERNALILLO COUNTY EMPLOYMENT AND OTHER ECONOMIC INDICATORS. Based on data presented in BBER, 1976, for medium population projections, and on U.S Census data.

Employment Sector	Number of persons 1975	1980	1985
Agriculture	710	666	616
Mining	96	96	98
Construction	12,200	13,779	15,069
Manufacturing (sub-total of below)	14,989	18,621	25,159
Food processing	1,933	1,860	1,809
Printing, paper, & wood products	2,437	2,740	3,127
Chemical, petroleum products, concrete & stone products	1,430	1,577	1,746
Machinery, electrical equipment fabricated metals, & misc. manufacturing	9,189	12,444	18,477
Transportation	3,956	3,943	3,952
Communications and Utilities	5,286	4,898	4,876
Wholesale and Retail Trade	35,897	37,104	37,400
Finance, Insurance, Real Estate & Insurance (sub-total of below)	28,621	31,100	34,313
F.I.& R.E.	7,673	8,115	8,823
Hotels & motels	2,610	3,180	3,526
Personal, business, & professional services	18,038	19,805	21,964
Educational, Non-profit, & Medical & Dental Services (sub-total)	18,425	20,634	23,371
Medical & dental	7,098	7,164	7,317
Educational & non-profit services	11,327	13,470	16,054
Government--Administration & Services	25,356	30,144	36,065
**********			
Total Employment Bernalillo County	145,236	160,985	180,919
Total Gross Output Above Sectors	$3,278x10^6	$4,006x10^6	$4,956x10^6
Percent of Employment in Albuquerque	93%	93.6%	94.3%
Personal Income Estimate-Bernalillo Co.	$ 4,368	$ 4,841	$ 5,310
Median Family Income in 1970 Albuq. $7,737, S. Valley $5,543; Remainder of County $6,646; County Average $7,371			
State's Share of Regional Employment	5.9%		5.2%
State's Share of Regional Earnings	5.3%		4.7%
State's Share of Regional Population	7.2%		7.0%
State's Per Capita Income as % of Nat. Ave.	80%		85%

Two aspects of area economics are of special interest in wastewater management planning. One is the fiscal capacity of local governments. Albuquerque has a large budget, exceeding $100,000,000 per year, with income originating from gross receipts tax, service revenues and bonds. This income is spent on a full range of municipal services and facilities. In contrast the County operates on a very small budget, about $13,000,000 in fiscal year 1974. Income is from property and gross receipts taxes and goes for very basic services, not including sewer, water, or other major capital investments. A discussion of City capital investments is given in 2.6.10.

The second aspect is the financial burden associated with use of on-site wastewater systems (OSS) in unincorporated, low-income areas. A survey of financial institutions in Albuquerque, including banks, the Federal Housing Authority, and Veterans Administration was made as part of a previous wastewater study (Matotan, 1975). The survey indicated that in locations such as the South Valley, loans are difficult to obtain and sale is sometimes held up for homes which are not connected to a sewer system, unless the homeowner is able to meet OSS standards. In addition, use of OSS generally depresses property values; a sewered house may be worth up to $500 more in a retail market than one which has a septic tank or cesspool.

2.6.4 Infrastructure

The term infrastructure refers to the framework of facilities and services which support life in any developed area, including: water supply, wastewater disposal, solid waste disposal, storm drainage, transportation, energy and communication utilities, health and safety, education, recreation and cultural facilities. This framework is important to wastewater planning for two main reasons. First it helps determine environmental conditions which interact with wastewater facility construction and operation, such as: buried utilities, storm runoff hazards, energy availability, and transportation-related air and noise pollution. Second, it is important in assessing the secondary land use consequences of extending sewerage utilities. All else being equal, urbanization is most likely to occur where adequate facilities and services are present. Thus provision of infrastructure allows for growth, and growth usually demands additional infrastructure.

Infrastructure considerations play a major role in the City/County Comprehensive Plan. The goal of accommodating growth by infill is intended to increase the use of existing facilities and reduce the need for new ones, thereby minimizing new public investment. One element of the Plan is directed explicitly to coordinating the construction of public infrastructure in the West Mesa area, to support expected growth and provide an alternative to further development of areas designated rural or open.

Sections 2.6.5 through 2.6.9 include information on important existing and future elements of the planning area's infrastructure. Three distinct areas can be identified.

- Within the City limits extensive public facilities and services exist, along with private utilities, educational and recreational facilities, good transportation networks and other urban infrastructure. By and large this area is capable of accommodating additional growth. A recent survey indicates satisfaction with most City services, with only the bus system and street repairs receiving less than 50% approval (Mallory, 1976).

- In the unincorporated valley areas services and facilities are much less extensive. However, this is not necessarily a critical factor restricting growth, because on-site water supplies and wastewater disposal systems are commonly used despite associated water quality problems. Given present regulations for on-site systems, development in the area must be at a relatively low density unless public sewers are available.

- Elsewhere in unincorporated areas infrastructure is generally limited, and on-site water supplies tend to be expensive or locally unavailable (e.g. East Mountain area). For such areas development probably requires public water systems (as well as transportation and other facilities). Wastewater collection facilities are also needed if the development is to be at medium or high densities (small lots; multi-family dwellings).

2.6.5 Water Supply and Sanitary Sewers

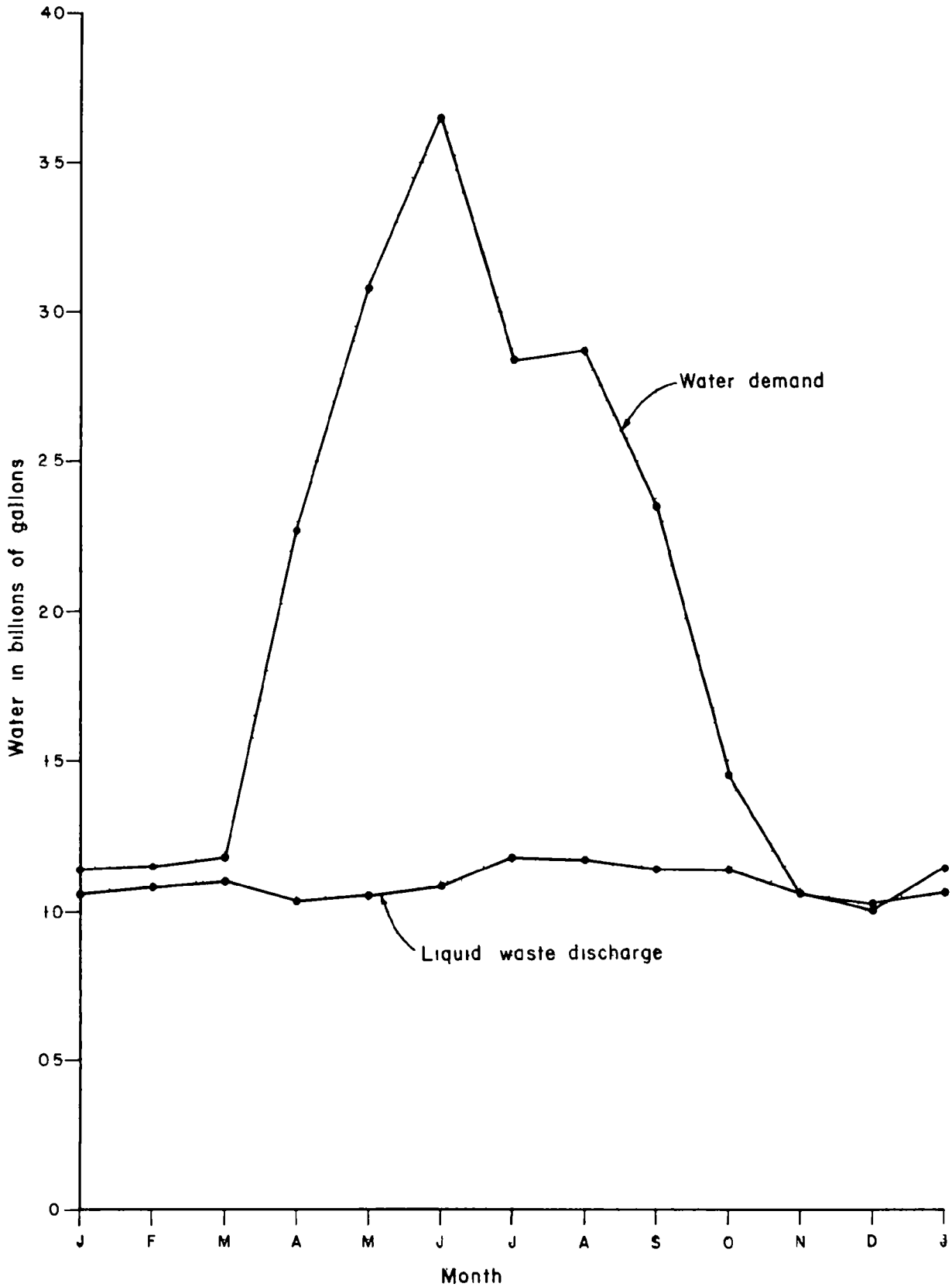
Water Supply. Albuquerque's municipal water supply is derived entirely from ground water by relatively deep wells and is of good to excellent quality. Subject to water right restrictions (see 2.3.4) there is little possibility of a shortage because of the large quantity of water stored in the Santa Fe Group aquifer. The pumped water is stored in a number of surface reservoirs (concrete and steel) and distributed by gravity through trunk and smaller lines to areas throughout the City, and to portions of the unincorporated North and South Valley. The distribution system, which involves 20 pressure zones, is controlled by computer automation. The supply is chlorinated to ensure that the naturally good bacterial quality is maintained throughout the system; it has been fluoridated since 1973. Additional information on the system, and other supplies in the area is given in Section F-3 of EPA (1977).

The master plan for water supply, developed in 1963 and followed rather closely since then, is now in the process of being updated and revised. The existing plan calls for continued extension of water lines into the unincorporated portions of the valley. Such extensions would go beyond the present South Valley service limit (Rio Bravo Road plus Adobe Acres) to the County line. Service would also extend to the Mountainview area including Wastewater Treatment Plant #2, which presently utilizes on-site wells for wash water and other purposes.

As would be expected on the basis of population growth, both total and peak water demand have increased in the past several decades, doubling every 15 years or so. In 1975, the average demand was 70 million gallons per day (78,500 acre-feet during the year) with peak demand exceeding 143 million gallons on June 25th. Per capita demand has also steadily increased, especially for peak periods which normally occur in June or July each year. In 1975, the average daily demand was 227 gallons per capita and the peak demand was 464 gallons per capita. These values are among the highest in New Mexico.

Figure 2-14 illustrates how water demand varied during the year 1974, and shows a pronounced peak during summer. The figure also illustrates the amount of return flow to the sewer system. During winter almost all the raw water pumped by the City was returned to and treated at Plants #1 and #2, and the consumptive use of water was small. In comparison, during summer only 25-35% of the water supply was returned to the sanitary sewer system; the remainder was consumed. Similar patterns are observed in other years. Presumably the high rate of water consumption in summer reflects use for lawns, air conditioning and other residential purposes, as well as increased needs by business and industry.

FIGURE 2-14. SEASONAL DISTRIBUTION OF MUNICIPAL WATER DEMAND AND LIQUID WASTE, ALBUQUERQUE, N.M., 1974



Outside of areas served by the City system, water is normally obtained from private wells; small water systems serve areas such as Sandia Heights and Paradise Hills. Private wells in the valley are often shallow and adversely affected by ground water contamination (see 2.4.4), but supply quantities are not limited, and water service as such does not effectively restrict growth in the valley. However, regulations as to lot sizes required for use of private wells and septic tanks do limit development densities. Private wells in the East Mountain area vary greatly in terms of yield and reliability; dry holes are not uncommon. Available planning documents indicate that the lack of adequate water supplies restrict the growth potential of this area (ABC, 1975d). In the mesa areas, since depth to water is normally great, well construction is expensive; private water supplies are thus readily available only to the affluent. Intensive development in the absence of public water supplies is unlikely.

Sewers. The City's sanitary sewerage system is described in 2.1.1. Service extends throughout the City, to Paradise Hills, and in the near future to most of the South Valley north of Gun Club Road. Parts of Sandia Heights and the Kirtland Base have their own facilities; elsewhere on-site systems are utilized. There are few areas where OSS of advanced design cannot overcome adverse soil conditions, and thus the absence of public sewer lines is not a constraint to development as such. However, as noted previously, existing regulations would prohibit dense development in the absence of public water and/or sewer service; in general OSS use is permitted only on lots 3/4-1 acre or larger. Special systems are needed for multi-family units, trailer parks, and the like.

Rate Structure. Section F-4 of EPA (1977) contains information on Albuquerque's complex rate structure for water and sewer service. Major components of the structure are:

- minimum monthly charges, based on meter size;
- incremental charges for water use beyond that allowed by the minimum charge;
- discounts (reduced rates) for large water users;
- discount in summer to residential water users;
- a standby charge for vacant lots which have access to a water/sewer line;
- sewer charges which are approximately half the water bill.

Minimum charges for residents in unincorporated areas are approximately twice those for City residents. This results in County residents paying the full cost of their water services, whereas part of the cost for service in the City has been borne by taxpapers via general obligation bonds.

Rate increases in the past year have amounted to 25.9%, and can be expected to climb further in the future, at least partly because of the past and projected rise in energy and treatment costs. This should result in reduced water usage.

Management. Late in 1976 the City of Albuquerque consolidated water supply and wastewater management into a central Water Resources Department. The new department is responsible not only for facility construction and operation, but also for water and sewer billing. It is expected that the reorganization will enable the City to engage in long-term planning regarding water resources. This planning is expected to include the development of water conservation programs.

2.6.6 Sewerage and Development in Albuquerque

Because sewer extensions are a major concern of wastewater planning, the wastewater management study has developed information on the complex relationships of urbanization and municipal sewer service, as they may apply to the Albuquerque situation (see Section F-5 of EPA, 1977). Important findings are as follows:

- As indicated in the Comprehensive Plan, low-density development tends to be expensive and inefficient; sprawling urban growth tends to increase government costs more than it increases revenues.

- Where municipal sewers are constructed, development tends to follow. Sewers thus have the potential to lead to premature or sprawling development unless properly planned.

- Historically in Albuquerque the availability of sewers and natural gas have been major factors determining development patterns. Where sewers are absent, and on-site system regulations are enforced, only relatively low-density single family residential development is possible, unless a developer utilizes advanced on-site systems or package plants (as in the case of Sandia Heights).

In addition to these findings it is important to note that no single agency presently has zoning authority for the entire planning area. Zoning enforcement by the City and the County have not followed identical criteria in recent years, and special use permits, which in effect change the zoning, have frequently been issued within the area subject to Bernalillo County zoning. Thus, development of areas such as the North and South Valley may respond to market forces to a considerable degree. The provision of sewers where planned growth is desirable can be a factor reinforcing market forces. However, the withholding of sewer service in itself is likely to limit only commercial and high-density residential development, rather than low-density single family development. When considered independently of other factors and controls, use of sewerage to influence land use patterns is of uncertain effectiveness. As noted by Tabors et. al. (1976), the record of using sewerage as a land use policy instrument is most effective where the governmental controls of planning policy are centralized. This centralization is lacking in Albuquerque.

2.6.7 Municipal Services; Utilities

Solid waste management involves regular pickups within the City limits, and disposal by landfill at two sites; a third site is planned for the near future. Within the County pickups are normally handled by private firms, and disposal is at two privately operated (though publicly owned) landfills. Litter is a major aesthetic problem in the area, especially near the landfills where private dumping is common, and near arroyos which are also popular sites for illegal disposal of solid wastes. Solid waste handling of sludge and other wastewater treatment by-products was discussed in 2.1.3. The Montessa Park landfill, or the East Mesa near Tijeras Arroyo, is used when treatment plant solids are disposed of or stockpiled. Septage, the solids pumped from septic tanks, is normally disposed of to the City sewer lines at a number of specially designated manholes.

Storm drainage is provided by a network of City-owned storm sewers, and by the special diversion works of the Albuquerque Metropolitan Arroyo Flood Control Authority. For large portions of the area there are proposed AMAFCA facilities; for example on the West Mesa a system of natural and improved arroyos, earth-lined diversion channels and multi-use detention and desilting basins will be utilized to limit flood hazards on the mesa and in the adjacent valley (Matotan, 1974). Somewhat similar works are to be built on the northeast mesa area; both systems conform with the goals of the Comprehensive Plan by retaining arroyos in a natural state to the extent possible, and by permitting the drainage works to service other purposes such as recreation. Soil Conservation Service flood control works have been installed in the northwest part of the area, but proposed facilities for the Corrales area have never progressed beyond the planning stage. While the flooding problem in Corrales remains unsolved damage is increasing as more homes are built in the area.

Energy utilities are well-established in the area. Electricity is provided by local gas-fired plants and by expanding coal-fired plants in northwest New Mexico. Transmission lines are an aesthetic problem in parts of the planning area, and the tendency is for new primary users (shopping centers, etc.) to be served underground. Natural gas pipelines from northwest New Mexico provide low-sulphur heating and industrial fuel for the entire area and buried lines are found throughout the settled sectors. More than most cities, Albuquerque is increasingly turning to non-conventional sources of energy to meet its needs. Solar energy has been used for space heating on a limited scale since at least the 1950's; solar heated homes and buildings are relatively common in new construction. An experimental solar-powered electrical generating station is nearing completion on the East Mesa, and a recently installed solar-powered irrigation well on Isleta Reservation appears to be highly successful. Geothermal energy has been tapped to heat and cool a major downtown office building since the 1950's, but no subsequent use of this source is known.

The 1975 electrical energy use averaged 18 megawatts per year for the average customer, including residential, commercial and industrial meters. By comparison, electricity consumed by the two treatment plants (beyond that supplied by on-site gas combustion) averaged 0.05 megawatts for each of the Cities 75,000 sewer connections. At a price of 3¢/kilowatt hour, the per-connection electricity cost for wastewater treatment is about $1.50/year; this represents about 0.3% of the electricity bill of the average customer. For residential customers only, average electricity use in 1975 was 6.5 megawatts/year. For such customers the electricity cost for wastewater treatment would represent just less than 1% of the average bill.

The gas produced at the treatment plants under 1975 conditions was about 220 million cubic feet per year. By comparison the annual natural gas consumption in Albuquerque amounted to 38.5 billion cubic feet, of which 12 billion was utilized by residential customers. Thus the gas production at the treatment works amounts to 0.5% of the total gas demand for the planning area.

The City has recently implemented a program to achieve energy conservation in municipal facilities. Among the objectives of this program which could affect wastewater management facilities are: lowering of thermostats, reduction in indoor and especially outdoor lighting, reduced energy use or use of alternate energy sources for water pumping.

Telephone/telegraph utilities are well developed. There are few buried cables of the type which would interfere with sewer construction.

2.6.8 Transportation; Health and Safety

Private trucks and automobiles are the dominant transporation form into and through the Albuquerque area. Two interstate highways (numbers 25 and 40) divide the City into quadrants and provide access to most principal arteries. A significant problem with reliance on fossil fuel propelled vehicles is that in the last decade auto emissions have begun to outstrip the dispersion capacity of the City's airshed (see Section 2.2.3). A major objective of the Comprehensive Plan is to provide a more compact urban form in which less vehicle travel would be necessary (hence less emissions and energy use). A long-range goal is to provide mass transit systems, but to date only a modest bus service exists. In the meantime transportation planning is focused on upgrading of existing arteries (widening; new bridges and overpasses).

Interstate passenger and freight service involves four major airlines serving the international airport, Amtrak and freight service on the Chicago-Los Angeles mainline, and frequent runs by truck and bus companies. Plans still under development call for a major new airport to be built on the far West Mesa (west of the Volcanoes), primarily to serve private aviation.

Health services are provided by seven major hospitals, numerous clinics, several cancer research centers, a large veterans hospital and a railroad employees hospital. All the major facilities are within Albuquerque. The City and County Environmental Health Departments have major responsibility for service related to sanitary surveys of wells and on-site systems. A discussion of health problems related to OSS is presented in 2.4.5.

City police and professional fire departments operate within the City; the Sheriff and volunteer fire departments act within the County. County fire service is hampered by lack of water lines in many areas.

2.6.9 Other Infrastructure Elements

Education throughout the area is provided by the Albuquerque public school system, with 109 schools attended by 83,000 pupils. There are also numerous non-sectarian and religious private schools, special schools such as the Southwest Indian Polytechnic Institute, and two universities. Recreational facilities are discussed separately in 2.7.2. Cultural events focus around musical and theatrical groups, school, university and professional sports, and the State Fair. Fifteen libraries contain approximately 13 million volumes. Public communications are provided by two daily newspapers with a combined circulation of about 110,000, and by four television stations and numerous radio stations.

2.6.10 Capital Improvements

The City maintains an ongoing capital improvements program which

schedules infrastructure needed by present or future residents. Funding of the improvements is accomplished with general obligation or revenue bonds as the primary source of income. For 1975, planned funding for capital improvements was as follows (source: City of Albuquerque, 1975):

	Purpose	G.O. Funds	% of Total
1.	Fire	$ 865,000	3
2.	Parks & Recreation	3,205,000	11
3.	Museum	2,900,000	10
4.	Animal Control	255,000	1
5.	Data Processing	495,000	2
6.	Courts Building	4,170,000	14
7.	Street Improvements	7,665,000	26
8.	Transit	985,000	3
9.	Library	320,000	1
10.	Sanitary Sewer	1,475,000	5
11.	Storm Sewer	6,395,000	21
12.	Zoo	1,045,000	4
13.	Water	110,000	-
	Total	$29,785,000	

With State and Federal participation, and other local monies, the total investment was about $57,921,000. Use of funds is about evenly divided between general utilities (fire, library, parks, civic building, water and sewer) and transportation-related items. In recent years most facilities have been built in one of four general locations: the fringes of the Northeast Heights, where new growth is occurring; portions of the West Mesa where development is ongoing; redeveloping areas such as the Central Business District; and previously unserved portions of the North and South Valleys (including some water and sewer facilities in unincorporated areas).

Fixed assets versus bonded indebtedness for the City and County in 1975 are listed below.

	Fixed Assets	Bonded Indebtedness
City	$195,000,000	$138,000,000
County	17,730,000	14,000,000

This fiscal information, along with that presented earlier, indicates the contrasting conditions between the City and adjacent unincorporated areas. A recent study by the State Legislative Finance Committee stated that "the City offers more to its residents in the way of services than is required to meet basic needs" (Albuquerque News, 11/4/76).

In contrast, County residents have access to fewer and more limited services, even though many live in urban conditions. Resources adequate to develop services in the valley area are not available to the County government; thus the water and sewer service that does exist has been provided by the City through extensions beyond its limits.

2.6.11 Jurisdictions

A significant factor affecting the planning area is that land use controls and other policy-implementation measures are under the control of different government bodies. The City, and each of the three small incorporated areas, have complete jurisdiction within their corporate limits. Elsewhere it is Bernalillo County which has the basic responsibility for providing government services. However there is an area in which municipal platting and planning authority overlaps with County authority; in the case of the City and County this extraterritorial zone extends three miles from the municipal boundary.

As might be expected with different governments there has not been a uniform approach to matters such as planning, even though both the City and County have adopted the same Comprehensive Plan. As noted in 2.6.10, the City has a greater capability for providing services and utilities, and is responsible for much of the water and sewer construction within the County area. The City also has tended to follow zoning regulations relatively stringently, while variances have been more common within the County. A significant factor, expressed often during the Public Hearings held during the 201 planning process, is the concern of County residents that the City may desire to annex areas within the County, and that the extension of water and sewer service to unincorporated areas is a prelude to such annexation. The stated City policy is that such utility extensions are not related to any annexations, and that the City will cooperate with the County in exercising their joint planning and platting authority in the extraterritorial zone.

Recognizing the fiscal limitations on County services, and desiring to foreclose any annexations by the City, residents in the unincorporated areas have increasingly shown an interest in corporate government. One example was the recent consideration of greatly enlarging the corporate limit of Tijeras, to include a large segment of the East Mountains. This proposal was widely debated, and eventually rejected. An even more significant example is the proposal to incorporate as a new municipality the entire valley and valley-side area south of Albuquerque. Such an incorporation was made possible by State legislation passed in 1976, and if effected would result in creation of a South Valley municipality with a population of at least 35,000 persons. As of May, 1977, no formal decision had been reached regarding this incorporation.

2.7 RESOURCE SITES; AESTHETICS

2.7.1 Archeological and Historical Resources

Archeology (Pre-History). Section G-1 of EPA (1977) provides a narrative discussion of Albuquerque's archeological history. The Middle Rio Grande Valley is a vast storehouse of artifacts left by people who have inhabitated the area for many millennia. The oldest recognized cultural period is termed Paleo-Indian, and refers to Stone Age big-game hunters who exploited the grassland environment typical in New Mexico during portions of the ice ages (9,000 years ago and before). These early nomads hunted large mammals such as the horse, camel, bison and mammoth, leaving behind evidence of camping, kill and butchering sites, especially near marshes, streams and adjacent ridges. Artifacts marking such sites include charred cobbles, flint chips, fossilized animal bones, and distinctive lance-shaped spear tips such as the well-known Clóvis, Folsom and Sandia points.

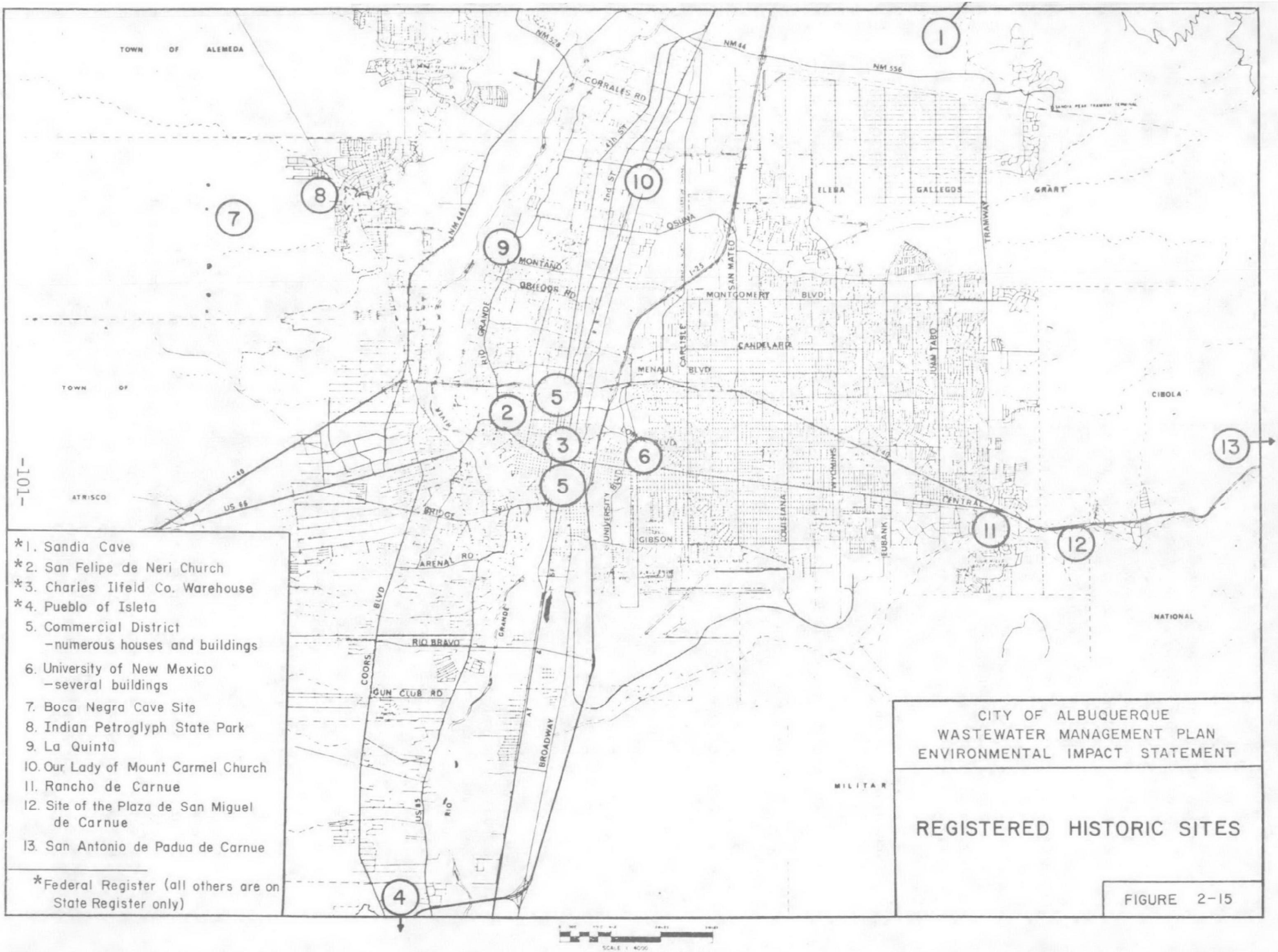
Possibly overlapping with, but generally following the Paleo-Indian culture was the Desert Culture-Archaic tradition of semi-nomadic hunting and gathering, which gradually evolved through a period of about seven thousand years. This culture involved game hunting (deer, antelope, other mammals) as well as seed and plant gathering. Thus artifact sites occur in a variety of locations. The best preserved artifacts are found in caves and under rock ledges and include basketry, cord and cloth, rock tools, and even a very early form of domestic maize. Small projectile points provide the most widespread markers of this period.

The Anasazi-Mogollon farming tradition, which evidently evolved from the Archaic culture, extended from about 2,000 years ago to historic times. The onset of this tradition is marked by introduction of the bow and arrow, new domestic crops, permanent settlements, and ceramic technology. The settlements include pithouses as well as pueblos, and with the associated pottery and stone implements represent some of the most important archeological resources in the Southwest. In Albuquerque such remains are rare prior to 1,000 years ago, because the Anasazi culture was centered in the San Juan River Basin to the northwest, while the Mogollon culture was common in southern New Mexico. However, migration into the Rio Grande basin gradually led to an increase in the size and number of farming villages in the area, up to about the year 1300 A.D. when the Pueblo people attained their highest levels of prehistoric population and socio-cultural expression. The Pueblo culture began to decline with the immigration into the area of aggressive newcomers, including other Indians (e. g. Apaches) and the Spanish.

History. The historic period began with the Spanish entrada in 1540, although permanent Spanish settlement did not occur until 1598. The Pueblo peoples declined steadily in numbers in the face of new weapons and diseases, although with the Pueblo Revolt of 1680 they were able to expel the Spanish for about a decade. Spanish control was unbroken from the late 1600's to 1821, when Mexico obtained its independence and took over rule of the territory. The United States won the territory in 1846, after which Anglo immigration began. The Spanish village of Albuquerque, founded in 1706, began its modern development after the arrival of the railroad in 1880. Other villages of the 1700 and 1800's, such as Atrisco, Arenal and Los Griegos, were settled at the same time and retained their identity until relatively recently; they are now identified most readily as neighborhoods within the sprawling urban complex. Refer to Reeve (1961) for a further discussion of the history of the region.

Registered Sites. Historic and archeologic sites listed on either the Federal or State Register of Historic Places are located on Figure 2-15 and contained in Section G-2 of EPA (1977). The sites fall into three categories: Indian sites, including Sandia Cave, Isleta Pueblo, and the petroglyphs of Volcano Cliffs; Spanish sites, such as the church in Old Town and the newly excavated Rancho de Carnue near the mouth of Tijeras Canyon; and more recent structures, including a number of historic commercial and residential buildings in and near downtown.

Other Sites. Many additional sites of archeological and historical importance occur in the area, and are listed in the files of the Center for Anthropological Studies (University of New Mexico), or the Museum of New Mexico. The locations of known sites have been recorded as part of this EIS and are available on a need-to-know basis as input to specific planning and



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*1. Sandia Cave
*2. San Felipe de Neri Church
*3. Charles Ilfeld Co. Warehouse
*4. Pueblo of Isleta
5. Commercial District
   -numerous houses and buildings
6. University of New Mexico
   -several buildings
7. Boca Negra Cave Site
8. Indian Petroglyph State Park
9. La Quinta
10. Our Lady of Mount Carmel Church
11. Rancho de Carnue
12. Site of the Plaza de San Miguel de Carnue
13. San Antonio de Padua de Carnue

*Federal Register (all others are on State Register only)

CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

REGISTERED HISTORIC SITES

FIGURE 2-15

design projects. Site file numbers and characteristics are provided in Section G-3 of EPA (1977). Locations of the sites are not reproduced here, in order to provide site protection. Rather, the general distribution of sites has been summarized in relation to the natural areas identified in Section 2.0.1; refer to Table 2-1 for information on this distribution.

In general, areas richest in archeological resources are the Mountain Lowlands (especially Tijeras Canyon), the Volcanoes including associated lava flows, and the Valley Side and Terraces. Most sites consist of Archaic-period camps overlooking watering places. Older artifacts are found locally on the Terraces and Sand Plains, and Anasazi petroglyphs occur in the Volcanic terrain. Several Anasazi farming sites and associated building foundations have been located on the East Mesa, near Tijeras Canyon.

The Valley Floodplain unit is the principal area of historical features--houses, churches etc. It contains older sites as well, but they are commonly disturbed by farming and construction.

2.7.2 Recreation, Open Space, Natural Areas

Recreation Sites. Formal recreation activity within the planning area involves use of both public and private facilities, including 156 municipal parks and centers occupying 10,371 acres. The City sites are well developed, and provide opportunities for a variety of sports, from golf to drag racing. In contrast, relatively few dedicated parks occur in the unincorporated portion of the planning area and these often have few or no facilities. Formal recreation outside the City is available within the nearby Cibola National Forest, Indian Petroglyph State Park, and Isleta Pueblo fishing lakes, as well as at more distant locations such as Cochiti Lake. The forest lands are used mostly for picnicking and pleasure driving, but also for skiing, hiking, camping and bowhunting (Adcock and McCormick, 1974). Downstream recreational areas are discussed later in this section.

Open Space. There are many tracts of open space, both publicly and privately owned, which are designated for protection by the Comprehensive Plan. Key public lands of interest are the riverside bosque and right-of-ways along irrigation canals and drains; arroyo right-of-ways; portions of the mountains within the National Forest; and portions of the volcanoes owned by the City or State. Storm drainage improvements, as proposed by recent flood control plans, are also to have a direct recreational function. The Plan calls for connections of these areas by horse and pedestrian trails and bikeways. Complementing the public lands would be the existing private open areas in the valley (irrigated agriculture) and on the mesas (grazing). As noted in 2.6.2, preservation of the private land is hampered by market pressures, unless very strict land use controls are imposed.

Although the open space lands normally contain no formal facilities, they are popular for many activities, even in the face of legal restrictions. These activities include hunting, fishing (mostly in drains), hiking and nature observation, horseback riding (especially in the mixed residential/agricultural valley lands) and swimming (especially in drains and in the river). The oxbow natural area, discussed in 2.5.1, has received special public attention as an area to be preserved for wildlife habitat purposes.

There has been little action in the past to integrate the Rio Grande and environs into the recreational life of the City. The recent "City Edges" study proposed numerous options for improving the situation to make the river a prominent, more attractive, accessible amenity of urban life (CCIC, 1975). The options stress a more balanced use of the river, with emphasis on recreation as well as flood control, and include formal parks and natural habitat areas along the river; some of the latter would be created through construction of ponds and marshes.

The Comprehensive Plan, City Edges study, and other reports indicate the character of recreational facilities which might interact with wastewater planning. Of special interest are recreation sites proposed for areas near or downstream of the treatment plants. These include: a possible Bravo State Park just south of the outfall from Plant #2; a small impoundment on the main stem of the river, below the outfall; designated open space and natural areas along the river and in the Southeast Valley where large tracts of irrigated land remain; possible trail systems along the river, which could be included in the State trail network; a possible small impoundment near the mouth of Tijeras Arroyo, just above the Mountainview community. Some of these facilities would be part of a State-supported park system extending more or less continuously along the Rio Grande for much of its length in New Mexico. The most specific recommendation which has been made in the recreation reports regarding wastewater is that treatment should be sufficient to permit primary contact activities such as swimming and wading (CCIC, 1975, p. 2-21).

Albuquerque is unusual in that a wilderness area has been proposed for designation within a few miles of the metropolitan limit. This area would lie within the Sandia and Manzano Mountains, in the Cibola National Forest. Other portions of the forest have been designated as game refuges, or proposed for designation as scenic areas. The proposed scenic areas include one which extends into the 201 planning area along Tijeras Canyon. Neither the game refuge nor wilderness zones overlap with the planning area at this time.

Downstream Areas. Information on recreational activities in the Middle Rio Grande Basin downstream from Albuquerque is summarized in a recent impact statement (BOR, 1975). The major features are the wildlife refuges as shown in Figure 2-8, and Elephant Butte and Caballo Reservoirs. Elephant Butte receives more than one million visitors per year, the majority of whom are interested in water skiing and fishing (Coppedge and Gray, 1968). Fishing is the major activity at Caballo Reservoir, which receives about half as many visitors as Elephant Butte.

The refuges are used for wildlife-associated activities, including observation and, in a few areas, hunting. However, total visitors are few compared to the reservoirs; for example during fiscal year 1974, a total of 26,178 persons visited the Bosque del Apache National Wildlife Refuge. Wildlife-oriented recreation is also limited for the Basin as a whole. For the Velarde-Elephant Butte reach, the estimated hunting and fishing use is about 100,000 days/year (BOR, 1975, p. B-169).

2.7.3 Aesthetics

The characteristics which make an environment aesthetically desirable are open to debate. Certainly the scenic quality of Albuquerque is a major environmental

attribute, and factors impairing this quality are undesirable. A recent survey of New Mexicans indicated that the most significant sources of visual blight in the State are junk cars and litter, including litter of City sidewalks and vacant lots (KNMB, 1975). Blowing dust and automotive exhaust-emissions were identified as problems for the Albuquerque area, along with industrial air pollution and inadequate animal control. Odors are the major aesthetic problem associated with wastewater management (See Section 2.2.4).

3. EVALUATION OF ALTERNATIVES

3.0 THE NO-ACTION ALTERNATIVE

Albuquerque is already committed to wastewater actions which include: expansion of Plant #2B to a capacity of 47 mgd; construction of sewers to service certain developed portions of the South Valley as well as developing neighborhoods in the Northeast Heights; and the general upgrading of system operation and maintenance. Federal funds are committed to support the plant expansion and the construction of South Valley sewers. By about 1980 these actions are expected to provide a well-run system capable of meeting NPDES requirements without causing substantial odor problems. Further, water contamination and health problems caused by use of OSS in one densely populated, unincorporated part of Bernalillo County would largely be eliminated. The total wastewater discharge in 1980 would be about 42.8 mgd, or 91% of the nominal capacity (MMC, 1977). Some environmental problems would remain, including relatively moderate odor problems at both treatment plants and continued use of on-site systems in most of the area outside the City limits. Further, the past trends of economic and population growth would be expected to increase wastewater flows rapidly, to the point that treatment capacity would be exceeded by about 1982.

The alternative exists of taking no significant wastewater management actions beyond those already planned. If this no-action alternative were adopted one of two conditions would result.

a) If population growth were allowed to increase wastewater flows beyond treatment capacity, treatment would become inadequate and severe odor problems would occur near Plant #2B, similar to the present situation. The legal mandates of the NPDES permit and the Stipulation would be violated.

b) Or, the City would be forced to adopt a no-growth policy stabilizing population at approximately 425,000 persons, the size which could be accommodated by the expanded treatment facilities. In this event the objectives of the City/County Comprehensive Plan would be negated, since there would be no prospect for the orderly development of the metropolitan area.

Regardless of which of the two situations occurred, problems related to OSS and treatment plant odors would remain. In the event that the City adopted a no-growth policy it is likely that new development would be concentrated in presently unincorporated areas, increasing the reliance on and contamination from OSS.

The no-action alternative would have the benefit of eliminating any further major public investment in wastewater facilities in the planning area. However, it is clear that the alternative would fail completely to address the basic objectives of P.L. 92-500, the National Environmental Policy Act, the City/County Comprehensive Plan, the Stipulation and other pertinent documents. Indeed, the terms of the Stipulation alone force rejection of the no-action alternative, since the City is obligated to achieve Best Practicable Control Technology for odors within the wastewater system; this can be done only by improvements additional to those already planned.

Beyond odor control, it is conceivable that the no-action alternative could be adopted were a no-growth policy to be in effect. However, lengthy and detailed studies undertaken as part of the Comprehensive Plan led to adoption of policies which are intended to accomodate moderate growth in the Albuquerque area. In effect the CP obligates the City to provide adequate facilities and services which, by supporting orderly development, will tend to enhance the environmental quality of the area. In the event Federal funding were not available for wastewater facilities it is likely that the City would fulfill its obligations by funding the necessary construction out of bond monies, without NEPA environmental review of the contemplated actions.

3.1 ENVIRONMENTAL CONDITIONS IN THE YEAR 2000

Wastewater management alternatives must be evaluated in the context of evolving environmental conditions which will prevail over the time-frame of the Facility Plan, and in particular must provide solutions to problems which are related to the collection, treatment, reuse and disposal of municipal liquid wastes in the Albuquerque area. For the most part future environmental conditions and problems are expected to be similar to those which now occur, and which were described in detail in Section 2. The discussions which follow summarize the conditions, with emphasis on any projected changes for better or worse. Section 3.1.1 outlines general environmental trends which are independent of wastewater facilities. Section 3.1.2 concerns water quality and water supply conditions which are caused by or which interact with wastewater discharges. Section 3.1.3 reviews other environmental conditions which relate to wastewater, such as odor control and resource use.

3.1.1 Environmental Trends

The major factor acting to modify existing environmental conditions over the next few decades will be population growth and development which occurs in conformance to the City/County Comprehensive Plan. By the year 2000 the planning area is projected to have a population of between 590,000 and 687,000 (see Table 2-13). For the purpose of evaluating wastewater collection needs, the City Planning Department distributed the population projections of Table 2-13 according to the land use patterns outlined by the Comprehensive Plan (MMC, 1977). Within areas designated urban (Figure 2-13) it is projected that infill will occur and that densities will be in the range 10-30 persons/ acre by the year 2000. Additional growth will occur in areas which do not now have full urban utilities and services. This new development has been projected to be concentrated on the near West Mesa, primarily in the vicinity of Central Avenue-Interstate 40 and near Paradise Hills. Development in the Northeast Heights/North Albuquerque Acres area has also been forecast, although much of this growth will not occur until the next century. In all the developing areas densities would generally reach 5-10 persons/acre by the year 2000, with some more densely populated neighborhoods occurring. A critical aspect of the projections is that, in conformance to the CP, no significant growth is projected for areas designated as rural or open. Thus population densities of less than 5 persons per acre are expected to prevail over much of the North and South Valley, in Corrales and the East Mountain area. Areas such as the far West Mesa are considered to remain unpopulated during the time frame of the Facility Plan.

The population density and land use trends noted above probably will be reasonably accurate over a short period - five or ten years - but could require adjustments before the year 2000. In particular it was noted in Section 2.6.2 that the rural nature of the Valley is gradually being lost to a more urban type of land use. Herkenhoff (1973) projects that the historical trend of reduced irrigation acreage could lead to elimination of agricultural lands in the Valley during the first half of the 21st century, but that the trend will probably shift so that irrigated acreage will stabilize at approximately 3,500 acres. These lands, which are less than half that now occurring, would mostly occupy small parcels, averaging seven or eight acres in size. Population densities could be semi-urban or even urban in much of the Valley area if the loss of irrigated lands continues. Other portions of the Albuquerque area also may develop in a manner somewhat different from that indicated by the CP. However, for purposes of wastewater facility planning, the forecasts made by the City Planning Department are taken as accurate in detail, recognizing that adjustments may be needed over time to reflect changing development patterns.

The local and regional economy is expected to improve parallel to the increase in population. However, the area will remain characterized by a high percentage of low-income families, and the existing ethnic diversity will not alter markedly. The level of government services and budgets can be expected to increase significantly, especially in presently unincorporated areas. A major change in government relationships would occur if the proposed South Valley community is incorporated. This new municipality could include areas as far west as Westgate Heights and as far east as Mountainview (encompassing Treatment Plant #2), from the Albuquerque City limits to the Isleta Reservation.

Despite the growth in Albuquerque, it is projected that most environmental conditions will not be radically different in the year 2000, compared to the present. This is because the increase in resource demands and environmental stresses associated with growth will by design be offset at least in part by actions which conform to the goals of the CP. For example the increased emission of air pollutants which normally occurs in developing areas is to be checked by reduced per capita travel which will result from creation of a more compact and efficient urban form; more direct control measures will also be used. Similarly, increased energy demands will be offset by conservation measures, the reduced travel requirements, and use of renewable resources such as solar heating. Increased solid waste production and litter should be balanced partially by increased recycling. Growth in flood-prone areas should be limited by development policies, with flood damages reduced by construction of control structures.

In brief, implementation of the Comprehensive Plan together with more direct environmental control measures is expected to minimize the environmental stresses and resource use which will occur as the result of population growth in the Albuquerque area. The appropriate goal of wastewater planning is to support these measures, as well as to solve specific wastewater-related problems which are discussed in the next two sections.

3.1.2 Water Quality and Water Supply

The analysis presented in Section 2.4 indicated that few if any water quality problems can be attributed to the present wastewater collection and treatment practices of the City, but that ground water contamination (and associated surface water effects) do occur because of the extensive use of on-site systems. It was also noted (Section 2.3) that wastewater is already an important resource, accounting for a significant portion of the river flow which is diverted at Isleta Dam, and utilized for irrigation purposes in the MRGCD.

Considerable change in the water resource patterns of the Middle Rio Grande Basin can be projected to occur over the next 20 or so years, related to factors such as population growth and the implementation of various water projects. The following review highlights these projected changes, and indicates the concerns over wastewater management which may occur by the year 2000. The projections given normally assume continued discharge of effluent to the Rio Grande. This is intended to provide a basis of comparison for evaluation of other alternatives, and does not mean that such a discharge is necessarily the preferred option.

Increased Wastewater Volume. Population growth and sewerage extensions are expected to increase wastewater flows in the Albuquerque area. Projections given in the Facility Plan are:

1985 ... projected flow of 50.7 mgd;
2000 ... projected flow of 76.55 mgd.

The wastewater volume in 1985 will exceed the capacity of the existing treatment system, even after completion of the proposed Phase IA improvements. This indicates that actions to increase treatment capacity need to be started by the early 1980's.

One consequence of the increased wastewater flow will be that the City will receive a large return flow credit for any alternative which involves discharge of all effluent to the Rio Grande. Although the projection given for the year 2000 is tentative, at best, indications are that the credit would be approximately 86,000 acre-feet per year.

Increased Value of Wastewater as a Resource. The water supplies of the Rio Grande Basin are relatively fixed, while the amount of wastewater is increasing; over time wastewater will grow in significance as a water resource. Not only will the value of wastewater increase, but it is likely that the present trend of using water to benefit wildlife and recreation will also continue. More traditional uses such as irrigation and municipal supplies will remain significant.

Quantitative Impact of Wastewater. Table 3-1 provides a quantitative analysis of wastewater impacts as measured at Isleta Dam in 1975 and 2000, for any alternative which does not change the present practice of direct effluent discharge to the Rio Grande. The analysis reflects both the increased wastewater discharge and the effect of several factors which will act to modify the flow regime of the Rio Grande over the 25-year interval.

TABLE 3-1. COMPARISON OF HYDROLOGIC AND WATER RESOURCE CONDITIONS, MIDDLE RIO RIO GRANDE BASIN, 1975 AND 2000. Based on analyses in Section D-2 of EPA (1977). All values given as acre-feet/year unless otherwise noted. All values of water use are for depletion. All entries marked by asterisk (*) represent values used in a model developed by the State Engineer, and may not conform to information provided in the Facility Plan or other documents.

Condition	Year. 1975	2000
Water use in Middle Rio Grande Basin	228,000	302,000
Water use in Bernalillo County	72,000	127,000
Water pumped by City of Albuquerque*	78,500	153,000
Effect of pumpage on river flows*	49,000	111,600
Return flow credit for wastewater*	39,000	76,500
Net depletion of river flow by City, hence water rights requirement of City water use*	10,000	35,100
Average discharge of the Rio Grande at Isleta Dam	520,000	600,000
Wastewater discharge if all flow is direct to river	40,000	86,000
Percentage of flow at Isleta which is wastewater	8%	16%[1]
Maximum monthly percentage of flow at Isleta which is wastewater, for average conditions	17%	28%
Flow volume diverted at Isleta for irrigation purposes	186,000	171,000
Flow volume diverted at Isleta which reaches farms	82,000	82,000
Amount of effluent diverted at Isleta which reaches farms	6,600	13,100
Percent of irrigation water in Belen Division which is wastewater	8%	16%

[1] May be as little as 14% depending on method of calculation.

- Rio Grande flows at Isleta are expected to increase because of the greater wastewater discharge and because of increased diversions of San Juan-Chama Project water for use in areas downstream of Albuquerque. The increased flows will occur despite the growing effects of City well field pumpage. The projection could be altered if recent climatic trends continue to lead to reduced water supplies in basin headwaters.

- The flow regime at Isleta will become more regular, with smaller spring peaks and larger discharges during the late summer low flow season. This stabilization will reflect the wastewater and San Juan-Chama influences noted above, and the regulating effects of recently constructed flood control reservoirs upstream of Albuquerque.

- Water use in the Middle Rio Grande Basin will increase due primarily to growth in Albuquerque. Water use quantities and patterns downstream of Isleta will not change markedly. A small decline in water diverted for irrigation purposes is projected due to increased efficiencies in irrigation practices. However, the water delivered to farms from diversions at Isleta is not expected to change.

Section D-2 of EPA (1977) provides further information on present and future water budgets.

Fate of Wastewater. The quantitative effect of wastewater discharges is relatively simple: since the discharge will approximately double by the year 2000, its impact on downstream water uses will increase approximately twofold during the same period. The following comparisons illustrate the change:

- by the year 2000, 16% of the water which reaches Isleta Dam will be wastewater from the City of Albuquerque, versus 8% in 1975;

- the amount of effluent reaching farms in the Belen Division of the MRGCD will increase from 6,600 acre-feet/year (8% of the total farm supply) in 1975 to 13,100 acre-feet/year (16% of the total farm supply in 2000);
- during late summer in an average year the percentage of farm irrigation water which will be effluent will increase from 17% to 28%, with even higher values being observed during dry years.

Impact on Water Rights. As indicated in Table 3-1, calculations based on an unpublished model developed by the State Engineer indicate that by the year 2000 the effect of pumping City water supply wells would be to deplete Rio Grande flows by 111,600 acre-feet/year. Assuming that all wastewater were discharged to the Rio Grande also, the net impact, or water rights requirement, would be 35,100 acre-feet/year. These estimates may be low; for example, the projected water use and wastewater flow is less than forecast in the Facility Plan. It is important to recognize that the growth in water rights requirements reflects not only increased pumping, but also the delayed effects of past pumping. Thus any actions which alter pumping or discharge patterns will not fully affect river flows until several decades after they are implemented.

If the water rights requirement in 2000 is approximately 35,000 acre-feet, then all the City's vested well rights and about one-third the San Juan-Chama Project rights would be needed at that time. Slightly less than 30,000 acre-feet of unused San Juan-Chama rights would remain, to be used to offset

delayed flow effects and to support population growth. For any alternative which completely cut off discharge to the Rio Grande, the water rights requirement in 2000 would be 111,600 acre-feet/year. This would utilize all the vested and San Juan-Chama rights, leaving a deficiency of about 46,600 acre-feet.

Clearly an expanding portion of Albuquerque's wastewater will reach the farms of the Belen Division of the MRGCD. It is conceivable that during very low-flow periods City effluent could represent half of all the water diverted at Isleta and applied to the land by downstream farmers.

The increased use of wastewater for irrigation purposes in the MRGCD will be associated with a slight reduction in the amount of wastewater reaching Elephant Butte Reservoir. Whereas perhaps two-thirds of the present-day effluent is calculated to reach the Reservoir, little more than one-half may be observed to impact the Reservoir in the year 2000. However, this change does not substantially offset the net effect of increased wastewater discharge. Thus, the total quantity of City effluent which can be calculated to reach the Reservoir will nearly double over the forthcoming two and one-half decades.

Impact of Water Quality: General. Despite the increased quantitative significance of wastewater in the future, qualitative changes may not be great for any alternative which meets NPDES requirements and which involves continuation of the present practice of direct discharge to the Rio Grande. This is because the concentration of most contaminants in the secondary effluent in 2000 will be much less than was observed in trickling filter effluent in 1975. The improvement in wastewater quality will offset the effects of larger effluent discharges. For example, in 1975 the average nitrogen concentration was 30 milligrams/liter and the average discharge was 36 million gallons/day. A total of 1645 tons of nitrogen was contributed to the Rio Grande. For the year 2000, assuming activated sludge treatment, the projection is that 76 mgd of effluent will contain 15 mg/l nitrogen, and contribute 1735 tons of nitrogen to the river. There is little difference between the two contributions.

Similar effects can be projected for organic material, bacteria and heavy metals. It will probably not be until near the end of this century, or early in the next, that the factor of population growth will overcome improvements in treatment technology, such that the total pollutant load from Albuquerque will become greater than experienced in the recent past. One major exception concerns total dissolved solids, which are not significantly controlled by secondary treatment. The salt loading and salinity impact of City wastewater can be forecast to parallel the quantitative changes, that is a two fold increase will occur by 2000.

Effect of Wastewater on Salinity. SEO (1974) projects that in the year 2000 the salt loading related to Albuquerque wastewater would amount to 52,000 tons/year, or 12% of the total dissolved solids measured at San Marcial. As indicated in the paragraph above, this is double the present impact. Dissolved solids concentrations below Caballo Reservoir would increase

to 657 mg/l, about 19% greater than present; at El Paso the concentration would rise to 1075 mg/l, 23% greater than now occurs. These levels, especially at El Paso, could adversely impact the use of water for irrigation practices. If so, the prospect exists that at some time in the future a salinity control program would be needed for point and non-point salt sources in the Middle Rio Grande Basin. The specific nature of such a program, if it ever occurs, cannot be projected at this time, and no alternatives have been developed which relate to salinity control.

Nutrient Loading at Elephant Butte Reservoir. Simple mass balance calculations presented in EPA (1977, Section D-5) indicate that in the future City wastewater will remain the dominant point source of nutrients in the Middle Rio Grande Basin. If effluent continues to be discharged to the Rio Grande, the City may account for approximately half of the total nitrogen measured at San Marcial in the year 2000. As discussed in Section 2.4.3, no significant nutrient-related problems have been identified at Elephant Butte Reservoir for historical nutrient and flow conditions. Moreover, even if problems occurred it would be difficult to determine the importance of City wastewater, as opposed to other nutrient sources. Therefore, it is impossible at this time to identify any basis for establishing a nitrogen-removal requirement for Albuquerque. However, both the Basin Plan and the Stipulation mandate that nitrogen-removal alternatives be evaluated by the Facility Plan and this EIS. A detailed analysis of such alternatives is provided in Section 3.4.1.

Possible Impairment of Agricultural Water Use in the Belen Division, MRGCD. It has been reported that in the past crop growth in the Peralta-Los Lunas area has been adversely affected when river flows were especially low and the water diverted at Isleta Dam contained a high percentage of Albuquerque wastewater (Charles Diebold, personal communication). No data are available to quantify this effect or to demonstrate the nature and cause of the problem. However, it is likely that pollutants such as salinity, alkalinity or one or more heavy metals (such as copper) which occurred in trickling filter effluent could have accounted for the observed impact on plant growth. So far the adverse effects have been comparatively minor and limited to drought periods.

Since the cause of the past problem cannot be identified it is not possible to predict if similar impacts will occur in the future. The immediate prospect is that projected improvements in effluent quality would minimize any such impacts. The long-term increase in total wastewater flows could be an offsetting factor, eventually leading to a recurrence of the problem. Thus the potential exists that irrigation water use will be impaired by wastewater discharges at some indefinite future time, especially during low-flow periods when the relative importance of wastewater is greatest.

Ground Water Contamination from OSS. Existing use of OSS in the Albuquerque area has resulted in low grade contamination of ground water, local sanitation problems, and possibly some harm to public health (see 2.4.4 and 2.4.5). The long-term implications of continued reliance on OSS for waste disposal purposes were summarized by Anderson (1972). "Surely, if unabated, before the year 2000 this continual pollution will affect the lower levels of the valley water table, thereby causing problems for all public and individual water wells in the Albuquerque area." "... if the continued use

of (on-site systems) leads to ground water pollution problems throughout Albuquerque, the economic costs resulting from correcting such a condition would be staggering".

In the absence of any particular public action, water pollution from OSS will continue in the area, contrary to the goals of P.L. 92-500. This suggests that either the systems should be upgraded extensively, or else replaced by some form of public sewerage. Ordinarily the decision to choose between upgraded OSS and sewers might be based on cost factors alone. However, the Albuquerque/Bernalillo County Comprehensive Plan specifically recommends against development in many of the areas served by OSS, and there is considerable concern that construction of sewers in the areas would spur unwanted growth. A search of the literature and a review of past development in Albuquerque suggests that sewers need not be a direct incentive to growth, but that the provision of sewerage service would be expected to remove a constraint to growth (see 2.6.5). Put another way, if on-site disposal regulations are enforced, the existing rural valley and mountain areas cannot readily develop at an urban density, because of requirments for large lot sizes. With sewers, densities can reach any reasonable level, and the preservation of large lot sizes would depend on strict enforcement of zoning or subdivision regulations.

Other Water Quality Trends. Except as noted above, changes in water quality in the Basin over the next 20-25 years will relate to factors other than Albuquerque wastewater. A significant reduction in sediment pollution is projected because of sediment storage in upstream reservoirs. Extensive mining development in the Grants area could affect water quality in the Rio Puerco drainage, and eventually impact the Rio Grande; parameters such as pH and alkalinity, nutrients, metals and radioactivity might be of concern from this stream. Controls of point sources can be expected to reduce pollution from animal confinement facilities, which are presently a significant origin of bacteria, nutrients and organic material. However, at best there will probably be only partial control of non-point sources such as irrigation return flow and urban storm runoff, which may remain significant sources of bacteria, nutrients and, in the case of urban flows, metals.

Impacts of Water Table Lowering. Increased pumping of City and other wells, combined with reduced recharge from irrigation, is projected to cause drawdown of the water table in the Albuquerque area. Reeder (1967) forecasts that the drawdown might eventually exceed 50 feet. In the area of the Rio Grande flood plain there will be a significant change in soil moisture and ground water hydrology conditions. The present situation whereby saturation occurs near the surface, and soils are often deficient in oxygen, will be replaced by a situation in which an extensive aerated zone exists between the surface and the water table. The impact of OSS discharges can be expected to change. Possibly a greater amount of nitrate contamination will occur per unit discharge, because soil nitrification processes will be more effective. However, the aerated soil and greater depth to ground water will probably increase soil treatment capabilities for bacteria, and also reduce the historical iron and manganese problem. It is not known if the onset of aerated conditions would lead to the leaching out of contaminants which were discharged by OSS and other sources in the past, and which may now be bound to soil particles near the ground surface.

Wastewater Management and P.L. 92-500. Actions which appear to be necessary to comply with the objectives of P.L. 92-500 include: treatment of Albuquerque wastewater to meet secondary standards as set forth in the proposed NPDES permit; reduction of ground water contamination from the use of on-site systems. These actions will not mean the immediate improvement of ecological productivity and recreation opportunities in the Middle Rio Grande Basin. Even if all sources of ground water pollution are eliminated in the Albuquerque area it will be a substantial period before water quality in the shallow alluvial aquifer improves to levels which cause no problems; this is because it will take many years for the contaminated water to be flushed out or diluted. Surface water improvement will be delayed also. More significantly, even if and when wastewater treatment actions improve water quality in the Rio Grande, they may not accomplish the ecological and recreational benefits sought under P.L. 92-500. According to the New Mexico Water Quality Control Commission (NMWQCC, 1975, page 7) "water pollution per se prevents the propagation of aquatic biota and recreational use of few, if any, New Mexico streams which would otherwise be suitable for these uses. In almost every case, intermittent flows and such hydrologic modifications as diversion for irrigation and impoundments are the overriding causes of poor fishery and recreational potentials of these waters".

Nonetheless, actions which improve existing water quality conditions can be expected to have some ecological and recreational benefits, for example by helping to protect the downstream wildlife refuges and Elephant Butte Reservoir. More local benefits could occur as well. Alternatives which continue the discharge of highly-treated wastewater to the Rio Grande would ensure that there is a continuous flow in the river above Isleta Dam, even during months when the stream is dry above Albuquerque. The river water can and probably will be used for swimming, especially during the hot summer months. Further, it is likely that there will be increased use of bosque areas for recreation, including development of parks and trails along the river. A permanent river flow can be considered to have a significant aesthetic value for persons who engage in such recreation.

3.1.3 Other Problems Related to Wastewater Management

Problems related to specific wastewater facilities are discussed in the evaluation of alternatives which relate to those facilities. For example, the adverse safety and other impacts of chlorination use are considered in Section 3.6. More general concerns which relate to several aspects of the treatment system include odor control and resource management.

Odor Control. Odors are undoubtedly the most significant environmental problem related to wastewater facilities in the City of Albuquerque and are especially severe at Treatment Plant #2. The City has proposed the following steps to reduce odor problems at Plant #2 (see Section 2.1.3).

a) Emergency operational measures will be implemented to reduce the severity of odor problems in 1977. The potential for serious odor problems will remain.

b) Emergency construction of sludge thickening units will eliminate the lack of adequate sludge handling facilities, which is the most significant

source of present problems. This action should result in the elimination of critical odors by the summer of 1978. The action is recommended by the Facility Plan, but will be funded directly by the City prior to completion of the 201 planning effort, in order to eliminate the problem as soon as practicable. It is anticipated that the City will seek Federal funds as reimbursement for a portion of the design and construction costs of this action, and for other lesser emergency measures which are to be undertaken.

c) Completion of the Phase IA improvements, which will expand the capacity of Plant #2B to 47 mgd, is expected to further reduce odor problems by early 1980; in particular operational flexibility will be enhanced so that odor-causing upsets of the treatment system should become extremely rare.

d) Additional measures will be taken to remedy minor odor sources at the Plant. Some, such as most of the steps specified by the Stipulation, have already been completed, or will be implemented in 1977-78. None of the measures are considered essential to the reduction of critical problems, but all are necessary to meet the mandate of the Stipulation for use of Best Practicable Control Technology.

Measures as outlined in d) above are also proposed to reduce odors at Plant #1.

Upon completion of the steps indicated above, some odor problems will still remain at both treatment plants. Most of the problems will relate to the sludge handling system; the most significant source at each plant will be the continued use of open drying beds for sludge dewatering. Other problems may include lack of preliminary treatment facilities at Plant #2B and lack of positive odor control measures (e.g. collection and treatment of gases) at facilities such as grit chambers and bar screens. Solution of these problems must be accomplished by measures recommended by the Facility Plan in order to comply with the Stipulation and to eliminate a serious environmental impact. Odor control measures are a high priority among all potential wastewater management actions.

Resource Managment. In Albuquerque, as elsewhere, there is a trend toward increased scarcity and cost of resources. Wastewater management thus faces the need to maximize recycling of waste products, while minimizing the consumption of resources. Specific potentials for improvements in recycling or resource use include the following.

a) Wastewater, and the nutrients it contains, is obviously a potential water supply source which might be recycled for many uses. Two types of recycling, agriculture and aquaculture, have been mandated for consideration in this EIS by the Stipulation. All alternatives for recycling must be judged against conditions which would prevail if existing practices were continued. Specifically, virtually all water in the Rio Grande Basin is put to beneficial use, either through formal exercise of a water right or informally by natural vegetation and wildlife. In effect, City wastewater is already being recycled by discharge into the Rio Grande.

b) The by-products of wastewater treatment can be recycled. As indicated in Section 2.1.3, sludge is already recognized as a valuable fertilizer-dressing for City parks. By the year 2000 the worth of sludge for this purpose will be approximately $300,000 per year; even more valuable uses for sludge may exist. One potential problem in future sludge reuse is that the solids produced by an activated sludge plant may differ from those produced by a trickling filter facility; for example, nutrient content may be slightly more or less, and metals concentrations will probably be less. Scum and sludge gas are other by-products which can be considered for recycling.

c) Water conservation programs, while normally aimed at reducing water demands, would have the benefit of reducing wastewater flows, and hence reduce the need for expensive system expansion. Energy conservation measures associated with collection and treatment facilities would similarly help reduce the problem of increasing resource use and costs.

d) Resource demands can be minimized by phasing the construction of collection and treatment facilities to avoid incurring premature or unnecessary commitments of capital, labor and materials.

3.2 WASTEWATER MANAGEMENT ALTERNATIVES

The Facility Plan contains technical and cost data on all alternatives which were given a complete analysis during the 201 planning process (MMC, 1977). The evaluation in this EIS divides the alternatives into six categories, as identified below. In practice the categories are interrelated, and the ultimate selection requires consideration of the compatibility of different system components.

Sewerage. The basic choice is between use of on-site systems for liquid waste disposal, or the construction of sewers and central treatment of wastewater. More detailed options relate to: different approaches to one-site system technology and management; pressure versus gravity sewers; the renovation of lift stations; construction of relief lines; sizing and phasing of sewer lines; and choice of sewer pipe materials (see Section 3.3).

Treatment. The most important alternatives relate to the siting of facilities which could be built to meet NPDES permit requirements, and the possibilities of using land application or advanced treatment to achieve nutrient removal (see Section 3.4).

Solids Handling. The major alternatives relate to the treatment and ultimate disposal of sludge, in order to achieve positive odor control and to maximize recycling. Thermoradiation of sludge, for subsequent use as an animal feed supplement, is one option to consider instead of sludge application as a fertilizer-dressing for City parks. Alternatives also concern the recycling of other solids - scum and grit - as well as sludge gas (see Section 3.5).

Disinfection and Chemical Odor Control. These alternatives include measures such as chlorination, ozonation and use of hydrogen peroxide (see Section 3.6).

Wastewater Reuse. In addition to use of wastewater for irrigation purposes (discussed in 3.4.1), alternatives include: aquaculture, silviculture, cooling water, recreation and open space, and others (see Section 3.7).

Ordinances and Management Policies. Alternatives relate to the liquid waste ordinace and toxic waste disposal, water and energy conservation, and other matters. (See Section 3.8).

3.3 SEWERAGE AND ON-SITE SYSTEM ALTERNATIVES

Should new sewers be built in areas which now depend on on-site liquid waste disposal? The available evidence indicates that at least some extensions are needed. As discussed in Section 2.4.5 the existing practice whereby 6 million gallons of wastewater are discharged each day from septic tanks and cesspools in the planning area is in conflict with accepted sanitary practice, because most of the discharge occurs in areas of shallow water table and/or where wells are in close proximity. Although regional health problems cannot be attributed with certainty to the use of on-site systems (OSS), widespread low-level degradation of ground water quality has occurred. This degradation runs counter to the objectives of P.L. 92-500 and to the goals of the City/County Comprehensive Plan. It can be reduced by either of two methods - upgrading of OSS or construction of sewers. Since many of the OSS occur in relatively urban areas, at least some sewer service can be provided at moderate cost with few if any adverse consequences or controversy. Thus, the real questions to answer are - which parts of the planning area need sewers the most, which need sewers at a lower priority, and which do not really need sewers at all?

The decision as to which areas need sewers and which do not depends on a site-specific evaluation of sanitation problems (as reflected in lot sizes and soil conditions), land use planning criteria, and construction problems. In turn, evaluation of these factors requires a look not only at conventional OSS versus sewers, but also at options which can improve OSS sanitation (e.g. use of advanced systems) or reduce the impact of sewers (e.g. pressure sewers). To encompass all these factors the analysis is presented in several sections, as outlined below.

Section 3.3.1 assesses the pros and cons of different technologies for on-site waste disposal, including advanced systems such as the aerated tank and the evapotranspiration field.

Section 3.3.2 discusses possible management options which would permit the upgrading of OSS so that they would provide environmental protection comparable to that afforded by sewers.

Section 3.3.3 presents brief evaluation of the common options associated with gravity sewers, such as sizing and phasing of lines, selection of pipe material, and route selection. It also provides information on pressure sewers, lift stations and relief of existing interceptors.

Given all the basic information, it is then possible to compare OSS to sewers in a general and systematic way. This comparison is provided in Section 3.3.4.

Section 3.3.5 applies the general considerations just mentioned to the specific areas of Albuquerque where new sewer systems are a possibility. It presents the major conclusions of the analysis.

3.3.1 Alternative On-Site System Technologies

The upgrading of OSS is an alternative to installation of sewers. Upgrading could involve at least two related types of actions: use of advanced systems (discussed here); and improved regulation and management of OSS (Section 3.3.2).

Only three methods of on-site liquid waste disposal can be considered to be widely available on a commercial basis for use in northern New Mexico: the septic tank-drainfield (used in at least 80% of new installations); the aerated tank and drainfield (increasingly common in problem areas); and the septic or aerated tank followed by an evapotranspiration field (limited use so far). In the future other methods should become available, such as recycling/composting systems; systems which discharge to neighborhood marsh or pond areas (see Small, 1976); and mound systems.

Tables 3-2 through 3-4 provide information on the pros and cons of these three technologies. From the point of view of dollar costs (Table 3-2), the following conclusions can be made.

a) Septic tanks and drainfields are a low-cost option for on-site wastewater disposal, but if soil conditions are poor aerobic units are no more expensive in the long run.

b) For clustered dwellings in which several units are installed at once, with some common use of drainfields, aerobic tanks may be the least-cost on-site option.

c) Evapotranspiration (ET) units seem very costly compared to the other systems; however, this cost disadvantage disappears as soil conditions become less favorable for the other systems. When impermeable, shallow or rock soils are present, only the ET system may be acceptable; similarly the ET system is best for high water table, non-flooding environments.

Table 3-3 presents some of the environmental costs and benefits of different systems. Evapotranspiration units stand alone in that they discharge no pollutants to ground or surface water and thus cause no contamination; the cost of this benefit is complete loss of the water resource instead of recharging ground water. Aerobic units may offer quite a high degree of environmental protection and also reduce odors; however, some contamination from substances such as nitrates and metals does occur, and bacteria loads can be sizeable unless the effluent is disinfected. Septic tanks and drainfields offer the least degree of environmental protection by far; as a rule these systems cause 2-3 times as much pollution on a per unit basis as do the least effective of the advanced systems. Use of multiple-chambered tanks improves the effectiveness of these systems somewhat.

Table 3-3 also presents information on system operation, maintenance and reliability, and indicates that on balance few of the on-site units are as potentially effective as centralized treatment plants which offer a greater prospect for adequate maintenance, hence reliable operation. Aerobic units are especially vulnerable to improper maintenance, to the point that they may render no more treatment than a conventional septic tank.

TABLE 3-2 ON-SITE WASTEWATER DISPOSAL SYSTEMS AND COSTS, BY EIA SOIL LIMITATION GROUPS, FOR INDIVIDUAL AND CLUSTERED DWELLING UNITS.*

ONE DWELLING UNIT (du)	Slight Limitations** - A (Percolation rate of 1-15 min/inch)			Slight Limitations - B (Percolation rate of 16-30 min/inch)			Moderate Limitations - C (Percolation rate of 31-60 min/inch)		
	SEPTIC TANK	AERATION UNIT	ET SYSTEM	SEPTIC TANK	AERATION UNIT	ET SYSTEM	SEPTIC TANK	AERATION TANK	ET SYSTEM
Drainfield Surface Sq. Feet	280-760	196-532	2000	764-1000	535-700	2000	1004-1320	703-924	2000
Equipment costs									
Tank	$ 400- 500	$1300-1400	$ 400- 500	$ 400- 500	$1300-1400	$ 400- 500	$ 400- 500	$1300-1400	$ 400 -500
Drainfield	$ 420-1140	295- 800	2000-2500	1146-1500	803-1050	2000-2500	1506-1980	1055-1386	2000-2500
TOTAL	$ 820-1640	$1595-2200	$2400-3000	$ 1546-2000	$2103-2450	$2400-3000	$ 1906-2480	$2355-2786	$2400-3000
Maintenance Costs/Year									
Pumping	$ 20	$ 10	$ 20	$ 20	$ 10	$ 20	$ 20	$ 10	$ 20
Drainfield Replacement	$ 21- 57	7- 20	100- 125	57- 75	20- 26	100- 125	75- 99	26- 35	100- 125
Maintenance Contract	0	35	0	0	35	0	0	35	0
Electricity	0	15	0	0	15	0	0	15	0
TOTAL	$ 41- 77	$ 67- 80	$ 120- 145	$ 77- 95	$ 80 86	$ 120- 125	$ 95- 119	$ 86- 95	$ 120- 125
25 DWELLING UNITS									
Drainfield Surface Sq. Feet	5250-14250	3675-9975	50000	14550-18750	10185-13125	50000	19050-24750	13335-17325	50000
Equipment Costs									
Tanks	$ 5000	$ 10000	$ 5000	$ 5000	$ 10000	$ 5000	$ 5000	$ 10000	$ 5000
Drainfield	3500- 9500	2450- 6650	33500	9700-12500	6790- 8750	33500	12700-16500	8890-11550	33500
TOTAL	$8500-14500	$12450-16650	$38500	$14700-17500	$16790-18750	$38500	$17700-21500	$18890-21550	$38500
Cost per du	$ 340- 580	$ 498- 666	$ 1540	$ 588- 700	$ 672- 750	$ 1540	$ 708- 860	$ 756- 862	$ 1540
Maintenance Costs/Year									
Pumping	$ 240	$ 120	$ 240	$ 240	$ 120	$ 240	$ 240	$ 120	$ 240
Drainfield Replacement	175- 475	61- 166	2500	485- 625	170- 219	2500	635- 825	222- 289	2500
Maintenance Contract	0	175	0	0	175	0	0	175	0
Electricity	0	80	0	0	80	0	0	80	0
TOTAL	$ 415- 715	$ 436- 541	$ 2740	$ 725- 865	$ 545- 594	$ 2740	$ 875- 1065	$ 597- 664	$ 2740
Cost per du	$ 16- 29	$ 17- 22	$ 110	$ 29- 35	$ 22- 24	$ 110	$ 35- 43	$ 24- 27	$ 110
Other:	Delivery at $1.50/mile; chlorination unit of aeration system is $157 initially.								

* estimates, based on a survey of suppliers and government officials in the Albuquerque, Santa Fe, and Los Alamos areas, 1975

** except where water table high

TABLE 3-3. ENVIRONMENTAL COSTS AND BENEFITS OF DIFFERENT ON-SITE SYSTEMS
Information on central and package plants is provided for comparison purposes

Organic Load. Organic load is a convenient measure of pollution, and is often expressed in terms of biological oxygen demand (BOD). Its significance as a pollution measure is not always clear in arid-zone New Mexico, but as a rule any system which does not reduce BOD to 30 mg/l or less is not achieving the degree of treatment which is generally required Typical BODs are

Raw sewage	250 mg/l
Septic tank	180 mg/l+
ST/DF*	100 mg/l
Aerobic tank Type II**	60 mg/l

All other systems achieve 30 mg/l or less BOD, including

Aerobic tank Type I**	(20 mg/l or less)
Aerobic tank Type II with drainfield	(often 10 mg/l or less)
Most package and central plants, if properly operated and designed, achieve 30 mg/l or less.	
Evapotranspiration units	Nil

Solids Load. Solids in final effluent discharges should not exceed 30 mg/l as a rule. As with BOD, high solids are more indicative of inadequate treatment than a direct measure of a pollution problem in New Mexico. Typical values are

Raw sewage	300 mg/l+
Septic tank	150 mg/l
Aerobic tank Type II	100 mg/l or less
ST/DF	50 mg/l
Aerobic tank Type I	40 mg/l or less

All other systems achieve 30 mg/l or less suspended solids, including.

Aerobic tanks and drainfields	20 mg/l or less
Package plants and central plants	30 mg/l or less
Evapotranspiration units	Nil

Bacteria Load. Bacteria can cause diseases, or be associated with other disease-causing organisms; coliform bacteria are used as indicators of disease potential. In raw sewage ten to fifteen million coliform colonies may be present per 100 milliliters of sample; the amount is little reduced by septic tank detention, and reduced only about 2-3 times in an aerobic tank Drainfields reduce it further, but only to barely tolerable levels. the best on-site systems still discharge 100,000 coliform colonies/100 ml, which is then reduced by soil filtration.

*ST/DF = septic tank and drainfield

** Type I Aerobic tanks are those meeting standard # 40 of the National Sanitation Foundation. Type II units do not meet the standard

Further bacteria control requires chlorination or other disinfection, and is usually associated with package or central plants; however some aerobic tanks do provide for addition of chlorine tablets Evapotranspiration units, of course, discharge no bacteria to the ground.

Other Contaminants. Contaminants such as nutrients and base metals are only moderately reduced by any conventional form of treatment, some of these substances may settle out with solids, but the rest are discharged to the environment, although sometimes in modified form. Special treatment facilities are needed to control these substances if contamination reaches a problem level, such facilities are most easily incorporated into full-scale treatment plants Evapotranspiration units, having no discharge, do not lead to pollution problems from these or other contaminants. Odor problems are sometimes associated with septic tanks and their drainfields. These problems are reduced when an aerobic tank is used or the drainfield is vented. Limited experience exists with regard to odors for ET system

Other Resources Package and central plants utilize electrical energy, considerable manpower, and some chemicals, aerobic tanks also consume energy Evapotranspiration units consume all water discharged to them, hence unlike the other units provide no opportunity for local recharge to ground water For a 25-unit community, this could mean a net loss of 10-15 acre-feet/per year of water from the local resource, a water rights loss might also be incurred

Operation and Maintenance Problems. As system sophistication increases, the following O&M situations are encountered. a) Most of the sophisticated systems (package plants and to a lesser extent aerobic units) require more attention than simple septic tank systems; this increases costs. An exception is the evapotranspiration unit, which compares to the septic system in terms of maintenance needs. b) System complexity usually determines effluent quality. The more complex the system, the better quality wastewater produced. However, if O&M is less than adequate, the benefits of the advanced treatment may be lost. Periods of peak use (surge flows) can upset aeration tanks and inputs of floating material and garbage grindings can clog the units. c) The potential for proper control of system operation is greater for the more sophisticated systems, just as is the environmental loss which occurs if control is not obtained

On balance, the centralized systems seem to offer more of a prospect for efficient operation and maintenance than do a proliferation of on-site systems It appears that aerobic tanks are particularly vulnerable to lack of maintenance, however, evapotranspiration units are relatively little affected. The situation could be changed by public management of on-site systems.

TABLE 3-4. SUMMARY OF TRADEOFF COSTS AND BENEFITS OF DIFFERENT WASTEWATER DISPOSAL OPTIONS*

OPTION	Septic Tank and Drainfield	Aerobic Tank and Drainfield	Evapotranspiration Unit
FACTOR.			
Economic Cost	Only marginally the least expensive, if at all cheaper, least up-front cost, however	Competitive with septics in many cases, especially over the long run.	Relatively expensive
Environmental Control	Limited, causes much more pollution than any other system unless soil filtration is effective	Relatively good but limited control over trace contaminants especially nitrates	No discharge, hence no ground water pollution
Reliability	Vulnerable to poor design and construction practices.	Vulnerable to lack of maintenance.	Reliable, with exception of possible liner deterioration, or flooding.
Legality	Not permitted on bad soils or small lots.	Acceptable on comparatively small lots and adverse soils	Generally can be used regardless of soil or lot-size consideration.
Summary	Adequate if soils are good, and lots and setbacks are large enough to allow treatment and dilution of contaminants before the effluent reaches ground water. Causes pollution if many are massed in a small area	May be encouraged provided that proper maintenance can be assured; pollution will be reduced several-fold. Will increase energy use, labor requirements.	To be encouraged if cost and water loss not a factor. Only choice where soil is shallow or rocky, or water table very high Odor control might require use of aerated tank, thus increasing costs

*This summary reflects information published prior to 1976.

Table 3-4 summarizes trade-off information presented in the Technical Reference Document. Based on the table the following conclusions can be reached.

a) Septic tank systems are less effective and cause more pollution than other systems, have only slight-cost advantages in the long run, and generally are not desirable in an urban situation unless soil conditions and lot sizes are very favorable.

b) Aerobic tanks work much better than septic tanks, and are not really much more expensive; however, their proper function requires adequate maintenance which may be lacking in many households.

c) Evapotranspiration units offer reliable and nearly complete environmental protection at high economic and water resource costs; flooding and deterioration of the buried plastic liner may be a problem.

Other technological options include use of passive aeration in the drain field (such as a vent pipe) to improve soil treatment of effluent, and use of clustered systems, whereby several homes discharge to a communal tank and field. The latter alternative has been utilized successfully in the Albuquerque area for small subdivisions and trailer parks, and reduces per capita disposal costs substantially.

It should be noted that, except where soil conditions are favorable, the conventional septic tank and drainfield would not meet the discharge standards which apply to central treatment facilities. Aerobic systems which meet particular construction criteria can produce effluent which meets most discharge standards. ET systems meet the goal of no discharge of pollutants, but not goals promoting wastewater reuse. Overall the advanced systems approach the level of pollution control mandated by P. L. 92-500. Existing regulations on OSS prohibit conventional tanks and fields in much of the valley portion of Albuquerque; increasing emphasis on the advanced systems is thus likely, even though the regulations do not now provide specific criteria regarding such systems.

3.3.2 On-Site System Management Alternatives

The management options are complex and address the question of how OSS can be controlled through regulations and management programs in order to promote the goals of P.L. 92-500 and the Comprehensive Plan. If on-site systems are to be viable in an urban/rural setting, they must at least approach the level of environmental control associated with centralized treatment works. Five management alternatives have been identified. In order of increasing complexity they are:

1. Continue present policies and procedures.
2. Adopt more stringent regulations without greatly increasing the role of government in OSS management.
3. Replace existing systems which do not meet modern standards.
4. Move to comprehensive management of all aspects of OSS.
5. Treat on-site systems as a public utility.

Alternative 1 would continue existing management practices. These are stringent with regard to construction standards, but provide little control over OSS already built, and are vague with regard to advanced systems. A number of additional measures, listed under Alternative 2, are needed if on-site systems are to be upgraded significantly.

Alternative 2 would upgrade regulations through steps such as:

- require advanced systems for new installations under specific conditions;
- require all new systems to meet standards such as those issued by the National Sanitation Foundation;
- provide for more frequent inspections of existing systems, especially advanced units such as aerobic tanks.

For Albuquerque this option would probably mean that aerated tanks and/or evapotranspiration fields would be required in most developing unsewered areas; see EPA (1977, Section A-6, part d) for details. Some personnel increases would be needed to permit government agencies to review construction plans, inspect installation sites and check up on system operation to at least a limited extent. However, on-site disposal would remain the responsibility of the private citizen and the government role would not change radically.

This alternative has the advantage of being the minimal cost option for upgrading on-site systems. It will accomplish at least some of the goals of P.L. 92-500 and the Comprehensive Plan, though it will not completely control water pollution, nor in itself restrict urbanization. Its major disadvantage is that it would not address problems caused by existing systems.

Alternative 3 would take up where Alternative 2 leaves off, by actively phasing out systems which do not meet stringent regulations. First priority would be to replace cesspools, privies and septic tanks/drainfields which fail a sanitary survey. Systems failing lot-size limits would be tackled later. In effect this option would eliminate the concept of accepting past mistakes, and it is probably the minimum step needed if existing health problems and water contamination are to be reduced.

However, this alternative is not likely to be equitable, since the persons affected would be financially responsible for system upgrading. In contrast, citizens with access to sewer service would have their sewerage costs reduced through government grants. As it often is the poorer neighborhoods which contain OSS, it is not certain that the replacement expense could be borne at all. To actually accomplish Alternative 3, a public subsidy program would probably be needed. Total costs for replacing existing systems could exceed $30,000,000 (at $2,000 per system for 15,000 units).

Another drawback is that this alternative would lead to extensive use of advanced systems, and thus increased energy and water use. Resource costs would probably exceed those associated with sewers and central treatment, without actually achieving the same level of effluent quality and potential for wastewater reuse. A sub-alternative to 3 would be to replace only some of the existing systems, e.g. cesspools in areas with a shallow water table. This would be less expensive and more readily justified on the basis of public health and protection of water quality.

Alternative 4 would establish a single government or non-profit agency to provide central management of on-site systems. Duties and obligations of the agency could include any or all of the following:

- maintain detailed information on soil, water table and water quality conditions, including any necessary operation of a monitoring program;
- perform feasibility studies and percolation tests on lots to evaluate the potential for the use of individual on-site systems;
- prepare plans for such systems on behalf of individuals, or review and approve submitted plans;
- license those responsible for system design, installation and maintenance;
- inspect all systems during installation, and periodically thereafter to ensure they are being operated properly;
- inspect tanks and fields every few years to determine their condition and ability to function, and require replacements if necessary;
- establish standards for system maintenance, for use of water softeners, for well depths;
- obtain grants or loans, and provide subsidies or incentives for replacement of existing systems not meeting standards;
- perform system maintenance, or require reporting of private maintenance;
- perform experiments, such as on test plots to determine the effect of dosing cycles;
- perform sanitary surveys, and require removal of cesspools and unsanitary systems;
- develop policies regarding utility extensions.

The agency would probably be supported by fees charged to those served, possibly with a government subsidy; private firms might be used on a contract basis to perform some of the work.

The major benefit would be that the level of management for OSS would approach that for central systems and system operation would improve with consequent reductions in environmental pollution. The primary disadvantage is that the concept is new and has only been initiated in a few locations; experience with centralized management of OSS is limited. The legal procedures needed to establish the agency are uncertain and costs would probably be substantial. However at a fee of $20/unit/year, the agency budget could reach $200,000 for management of 10,000 systems, and would be sufficient to perform many of the listed tasks.

This alternative, as well as the one to follow, could be implemented for the entire planning area, for one of the incorporated communities, or for any special district within the region.

Alternative 5 would extend the central management concept to include central public ownership of on-site systems. The management agency would be a full-fledged public utility, responsible for all aspects of liquid waste disposal, whether by sewers or individual systems. The agency could extend the concept of clustered units to properties other than subdivisions and trailer parks, and could be responsible for operation and maintenance of pressure sewer systems.

A major advantage of this alternative is that new facilities might be eligible for Federal and State funding, and such funding might extend to replacement of cesspools, tanks and fields which do not meet sanitary standards. However, the legal implications of this option have not been explored, and it is not certain how the public would respond to the incursion of government activity into the private sector. The pros and cons of both Alternatives 4 and 5 are being evaluated under the 208 Program, in order to determine approximate costs, impacts and legal constraints.

Summary. Alternative 2 is the minimum effort needed to upgrade on-site systems to the point where at least some environmental benefits are achieved from system operation. The more sophisticated options are worth considering on a regional or local basis, especially if there is concerted interest in maintaining on-site systems to minimize the need for sewer extensions and interest in improving water quality to respond to the goals of P.L. 92-500. However, these alternatives are relatively unproven. On-going studies should clarify the tradeoffs on these more intense alternatives and permit better decisions to be made as to when an option such as Alternative 4 or 5 can be implemented. Until the studies are completed, Alternative 2 appears to be an effective choice.

3.3.3 Alternatives Related to Sewer Construction

Sanitary sewer systems commonly consist of gravity collector and interceptor lines. Options exist with regard to sizing and phasing of lines, selection of pipe material, and route selection; also in some circumstances pressure sewers and force mains may be considered instead of a gravity system. Other alternatives to be evaluated are proposed interceptor capacity increases and lift station renovations.

Sizing of lines is a function of expected population development. According to the Facility Plan, population forecasts for ultimate development in different parts of the area have been provided by the City/County Planning Department. Future per capita flows have been estimated to be the same as now experienced, namely, 110 gallons per day. Collection and interceptor lines are then sized in order to carry the ultimate projected flow, even though such flow may not occur for several decades.

Two exceptions to the sizing policy occur. First, in many valley locations the slope of the proposed gravity lines is very slight and projected flows are rather small; flow velocities within a normally sized pipe would be low, and odor problems might result. To avoid such problems the Facility Plan proposes to use pipes which are significantly larger than required to convey the wastewater flows. Such larger pipes reduce the frictional slowing of the flow, increase velocities, and reduce odor potential. Drawbacks to the larger pipes include higher cost, and the possibility that the excess capacity of the lines could be an indirect stimulus to development. Since the lines with excess capacity are proposed for valley locations a possible conflict with the Comprehensive Plan exists. Should an actual conflict occur alternatives such as the use of a lift station and force main need to be considered, to ensure that the large lines represent the best solution to the problem.

The other exception to sizing policy is that in order to meet EPA regulations, interceptors large enough to accommodate ultimate development are not constructed if they would be less than half-full by the end of the planning period (1996 or so). Instead smaller lines are constructed. This approach not only reduces short-term dollar costs, but avoids making a commitment toward future population conditions which may or may not come to pass.

The phasing of sewer construction is also based on population forecasts. According to the Facility Plan service would generally not be provided until densities reach or exceed 5 persons per acre. This is approximately the density associated with "semi-urban" development as defined by the Comprehensive Plan (ABC, 1975), and indicates that the population has reached the level where urban services may be considered appropriate, provided that other factors are favorable to provision of sewers. The timing of construction in accordance with population projections has several advantages, especially in that premature costs are avoided while the expansion of urban infrastructure is closely coordinated with properly sequenced development.

Alternatives with regard to pipe material are discussed in the Facility Plan. The basic choice is between material which is "permanent" and that which is less expensive, but which may require periodic replacement. From an environmental point of view permanent materials have many advantages. In particular they reduce the potential for infiltration or exfiltration to a negligible level, and minimize the prospect of construction impacts that would occur during line replacement. In recognition of these environmental benefits the Facility Plan recommends use of permanent materials for all circumstances. Based on costs and proven performance capabilities, the specific recommendation is to utilize vitrified clay for lines 15 inches in diameter and smaller, and to utilize concrete pipe with a PVC crown liner for larger lines. Alternate materials considered included plastic pipe, unlined concrete, asphalt-lined concrete, and concrete lined with coal tar epoxy coatings; these four materials all face the prospect that their long term performance may not be satisfactory.

With selection of permanent pipe, long-term ground water contamination problems associated with exfiltration or leakage would be expected to be minimal, and to occur only where special problems exist, such as penetration of the line by tree roots, rupture because of superimposed loads, or poor construction at the time of pipe laying. Should leakage take place the result would be similar to the effects of septic tank discharge, that is the trench would act as a percolation field and marginally renovate the sewage. It has been noted that "the true effect of sewer leakage on ground water quality is probably far less than the theoretical potential" (EPA, 1973).

Alternatives with regard to route location are determined on a case-by-case basis in order to reflect site-specific problems such as right-of-way availability and grade. In general a route selected on the basis of cost and engineering considerations could be rejected on environmental grounds if any of the following problems were significant:

- the construction would disturb an environmentally sensitive site; that is a site characterized by especially valued archeologic resources, a site occupied by a viable natural ecologic community, a site where the soils are especially vulnerable to water or wind erosion, or a site where dewatering would have especially adverse effects on wells;

- the proposed route would cause unacceptable noise levels or traffic disruption; for example, a route which passed near a hospital and not only caused excessive noise but cut off emergency access would not be acceptable.

Few problems of this type are anticipated in Albuquerque. During design and construction stages certain measures will be used to minimize construction impacts; these are discussed in Section 5.1.

Where gravity flow is difficult or expensive it is necessary to consider use of lift stations with or without force mains. These stations may also be considered to avoid oversizing of lines. Use of lift stations can result in several environmental concerns including: a general increase in the potential for odors; increased energy consumption; increased operation and maintenance requirements; and increased risks in the event of power failure. On balance, these factors lend support to the recommendation of the Facility Plan that new lift stations not be considered except where their drawbacks are offset by significant benefits. In practice these benefits would occur where lift stations reduced the need for deep trenching and dewatering, and thus lessen construction impacts and dollar costs.

While lift stations are generally not recommended, those which do exist or will be built need to be in good condition and properly maintained. To this end the Facility Plan contains a number of recommendations for renovations to specific lift stations. General recommendations are made to provide a lift station alarm/monitoring system, and to provide standby power to be utilized in the event of a blackout. If implemented, these recommendations would benefit system function while involving very small-scale and short-term construction impacts. The recommendations, which are listed in Section 4.1, would cost less than $1,000,000. The only apparent benefit of not making the improvements would be the short-term saving of funds.

Pressure sewers represent a special type of system in which a grinder or effluent pump and holdover tank are installed at each household (or for a cluster of households). The pumps act as small lift stations and feed the wastewater to small diameter (normally two-inch) pressure lines for ultimate discharge to a larger gravity sewer or to a larger force main. Grinding of the wastes prior to pumpage reduces the solids to a small diameter, so that the pressure line does not get clogged. The major advantage of pressure sewers is the reduction in construction impacts. The lines require only a shallow, narrow trench; traffic disuption is minimal and dewatering is seldom required. Structures such as irrigation canals, which are major obstacles to a gravity sewer, can be readily crossed by a pressure line. Line capacities are limited, a fact which would be compatable with construction of sewers in areas designated by the Comprehensive Plan for minimal further development.

Disadvantages relate especially to the need for regular operation and maintenance of the individual pumps and to the lack of experience in using pressure sewers on a large scale. Additional staff would be necessary to ensure that a failed pump was immediately replaced, so that sewage would not back up into a house or otherwise cause problems. Energy use would be about one KWH/unit/day; for a large system the total energy commitment would be significant. Installation of the pumps within individual property lines would generally be required, resulting in potential legal problems of access.

Because of these disadvantages, pressure sewers are considered mainly for problem areas such as the Valley, where construction impacts and land use concerns are especially significant. Specific locations where pressure sewers have been considered as an alternative are discussed in Section 3.3.5. It is possible that future experience with pressure sewer systems will indicate that this alternative is cost-effective in many situations. A particularly attractive option is the use of existing septic tanks coupled with effluent pumps (DCEO, 1974).

The Facility Plan discusses a number of existing interceptors which do not have sufficient capacity to carry increased flows which are projected to occur within the planning time frame. For most of these lines there are two alternatives to be considered at the time that increased capacity is needed. The first choice is to run a new line parallel to the old; the second is to completely replace the existing line with a new one. Advantages of the first option are a much lower cost and much simpler construction. The second alternative is considered mainly if the existing pipe, when inspected, appears to be in comparatively poor condition and thus in need of replacement. A summary of the alternatives, with costs, is given in Table 3-5.

3.3.4 Comparison of Sewers and On-Site Systems

Many of the environmental characteristics of sewers and on-site systems are generic, that is they apply to most situations and depend to only a limited degree on site-specific conditions. Significant generic characteristics of the two basic alternatives are listed in Table 3-6. In general on-site systems have the following advantages:

- construction impacts are minimal and localized, involving no traffic disruption or dewatering, and creating minimal dust and noise;
- initial costs are low, especially since existing households in an unsewered area have already incurred the major expenses.

Conversely, sewers are favored for reasons of water quality protection, including:

- there is almost no direct contamination of ground water;
- the collected sewage is centrally treated, and the potential exists for almost any desired level of treatment and reuse of wastewater;
- sewers are reliable (whereas the failure rate for OSS is high);
- long-term replacement costs are low.

A major factor in the evaluation of sewers and OSS is their impact on land use. Sewer service is essential in any area which is to be developed in a highly urban form. Conversely, the use of OSS is by itself a factor which forces land use to be low-density in character, since sanitary regulations prohibit use of on-site waste disposal on small lots. In areas designated rural or semi-rural by the Comprehensive Plan the use of on-site systems will provide a strong support to the objectives of the CP, while the installation of sewers would eliminate a significant restraint to small lot or multi-family development. This does not mean that the provision of sewers in rural areas would force development, since measures such as strict zoning ordinances, enforcement of subdivision regulations and widespread use of greenbelt-type tax subsidies can slow or prevent urbanization.

TABLE 3-5 SUMMARY OF NEEDED INTERCEPTOR CAPACITY INCREASES (MMC, 1977)

Line Number	Location of Interceptor	Date Overloading Expected	Est. Cost[1] to Parallel Existing Line[2]	Est Cost[1] to Replace Existing Line[2]
103	Comanche Road (Juan Tabo to Moon)	1985-1994	203,700	283,200
104	Near Menaul and Juan Tabo Blvd.	1980	30,800	42,300
105	Hannett Place(Eubank to Parsifal)	1982	70,100	90,700
112	Eubank Blvd.(Buena Ventura to Copper)	1985	95,500	121,400
113	Near Lomas and University Blvd.	1980-1985	30,700	50,200
119	Comanche Road(San Pedro to Pojoaque)	1980	49,800	67,400
120	Near I-40 siphon(San Pedro & Indian School)	present	(see note 3)	
121	Carlisle Blvd.(Candelaria to Aztec)	1985	(see note 4)	
132	Edith Blvd.(San Francisco to Palomas)	1991	39,900	56,300
142	Anderson Ave. & AT&SF RR tracks	1992	8,600	11,500

Notes:

1 Today's prices.

2. The choice between paralleling or replacing a line would depend on the physical condition of the line when overloading occurs

3 No problems are being caused by the present surcharge, nor are problems expected within 20 years, but a complete population survey and flow analysis is recommended for 1980.

4. The surcharge expected is, and should remain, significant. Due to age and material used, an inspection and population analysis is recommended for 1985.

TABLE 3-6 COMPARISON OF ENVIRONMENTAL IMPACTS OF ON-SITE SYSTEMS AND SEWERS

Category	On-site systems (OSS)	Sewers
Construction	Impact normally localized and minor. Some locations may require construction of a mound, or small blasting	Potential for considerable noise, dust and traffic disruption. Deep lines in valley require extensive dewatering, adversely affecting wells. Blasting may be needed in mountains. Impact of pressure sewers is much less.
Pollution Control	Conventional systems lead to degradation, advanced systems may meet standards of 92-500, but have limited potential for tertiary treatment and reuse Centralized management system might utilize effluent for irrigation.	Potential exists for thorough treatment and reuse of wastewater. Minor problems can occur with lift station failure, exfiltration, odors.
Land Use	With existing regulations, use of systems would not be permitted on most small lots Therefore this alternative will tend to perpetuate low-density development. Use of advanced systems could reduce lot-size requirements.	In theory lines can be sized to support any level of density and pattern of land use However, practice shows the need for large lines in valley areas, in order to maintain proper flows Thus where sewers are installed the potential for dense development is increased unless controlled by zoning, subdivision regulations or the like.
Other	Flexible with regard to timing, capacity, layout. But requires careful site-specific analysis of soil conditions, and may not be acceptable everywhere System failure rate is comparatively high, reliability is limited without central management Normally not eligible for grant funds. Initial low costs offset by need for replacement	Represents a sizeable commitment of funds, resources; flexibility somewhat limited, except for pressure lines. Requires moderate to high density to be cost-effective Very reliable, and may be eligible for government funds Initial cost offset by modest long-term replacement and operation costs.

However, in the absence of such controls there is little question that sewer systems in areas such as the North and South Valley and Corrales could serve to stimulate development.

To some extent the comparative differences between sewers and OSS can be lessened by actions such as centralized management of OSS (to provide reliability comparable to sewers) or installation of pressure sewers (to reduce construction impacts). On balance the fact that sewers provide much more protection of water quality than OSS means that they are more in keeping with the goals of P.L. 92-500. For OSS to be preferred to sewers in an area where there are water quality problems, at least one of the following conditions must exist:

- severe construction impacts would result from sewer installation (for example where there is a need for deep dewatering, or a need to cross many canals and drains);
- sewer service would remove a major constraint to denser development in an area designated as rural by the Comprehensive Plan;
- the cost of sewer service cannot be justified on the basis of projected population levels and wastewater flows.

Guidelines for Selection of Sewerage Alternatives. Where land use patterns already reflect urbanization, the drawbacks of sewers are comparatively small while those of OSS are substantial. Sewer service provided to such urban areas will generally not have significant adverse long-term impacts, although it will result in short-term construction effects. Based on the Comprehensive Plan (ABC, 1975, page 3) the extension of sewer service would be appropriate where densities equal or exceed 3 dwelling units (du) per acre. All else being equal, high density areas and those with soil conditions adverse to OSS would have the highest priority for sewer construction.

Conversely in areas which are now and will remain rural, installation of sewers is commonly expensive, and may conflict with land use planning goals. In many such areas continued use of OSS can be expected to be an effective alternative, especially if advanced systems are used to overcome soil problems, and if improved management of the OSS is undertaken. Based on the Comprehensive Plan the use of OSS is generally preferred where densities are less than 1 dwelling unit per acre.

In semi-urban areas with densities of 1-3 du/acre, the decision regarding sewerage versus OSS depends on site-specific conditions, especially soil characteristics and presence of open space. Factors such as health hazards and gross ground water pollution would be more significant, but in practice are difficult to demonstrate in the planning area. If soil conditions are such that conventional on-site systems will not be able to function, then extension of sewers would tend to be favored. This is especially true if the existing development is clustered and comparatively near already developed areas; in such cases extension of a small sewer line could take place without providing a significant stimulus to development. Where soil conditions are relatively favorable for conventional or advanced OSS, and where development is scattered or physically separate from urban areas, then extension of sewers would tend not to be favored. Obviously a fixed criteria cannot be stated to indicate exactly when one of the options is preferred over the other; however, the above guidelines will resolve most situations rather quickly. They also may apply to

some rural areas. Thus even if development is less than 1 du/acre on the average, a clustered neighborhood located near the urban area and faced wit adverse soil conditions may be considered for sewer service. Similarly, an urban area completely separated from the main city by an open space corr may be better served by a local collection system and treatment facility.

As noted in 2.6.2 and elsewhere, the prospect exists that the legal measures used to implement the Comprehensive Plan may not always succeed in achieving development at desired levels. While control of sewer extensions can be used to support the Plan, this technique is an imperfect mechanism for land use decision-making. Therefore, in the event that development in designated rural areas actually takes place to urban densities, it would be appropriate to consider extending sewers to protect ground water quality. To this end it would be appropriate to design any proposed interceptors so that they have adequate capacity should extensions eventually be required, provided that the capacity by itself is not a factor which would lead to excess growth.

At least three other factors must be considered in selecting between OSS and sewers in rural areas such as the North and South Valley. The first is that many residents in these areas have low incomes and cannot easily afford either a sewer hookup or OSS upgrading. The actual cost of the alternatives to the homeowner is thus an important consideration in any evaluation. The second factor is the desire of many County residents to be relatively independent of the City government, as evidenced by the ongoing effort to incorporate parts of the South Valley. Some residents may consider sewer extensions as a prelude to annexation or extraterritorial zoning; if so, implementation of any sewerage alternative might be difficult. Finally, plans already exist to extend City water lines throughout much of the partly settled valley area; some extensions have already been made. This action may reduce the desire of residents for sewer service, since it eliminates the problem of contaminated drinking water supplies for those who hook up to the public system. Provision of sanitary water supplies may be a useful short-term alternative to extension of sewer lines in many areas, since the lot size restrictions associated with OSS would remain as an obstacle to intensive development of rural areas.

The above factors all contribute to the possibility that many valley residents might not utilize public sewerage service even if it were available and thus the benefits of sewers would not be fully realized. Other evidence suggests that most residents would connect to a public sewer within a few years of construction This evidence includes the high failure rate and replacement cost of OSS, and the fact that inadequate OSS facilities foreclose access to many of the fiscal resources needed in a low-income area. Such strong economic pressures for connection augmented by the fact that a hookup results in immediately increased proper values which tend to offset the potentially high charges and fees associated with the hookup. In addition, the procedure for assessing connection charges is to roll part of the charge into the monthly rate, and to permit payment of the remainder in 60 monthly payments (after a 10% downpayment). Other factors which will lead to a high percenta of hookups include: most low-income residents live in rental units, so that the sewerage expenses will be borne initially by landlords; and plumbing code ordinances will be used to force hookup on lots where use of OSS is leading to unsanitary condition

3.3.5 Evaluation of Specific Alternatives

The process of arriving at a sewerage plan for Albuquerque involved a lengthy procedure which included: separation of the planning area into eleven

sewerage system analysis areas; development of initial alternatives for each of these areas; use of a screening process to eliminate inappropriate alternatives; detailed technical, cost and environmental evaluations of the remaining alternatives; and recommendation of the preferred alternative. In most areas the detailed evaluations concerned the comparison between construction of gravity sewers versus use of on-site systems, but in some areas the major options were gravity sewers versus pressure lines or force mains.

The eleven sewerage system analysis areas are shown on Figure 3-1. A list of the alternatives which received a detailed evaluation for each area is given in Table 3-7, with cost data. The extent of the construction which would occur were all potential lines to be constructed is shown on Figure 3-2.

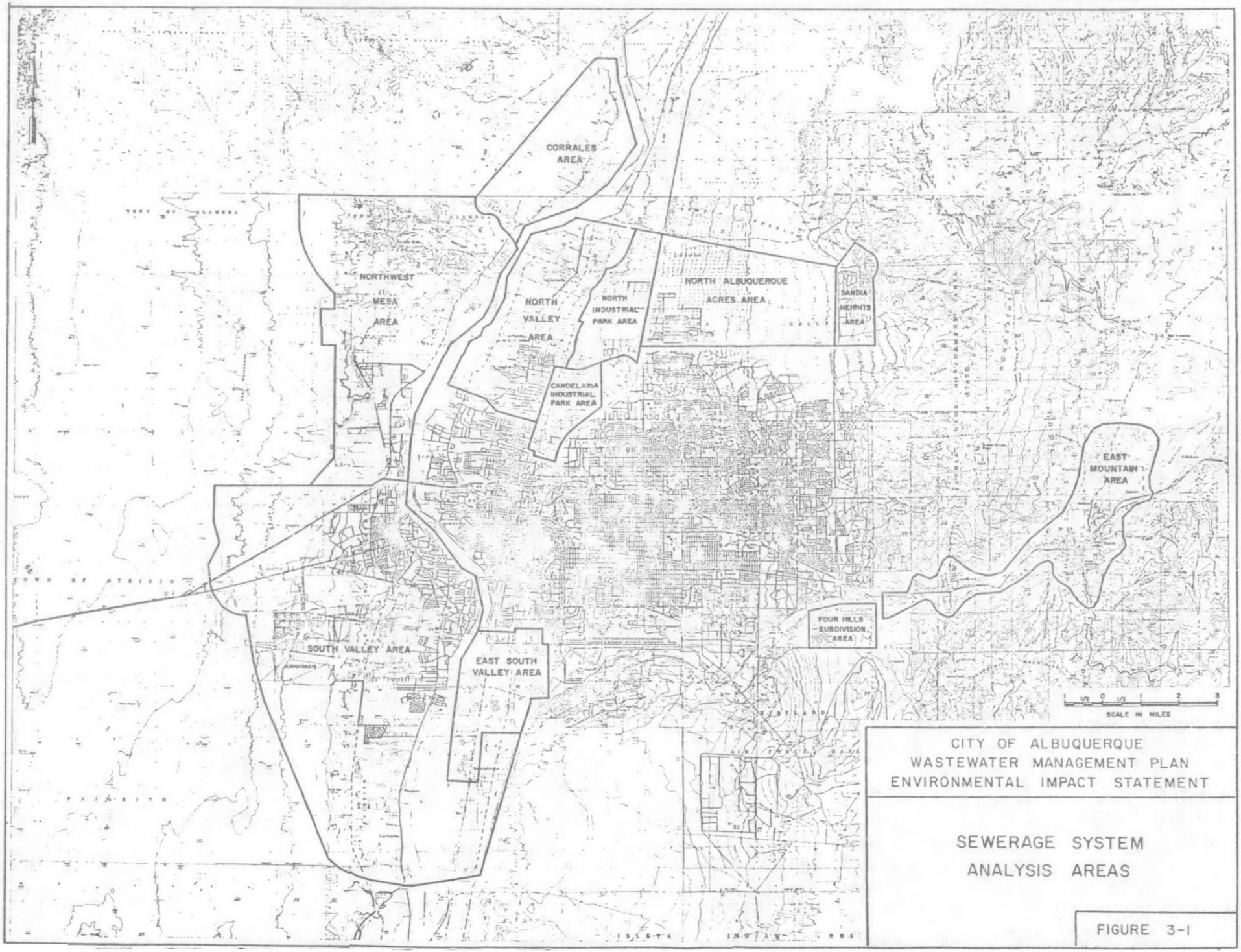
As part of the 201 planning process, all the alternatives which were evaluated in detail in the Facility Plan were analyzed according to environmental considerations (Table 3-8). The conclusions which result from this analysis are summarized below for each of the eleven areas.

Corrales. The information given in Table 3-8 indicates that OSS face problems in the Corrales area due to high water table, flooding and other concerns. However, the main alternative to these systems, construction of a conventional sewer system, would have substantial adverse environmental impacts including: severe construction problems associated with deep trenching on narrow winding streets, with a shallow water table; extensive need to cross canals and drains; probable support of dense development, conflicting with Village policies which aim to retain the rural character of the area. For these environmental reasons the sewerage alternative was rejected.

The preferred alternative for Corrales is thus continued reliance on OSS, with some upgrading to reduce the present problems. In effect this upgrading will involve improved regulations such as set forth in Alternative 2 of Section 3.3.2. At the request of Village officials the Facility Plan contains a contingency plan to be used in the event that growth pressures lead to the urbanization of Corrales. Because of construction impacts indicated above, widespread use of conventional sewers were rejected for the contingency plan. Rather, the contingency actions would include use of gravity sewers on a limited basis, to serve only the most densely settled part of Corrales, and use of OSS in the remaining areas. It is expected that under the contingency plan central management of OSS would occur, following Alternative 4 or 5 of Section 3.3.3. However, as indicated in that section it is not possible to define such a management system at this time, pending guidance from studies which are being undertaken under the 208 Program.

Northwest Mesa. Substantial portions of this area are designated for urban use by the Comprehensive Plan. For such areas the alternative of providing conventional sewer service is favored for sanitary reasons, and is not expected to have adverse land use or other environmental impacts. The Facility Plan has recommended a schedule for providing this service in accordance with population projections made by the City Planning Department, following the policies of the Comprehensive Plan. The phased construction of lines would be favored over immediate construction, since the latter could lead to premature service, or to service which does not in fact follow the development patterns which actually evolve.

North Valley. The North Valley is actually a complex mixture of development patterns and soil/water table conditions. In general the east side of



CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

SEWERAGE SYSTEM
ANALYSIS AREAS

FIGURE 3-1

PAGE NOT

AVAILABLE

DIGITALLY

TABLE 3-7. SUMMARY OF SEWER EXTENSION ALTERNATIVES (MMC, 1977)

Area		Alternatives	Present Worth
Corrales	1.	Continue use of individual systems, with "advanced" units for new homes - cost for new home	$ 4,060[1]
	2.	Provide gravity sewer service to more densely populated areas (more than 5 person/acre)	
		- cost per home served	5,112
		- total cost of sewer system	5,418,800
Northwest Mesa	1	Provide interceptor service[2] to developing areas but do not serve Corrales	3,409,000
	2	Provide interceptor service to developing areas and do serve Corrales (after 1985)	3,380,000
	3	Continue use of individual systems near river below Alameda Bridge	see Corrales Alternative 1
	4	Provide gravity collector sewers for developed area just below Alameda Bridge	38,000
North Valley	1	Provide gravity sewers to all developed areas	11,860,000
	2	Provide a combination gravity-pressure system to all developed areas	12,579,000
	3.	Provide gravity sewers only to areas designated semi-urban in Comprehensive Plan, plus portion at 2nd and 4th St corridor	9,465,000
North Industrial Park	1	Continue use of septic tank and drainfield	2,085,700
	2	Replace septic tanks with aerated tanks	2,320,400
	3	Provide gravity sewers for existing development in vicinity of Bear Canyon Lane and Arroyo Seco Drive[3]	362,500
North Albuquerque Acres		Provide interceptor in 1995 for projected growth (existing population is presently served)	213,700
Sandia Heights	1	Continued use of on-site systems and package plant through year 2000	1,347,800
	2	Extend sewer service from Albuquerque	2,700,800
Candelaria Industrial Park	1.	Continued use of septic systems	662,400
	2	Replace septic tanks with aerated tanks (8/yr)	691,000
	3	Extend sewer service from Albuquerque via lift station and force main	2,225,500
	4.	Extend sewer service from Albuquerque via lift station and no force main	2,283,000
Southwest Valley	1	Continue use of on-site systems, with "advanced" units for new homes	$1,839,000
	2.	Using a "westside" treatment plant	
		a. Provide gravity sewer service	1,558,000
		b Provide pressure sewer lines which would discharge to gravity interceptors	4,852,200
		c. Provide a combination of gravity and pressure sewers	3,240,900
	3	Using Treatment Plant #2	
		a Provide gravity sewer service	5,859,000
		b. Provide a pressurized sewer system	5,513,000
		c Provide a combination of gravity and pressure sewers	7,541,800
Southeast Valley	1	Continue use of individual systems, with advanced units for new homes - cost for new home	4,060
	2	Provide gravity sewer system with force main to Plant #2	484,100
	3.	Future interceptor work	88,300
East Mountain Area	1	Continue use of septic systems	2,312,300
	2	Use aerated tanks and drainfields	2,459,900
	3	Extend sewer service from Albuquerque	4,415,800
	4	Provide sewer service and treatment locally	4,840,900
Four Hills	1	Construct gravity interceptor up Tijeras Canyon, sized for possible collection of East Mountain area wastes	942,500
	2	Construct gravity interceptor up Tijeras Canyon but do not size for possible collection of East Mountain area wastes	828,000

1. Total cost not given in Facility Plan
2 Collector sewers would be provided by developers as development occurs.
3 Does not include service to Coronado Village Trailer Park.

TABLE 3-8 ENVIRONMENTAL EVALUATION OF SEWERAGE SYSTEM ALTERNATIVES
Generic impacts are summarized in Table 3-6 OSS = on-site systems. CM = central management of OSS GS = gravity sewer PS = pressure sewers. CP = Comprehensive Plan
Asterisks mark recommended alternative (see Section 4 1)

	Area	Environmental and Land Use Considerations	Possible Impacts, Comments
1	Corrales	OSS function limited by soils, high water table, flooding and local high densities Water quality impaired Canals, drains, low grade, high water table affect construction. Basically rural area; zoning recently adopted to maintain low density patterns Incorporated village, capable of independent management.	*OSS, with improved regulations, would be compatible with local goals and zoning for some time GS would involve significant construction impacts, use of many lift stations, however, impact on land use could be minimized by strong zoning measures. PS would minimize construction impacts in selected areas *Small GS system could be combined with CM for a contingency system Public water service may be higher priority than sewerage.
2	Northwest Mesa	Most of area designated for urban uses by CP Areas designated rural are generally unsuited for OSS because of water table or flooding problems Many of these areas already have access to public sewers	*GS in urban and urbanizing areas are compatible with all goals and will promote growth outside of valley Some construction impacts could be greater than normal if line 302 is located in arroyo.
3	North Valley	East side of area is developed (south) or developing (north) West is more open and designated rural by CP OSS limited, especially in west, by high water table Water quality impaired. Canals, drains, low grades and high water table could adversely affect construction, especially toward western part of area Public water service exists or is planned for most of area Los Ranchos de Albuquerque is incorporated and could provide independent management capabilities	*OSS and CM in western part of area could be compatible with goals and be designed to minimize impacts. *GS in eastern "semi-urban" part would probably have minimal adverse long-term impact GS in western part has potential conflict with CP, and could involve greater than normal construction impact. Thus alternatives proposing interceptors along Rio Grande Blvd. were screened out by initial environmental review No alternatives were presented for Los Duranes. Several proposed lines have excess capacity, alternative use of lift stations could reduce need for oversized lines *Routing along Guadalupe Trail will have greater than normal construction impacts
4	North Industrial Park	Urban/industrial land uses existing or planned Some sewer service already available Soils comparatively favorable for low density use of OSS	*OSS would produce no unacceptable impacts for majority of area *Limited provision of GS, as proposed, would serve existing development, and not conflict with CP.
5	North Albuquerque Acres	Soil conditions generally favorable to OSS at low density Mostly undeveloped, but planned for expanding urbanization over next several decades, to densities greater than can be supported by OSS	*GS extended in accordance with population projection would not conflict with CP *OSS can provide for disposal in interim

TABLE 3-8 (continued)

Area	Environmental and Land Use Considerations	Possible Impacts; Comments
6. Sandia Heights	OSS face moderate limitations (bedrock, slope) CP calls for "semi-urban" development, which accords with existing plats. Private sewer service available in portions of area, with treatment via a package plant discharging to a drainfield.	*Use of OSS and package plant would probably have no unacceptable impacts over the 20-year planning horizon. Premature extension of GS from City could produce leap-frog development pattern
7. Candelaria Industrial Park	Soils adequate for OSS operating at low densities Area open (gravel pits) in east, moderate to densely developed on west	Use of OSS in area along Edith Blvd. would require CM in order to meet water quality goals which would be achieved by sewers. Would also need better control of industrial sources. Densities locally too high for most OSS to be acceptable. *Sewers in developed area would be compatible with CP, but would involve lift station. Construction impact less if force main option chosen.
8. South Valley	Valley side (West Mesa) suited for OSS at low densities. CP indicates development will be urban (including satellite centers), but population projections show only a portion developing by year 2000. Valley bottom characterized by complex patterns, but in most areas conditions are unfavorable to OSS because of soil permeability, shallow water table, or local flooding Water quality impaired, especially in Pajarito area. Canals and drains are common, grades very low Arenal district in Valley is comparatively developed, designated semi-urban by CP, and has access to City water. Large interceptor already in existence Pajarito-Padillas district characterized by cluster development and substantial open space, designated for rural use by CP, with no water service as yet planned	*GS to serve projected development on West Mesa (valley sides) would be compatible with all goals and would promote growth outside sensitive valley areas Interim use of OSS in remainder of valley side area would serve very low densities, and probably have no significant adverse impacts *GS for Arenal area would eliminate OSS in an area where the latter are not suitable, and would not appear to conflict with the CP. GS for Pajarito-Padillas district could conflict with CP, even if carefully laid out to serve only clustered development, because of interceptor construction through open areas Construction impacts would be greater than normal because of the shallow water table and large number of canals and drains Much of the area might be served by OSS, with improved regulations GS would be more feasible if a westside treatment plant were built
8. South Valley (cont'd)		Evaluation of PS also depends on decision to build a westside plant. With such a plant PS could minimize construction impacts on some collection lines. With eastside treatment, PS may be more cost-competitive with interceptors/ lift stations, especially if service is only to most densely settled areas
9. East South Valley	Conditions unsuited for OSS in most of Valley area because of shallow water table, but suitable on valley sides. Water quality problems severe in Mountainview area, but cause is probably natural discharge from Tijeras Canyon. Mountainview is already developed at moderate density, but rest of area is open. Valley bottom is designated rural by CP, valley sides are planned for urban development, but projections are for limited growth in next 25 years	*GS (with force main) to serve Mountainview would not conflict with CP *GS can also serve built up areas North and Northwest of Plant #2 For all areas, water service may have higher priority *OSS acceptable as interim disposal method for valley side. *OSS acceptable in rural valley only if densities remain low as planned. Otherwise CM or sewers would be needed to control ground water pollution
10. East Mountain Area	Shallow bedrock and steep slopes are unfavorable to OSS, but Lowland areas locally suitable for OSS at low density. Primarily a rural area with village clusters, plans are to continue this pattern Water quality problems occur, but cause is uncertain Limited reliable water supply for private wells is a major constraint to development. Greater than normal concentration of archeological sites	*OSS might require CM or at least improved regulations in order to minimize potential for significant adverse impacts by future development GS would probably have greater than normal construction impact because of shallow bedrock and frequency of archeological sites Potential conflict with CP exists, but extensive development would probably not occur without provision of central water supply.
11. East Mesa and other areas	These elements of the Facility Plan refer primarily to extension of existing lines to serve developed areas. In general the decision regarding these actions are based on engineering considerations Relief of most overloaded lines should not conflict with the CP, or have other significant long-term impacts Some construction impacts might be greater than normal with use of Tijeras Arroyo for construction of an interceptor to serve Four Hills	

the area is already undergoing urbanization, especially toward the south; the western part retains the rural character which is to be protected by the Comprehensive Plan. This suggests that sewerage service might be appropriate in the eastern and southern parts of the North Valley, but not to the west, in order to match sewerage service to land use patterns. The same conclusion is reached by observing that sewer construction in the western area would be costly and would have significant impacts for reasons of deep trenching in an area of shallow water table and frequent canals and drains. The only contrary indication is the fact that the high water table limits OSS use in the western part of the area, indicating that system upgrading or replacement should be considered.

In accordance with actual and projected land use patterns, the preferred alternative for the North Valley is to provide sewer services in areas which are urban, or are urbanizing. On this basis service to the southeastern part of the area would have high priority, as development is already quite dense. Subsequent construction would be appropriately phased to extend service up to the east side of the area, primarily along the urbanizing Second and Fourth Street corridors.

Similarly, to protect the rural land use character of the western North Valley, and avoid the high dollar costs of sewering a low-density area, continued use of OSS would be preferred to the extension of interceptor lines. OSS upgrading as per Alternative 2 of Section 3.3.2 is recommended by the Facility Plan. Consideration of central management (see discussion for Corrales) may be appropriate in the future in the event sanitation problems result from OSS use. Should enforcement of the CP not be adequate to preserve low-density land uses in the western North Valley, it may be appropriate to reconsider the Facility Plan recommendations at a future date.

North Industrial Park. Land use patterns for this area (existing and projected) indicate that a small portion will be urban/industrial and the remainder will continue to have little or no development prior to the year 2000. Soil conditions are favorable to OSS use throughout the area, provided that only low density development occurs. Evaluation of alternatives is relatively simple. Conventional sewers are appropriate and cost-effective for the small part which is or will be developed. They are not appropriate, and indeed are excessively costly, for the remainder of the area, especially considering that OSS can operate effectively.

North Albuquerque Acres. This area is similar to the above in that portions will urbanize in the next few decades while the remainder will be undeveloped. Soils are suitable for OSS given low-density or rural land uses. Clearly it is appropriate to plan for phased extension of conventional sewers to the developing portions of the area, in accordance with population projections. Until development occurs, OSS will provide an adequate interim means of waste disposal.

Sandia Heights. Sandia Heights is unusual in that a privately owned and operated treatment system serves part of the area, with OSS being used elsewhere. Population projections indicate that the sector between Sandia Heights and the present urban area will fill in over the next three decades, such that sewer service would be appropriately extended to Sandia Heights sometime near the year 2000. In the meantime, extension of an interceptor to the area would be premature in terms of the Comprehensive Plan, since such a line would run through an open space sector and could encourage a leap-frog development pattern.

There is no direct evidence to indicate any ground water contamination results from the treatment plant discharge or from septic tank discharges. Indirect evidence suggests that the contamination would probably be minimal because: a) the plant effluent is of good quality (with nitrogen levels of 10 mg/l) and is chlorinated to kill pathogens; and b) both plant and septic tank effluent would percolate about 300 feet vertically before reaching ground water, so that passage through the soil would remove many impurities. Documented cases of nitrate pollution related to sewage discharges indicate that problems are most likely in shallow aquifers, and are rare for water tables as deep as those which occur in the Sandia Heights area.

Since construction of sewers does not conform to the CP, and existing practices are not identified as causing problems, the recommended alternative is to take no action regarding sewerage in Sandia Heights at this time.

Candelaria Industrial Park. The western part of this area is developed in small, light industry; use of OSS is inappropriate for wastes from these sources. Since a sewerage system in the area would not conflict with the Comprehensive Plan, the preferred alternative is to provide sewer service. By connecting the industrial park with the existing system, it was determined that construction impacts of a new interceptor would be less if a force main were used, rather than a gravity interceptor. For this reason, and because of cost factors, a force main has been recommended by the Facility Plan. The eastern part of the industrial park is presently open and not expected to change over the next two decades. Soils are adequate for the minor amount of liquid waste which occurs in this open area and thus the preferred alternative is to continue use of OSS.

South Valley. As defined for sewerage analysis purposes, the South Valley actually consists of five markedly different areas.

a) Valley-side lands near Westgate Heights are expected to develop at urban densities, with some of the growth occurring prior to the year 2000. In order to accommodate this growth the recommended alternative is to phase in construction of conventional sewers in accordance with population projections. Because soil conditions are favorable, interim use of OSS for low-density development is not expected to have significant adverse impacts.

b) The Arenal district is characterized by considerable development, and is designated for semi-urban land use by the CP. OSS are generally not suitable for use in this area but public water supplies are available. Similar considerations were the basis for the recent decision to provide sewer service to extensive areas north, east and south of the Arenal district. Given the existence of these lines adjacent to the area, and the land use designation of the CP, it appears appropriate to provide central sewer service to the area and to eliminate a large number of unsuitable OSS. Since the Arenal neighborhood is already relatively developed, such service would have a high priority.

c) The remainder of the Southwest Valley is characterized by cluster development mixed with substantial open space; this area, known as the Pajarito-Padillas district, is designated for rural use by the CP. Although OSS are generally not suitable, the extension of sewers would appear to conflict with the CP, since interceptor construction would occur through open areas. Also construction impacts would be considerable because of the shallow water table and large number of canals and drains. Thus, while parts of the

area would benefit from sewer service, it appears that the preferred alternative would be to support a rural land use pattern by continued use of OSS. Upgrading of OSS (through measures such as Alternative 2 in Section 3.3.2) is recommended to minimize the problems which are expected to occur because of the continued use of on-site systems. As in the North Valley, this recommendation would change if development occurs despite the provisions of the CP.

d) The Southeast Valley consists largely of agricultural lands, which represent a major part of the open and rural areas to be protected by the CP. In addition, conventional OSS are not suitable in this area and densities are so low that sewer construction would not be cost-effective. Therefore the recommended alternative is to upgrade OSS, through measures such as outlined in Alternative 2 of Section 3.3.2.

e) The valley side adjacent to the Southeast Valley is not expected to develop extensively during the time frame of the 201 plan. As OSS will function adequately in the area at low densities, use of such systems is the preferred alternative.

East South Valley. This area includes developed neighborhoods such as Mountainview and along Rio Bravo which could be served by sewers without creating a conflict with the CP. As OSS are only marginally suited for this area, the extension of sewers is the preferred alternative. Although ground water contamination in the Mountainview area is severe, the construction of sewers is not considered a high priority because it is believed that natural contamination from Tijeras Canyon is the cause of the problem, not local septic tank discharges. The remainder of the area is not expected to be urbanized within the time frame of the 201 plan, and continued use of OSS is therefore recommended.

East Mountain. This area is similar to Corrales in that the existing rural land use pattern makes sewers an expensive and environmentally undesirable option, even though conditions are not particularly suited for OSS. Further, sewer construction impacts would be unusually large in this area, due to shallow bedrock and numerous archeological sites. Therefore, the preferred alternative is to continue use of OSS, with upgrading through more stringent regulations.

The East Mountain area is unusual in that water shortages and water quality problems (which are not related to OSS) limit development. If a central water system were constructed the area might well develop beyond its present rural condition, unless zoning and other measures were stringent. To meet this eventuality a contingency sewerage system has been evaluated by the Facility Plan, and could be implemented if and when the need arises.

Four Hills and Other Areas. Several alternatives in the Facility Plan relate to increased service to already developed areas. In general the selection among the different alternatives is based on dollar cost, not environmental or land use criteria.

Summary and Priorities. Sewer service is recommended for all urban and urbanizing areas of the Albuquerque region in order to promote sanitary conditions, protect public health and prevent ground water contamination. Two areas which are already extensively developed would have a high priority for such service: the southeast part of the North Valley and the Arenal district of the South Valley. Other areas to be served include: the

Northwest Mesa; the Mesa portion of the North Valley; the middle North Valley; Mountainview and vicinity; and parts of the North Industrial Park, Candelaria Industrial Park and North Albuquerque Acres. For all proposed sewerage extensions, lines will be phased in accordance with population projections, sized according to expected flows, and will involve use of permanent pipe materials.

All other portions of the planning area will utilize on-site systems for liquid waste disposal (except portions of Sandia Heights). This recommendation has been made for reasons of cost and because of land use considerations, that is the need to limit premature or undesired growth which might occur were sewer service to be provided. Many of the areas which will continue to use OSS may experience some sanitation or water contamination problems, especially in the more densely settled valley neighborhoods. To minimize such problems it is the recommendation of the Facility Plan that regulations regarding OSS be strengthened, generally along the lines of Alternative 2 as described in Section 3.3.2. This alternative will lead to increased use of advanced systems at sites unsuited for conventional units, and should result in increased government involvement in assuring proper operation and maintenance of new systems. If problems persist more advanced alternatives may need to be implemented, addressed especially to existing systems; guidelines on such advanced options are expected to be forthcoming from an on-going 208 study.

Throughout the areas to be served by OSS the prospect exists that market forces will lead to some urbanization which does not conform with the Comprehensive Plan, even though sewers are not constructed. If so, it may be necessary to reconsider the recommendations of the Facility Plan, and eventually to construct sewers in those now-rural areas in order to control sanitation and water quality problems.

3.4 TREATMENT ALTERNATIVES

Alternatives related to wastewater treatment concern the process or processes to be used, and the preferred locations for current or new facilities. With regard to process, there are two basic levels of treatment to be considered:

- secondary treatment to meet existing Federal and State standards related to parameters such as oxygen demand, suspended solids, and coliform bacteria;

- additional treatment which might be needed to achieve existing or potential standards for nitrogen, phosphorus, metals, or other substances which may adversely affect surface or ground water quality.

With regard to siting, options exist concerning on-going use of Plant #1 and/or #2, and construction of new facilities at many possible locations throughout the planning area.

Alternatives regarding treatment processes and plant sites are interdependent, and were evaluated simultaneously in the facility planning process. The analysis of nitrogen-removal options turned out to be fundamental in consideration of other alternatives, and is thus presented first in this EIS. All evaluations of treatment processes assume that proper operation and maintenance will occur, since there is no acceptable alternative to good operation and maintenance techniques.

3.4.1 Nitrogen Removal Alternatives

At this time no Federal or State requirement exists which would mandate nitrogen removal from Albuquerque's wastewater, but the prospect exists for such a requirement at some future time. Further, an evaluation of both nitrogen and phosphorus control alternatives is specifically required in this document by the terms of the Stipulation.

The nature of the possible future N-removal standard is difficult to forecast. As discussed in 2.1.3, activated sludge treatment may have the capability to achieve 35-50% N-removal. If such a removal can be obtained reliably, some potential N-standards could be met simply through proper operation of the activated sludge process.

If additional removal is required, the major alternatives available with present technology are: a) advanced treatment processes such as special nitrification-denitrification units; or b) land application of effluent to an irrigated field or infiltration-percolation site. Table 3-9 summarizes the most prominent pros and cons of these two alternatives, as determined in the Facility Plan and in the technical literature. Section 3.7 discusses other possibilities, such as aquaculture.

Advanced treatment has the merit of providing reliable control of effluent quality, with a minimum land requirement and with increased nutrient value in sludges. Its disadvantages are numerous, commonly including high capital and operation costs, considerable use of energy and chemical resources and the fact that it minimizes direct, positive reuse of nutrients.

In many cases land application through crop irrigation is preferable. Although process control is less than for advanced treatment, and nitrogen removal is less than 90%, irrigation with effluent provides a positive reuse of both wastewater and the nutrient contaminants within it. There are numerous examples in which effluent has replaced surface or ground water as an irrigation source, and thus reduced the regional demand for both water and fertilizers. Other advantages include: preservation of open space; no special requirement for chemicals (however chlorination is often utilized); generally a considerable improvement in soil condition; and removal of other contaminants (e.g. metals, phosphorus).

Among the more significant disadvantages of land application which may vary according to local conditions are the following: generally large land requirements; potential for ecological disturbances and displacements if land is not already cultivated; potential for contamination of crops and the food chain by pathogens, metals and other contaminants, and for airborne pathogens to infect farm workers and those living nearby; and depletion of part of the water resource, with resultant loss of water rights.

TABLE 3-9 TRADEOFF FACTORS TO BE CONSIDERED IN ENVIRONMENTAL EVALUATIONS OF ADVANCED TREATMENT AND LAND APPLICATION. Based on Facility Plan (MMC, 1977) and technical literature, especially CWC (1976, e.g. Table 10), and EPA, 1975 The evaluation concentrates on factors pertinent to nitrogen-removal. All factors are subject to variation on a site-specific basis, and no consistent relationship between process type, dollar costs and environmental impacts will exist for all situations.

General Considerations -- Advanced Treatment -- Processes such as nitrification-denitrification, breakpoint chlorination and ammonia stripping can be considered, not all have been demonstrated on a long-term large scale basis.

Land Application -- Includes watering of crops, parks, golf courses and other vegetated areas and direct recharge at an infiltration/percolation site. Factors such as land cost and energy use (for pumping to the site) vary enormously according to location. Long-term impacts not well-known. Impacts may vary depending on whether farm site is publicly or privately owned/operated.

	BENEFITS OR POSITIVE FEATURES	DISADVANTAGES OR NEGATIVE FEATURES
ADVANCED TREATMENT	Generally reliable and subject to direct process control. Obtains high percentage removal of nitrogen (95% +) Relatively small land requirements and, often, minimal siting restrictions. Treated water is fully available for further use, including stream discharge to benefit water-short areas downstream. Some processes produce sludges with relatively enhanced nutrient value. May create more jobs than a similarly sized land application project	Normally requires large capital investments, with on-going high operating costs. Most processes involve considerable energy and chemical resource use Nutrients such as nitrogen are recovered to only a limited extent (except in sludge). Possible equipment noise problems if sited in populated areas Some increase in local traffic. Secondary pollution may occur (solid wastes, gases). (See, for example, Antonucci and Schaumberg, 1975.)
LAND APPLICATION	Tends to have comparatively small operation costs which may be offset in whole or part by income from sale of crops. Minimizes use of chemical resources (but chlorination normally is practiced). Provides for positive, direct reuse of wastewater and its nutrients, return flows can be collected (at increased cost) and used again. If not reused, then water will augment stream flow and ground water recharge Potential exists for additional treatment of other contaminants phosphorus. metals, solids, organic load, bacteria. Land utilized for crops provides often valued open space and greenbelt areas, farmland.wildlife habitat, and potential for some recreation (e g hiking during non-irrigation season). Organic material and trace elements tend to accumulate in the irrigated soil, and improve long-term fertility (see, for example, data in COE, 1974)	Control of the treatment process is indirect and potentially less reliable than advanced treatment with regard to producing effluent of a given quality (e.g. see CWC, 1976, p. 29, 33). Extensive monitoring is advisable. Less nitrogen removal than advanced treatment (normally less than 90%), export of crops needed for maximum N-removal from basin. Large land requirement needed to permit proper design for nutrient, hydraulic loadings If land costs are high, this may lead to large capital costs For urban areas, large parcels may be distant and require sizeable pumping/delivery facilities. If land has not been previously cultivated, extensive clearing may be required; in some areas relocation of individuals, business, utilities is needed. Archeological sites may be destroyed. Clearing may increase erosion hazards and need for runoff control structures Tax revenues from land may be foregone. Site selection limited by soil and geologic conditions. System operation varies with

TABLE 3-9 (CONT'D)

	BENEFITS OR POSITIVE FEATURES	DISADVANTAGES OR NEGATIVE FEATURES
LAND APPLICATION	Potentially could be used to prevent intrusion of saline water into fresh water aquifers, or obtain other recharge-related benefits.	climate. Normally, year-round full-scale cropping not practicable. Depending on crop, may need to use normal water during some periods (e.g. maturation period). Thus effluent must be discharged directly at some times, or large storage facilities must be constructed. These may provide sites for breeding of vector insects. Questions have been raised regarding pathogens, which may contaminate food crops during irrigation. Normally crop restrictions are imposed (thus reducing cash value). Spray irrigation may lead to airborne pathogens and increased disease levels among those living or working on or near the fields. For example, Katzenelson, et al. (1976) presented data from Israel which demonstrate increased incidence (by a factor of 2 to 4) of shigellosis, salmonellosis, typhoid fever, and infectious hepatitis in communities practicing wastewater irrigation. Questions have been raised regarding tendency for heavy and possibly toxic metals to build up in the irrigated soil and/or food chain Study of an area irrigated for 70 years with raw or minimally treated sewage showed increased metals levels in grazing forage, but no direct hazard to sheep and cattle, however, changes in macro-nutrient concentrations (calcium, magnesium, potassium) did increase the risk of grass tetany in grazing animals (COE, 1974). Soil salt buildups may also occur and supplemental use of chemical fertilizer may be needed to provide balanced plant nutrition. Some of the wastewater resource is consumed during irrigation, reducing overall water availability. In water-short areas this may have significant legal consequences with regard to water rights. (see EPA, 1975c, p. 24). Fog formation from spray irrigation has been reported in some locations. Odor problems have been reported and soil clogging by solids may occur; pretreatment facilities thus are required (EPA, 1975c). Normally, access to sites must be controlled, fences may inhibit wildlife movement. As noted above, crop selection is limited by concern for pathogens; foodstuffs which are eaten raw are not grown. Moreover, wastewater is normally more saline than the raw water supply of an area; salinities of 500 mg/l or higher can have detrimental effects on some crops, further limiting crop selections (EPA, 1975c p. 25) Knowledge of the effects of large-scale land disposal is presently insufficient (Spyridakis and Welch, 1976) Even small-scale projects may present problems which are not yet adequately identified (Walker, 1975)

One of the most recent comparisons of advanced treatment and land application is that by CWC (1976). Their findings can be summarized as follows.

- The two alternatives vary greatly according to site-specific conditons, but in general advanced treatment will tend to be more cost-effective than land application as the amount of wastewater to be treated increases; for some common situations the break-even point is in the range 2-10 mgd.

- Factors which could make land application more favorable, especially at flows above 10 mgd, include: low land costs; low costs for land preparation; no requirements for water rights retirement; land suited for simple irrigation systems; no need for subsurface drainage. Clearly lowest costs will occur when existing irrigated lands are utilized and effluent replaces an existing water supply.

As will be indicated below, site-specific conditions in the Albuquerque area tend to be unfavorable for land application, especially cropland irrigation. A particular problem is the large land parcel required. With more than 100 acres needed per 1 mgd of effluent treated, about 7 square miles or more than 4500 acres would be required for the existing effluent alone. Siting considerations differ for the two major areas of irrigable land: valley and mesa. The valley sites are of interest not only because they might be used for a formal, large-scale program designed to achieve certain levels of nitrogen removal, but also because the valley is already the location of an informal land application program, that is the use by local farmers of effluent-river water mixtures for conventional irrigation. At present this informal program has no public control, and no wastewater treatment objectives.

Valley Sites. The Rio Grande Valley south of Albuquerque includes large tracts of irrigated lands in the MRGCD. Use of these sites for effluent recycling would have the advantage of protecting open space and conforming to existing water use patterns and water rights regulations in the Middle Basin. However, at least two significant sets of problems appear to rule out large-scale use of such sites.

The major physical problem with the valley location is that the water table is generally within a few feet of the ground surface, so that processes such as nitrification-denitrification are probably not completely effective due to the lack of aerobic conditions in the soil. Thus, operation of the land application system to achieve a required level of nitrogen removal would be difficult. In addition, the capacity of the thin unsaturated soil zone to provide additional treatment would be limited, and contamination of ground water by pathogens, metals and even phosphorus could occur.

The other problem concerns existing socio-economic patterns. Presently the farms of the MRGCD involve many small parcels and a large number of land owners; garden foodstuffs are commonly grown in addition to the dominant crops such as alfalfa. A formal land application program would require that the individual farm owners be subject to close control in order to achieve proper effluent management. Many popular foodstuffs could not be grown. Monitoring would have to be very complex in order to reflect the great variety of soil and hydrologic conditions which would occur over a several square mile area of the valley. Administration requirements to oversee such a project would present

a significant barrier to implementation, especially given the traditional independence of the several hundred land owners who would be affected. While direct acquisition of the needed land by the City would simplify the administrative problem, the consequent relocation requirements and/or life-style change for valley residents would represent unacceptable social and economic costs.

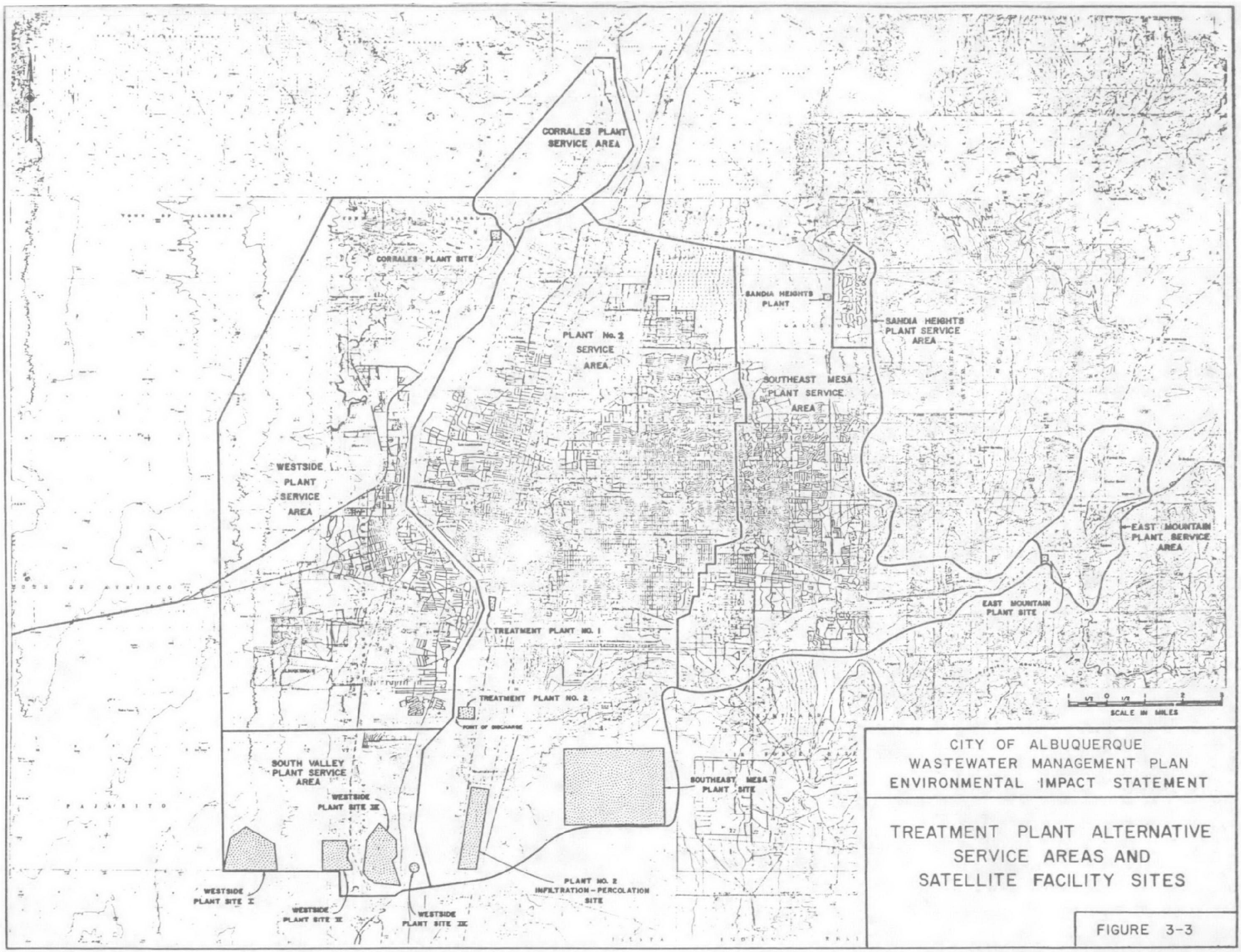
Mesa Sites. Development of full-scale irrigation on presently non-cultivated mesa sites has been considered in detail in the Facility Plan. The search for an acceptable site is made difficult by the land-size requirement, and by the fact that mesa soils are at best only moderately suited for irrigation due to problems such as excessive drainage. As part of the environmental analysis, many potential sites were considered and rejected. For example, use of Tijeras Arroyo is unacceptable because of soil conditions; field inspections of possible sites indicate that clay lenses are numerous and that a serious soil-piping erosion problem would result if the arroyo area were cultivated. Some other mesa sites were rejected because they lie on Indian land. The major site evaluated in the Facility Plan is the mesa south of Tijeras Arroyo (Figure 3-3). This site has no particularly adverse characteristics not found elsewhere in the area, and has one advantage: effluent from the North-east Heights could be diverted to the mesa with a relatively small pumping lift (about 100 feet) and pretreatment works could be constructed on-site without any unusual problems or costs resulting. Much of the projected increase in City wastewater flows could be handled by a Mesa facility sized at 20 mgd. The remoteness of the site from existing and planned development areas would be attractive as it would minimize odor and vector problems.

Unfortunately, because it would be a completely new operation, this site lacks many of the advantages commonly attributed to land application. For example, it does not have the benefit of replacing existing water and fertilizer usage -- and thus reducing total resource demands in the project area. Rather, resource demands could increase because of the energy use involved in pumping and farming and the need for supplemental fertilizers (e.g. potassium additives). Other significant adverse impacts include:

- several square miles of land would be cleared and otherwise modified, with resulting loss of habitat, archeologic sites and other resources;

- the cleared soils would be very vulnerable to wind erosion during periods when crop cover was not present, and air pollution problems related to fugitive dust would increase.

The water rights impact of a land application project on the mesa has been evaluated by the Albuquerque office of the State Engineer, in unpublished file documents which are summarized in Section D-4 of EPA (1977). The impact is determined on the basis of a hydrologic model which takes into account geologic conditions and the delayed effects of pumping and recharge. As indicated in Section 3.1.2, an alternative which involves direct wastewater discharge to the Rio Grande is calculated to offset most of the impact of well pumping, leaving a net water right requirement in the year 2000 of 35,100 acre-feet/year. Conversely, an option which completely eliminates direct discharge would increase the water rights requirement nearly threefold, to 111,600 acre-feet/year.



CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

TREATMENT PLANT ALTERNATIVE SERVICE AREAS AND SATELLITE FACILITY SITES

FIGURE 3-3

In practice a land application project would not completely eliminate return flow to the Rio Grande. Some fraction of the irrigation wastewater will percolate to the water table, and eventually reach the river or its immediately associated aquifer. The State Engineer projections indicate that for a project 5.1 miles east of the Rio Grande using all the City's wastewater for land application, with half the wastewater percolating to the water table, the net water rights requirement would be 90,100 acre-feet/year. A requirement of this amount would exceed the present water rights holdings of the City, including vested rights and San Juan-Chama Project water, by approximately 25,000 acre-feet/year. The estimate of 50% percolation is probably optimistic; if so, the water rights impact would be larger.

Because of the effects of delayed pumping, and assuming increased water use and wastewater flows, even larger water rights impacts would occur in 2020. For the situation described in the previous paragraph, the State Engineer calculation is that the water rights requirement would be 128,600 acre-feet/year at that time. If the percolation rate were less than the assumed 50%, an even greater impact would be experienced. In the event there were no percolation and return flow from land application, the water rights requirement would be 163,600 acre-feet. The only way the City could obtain substantial water rights beyond its present holdings would be to purchase and retire rights on irrigated lands along the Rio Grande Valley. This action would defeat the goal of providing agricultural bottomlands as recommended by the Comprehensive Plan. Thus development of a project to recycle all City wastewater at a mesa land application site can be considered unacceptable.

Smaller-scale projects which reduce water rights effects could be acceptable if they would not lead to loss of other irrigated lands. The specific alternate discussed in the Facility Plan would involve land application of 18 mgd. Using the same percentage relationships developed by the State Engineer, and assuming that the State Engineer projections for pumping and wastewater flow are correct, the water rights requirement in 2000 would be 49,600 acre-feet/year, or 14,500 more than if land application were not undertaken. In the year 2020 the water rights requirement would be 74,600 acre-feet, or 13,200 more than if land application were not undertaken. Note that over time the impact of a constantly-sized land application site actually declines due to the fact that it will take many years for the full benefit of land application recharge to be felt at the Rio Grande.

The following tabulation summarizes the water rights requirements associated with different land application projects in the year 2000.

Project	City Water Rights Need	Excess of Need Over Available Rights
No irrigation; all effluent to river	35,000 acre-feet/year	None
18 mgd project Southeast Mesa; 50% percolation	49,600 acre-feet/year	None
76 mgd project Southeast Mesa; 50% percolation	90,000 acre-feet/year	25,000 acre-feet/year
76 mgd project Southeast Mesa; no percolation	111,600 acre-feet/year	46,600 acre-feet/year

For conditions in the year 2020, the following values would apply.

Project	City Water Rights Need	Excess of Need Over Available Rights
No irrigation; all effluent to river	61,400 acre-feet/year	None
18 mgd project Southeast Mesa; 50% percolation	74,600 acre-feet/year	9,600 acre-feet/year
76 mgd project Southeast Mesa; 50% percolation	128,600 acre-feet/year	63,600 acre-feet/year
76 mgd project; Southeast Mesa; no percolation	163,000 acre-feet/year	98,000 acre-feet/year

Based on the above calculations, and assuming that the City does not obtain additional water rights, the full City allocation of San Juan-Chama Project water will be committed around the year 2020 if no land application is undertaken and perhaps 10-15 years earlier if an 18 mgd land application project is undertaken. Complete reliance on land application for wastewater disposal would, for all practical purposes, completely commit the City's water rights as soon as the irrigation project began operation.

This analysis indicates that the water rights impact of a relatively small wastewater irrigation project would probably be less than 15,000 acre-feet/year. Based on the present price of San Juan-Chama Project water, the cost of this impact would be nearly one-half million dollars per year. However, it is important to note that the City must pay for San Juan-Chama water whether or not the water is put to beneficial use. Thus, through the year 2000 the City could utilize San Juan Chama water to offset the effects of an 18 mgd wastewater irrigation project without actually increasing water rights expenditures. After the year 2000 a conflict would exist between use of the San Juan-Chama supply to offset irrigation, and use to support municipal growth by offsetting the effects of City well pumping. For a project of fixed size this impact would gradually decline.

The conclusion reached from the above analysis is that it may be economically and technically feasible to use existing City-owned water rights to offset the legally determined hydrologic effects of a moderately sized land application project located on the Southeast Mesa. Indeed, since the City already pays for unused San Juan-Chama water, water rights costs need not be a major factor in the economic analysis of wastewater irrigation proposals. Moreover, water conservation programs (Section 3.8) could further improve the water rights position of a land application project.

Another aspect of land application would be its actual physical impact on the surface water hydrology of the Rio Grande. The legal basis of water rights determinations relate to the long-term effects of water use as the use reduces flows measured at San Marcial gaging station. Thus the fact that a water use (such as land application) is covered by water rights does not assure that there will be no impact on short-term flow conditions. What then would be the physical consequences of land application? Presently wastewater discharges to the river provide a physical augmentation of river flows; during drought periods wastewater may represent the dominant source of flows which are diverted at Isleta Dam. If some wastewater were utilized for land application this physical discharge would be reduced and surface flows would also be reduced. Legally speaking the lost discharge would be offset by existing City water rights (not actual water), long-term subsurface return flows from the irrigation area (not actual surface discharges or even, necessarily, short-term actual subsurface flow), and releases from the San Juan-Chama Project. Of these only the latter would be physical surface water, and this too might be limited in dry years if the flows available from the San Juan Basin were in short supply.

Use of wastewater for a mesa irrigation project would thus reduce surface water flows in the Rio Grande over the short-run, for example during late summer and during prolonged drought periods. If the reduced flows were accounted for by water rights, then legally speaking it would be assumed that long-term flows measured at San Marcial would not be reduced. However this is no guarantee that such a reduction would not occur in reality, nor does it imply that flows above San Marcial would not be reduced. The major environmental consequence of reduced surface flows between Albuquerque and San Marcial would be that recharge of ground water from irrigation canals and the river channel and floodway would be lessened, thus limiting the amount of water available to riverside woodlands and marshes which provide a prime wildlife habitat. As much of the habitat (especially the woodlands) is not protected by water rights, there would be no legal or physical basis for offsetting the reduced water supply. The impact would probably be small under most conditions. However, it could become severe during a prolonged drought and could lead to irreparable loss of wildlife resources.

Substantial benefits must accrue to a land application project to offset the water resource impacts noted above. As noted previously, water quality benefits associated with such a project cannot now be identified. Economic benefits are probably minimal. Calculations given in the Facility Plan indicate that the project would operate at a net loss, that is income from crop sales would not offset operating costs, much less capital investment costs. This is not surprising, considering that existing farms in the MRGCD generally operate with little or no profit. For example, long-time records from one of the largest and most productive farms in the Peralta area show that income from corn and alfalfa averages $336/acre, while operating expenses average $305/acre (Charles Diebold, personal communication). The small profit (10%) provides little return on land or other investments. That the profit occurs at all probably reflects the low cost of MRGCD water; if the farmer had to pay municipal prices for San Juan-Chama project water to irrigate the fields, the operation would show a deficit. The fact that large scale farming takes place in the Middle Rio Grande Basin probably reflects historical economic and social patterns; certainly there is little economic incentive to increase agricultural activity.

In summary, use of a Southeast Mesa site for effluent irrigation purposes has many environmental disadvantages and few if any benefits; it does not appear to be an effective approach for maximizing the long-term beneficial use of the area's physically limited surface water resources. The disadvantages of this alternative are reflected in dollar costs, which are several million dollars higher for land application than for an equivalently effective advanced treatment process.

Other Land Application Alternatives. In addition to cropland irrigation as just described, three other land application processes are available: high-rate irrigation; overland flow; infiltration-percolation. The first two of these are not appropriate for Albuquerque; high-rate infiltration has the same fundamental problems as normal irrigation, while overland flow requires relatively impermeable soils to be effective.

Infiltration-percolation involves the rapid spreading or spraying of effluent onto relatively coarse soils which normally are not cultivated. The effluent is renovated as it percolates rapidly through the soil; the high rate of application results in a smaller land requirement per effluent volume than irrigation. Other advantages include: large potential for recovery of recycled water and/or larger percentage of effluent recharging ground water; water rights requirements are therefore much less than for irrigation; generally more easily operated than irrigation. Disadvantages include: much less effluent treatment than irrigation, especially for nitrogen; no income from crop sales; recharge may increase salts and hardness of local ground water.

Evaluation of a possible infiltration-percolation site near Mountainview (Figure 3-3) indicates that this alternative is more favorable than mesa irrigation in many respects, but still has substantial drawbacks. Because of reduced land and water rights requirements, the site is probably capable of achieving some degree of nitrogen removal at a dollar cost which is broadly comparable to some advanced treatment alternatives. However, the process offers no benefits except additional treatment, since crops would not be grown and the ground water recharge would provide no advantages over direct discharge of treated effluent to the river. Disadvantages are significant. The land parcel is highly visible from the valley area. Clearing of the site would produce aesthetic problems. The site is upwind of Mountainview in summer, so that odors, if present, could impact an area which historically has suffered from odor pollution. In particular, by placing an infiltration-percolation site south of Mountainview, and continuing the operation of Plant #2 north of Mountainview, any odor-causing problems associated with sewage treatment would be almost certain to impact the neighborhood, whereas at present, at least some wind patterns spare the community from this problem. More distant sites would reduce the possible odor and aesthetic impacts, but would greatly increase transportation costs.

Advanced Treatment. The Facility Plan provides detailed evaluations of seven alternatives for nitrogen removal, four of which involve advanced treatment. Using the Facility Plan designations, the alternatives are as follows:

A. Activated sludge treatment for partial N-removal, as discussed at the beginning of this section.

B. Two-stage nitrification-denitrification, with secondary treatment for BOD being accomplished in the first stage.

C. Three-stage nitrification-denitrification. That is, BOD removal is accomplished in a first stage (standard activated sludge), nitrification occurs in a second aerated basin, and methanol is added to an anaerobic reactor in the third stage to obtain denitrification.

D. Infiltration-percolation of activated sludge effluent (discussed above).

E. Same as C but for only a portion of the total effluent flow.

F. Similar to C except the second (nitrification) stage utilizes an ultra-high rate trickling filter, and the third stage is a nitrogen gas-filled column.

G. Primary treatment followed by infiltration-percolation (similar to D, and discussed further in 3.4.2).

If nearly complete (95%+) N-removal is required, alternate B would be the lowest dollar cost option. However, this would require an almost immediate decision if it were to be implemented effectively. In the absence of a nitrogen standard for the Rio Grande, the two stage N-removal system would simply increase environmental and dollar costs without obtaining any clearly defined benefits.

Alternatives C, E and F are all similar in that they can be added onto activated sludge at any time; depending on design, almost any desired level of N-removal can be obtained. All are broadly comparable in terms of environmental characteristics, involving modest amounts of land (10-20 acres) and requiring about 100% more energy than needed for activated sludge treatment alone (per mgd treated). Alternative F has slight advantages in terms of minimizing land and energy use, and is the lowest dollar cost option if only a portion of the effluent is treated for N-removal. Alternate C achieves slightly better odor control and is the lowest dollar cost for treatment of all the effluent. Both C and F are less expensive than land application.

Should advanced treatment ever be necessary, it would be appropriate to choose between alternatives C, E and F depending on the specific N-removal requirements and environmental conditions occurring at the time. Dollar costs are not greatly different among the options at present, so that if in the future energy conservation were the highest goal, alternative F might be preferred, while if odor control is critical, alternatives C or E could be chosen even if direct costs were slightly higher.

Irrigation Reuse in the MRGCD. As discussed in 2.3.2, presently about 6,600 acre-feet of Albuquerque's wastewater (mixed with river water) are used for cropland irrigation in the Belen Division of the Middle Rio Grande Conservancy District. This amount will about double by the year 2000. During drought periods the ratio of effluent to river water may reach 1:3, and it may approach 1:2 by 2000. This unregulated land application program probably has some treatment benefits through nitrification-denitrification in irrigated fields and along canals and drains, and through crop uptake and export. Based on the nitrogen budget for the Middle Rio Grande Basin (2.4.3), the removal efficiency can be tentatively estimated at about 40% (versus 70-90% in properly designed and operated programs).

No data are available to indicate that pathogenic contamination of foodstuffs occurs in the MRGCD, but as reported in 3.1.2, farmers in the Peralta area have experienced adverse effects on alfalfa growth when the ratio of effluent to river water is comparatively high. Long-term toxic element accumulation could occur (Chaney, 1973). Problems associated with the informal land application program can be expected to increase as effluent loadings increase over the next few decades.

Study of MRGCD irrigation, as it relates to Rio Grande water quality, will be undertaken in the 208 program described in 1.5, but only a portion of the major questions will be approached due to funding limitations. Thus additional research would be appropriate to achieve two objectives:

- an understanding of effluent reuse in the MRGCD, as it may effect crop growth, contamination of foodstuffs, soil conditions, fertilizer use, and farming practices;

- an analysis of how the reuse might be better managed to reduce adverse effects on farms and crops and, if possible, to achieve a reliable and possibly increased amount of nitrogen-removal.

A possible research program discussed during the public hearings would involve use of farmland near Plant #2 for experimental purposes, to determine the detailed interaction of farming practices, effluent quality, and nitrogen-removal. Such research would be compatible with the recommendation of Bouwer (1973) that "because the performance of a land treatment system for liquid waste depends so much on the local conditions ... pilot systems should precede any large-scale development." Since some land application already occurs the pilot study would seem an appropriate undertaking in the near future. The Facility Plan makes no formal recommendation regarding such a pilot study, as it is in effect an element of system operation.

Should research determine that effluent reuse in the MRGCD can achieve reliable nitrogen-removal under certain circumstances, then steps to formalize the land application program could include:

- institution of farm management practices to ensure against foodstuff contamination;

- institution of practices to achieve the desired level of N-removal, or control of other contaminants;

- supervision by the City to ensure that proper practices are followed.

The possibility exists to significantly increase the amount of effluent reused in the MRGCD, by changing the point of discharge from the river to the canal/drain network passing Plant #2, and then extending the network to Isleta Dam. However, such an action would not be sound unless the research determined that adequate effluent management practices could be reliably implemented throughout the Conservancy District.

Summary. Table 3-10 indicates factors pertinent to the evaluation of nitrogen removal alternatives. All are expensive and in the absence of an N-control standard or N-removal benefits, the no-action alternative is preferred. In the event a significant N-removal requirement is imposed on Albuquerque's effluent discharge, construction of a three-stage nitrification-denitrification process for advanced treatment would be the lowest cost option. While some environmental costs would be high - especially energy use - the most important resource of the area, water, would be protected, and the treated water could be discharged to the water-short Rio Grande for reuse downstream.

A formal land application project would increase dollar and environmental

TABLE 3-10. COST-EFFECTIVE DISPLAY: NITROGEN REMOVAL ALTERNATIVES. As given here, alternatives differ according to treatment process at Plant #2 (two-stage or three-stage nitrification-denitrification, or infiltration-percolation) and presence or absence of a Westside (three-stage) or Southeast Mesa (irrigation) facility.

Plant #2:	2 Stage	3-Stage*	3-Stage*	3-Stage*	3-Stage, partial treatment only	Infiltration-percolation
Satellite:	None	None	Westside	Mesa	None	None
Dollar Cost (Present Worth)	42,979,000	51,066,000	51,082,000	52,921,000	37,488,000	33,367,000
Total N mg/l	2	2	4.5	2	7-11	11-15
Construction Impact	small	small	moderate	moderate	small	moderate
Odor Potential	small	small	small-moderate	small	small	moderate
Other Effects	energy use	energy use	energy use & land use	energy use & land use; large water rights loss	energy use	large land area required for pond; large water rights loss
Reliability and Flexibility	fair-good	good	good	good	good	fair-good
Rating	6**	2	4	5	1	3

* Aerobic reactor second stage; methanol addition to anaerobic reactor third stage
** Must be implemented immediately

costs without achieving substantial benefits. This fact occurs even though land application is often a desirable alternative elsewhere in New Mexico. There are two major reasons for the unfavorable evaluation: the scale of land application for Albuquerque would be much larger than for any other New Mexico city; the land application would be a new use of water in an area where surface water resources are limited, and thus the total surface water supply of the Basin would be further reduced.

The partial nitrogen removal which occurs with reuse of effluent/river mixtures in the MRGCD can never be upgraded to a full-scale highly efficient land application treatment system because of high water tables in the river valley, and because the farms of the MRGCD are in the hands of a large number of private owners, with only limited potential for thorough supervision and consistent operations. Nonetheless, research could help reduce problems associated with the effluent reuse, and possibly increase the degree and reliability of N-removal. In the event that only a modest N-removal requirement were imposed, the existing reuse program might provide an acceptable alternative.

3.4.2 Secondary Treatment; Phosporus Removal; Metals Removal.

Secondary Treatment. Activated sludge is "presently considered to be the superior method of biological treatment consistent with present and future treatment requirements as set forth in the Federal Water Pollution Control Act Amendments of 1972" (Battelle-PNL, 1974, page 7.). Most alternatives to activated sludge for secondary treatment involve physical-chemical processes which increase dollar costs and resource usage, with few if any increased environmental benefits. A particular advantage of activated sludge is that it is reliable, achieves significant levels of nitrogen, phosphorus and metals removal, and can be modified by "add-on" technology to achieve additional removals if and when they are required. The process is the same as now used by the City, and thus its continued use would simplify operation and maintenance; the potential for solids recycling would also be continued.

The process does have some disadvantages, including substantial energy use and the need for highly qualified operators. Recycling of sludge gas can provide some of the needed energy. In Albuquerque, the newly completed activated sludge units have been responsible for severe odor problems. These have been determined to be due primarily to design limitations caused by funding cutbacks at the time the units were undertaken; construction to remedy the limitations has been proposed and would begin prior to any additional actions taken under this Facility Plan. See 3.6 for a further discussion of odors.

The only secondary treatment alternative to activated sludge which was analyzed in detail in the Facility Plan was primary treatment followed by infiltration-percolation. This alternative resembles that discussed in 3.4.1, except that only primary treatment occurs prior to land application. Dollar costs are thus reduced, but odor problems would be increased, and the potential for public acceptance would be small. Thus the alternative would not be considered cost-effective.

Phosphorus Removal. The situation regarding phosphorus is similar to that for nitrogen: no removal requirement now exists, nor can one be forecast with certainty; activated sludge treatment accomplishes significant P-removal; alternatives involving large-scale land application are not cost-effective; should P-removal be required, advanced treatment could accomplish almost any degree of removal at a reasonable cost.

For phosphorus, advanced treatment would consist of chemical precipitation prior to final clarification. This treatment has two significant environmental costs: chemical resource use (probably aluminum salts), and a great increase in the amount of sludge to be disposed of. Further, the sludge is much less suitable for parks fertilizer than that from secondary treatment processes. Chemical control of process pH would also be required. Advantages are simplicity of the process, low dollar costs, and the fact that the treated water is not consumed, as it would be by land application.

Given the lack of a phosphorus standard in the Rio Grande, the no-action alternative is favored regarding P-removal. Chemical treatment would be appropriate should a requirement be developed. However, as with nitrogen, it may be that effluent reuse in the MRGCD could be improved to meet a modest phosphorus removal standard, and such an option should be explored prior to accepting the environmental costs of chemical treatment. Should nitrogen, phosphorus and metals removal all be required at some future date, then even the full-scale land application alternative, with its associated water usage, would warrant reevaluation.

Metals. The Facility Plan provided analysis of five alternatives for metal removal. Two of these involved land application, and suffer from the same problems discussed with reference to irrigation and infiltration-percolation in 3.4.1. The third, chemical precipitation, was rejected because of high dollar cost.

Rigid enforcement of the industrial waste ordinance is the fourth alternative. Based on the Facility Plan, the following is the minimum reduction in metals loadings which could be obtained given such enforcement:

Metal	% Reduction	Metal	% Reduction
As	0	Hg	5.3
Ba	0	Mo	13.3
B	1.1	Ni	13.2
Cd	4.0	Se	0
Cr	6.6	Ag	1.5
Cu	30.5	Zn	0.0
Pb	2.5	Mn	0

Other than monitoring and enforcement costs, there is no additional expense for this alternative. However, without additional treatment the above reductions would not be sufficient to consistently meet the discharge limitations set forth in the Stipulation. See 3.8 for a further discussion of metals control through regulation, rather than treatment.

The Facility Plan recommends the fifth alternative--combining ordinance enforcement with activated sludge treatment. The activated sludge process, as

now operated at Plant #2, achieves substantial metals removals from influent, and is able to meet discharge standards. The most important enforcement step under this alternative would be to prevent large heavy metal "dumps" by industrial sources. One disadvantage of this option is that metals found in sludge would increase on a total mass basis. It is not known if future changes in plant operation (e.g. an increased or decreased rate for wasting activated sludge) would affect heavy metal removals.

3.4.3 Satellite Treatment Facilities

The Facility Plan presents many alternatives which differ mainly in the extent to which they involve satellite plants in addition to the continued operation and/or expansion of Plant #2. The alternative of eliminating Plant #2 was rejected because of the large dollar cost involved, including loss of major recent investments for construction of activated sludge units. Continued use of #2 is based on the engineering analysis that if organic loadings are maintained at a proper level, and adequate sludge handling facilities are provided, the Plant can operate in a manner which normally will be free of offensive odors, and will produce a high-quality effluent. All evaluations relating to Plant #2 take as given that the proposed expansion of activated sludge capacity to 47 mgd will take place prior to 1980. Further, the Facility Plan recommends that regardless of whether or not Plant #2 is expanded further, its operation should be improved by renovation of equipment such as the grit chamber and primary lift stations.

Given that Plant #2 would continue to be a mainstay of the City's wastewater management system, decisions remain as to how best to meet expanding wastewater flows in the future. One option would be to expand #2 as needed; alternately new plants could be constructed to handle some or all of the increased flows or to serve the needs of somewhat isolated rural areas. In addition, the question must be raised regarding Plant #1 -- should it be renovated and retained in its present role as a satellite facility, or abandoned?

The following discussion evaluates all of the satellite facilities which could be built as an alternate to expansion of #2. The discussion refers to activated sludge treatment facilities, but also would apply to N-removal. While the Facility Plan discusses these satellites in various combinations, the evaluation here is simplified by considering each facility independently of the others. The location of each satellite site is shown in Figure 3-3.

General Considerations. A number of factors favor use of a single existing treatment plant such as #2, instead of multiple facilities. The advantages of centralization include:

- the concentration of all management efforts at one location should result in better operational control and reliability of the treatment process, and thus better long-term effluent quality and odor control;

- development of new plants would result in construction impacts, as well as conflicts in land use if the facility were built in a non-rural setting;

- costs of treatment per unit of flow generally decrease as the total flow increases, making large plants more economical than small ones, especially when advanced treatment is required.

For satellite plants to be seriously considered, they need to provide benefits which outweigh the advantages of centralization. Depending on the specific area, such benefits might include: a substantial reduction in the need for interceptor or force main construction; a reduction in the need to route sewers through open space or rural areas where they could lead to undesired development; and an increase in the potential for reuse of effluent or solids, for example to facilitate land application by putting the plant at an irrigation site.

Three large treatment facilities are considered in the Facility Plan in addition to Plant #2. These are Plant #1; a Westside Plant; and a Southeast Mesa plant. The latter was proposed for consideration only in the event that large-scale irrigation with effluent proved to be cost-effective. Therefore, it was discussed in Section 3.4.1, in terms of the overall benefits and drawbacks of land application.

Plant #1. According to the Facility Plan, extensive rehabilitation would be needed to permit continued use of Plant #1. This is a slightly more expensive alternative than the option of demolishing the facility and providing equivalent capabilities at #2. When costs are expressed in terms of treatment obtained per dollars spent, the comparative expense of operating #1 is even more apparent. The advantages of centralization, noted above, also favor abandonment of #1.

In the past, operation of Plant #1 has had an adverse effect on surrounding areas, as evidenced by the razing of residences in the South Barelas neighborhood. Thus elimination of the facility would remove a serious land use conflict. It would probably also benefit the City's efforts to develop a business/manufacturing center in the area. The land now occupied by the plant could be used as part of the industrial complex for other purposes, such as a park. However, the prospect for park development is limited because local demand is small, and one facility already exists in the area.

All the above considerations lend support to the recommendation of the Facility Plan that Plant #1 be abandoned. However, this recommendation in itself does not imply that expansion would take place at #2.

Westside Plant. Turney (1963) recommended eventual construction of a treatment works in the Southwest Valley in order to handle all the sewage generated west of the river, and save the cost of pumping it to the existing plants on the east side. The Facility Plan considers several alternative sites for such a plant, as well as treatment options which include extended aeration (activated sludge), land application (irrigation or infiltration-percolation), and advanced treatment for nitrogen removal (nitrification-denitrification).

Based on cost estimates presented in the Facility Plan it appears that all alternatives involving a Westside plant are more expensive than those which instead involve an expansion of Plant #2. The cost differentials vary according to whether or not nitrogen-removal is a treatment requirement in the

future. If it is not, and all facilities involve secondary treatment, then a Westside plant would involve a net increase in cost of about $9,000,000. If nearly complete N-removal is required, the difference is only $3,000,000.

None of the Westside sites have special advantages in terms of reducing collection system costs, or improving the prospects for land application. If sites at the south end of the planning area are used, then large interceptors would be constructed through existing semi-rural areas of the far South Valley. This action would probably be contrary to the goals of the Comprehensive Plan. In addition, several of the prospective plant sites are in semi-rural neighborhoods; use of such sites would undoubtedly have adverse local impacts related to land use conflicts and possible odor problems.

Small Satellite Plants. Small satellite facilities with a capacity of a few million gallons per day or less can be considered to serve somewhat isolated parts of the planning area. These facilities are too small to substantially affect waste loads at Plant #2, and thus must be considered as an addition to whatever major treatment works are constructed. The Facility Plan investigated small plants for five locations.

Corrales. A 400,000 gallon per day satellite plant at Corrales could be constructed for about $800,000; if land application is considered, the costs are greater, with crop irrigation costing about $1.4 million. In comparison, should sewer service be extended to Corrales and the wastewater treated at Plant #2, the cost would be less than $500,000. There appear to be no special benefits which would offset this cost differential. For example, the local sewer system, if ever built, would be virtually the same under either alternative. Prospects for a profitable land application program are restricted because of shallow water table conditions which limit the availability of usable parcels.

Los Ranchos de Albuquerque. A treatment works for the North Valley-Los Ranchos area was eliminated during the initial screening portion of the Facility Plan. According to the Facility Plan, such a plant would increase treatment costs compared to the alternative of utilizing Plant #2. It would not reduce sewerage requirements since, like the Corrales area, the North Valley is not really physically separate from Albuquerque. Land application would be difficult because of the large acreage requirement and the shallow water table. Land use conflicts would be substantial, because all available sites lie in residential areas.

Sandia Heights. A small package plant already serves the more densely settled portions of Sandia Heights, with remaining moderate density development being served by septic tanks. Since the plant is privately owned and operated, its continued use would not involve general public expense, nor would it adversely affect management at Plant #2. As indicated in 3.3.5, no adverse ground water quality impacts are expected to occur due to continued operation of the package plant.

Far South Valley. If a Westside plant is not built, a number of options exist to service the needs of the Los Padillas-Pajarito area, including service by pressure sewers discharging to Lift Station #20 and Plant #2, or

service by gravity sewers and treatment at a local plant. Based on present land use patterns and planning goals, extensive service to the area would not be cost-effective at this time; on-site systems are marginally adequate in most locations. However, locally the development densities exceed those for which OSS are desirable; the problem areas include Los Padillas and Pajarito. If the adopted plan and zoning measures are inadequate to restrict development in these areas, then consideration should be given to provision of some sewerage, and construction of a small treatment plant.

Tijeras-East Mountain. The Facility Plan recommends no sewer service to the East Mountain area because: a) existing densities are moderate to low and soil conditions are marginally adequate for OSS, indicating that sewers are not essential in the area; b) high nitrate levels in local groundwater are probably the result of natural causes, not sewage pollution (See Section 2.4); and c) provision of a central water system would be a more important action to take in the event public services are needed in the area. The possibility exists that if public water supplies are provided, development densities could greatly increase. In this case sewerage may some day be needed.

Should sewers be built in the East Mountain area, the costs of a local satellite plant would be about the same as those involved in constructing an interceptor through Tijeras Canyon and treating the wastes at Plant #2. Two factors suggest the satellite plant would have some added benefits. First, local treatment would avoid the prospect of very significant construction impacts associated with laying an interceptor in canyon terrain. Second, if the plant provided nearly complete N-removal, then the discharge of N-free water would help reduce high nitrates and thus improve the quality of local water supplies.

Summary. Table 3-11 indicates factors pertinent to evaluation of major satellite alternatives for obtaining secondary treatment. Centralization of facilities at Plant #2 results in low costs, increased reliability, and elimination of construction and land use impacts at new sites. Satellite plants are preferable only if they provide special benefits; the major satellite plants evaluated in the Facility Plan do not have such benefits. In particular a Westside plant built in the Far South Valley would be expensive compared to collection and treatment of westside effluent at Plant #2, and would mandate construction of larger interceptor sewers through rural areas. Should existing settled portions of the Far South Valley need service, a small local facility could be constructed. The only alternative to expanding Plant #2 which would reduce dollar costs is primary treatment followed by infiltration-percolation. This option is unacceptable because of possible odor problems.

Expansion of Plant #2 appears to represent the cost-effective solution to treatment of expanded wastewater flows in Albuquerque, provided that existing odor problems will be fully controlled, as discussed in the Facility Plan. The decision to abandon Plant #1, which is now satellite to #2, appears to have little effect on the long-term cost of wastewater management, but would permit the City to concentrate all of its efforts, including odor control, at a single facility. It would also remove a source of environmental problems in the Barelas area.

TABLE 3-11. COST-EFFECTIVE ANALYSIS OF SECONDARY TREATMENT ALTERNATIVES. Costs include sludge handling facilities as described in 3.5.

Alternative:	A Activated Sludge Plant #2	B Same as A except #1 Retained	C Activated Sludge Plant #2 and Westside Satellite	D Infiltration-Percolation after Primary Pretreatment
Dollar Cost (Present Worth Method)	25,315,000	27,732,000	34,237,000	22,641,000
Ability To Meet Standards	good	good	good	good
Construction Impact	small	small	moderate	moderate
Odor Potential	small	moderate	small	moderate - large
Energy and Land Use	small land, moderate energy	moderate	moderate	low energy, large land
Sludge Reuse Potential	excellent	good	good	good
Reliability and Flexibility	very good	very good	very good	fair-good
Rating (1=best)	1	2	3	4

3.5 SOLIDS HANDLING ALTERNATIVES

Sludge is the main solid to be handled during wastewater treatment, with a projected dry output of about 17,500 tons in the year 2000. Sludge-related alternatives fall into two basic categories: processing at the treatment plant (3.5.1); and ultimate disposal (3.5.2). An unusual alternative which has been suggested for Albuquerque is thermoradiation of sludge prior to reuse as an animal foodstuff (3.5.3). Other solids to be considered are scum and grit (3.5.4).

3.5.1 Sludge Processing

Elements in the sludge processing cycle may include: thickening, digestion, gas recycling, supernatant recycling, and drying.

Thickening. Presently there is inadequate capacity for thickening of waste activated sludge at Plant #2. This significantly increases the potential for odor problems. No alternative exists for this problem except construction of thickener units. Of the available technologies, air flotation has advantages which include lower energy and chemical resource demands and less complex operation and maintenance than alternatives such as centrifuging. The Facility Plan recommends that thickeners be installed as an emergency measure. The City intends to construct thickeners in 1977, to be operational prior to the summer of 1978. The design and construction may begin prior to completion of the 201 planning effort, in which case the City will fund the improvements and subsequently request payment for items which are eligible for Federal and State funding.

Digestion. Two-stage anaerobic digestion of sludge, with regular digester clean-out, is an environmentally acceptable technique which can be expanded to provide adequate capacity. However, the digestion system is a potential odor source, and operation and maintenance must be sufficient to minimize problems.

An alternative to complete reliance on the anaerobic process would be to use aerobic digesters to handle only the waste-activated portion of the sludge. Primary sludge would continue to be processed as at present. Advantages of the aerobic/anaerobic alternative, compared to the present completely anaerobic system, include: less potential for odors; reduced problems in sludge dewatering; higher nutrient retention in the sludge; less supernatant to be recycled and treated; more stable and less sensitive operation; and lower investment (Wyatt and White, 1975). The major environmental disadvantage is that the aerobic process produces no gas which can be converted to a plant energy supply; moreover, it will increase total power consumption. Also, operation of two different types of processes increases the complexity of the treatment system. On balance the factor of improved odor control appears to favor the use of aerobic digestion for waste activated sludge, when only environmental impacts are considered. The Facility Plan recommends this alternative, subject to review prior to implementation.

Gas Recycling. The combustion of digester gas to generate electricity is a positive reuse of a waste product with no significant adverse impacts

and provides a worthwhile method of reducing energy demand (Miller, 1973). The only problem at present is that inadequate generating capacity exists at Plant #2. The Facility Plan recommends provision of 3 new storage tanks, and a 600 KW generator/engine. This action would enhance resource recycling and energy conservation, and provide a savings in power costs of $800,000 per year. Emission of air pollutants would probably increase to slightly more than 100 tons per year, dominantly nitrogen oxides. This emission is small, and not significantly larger than the emissions from a power plant which would provide the alternative energy source. It is possible that research being undertaken elsewhere could develop alternate uses of sludge gas (e.g. methanol production) and/or means to increase gas production and energy production per unit of sludge (Kapoor and Newton, 1975).

Supernatant Recycling. Supernatant has the potential of causing operational problems when recycled through the wastewater treatment system; odor problems may result. The Facility Plan recommendation is to utilize lime addition and ammonia stripping for supernatant treatment, should problems arise. On an environmental basis, this would be a priority item should the potential odor problem occur.

Drying. The existing program of sand-bed drying is adequate for present conditions, but has two environmental problems: odor may occur in summer, requiring use of digesters as holding tanks instead of treatment units; the projected increase of sludge loads at Plant #2 will require acquisition of 24 acres to provide space for new drying beds. The Facility Plan recommends mechanical dewatering as an alternative to sand-bed drying for two reasons: less use of space, and greater operational flexibility. Mechanical dewatering would be expected to provide a significant improvement in odor control for reasons which include: elimination of drying beds, a present odor source; elimination of operational problems associated with sludge-handling capabilities; reduced environmental exposure time for each unit-volume of sludge; and the prospect that the dewatering facility can be enclosed, so that any odorous gases can be collected and treated prior to venting to the atmosphere. As the dollar cost for mechanical dewatering is similar to sand-bed drying, the considerations of odor control indicate that the dewatering alternative is preferred. Indeed this option would be essential to meet the goal of the Stipulation that Best Practicable Odor Control Technology be utilized.

The only drawback to mechanical dewatering is increased energy use. The best method of mechanical dewatering cannot be determined at this time, but for a process such as vacuum filtration the energy consumption projected in 2000 would be about 220,000 kilowatt hours per year. This is equivalent to the present electricity use in 35 houses in Albuquerque. It is not known what the energy use requirement is for sand-bed drying. However it is certain that a significant portion of the vehicle use which occurs at the treatment works is related to bed cleaning, indicating that gasoline consumption does occur with the existing system, and would increase if sand-beds were used in the future.

The Facility Plan makes no recommendation regarding the actual means of mechanical dewatering, on the basis that a more informed decision can be made when the facilities are designed (e.g. 1985). However, indications are that the City would prefer to build these facilities at an earlier date, to achieve improved odor control. The major methods under consideration would be vacuum filtration and filter pressing. The former uses less energy and would better meet environmental goals

3.5.2 Sludge Reuse and Disposal

The benefits and possible drawbacks of using sludge as a fertilizer-dressing for City park soils were discussed in Section 2.2.10. These existing impacts would be expected to continue and increase in the future. There are no data on sludge characteristics from the activated sludge treatment plant. However, the treatment process has approximately doubled the nitrogen removal from wastewater, and also substantially increased phosphorus and metals removal. The total volume of sludge produced has also about doubled. The net affect is probably a sludge of a composition which is similar to that produced in the past, although the sludge may have slightly less nutrient and metals content than historically. Nonetheless, the value of Albuquerque sludge in the year 2000 should be approximately $300,000/year (based on present worth).

At present there are no readily apparent alternatives for sludge reuse which would increase benefits and reduce impacts. This situation may change in the future, as research into sludge recycling is intensive and likely to develop new technologies. Moreover, nutrient loads associated with sludge reuse can be reduced by collecting and removing grass clippings after the park lands are mowed. The Facility Plan notes that should sludge production exceed the demand for parks fertilizer, alternatives exist to sell the fertilizer-dressing as a soil conditioner, or to dispose of it by landfill. Direct sale prospects are uncertain because of possible health or aesthetic risks, and the fact that extensive safeguards would be needed to avoid possible liability problems. Landfill is potentially acceptable at a properly located and operated site, but eliminates practical reuse of the sludge material. The thermo-radiation-animal feed alternative (3.5.3) may also be considered, if sufficient data are available to demonstrate its safety and feasibility.

Other alternatives were not considered in detail because of the low cost and high resource value of the present recycling programs. These options could be considered if excess sludge is produced in the future and include: use of sludge for fertilizer/soil conditioning at the U.S. Forest Service tree farm (proposed) near Montessa Park; use for reclaiming damaged land, such as sand and gravel quarries and sanitary landfills; and combining with municipal refuse for composting purposes (e.g. see Wyatt and White, 1975). Research which has been reported in recent years indicates that additional possibilities may develop, including: by-product recovery (e.g. metals, vitamins and protein); conversion to heavy oil or bitumen; filter charcoal or fuel gas; production of construction brick.

Two alternatives do not seem appropriate at this time. One is sludge incineration; this would recover the heat value of sludge, but at a locally unacceptable cost in air pollutant emmissions. The second is use of sludge for fertilizer on agricultural lands, such as the MRGCD. This option runs the risk of introducing heavy metals into the food chain and there is sufficient uncertainty about the safety of the practice to make it unacceptable as long as the existing reuse is successful. It is possible that research in the MRGCD could demonstrate the safety of agricultural sludge applications, since for many circumstances no substantial dangers exist (Hinesley et. al., 1971).

3.5.3 Use of Thermoradiated Sludge for Animal Feed

Sivinsky (1975) described a process for sludge sterilization in which raw or digested sludge is heated to 149°F and then subjected to 200 krads of radiation for 5 minutes. The pathogen kill is very effective, and the sludge has the potential for various uses, such as an animal feed supple-

ment. The sludge would also be suitable for public sale as a sterilized soil conditioner. Laboratory experiments on this process are being conducted at the ERDA facilities of Sandia Laboratories in Albuquerque, and it has been suggested that the process could be implemented on a pilot scale at Plant #2. The concept is very attractive on a resource management basis, since it provides positive uses for both sludge and nuclear wastes.

At present there are insufficient data to determine if: a) the process can be conducted at a pilot scale with complete environmental protection; and b) if the treated sludge can be used safely and economically as a feed supplement. On-going studies at Sandia should answer the first question, while the second is being addressed by feeding experiments undertaken at New Mexico State University. These tests will determine if the sludge is palatable to sheep, goats and other ruminants and if any toxic metal buildups occur. The results of the studies are needed before a cost-effective analysis of the alternative can be made. Because radioactive materials are involved, it is anticipated that a separate environmental assessment or impact statement would be prepared prior to construction of a pilot facility at any municipal treatment plant.

3.5.4 Comparison of Sludge Handling Alternatives

The Facility Plan recommends that primary sludge be treated by anaerobic digestion, that waste gas be fully utilized for power generation, that waste activated sludge be thickened and treated by aerobic digestion, and that digested sludge be mechanically dewatered and used as a fertilizer/ dressing for City parks. As has been seen, this recommendation provides for almost complete use of sludge energy and nutrients, is operationally feasible and should improve odor control.

Table 3-12 compares the recommended alternative with some of the other options already discussed - such as a completely anaerobic digestion system and use of sand beds for drying - as well as the thermoradiation option. The latter is shown to be much more expensive than conventional sludge treatment, at least partly because no forecast of possible income from sludge reuse can be made. Thus, marketability of the sludge by-product must be demonstrated before the thermoradiation alternative could be seriously considered on a large scale.

3.5.5 Other Solids

Disposal to a public landfill appears to be the only sanitary process for handling grit material. This action does not foreclose future reuse, if and when landfill mining becomes feasible.

The Facility Plan recommends that scum from primary clarifiers be centrally collected rather than piped to digesters as at present. This alternative is highly desirable as a means of improving digester operation, and thus has secondary odor control benefits. The Facility Plan also recommends that the scum be recycled, if a market can be found. The recycling would involve sale to a firm which would reclaim the grease in the scum for use as a cattle feed supplement. The gross value of the scum material is expected to be about $30,000, for present production and price levels.

TABLE 3-12. SUMMARY EVALUATION OF ALTERNATIVES FOR SLUDGE HANDLING & DISPOSAL, WITH RELATIVE RANKING All options assume wastewater treatment by expansion of activated sludge at Plant #2 WAS = waste activated sludge

Item	Anaerobic Digestion Drying Beds - Use as Fertilizer/Dressing	Anaerobic Digestion Thermoradiation and Drying Beds - Use as Fertilizer	Anaerobic Digestion Mechanical Dewatering - Use as Fertilizer/ Dressing	Anaerobic Digestion Mechanical Dewatering Thermoradiation - Use as Fertilizer/Dressing	Thermoradiation of Raw Sludge & Drying on Beds - Use as Animal Feed	Thermoradiation of Raw Sludge & Mech. Dewatering - Use as Animal Feed	Anaerobic Digestion of Primary Sludge, Aerobic Digestion of WAS - Use as Fertilizer/Dressing after Mechanical Dewatering
Legal/Regulatory Requirements	Meets Requirements	Meets Requirements	Meets Requirements	Meets Requirements	Would probably meet requirements	Would probably meet requirements	Meets Requirements
Dollar Cost	3 - $6,168,200	5 - $10,551,100	2 - $5,954,200	4 - $10,326,700	6 - $11,320,500	7 - $12,820,900	1 - $5,674,800
Methane Usable for Fuel?	Yes - 1	Yes - 1	Yes - 1	Yes - 1	No	No	Yes - 2
Retention of Nutrient Value	Fair - 3	Fair - 3	Fair - 3	Fair - 3	Excellent - 1	Excellent - 1	Good - 2
Market for Product	Poor - 3	Uncertain - possibly for all of sludge -1	Poor - 3	Uncertain-possibly for all of sludge - 1	Uncertain-possibly for some of sludge-2	Uncertain-possibly for some of sludge-2	Poor - 3
Bacterial & Viral Safety	Poor	Good - 1	Poor	Good - 1	Good - 1	Good - 1	Poor - 2
Suitable for Use on Food crops	No - 4	Probably - 1	No - 4	Probably - 1	Probably, though odor would be a problem - 2	Probably, though odor would be a problem - 2	No - 3
Additional Land Required ?	Yes - 2	Yes - 2	No - 1	No - 1	Yes - 3	No - 1	No - 1
Odor Potential	Some if upset - 3	Some if upset - 3	Some if upset - 2	Some if upset - 2	Very high - 5	High - 4	Lowest - 1
Other							Liquid-Solids separation better than combined sludge
Overall Environmental Ranking (1 = best)	3	5	2	4	7	6	1

3.6 DISINFECTION AND CHEMICAL ODOR CONTROL

Presently the City utilizes chlorination for odor control and disinfection purposes. A number of environmental concerns result from this practice, as discussed in Section 3.6.1. This is one reason for the investigation of alternatives to chlorination (3.6.2), and for detailed evaluations of hydrogen perioxide for odor control on sewer lines (3.6.3), and ozone for disinfection at the treatment works (3.6.4). Actions appropriate to solution of existing odor problems are summarized in Section 4.2.

3.6.1 Chlorination: Environmental Concerns

Chlorination is the only widely utilized process for wastewater disinfection. It is used because of its reasonable cost and extensive environmental benefits. These benefits include control of odors, and especially control of disease-causing organisms such as bacteria. Without chlorination, or an equivalent process, Albuquerque's effluent would not comply with applicable standards, and the frequency of excess bacterial levels in the Rio Grande would increase. Public health problems could also increase, since the river water is used for recreation purposes throughout the Middle Basin.

In recent years, potentially adverse environmental effects of chlorination have been identified which could offset the above benefits in some cases. These negative effects include: secondary impacts on water quality; incomplete disinfection; and safety hazards. Each effect is discussed below; for further information refer to EPA (1976).

Secondary Impact on Water Quality. Chlorination of wastewater leaves a chlorine residual which can have a toxic effect on aquatic life (Zillich, 1972). Before construction of a chlorine contact tank at Plant #2, Albuquerque's wastewater discharge frequently exceeded the desirable level for chlorine residual (see Table 2-2). However, it is unlikely that any significant adverse impact resulted because no productive aquatic ecosystem exists in the river immediately below the plant outfall. A rapid decline of the residual would be expected to occur downstream (Brungs, 1973), so that no impact would be anticipated on the nearest significant aquatic ecosystem--the drain fisheries below Isleta Dam. It is possible that waterfowl using the river channel between the outfall and Isleta Dam might incur some adverse effects. However, there is little information available in the technical literature which would permit such an impact to be evaluated. With eventual operation of the contact tank the chlorine residual should be reduced to a level which minimizes these risks.

Recent reports indicate that chlorination may lead to formation of carcinogenic (cancer-causing) compounds, especially if the water being chlorinated contains certain types of industrial waste. The significance of this impact has been widely discussed; see, for example Ingols (1975), Genetelli, et al., (1975), and Rehburger (1975). Many references conclude that the link between chlorination and cancer seems to be largely circumstantial and not clearly demonstrated.

No data on chlorinated compounds are known to be available for the Albuquerque area. However, at least two lines of evidence indicate that wastewater chlorination would not increase health risks in the Middle Rio Grande Basin. First, the river water is not used as a source of domestic or municipal supplies, except indirectly where river water serves as a source of recharge for ground water reservoirs. Second, most of the reported problems have occurred from chlorination of raw water supplies which contain industrial wastes,

rather than from chlorination of wastewaters. Specifically, Morris (1975) reports that the compounds formed from chlorination of sewage readily degrade biochemically, and are unlikely to cause problems at downstream water treatment plants.

Incomplete Disinfection. While chlorination is effective in killing many bacteria, it is much less effective (at normal doses) against viruses, cysts and other, more resistant pathogens (Cramer et al., 1976). The normal test organism for disinfection--coliform bacteria--is not a good indicator of viral contamination. It is difficult to evaluate whether or not the public health is affected by viruses and other pathogens in Albuquerque's wastewater. On the one hand, the work of Pavoni et al. (1972) suggests that complete virus removal is needed to protect water quality. However, no virus standard for water has been established. There is probably considerable removal of viruses by activated sludge, since this process is normally effective in controlling 65-90% of such pathogens (Pavoni et al., 1972). Certainly no outbreats of viral-caused waterborne disease have been reported in the Middle Rio Grande Basin.

Safety Hazards. Chlorine gas is highly toxic, and because it is stored under pressure, the possibility exists that it may leak to the atmosphere and cause chlorine poisoning. The most serious problems occur at the City's odor control station on sewer lines. While no deaths or serious injuries have occurred to date, leakage incidents have occurred and the potential for causing extensive injury or fatalities exists (MMC, 1977, p. 180). City employees who service the stations are especially vulnerable should small leaks occur. Even with improved chlorination facilities at the odor control stations, the same hazard would remain since most stations are in residential neighborhoods and are vulnerable to vandalism or to traffic accidents.

Summary. The most serious environmental concern about chlorination, for the specific case of Albuquerque, is the safety hazard at odor control stations. This problem is substantial, and mandates that some alternative approach to odor control be considered and, if practicable, adopted. In contrast, the use of chlorination for wastewater disinfection cannot be demonstrated to result in significant problems at this time. Thus, chlorination as now practiced at the treatment plant is an acceptable means for protecting public health, and need not be abandoned unless a more cost-effective alternative is available.

3.6.2 Alternatives to Chlorination

Table 3-13 provides summary information regarding the effectiveness, cost, and secondary impact of potential alternatives for disinfection and odor control. The table shows that chlorine is generally no more expensive, and often much less expensive than the other options. Sodium hypochlorite, a liquid, can be used for chlorination in the place of chlorine gas, eliminating some safety hazards, but providing no other special benefits. This alternative was rejected during the screening phase of the Facility Plan because of high costs. The table lists two alternatives for dechlorination, which serves to eliminate chlorine residual problems. These alternatives were screened but rejected because no chlorine toxicity to aquatic life is evident in the Rio Grande.

TABLE 3-13 COMPARISON OF DISINFECTION AND ODOR CONTROL ALTERNATIVES Based on EPA (1976) and Rubosky (1972), Morris (1975), Ward et al (1976)

Alternative	Disinfection Effectiveness	Odor Control Effectiveness	Water Quality Impact	Disinfection Cost for a 10 MGD Plant*	Safety Considerations	Supply	Other Consideration
Chlorine	Good Leaves a long lasting disinfection residual May not be adequate against viruses	Very good. May cause odor problems if phenols present.	Potentially great. Chlorine residuals are very toxic to aquatic life. Chlorinated hydrocarbons are potentially carcenogenic.	190/1 42	Involves transport & storage of a toxic gas under pressure.	Available from a number of sources.	Possibly reduces BOD. Is presently the favored method.
Sodium hypochlorite	*Same as chlorine.*	*Same as chlorine.*	*Same as chlorine.*	190/7 10	Hazardous chemical, but safer than chlorine (solution instead of gas)	Can be bought or generated on-site.	---
Dechlorination with Sulphur Dioxide	---	---	Removes chlorine residual toxicity.	220/1.75 360/2.39 (with aeration)	Involves use of a toxic gas stored under pressure	Available	Probably will reduce effluent Dissolved Oxygen
Dechlorination with Carbon	---	Very effective	Removes chlorine residuals & chlorinated hydrocarbons.	2800/8 60	No hazards except when maintenance work is done in the carbon column.	Available	Removes odors & tastes. Reduces COD.
Ozone	Excellent. Rapid high kills. Effective against non-bacteria	Excellent	Toxicity of ozone not known Decomposes rapidly leaving no residual.	1070/4.02 (air generated) 700/3.49 (oxygen generated)	Ozone is a very toxic gas Generated on-site, no transportation hazards. Easily detectable by odor.	Generated on-site	Reduces BOD, COD, & TOC Increases DO Breaks down refractory organics Eliminates color & turbidity
Bromine chloride	Similar to chlorine Bromamines are more effective than chloramines.	---	Bromine residuals lose their toxicity more rapidly than chlorine residuals.	130/3.04	Same as chlorine.	Supplies limited.	Use to date has only been bench scale
Ultraviolet light	Good if the water not too turbid.	---	Physical process - no chemical added.	360/270	Same as ozone (since UV equipment generates O3)	Numerous suppliers	Helps break down refractory organics
Hydrogen peroxide	Little to none	Very effective	Decomposes to water and oxygen.	Competitive with chlorine.	Relatively non-hazardous chemical. Care needed in handling	Available	Good alternative for control of sewer odors.

* Values are capital/O&M costs, where capital is expressed as thousands of dollars and O&M is in cents per thousand gallons

Ozone is an extremely powerful agent for disinfection, is effective against viruses, and lacks the secondary adverse impacts of chlorination. For this reason the ozone alternative was evaluated in detail in the Facility Plan (see 3.6.4). Bromine chloride is one of many chemicals available for disinfection; others include bromine, chlorine dioxide, lime, silver and iodine. All were screened out because of high costs and/or lack of experience in large-scale operations. Ultraviolet radiation was rejected during the screening phase because of the potential for interference if the wastewater is turbid. This would result in the need for expensive filtration equipment, and much higher dollar costs than indicated in the table. Finally, hydrogen peroxide is an attractive alternative for the purpose of odor control only; no disinfection is obtained. Its use at odor control stations was evaluated in detail in the Facility Plan, as discussed in the next section. The alternative of using chlorination for disinfection only on a seasonal basis (see Genetelli, et al., 1975) is not available given existing water quality regulations, and was not considered.

3.6.3 Hydrogen Peroxide for Odor Control Stations

Three alternatives for the odor control stations on the City sewer lines are considered in the Facility Plan. One involved continued use of existing equipment, and was rejected because it did not adequately address the safety hazards discussed above. The two remaining choices are: chlorination using safer vacuum-feed equipment, and use of hydrogen peroxide.

Chlorination with vacuum-feed equipment would reduce but not eliminate the safety hazards at odor control stations. Its other advantages are lower dollar cost compared to hydrogen peroxide, and the fact that City personnel are familiar with chlorine use. Use of hydrogen peroxide has many advantages (see, for example, Shepard and Hobbs, 1973; Cole et al., 1976). It is very effective in oxidizing hydrogen sulfide, the major source of sewage-related odors and corrosion. Its use eliminates the possibility of toxic chlorine residuals or chlorination compounds. Rather, the only by-products are water and dissolved oxygen; the latter may reduce BOD levels in sewage, and thus reduce organic loading at the treatment plant.

The most important benefit of hydrogen peroxide is safety. Should the liquid escape it is readily flushed by fresh water. Operators or citizens coming in contact with a spill could suffer skin and eye irritation, but would experience no serious injury. In short, use of hydrogen peroxide would eliminate serious safety hazards at odor control stations. The only drawback is the slight additional cost of switching from the existing system. This cost is less than 5¢ per resident of the area per year, an amount not considered significant when compared to safety benefits. Moreover, as noted in the Facility Plan, chlorine prices have risen in recent years while hydrogen peroxide prices have been stable. If this pattern continues, the hydrogen peroxide option might actually become less expensive.

Based primarily on safety reasons, use of hydrogen peroxide is the preferred alternative for odor control on the Albuquerque sewerage system. The Facility Plan recommends immediate conversion of one chlorine station to hydrogen peroxide, in order to obtain experience in use of the new chemical and to confirm the benefits described above. If the test is successful,

the remaining active stations would all be converted at the same time, in order to achieve the efficiency of using a single technique throughout the system. This program appears to have substantial environmental benefits and no significant drawbacks.

According to the Facility Plan a number of renovations are needed to several odor control stations, regardless of whether or not hydrogen peroxide replaces chlorine for odor control purposes. These actions include replacement of skylights and other relatively minor matters, and are all necessary to improve the function of the stations. No adverse environmental effects are anticipated.

3.6.4 Ozone for Effluent Disinfection

The benefits of switching to ozone for disinfection are described in many references, including Nebel et. at., (1973); Gould and Weber (1976); and Netzer and Miyamoto (1976). The most significant environmental benefits include the lack of secondary water quality problems and the effectiveness of ozone against viruses, cysts and other pathogens which resist chlorine. Ozone also improves effluent quality by reducing color, odor and taste problems, reducing organic load, and increasing dissolved oxygen. Countering these benefits are several disadvantages, including high dollar costs. One source of the costs is the high energy demand for on-site generation of ozone. For example, in the year 2000 the City would use 7 million kilowatt hours to generate ozone for disinfection at Plant #2, whereas the commercial production of chlorine for disinfection would require use of about 3.5 million kilowatt hours, including transportation. A major concern regarding ozone use is uncertain reliability for large-scale facilities; there appear to be no existing wastewater ozonation systems successfully operating at a scale which would assure success in Albuquerque. The operational problems relate to the equipment used, to the need for highly skilled personnel, and the fact that filtration of effluent may be needed to meet bacteria standards. A special problem, noted by Hamelin and Chung (1975), is that ozone may have mutagenic effects.

On balance, the disadvantages of ozone use outweigh benefits at this time, at least partly because there are no demonstrable problems which now occur as the result of chlorine use. In other words, the increased cost of ozone, and the increased energy use, would not result in any readily identifiable improvement in environmental quality. There are indications that this situation may change in the future, as the technology for ozone use becomes more widely established, and costs come down. This is the basis for the Facility Plan recommendation that ozone be reevaluated before any major investment in new chlorination facilities is made.

The only such investment under consideration is construction of a rail spur for delivery of bulk chlorine to Plant #2. This option is recommended in the Facility Plan because of slight economic benefits. Environmental benefits of rail delivery include: greater safety; less air pollutant emissions during chlorine transport; and less energy use during transport. All these benefits are based on the general advantages of rail freight for transport of bulk cargos. Other bulk products, including hydrogen peroxide, could also be handled by the rail facility. Adverse impacts associated with the rail line include: land requirement for an approximately 2000 foot long right-of-way; dust, noise and other effects of line construction; the need for a crossing over the Barr canal; and noise, diesel emissions and other effects of train operation.

The small land requirement may not be a significant factor, if the land acquired as a contingency for advanced treatment facilities is utilized. Construction impacts can be minimized (see Section 5.1), and would be expected to be small because of the low population of the area being affected. Train operation impacts would be minimized by the infrequent use of the spur, and by the fact that the Atchison, Topeka and Santa Fe mainline already exists within one-half mile of the treatment plant. The adverse effects appear to be acceptable, especially given safety benefits. However, the tradeoffs are not conclusive, and would appropriately be reviewed at the time when ozone and chlorination are again compared.

3.7 WASTEWATER REUSE ALTERNATIVES

The subject of effluent reuse for irrigation was discussed in 3.4.1. Such use occurs even though there is no formal program for land application of Albuquerque effluent. Similarly, by contributing to the flows of the Rio Grande, the effluent is also reused downstream for recreation purposes and for support of aquatic habitats and wildlife refuges. Reuse of wastewater can also be considered for aquaculture, silviculture, cooling water, recreation, open space and other purposes.

3.7.1 Aquaculture

Aquaculture is water-based agriculture, and provides a means of using wastewater nutrients to help grow a supply of protein food. Historically, aquaculture has often involved fairly primitive techniques for algal growth, usually at a small scale, but active research on the subject is underway and predictions have been made that a substantial development of aquaculture will occur by the end of the century, as biological engineering skills improve (Bardach, 1968).

Walrath and Natter (1976) provide an extensive discussion of aquaculture as an alternative for nutrient removal in wastewater treatment. The major benefit is potential recovery of foodstuffs, fuels and fertilizers. In addition, only a small part of the water resource is consumed, so that the treated effluent is available for further use or discharge. Thus, for Albuquerque aquaculture has the advantage that water rights losses would be small, and the amount of water available in the Rio Grande would not be significantly reduced.

Aquaculture also has numerous disadvantages, including high space requirements (10 or more acres per mgd treated), seasonal variations in production (organisms may be killed during winter), and the unknown significance of heavy metals and pathogens which may contaminate the final product. Another disadvantage is that for nitrogen:phosphorus ratios like those in Albuquerque's wastewater, there would be little phosphorus removal expected. Thus aquaculture could only be used for nitrogen removal purposes. Moreover, ammonia-N removal would be dominant; organic-N could remain in the water. Harvesting of algae may require extensive facilities and use of energy. This problem can be partially overcome if filter-feeding shellfish are used to harvest part of the algae crop. Odor problems may occur at some aquacultural sites.

Because of the many disadvantages, especially the land requirements and difficulty of harvest, aquaculture tends to be an expensive process. It has proven most successful where a market exists for the more valuable products of the process. Discussions with scientists at Los Alamos Scientific Laboratory during this planning effort indicated that the costs of constructing a large-scale aquaculture facility would be broadly comparable to building a Southeast Mesa treatment plant and land application system. No certain large-scale markets for the resulting products could be identified. On this basis, the option was eliminated during the screening phase.

As research into aquaculture proceeds elsewhere it is possible that this option may become more attractive for large cities such as Albuquerque. Nothing in the existing system or proposed improvements would preclude adding on an aquaculture system in the future, should market benefits outweigh costs, or should nitrogen-removal someday become a treatment requirement. An interesting variation on the aquaculture alternative was discussed by Vaseen (1976) who indicated that the microbial mass produced during the activated sludge process might be harvested as a food source. Presumably, such a harvest could be achieved at Albuquerque if and when the technology becomes available. Similar conclusions would apply to such aquaculture variations as the use of water hyacinths.

3.7.2 Silviculture

Silviculture, or tree-growing, can be practiced using wastewater. The process is similar to land application of effluent in an irrigation system, except that nitrogen-removal is relatively small at a tree farm. The U. S. Forest Service is developing a tree nursery in the Tijeras Arroyo area, several miles east of Plant #2. The prospect of recycling Albuquerque effluent at the nursery was discussed with the Division of Timber Management as part of this environmental evaluation. Obstacles to such a project include: the small amount of effluent needed at the Tijeras Arroyo site (0.4 mgd); the long transport distance and pumping lift involved from Plant #2 to the site; and the availability of a low-cost supply of fresh water at the site. Development of the project would require extensive trial runs and pilot projects to demonstrate that no problems with toxic metals exist. Because of these obstacles, the silviculture alternative was rejected during the screening phase of the Facility Plan.

3.7.3 Cooling Water

Use of wastewater for cooling of boilers is the most common form of industrial reuse, because water quality requirements for boiler-water are less strict than for many other uses. Only one large-scale user of boiler water could be identified in Albuquerque: Public Service Company of New Mexico (PNM). PNM operates two gas-fired power plants, one of which occurs less than two miles from Plant #2. As part of the environmental evaluation, the prospect of selling City wastewater for cooling purposes was discussed with PNM officials. Based on an evaluation of wastewater quality and a preliminary consideration of economics, these discussions indicated that there is no serious obstacle to such a sale. Thus the Facility Plan recommends that such a sale be negotiated, provided that a net revenue to the City can be obtained. The revenue will help offset treatment costs.

The total amount of wastewater needed by PNM is approximately 1 mgd. A portion of this would be consumed by evaporation at the power plant site; the remainder would be discharged to the Rio Grande as boiler wastewater, and would be subject to control by an NPDES permit. By using the effluent supply, PNM would no longer have to pump wells at the power plant, thus reducing the demand for ground water in the Albuquerque area. The effect of this reuse on water rights will be a matter to be negotiated between the City and PNM.

Another potential customer for cooling water would be any large-scale solar power plant developed as part of ongoing solar energy research projects at Sandia Lab. Discussions with Energy Research and Development Agency officials indicated that no such reuse would be possible with existing pilot power plants, but that reuse for larger facilities could be considered if and when such facilities are built.

3.7.4 Recreation and Open Space

As noted above, the present practice of discharging wastewater to the Rio Grande provides for downstream recreational reuse of the wastewater. More direct reuse of the effluent could be accomplished through at least three means. First, lakes could be built in major arroyos throughout the City, and supplied by effluent. Gill (1969) discusses the possibility of using San Juan-Chama Project water for such lakes, including a 270-acre water body which could be built in Tijeras Arroyo near Interstate-25, about two miles from Plant #2. The arroyo lakes were rejected as a possible use of Project water because of siltation problems and high costs. The same obstacles would preclude development of such lakes using wastewater.

A second use of effluent for recreation could involve impoundments in the Rio Grande, as suggested by the City Edges Study (see 2.7.2). The effluent could be piped to a point north of the City and used to fill the river channel as it flows through the City. This would have some advantages over direct use of San Juan-Chama Project water for the river impoundments, since no water loss would occur between Albuquerque and northern New Mexico where the Project water is obtained. Disadvantages could occur if the wastewater were not completly suited for contact recreation. This alternative has not been explored in detail; it would be appropriately considered if and when the recommendations of the City Edges study are implemented regarding lakes in the Rio Grande.

A third use of effluent has been suggested by the Corps of Engineers and would involve a wastewater supply to man-made marsh communities created as an off-shoot of borrow excavation and levee construction activities. This use can be explored further as more details on the Corps proposal becomes available. Advantages of this option include the high value of wastewater nutrients and organics to the marshlands, the extensive treatment of wastewater which would result, and the prospect that the wastewater could be taken directly from the nearest sewer line and, after preliminary treatment and disinfection could be used directly without further transport or treatment.

The potential for using wastewater to protect open space (irrigated agriculture) was discussed in 3.4.1. Such a reuse would be difficult to accomplish because of the shallow water table beneath the agricultural areas. However, to the extent that the existing use of effluent-river water mixes occur in the MRGCD, then the present practice of wastewater treatment and discharge can be considered to contribute to maintenance of open space in the Middle Rio Grande Valley.

3.7.5 Other Purposes

There are many other possibilities for wastewater reuse (see, for example, Linstedt et. al., 1975). These could include industrial process water, irrigation of parks, golf courses, cemeteries and highway medians, sprinkling for dust control, and water for fire fighting. In all cases in Albuquerque an existing low-cost supply of fresh water is available for these purposes. To replace the existing supply with wastewater would required special transportation facilities (e.g. a pipeline), and expensive, energy-consuming pumping. Such a replacement is cost-effective only where the demand for water is large and concentrated in a few locations. However, in Albuquerque the demand for such water tends to be scattered widely, and to be small at any one location. Thus reuse of wastewater for the stated purposes was rejected during the screening phase of the Facility Plan. Only the reuse for cooling water at the PNM power plant described above is large enough to be cost-effective.

Recycling of wastewater for drinking water purposes is contrary to State policy, and was not evaluated. Recycling to provide recharge of ground water reservoirs was discussed in association with land application projects (3.4.1).

3.8 ALTERNATIVE ORDINANCE AND MANAGEMENT POLICIES

Centralization of Management. The alternative of combining water supply and wastewater management in Albuquerque was suggested for consideration at the onset of the 201 planning process. The City implemented this reorganization in 1976, hence the alternative was not included in the Facility Plan. CDM (1977a) has recommended further reorganizations take place. These recommendations occurred subsequent to completion of the Facility Plan and are not analyzed in detail here. However, insofar as the reorganization will benefit operation and maintenance of City facilities they would be essential to achievement of environmental goals.

Liquid Waste Ordinance. Enforcement of the liquid waste ordinance is expected to have benefits such as the reduction of metals in influent, effluent and sludge. The Facility Plan considered for evaluation the alternative of progressive enforcement of the ordinance, concentrating on those industries which contribute the greatest mass of metals to the sewerage system. Such enforcement would delay action against small industries which may occasionally violate concentration standards set in the ordinance, but which do not actually contribute a significant mass of metals to the system. Presumably, under the progressive enforcement approach variances might be granted where the benefits of metals control are minimal. Minimal benefits would occur when the potential reduction in metals discharge would not result in a significant (or measurable) change in the amount of the metal in effluent or sludge. For example, if a "significant" source were defined as contributing 0.01% of the total mass of a metal, then a source discharging a few thousand gallons per day could slightly exceed ordinance standards without being a significant source. A priority under progressive enforcement would be to act against sources which are responsible for large "dumps" of heavy metals, and which thus might appear to meet ordinance standards during routine sampling runs.

The alternative of progressive enforcement has the benefit that it will focus attention on sources which contribute enough of a metals load to make pretreatment and/or recycling a viable action. Conversely, there will be less focus on industries which may be too small to implement a control or recycling program, and which might be forced to close rather than conform to the ordinance. The progressive enforcement alternative appears to have no significant environmental drawbacks, and would not by itself be expected to lead to unacceptable metals levels in City wastewater discharges or sludges. However, because the ordinance reflects a specific mandate--the Stipulation--it is not certain if variations in enfocement can be implemented legally. It can be expected that the ordinance will be revised to accommodate the unified national strategy for industrial pretreatment now being developed by EPA.

Industrial Waste Disposal Site. Enforcement of the liquid waste ordinance is expected to lead to construction of wastewater treatment systems at several industrial sites. These systems will themselves produce concentrated waste products which will require a disposal mechanism. In the event private industry is not able to provide for the convenient disposal of the concentrated wastes, the alternative exists that the City could, by itself or in cooperation with a regional/State agency, construct an industrial waste disposal site, and operate it on a fee basis. According to the Facility Plan, an appropriate site would be in the Montessa Park area, near the Police Academy. No adverse impacts can be identified which would occur if such a site were developed; indeed, such a means for disposal of concentrated and potential toxic wastes is essential if the benefits of the liquid waste ordinance are to be obtained.

Non-Industrial Metals. Section 2.1.3 indicates that a substantial portion of the metals in Albuquerque sewage appears to originate from commercial and domestic discharges. The same pattern has been observed in other cities (see Davis and Jacknow, 1975, for example). The only effective alternative which can be identified to control such discharges is an education program to advise the public of the problems associates with pouring potentially toxic and harmful substances into a sink or toilet. The City Environmental Health Department has begun such a program (Bickel and Servis, 1975).

Service to Unincorporated Areas. Only one mechanism exists by which the City can provide wastewater services in areas outside the City Limits, that is through a Joint Powers agreement with the County or Village government which has jurisdiction over the area receiving service. Because the City obtains no tax revenues from such areas, sewer rate charges are normally higher than within the City. However, the net tax and utility charge burden on City and non-City residents is the same, so that no special economic costs occur to different portions of the public.

Flow Reduction. The City of Albuquerque is committed to water conservation programs, although detailed consideration of conservation measures is just now underway. It can be expected that the conservation programs will initially focus on outdoor water use. This is because it is summer-season use of water for lawn sprinkling, swimming pools, air conditioning, and other purposes which accounts for peak water supply demands, and thus determines the cost of water supply facilities (see Figure 2-14). Reductions in outdoor water use would be expected to have no effect on wastewater flows, but would reduce the pumping rate of City wells, and thus reduce the demand for water rights.

Conservation measures can also be expected to involve indoor water use, especially for new construction. Measures which may be taken to reduce wastewater flows include: use of pressure-reducing valves or faucet heads in bathroom and kitchen fixtures; use of shallow-trap toilets; use of systems which recycle "grey-water" from bathing and washing; and restrictions on garbage disposals. The effectiveness of most of these measures depends on the habits of the individual -- a flow-restricting faucet left on produces more wastewater than a normal faucet which is properly used. Data provided by Cohen and Wallman (1974) indicate that potential flow reductions from the listed measures could amount to 30% or more; most of the savings would be associated with use of a grey-water recycling system. The actual effect of such a savings would depend on the degree to which the measures were adopted city-wide. It should be noted that the projected per capita wastewater flow of 110 gallons/day, which was used in the Facility Plan, was based on an assumption of 5-10% effectiveness of water conservation measures city-wide. It would seem that flow reduction much beyond 100 gallons/capita/day would require that the water conservation measures noted above be used by a sizeable majority of all residents, in both new and old construction; the mechanism for achieving such conservation has not been identified.

Energy Conservation. Alternatives for modest energy conservation exist as Plant #2 is expanded. Projected electricity demand for the plant is about 32 million kilowatt hours in the year 1985, and nearly 43 million kilowatt hours in the year 2000. Approximately 10-20% of this demand can be met by on-site generation using recycled sludge gas. The remainder will be purchased from outside. Substantial reduction in demand is probably not practical because the major consumption is for aeration and pumping, operations which cannot be cut back without adversely affecting plant operation. However, small amounts of energy savings are possible through measures such as changes in ventilation standards and reduced plant lighting (Voegtle, 1975). Reduction in lighting at Plant #2 would also have an aesthetic benefit for the surrounding neighborhood. More significant steps could include use of Albuquerque's ample solar energy for heating and power purposes. Wilke (1976) discusses the use of solar energy to heat sludge digesters; similar measures could be explored during the next phase of digester design and construction. The proposed administration/laboratory building could be heated and cooled by solar energy. Solar-powered pumps of the type recently installed on Isleta Indian Reservation could also be considered. It is anticipated that the new City energy conservation program will address these measures and implement those which are cost-effective.

Noise Control. Noise control alternatives at Plant #2 are discussed in CDM (1977) and were not considered in the Facility Plan. The technically most effective measures are considered to be acoustical treatment and direct muffling in problem areas. The potential also exists to elevate, extend and/or landscape the noise barrier which has been built at Plant #2. Landscaping of the barrier, and of boundary fences, would have aesthetic benefits as well. EPA (1976a) provides further information on the technology of noise control at treatment plants.

User Charge. EPA will require that the City adopt a system for distributing the costs of the wastewater system among the users of the system in a fair and equitable way. The Facility Plan discusses alternative formulae for calculating the charge. All are designed to ensure that the system pays for itself by rate-derived income, and that sources of wastewater which are more costly to treat than normal pay an appropriate surcharge.

4. DESCRIPTION OF PROPOSED ACTIONS

Of the alternatives described in Section 3, those which present the most cost-effective solutions for wastewater management in Albuquerque have been recommended for implementation. These proposed actions are described in the Facility Plan and summarized briefly here.

4.0 SEWERAGE SYSTEM

The major action proposed for collection of sewage is construction of interceptor and collector sewers to serve developed and developing urban areas. The cost of the proposed sewerage system exceeds $25,000,000; 40% of this expenditure is projected to occur by 1981. Other proposed actions include conversion to hydrogen peroxide for odor control, renovations of lift stations, and improved regulation of on-site systems in rural areas.

Figure 4-1 indicates the approximate location of all interceptor and collector lines which are proposed to be constructed in the next 20 years. Table 4-1 describes the recommended sewerage action for each part of the planning area and includes cost estimates. As shown in the figure and table, sewerage facilities will be provided to the already developed areas outside the City limits, including: the Arenal District of the South Valley; the southern and eastern portions of the North Valley; and neighborhoods near Plant #2. Sewerage will also be provided to developing urban areas on the West Mesa and in the Northeast Heights. Contingency plans for providing sewer lines have been prepared for the Corrales and East Mountain areas, in the event that development occurs at levels beyond those now projected. All sewer installations will utilize permanent pipe materials. Specifically, vitrified clay pipe is to be used for lines up to 15 inches in diameter, and treated, reinforced concrete pipe is to be used for larger lines.

Table 4-2 provides a cost estimate for the recommendation that the City's odor control stations be converted to utilize hydrogen peroxide. The table also indicates the cost of other renovations proposed for the stations, including measures to be taken if the initial pilot use of hydrogen peroxide does not prove satisfactory and chlorination facilities are retained. Renovations and improvements are also proposed for most of the lift stations. These improvements, which include a monitoring/alarm system and standby power, are listed in Table 4-3 and have a high priority for safety reasons. Two new lift stations are proposed in Mountainview and in the Candelaria Industrial Park area.

The use of on-site systems in remaining rural areas is associated with some environmental problems. To reduce these problems it is proposed that appropriate government agencies, such as the City and County, adopt stricter regulations to govern new on-site units. Such regulations would require use of advanced systems for lots where conventional septic tanks are unacceptable, and would establish criteria for the proper design, installation, operation, maintenance and replacement of the systems.

PAGE NOT

AVAILABLE

DIGITALLY

TABLE 4-1 PROPOSED SEWERAGE ACTIONS. The following courses of action were recommended by the engineering consultants Where no sewers are proposed, wastewater management would continue to rely on on-site systems CP = Comprehensive Plan Cost is estimated on a present worth basis.

Area	Recommendation	Comments	Cost	Year Needed
Corrales	Continue use of on-site systems, but adopt upgraded regulations for installation of same	Conforms with Corrales Master Plan and public hearing input	-	-
	Adopt contingency plan for 1) gravity collection of existing flood plain development and 2) treatment at an Albuquerque plant	Provides course of action in case of unexpected growth, would protect ground water from increased potential of pollution	$5,383,400	-
Northwest Mesa	Provide interceptors as needed for growth, size for possible Corrales flows	Conforms with CP, could relieve North Valley development pressures.	3,946,000	1980 - 1990
North Valley	Phase I Extend North Valley interceptor to Alvarado School	Eliminates two lift stations	1,106,400	1980
	Phase II Extend North Valley interceptor to Chavez Ave Extend 2nd & 4th St. interceptors to Ranchitos Rd Provide collection lines in these areas	Provides sewers to established semi-urban area	2,549,400	1985
	Phase III Extend North Valley interceptor along Guadalupe Trail to Ranchitos Rd Extend 2nd & 4th St interceptors to Corrales Rd Provide collectors for adjacent existing development 10+ years	Provides sewers to established semi-urban areas, but allows CP time to develop controls to growth in adjacent rural areas	2,930,900	1990
	Phase IV Provide interceptor and collection lines to north Edith Blvd area as needed 10+ years	Anticipates in-filling of this area as indicated in CP	1,019,600	1995
North Indus Park	Provide for gravity collection in Bear Canyon Ln-Arroyo Seco Dr. area.	Would serve existing clustered development.	362,500	1980
North Albuquerque Acres	Provide gravity collectors to Data Analysis Subzone 7121.	Anticipates urban growth according to population forecasts.	213,700	1985-2000
Sandia Heights	No service before year 2000, unless intervening area infills	Avoids influencing development out of sequence with CP	-	-
Candelaria Indust Park	Provide service to area (with lift station and force main)	Would serve existing development, low priority because of high cost per connection	2,225,000	2000
Southwest Valley & SW Mesa	Provide gravity service to "South Valley Phase I, Priority 2 area (Arenal locale) and developed areas along Gun Club Road.	Would serve existing semi-urban development	3,753,500	1980
	Provide interceptors west of Coors Road as needed for growth.	Anticipates development indicated by CP	2,436,000	1990
Southeast Valley	Provide service to Mountainview area (with lift station and force main).	Would serve existing semi-urban development	848,800	1980
East Mountain	No service before year 2000	Sewers premature in light of physical separation and low densities	-	-
Four Hills	Extend interceptor up Tijeras Canyon to relieve overloading(with East Mt capacity)	Would eliminate lift station and serve existing development	942,500	1978
Tijeras Interceptor	Extend to Academy Road	Would relieve existing overloading of lines	1,203,400	1978
Throughout City	Provide replacement line for overloaded interceptors - lines # 25, 103, 104, 105, 112, 113, 119, 132, 142, 142A	Lines 25, 104, 113, 119, 142A to be replaced by 1980 Others at later dates.	1,227,400	1978-1990

TABLE 4-2. SUMMARY OF PROPOSED ACTIONS FOR ODOR CONTROL STATIONS

Action	Cost
1. Convert stations to hydrogen peroxide	$ 209,000

2. Renovate stations as follows:

Station No.	Presently in use?	Recommended Renovations	Estimated Cost
1	Yes	Correct safety problems	$ 800
2	No	New chlorinator if activated	-
3	No	New chlorinator if activated	-
4	No	New chlorinator if activated	-
5	No	Safety problems would have to be corrected and chlorinator rebuilt if activated	-
6	No	New chlorinator if activated	-
7	No	New chlorinator if activated	-
8	Yes	Chlorinator should be replaced	1,700*
9	No	New chlorinator if activated	-
10	No	New chlorinator if activated	-
11	Yes	Replace blower and corroded pipes	300
12	No	New chlorinator if activated	-
13	Yes	Add additional chlorinator for increased capacity	2,800*
14	No	New chlorinator if activated	-
15	Yes	Replace vent pipe	500
16	Yes	-	-
17	No	Prepare for use, replace chlorinator, water line and blower	3,100*
18	Yes	Renovate existing chlorinator to provide increased capacity, convert to ton cylinders	6,500*
19	Yes #	Correct safety problems if activated ($9,000)	-
20	No	Skylight and vent repair	200
21	No	Skylight replacement	100
22	No	Chlorinator repair if activated	-
23	No	Chlorinator repair and booster pump replacement if activated	-
24	No	Provide chlorinator if activated	-
25	Yes	-	
26	No	Skylight replacement	100
27	No	Repair roof Chlorinator would have to be repaired, hoist replaced & safety problems corrected if activated	400
28	Yes	Repair blower	300
			$16,800*

Until recent leakage incident

* Required only if chlorination is continued rather than conversion of stations for use of hydrogen peroxide as recommended. Otherwise total estimated cost = $2,700.

TABLE 4-3. SUMMARY OF PROPOSED ACTIONS FOR LIFT STATION RENOVATION

Lift Sta. No	Proposed Renovations	Estimated Costs Immediate	1985	1990
3	Replace wet well ladder and dry well door	$ 800	$	$
5	Provide additional pump		7,000	
6	Provide shaft guards and change access doors	1,500		
11	Replace wet well lighting, patch leaks in wall	500		
12	Refit wet well, replace ventilation blowers	1,600		
15	Rebuild with submersible pumps	7,500		
16	Provide wet well ladder	400		
17	Provide access ladder extension	200		
20	Increase capacity	190,000		200,000
24	Provide ladder, safety rail, belt hook; replace pumps	41,000		
25	Provide ladder, safety rail, belt hook; replace pumps	41,000		
	Sub-total	$284,500	7,000	$200,000
all	Provide alarm system	57,000		
all	Provide standby power	80,000		
	Total	$421,500	$7,000	$200,000

Note:

The cost of new lift stations in Mountainview and the Candelaria Industrial Park are included in Table 4-1.

4.1 TREATMENT SYSTEM

It is proposed to expand the activated sludge process at Plant #2 and to abandon Plant #1, at a total construction cost of approximately $18,000,000. The expansion will involve three steps, designated Phase IA, Phase II and Phase III (Figure 4-2).

Phase IA is the already approved expansion of the plant to a capacity of 47 mgd, and should be completed by 1980. The expansion primarily involves construction of aeration basins and clarifiers, and completion of a new outfall line. The Facility Plan proposes that emergency construction measures for odor control be integrated into Phase IA, including facilities for sludge thickening, mechanical screening of raw sewage and additional sludge drying bed capacity.

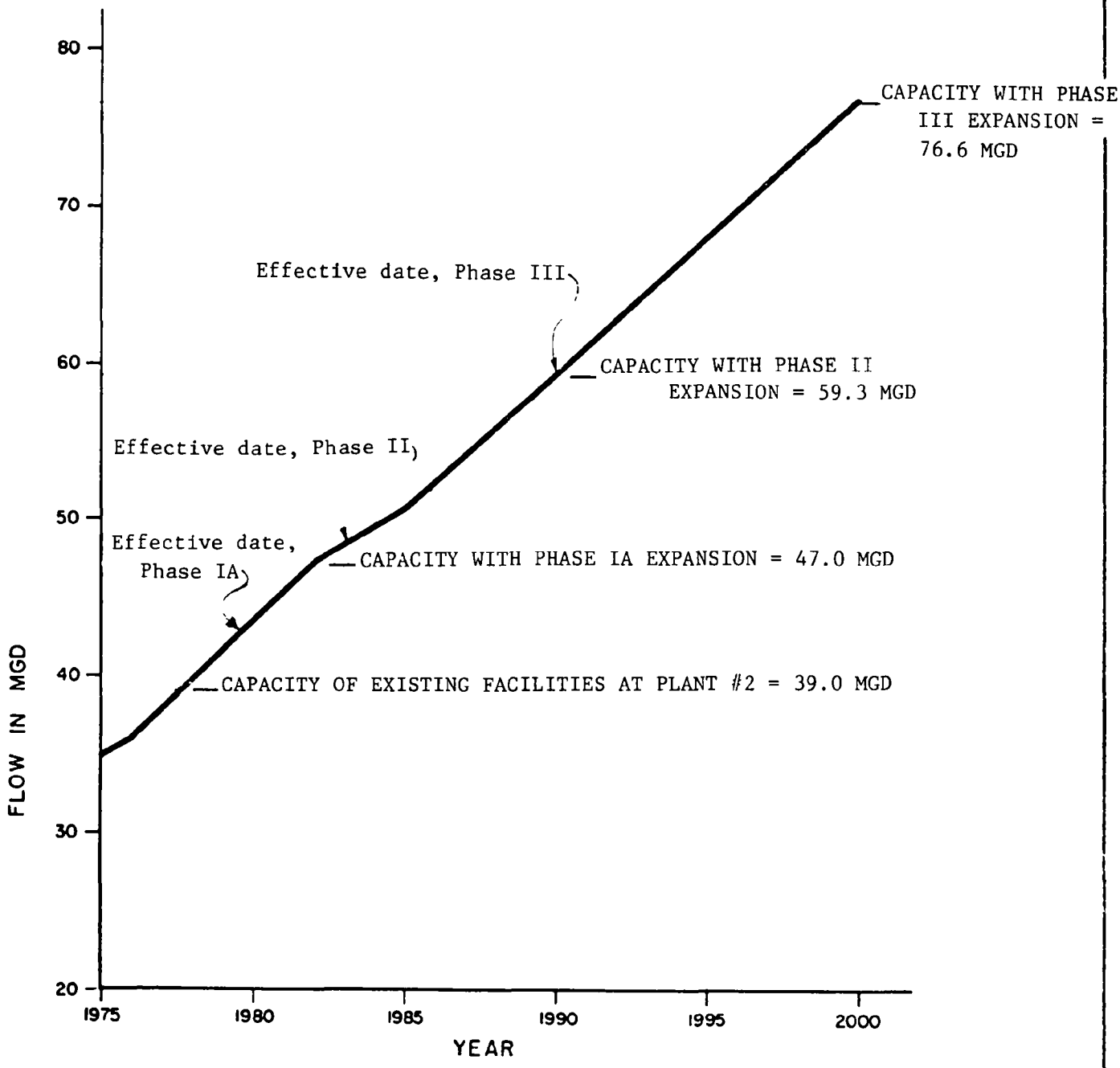
Phase II would expand Plant capacity to 59.3 mgd by 1983. This is the major construction project proposed by the Facility Plan. In addition to the simple expansion of treatment and sludge handling facilities, Phase II would include: construction of mechanical dewatering facilities to replace sludge drying beds (with resultant reduction in odor problems); completion of preliminary treatment facilities for raw sewage which flows to Plant #2B; construction of an administration/laboratory building; provision of facilities for scum handling; overhaul and expansion of the gas recycling system; overhaul of trickling filter units at Plant #2; and construction of a rail siding for bulk delivery of chlorine. If recommended studies so indicate, aerobic digesters would be constructed to process waste activated sludge. Plant #1 would be abandoned upon completion of the Phase II improvements at Plant #2.

Phase II probably will be implemented over a period of several years, in order to most efficiently utilize limited financial resources. Initial emphasis will be on improvements which achieve odor control, such as mechanical dewatering. The general plant expansion, and razing of Plant #1 would follow.

Phase III will expand treatment capacity at Plant #2 to 76.6 mgd. It is programmed to be completed around 1990, but this schedule could be modified if wastewater volume increases at a faster or slower rate than now projected. Phase III will involve the expansion of all major aspects of the treatment system, including pretreatment, aeration, clarifier and sludge-handling units.

Table 4-4 lists the specific facilities to be built or modified during Phase II and Phase III, and provides cost data. Not included in the table are the basic Phase IA improvements which, as explained in 2.1.2, preceed the implementation of the Facility Plan. The emergency additions to Phase IA, as proposed by the Facility Plan for odor control, are estimated to cost in excess of $1,000,000 (MMC, 1977, Appendix G).

Table 4-5 provides a description of the proposed treatment system from the point of view of capacity, loading rates, physical dimensions of units, and treatment efficiencies. Figure 4-3 is an engineering schematic digram which illustrates the detailed passage of wastewater and solids through the treatment works. A simplified version of the flow diagram follows, on page 191.



CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

PROJECTED SYSTEM FLOWS

Adapted from MMC, 1977

FIGURE 4-2

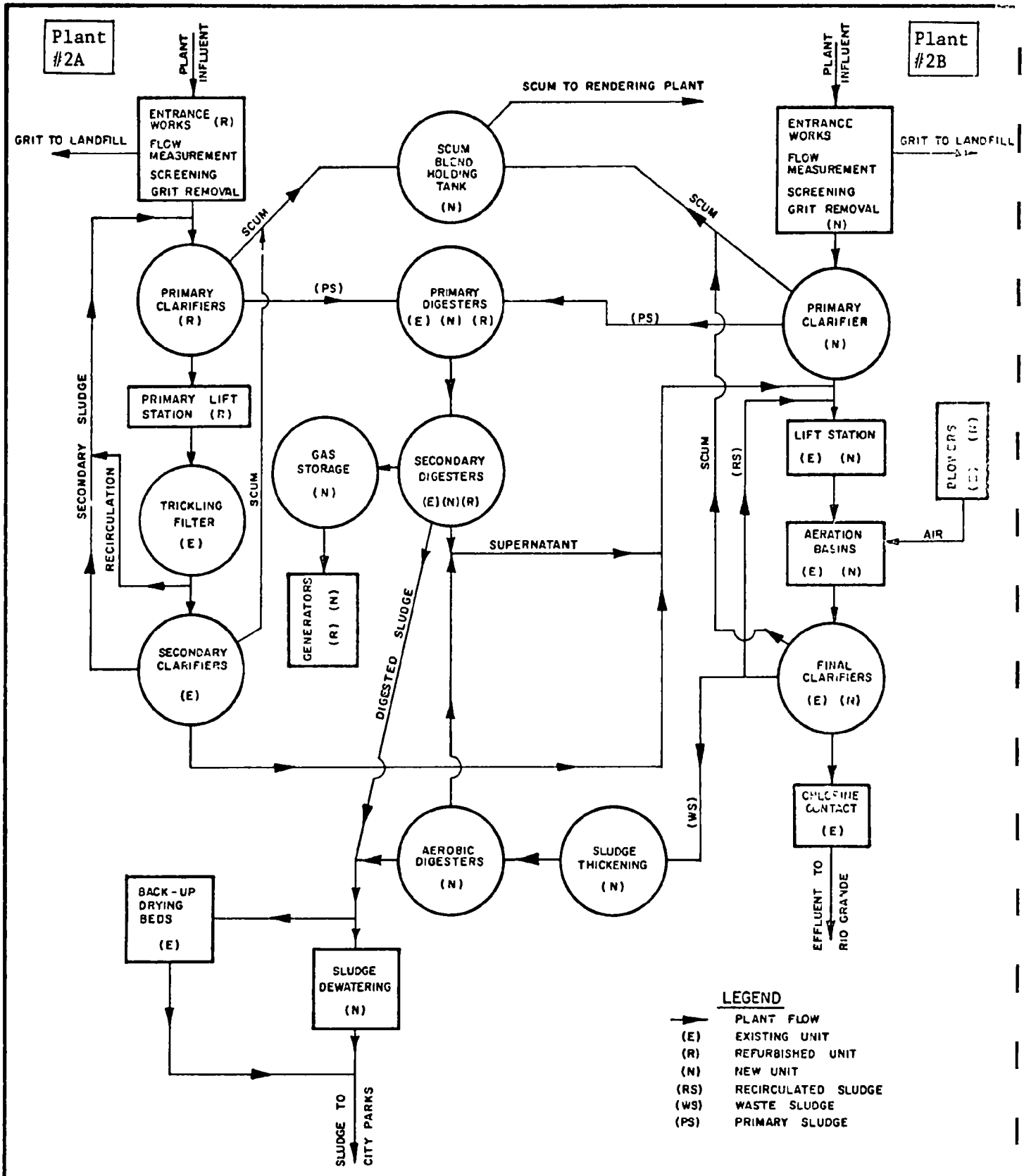
TABLE 4-4. ESTIMATED TOTAL DOLLAR COST OF PROPOSED TREATMENT ACTIONS (MMC, 1977).

Item	Phase II (1983)	Phase III (1990)
Design Capacity	59.3 MGD	76.6 MGD
Entrance Works	$ 608,000	$ 405,000
Primary Clarifiers	887,000	355,000
Raw Waste Lift Station	700,000	200,000
Aeration System	1,180,000	541,000
Aeration Basins	510,000	935,000
RAS Pump Station	370,000	55,000
Final Clarifiers	-0-	541,000
Flotation Thickners or Centrifuges	223,000	-0-
Yard Work	578,000	580,000
Administration & Lab Facilities	590,000	-0-
Scum Collection & Blending	41,500	-0-
Anaerobic Digesters	659,100	-0-
Aerobic Digesters	890,000	350,000
Mechanical Sludge Dewatering	1,183,000	422,500
Gas Storage Spheres	538,200	269,000
Engine - Generators	180,400	-0-
Pump Station & Pipeline to Public Service Co.	400,000	-0-
Rebuild Trickling Filter Plant Bar Screens	40,000	-0-
Renovate Trickling Filter Plant Grit Collection	75,000	-0-
Replace Trickling Filter Plant Primary Clarifier Weirs	15,000	-0-
Overhaul Trickling Filter Plant Primary Lift Station	60,000	-0-
Overhaul Existing Generators	50,000	-0-
Clean Digesters	160,000	-0-
Raze Plant 1 (Net after Salvage)	251,000	-0-
Chlorine Rail Car Siding	210,000	-0-
Subtotal	$ 10,399,200	$ 4,653,500
Engineering, Contingencies, etc. @ 16%	1,663,900	744,600
Subtotal	$ 12,063,100	$ 5,398,100
Interest During Construction 6 1/8% of 50% of All Costs	369,400	165,300
Total	$ 12,432,500	$ 5,563,400
Total Annual O&M (Net After Power Generation)	$ 1,049,500	$ 1,159,200

TABLE 4-5. DESCRIPTION OF UNIT OPERATIONS AND PROCESSES - PROPOSED TREATMENT SYSTEM

Process or Operation	Flow Rate Phase II 1983 Expansion	Flow Rate Phase III 1990 Expansion	Loading Rate Phase II	Loading Rate Phase III	Total No. of Units at Completion of Phase IA 1978	Total No. of Units at Completion of Phase II 1983	Total No. of Units at Completion of Phase III 1990	Physical Dimensions if Applicable (each unit)	Removal Eff. % BOD_5	Removal Eff. % SS
A. Trickling Filter Plant										
Parshall Flume	14-35 MGD	14-35 MGD			1	1	1	36" throat	NR*	NR
Mechanical Bar Screen	22 MGD	22 MGD	1.1 fps	1.1 fps	2	2	2	6' wide	SR*	SR
Mechanical Grit Chamber	22 MGD	22 MGD	1 fps	1 fps	2	2	2	6' w x 60' lng	SR	SR
Primary Clarifiers	38.5 MGD	38.5 MGD	850 gpd/SF 1.68 hr DT	850 gpd/SF 1.68 hr DT	4	4	4	120' dia x 8' SWD	33	58
Trickling Filters	38.5 MGD	38.5 MGD	2.21 lb BOD/cy	2.21 lb BOD/cy	8	8	8	100' dia x 6' depth	60	60
Secondary Clarifiers	22 MGD	22 MGD	865 gpd/SF 2.23 hr DT	865 gpd/SF 2.23 hr DT	4	4	4	90' dia x 10.75' SWD		
B. Activated Sludge Plant										
Mechanical Bar Screens	37.3 MGD	54.6 MGD	2 fps	2 fps	-	2	3	10' w x 5' SWD	SR	SR
Aerated Grit Chambers	37.3 MGD	54.6 MGD	4 min DT 5 cfm air/ft	4 min DT 5 cfm air/ft	-	2	3	38' x 16.5'x11' SWD	SR	SR
Parshall Flume	13-68 MGD	20-103 MGD			-	1	1	120" throat	NR	NR
Primary Clarifiers	37.3 MGD	54.6 MGD	729 gpd/SF 2.46 hr DT	800 gpd/SF 2.24 hr DT	-	3	4	227.5x75'x10' SWD	33	60
Raw Waste Pumps	13-68 MGD	20-103 MGD			3(1)	4(1)	6(1)	17.28 MGD	-	-
Trickling Filter Effluent Pumps	14-35 MGD	14-35 MGD			3(1)	3(1)	3(1)	17.28 MGD	-	-
RAS Pumps	7-44.5 MGD	12-57.5 MGD			3(1)	4(1)	5(1)	11 MGD Existing 12.25 MGD Proposed	-	-
Aeration Basins	59.3 MGD	76.6 MGD	5.74 hr	5.92 hr	5	6	8	75.5'x279'x15'SWD	80	70
Final Clarifiers	59.3 MGD	76.6 MGD	690 gpd/SF 3.38 hr DT	669 gpd/SF 3.49 hr DT	6	6	8	135' dia x 13' SWD		
Chlorine Contact Zone	110 MGD Max	135 MGD Max	20.2 min DT	16.46 min DT	2	2	2	Tanks 165.75'x35'x12'	NR	NR
					2	2	2	Outfall 72" dia x 1186'		
Blowers	86,900 ACFM	121,660 ACFM	1495 SCFM/ lb BOD_5	1517 SCFM/ lb BOD_5	7(1)	10(1)	14(1)	8690 ACFM	-	-
C. Sludge Handling										
Primary Anaerobic Digesters(2)	75,000 lb solids/day	96,000 lb solids/day	41.4 days DT	32.4 days DT	5	6	6	75' diax22.5' SWD	-	-
WAS Thickeners(3)	45,000 lb/day	60,000 lb/day	21 lb/day SF	21 lb/day/SF	0	3	4	30' dia	-	-
Aerobic Digesters	45,000 lb/day	60,000 lb/day	14.7 days DT	14.7 days DT	0	3	4	60' diax25' SWD	-	-
Mechanical Dewatering	37 tons/day	48 tons/day	Type to be selected based on market and pilot testing @ design							

(1) Plus 1-spare
(2) Secondary digesters same size
(3) Based on dissolved air flotation
* NR - no reduction
SR - slight reduction



CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

FLOW SCHEMATIC OF PROPOSED TREATMENT FACILITIES, PLANT NO. 2

FIGURE 4-3

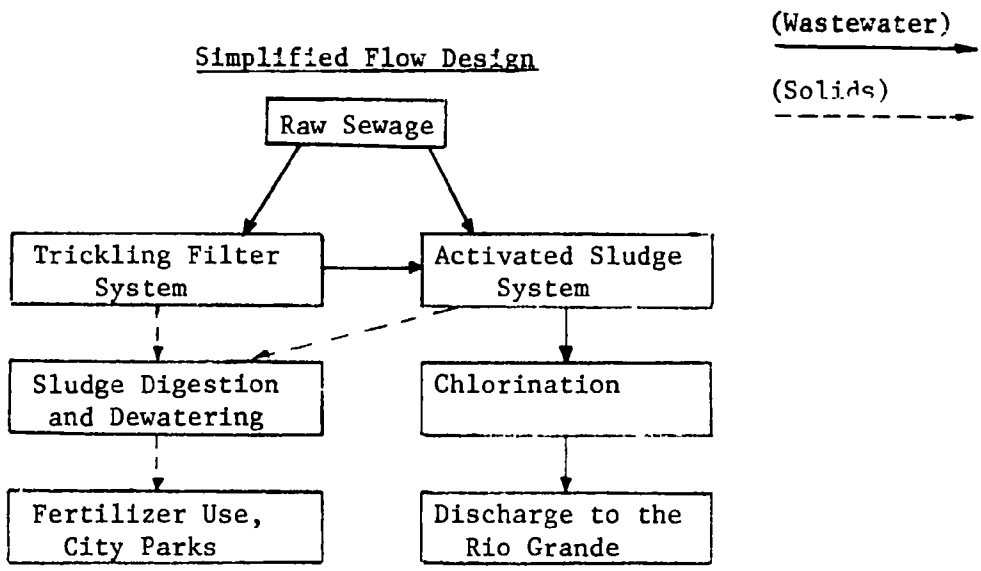


Figure 4-4 shows the physical layout of Plant #2 as it will appear after each expansion. The figure, which is taken directly from the Facility Plan, does not reflect implementation of emergency odor-control measures in Phase IA; a diagram showing the location of these improvements is given in CDM (1977).

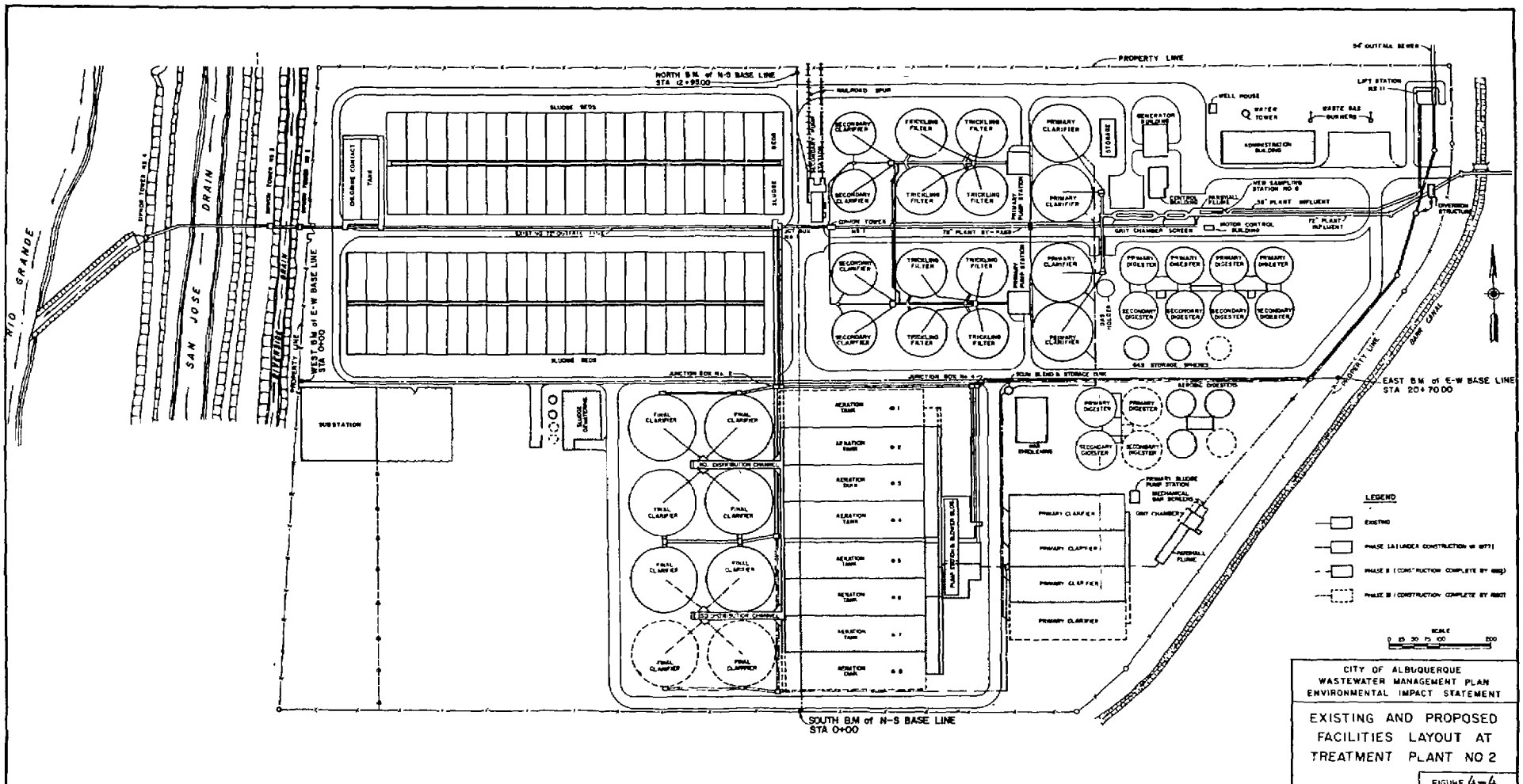
All expansions of the treatment works will rely upon activated sludge and chlorination to achieve NPDES permit requirements. Table 4-6 indicates the effluent quality that is expected to result from these processes, and the amount of potential pollutants which will be discharged to the Rio Grande in 2000. The proposed sale of 1 mgd of effluent to Public Service Company will be implemented at such time as a contract is negotiated with the utility. This action, which is expected to have a construction cost of $478,000, is not included in a particular phase nor reflected in any of the figures or tables.

The proposed actions involve extensive modifications to solids handling facilities, including use of new processes such as sludge thickening, mechanical dewatering, aerobic digestion and scum collection. As at present, dried sludge will be used in City parks as a fertilizer/dressing. Existing facilities for recycling of digester gas will be expanded, so that all gas is utilized to generate electricity for in-plant use.

A number of proposed actions or alternatives are to be reevaluated over the next 20 years, including: the use of ozone instead of chlorine for disinfection; the use of aerobic digesters; advanced treatment for nitrogen or phosphorus removal; and thermoradiation of sludge. As a contingency in the event advanced treatment facilities are needed, the Facility Plan proposes that the City acquire at least 25 acres of land adjacent to Plant #2. The prospects for wastewater reuse, including land application, will be reevaluated as new information becomes available.

4.2 ACTIONS REGARDING ODORS, NUTRIENTS AND METALS

This section summarizes the proposed actions which are addressed to the major environmental problems identified by the Stipulation: odors, nutrients and metals.



CITY OF ALBUQUERQUE
WASTEWATER MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT

EXISTING AND PROPOSED FACILITIES LAYOUT AT TREATMENT PLANT NO 2

FIGURE 4-4

TABLE 4-6. PROJECTED CHARACTERISTICS OF ALBUQUERQUE'S WASTEWATER IN THE YEAR 2000 (if proposed actions are implemented). Based on engineering analysis (MMC, 1977). Values marked by an asterisk (*) will exceed 1975 discharge levels--generally by a small amount.

Parameter	Concentration in influent (mg/l)	Concentration in effluent (mg/l)	Total mass discharge (tons/year,maximum)
BOD	142	10-15	1750
COD	466	40	4650
Suspended Solids	88	10-15	1750
Total Nitrogen	31	5-10	1200
Total Phosphorus	11	7-8	925
Dissolved Oxygen	0	2+	200+
Arsenic	< 0 01	< 0.01	1 or less
Barium	0.185	0.084	10
Boron	0.519	0.544	63*
Cadmium	< 0.003	< 0.003	< 1
Chromium	0.03	< 0.015	2
Copper	0.085	0.024	3
Lead	0.066	< 0.023	3
Manganese	0.04	0.04	5*
Mercury	< 0.002	< 0.002	< 1
Molybdenum	< 0.001	< 0.001	< 1
Nickel	0.026	0.026	3*
Selenium	< 0.01	< 0.01	1 or less
Silver	0.017	< 0.007	< 1
Zinc	< 0 21	< 0.1	12*
Fecal Coliforms (colonies/100 ml)	10^7 +	< 200	--

Odors. Odor sources and controls are discussed in MMC (1977) and CDM (1977). Of interest are: actions taken in response to the Stipulation; emergency operational measures; Phase IA expansion; emergency additions to Phase IA; Phase II expansion.

Actions Taken in Response to the Stipulation. The Stipulation addressed the need to control five major sources of odors at Plant #2 which were significant in 1973. The City has accomplished the required controls for some sources, and is in the process of implementing the other measures. It is the position of the City that the odor problems identified in the Stipulation are no longer significant, with one exception - summer pumping to sludge drying beds. The Stipulation provided that minimal pumping would occur in summer (May 15 - September 15), but because of the recent sludge handling problems at Plant #2, such pumping is essential to avoid even greater odor problems which would occur if the sludge were stored in digesters over the summer.

Emergency Operations. In 1977 the City will initiate or continue a number of operational procedures which are intended to minimize the risk for a repeat of the gross odor problems which occurred in 1976. These measures inlcude digester cleaning, hauling of liquid sludge to a landfill, and direct discharge of trickling filter effluent to the Rio Grande. Even with these actions, it is expected that the potential for severe odor problems at the Plant will remain significant.

Phase IA. Expansion of the activated sludge facilities at Plant #2 is expected to improve on operational flexibility and decrease the volume of waste activated sludge which requires treatment. Consequently, by the end of 1979 a major factor contributing to the potential odor problems will be solved.

Emergency Construction during Phase IA. The first odor control actions specifically proposed by the Facility Plan relate to measures which should be incorporated into Phase IA in order to resolve all the problems which contributed to the critical odor situation of 1976. The measures include facilities for sludge thickening and drying, and mechanical screening. The thickener units are most important, and the City intends to initiate design and construction of such units prior to completion of the Plan. This should enable odor problems to be significantly reduced by the summer of 1978. The remaining facilities will be included in Phase IA, and should further reduce odor problems by the end of 1979.

Phase II Expansion. Phase II will implement the requirement of Best Practicable Odor Control Technology by resulting in a Plant in which all facilities: a) involve an aerobic or oxidation process; or b) are capable of oxidation by chemical additions; or c) are capable of being enclosed, with collection and treatment of odorous gases. These measure will be in accord with odor-control technology described by EPA (1976a). In particular, Phase II will provide for the following improvements which will have significant odor control benefits: mechanical dewatering of sludge, and elimination of drying beds; improved pretreatment of influent; renovations to existing facilities; possible use of aerobic digesters for waste activiated sludge; provision of scum collection equipment; abandonment of Plant #1. Expansion of Plant #2 to a 59 mgd capacity will further improve operational flexibility, and should minimize odor-causing system upsets and problems which occur when units are taken out of service for maintenance and repairs.

It is anticipated that reasonably "odor-free" conditions will exist by about 1983, after which the only odor at Plant #2 will be a normal, mild and musty smell which is not offensive. However, rare odor-causing upsets of the system will always be a potential problem.

Nutrients. The analysis given in this EIS and by EIA (1976) indicates that no benefits from nutrient removal can be identified at this time. Should nitrogen treatment be required in the future the Facility Plan proposes that a nitrification-denitrification system be added on the activated sludge facilities. Should phosphorus removal become a requirement, alum precipitation is proposed. In either case, it will be appropriate to reevaluate the prospects for land application of effluent/river mixtures in the MRGCD.

Metals. To meet the metals standards set in the Stipulation, the proposed action is to rely on activated sludge treatment. To reduce metals levels in sludge, the liquid waste ordinance will continue to be enforced, with emphasis on sources which contribute a large mass of toxic metals to the sewerage system.

4.3 PRIORITIES

The priority schedule for implementing proposed construction is given in Table 4-7, and indicates that total expenditures of $46,741,700 will be required by the year 2000. It is possible that odor control actions included within Phase II, and scheduled for completion by 1983, will be accomplished sooner if funds are available.

4.4 QUALITY ASSURANCE FOR DESIGN AND CONSTRUCTION

EPA will take measures to assure that high standards of design and construction apply to the proposed facilities. These measures will include a value engineering analysis and inspection services of the U.S. Army Corps of Engineers.

The design of facilities which are projected to cost more than $10 million in total will undergo a value engineering analysis. The total cost of Albuquerque facilities will exceed $10 million, and the EPA thus intends to require a value engineering analysis even though the project will be phased. The analysis will involve a review of the project design made by members of a five or six member team. Each team member is a specialist in one of the disciplines involved in the design of the project. The goal of the analysis is to improve the operability of the project facilities, and to reduce construction costs.

The EPA has recently entered into an agreement with the U.S. Army Corps of Engineers which provides that the Corps will conduct interim construction inspections for the EPA on wastewater treatment plant projects. These inspections will be conducted at least quarterly and will include construction quality and construction management. More frequent inspections may be conducted if necessary.

4.5 OPERATION AND MAINTENANCE

CDM (1977a) outlined specific steps which need to be taken by the City of

Albuquerque in order to achieve reliable, consistent and proper operation and maintenance (O&M) of the wastewater system. These measures are in addition to the emergency steps already discussed. At the Public Hearing held July 20, 1977, the City indicated its basic commitment to take the necessary steps. The most important measures will be:

- repair and rehabilitation of all process equipment which is not operating as desired;
- continued adjustment of the treatment process to achieve stable operation;
- increased use of laboratory data to monitor treatment process;
- probable operation of Plant #1 as a primary treatment facility, until such time as it is razed.

Even more critical are the recommendations made regarding reorganization, including provision of additional staff and budget, improved record keeping, and increased staff training.

EPA will take a number of positive steps to ensure that the City accomplishes the goal of good O&M. These include: requirements for a plan of operation, provision of technical assistance, requirements for an operation and maintenance manual, enforcement of the NPDES permit, requirement for an adequate user charge, requirement for State monitoring, and provision of technical assistance.

A draft Plan of Operation will be required at the conclusion of the design phase of any major expansion of the facilities, such as the Phase II expansion. As a minimum this plan shall include: provisions for an adequate budget and properly trained management; operation and maintenance personnel sufficient to accomplish proper O&M of existing and proposed facilities; provisions for responding to emergency operating conditions; provisions for proper routine reporting of operational conditions; and provisions for laboratory testing adequate to determine removal efficiencies. A final Plan of Operations will be required at 50% completion of facility construction. Copies of the Plan will be made available for public inspection at City offices, and EPA will release an announcement of this availability to the press and to organizations which indicate an interest in inspecting the document.

A detailed operation and maintenance manual will be required for all facilities. The draft will be required at 50% of construction, the final at 90% of construction. The document will be made available for public review under the same provisions as discussed above for the Plan of Operation.

Operation and maintenance which significantly departs from acceptable levels can be expected to lead to violation of NPDES permit conditions. EPA will enforce the permit, and in the event of operation-caused violations will use its authority to see that the problems are fully resolved.

EPA will require that the City institute an adequate user charge system, as described in Section 3.8. This will ensure that budgetary resources are sufficient for the necessary O&M activities; wastewater management will no longer compete with other elements of the municipal budget for operating funds.

The State of New Mexico will be required to continue its monitoring and inspection activities. It can be expected that inadequate O&M will lead to

appropriate State inspection reports and actions.

EPA will continue to provide technical assistance, especially in the form of technology transfer seminars and programs which will familiarize design and operating personnel with proper operation and maintenance techniques.

Each of the above actions will address at least part of the O&M problems which could occur in Albuquerque. The actions will ensure that O&M has adequate funding, that proper procedures for O&M are spelled out in a Plan of Operation and O&M Manuals, and that permit standards and annual State inspections are used to enforce diligent operation and maintenance of the City facilities.

The above actions do not address all O&M measures which might be necessary to achieve Best Practicable Odor Control. An existing mechanism for addressing such measures is the Odor Committee formed under the terms of the Stipulation. This committee is empowered to address any and all problems which give rise to objectionable odors, and is considered the appropriate tool to address odor control.

TABLE 4-7 PRIORITY & IMPLEMENTATION SCHEDULE FOR FACILITY PLAN RECOMMENDATIONS

Approximate Year of Completion		See Map(s)*	Construction Cost (3)	Portion Ineligible	Eligible Costs (4) Federal Share 75%	State Share 12-1/2%	Total City Share(4)
1978	Phase I-A Treatment Plant Expansion (City CIP Project 71235)	H	$ 3,064,000 (5)	$ 838,400	$1,669,200	$ 278,200	$ 1,116,600
	Line 142A Capacity Increase (2nd St. Interceptor from Rio Bravo to Plant 2)	H	490,300	-0-	367,700	61,300	61,300
	Line 101 Extension (Tijeras Canyon Phase V-A, City CIP Project 73239)	P & Q	1,203,400	-0-	902,600	150,400	150,400
	Four Hills Interceptor - Line 403 (Tijeras Canyon Phase II)	N & O	942,500	-0-	706,900	117,800	117,800
	Northwest Mesa Lift Stations 24 & 25 (City CIP Project 70223-Part)	J	112,000 (1)	-0-	84,000	14,000	14,000
	Lift Station Alarm System (City CIP Project 70223-Part)	NA	57,000	-0-	42,800	7,100	7,100
	Land for Future Plant Expansion (City CIP Project 70228)	H	62,500	62,500	-0-	-0-	62,500
	Total 1978		$ 5,931,700	$ 900,900	$3,773,200	$ 628,800	$ 1,529,700
1980-1981	Line 104 Capacity Increase (Near Menaul and Juan Tabo)	P	$ 30,800 (2)	$ -0-	$ 23,100	$ 3,850	$ 3,850
	Line 113 Capacity Increase (Near Lomas and University)	I	19,100 (2)	-0-	14,300	2,400	2,400
	Line 119 Capacity Increase (on Comanche between San Pedro & Pojoaque)	J	49,800 (2)	-0-	37,400	6,200	6,200
	Line 25 Relief (near 2nd & Griegos)	J	57,400	-0-	43,100	7,150	7,150
	Lift Station 20 Capacity Increase	H	190,000 (1)	-0-	142,500	23,750	23,750
	Northwest Mesa Interceptors 304 & 305 (Includes CIP Project 66199-Westside Interceptor Phase III, Section 3A)	J & K	1,430,500	-0-	1,072,900	178,800	178,800
	North Valley Phase I(includes Interceptor 380 to LS No. 19)	J	1,106,400	-0-	829,800	138,300	138,800
	South Valley Interceptors & Collection Sys.						
	a) So.Valley Phase I, Priority 2 Area Intercep.390,391,392,393,394 & Collection Lines	H & I	2,816,500	-0-	2,112,400	352,050	352,050
	b) Mountainview Area(Interceptor 389 and Collection Lines	C & H	848,800	-0-	636,600	106,100	106,100
	c) Remainder of W. So. Valley No. of Gun Club Road(Interceptors 395, 396,397 and Collection Lines)	B,C & H	937,000	-0-	702,800	117,100	117,100
	Lift Station Standby Power & Metering System	NA	74,000	-0-	55,500	9,250	9,250
	Conversion of Odor Control Stations	NA	209,000	-0-	156,800	26,100	26,100
	Collection System for North Industrial Park	J	362,500	-0-	271,900	45,300	45,300
	Collection System for 46000 Central N.W., Crescent N.W. & Riverview S.W.(Replacement)	I	73,800	-0-	55,400	9,200	9,200
	Total 1980		$ 8,205,600	-0-	$6,154,500	$1,025,550	$1,025,550
1982	Line 105 Capacity Increase (Hannett Pl. between Eubank & Parsifal)	O	$ 79,000 (2)	-0-	59,300	$ 9,850	$ 9,850
	Expand Lift Station No. 5	I	13,000	-0-	9,800	1,600	1,600
	Total 1982		$ 92,000		$ 69,100	$ 11,450	$ 11,450

TABLE 4-7 (Cont'd)

Approximate Year of Completion		See Map(s)*	Construction Cost (3)	Portion Ineligible	Eligible Costs (4) Federal Share 75%	State Share 12-1/2%	Total City Share(4)
1983	Expand Treatment Plant No. 2	H	$11,654,500	$ 478,000	$8,382,400	1,397,100	$1,875,000
	Raze & Salvage Treatment Plant No. 1	I	300,000	-0-	225,000	37,500	37,500
	Facilities for Sale of Effluent to PNM	H	478,000	478,000	-0-	-0-	478,000
	Total 1983		$12,432,500	$ 956,000	$8,607,400	$1,434,600	$2,390,500
1985	Line 103 Capacity Increase (On Comanche from Moon to near Juan Tabo)	P	274,200 (2)	$ -0-	$ 205,700	$ 34,250	$ 34,250
	Line 112 Capacity Increase (On Eubank from LaMesa-Central)	O	128,600 (2)	-0-	96,500	16,050	16,050
	Line 113 Capacity Increase (Near Lomas and University)	I	15,600 (2)	-0-	11,700	1,950	1,950
	Northwest Mesa Interceptors 302, 303, 306 and 307	K	1,367,600	-0-	1,025,700	170,950	170,950
	North Valley Phase II (Interceptors 381, 382,383,384,385,386 & Collection Lines)	J & K	2,549,400	-0-	1,912,100	318,650	318,650
	Collection System for E. South Valley	H	483,800	-0-	362,900	60,450	60,450
	Line 400 (to serve No. Albuquerque Acres)	Q	213,700	-0-	160,300	26,700	26,700
	Total 1985		$ 5,032,900	-0-	$3,774,900	$ 629,000	$ 629,000
1990	Expand Treatment Plant No. 2	H	$ 5,563,400	-0-	$4,172,600	$ 695,400	$ 695,400
	Expand Lift Station 20	H	200,000	-0-	150,000	25,000	25,000
	Line 132 Capacity Increase (on I-25 from San Francisco to Palomas)	K	76,700 (2)	-0-	57,500	9,600	9,600
	Line 142 Capacity Increase (Anderson Ave @ ATSF RR)	I	25,000 (2)	-0-	18,800	3,100	3,100
	Northwest Mesa Interceptors 308 and 309	J	569,900	-0-	427,400	71,250	71,250
	North Valley Phase III (Interceptors 387, 388, 369, 370 and Collection Lines)	K	2,930,900	-0-	2,198,200	366,350	366,350
	South Valley Interceptors 395,396,397, 398,399 and 399a	B,C & H	2,436,000	-0-	1,827,000	304,500	304,500
	Total 1990		$11,801,900	-0-	$8,851,500	$1,475,200	$1,475,200
1995	North Valley Phase IV (Interceptor 371 and Collection Lines)	K	$ 1,019,600	-0-	$ 764,700	$ 127,450	$ 127,450
2000	Candelaria Industrial Park Collection Sys.	J	$ 2,225,500	-0-	$1,669,100	$ 278,200	$ 278,200

(1) Cost includes stand-by power
(2) Cost given is cost to parallel existing line. Cost to replace line is higher. See Facility Plan text.
(3) Costs include engineering, legal and contingencies @ 16% of construction cost and interest during construction @ 6-1/8% of 50% of all costs.
(4) Eligible costs and total City share based on existing regulations which may change & presume availability of funds.
(5) City budget amount - Estimate not presented in Facility Plan.

* Refer to Volume 2 of the Facility Plan

5. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

The environmental consequences of the actions described in Section 4 were discussed in Section 3 as part of the evaluation of alternatives. These impacts are summarized in this section in order to provide a concise description of the implications of the proposed actions. Measures which may be taken to mitigate or reduce the impacts are also identified. The discussion refers to impacts in four categories: short-term (5.0), construction impacts (5.1), long-term (5.2) and secondary (5.3).

5.0 SHORT-TERM IMPACTS

The proposed actions will result in two types of impacts of a short-term nature. First, existing adverse environmental conditions caused by wastewater management in the area will continue until such time as the proposed actions are implemented, that is for a period of three to twenty years. Second, construction of the proposed facilities, especially sewers, will result in a number of localized impacts such as noise, dust, traffic disruption and dewatering; these are set forth in Section 5.1.

Because the proposed actions are intended to provide substantial long-range benefits with minimal adverse long-term consequences, the short-term impacts represent the most significant negative effects of the proposed wastewater management system.

Continuation of Existing Impacts. The lack of adequate sludge-handling facilities at Plant #2 is largely responsible for severe odor problems in the surrounding neighborhood. The potential for such problems to occur will continue until 1979 when the proposed Phase IA expansion of Plant #2 is implemented, including facilities for sludge thickening. "Odor-free" conditions will not be achieved until completion of the Phase II expansion, in 1983. Odor problems at Plant #1 will continue until the facility is razed in 1983. Proper operation and maintenance at the Plant should limit odors to the level now experienced, and prevent any significant nuisance.

Ground water contamination from on-site systems which operate under adverse density and/or soil conditions will continue in areas designated for sewerage service, until such service is provided. For parts of the area sewers will be provided within 5-10 years; elsewhere they may not be available until 1995. Until the service is provided, it can be expected that chronic low-grade nitrate contamination will occur in the shallow alluvium beneath the Rio Grande floodplain. Other problems possibly associated with this contamination would remain, including iron and manganese pollution, potential public health hazards, and financial disadvantages to valley-area homeowners.

5.1 CONSTRUCTION IMPACTS

The process of installing wastewater facilities, especially interceptor and collector sewers, is often a source of unavoidable adverse environmental impacts of a temporary and localized nature. These impacts are discussed as follows: general characteristics; problem areas; environmental protection measures; and specific impacts and mitigation measures.

5.1.1 General Characteristics

Sewer construction normally involves a sequence of actions, the most significant of which are: surface disturbances, such as by breaking pavement; excavation of a deep but normally narrow trench (less than 10 feet wide); laying of pipe and refill of the trench with necessary compaction and restoration of the original surface. Associated activities include moving of equipment to and from the site, and on-site storage of equipment, pipe and excavated fill. The duration of the sequence at any one site varies according to construction schedules, from a minimum of 5-10 days to a normal maximum of about two months. During much of this period the site is inactive. The most intense activity occurs during the period of trench excavation and refill, each normally accomplished within one or two working days. More prolonged construction can occur when sewer installations are combined with other utility installations.

Major impacts from construction include:

-dust and erosion (throughout the period of construction);
-equipment noise and emissions (during active periods only);
-traffic and utility disruption (especially during active periods);
-possible disturbance of archeological, historical and biological resources (primarily at the time of initial surface disturbance and/or excavation);
-dewatering (during excavation in areas with a shallow water table).

Other impacts which may be locally significant include: blasting, odors, relocation of utilities, and acquisition of easements on private property. In addition, construction involves impacts of a general nature, such as consumption of resources and generation of solid wastes.

5.1.2 Problem Areas

The proposed construction activities will take place in four types of situations, each with its own set of environmental constraints.

a) Most of the proposed sewer lines will be installed beneath existing streets -- main thoroughfares and paved and unpaved side roads. The vast majority of these lines occur in valley locations which are characterized by narrow streets, many unpaved and/or dead-end streets, relatively dense settlement, and frequently congested traffic conditions. Thus impacts such as dust, noise and traffic disruption are of special concern. The valley locations are also typified by a shallow water table and many canals and drains. Dewatering is normally necessary, and special measures must be taken when crossing irrigation structures.

b) Most of the remaining sewer lines, especially in mesa locations, are expected to follow an existing or proposed right-of-way along a dedicated but unbuilt street, or along another utility easement. It is likely that construction would precede full development in these areas, and it is probable that in some cases construction will alter a previously undisturbed surface. Specific impacts cannot be identified now because detailed routes will not be determined until each line is designed. However in general impacts such as noise or traffic disruption would be much less than in the valley. There

would be an increased potential for disturbance of archeological or biological resources.

c) Two major interceptors will be located in arroyos. These lines, in Tijeras and Calabacillas Arroyos, would have impacts similar to the mesa lines but with increased special problems associated with flood and erosion hazards, and with the local need for rock excavation.

d) In addition to sewer construction, wastewater facilities will be added at Plant #2 and razed at Plant #1. All activity will be within the existing plant sites, and thus relatively minor impacts on the general public would be expected, with the exception of possible local dewatering effects. Impacts associated with renovation of odor control and lift stations would be very localized and minor.

For the planning area as a whole, approximately 103 miles of new sewer lines will be installed by the year 2000. About half of this amount would be built in the 1980's; the maximum rate of construction would thus be about 5 miles per year.

5.1.3 Environmental Protection Measures

Construction impacts will be significantly reduced by careful planning and selective use of measures which control or eliminate potential problems. The City will develop a site-specific environmental protection program during the design of each construction project. This approach will enable the program to be responsive to specific site problems, and will allow the latest environmental control technology to be utilized (Riggins et. al., 1975).

There are several steps which will be taken to develop and implement the environmental protection measures. First, the proposed project will be evaluated to determine the significance of the various impacts. For example an archeological survey may be performed to identify sites to be salvaged or avoided; or a traffic survey may identify an area where disruption is of special concern. Second, if practicable the siting of the proposed sewer or other facility will be adjusted in order to minimize adverse impacts. Third, guidelines to be followed during the construction project will be set forth in bid specifications and the construction contract. Fourth, the selected contractor will develop any environmental protection plans required by the contract guidelines. Finally, inspection procedures will be utilized to ensure that the guidelines are followed out. A special step appropriate to Albuquerque will be to utilize the municipal excavation ordinance as a mechanism for reviewing and improving contractors detailed plans, and for enforcing any provisions of those plans.

Throughout the process outlined above, it is important to determine that the measures being taken are cost-effective . This can be accomplished by using flexible contract specifications which establish performance criteria for the contractor, but allow discretion in the selection of control techniques. Also, the extent of protection must be adjusted to the project, with the most stringent regulations being applied to large projects and/or those located in especially sensitive areas.

Specific impacts and mitigation measures are reviewed in the following sections. A control technique which applies to almost all impacts is to manage the extent of construction to limit the duration of impacts at any one site. This is commonly accomplished by restricting the length of an open trench to the distance between manholes (a maximum of 400-500 feet); in some cases the length of disturbed areas ahead of and behind the trench may also be specified. Since the trenching phase of a project is relatively brief and tends to move rapidly along the line, these restrictions normally ensure that the nuisance impacts of construction are short-lived at each particular location. Another useful technique is the provision in the excavation ordinance which calls for penalties when a street cut is reopened within a three-year period. Over the long term, this should minimize the amount of construction activity at any one location. Another technique is to parallel sewer construction with the activities of other agencies. For example, the proposed interceptor capacity increase on Juan Tabo south of Menaul in about 1980 (line 104, Table 3-5) should be coordinated with the upcoming highway project M-4065 (1) for the reconstruction of Juan Tabo Blvd.

5.1.4 Dust and Erosion

Dust may be generated at a construction site by soil disturbances and vehicle movement, by wind erosion of excavated material, and by operations such as concrete mixing and blasting. Construction dust is a nuisance material which causes annoyance, soiling and, in some cases, impaired local visability. Albuquerque has a relatively dusty environment so that in some cases no special dust control measures will be needed. However, if a large dust source is created near a residential area or major thoroughfare, positive dust control will be obtained through: a) spraying loose and erodible material with water during construction; and/or b) mulching and reseeding of a surface which had a natural plant cover prior to construction. Where reseeding is deemed necessary, it is generally preferable to use native grasses which do not require significant amounts of irrigation, and which will flourish once established. If dust control measures are not specified in a construction contract, they will be required as part of the dust control plan which is prerequisite to issuance of an excavation permit in Albuquerque.

Erosion is generally not a problem at most Albuquerque sewer construction sites because of gentle natural slopes. However, lines which lie in or cross an arroyo may be affected by storm runoff, with resulting erosion damage. Because the normally dry arroyos are naturally silt-laden during floods, the eroded material would not be expected to cause special environmental impacts but would add to the aggradation or clean-up associated with flooding in the area. The potential erosion will be limited by siting lines outside flood-prone areas to the extent feasible, and by eliminating any activity which would lead to unnecessary damage to an arroyo bank. If prolonged exposure to runoff hazards is anticipated during the summer thunderstorm season, it may be necessary to build small temporary structures for diverting flows around a site and/or for collection and desilting of flows from a site. After construction it is conventional practice to grade a slight mound along any line which is not in a street right-of-way. This provides positive drainage away from the bare area, and reduces the potential for erosion. If this is not considered adequate at a particular site, mulching and/or reseeding may be required. Refer to DWR (1972) and EPA (1973) for further information on erosion control planning.

To avoid erosion damage to a completed sewer in an arroyo crossing, it is generally necessary to provide positive protection against flood flows. Measures such as sheet piling and encasement in concrete will be used to stabilize the sewer line and prevent undercutting. None of the dust and erosion control measures noted above, nor the original construction activities, would be expected to lead to any significant long-term alterations in the landscape, or to a change in the character of a natural drainageway.

5.1.5 Noise and Vibration; Equipment Emissions

Noise levels typically found at a sewer construction site were discussed in Section 2.2.5. Within 50 feet of active equipment, levels of 65-80 dBA would be expected to occur throughout the work day, with peaks to 85-90 dBA. These levels would be lowered by at least 6 dBA with each doubling of distance from the site and a greater amount where the site is screened by vegetation or buildings. Vibrations could be associated with use of some equipment and operation of pumps for dewatering may involve noise generation during night-time periods. The noise will be experienced for only a few days at any one location, and will normally occur along roadways where traffic noise already occurs. The primary impacts will be an increase in public annoyance, possible interference with speech (e.g. at a school), and possible interference with daytime sleeping. Based on present plans, there would be no significant impact on any major medical facility.

Enforcement of Albuquerque's excavation and noise ordinance will be effective in controlling noise problems by restricting work to the hours between 7 a.m. and 7 p.m. under normal circumstances, and by requiring that all construction equipment utilize noise control equipment equivalent to that installed at the factory. More strict requirements could be considered for construction in sensitive areas, such as where houses are sited near a narrow street. For example, a contractor could be required to meet Federal standards for new equipment, such as the standard for air compressors of 76 dBA, or to provide air-exhaust mufflers for pneumatic tools. References such as Schomer & Homans (1975), contain additional information on noise control.

The exhaust from gasoline or diesel-powered equipment is the main source of air pollutant emissions at most construction sites. Emissions will be small compared to regional quantities, and would mainly have a localized impact during periods when air ventilation is poor. Fumes and odors might reach an annoyance level, but strict enforcement of OSHA (Occupational Safety and Health Administration) standards to protect construction workers should protect area residents against health impacts, although annoyance and irritation may occur. An additional measure which could be considered for sensitive sites would be to specify that all equipment used by a contractor be subjected to an exhaust inspection by the City and adjusted or retrofitted to meet pertinent exhaust standards.

5.1.6 Traffic and Utility Disruption

Sewer construction generally restricts traffic flow when lines are placed in street rights-of-way. Street closings commonly occur, especially during excavation period. Impacts resulting from traffic disruption include: inconvenience to those who use the affected street, especially if the street is used to provide access to homes or businesses; a temporary decline of business at commercial establishments; and increased noise and vehicle emissions on nearby streets which receive rerouted traffic.

A variety of measures will be used to maintain traffic patterns near normal levels, and minimize these impacts. The most important is to control the size of the affected area by limiting trench length. Other measures include: restrict equipment movement to only a portion of the roadway, and use flagmen to aid traffic movement; restrict active construction so that no more than one intersection is crossed at one time, and for no more than one day at a time; if necessary, cross major intersections one-half at a time; block dead-end streets for no more than one day at a time, or cross one-half at a time; bore beneath major thoroughfares, such as state highways; provide pedestrian crossings at intervals of no more than 300 feet; mark all sites with adequate signals, barriers, signs and lights, especially if a trench segment is left open overnight; and develop a public relations program to advise the public of the anticipated traffic disruptions.

When excavated trenches cross underground utilities, such as gas and water lines, it may be necessary to interrupt service for a brief period, or to relocate the other utilities. To minimize the effect of utility disruption, contractors are normally required to determine all utility locations along the sewer right-of-way, and to take steps to ensure coordinated activity at the construction site. Only utility owners are permitted to undertake relocations.

5.1.7 Disturbance of Archeological and Biological Resources

A review of the National Register of Historic Places indicates that no properties included in or eligible for inclusion in the register will be affected by the proposed action. Museum and library records were reviewed and it was found that some sites might be disturbed by project construction, but that the nature of such disturbances could be determined only at such time as a particular project reached the detailed planning and design phase. Additional historical and archeological resources may be found in the area, and also potentially disturbed by construction activity.

EPA will require the City to perform an archeological reconnaissance survey during the design phase of each construction project to determine if any archeological and/or historical resources will be affected. The survey shall be performed as soon as the tentative right-of-way of the construction is known, in order to permit rerouting, if necessary. When any identifiable archeological and/or historical resources are discovered, they will be evaluated in accordance with the "Procedures for the Protection of Historic and Cultural Properties", as published in the Federal Register (36 CFR, Part

800). This requirement will be a grant condition; the Advisory Council on Historic Preservation will be allowed to comment on this grant condition.

Some archeological resources not identified during project design may become evident during construction, especially when they are buried, and are found only upon excavation of a trench. Should any resources be discovered during construction, work will be halted until the cultural significance of the materials can be determined and compliance with all applicable laws and regulations can be assured. Copies of the archeological clearance of each project will be filed with the State Historic Preservation Officer, Santa Fe. His letter regarding the overall project, as now planned, is provided in Appendix A to this EIS.

It is not expected that proposed construction would significantly affect biological resources. Sewer lines outside of street alignments would generally cross areas characterized by low-quality grass and shrub vegetation which is presently utilized for grazing purposes or as open space. None of the lines proposed are expected to cross an area of woodland or bosque, or to alter a significant terrestrial or aquatic habitat. The areas which are affected by construction would be expected to be small, and to have little effect on long-term productivity. However, the unaesthetic scars of vegetation removal would be likely to remain for many years, as recovery of the native plant cover would normally be very slow.

A number of measures will be taken to minimize the amount of vegetation removed, and to restore the disturbed land where necessary. These may include: careful marking of the construction site, with prohibition of activity or storage outside designated areas; selection of routes to minimize tree-cutting, and protection of trees outside of the right-of-way; storage of topsoil, and replacement of same atop the completed trench; use of removed vegetation as a mulch on the bared soil, to help protect it from erosion and to provide seeds and nutrients for regrowth; use of sludge on all sites to provide a fertilizer and soil amendment which will improve the potential for long-term regrowth; no use of pesticides, herbicides or defoliants; and reseeding of sites with native grasses which can be readily established without substantial outside sources of water.

In the past the option of reseeding sewer construction sites has not generally been taken. However, in recent years the technology for reseeding disturbed sites has greatly improved, and the need for expensive seeding and irrigation operations has been reduced. Reseeding with native grasses is now a cost-effective alternative for many construction sites. Merkel and Herbel (1973) provide detailed information on the techniques involved, including selection of species, seedbed preparation and seeding, fertilization, and management. Among the more likely species to be utilized are the following: Indian ricegrass (Oryzopsis hymenoides), several types of wheatgrass (Agropyron sp.), bluestem grasses (Andropogon sp.), grama grasses (Bouteloua sp.), buffalograss (Buchloe dactyloides). After a short growing season there should be minimal problems associated with wind or water erosion; in general the reseeded area will be as aesthetic and productive as surrounding areas, if not more so.

Some construction in the valley may affect agricultural lands where irrigated pasture grasses are grown. For such greenbelt sites, the protective measures noted above will be mandatory, and complete restoration of the original ground cover will normally be required. This will be facilitated by stockpiling of topsoil, and immediate reseeding upon completion of construction.

5.1.8 Dewatering

Trenches excavated in the valley will generally intercept the water table. To prevent water from standing in the trenches during construction, it is general practice to pump the water to an irrigation drain or storm sewer. Two types of impacts result. First, the pumping lowers the water table in the vicinity of the trench. Shallow domestic wells near the trench may experience a drop in water levels; in extreme cases the wells may dry up for a short period, and it is possible that pumps could incur permanent damage. Second, the pumped water is normally taken from the contaminated upper portion of the shallow flood plain aquifer. It may contain high amounts of iron and manganese or other dissolved solids, and may also have a slight odor. If the trench is near a cesspool or saturated drainfield, excess bacteria may be found in the water. Finally, the pumping process can result in the water being turbid, with an excessive silt load.

To avoid the adverse impact of water table lowering, it will be necessary to evaluate the extent of water table decline near a trench and to identify all wells along a construction route which may be affected. Well owners will then be advised of the problem, and instructed to utilize pumps on a manual basis only. If a serious water level decline is observed, the contractor will be required to provide an alternate supply until the water table recovers.

The discharge from trench dewatering normally requires permission from the MRGCD, if a drain or canal is used, or the City, if a storm sewer is used. Problems of sediment quality are managed by utilizing sand-point wells which are relatively protected against the influx of silt. Where appropriate, the outfall from dewatering can be designed to minimize erosion from the discharge by minimizing discharge velocity and turbulence. Other water quality aspects of the discharge water are not normally regulated, since the ground water would naturally flow to irrigation drains and the river. Dewatering also requires permission from the State Engineer, but because the pumping is of a short-term nature, no water rights need to be obtained.

5.1.9 Other Construction Impacts

In addition to the effects discussed above, the following are associated with wastewater facility construction:

- Resources will be utilized, including construction materials (pipe, asphalt), energy for equipment operation, labor and capital. Minor amounts of water may also be consumed during dewatering or for dust control and plant reseeding. Overall, this impact has the positive feature of providing a stimulus to the economy, by requiring material production and providing construction jobs.

- A construction site may be unaesthetic, because of the disturbance of the normal scene, the presence of equipment, and the distribution of stored materials and spoil stockpiles. This impact is minimized by following requirements set forth in the excavation ordinance and other regulations, such as by maintaining a trim site, by providing proper facilities for handling of solid and liquid wastes, and by thoroughly cleaning up the site as part of the restoration activity at the end of the project.

- Solid wastes may be generated at a construction site, especially old sewer pipe and excess soil. Where possible, this material will be recycled; the pipe may be used as rip-rap, and soil of good quality can be used as fill. If recycling is not feasible, the material will be disposed of in a sanitary landfill.

- Special care must be taken to avoid spills of any fuels or chemicals stored or used at the construction site. Provision of site security is also necessary, especially where the safety of children would be jeopardized by access to heavy equipment or open trenches.

- Very small and localized blasting may be needed along portions of the two arroyo interceptors, and if the East Mountain contingency plan is implemented. Impacts will be minimized by using matting over the blast site, thus restricting noise, dust and debris. Security measures will be required throughout the period that explosives are being used or stored at the site.

- Construction in valley areas will require that sewers cross irrigation canals and drains. MRGCD requires that such crossings not interfere with flows. Canals can be crossed by cuts in winter, with the hydraulic section being built after construction is complete. During other periods for canals and throughout the year for drains, it is normally necessary to bore beneath the irrigation channel in order to install the sewer line. Proper construction procedures, such as use of jacks and/or concrete encasement, will be used to avoid either short or long-term impacts.

- Bypassing of sewage will be prohibited during construction. Refer to the Facilities Plan for discussion of this matter. Open burning will be prohibited.

5.1.10 Summary

Construction of sewers and other facilities in the Albuquerque area has the potential to lead to significant short-lived adverse environmental impacts, including dust and eroision, noise, vehicle emissions, disruption of traffic and utility service, disturbance or loss of archeologic and biologic resources, dewatering, and others. All the potential impacts will be minimized or eliminated through use of mitigation measures of the type discussed in this document. The City and its contractors will develop site-specific environmental protection plans on a project-by-project basis. These plans will be effected through careful route selection, specifications in construction contracts, and use of procedures outlined in the municipal excavation ordinance.

With proper controls to ensure that the construction impacts are minor, the short-term effects of the proposed action should represent an acceptable environmental cost which must be incurred in order to obtain the benefits of improved wastewater management. Further, construction involves substantial economic benefits by providing jobs and increasing the demand for products such as pipe material and heavy equipment.

5.2 LONG TERM IMPACTS

The direct long-term effects of the proposed improvements to the wastewater management system in Albuquerque are expected to have benefits in terms of improved water quality, odor control, resource use, and other factors. Of special significance is the benefit of providing necessary facilities for the collection, treatment and disposal of wastewater which is projected to be generated in the planning area through the year 2000. These benefits are the justification for the proposed actions. Some possibly unfavorable impacts also occur in the long-term; these include the consumption of resources by the proposed facilities, the generation of wastes, some of which are not recycled, and the fact that not all wastewater problems in the area will necessarily be fully resolved by the proposed actions.

The discussions of long-term impacts concerns effects on water quality and water supply (5.2.1), odors (5.2.2), resource reuse and conservation (5.2.3), health, safety and welfare (5.2.4), and ecology and recreation (5.2.5).

5.2.1 Water Quality, Water Use and Water Rights

Water Quality. Based on Table 4-6, it is reasonable to expect that the proposed treatment system provides considerable protection of water quality in the Rio Grande. There are no adverse water quality impacts which can be reliably predicted to result from the discharge of Albuquerque's wastewater. However, as discussed in 3.1.2, some long-range water quality problems may exist in the Middle Rio Grande Basin, and may require additional analysis in the future. These potential problems are as follows:

- The river standard for fecal coliform will probably continue to be exceeded in the future due to non-point source discharges. As noted below, the extension of sewers and elimination of on-site systems (OSS) may reduce bacteria discharges from the non-point sources, and could result in reduced bacteria levels in the river.

- It is not known at this time whether or not water quality problems in Elephant Butte Reservoir would occur because of nutrients discharged in Albuquerque. The evidence now available does not demonstrate any such problem now or in the future, but continued study of the situation could modify the evidence and lead to a requirement for nutrient control at Plant #2. If so, the facilities can be modified to meet any specification for nitrogen and/or phosphorus removal.

It should be noted that total nitrogen discharges from Albuquerque in the year 2000 will probably be less than in 1975; however, phosphorus discharges will be greater. It is possible that the reduction in nitrogen discharged by Albuquerque will reduce nitrogen in the Elephant Butte Reservoir sufficiently to adversely affect aquatic productivity.

- As discussed in Section 3.1.2, the possibility exists that some contaminants in Albuquerque's effluent may interfere with irrigation use of Rio Grande water during low-flow periods when the ratio of effluent to river water is high. This matter requires further study to determine which contaminants are of concern, and how irrigation practices and/or wastewater treatment can be altered to minimize problems.

- As noted in Section 3.1.2, a long-range potential exists that Albuquerque's wastewater discharge could be associated with salinity problems in the future. The nature of such problems, and any need for treatment, cannot be forecast at this time. The source of the problem is the concentrating effect of beneficial water use in Albuquerque--wastewater is nearly always more saline than the original water supply. Under present State policy, normal increases in salt concentration from beneficial water use are considered an acceptable degradation of water quality, and would not be subject to a treatment requirement.

The proposed actions should improve ground water quality by reducing water pollution caused by on-site systems. The extension of sewers will cause many OSS to be eliminated. By 1985 it is projected that only 11,500 OSS will remain in the planning area; this will reduce to 9,000 in the year 2000. Moreover, stricter controls over the OSS which remain should lead to an upgrading of on-site treatment. Most of the OSS which occur in the year 2000 will be installed after the Facility Plan recommendations become effective. Thus all should meet modern standards as to construction, installation and lot size. If adequate upgrading is not accomplished, then consideration would be given to adoption of more stringent regulations to control OSS.

The major effect of reducing pollution from OSS is that the present pattern of increasing contamination of shallow ground water beneath the Rio Grande floodplain should be slowed or reversed. This will not mean that the shallow ground water will become uncontaminated in a short time, because ground water quality recovery is a slow process, and other sources of pollution remain a concern. However, the deeper aquifer, which is the source of Albuquerque's municipal supply, should be protected from the gradual downward migration of the upper polluted zone. With time, some improvement in shallow ground water quality would be expected. This should be reflected in improved surface water quality in irrigation drains and in the Rio Grande.

A substantial benefit of extending sewers and regulating OSS is that existing unsanitary situations should gradually be eliminated. The incidence of health problems related to unsanitary conditions would be expected to decrease, and the improvement in public health would be expected to reap many socio-economic benefits (see 5.3.2). Another benefit is that the overall discharge of pollutants to the environment will be decreased. This

is because the degree of treatment obtained by cesspools and septic tank drainfield systems is small in situations such as Albuquerque, where lots are often small and the soil is saturated by a shallow water table. Conversely, activated sludge treatment followed by disinfection is very effective in removing the pollutants which would not be controlled by OSS.

Other elements of the proposed actions are not expected to affect water quality. The best available data indicate that nutrients and metals which occur in sludge used on City parks will be used by park grass and/or taken up in the soil, without leaching to ground water. Application of the sludge in winter or early spring, as at present, should protect the freshly applied sludge from storm runoff. Sewers are to utilize permanent materials; leakage is expected to be negligible.

The proposed actions are in accordance with recommendations made by appropriate State and Federal agencies regarding water quality. Specifically, they are compatible with recommendations made by the New Mexico Water Quality Control Commission in its Basin Plan (NMWQCC, 1976a), and the New Mexico Environmental Improvement Agency in its study of Elephant Butte Reservoir (EIA, 1976). The action also will meet standards set forth by the Federal and State governments in the City's proposed NPDES permit, and those specified in the Stipulation. The total mass discharge of pollutants to the Rio Grande is expected to be less than in the past, primarily because activated sludge will be used in place of trickling filter treatment and because the extension of sewer lines will substantially reduce the number of cesspools and septic tanks in the planning area.

Water Use. The high level of wastewater treatment achieved by activated sludge should improve the potential for use of Rio Grande water into which Albuquerque effluent will be discharged. With time, the percentage of effluent in the river will become an increasingly important component of the water supply of the Middle Rio Grande Basin. The river/effluent mix will be fully consumed downstream for irrigation purposes, wildlife watering in Federal and State refuges, support of aquatic habitats and recreation at Elephant Butte Reservoir, support of phreatophyte vegetation and associated habitats, and generation of hydroelectric power. Sale of a small amount of wastewater (1 mgd) to Public Service Company of New Mexico will be offset by reduced pumping of company wells, thus reducing the demand on Albuquerque's reservoir of fresh underground water.

The discharge of wastewater to the Rio Grande will tend to increase river flows, especially in summer when the river might otherwise be dry. The potential for year round aquatic life in the river may slightly increase as a result, although physical problems such as high sediment loads will preclude the river's being a significant fishery. The increased flows will probably have an aesthetic value for those who view the river, and may lead to increased recreational use of the river for swimming and boating during warm summer months. The increased flows will also increase the amount of river water which seeps into the channel and recharges ground water beneath the adjacent floodplain. Indirect reuse of effluent for drinking water purposes may result, and should not be adversely affected by any aspect of wastewater quality. The river flows and recharge should benefit the rare wetland habitats along the river, and any threatened species which utilize those habitats. The flows will also augment the pool in Elephant Butte Reservoir, especially during dry periods.

The reduction in OSS use in the area will reduce recharge in the Rio Grande floodplain of Albuquerque by a small amount, perhaps 2,000 acre feet per year. Over time, this could result in a lowering of the water table in the valley area, by perhaps one foot over 20-30 years. However, the lowering might be offset in areas which receive City water lines, since local pumping of wells would be reduced at the same time local discharges to OSS are eliminated. In any case, regional drawdown from pumping of the City well fields would have a much greater effect on water levels throughout the planning area, an effect compounded by reduced irrigation recharge as valley lands become urbanized.

Water Rights. Through implementation of the proposed actions, the City would be expected to retain the water rights credit associated with wastewater discharge to the river. With projected flow increases, this credit would exceed 85,000 acre-feet in the year 2000, and reduce Albuquerque's water rights needs in that year by 50%. A small water rights loss could occur through sale of wastewater to Public Service Company. It is assumed that this loss would be compensated for in the sale contract or by a transfer of water rights from the company.

5.2.2 Odors

The proposed actions are designed to eliminate nuisance odors associated with normal operation of wastewater collection and treatment facilities, and to provide sufficient flexibility in the treatment process that odor-causing upsets and breakdowns will be eliminated under all but the most exceptional circumstances.

Plant #2. The critical odor control problems at Plant #2 are expected to be solved primarily by emergency operational actions taken in 1977 and 1978, construction of sludge thickening facilities by the summer of 1978, and completion of the Phase IA expansion by 1979. Remaining problems are expected to be relatively minor, and will be solved by the continued upgrading of plant operation and maintenance, and by the Phase II improvements to the Plant. Phase II, which will include odor-control measures such as mechanical dewatering, increased treatment capacity, improved pretreatment facilities, and renovation of existing units, will lead to an "odor-free" facility by 1983. By that date, Best Practicable Control Technology for odors will be effective throughout the wastewater system. It must be realistically anticipated, however, that on some occasions there may be a malfunction which results in a short-term odor problem. With proper operation and maintenance these occasions should be rare.

It is important to recognize that control of odors from Plant #2 will not result in an odor-free environment in surrounding neighborhoods. Existing odors from animal confinement facilities and other sources would not be affected by the proposed actions, and would be expected to continue to cause complaints at some times and places in the southern part of the planning area. The area most benefiting from the improvements at Plant #2 would be that immediately adjacent to the plant, that is Mountainview community. In this community the odor problems attributed to Plant #2 should be greatly reduced, and eventually eliminated.

Plant #1. The razing of Plant #1 in or after 1983 will eliminate a significant odor source in the South Barelas neighborhood. As at Plant #2, complete odor protection for the area will not be provided, because of the existence of other sources such as the packing plant south of #1. However, odors in the immediate vicinity should be reduced, and the working and living environment will be improved. In particular, the potential for development of the City's industrial park north of the Plant #1 site should be significantly enhanced.

Sewerage System. Continued operation of odor-control stations using hydrogen peroxide is expected to provide a safe, effective means of eliminating odors at critical locations along the sewer lines. New stations will be constructed if and when additional problems arise. The design of interceptor and collector lines to maintain an adequate minimum flow will minimize the prospect of septic conditions. In some cases this odor-control measure has resulted in lines which have a large capacity compared to projected flows. The reduction in on-site liquid waste disposal will reduce odor problems of on-site systems, including odors which occur when sewage is discharged near the surface in an anaerobic soil, and odors which occur when septage is pumped from tanks and disposed of to the City sewer system.

Parks. Use of digested, ground sludge as a fertilizer dressing in City parks could result in slightly detectable odors under some circumstances. If the sludge is properly dried, stored and applied, no significant problems would be anticipated.

5.2.3 Resource Use and Conservation

The proposed actions are generally intended to increase the amount of waste materials which are recycled, and to restrict resource use for wastewater management to a level as low as is reasonably compatible with an effective collection and treatment system. This section itemizes the resources produced or used by the proposed facilities, and indicates any major benefits or adverse impacts associated with those resources. Where quantitative information is readily available and of interest, projections of resource production or use are given for 1985 (following Phase II expansion of Plant #2, and most major extensions of sewer service to already developed areas), and for 2000 (following implementation of all the proposed actions).

Water. The projected wastewater discharge from Albuquerque is 50.7 mgd in 1985 (serving 443,300 persons) and 76.5 mgd in 2000 (serving 674,200 persons). As indicated in 5.2.1, discharge of this wastewater to the Rio Grande will augment the water supply of the Basin, especially during low-flow periods. The wastewater will be fully utilized downstream for many purposes. In addition, 1 mgd will be recycled by Public Service Company for boiler-cooling purposes. Because ground water is generally available at low cost throughout the area, there are no other municipal or industrial markets for reclaimed wastewater which could increase the value of the resource. The fact that surface water is in short supply could indicate that the wastewater might be sold to the MRGCD for use in an irrigation program. Limitations to this option include: presently MRGCD already reuses much effluent by diverting river-effluent mixtures at Isleta Dam; any more formal reuse would require study to minimize problems of land application on numerous private farms in a shallow water table area. Continued study of irrigation with effluent is recommended by the Facility Plan, and could lead to an upgrading of wastewater recycling.

The proposed actions do not foreclose any reasonable program for recycling of wastewater, if and when cost-effective options are developed. Thus reuse for aquaculture, recreation lakes and other purposes could be implemented if desired. Minor water resources may be utilized by the management system for purposes such as landscaping, reseeding of construction lands, and watering for dust control.

As noted in 5.2.1, recharge in the valley area will be reduced as OSS are eliminated. This water instead will be discharged directly to the Rio Grande for reuse downstream. New regulations are likely to increase the use of evapotranspiration (ET) systems in the areas which remain unserved by public sewerage, and further reduce local recharge.

Sludge. Sludge production is projected to equal about 11,000 dry tons/year in 1985, and 15,500 dry tons/year in 2000. Sludge quality is expected to improve with the elimination of Plant #1 (which produces subpar material) and with improved sludge handling facilities at Plant #2. The proposed use of the sludge as a fertilizer-dressing on City parks will recover most, if not all of the nutrient value of the material. Other benefits include: a reduced demand for commercial fertilizer; support of biologic productivity and recreation in the parks; and improvement in overall soil condition (higher organic content; greater water-holding capacity; greater fertility; higher cation exchange capacity; greater resistence to soil erosion). The dollar value of the sludge, based on the cost of equivalent fertilizer (1976 prices) will be $220,000 in 1985 and $310,000 in the year 2000.

As indicated in Section 3.5.2, no adverse impacts from sludge reuse can be projected. However, over the long run it is possible that metals could build up in park soils to the point that the cation exchange capacity would become exhausted, and additional sludge application would lead to leaching of metals to ground water. It is projected that the metals levels in sludge will be about 95 per cent of those experienced in 1975 because of the increased removal of metals from effluent by activated sludge, and the offsetting factors of increased sludge production and decreased influent metals (due to progressive control of industrial and other sources). This reduction in metals content should ensure that no metals problems will occur over the planning time frame.

Based on the literature, it appears that no health problems should result from the proposed reuse program. However, it should be noted that numerous organisms have been identified which survive in the Albuquerque sludge (Brandon and Langley, 1976). These organisms are not known to cause any danger to the public. Further study of the organisms is being undertaken as part of Sandia's analysis of thermoradiation sludge treatment.

Sludge produced by OSS (septage) will be reduced in amount. This should lessen the influx of organic solids to Plant #2 (on a per capita basis), with consequent reduction in odor and sludge-handling problems.

Gas. The thermal resources of digester gas will be fully recovered by recycling it to gas-powered turbines for electricity generation. The projected gas production is about 160 million cubic feet in 1985, and 250 million cubic feet in 2000. The gas is expected to average 640 BTU's

per thousand cubic feet and to provide for the generation of 15,500 kilowatt hours/day in 1985 and 24,000 kilowatt hours/day in the year 2000. At a value of 3¢ per kilowatt hour, the electricity so produced will be worth about $70,000 in 1985, and $250,000 in the year 2000. The cost of electricity for the wastewater facilities would be reduced by this amount.

The most significant adverse impact of gas recycling is that the combustion will result in emission of some air pollutants. Natural atmospheric constituents such as nitrogen and water vapor and carbon dioxide will be emitted, but particulates, nitrogen oxides and other contaminants will also be discharged to the air. For the year 2000 the total emissions were estimated using standard factors provided in EPA (1975a) and should be approximately: 100 tons of nitrogen oxide, 4 tons of particulates, 25 tons of carbon monoxide, 10 tons of hydrocarbons, and one ton of sulfur dioxide. These emissions will represent an extremely small addition to the total pollutant burden of the planning area, and will have no significant effect on air quality in Albuquerque.

Grit. The projected production of grit is approximately 3000 cubic yards/year in 1985 and 4700 cubic yards/year in 2000. This material will be disposed of by landfill; the capacity of City landfills will thus be reduced by the indicated amounts. No recovery of any resources which might be associated with the grit is intended; however, if landfill mining becomes practical in the future, such resources would be recovered.

Scum. The projected production of scum is approximately 8600 tons/year in 1985, and 13,000 tons/year in 2000. The grease in the scum material will be recycled if a buyer can be found. If sold, the value of the scum resources would be about $40,000/year in 1985, and $60,500 in the year 2000. The benefit of scum collection and recycling is that operation of anaerobic digesters is expected to be considerably improved, enhancing the potential for odor control.

Land. It is proposed that at least 25 acres of land be acquired adjacent to Plant #2 to provide room for expansion in the event advanced treatment facilities must be constructed at a later date. This land would undoubtedly come from one of the farms which border the site, and would be obtained by purchase or condemnation. The productive value of the land need not be lost over the short run, if it is utilized as an experimental farm to determine the optimum practices for managing mixtures of effluent and river water for irrigation purposes in the MRGCD.

Approximately 25 acres of land at Plant #1 will become available for alternate uses when the plant is eliminated. The most likely use would be for expansion of the City industrial park now being developed north of the plant site. The land could also be developed by the City for recreation purposes, or sold. In either case, the availability of land for productive purposes would increase. No productive land is to be permanently taken for construction of sewerage facilities; the restoration of any farmland or grazing land used for sewer lines would be expected to restore productivity to pre-construction levels.

Energy. The proposed action will increase the demand for electricity. Assuming generation of on-site power as described above, the net demand for

Plant #2 will be approximately 39,000 kilowatt hours/day in 1985, and 117,500 kilowatt hours/day in 2000. Two-thirds of the total power demand of the plant is for the blowers used in the activated sludge process. The other major demands are for pumping, with some use for mechanical dewatering, aerobic digestion, and plant lighting. As indicated in 3.8, this demand can be lowered only a small amount by implementation of energy conservation measures. The decision to forego advanced treatment at this time results in a substantial lowering of energy needs when compared to alternatives which would involve such treatment.

The per capita electricity consumption at Plant #2 will be 40-50 kilowatt hours/year. This is an increase of approximately twofold compared to energy use in 1976. The increased energy use reflects the shift to activated sludge treatment, and is necessary in order to adequately renovate a large quantity of wastewater in a reliable and effective manner. The consumption is slightly larger than reported to occur at other activated sludge plants (Smith, 1973), probably because trickling filter units and additional pumping occur in Albuquerque. The net electricity demand of the facility is very small when compared to energy use for society as a whole. For example, the demand for outside electricity is equivalent to that which would be required to operate one 100-watt light-bulb for one hour each day for each citizen who is served by the system.

Natural gas use at the proposed facilities will reach a maximum of 220 million cubic feet per year in 2000. This is a small amount of the demand experienced in the area as a whole. Utilization of solar energy for building heat and/or digestion might lower this demand by a significant amount.

Energy use by the on-site systems industry (e.g. for installation and pumpage) will be reduced. However, new regulations are likely to increase the number of aerobic systems in use, increasing per unit consumption slightly.

Chemicals. The major chemicals utilized by the proposed system will be those used for odor control and disinfection. Chlorine use will be approximately 500 tons/year in 1985 and 765 tons/year in 2000. Hydrogen peroxide use will be 20 tons/year in 1985 and 30 tons/year in 2000. Supply of these chemical will, of course, involve consumption of energy and materials by manufacturers (as well as provide manufacturing jobs). No other chemicals are available for the designated purposes which would substantially reduce the secondary impacts of manufacturing. Chemicals for advanced treatment are not proposed for use at this time. Toxic chemicals such as pesticides and herbicides are also not proposed to be used.

Materials. The proposed actions will consume numerous materials, such as more than 100 miles of pipe for sewers, and 15,000 cubic yards of concrete and 2000 tons of steel for expansion of Plant #2. As with chemicals, there are secondary effects associated with the supply of these materials. Material consumption for production of OSS will decline.

Labor. The wastewater management system will provide 160 permanent jobs in 1985, and 240 jobs in the year 2000. This will be offset in part by a decline in jobs in the on-site systems industry (firms which supply and/or maintain septic tanks and other units). The proposed modifications of lift and odor control stations and to Plant #2, and the elimination of Plant #1,

should improve safety conditions througbout the system, and result in a reduction in man-hours lost to accidents. It was noted in Table 3-9 that the spraying of wastewater may result in the spreading of disease by aerosols. The impact of such spraying on workers who function near trickling filter or aerator units is not known, but is presumed to be not significant, as no history of health problems among system workers has been established. EPA (1976a) summarizes studies indicating that there is no evidence linking health problems to aerosols from aeration system facilities.

Funds. The proposed actions will require a capital investment of approximately $45,431,000, and an annual operation budget of $1,049,500 in 1985, and $1,159,200 in the year 2000. This represents a sizeable investment of public funds, and reduces the funds available for other purposes. However, such investments are mandatory if wastewater produced in the area is to be effectively treated to permit further use, and if odor control and other measures are to be implemented.

The cost of wastewater management per citizen is expected to increase with resultant increases in sewer service charges. Rate hikes of at least 10% per year are envisaged from 1979 through 1984. However, costs to residents who now have OSS and who will obtain access to sewerage service should decrease, when compared to the alternate of maintaining an adequate on-site system. The distribution of charges to the public is expected to be more equitable as the result of developing a user fee which provides for a surcharge to industries which contribute large amounts of organics or other pollutants to the system. Similarly, the adopted practice of imposing sewer standby charges to owners of vacant land will lead to a wider sharing of costs among those who benefit from the wastewater system. Enforcement of the liquid ordinances, with emphasis on large contributors of heavy metals, will require investments by and increased costs for those industries and institutions affected.

5.2.4 Public Health, Safety and Welfare

Previous sections of 5.2 have discussed many impacts to public health and welfare, such as those associated with protection of ground water and improved odor control. Substantial benefits will accrue where sewers replace OSS and localized sanitation problems are eliminated. Reduced use of OSS will be reflected in a lower incidence of water-borne disease in the affected areas, as well as fewer odor and mosquito problems. A significant improvement in public safety will result from the use of hydrogen peroxide in place of chlorine for sewerage odor control. The risks of chlorine leakage from odor control stations or from supply vehicles will be eliminated by this action. Potential problems of sewerage malfunctions should also be reduced by provision of an alarm system and standby power for all lift stations.

The public will also be protected by measures such as: control of access to treatment and other facilities; the increased regulation of on-site systems to reduce unsanitary conditions; routine operation and maintenance procedures designed to minimize vector organisms and other nuisances at Treatment Plant #2 and other facilities. The proposed action involves no relocations of businesses, homes, or other private property (except, locally, utility lines).

No special hazards related to seismic activity have been identified. Existing flood control structures--such as the levee system along the Rio Grande and the South Diversion Channel on the East Mesa -- protect the facilities at Plant #2 from floods which have less than a 100-year recurrence frequency.

The aesthetic environment will be improved by the proposed actions due to increased dry-season flows in the Rio Grande (see 5.2.1); reduced odors from Plant #2; and elimination of Plant #1. It is expected that the laboratory/administration building at Plant #2 will be designed to blend in with other buildings in the Mountainview area, that is it will have a low profile and be finished with materials and colors typical of the valley (e.g. stucco, muted colors such as earth tones). Plant landscaping will have aesthetic benefits. Plantings at the boundary line and on the acoustical berm will also help screen noises and mask odors.

A potentially significant adverse impact to public welfare could be noise levels from Plant #2, which might exceed 50-55 dBA immediately adjacent to the property line. Such levels could exceed the background noise in surrounding neighborhoods by more than 10 dBA, and could interfere with sleep and other quiet-time activities. Measures to improve soundproofing at Plant #2 will be included as part of the Phase IA expansion.

5.2.5 Ecology and Recreation

The proposed actions will provide continued protection of existing ecological and recreational values in the Middle Rio Grande Basin. In particular, by contributing discharges to the water-short Basin, the actions will help maintain water-dependent ecosystems in downstream areas, especially those in wildlife refuges and Elephant Butte Reservoir. The numerous rare and endangered species which utilize the area will benefit, since almost all rely on the wetland habitats for survival. Recreational opportunities associated with the refuges and reservoir will be sustained as well. No direct adverse impacts on any significant habitat or species can be identified.

Because factors other than wastewater management are responsible for the limited productivity and recreation potential of Basin waters, the proposed actions by themselves will not produce a river-reservoir system which meets the goals of P.L. 92-500. However, recreational opportunities in the Albuquerque area will probably be improved due to swimming, boating and viewing opportunities afforded by a permanent river flow above Isleta Dam.

5.2.6 Summary of Long-Term Impacts

The proposed actions are intended to provide for the management of municipal wastewaters in and near Albuquerque through phased construction of facilities for collection and treatment of urban wastewaters and through effective management of on-site systems in rural areas. Most of the improvements are proposed to be constructed prior to about 1985. These initial actions are primarily to serve existing development in the planning area, by providing an adequately sized treatment plant which can operate in a reliable, flexible manner, and by extending sewerage service to already developed areas where unsanitary waste disposal practices and/or low-grade ground water contamination are common. Much of the subsequent construction is primarily to serve projected growth in areas such as the West Mesa, and is needed only to the extent growth actually occurs.

The long-term beneficial impacts of the proposed action relate especially to the pre-1985 improvements, and the subsequent maintenance of adequate facilities. These benefits include:

- protection of water quality in the Middle Rio Grande Basin for all existing beneficial water uses;
- reduction of on-site waste disposal in valley areas where conditions are adverse to such disposal;
- protection of ground water quality in areas where on-site disposal is eliminated;
- improvement of public health at sites where unsanitary on-site systems are eliminated;
- augmentation of flows in the Middle Rio Grande, especially during low-flow seasons;
- improvement of aesthetic values, recreational use, and support of wetland and aquatic habitats because of the increased surface water flows;
- reduction of nuisance odors and other adverse effects of operation of Plant #2;
- elimination of odors and other adverse impacts of Plant #1;
- provision of land at Plant #1 for an alternate use;
- elimination of safety hazards associated with chlorine use at odor control stations;
- recycling of waste products such as sludge, sludge gas and scum.

Minor adverse long-term impacts will result from the proposed actions, including;

- consumption of energy, materials, chemicals and financial resources;
- generation of small amounts of non-recycled wastes and pollutants;
- some loss of recharge in valley areas, contributing slightly to water table lowering;
- commitment of 25 acres of farm land for treatment facilities at Plant #2;

Potentially more significant long-term impacts may occur, and will require reanalysis in the future as additional information becomes available. These include:

- the continued discharge of wastewater from on-site systems, which could lead to local contamination of ground water;
- the possible adverse effect of nutrients on aquatic productivity and recreational use in Elephant Butte Reservoir;
- the possible adverse effect of using mixtures of effluent and river water for irrigation in the Middle Rio Grande Conservancy District;
- possible water pollution associated with salts, fecal coliforms and other contaminants which arise from many sources, one of which is Albuquerque wastewater.

The proposed actions do not foreclose any future decisions which might be needed to reduce these impacts, if and when they occur.

5.3 SECONDARY IMPACTS

Secondary impacts of the proposed actions include the furthering of land use and environmental policies set forth in the City/County Comprehensive Plan (see Section 5.3.1) and a general improvement in socio-economic conditions, especially in the valley area (5.3.2).

5.3.1 Impacts Related to the Comprehensive Plan

The goals of the Comprehensive Plan (CP) were used extensively in the screening of alternatives, especially those related to extension of sewer lines into non-urban areas (3.3). As a result, the provision of sewerage service is carefully coordinated to conform to population projections which in turn are based on land use policies and densities set forth in the CP. Specifically, the following land use patterns will be supported by the proposed actions.

- Rural areas such as the far North and South Valley will not receive urban-type sewerage facilities, thus helping to maintain their character.
- Open space and greenbelt areas will not be affected by any major expansion of wastewater facilities.
- Already developed urban areas will obtain expanded facilities such as a larger treatment plant and replacement of overloaded interceptors; this is necessary to promote infill of population within the urban sector.
- Areas on the mesas which are considered capable of accommodating growth will receive service, thus providing facilities which will permit the orderly development of Albuquerque on land which is less sensitive to such development than valley or mountain regions.

The relationship of the proposed actions to the CP is more complex in other parts of the planning area, specifically the near North and South Valleys, Corrales and East Mountain.

Extension of City sewers to the North and South Valleys does not directly conflict with the CP, since these areas are no longer rural and low-density in character, and have sanitation and ground water contamination problems which cannot be readily solved except by provision of an urban type of sewerage system. However, the extension of sewers has a major land use implication in that it removes a constraint to high-density development. That constraint exists at present because of minimum lot size restrictions in areas where on-site systems are used for liquid waste disposal. These restrictions generally limit development in the valley to lots of one acre or larger, thus preventing the area from high-density land uses. With sewers, development at any density is technically possible, including apartment complexes, condominiums and mobile home parks. The provision of sewerage service does not mandate growth. Rather, it increases the need to use zoning, subdivision and other regulations to achieve the land use goals of the CP. Without strict enforcement of regulations, the land use patterns in the valley could change in a manner which conflicts with the CP.

There appears to be no acceptable sewerage alternative which can guarantee

fulfillment of the CP in the valley areas. For example, the option of restricting sewer sizes so that only the existing population would be served is not feasible. Large lines are needed to provide adequate sewage flow velocities in pipes laid in flat terrain, in order to avoid odor problems associated with sluggish flow. The option of denying sewer service would sacrifice ground water quality in order to use an imperfect mechanism for lot-size controls. Direct controls, such as zoning, are more appropriate for this purpose.

In the Corrales and East Mountain areas sewerage contingency plans have been formulated in the event these areas develop beyond their present rural character. As the plans would be implemented only after development had reached a semi-urban level, no conflict with the CP would be anticipated. However, as with the valley situation, the provision of sewers in these areas would eliminate a constraint to even more intensive development, and would increase the pressure on government agencies to strictly enforce land use regulations which will achieve the goals of the CP.

Overall, the proposed actions generally conform to the land use policies and goals of the City/County Comprehensive Plan, and will tend to lead to compact urban areas in which most new growth is accomodated by infill and development on selected portions of the West and Northeast Mesas. This urban form will improve the environmental quality of the planning area, as illustrated by the following:

- growth in valley areas will be restricted, resulting in less problems of air quality, flood damage, and water contamination in those areas;
- the more compact urban form will result in less vehicle travel, exhaust emissions and energy use;
- the emphasis on infill will increase the use of existing infrastructure, rather than requiring the expensive development of new facilities and services; the costs of growth will thus be reduced;
- open space and greenbelt areas will remain undeveloped.

The proposed actions also conform to other aspects of the CP, for example by: upgrading on-site systems in rural areas; promoting the recycling of waste materials; providing sludge-fertilizer for use in maintaining park recreation sites; augmenting low flows in the Rio Grande and thus improving the aesthetic quality and recreation potential of the river; and in general providing a necessary public service which minimizes environmental stresses associated with wastewater management, and which supports orderly growth and development in the Albuquerque area.

5.3.2 Socio-Economic Impacts

The proposed actions will involve substantial public investments in the construction and operation of wastewater management facilities, as well as some private investments by industries which discharge heavy metals. These investments will provide a stimulus to the local economy, for example by providing construction and maintenance jobs. They will also stimulate the regional economy, through use of materials, chemicals and energy produced elsewhere. These primary economic impacts will have associated secondary effects, as the stimulation of the investments passes through the community and multiplies. The monies committed for wastewater management will not be available for other purposes; this will reduce to some extent the ability of governments such as the City of Albuquerque to expand facilities and services which might otherwise use

these funds. Increased sewer service bills can be expected for most citizens.

The provision of sewerage service to areas which now utilize on-site systems will have a significant impact on conditions in those areas. These impacts include:

- elimination of restrictions on mortgage and home improvement loans imposed because of unsanitary OSS, improving the access of home-owners to such loans;
- increases in property values probably averaging about $500 per dwelling unit as the result of replacing OSS with public sewers;
- slightly higher taxes and increased property tax revenues when properties are reassessed;
- elimination of costs for maintaining and replacing OSS, reducing waste disposal costs for most households;
- marked reduction in demand for OSS, adversely affecting the many firms which construct and service on-site installation, with resulting loss of some jobs and closure of some firms.

A particularly significant impact is that unsanitary conditions will be eliminated at many sites which presently experience water supply contamination from improperly constructed OSS and wells. With the improvement in local sanitation will come a reduction in rates of enteric disease, a reduction in the number of school and work days missed by local residents because of illness, and a better potential for a higher quality of life and better economic conditions.

Improvements in quality of life and property values should also be experienced near both treatment plants. The increased odor control and reduced noise levels at Plant #2 should make it a better neighbor to the Mountainview community and remove a significant factor impairing the outdoor lifestyle of that area. The elimination of Plant #1 will remove a facility which is disagreeable to many nearby businesses and residences, and improve the potential for redevelopment of the South Barelas area.

The proposed actions will have the general effect of benefitting productivity in the planning area and downstream. For example, the discharged effluent will be fully consumed downstream by irrigated agriculture, wetland and aquatic habitats, and recreation, while solids such as sludge and scum will be used to support plant and/or animal growth.

Another general effect will be the increased involvement of government in matters which were once in the private and individual domain. This effect will be felt particularly in rural areas as on-site system regulations are formulated which provide for more centralized control of OSS construction, operation and maintenance.

6. ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Construction impacts which cannot be avoided include noise, dust, equipment emissions, terrain and vegetation displacement, dewatering, traffic disruption, and possible disturbance of archeological resources. Mitigation measures specified in Section 5.1 will be used to restrict these impacts to acceptable, minimal levels. Most of the impacts will be temporary and localized in nature. The most significant disruptions will occur in the already developed portions of the valley which will receive sewerage service. For the most part persons inconvenienced by construction will also be those who benefit directly from the sewerage extensions.

Existing problems of odors and ground water contamination will persist in the area until the proposed actions are fully implemented. Thereafter, ground water contamination will occur at a reduced level from the operation of on-site systems in areas not served by sewers. Nuisance odors may occur under exceptional operating conditions at Treatment Plant #2 after 1983.

Most long-term impacts are beneficial and relate to improved wastewater management and decreased environmental pollution. Potential long-term adverse impacts include:

- increased salinity in the Rio Grande as a result of beneficial water use and wastewater discharge in Albuquerque;
- possible interference with irrigation water use as the percentage of wastewater in river flows increase;
- possible adverse changes in the nutrient balance at Elephant Butte Reservoir as nitrogen and phosphorus discharges change in the future;
- a slight lowering of the water table in the valley due to decreasing use of on-site systems, possibly resulting in release of soil-stored pollutants;
- possible saturation of City park soils by metals from sludge applications;
- minor increases in air pollutants from combustion of recycled sludge-digester gas;
- possible noise levels in excess of 50 dBA near Plant #2;
- increased costs to industry for control of waste discharges with continued enforcement of Industrial Liquid Waste Ordinance;
- reduced employment in the on-site systems industry;
- possible overdevelopment of valley areas which receive sewer service, if land use control measures are not implemented to enforce the Comprehensive Plan;
- increased costs of wastewater treatment, including increased expenditures for energy and chemical resources;
- the commitment of extensive public funds for wastewater treatment.

Many of these impacts are small and an unavoidable result of providing wastewater services to an urban and urbanizing area. Others, such as those related to long-term water quality degradation, are speculative at this time. Ongoing studies will help determine if these impacts are likely to develop to serious levels; if so, the proposed actions are flexible enough to be modified to achieve almost any practicable level of wastewater treatment to meet a future discharge standard. In all cases, the proposed actions have fewer adverse environmental impacts than any other available alternative, and are far less objectionable than the no-action alternative.

7. SHORT-TERM USES OF THE ENVIRONMENT VERSUS LONG-TERM PRODUCTIVITY

The purpose of the proposed actions is to promote long-term productivity by protecting surface and ground water for its designated uses, by providing sewerage service to all developed areas in conformance to the Comprehensive Plan, and by reducing odor, safety and other problems which adversely affect the public well-being. These long-term gains are to be obtained with relatively small losses in environmental quality over the short and long-term, as summarized in Section 6. The most significant long-term problem likely to result from the proposed actions is that very substantial capital investments and operating budgets will be required to achieve a properly sized and maintained system. Public funds and bonding capacity for other purposes will be reduced as a result. However, provision of adequate wastewater facilities is essential to avoid gross pollution or land use problems, and no reasonable alternative to the public expenditures is available. To minimize the effects of the funding problem, the proposed actions will be developed in phases, with the full Facility Plan being implemented only when and if needed. Phased development preserves long-term options in the event that changing conditions dictate alternate uses of available resources.

No aspects of the proposed actions have been identified which will significantly lessen long-term productivity. Should increased effluent discharges adversely impact downstream water uses, additional treatment of the effluent would provide control of any potential problem. The increased capacity of Treatment Plant #2 is particularly beneficial, in that it reduces the long-term risk of treatment system breakdowns, and resultant odor and water quality problems. All viable options for reclamation of wastewater, reuse of sludge, or other improved management of waste products remain available and can be implemented, if and when they become cost-effective.

8. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Resources to be utilized by the proposed actions were itemized in Section 5.2. Construction will utilize considerable capital, man-power, materials and energy. Except for salvage of materials, these commitments are irreversible. Similarly, funds, labor, chemicals and energy will be required to operate the facilities on an on-going basis. No alternative to such resource use exists if adequate collection and treatment of municipal watewaters is to be provided in Albuquerque.

The proposed actions will maintain or increase the diverse and beneficial resource values of wastewater, sludge, sludge gas and scum. The actions also reduce the needs for energy and other resources needed to support the management system when compared to other alternatives. Should technologies develop to substantially improve such resource reuse and convervation measures, the proposed facilities would probably be capable of modification. For example, the proposed actions do not foreclose use of effluent for irrigation or aquaculture purposes, and they provide no physical limitation to thermo-radiation of sludge for purposes of providing supplemental cattle feed.

9. PUBLIC PARTICIPATION

9.0 PLANNING PROCESS

There have been extensive opportunities for public involvement in the facility planning process, through direct communication, attendance at Steering Committee meetings, and input at public hearings.

Direct communication involved interaction on a personal level between those preparing the Facility Plan and environmental documents, and members of the public who represented public agencies, environmental organizations or other interests. The communication, both written and oral, was directed to obtaining information regarding environmental conditions and wastewater management options pertinent to the Albuquerque situation. A list of persons and organizations who were contacted during the planning period is provided in Section H-1 of EPA (1977).

Steering committee meetings provided a more structured but still informal arena for public comments on the Facility Plan and environmental documents. The Committee was a task force established by the City to guide the consultants charged with preparation of the plan; it held eight meetings, all open to the public, from November 1975 through November 1976. Local and regional government organizations with direct interests in the plan were represented on the Committee as follows: City of Albuquerque (four representatives, from the Public Works, Environmental Health, Planning and Legal Departments); City Environmental Planning Commission; Middle Rio Grande Council of Governments; and New Mexico Environmental Improvement Agency. Members of environmental organizations who expressed an interest in the plan were issued written invitations; the meetings were also listed in the weekly calendar published by the Albuquerque Journal. Section H-2 of EPA (1977) lists members of the Steering Committee, the dates of all meetings, and the names of persons who were routinely notified of the meetings by mail. As all major environmental issues raised at the meetings were also discussed at the public hearings, the public input on these issues is presented below.

Public hearings were held by the Albuquerque Environmental Planning Commission on 18 December 1975, 5 August 1976, 14 October 1976 and 21 December 1976. At each hearing the consultants responsible for preparation of engineering and environmental studies presented their conclusions and/or recommendations. Public comments on and input to the plan were solicited through formal oral testimony and subsequent written statements. The public was notified by use of a mailing list, publication of an official advertisement in the City's daily newspapers thirty days prior to each hearing, and some media coverage. The complete record of the public input is provided in the hearing transcripts which are published as Volume 4 of the Facility Plan; Volume 4 also includes the mailing lists. These transcripts are briefly summarized below.

18 December 1975. The first public hearing was held to discuss the work program, schedule and general objectives of the planning process. Specific issues discussed by the public at the hearing included the need to:

- consider areas other than the South Valley for treatment plant sites;
- analyze summer odor problems;
- provide adequate information to the general public prior to hearings which could be held throughout the community;
- provide more opportunity for public comment during the period in which goals and objectives (selection criteria) are developed and alternatives undergo the initial screening process;
- reduce pollution in the shallow water table areas;
- study pre-plant chlorination alternatives;
- provide a transcript of hearings for public inspection;
- control toxic substances and possibly construct a regional toxic waste facility.

At this hearing the Environmental Protection Agency provided assurances that all elements of the Facility Plan subject to Federal funding would be reviewed by EPA and stated that: the only non-point source to be studied in depth would be septic tanks; there would be no detailed sewerage plans developed for unpopulated areas other than lines necessary to assure adequate capacity for projected growth; and EPA would not fund a metals removal facility if the source of the metals was industrial. The consultants explained that: the cost-effectiveness study would be used to aid selection of alternatives; well water quality and point sources would be studied; wastewater pollution sources would not only be analyzed, but treatment alternatives suggested as well; the sewer use ordinance would be checked for compliance with P.L. 92-500; and the environmental consultant would work closely with the engineers.

5 August 1976. The second public hearing was held to discuss the alternatives which had been developed, to receive information and opinions on these alternatives, and to identify any other alternatives the public felt should be considered. At this point the alternatives had been developed for discussion purposes only and no recommendations were made regarding the most cost-effective course of action. Issues raised at this hearing by the public included the need or desire to:

- provide greater publicity for upcoming public hearings and steering committee meetings and to actively encourage the public to participate;
- provide more readable summaries of the consultants' reports with sufficient time for the public to review them prior to the hearings;
- protect the ground water quality by providing sewer collection (specific areas mentioned were the far South Valley, Corrales, North Valley, and Los Ranchos de Albuquerque)
- research Corrales sewerage alternatives more carefully;
- not sewer the East Mountain area (Tijeras), but provide a water supply system first;
- provide alternative plans for areas such as Sandia Heights and North Albuquerque Acres which might undergo zoning changes;
- not build a westside treatment plant;
- abandon Plant #1 and consider using the site for a neighborhood park rather than as an industrial area;
- give more consideration to land application, infiltration-percolation and aquaculture, possibly as a demonstration project;
- study whether the San Juan-Chama allocation could provide the necessary water rights for land application or other projects;

- enforce the liquid waste ordinance to reduce COD and metals in the wastewater influent, and not relax the Stipulation standards for heavy metals;
- develop methods to effectively measure industrial contributions;
- ensure that metals in applied sludge would not adversely affect plants and/or the food chain;
- consider aerating sewage in the collection system to reduce BOD loads entering the plant;
- look closely at ozone and hydrogen peroxide for disinfection and odor control, i.e., attempt to eliminate chlorine use;
- solve the treatment plant odor problems;
- analyze the effect of feedlots on the sewerage system and ground water quality;
- use sand beds rather than mechanical dewatering to dry sludge, in order to reduce energy consumption;
- reconsider aerobic digestion and a pure oxygen activated sludge system;
- implement water conservation measures, including a rate structure which discourages heavy water consumption;
- designate the Rio Grande as a primary contact recreation area and treat the wastewater accordingly;
- consider a North Valley treatment plant to serve northern Albuquerque in order to reduce the load at Plant #2 and increase citizens awareness of the effects of wastewater;
- possibly use a computer weighted model to choose between alternatives;
- put effluent into the canals, rather than the river, in order that the effluent be applied more directly to fields.

The EPA explained that an NPDES discharge permit for the City of Albuquerque had been proposed, but was being held in abeyance until the results of an adjudicatory hearing became known. The EPA, under P.L. 92-500, can provide funds to bring the plant up to permit standards. There would be no objection to additional treatment, but it could not be funded by EPA at this time.

14 October 1976. This public hearing was held to discuss the consultants' recommendations for selection alternatives. It was the most widely attended and lengthy hearing. The primary issue raised by the public was that of odors, particularly those emanating from Plant #2. It was pointed out that these odors interfere with the sleep, health, appetite, and recreation of South Valley residents and reduce property values. Concern was expressed that adequate odor control would not be included with expansion of Plant #2 facilities. A request was made that odor control be made the top priority for the 201 plan.

The engineers summarized a report they had prepared on the odor situation and indicated that effective odor control at Plant #2 awaited cleaning of digesters and expansion of the plant to its original design capacity. A good deal of the discussion and testimony at the hearing related to ascertaining when the facilities needed for odor control would be installed and how they would be funded.

Other issues and recommendations presented by the public included concerns that:

- chlorination might not be effective agains viruses, and that the South Valley might be virally contaminated;
- Mountainview be a priority area for sewerage, due to the problem of high nitrates in that region;
- the noise from the aeration blowers interfered with sleep;
- a new treatment plant should be built away from all residential areas;
- provision be made for control of odors at Plant #1 until it is abandoned.

21 December 1976. This public hearing was held to gain any final comments from the public concerning the proposed Facility Plan. Public input was brief. Objection was made to the abandonment of Plant #1 and expansion of Plant #2, and to potential hazards of chlorine transportation. EPA explained that South Valley sewer connection charges would be established after the construction contract was let and the costs established. They also stated that the grant increase for Phase I-A was expected to be approved by the end of 1976.

9.1 ENVIRONMENTAL STATEMENT

The draft of the Environmental Impact Statement was distributed to all interested agencies, public groups and officials on June 14, 1977 (see Part 6 of Summary for distribution list). A notice of availability of the draft statement appeared in the Federal Register dated June 24, 1977. The Council on Environmental Quality's due date for receipt of comments on the draft statement was August 8, 1977. A public hearing on the draft statement was held July 20, 1977 in City Hall, Albuquerque, New Mexico.

Appendix A contains a copy of all written comments which were received on or before August 8, 1977. The Appendix also contains EPA's responses to these comments, either in detail or by reference to sections in this final statement which have been revised, rewritten or otherwise altered from the draft statement.

Appendix B contains a copy of the transcript of the public hearing held July 20th. Also included are EPA's specific responses to public comments made at the hearing. These responses are given either in detail or by reference to revised portions of the final statement.

Written communications which contained no substantive comments (except in some cases, approval or endorsement) were received from the Federal Highway Administration, Advisory Council on Historic Preservation, Cibola National Forest, Soil Conservation Service, Federal Aviation Administration, New Mexico State Planning Office and State Historical Preservation Office.

Substantive comments were received from the Southwest Research and Information Center (SRIC) and the U.S. Army Corps of Engineers (COE). Comments from SRIC concerned operation and maintenance, cost-effectiveness, odor, metals and conservation. In addition to the specific responses to these comments in Appendix B, several sections of the EIS have been revised or added in order to reflect the comments (see 2.1.2, 2.1.3, 3.6, 4.4, and 4.5). Comment from

COE primarily addressed points needing clarification or expansion. The most substantial revision resulting from these comments appears in Section 3.3.4 (regarding sewerage for low-income neighborhoods) and 3.7 (regarding an additional alternative for wastewater reuse).

The major thrust of comments received at the public hearing was:

a) the wastewater treatment facilities were responsible for considerable environmental stress (especially odors in the South Valley);

b) the stress resulted from problems which included design, construction, operation and maintenance of facilities; and

c) the City of Albuquerque had not responded adequately to resolve these problems.

These comments essentially addressed the concern that given past problems there was insufficient assurance that the proposed actions would in fact be implemented in a manner which would achieve the stated goals.

Other comments dealt with concerns such as: enforcement of the liquid waste ordinance; the definition of cost-effectiveness; nitrate levels in ground water; odor problems along a force main in the South Valley; the impact of dewatering, the high cost of sewer service to low-income residents; and the failure to hold meetings in the neighborhoods actually impacted by the proposed actions.

List

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APPENDIX A.
WRITTEN COMMENTS RECEIVED ON DRAFT ENVIRONMENTAL STATEMENT

Responses are numbered to refer to particular comments for the letters submitted by the Southwest Research and Information Center and the U. S. Corps of Engineers. No responses are required for the remaining letters.

Southwest Research and Information Center
P.O. Box 4524 Albuquerque, New Mexico 87106

August 4, 1977

Clinton B. Spotts
Regional EIS Coordinator
U.S. Environmental Protection Agency
1201 Elm Street
Dallas, TX 75270

Dear Mr. Spotts:

Please accept these comments on the Draft Environmental Impact Statement for the Albuquerque Wastewater Treatment Facilities. These comments are not indeed to jeopardize Albuquerque's opportunity for grant acceptance by October 1, 1977.

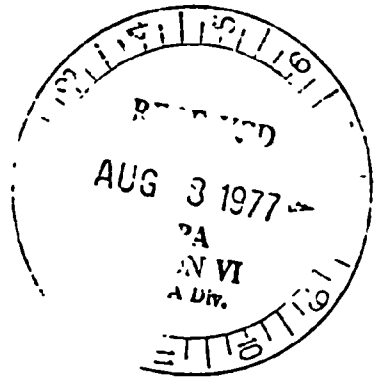
Sincerely,

Paul Robinson

Paul Robinson
Research Associate

PR/jm

Enclosure



Comments on the

DRAFT Environmental Impact Statement

for Albuquerque Wastewater Treatment Facilities[1]

These comments are loosely arranged in five sections: Operation and Maintenance, Cost-Effectiveness, Odor, Metals and Conservation. Many particular points overlap, since, the impact of complex systems on their surroundings are interwoven.

SRIC COMMENTS

1) - Operation and Maintenance -

2) The Draft Environmental Impact Statement (DEIS) section on the "Proposed Action" (section 4) barely mentions either Operations and Maintenance considerations or staffing and budgeting improvements Without such discussion there can be no basis for an assumption of "proper operation and maintenance" (DEIS p.210) for the Albuquerque Wastewater Treatment operation

3) In the "Environmental Setting"-section we find only limited mention of Albuquerque's present problems. DEIS p.23 simply notes the present staffing and budgetary inadequacies and their impact on plant operation. This brevity is inappropriate considering the "past 15 years of problems" (DEIS p 36) at Treatment Plant #2 and the extent of knowledge as to the causes and impacts of such problems

4) Two United States General Accounting Office (GAO) reports[2] on Wastewater Facilities across the country point out that the magnitude of problems at Albuquerque plants is not unique. Other regions also find treatment plants not meeting performance requirements for several reasons, including poor operation and maintenance and faulty design work Local and Regional decision-makers seem aware that these problems are part of the Albuquerque experience They must assure the people that such concerns are reflected in the planning process Part of this assurance must be a fully adequate Final Environmental Impact Statement Without any more status than a one line budget item, see DEIS p 188, we have no guarantee that "continued upgrading plant operation and maintenance"(DEIS p 210) can or will occur

While we are aware Operation and Maintenance costs are not an integral part of the grant proposal the DEIS assesses, the complex

EPA RESPONSES

1) EPA agrees with the basic thrust of these comments The Final EIS is revised accordingly

2) A new section, 4 5, has been written to outline anticipated improvements with regard to operation and maintenance Further detailing of these improvements will come when the required Plan of Operation is submitted at the completion of facility design

3) Section 2 1 2 has been expanded extensively to provide more detail on the existing operation and maintenance problems at the Albuquerque facilities

4) New Sections (4.4, 4 5) have been written to indicate how EPA proposes to assure the quality of project design, construction, operation and maintenance, through requirements for a Plan of Operation, a Value Engineering Study, and use of inspection services provided by the U S Army Corps of Engineers

construction project can only work when sufficient qualified staff and an adequate budget are part of the system

5) Other documents such as Camp, Dresser and McKee's Sludge Handling, Noise Reduction and Odor Control[3] and the Facilities Plan[4], in Appendix G, detail the present situation to a greater extent than the DEIS Camp, Dresser and McKee are also contracted to prepare a report, due May 2, 1977 but as yet unavailable, dealing with operational problems and needed changes before and after phase IA[5] Such a report may offer concrete solutions to present inadequacies

6) We feel these documents focus on the problems at hand and should be used more, along with the GAO reports, to fill out the description of the "Environmental Setting " In that way we can get a clearer picture of the needs of the present plant

7) As it is, the DEIS fails to mention Operation and Maintenance options as "alternatives" or "proposed actions." While there are no good alternatives to good operation and maintenance, there are alternatives to the present system Good Operation and Maintenance holds the key to a qualitative change in future plant performance and must be a well developed part of the "proposed action " While the DEIS assumes proper operation and maintenance, there are no specific operational changes in the "proposed action." Such plans are surely brewing - they could be included in the Final EIS The discussion needs to include detailed staffing and budget projections for the proposed plant expansion at each step of growth

8) Other points needing more work for a systematic environmental statement include plant design and performance. The Albuquerque system could use major improvements in these areas as well DEIS p 200 recommends "guidelines to be followed during the construction project will

5) The two documents prepared by Camp, Dresser and McKee are considered to provide the greatest detail regarding the specific problems experienced at Albuquerque facilities, and have been used in making the revisions noted above

6) See response #3, above The GAO reports have not been referenced directly, because of their general nature However all the types of problems described by GAO which occur in Albuquerque have been discussed in the Final EIS

7) Section 4 5 addresses certain operation and maintenance measures which will take place Section 4 5 also describes the requirement for a Plan of Operation prior to the next major funding of plant construction There are no options discussed regarding these actions since, as noted in the comment, there are no good alternatives to good operation and maintenance

8) Section 4 4 addresses a quality assurance program intended to provide for good design, construction, operation and maintenance of the proposed facilities The performance guidelines cited in the comment (page 200 of DEIS) refer to environmental protection safeguards, and do not directly address questions of facility design and construction They therefore are not intended to address the types of problems described in these comments, and have not been modified

be set forth in bid specifications and the construction contracts .. the selected contractor will develop any environmental plans required by contract guidelines inspection procedures will be utilized to insure that the guidelines are followed out " This DEIS passage correctly implies that there are problems with contractors and the enforcement of contract guidelines Unfortunately, there are no specific solutions stated, other than the assurances just listed. Given the performance of plant #2 and the GAO reports, this paragraph should be expanded Details are necessary, not simply to pinpoint the culprits, but to properly describe background problems and to integrate contractor monitoring in future planning design and construction

The city has been involved in several lawsuits resulting from poor plant operation and has just signed a $1,000,000 plus contract[6], partially funded by city taxes, which calls for redesigning components or correcting oversights of several elements from phase 1 design and construction. Camp, Dresser and McKee find severe problems with sizing

9) and function of key components in the Waste Activate Sludge plant, specifically blower capacity, diffusor capacity and the pressurized air manifold[7] The computer facility, designed to "reduce manpower (sic) requirements"[8] remains "essentially nonfunctional"[9]

These examples point to serious problems with the contracting and construction aspects of Albuquerque's Wastetreatment Facilities Such poor performance needs to be watched Though Camp, Dresser and McKee say, "ultimate responsibility for costs and performance of the system will rest with the design engineers"[10], the ultimate costs are born by the environment and the taxpayers

Because of the importance and depth of contractor related problems, more than a paragraph ought to be devoted to them For an adequate Final EIS, we recommend detailed discussion of guidelines in contracts

10) outlining quality control criteria in both construction and design phases of the contracts We recommend the Final EIS details a regular inspection and monitoring program, by qualified independent engineers, to assess construction progress and quality

9) Problems such as those with the air supply system are discussed in the revised Section 2 1 2 According to the City of Albuquerque the computer facility is operating adequately with regard to most of its intended functions

10) Quality control will be obtained by use of the value engineering analysis, and by regular inspection and monitoring of construction by the U S Army Corps of Engineers Refer to Section 4 4 for a discussion of these measures.

- Cost-Effectiveness -

"It is proposed that additional actions be reevaluated during the next 20 years and recommended that they be implemented if changing factors lead to a favorable cost-effectiveness analysis" (DEIS p.viii) We support and encourage these reevaluations The DEIS never defines cost-effectiveness and fails to provide quantitative cost-effectiveness analyses for alternatives considered We hope the recommended reevaluations can provide the detailed study missing in the DEIS. Several examples substantiate this comment and recommendation

11)

Section 3 6 4. (DEIS p 173) purports to evaluate ozone as an alternative to chlorine for disinfection There is no way to balance the value of the "effectiveness" of ozone on cysts, viruses and pathogens over chlorination versus the "high" dollars cost of ozonation While numbers are given for power requirement for production of ozone and chlorine, they are misleading Chlorine appears to use one half of the energy for production as ozone but chlorine will not be produced on site The "proposed action" calls for building a railspur to bring chlorine to the plant. The costs for this are not added into power requirements leaving a misleading, or at best incomplete, conclusion Environmental Health costs are also dealt with superficially in the disinfection discussion. The consequences of the city's excess discharges of chlorine are not assessed (the chlorine contact chambers, though completed, are not presently in use at plant #2) The text fails to consider impacts of low concentration chlorine compounds[11] on wildlife in the bosque bordering the Rio Grande, especially during low natural flow periods There are

12)

13)

14)

15)

11) The definition of cost-effective should have appeared in the DEIS A discussion of cost-effective anlysis has been included in Section 1 3 of the FEIS Note that the discussion states clearly that cost-effectiveness analyses are not intended to resolve all factors into quantitative terms Techniques are not now available for converting all environmental values into fixed numbers It is questionable if such techniques will ever be available, and debatable if they are even desired, given the highly intangible value of concepts such as wilderness, beauty, endangered species, and the like. The evaluations given in the DFIS are quite detailed, notwithstanding the fact that only some of the factors are quantified Where quantitative detail is available and pertinent it has been supplied Elsewhere qualitative statements have been utilized An example of the level of detail is Table 3-13, which involves extensive information on 8 different disinfection and odor control alternatives in a manner which permits fairly straightforward comparison of the options This table was prepared especially for the DLIS, although only four references were cited, the information was checked against 60 references to ensure its accuracy and comprehensiveness Similar detailed information was developed for the other cost-effective analyses

12) We agree that there is no way to balance "effectiveness" versus "cost" This is exactly why cost-effectiveanalysis does not try to resolve all factors into quantitative terms The cost of ozonation would presumably not be a major consideration if the following were true the process was completely reliable at large scale, the superior effectiveness of ozone could be shown to benefit public health; and side-effects (such as Mutagenesis) could be shown to be unimportant However, debate exists as to the validity of all three of these statements This is the basic reason for rejection of ozone at this time, however, its potential remains high, hence the recommendation for reevaluation at a later date The FEIS has been rewritten to clarify the significance of process reliability in the evaluation of ozone

13) The FEIS has been revised to state that the energy cost of chlorine includes transportation Rail transport of chlorine involves an energy use of 1630 BTU/ton-mile (R Bezdek and B Hannon, Science, 185 (4152), 1974) For the year 2000, with a transport of 765 tons/year, and assuming the present source of supply at a distance of approximately 300 miles, the energy for transport would be about 375 million BTU/year This represents about 1% of the total energy cost for chlorine The statement in the DEIS regarding energy costs was incomplete, but not misleading

14) The environmental health costs were stated in the paragraph on incomplete disinfection, and in the discussion of secondary impacts on water quality Specifically, no health impacts can be attributed to pathogens which are not controlled by chlorine (e g viruses) No data are available regarding possible effects of chlorinated compounds, but as stated in the DEIS, situations elsewhere where adverse effects have occurred do not parallel the Albuquerque setting

15) The consequences of the city's chlorine discharges were stated in the discussion of secondary impacts on water quality Specifically the combined effect of a decline in chlorine residuals downstream, plus the lack of a viable aquatic ecosystem in the river reach below the treatment plant outfall, appears to limit the prospect of any adverse effects As far as we can determine, no other water quality study of the Albuquerque area (e g the Basin Plan) has ever reported such effects, and no observations of damage to aquatic organisms are on record with any Federal or State Agency

16) no comparisons of the relative health effects of chlorine and ozone, such data is necessary for a full evalu- ·n of these options The DEIS data is incomplete and the advisability of continued chlorine dependence has yet to be firmly established

17) The DEIS (on p 173) says "on balance," but we can find no useful balancing, just phrases to list on the cost and benefit side Clearly, detailed quantitative analyses are required for a final decision The DEIS calls for reevaluation of ozonation before any major chlorine investment We agree, the expenditure for the chlorine railspur must not preclude a further reevaluation of ozone and chlorine

18) We also recommend future reevaluation of the "Wastewater Reuse Alternatives," discussed in Section 3 7 (DEIS p 174) While five alternatives are listed, no quantitative comparisons are made or attempted in this key resource use area Without a cost balancing or an attempt at evaluating advantages versus disadvantages, we have no clear idea of the factual bases underlying the prose discussions How are we to understand the advantages of the $400,000 - 1 mdg pump line to PNM (DEIS p 188) without costs for other options to compare it with?

19) This non-quantitative bias stands out most in the evaluation of land application Though commonly, a wastewater reuse option, land application is dealt with as a Nitrogen Removal Alternative (Section 3 4.1 p 144).

20) The treatment of this alternative centers on the water rights impact of land application Strangely, this section considers impacts to the year 2020, though elsewhere the planning extends only to the year 2000[12] We feel assumptions underlying this discussion are suspect, as we have no population figures, water cost projections or even facility plans for 40 years hence

21) The DEIS listing of costs and benefits includes a survey of the

There is no literature or other information which appears to permit ready identification of any wildlife impacts of chlorinated compounds in the Middle Rio Grande, primarily because the river does not have a viable aquatic community which could be easily studied The references cited in the comments do not appear to contain information not found in the references cited by the DEIS

The statement regarding the chlorine contact chamber operation was correct at the time the comments were written, however, as of early August the chambers were in operation

16) The discussion of ozone and chlorine clearly indicated that ozone appears to be superior in killing disease-causing organisms. However, the factors noted in response 11, above lead to the evaluation of ozone to be unfavorable at this time. Disinfection is mandated by the terms of the NPDES permit, and by the stream standards set by the State of New Mexico, both of which require control of coliform bacteria as an indicator organism. Chlorine is the only proven method of achieving the necessary control on a reliable, large-scale, cost-effective basis at this time. However because of questions about side-effects of chlorine use, the recommendation to reevaluate disinfection methods was made.

17) Cost-effective analysis is the listing of "phrases" on cost and benefit sides Quantitative analyses are not required for a final decision

18) As recommended by the Draft EIS, future reevaluations will occur Quantitative comparisons will be made at such time as the reuse alternatives can be more clearly defined The existing discussion presents definite balancing statements regarding advantages and disadvantages of each type of alternative. To summarize· aquaculture is not feasible on a large scale at this time; no users in need of water for silviculture or cooling purposes have been identified (except PNM); no other use can be identified which is really worth detailed consideration at this time. The advantage of the line to PNM is simple, the City will sell effluent for a price which exceeds the cost of effluent treatment, while at the same time reducing the pumping of ground water in the Albuquerque area.

19) Land application is dealt with as a nitrogen-removal alternative before being discussed as a reuse option because of mandates which appears in State documents and the Stipulation. These mandates, either explicitly or implicitly, make the nitrogen-removal aspects of land application a prime consideration. Had the evaluation of land application for nitrogen removal indicated that the alternative was cost-effective, the subsequent analysis of land application for reuse would have been unnecessary

20) The use of data to the year 2020 was made because a fixed-size land application project may have decreased water rights impact over time. In the case of the Southeast Mesa project, this approach produces a more favorable evaluation of land application than would otherwise occur. The projections through the year 2020 assumed that continuation of Facilities Plan policies through that period. Population figures underlying the projection to the year 2020 are given in Section D-4 of the Technical Reference Document; this reference was cited on page 148 of the EIS.

21) The cited listing is not intended to be a "favorable" cost effectiveness analysis; it is a list of factors which were used by EPA to provide a background for the site-specific analysis of Albuquerque conditions EPA's use of these factors in balancing land application and advanced treatment was given on page 144 of the DEIS

of the literature on land application, but contains no attempt to balance the worth or relative importance of each phrase A long list of descriptive phrases does not constitute a favorable cost-effectiveness analysis

22) The value of maintaining irrigated land, greenbelt, in light of Herkenoff's prediction and the goals of the Albuquerque/Bernalillo County Comprehensive Plan noted on DEIS p 85, would be considerable. When offset with the value of water we might find a fair balancing If we approximate the value of land, with water rights, at $3-5,000[13] per acre, then Herkenhoff's lost 200 acres per year might be worth some $600,000 - $1,000,000 annually Water, worth 36 50 per acre foot[14] at 25,000 to 46,600 acre feet per year (DEIS p.150), could cost $912,500 to $1,700,900 per year Just these rough calculations show the abstract resources of land use and water rights might be valued within a factor of less than two, and that the cost of water rights may not be as insurmountable as the DEIS implies Were general crop values to offset

23) the cost of operation[15], we might find an option opening where part of the sewage treatment plant pays for itself independently.

24) The DEIS says on p 152, "The disadvantages of this (land application) alternative are reflected in dollar costs, which are several million dollars higher for land application than for an equivalently effective, advanced treatment plant " We don't have this detailed analysis referred to, only a flat statement of unsubstantiated fact. Clearly land application offers more than just advanced treatment (crop value and greenbelt, see above) By not considering land application rigorously, or in conjunction with other wastewater reuse options, we have no firm basis on which to evaluate the relative merits of each alternative's actual case

We support the DEIS call for reevaluation of land application Hopefully that study will offer a rigorous analysis detailing all the costs and benefits involved in such decisions The city needs to have such options open as costs change and new information comes out A well developed reevaluation should provide such data

22) We are unable to respond to this comment directly. As described the value of water is the annual cost of San Juan-Chama water which would be used to offset a land application project This is a type of operating cost The value of land as cited is a capital cost which reflects the worth of the land for productive use, and which is not its value as greenbelt. (On a pure open market basis, land which was by convenent maintained in green belt would probably be less valuable than land which could be developed; in this context the "value" of greenbelt would be a minus quantity, which is yet another reason why cost-effective analysis does not rely strictly on monetary considerations). We do not understand how the capital cost of land can be compared to the annual cost of water, even if the land cost did reflect greenbelt values Regardless, the DEIS (page 152) stated that "the direct water rights impact of a moderately-sized land application project might be within acceptable limits" and pointed out (p 151) that San Juan-Chama water could be used without actually increasing costs associated with water rights The statement that in effect the DEIS implies the cost of water rights to be an insurmountable obstacle to land application is therefore not valid The Final EIS has been rewritten to cast the appropriate statements in unmistakable terms.

23) The assumption made in this comment is explicitly stated to be incorrect in the Draft EIS Crop values exceed costs of operation only for situations in which water is extremely cheap, and no return on investment is required The cost of locally grown alfalfa versus the cost of growing and trucking alfalfa into the area (see footnote 15) is broadly comparable, since the selling price of the imported alfalfa is only moderately above the price of the local alfalfa, yet comes from large-scale commercial sources where return on investment is included in the price

24) The detailed analysis referred to appeared in the paragraph above the referenced statement, which in turn references the Facility Plan The consideration of land application given here rigorously followed all guidelines and produced a firm basis for concluding that the alternative was not cost-effective at this time.

- Odor -

There is a strong citizen distrust[16] of the city and its promises for odor-free treatment plants This feeling stems from the 15 years of odor problems at plant #2 and the continual unfulfilled promise of odor-free operation The city must deal honestly with the public for support in its renewed effort for odor-free operation.

A specific DEIS problem regarding odor includes the statement on p.36, concerning the Stipulation's requirement of Best Practicable Odor Control Technology. EPA, in section 261(g)(2) of the Federal Water Pollution Control Act, PL 92-500, require Best Practicable Technology (BPT) in grants for the acquisition of plants discharging into the

25) nation's water Wherever the goal of BPT gets credited to the Stipulation the Final EIS should also say EPA requires BPT on all its projects.

26) Another incongruity can be found between the "many square miles" (DEIS p.35) of odor impact area and the absurdly small odor areas on figure 2-5 (between page 20 and 23) Such discrepancies must be remedied in the Final EIS For this point we recommend an odor map based on a wind rose as the measure of odor dispersal rate and distance

27) The Evaluation of Sludge Drying Alternatives on DEIS p 165 requires clarification The sludge beds are a prime source of odor now and have been at least since the time of the stipulation, 1973 The DEIS acknowledges mechanical dewatering to be BPT now for sludge drying The DEIS at page 165 doesn't envision the Mechanical Dewatering being designed until 1985, while the summary of the proposed action (DEIS p viii) expects Mechanical Dewatering to be in the phase II expansion, to be on line in 1983 We recommend the final EIS clear up this point, for the Mechanical Dewatering system need to be on line at the earliest possible date.

Because the "odor rights" lawsuit has been the subject of much comment at public meetings one clarification should be made One frequent misunderstanding is how many people were affected by the suit. The DEIS properly observes that it only applied to fourteen persons Additionally, please note that while persons were compensated for past and future damage to property, they are not barred by the settlement from damages for future

25) The goal of BPT for odor control is specifically mandated by the Stipulation, and is not an EPA requirement. EPA requires BPT with regard to wastewater treatment. In practice the EPA requirement will lead to good odor control, however, it does not extend as far as the requirements set forth in the Stipulation For example, the replacement of sludge drying beds by mechanical dewatering is a requirement for BPT to achieve odor control; it would not be a universal requirement of BPT for wastewater treatment.

26) The odor areas on Figure 2-5 are sources of odor problems; they are small to indicate that odors come from very specific locations within the wastewater system. The referenced statement (page 35) is in a separate section, and is accompanied by Figure 2-6 which shows the regional extent of the odor problem in a conceptual manner The Final EIS has been revised to make explicit reference to the figure No wind rose was included because the only reliable long-term wind data available for the Albuquerque area are from stations located on the mesa, the data do not reflect the microclimate conditions which typify the valley area in which the odor sources are located. Therefore, no wind rose can be drawn which actually shows the distribution of odors from the treatment plant

27) This statement has been clarified to indicate that the proposed facilities will in fact probably be constructed well before 1985

personal damages, such as sleeplessness and discomfort

Odors are the perceptable signals of poor operation and the aspect of the plant most obvious to the public Priority for reduced odors could alleviate the present citizen outcry against Albuquerque's Wastewater Treatment system

- Metals -

The action proposed in the DEIS and the Facility Plan to meet the metals standards of the Stipulation is reliance on activated sludge treatment. In addition the liquid waste ordinance is to be enforced, with emphasis on large contributors of metals

The proposed alternative quite properly rejects the course of simply meeting effluent limits by means of activated sludge treatment. Instead the proposed action acknowledges the need for minimizing metals levels in sludge It is noted in the DEIS that "the activated sludge facilities have not yet operated in a fully effective manner" (DEIS p 25) Should the sludge begin to exhibit high levels of metals more pretreatment measures will have to be considered Therefore this strategy should be among those actions which must be reevaluated

28) The discussion of this alternative suffers from a rosy view of reality. The City of Albuquerque has been committed to enforcement of metals limitations on industries since August of 1973 by virtue of the Stipulation Ordinances dealing with metals discharges have been on the books for many years Nonetheless the City's data reveals frequent violations of the ordinance, and a seemingly lackadasical attitude towards monitoring and other enforcement measures[17] The only mention in the DEIS of the existing problems with enforcement of the ordinance are found in the Summary where it is noted that a problem related to wastewater management in Albuquerque is " .the discharge of heavy metals by some industries in amounts which violate the City Liquid Waste Ordinance" (DEIS p iv)

29) Given the gap between an ordinance on the books and enforcement, the DEIS and the Facility Plan should have required specific commitments from the City regarding enforcement Two excellent "suggestions" in the

28) Section 2.1 3 has been revised to include additional statements regarding the past lack of enforcement of the ordinance

29) The City made such a commitment at the Public Hearing (see Appendix B). In its adoption of the Facilities Plan, the City Council has made a commitment to the cited suggestions

Facilities Plan should have become specific pledges by the City requiring installation of sampling manholes, and the construction of a toxic waste facility by the City[18]

30) The proposed action of "progressive enforcement" lacks sufficient clarity While the exact numbers will have to be arrived at as an amendment to the Stipulation, and following City legislative action, a disturbing inconsistency appears in the DEIS and the Facility Plan The Facility Plan speaks of enforcing the Ordinance against contributors of declining amounts, ".. to the point where no further significant reductions in plant influent concentrations can be attained."[19] The DEIS, on the other hand, seems to interpret the purpose of progressive enforcement as preventing industrial "dumps" (DEIS p.159). Clarification in the DEIS that progressive enforcement would not mean abandoning concern over metals levels in sludge should rectify this confusion.

30) Section 3 8 has been revised to clarify the concept of progressive enforcement

- Conservation -

31) While the city of Albuquerque appears to be committed to water conservation measures (see DEIS p 178), we find no proposed actions or detailed discussion of actual conservation measures Possible actions are only listed and not evaluated, a severe short-coming found in many areas of the DEIS The reader has no real idea which measures would have what impact on Albuquerque water use Such measures merit reevaluation as more concrete ideas of conservation options for the city are developed Such reevaluations need to be a part of the proposed action. For example, p 178 mentions the insignificant impact of high summer waterwaste on treatment plant flows While this appears to be valid on the surface, some aspects of this relationship break down under closer scrutiny. Were the 3,600,000,000 gallons or (at 3 acre feet per million gallons) 10,000 acre feet per month (DEIS p 93) reduced significantly, the water rights question so important to land application would again be less overwhelming Less wastewater flow would be needed to offset less groundwater pumping, and the precious groundwater resources would be maintained for future use

31) The discussion of water conservation measures has been expanded to indicate the amount of flow reduction which might be accomplished by a conservation program, and to state the additional water rights benefits of indoor or outdoor conservation.

32) Again, were serious consideration given to low water toilets, significant wastewater flow reductions would result Given the high cost of treatment plants, such options merit consideration in depth Composting toilets, or closed loop oil flush modifications on regular toilets offer minimal water waste solutions not mentioned in detail in the DEIS, though such options could significantly affect the wastewater flow in Albuquerque

There and other low water or water reuse options (e g graywater reuse on lawns and gardens) deserve more than passing mention Such alternatives are likely to be mandated in the future EPA shouldn't allow Albuquerque's decisionmakers to slough off such solutions simply because they are new, or radical (relating to the root) solutions to a problem The energy and water conservation issues will heat up rapidly in the future, and radical solutions may be the only answers As new information comes in, reevaluation of conservation will be in order

33) Albuquerque should not close itself off to such options should further study establish their worth

Another problem of wastewater reduction measures open is in reference to sewering the South Valley, and by analogy other areas being sewered in the near future Sewer facilities will perhaps be prohibitively

34) expensive (what will hook-up and monthly costs be?) for low income South-Valley residents and will further increase control of the city outside its boundaries Were individual waterless toilets considered, possible advantages would include relatively low costs, elimination of sewer lines, and SouthValley residents owning their own system and not being required to purchase city services. There is a chance fitting these and other existing homes with waterless toilets would pay for itself in reduced flow benefits Such scenarios deserve reevaluation in the future as more become known about their costs These options are no more outlandish than

35) requiring low-income people to fork over $5-7,000, plus $20 per month, for sewerage After making them suffer 15 years of odor nuisances in their neighborhood, they will likely now pay for and contribute to future nuisances

32) In general these options are not now technically feasible. For example, there is considerable uncertainty about the long-term reliability of composting toilets Graywater reuse on lawns and gardens may be practiced on a small scale by willing individuals; it has not been demonstrated that such reuse will be accomplished voluntarily on a large scale, or that a government agency may reasonably impose such reuse without additional research regarding health, aesthetic and other impacts

33) All those facilities proposed as part of Phase II need to be built within the next few years to handle increases of flow resulting from population growth and sewer line extensions It is unlikely that any feasible conservation programs would eliminate the need for this construction. On the otherhand the expansion known as Phase II depends entirely on future increases of wastewater flow, and will not be brought on-line until about 1990 Should the City determine that particular conservation measures are worthwhile, the resulting flow reduction would postpone or possibly eliminate the need for Phase III. Thus the City retains all options now available with regard to conservation

34) Section 3 3 4 has been revised to address the question of hookup expenses for valley residents Waterless toilets are not considered a demonstrated technology at this time, nor do they eliminate the need for wastewater disposal They do not overcome the fundamental problems associated with use of septic tanks and cesspools on small lots where the water table is shallow, and they would not have the benefits of sewers with regard to increasing property values, increasing access to bank loans, and elimination of wastewater-related water-borne enteric diseases.

35) Personal communication with Mr Robinson indicates that this comment contains a typographical error and should refer to a charge of $500-700. See 3 3 4 for discussion of time payment procedures for connection charges The anticipated monthly charge (exclusive of time payments) is not expected to exceed $10 in the next few years

36) We recommend the Final EIS include the following summary, developed by Lee Wilson, of the water quality criteria for the 14 metals listed Such data is essential to understanding the importance of maintaining minimal metal concentration in aquatic systems

FOOTNOTES

1 Draft Environmental Impact Statement for Albuquerque Wastewater Treatment Facilities

Project No C-35-1020-01, Albuquerque, New Mexico, Environmental Protection Agency, Region VI, Dallas, Texas June, 1977

2. U S GAO, "Federal State Local and Public Roles in Construction of Wastewater Treatment Facilities," RED-76-45, December 5, 1975

U.S. GAO, "Continuing Needs for Improved Operation and Maintenance for Municipal Waste Treatment Plants," CED-77-49, April 11, 1977

3. CDM 1977, in DEIS.

4. MMC 1977, in DEIS.

5 CDM 1977, cover letter, signed John Rattray, VP, CDM

6 Supplemental Agreement No 4, dated June 10, 1977 between City of Albuquerque and Wm. Matotan and Associates

7. CDM 1977, p I-8

8. DEIS, p 23

9. MMC 1977, Appendix G

10. CDM 1977, p I-5.

11. See Jolley, Journal of Water Pollution Control Federation, 47-601 (1975)
See Glaze, Jolley et al "In Identification and Analysis of Organic Pollutants in Water," Ann Arbor Science Publishers, Inc , Ann Arbor, Michigan.

See Glaze and Henderson, JWPCF 47,2511 (1975)

See JWPCF, Literature Reviews June 1976, and June 1977, "Disinfection "

12 This data marks the furthest population projection and no actions are proposed past 1995, DEIS executive summary

36) The cited material is attached. Two points of clarification are required The material was prepared by Ann Claassen of Lee Wilson and Associates, Inc The material was prepared early in the process of environmental analysis, and parts may have been rendered out-of-date by subsequent investigations which are reported in Section D-5 of the Technical Reference Document.

13 Bernalillo County Assessor's Office

14 MMC 1977, p 76

15. What is the cost of local grown alfalfa versus the cost of growing and trucking alfalfa into the Albuquerque area Charles Diebold's $30/ acre profit on 4,500 acres yields $135,000

16 "Residents Criticize City Sewage Treatment," Albuquerque Journal, July 22, 1977, p A-9

17 The reference to the City's "intensive industrial samplying program" at vol I, pg 95, is curious in light of the data available from the City

18 MMC 1977, p 95-6

19 MMC 1977, p 96

WATER QUALITY CRITERIA

Standards and existing levels in Albuquerque for Arsenic, Barium, Boron, Cadmium, Chromium, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, and Zinc

ARSENIC

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
drinking water	EPA (1)	0.1 mg/l	Adverse physiological effects on humans: gastrointestinal, kidney, liver, neural, bone marrow, and skin disorders and injury; fatigue
	EIA (2)	0.05 mg/l	May be harmful to human health.
	EIA (3)	0.01 mg/l (PHS '62)*	A considerable proportion is retained by the body even at low intake levels.
general	Alb. stipulation (4)	0.05 mg/l from a non-residential point source 0.05 mg/l in treatment plant effluent;0.075 mg/l for sure	
irrigation	EPA (1)	0.10 mg/l for continuous use on all soils 2 mg/l for use up to 20 yrs. on fine textured neutral to alkaline soils	Accumulation of arsenic to toxic levels in the soil. Reduction of the rate of growth of plants.
	EIA (2)	0.05 mg/l	
livestock	EPA (1)	0.2 mg/l	Toxicity to animals. This level provides the necessary caution.
	EIA (2)	0.05 mg/l	

* United States Public Health Service Drinking Water Standards, 1962

ARSENIC - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER .05 mg/l and .1 mg/l	No. OF TESTS
plant #1 influent	5/74 - 7/74	-.028	.100	-.010	4% and 0%	50
effluent	11/74 - 6/75	-.012	-.030	-.010	0% and 0%	20
plant #2 influent	6/74 - 7/74	-.022	.860	-.010	2% and 2%	44
effluent	12/74 - 6/75	-.012	-.030	-.010	0% and 0%	18
Rio Grande at Barelas bridge (above plants)	12/74 - 5/75	-.010	.010	-.010	0% and 0%	8
Rio Grande at Isleta diversion (below plants)	12/74 - 5/75	-.010	.010	-.010	0% and 0%	7
Albuquerque wells (3)	1974	-.0262	.180	negative	3% and 2%	62
New Mexico drinking water sources (5)	1962 - 1963	-.010				

Major Albuquerque contributors: Sunbell Corporation

discussion

Arsenic is notorious as a poison. It is present in all living tissues in inorganic and organic forms. It has been used medicinally and is considered to be a safe feed additive (as a growth stimulant) for certain domestic animals. The toxicity of arsenic depends on its form. Inorganic oxides are much more toxic than organic forms. The trivalent ion is considerably more toxic than the pentavalent species. The pentavalent inorganic form is probably the most prevalent in drinking water.

Arsenic is poisonous to microorganisms and acutely toxic to invertebrates. The acute toxicity of inorganic arsenic to domestic animals ranges from 0.05 grams per animal for poultry to 30 g per animal for cattle. 130 mg can be lethal to humans. 27 ppm is acutely toxic to young salmon and trout; 20 - 250 ppm is chronically toxic to minnows. The hazard of arsenic is that it can accumulate faster than it is excreted. A succession of small amounts taken in from the air, water, and food can add up to a lethal dose.

There has been some concern that arsenic may be carcinogenic, but the evidence is not strong. In fact, one study found a significant decrease in tumor incidence when sodium arsenite was fed to mice and rats.

Sources for arsenic in the water include industry,mining, laundry detergent, and pesticides. Natural waters seldom contain more than 0.2 mg/l arsenic.

BARIUM

WATER USE	AGENCY	STANDARD(concentration not to be exceeded)	RATIONALE(effects expected if limit exceeded)
drinking water	EPA (1)	1 mg/1	Adverse physiological effects: cardiovascular and nervous systems affected. Standard based on the barium-in-air standard, plus a safety factor, since there is no study on the amounts of Ba that can be be tolerated in drinking water.
	EIA (2)	1 mg/1	May be harmful to human health.
	EIA (3)	1.0 mg/1 (PHS '62)*	Toxic effect on the heart, blood vessels, and nerves.
general	Alb. stipulation (4)	5.0 mg/1 from a non-residential point source 1.0 mg/1 in treatment plant effluent	

EXISTING LEVELS

LOCATION	PERIOD	(mg/1) AVERAGE	HIGH	LOW	%TEST RESULTS OVER 1mg/1	No. OF TESTS
plant #1 influent	7/74	.293	.820	.030	0%	29
effluent	1/75 - 5/75	.260	.370	.160	0%	9
plant #2 influent	7/74	.224	.310	.010	0%	29
effluent	1/75 - 5/75	.210	.310	.110	0%	9
Rio Grande at Barelas bridge (above plants)	1/75 - 5/75	.235	.310	.120	0%	10
Rio Grande at Isleta diversion (below plants)	1/75 - 5/75	.284	.370	.170	0%	10
Albuquerque wells (3)	1974	-.580	1.000	-.500	0%	58
New Mexico drinking water sources (5)	1962 - 1963		.050	.025		

Major Albuquerque contributors: no industrial samples tested exceeded 5.0 mg/1.

discussion

Barium in the water comes largely from ores. It is used for paper manufacturing, fabric printing and dyeing, and synthetic rubber manufactering. All water-soluble barium compounds are poisonous; however, its solubility is limited by sulfates and carbonates, with which barium rapidly precipitates. Barium does not accumulate in the t: :. - f g ( )e l t mai

BORON

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
drinking water	EPA (1)	More information is needed before deciding if specific limits on boron are needed for physiological reasons.	
	EIA (3)	1 mg/l (PHS '62)*	Ingestion of large amounts can affect the central nervous system. 1 mg/l provides a good factor of safety and considers the use of water for home gardening
irrigation	EPA (1)	0.75 mg/l for sensitive crops on all soils 1 mg/l for semitolerant plants 2 mg/l for tolerant plants 2 mg/l on neutral and alkaline fine textured soil for 20 yrs.	Boron is essential for the growth of plants, but toxic at high enough levels. Toxicity depends on plant species and type of soil (how absorptive). These limits should prevent boron from accumulating to toxic levels.
	EIA (2)	0.75 mg/l	
livestock	EPA (1)	5.0 mg/l	Small possibility of toxicity. This limit provides for a large margin of safety.
general	Alb. stipulation	1.0 mg/l from a non-residential point source .75 mg/l in treatment plant effluent	

BORON - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER 0.75 mg/l	NO. OF TESTS
plant # 1 influent	6/74,7/74,12/74	-.614	-1.000	.090	34%	44
effluent	1/75,4/75,5/75	-.570	-1.000	.080	20%	10
plant # 2 influent	6/74,7/74,1/75	-.493	-1.000	-.100	24%	41
effluent	2/75,4/75,5/75	-.600	-1.000	.110	33%	12
Rio Grande at Barelas bridge (above plants)	1/75,2/75,4/75 5/75	-.320	-1.000	.020	25%	8
Rio Grande at Isleta diversion (below plants)	1/75,2/75,4/75 5/75	-.316	-1.000	.030	25%	
Albuquerque wells (3)	1974	-.332	-.500	-.250	0%	59
New Mexico drinking water sources (5)	1962 - 1963		.090	.030		

Major Albuquerque contributors: Sunbell Corporation, Sparton Southwest, University Heights Hospital, G.T.E. Lenkurt

discussion

Boron is an essential element for plants, but is not required by animals. It has a low order of toxicity, and there is no evidence that it accumulates in the body tissues. In most natural waters, the concentration of boron is well below 5 mg/l.

There is only meager evidence of boron toxicity to animals. 2500 mg/l in the drinking water will inhibit animal growth. 250 - 330 mg/kg is lethal to humans. 2000 mg/l had no effect on trout; 18,000 to 19,500 mg/l is the minimum lethal dose for minnows. (The figures for fish are of boron as boric acid.)

The accumulation of boron in the soil is an adsorption process; the adsorptive capacity of the soil must be saturated before soluble boron levels of 1 to 2 mg/l can exist. Levels above 4 mg/l are unsatisfactory for nearly all plants.

Sources of boron in the water include chemical, petroleum, pottery and porcelain, wood preservation, glass, and textile industries. Sodium borate is used in herbicides.

CADMIUM

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
aquatic life (freshwater)	EPA (1)	.03 mg/l in waters with a total hardness greater than 100 mg/l and .004 mg/l in waters with a hardness 100 mg/l or less	Toxicity to aquatic life, such as rainbow trout, fathead minnows, and Daphnia magna.
		.003 mg/l for hard water .0004 mg/l for soft water	Toxicity to crustaceans. Death of eggs and larvae of salmon.
drinking water	EPA (1)	.010 mg/l	Adverse physiological effects: cardiovascular disease, hypertension, violent nausea, Itai - Itai disease.
	EIA (2)	.01 mg/l	May be harmful to human health.
	EIA (3)	.01 mg/l (PHS '62)*	Interference with the metabolism and arterial changes in humans. Cadmium is non-essential, non-beneficial, and has high toxic potential.
general	Alb. stipulation	.02 mg/l from a non-residential point source. .01 mg/l in treatment plant effluent; .015 mg/l for sure	
irrigation	EPA (1)	.01 mg/l for continuous use on all soils .05 mg/l on neutral and alkaline fine textured soils for 20 yrs.	Phytoxicity to plants, decreased yields, accumulation in plants. There is a lack of soils information in relation to Cd. Potential problems in foods and feeds grown with high Cd concentrations.
	EIA (2)	.01 mg/l	
livestock	EPA (1)	50 ug/l	Toxicity to animals: accumulation in body tissues. This level is not likely to be exceeded in natural waters.
	EIA (2)	.01 mg/l	

CADMIUM - EXISTING LEVELS

LOCATION	PERIOD	AVERAGE	(mg/l) HIGH	LOW	%TEST RESULTS OVER 0.01 mg/l	NO. OF TESTS
plant #1 effluent	9/72 - 7/73	-.005	.110	-.001	3%	200
influent	1/74 - 6/75	-.006	.170	-.001	5%	548
plant #2 influent	7/72 - 7/73	-.004	.120	-.001	1%	737
effluent	7/74 - 6/75	-.004	.050	-.001	1%	232
Rio Grande at Barelas bridge (above plants)	11&12/72, 2-9/73,1&2/74 12/74 - 5/75	-.003	.012	-.001	5%	189
Rio Grande at Isleta diversion (below plants)	same as Barelas	-.003	.020	-.001	5%	184
Albuquerque wells (3)	1964	-.007	.010	-.010	0%	64
New Mexico drinking water sources (5)	1962 - 1963		-.013	-.006		

Major Albuquerque contributors: Brother's Plating, Kaehr Plating, Alamo Radiator, State Lab(EIA), Sanitary Laundry, University of New Mexico, Bataan Hospital, Aladdin, General Electric, Duke City Bumper, Bumper and Supply, Four Hills, Royal Crown Cola

discussion

Cadmium is a biologically nonessential and nonbeneficial element with a high potential for toxicity. In mammals and fish it causes an insidious, progressive chronic poisoning, because there is almost no excretion of the metal. The toxicity of cadmium is determined by its concentration, rather than an absolute amount. Equivalent concentrations are more toxic in water than in food. Only a small part of ingested cadmium is absorbed; that which is is accumulated in the liver and kidneys and has a very slow turnover rate. However, most major animal products, including meat and milk, are well protected against cadmium poisoning. Cadmium will act synergistically with other metals. No-effect levels have not been established for humans.

Cadmium is obtained as a by-product of zinc smelting. It is also found in superphosphate fertilizers and pesticides. Water carrying pipes, food, electroplating plants, and ore processing are other sources of cadmium in the water. Cadmium is present in nearly all drainage waters, though usually at very low levels.

CHROMIUM

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
aquatic life (freshwater)	EPA (1)	0.05 mg/l	Toxicity to aquatic life. This level protects Daphnia and certain diatoms which are particularly sensitive.
drinking water	EPA (1)	0.05 mg/l	Potential toxicity to humans. Causes lung tumors when inhaled and induces skin sensitization. No-effect levels not established.
	EIA (2)	0.05 mg/l	May be harmful to human health.
	EIA (3)	0.05 mg/l	Effects not known. 0.05 mg/l set by the U.S, Public Health Service based on the lowest amount analytically determinable at the time the standard was established.
general	Alb. stipulation	5 mg/l from a non-residential point source 0.01 mg/l in treatment plant effluent	
irrigation	EPA (1)	0.1 mg/l for continuous use on all soils. 1.0 mg/l on neutral and alkaline fine-textured soils for 20 yrs.	Toxicity to corn. Causes reduced growth and iron deficiencies in plants. Little is known about the accumulation of Cr in soil relative to its toxicity.
	EIA (2)	0.05 mg/l	
livestock	EPA (1)	1.0 mg/l	Up to 5 mg/l is believed to not be harmful to livestock. 1 mg/l provides for a margin of safety.
	EIA (2)	0.05 mg/l	

CHROMIUM - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER 0.05 mg/l	NO. OF TESTS
plant #1 influent	9/72 - 7/73	.050	.290	-.010	32%	549
effluent	1/74 - 6/75	.030	.090	.010	5%	198
plant #2 influent	9/72 - 7/73	.070	12.500	-.010	34%	737
effluent	1/74 - 6/75	.040	2.000	-.010	14%	271
Rio Grande at Barelas bridge (above plants)	11&12/72,2-9/73 1&2/74,12/74-5/75	-.020	.200	-.010	2%	107
Rio Grande at Isleta diversion (below plants)	same as Barelas	-.020	.100	-.010	2%	92
Albuquerque wells (3)	1974	-.030	-.050	-.010	0%	60
New Mexico drinking water sources	1962 - 1963		-.006	-.005		

Major Albuquerque contributors: Bumper and Supply, Brother's Plating, Aladdin Plating, Duke City Bumper, Kaehr Plating, Bataan Hospital, Alamo Radiator, General Electric, UNM

discussion

Chromium can be detected in most biological systems and there is reasonable evidence that it plays a biological role. 5 mg/l of Cr^{+3} in the drinking water of mice and rats has beneficial effects, including increases in growth rate, survival, and longevity. Small additions of chromium to the soil can give increased crop yields. Chromium has a rather low level of toxicity. The hexavalent form (Cr^{+6}) is much more toxic than the trivalent form (Cr^{+3}). Trivalent chromium is not likely to be found in waters with pH above 5, because its hydrated oxide is not very soluble. Up to 25 mg/l in drinking water has no known ill effects on humans, other than possibly some nausea and vomiting at higher levels. Up to 25 mg/l is not toxic to rats. Chromium is not readily absorbed by animals, and does not tend to accumulate in the tissues at levels below 5 mg/l.

There is a great range of sensitivity to chromium among different aquatic species. Some lethal levels were found to be: 17 -118 mg/l for fish, 0.05 mg/l for invertebrates, and 0.032 to 6.4 mg/l for algae.

Sources for chromium in the water include plating wastes, blowdown from cooling towers, and circulating water in refrigeration equipment. It is rarely found in natural waters; most waters contain less than 0.05 mg/l of Cr^{+6}.

COPPER

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
aquatic life (freshwater)	EPA (1)	The 96-hr LC50# determined using the most sensitive important species in the area as test organism, multiplied by a factor of 0.1	Toxicity to fish, such as minnows and brook trout, and particularly to algae and mollusks. Detrimental effects on reproduction and growth.
drinking water	EPA (1)	1 mg/l	Taste problems.
	EIA (2)	1 mg/l	Above this is undesirable for reasons other than human health.
	EIA (3)	3.0 mg/l (PHS '62)*	Taste problems.
general	Alb. stipulation (4)	1.0 mg/l from a non-residential point source 0.1 mg/l in treatment plant effluent; 0.2 mg/l for sure	
irrigation	EPA (1)	0.20 mg/l for continuous use on all soils 5.0 mg/l on neutral and alkaline fine-textured soils for 20 yrs.	Toxicity to plants. A safety margin may be added by liming the soil.
	EIA (2)	1 mg/l	
livestock	EPA (1)	0.5 mg/l	Toxicity, especially to sheep. Few natural waters should fail to meet this standard.
	EIA (2)	1 mg/l	

The 96-hr LC50 is the concentration which will kill 50% of the test organism within 96 hours.

COPPER - EXISTING LEVELS

LOCATION	PERIOD	(mg/1) AVERAGE	HIGH	LOW	% TEST RESULTS OVER .1, .2, and 1.0 mg/1	NO. OF TESTS
plant #1 influent	9/72 - 7/73	.149	3.100	.020	72%, 13%, 1%	554
effluent	1/74 - 6/75	.091	.750	.030	34%, 3%, 0%	201
plant #2 influent	7/72 - 7/73	.202	1.200	.010	87%, 42%, 0.1%	741
effluent	7/74 - 6/75	.137	.900	.030	60%, 12%, 0%	238
Rio Grande at Barelas bridge (above plants)	11,12/72 2-9/73;1,2/74 12/74 - 5/75	-.016	.110	.005	0.5%, 0%, 0%	190
Rio Grande at Isleta diversion (below plants)	same as Barelas	-.018	.120	.005	1%, 0%, 0%	184
Albuquerque wells (3)	1974	-.020	-.050	-.025	-78%, -78%, 0%	63
New Mexico drinking water sources	1962 - 1963		.020	.003		

Major Albuquerque contributors: G.T.E. Lenkurt, Sparton Southwest, Sunbell Corp., Alamo Radiator, Kaehr Plating, Bumper and Supply

discussion

Copper is an essential and beneficial element in the human metabolism. A deficiency in copper results in nutritional anemia in infants. Since the normal diet provides only a little more than is required, copper in the drinking water may prevent deficiencies of this element. In small doses (10 - 30 mg), copper is not toxic. 60 to 100 mg will cause gastrointeritis and nausea, liver damage may result from large doses, and 10,000 mg/kg is lethal to humans.

Copper is also an essential trace element for livestock and poultry. Most livestock are tolerant of rather high levels of copper, though sheep are not. 18,000 to 180,000 mg/kg is the lethal level for sheep.

Copper salts have bactericidal properties, and copper sulfate is used in algae control. Copper is also toxic to invertebrates, fish, and plants. It exhibits synergistic effects with zinc, cadmium, mercury, and pentachlorophenate.

Sources for copper in the water include industrial effluents, corrosive action of water on copper and brass tubing, herbicides, and the weathering of rock. Most natural waters contain less than 0.5 mg/1 of copper.

LEAD

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
aquatic life (freshwater)	EPA (1)	0.03 mg/l	Toxicity: effects on reproduction. Based on the safe level for Daphnia magna, because preliminary tests show it is probably also the safe level for the fathead minnow, brook trout, rainbow trout, guppies, sticklebacks, and goldfish.
drinking water	EPA (1)	0.05 mg/l	Toxicity: gastrointestinal disturbances, mental confusion, visual disturbances, paralysis, anemia.
	EIA (2)	0.05 mg/l	May be harmful to human health.
	EIA (3)	0.05 mg/l (PHS '62)*	Very toxic taken in by either brief or prolonged exposure. A cumulative poison.
general	Alb. stipulation	0.1 mg/l from a non-residential point source 0.05 mg/l in treatment plant effluent; 0.075 mg/l for sure.	
irrigation	EPA (1)	5.0 mg/l for continuous use on all soils 10 mg/l on neutral and alkaline fine-textured soils for 20 yrs.	Phytotoxicity relatively low.
	EIA (2)	0.05 mg/l	
livestock	EPA (1)	0.1 mg/l	Potential toxicity. Apparently decreases disease resistance. May accumulate in tissues and milk in levels toxic to humans.
	EIA (2)	0.05 mg/l	

LEAD - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER 0.05 mg/l	NO. OF TESTS
plant #1 influent	9/72 - 7/73	-.104	.540	.010	87%	550
effluent	1/74 - 6/75	-.055	.150	-.020	61%	196
plant #2 influent	7/72 - 7/73	-.079	.600	-.010	82%	821
effluent	7/74 - 6/75	-.044	.500	.010	28%	236
Rio Grande at Barelas bridge (above plants)	11&12/72,2/73-9/73,1&2/74, 12/74 - 5/75	-.024	.300	-.010	5%	190
Rio Grande at Isleta diversion (below plants)	same as Barelas	-.026	.110	.005	8%	184
Albuquerque wells (3)	1974	-.011	.022	negative	0%	63
New Mexico drinking water sources (5)	1962 - 1963		-.025	-.010		

Major Albuquerque contributors: Alamo Radiator, G.T.E. Lenkurt, American Linen Supply, Kaehr Plating, Sparton Southwest, Royal Crown Cola, Aladdin Plating, University of New Mexico, Sanitary Laundry, Bataan Hospital, Brother's Plating, Sexton Plating, Sunbell Corp.

discussion

Lead is an element for which there is no nutritional need and which can be toxic. It is a cumulative poison, having a tendency to accumulate in tissues. Chronic lead poisoning is similar to multiple sclerosis in its symptoms, and excess chromosomal breaks have been found in chronically poisoned human beings. Cattle and sheep are considerably more resistant to lead toxicity than horses.

The toxicity of lead to plants is low; in fact, there is not sufficient evidence to indicate that lead, as it occurs in nature, is toxic to vegetation.(ref. 1,p. 343) It may inhibit cell proliferation. The principal entry of lead into plants is from aerial deposits, indicating that lead which falls on the soil may not be available to plants.

Lead is absorbed from food, the air, water, and tobacco smoke. Sources for lead in water include industry, the action of water on lead pipes, and deposition from polluted air. The lead concentration in natural waters seldom exceeds 0.05 mg/l.

MANGANESE

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
drinking water	EPA (1)	0.05 mg/l of soluble manganese (Mn^{++})	Taste problems, staining of plumbing fixtures and laundry, accumulation of manganese deposits in distribution system.
	EIA (2)	0.2 mg/l	Undesirable for reasons other than human health.
	EIA (3)	0.05 mg/l (PHS '62)*	Unpleasant tastes and stains. Fosters growth of some micro-organisms in resevoirs and filter and distribution systems.
general	Alb. stipulation (4)	1.0 mg/l from a non-residential point source 0.1 mg/l in treatment plant effluent	
irrigation	EPA (1)	0.20 mg/l for continued use on all soils 10 mg/l on neutral and alkaline fine-textured soils for 20 yrs.	Toxicity to many crops, especially in acid soils. The allowable concentration can be increased with alkaline and calcerous soils and with crops having higher tolerance.
	EIA (2)	0.2mg/l	
livestock	EPA (1)	An upper limit of acceptability is not necessary.	Manganese is a required trace element, and it is unlikely that it would be found at toxic levels in supply waters.

MANGANESE -EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER .05, .1, and .2 mg/l	NO. OF TESTS
plant #1 influent	2/73 - 6/73	.062	1.600	.030	30%, 2%, 0.4%	501
effluent	1/74 - 6/75	.048	.120	.020	20%, 0.7%, 0%	151
plant#2 influent	2/73 - 7/73	.050	.170	.010	33%, 2%, 0%	508
effluent	7/74 - 6/75	.040	.110	.020	16%, 0.5%, 0%	191
Barelas extractable	3/73 - 9/73	.604	9.400	.010	98%, 96%, 85%	80
filtrate	1&2/74,1-5/75	-.028	.280	-.010	12%, 5%, 3%	74
Isleta extractable	same as Barelas	-.574	3.400	-.010	99%, 97%, 91%	74
filtrate		-.044	.680	-.010	9%, 8%, 5%	75
Albuquerque wells (3)	1974	-.05	.05	.02	0%, 0%, 0%	63
New Mexico drinking water sources (5)	1962 - 1963		-.013	-.006		

Major Albuquerque contributors: No industries in Albuquerque that have been tested have been found to produce manganese in excess of the maximum allowable concentration.

discussion

Manganese is a required trace element for animals, but can be toxic in high enough amounts. It is unlikely that toxic amounts would be present in water supplies. Surface waters rarely contain more than 1 mg/l of manganese, since its carbonates, oxides and hydroxides are only slightly soluble. There is a possible association of manganese toxicity with hemochromatosis. 0.005 mg/l is toxic to some algae. 0.05 mg/l is not toxic to fish. The toxicity of manganese towards crops is associated with acid soils, decreasing with increasing pH. Sources for manganese include weathering of rock, mining, inks, dyes, glass, ceramics, matches, dry-cell batteries, paints and varnishes.

MERCURY

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
aquatic life (freshwater)	EPA (1)	Total body burden 0.5 ug total Hg per g wet weight of any aquatic organism & 0.2 ug/l at any time or place & 0.05 ug/l total Hg as the average in unfiltered water.	Toxicity. Fish, such as Northern Pike and rainbow trout, phytoplankton, macrophytes, and other aquatic life magnify Hg concentrations from the water and the food chain. These limits should protect selected species of fish and predatory aquatic organisms.
drinking water	EPA (1)	0.002 mg/l	Adverse physiological effects, both acute and chronic: neurological disorders, kidney damage, muscle tremors and spasms, nausea, death.
	EIA (2)	0.002 mg/l	May be harmful to human health.
	EIA (3)	0.005 mg/l (Technical Review Committee Tentative Standards)	Severe neurological disorders. Toxicity to aquatic life.
general	Alb. stipulation (4)	.005 mg/l from a non-residential point source .001 mg/l in treatment plant effluent; .0015 mg/l for sure	
livestock	EPA (1)	10 ug/l	This limit provides an adequate margin of safety to humans, who will subsequently not be exposed to as much as 0.5 ppm of Hg through consumption of animal tissue.
	EIA (2)	0.0002 mg/l	

MERCURY - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER .002mg/l	NO. OF TESTS
plant #1 influent	6/74 - 6/75	-.003	.040	-.001	51%	190
effluent	" "	-.002	.004	-.001	10%	52
plant #2 influent	" "	-.002	.150	-.001	14%	356
effluent	" "	-.001	.005	-.001	8%	86
Rio Grande at Barelas bridge (above plants)	12/74-5/75	-.001	.005	-.001	0%	11
Rio Grande at Isleta diversion (below plants)	" "	-.001	.002	-.001	0%	11

Major Albuquerque contributors: State Lab (EIA), Alamo Radiator, G.T.E. Lenkurt

discussion

Mercury is ubiquitous in the environment. It sorbs readily onto a variety of materials, including the bottom sediments of streams. There it may undergo biological methylation by micro-organisms. It enters the food chain through uptake by aquatic plants, lower animals, and fish. Mercury causes both acute and chronic poisoning. Trace copper will increase the toxicity of mercury. Mercurous (Hg^{+}) salts are less toxic than mercuric (Hg^{++}) because of being less soluble in the digestive tract. Organic compounds are the most toxic mercury derivatives to humans, especially alkyl mercury compounds. About 90% of ingested methyl mercury is absorbed, as opposed to 2% of ingested mercuric ion. The half-life of methyl mercury in humans is about 70 or 80 days. Alkyl mercury poisoning may manifest itself after a few weeks or not until a few years. 0.2 ppm is the lowest whole blood concentration of methyl mercury which produces toxic symptoms in humans; 20 - 30 mg of mercuric salts is a fatal dose. Mercury will cause excessive chromosomal breaks and inhibition of mitosis. Mercury is present in food, especially fish. The FDA has set 0.5 mg/kg as the maximum allowable concentration of mercury in fish to be consumed by humans.

Aquatic organisms concentrate metyl mercury in their bodis directly from water or through the food chain. Freshwater phytoplankton, macrophytes, and fish are capable of concentrating mercury from the water 1000 to 10,000 times. The half-life of mercury in fish is considerably longer than in humans - about two years. Fish can survive relatively high concentrations of mercury for short periods; the lethal concentration is lowered as exposured time is lenghtened. 1 mg/l of inorganic mercury was found to be fatal to fish within 96 hours; over ten days, 10-20mg/l was lethal. 0.2 ug/l of methyl mercury killed fathead minnows. Gammarus, Daphnia, top minnows, and brook trout were no more sensitive. Mercury alters the epithelium of fish skin and gills and causes severe disturbance of egg development. Some species of phytoplankton are particularly sensitive to mercury toxicity.

Alkyl mercury has a high degree of stability in the body, resulting in a cumulative effect. Its half-life in most animal species is 20 - 70 days. It concentrates in the brain, liver and kidney, and may be transferred to fetuses and eggs.

Sources for mercury in the water include leaching from geological formations, smelting of ores, industrial and agricultural applications, burning of fossil fuels, and dumping of consumer products into sewers.. U.S. waters usually contain less than 0.5 ug/l. The low concentrations recommended for aquatic life by the EPA are difficult to determine; therfore a standard for mercury levels in fish, which is easier to measure, is included.

MOLYBDENUM

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
drinking water	EIA (3)	0.01 mg/l	
general	Alb. stipulation	0.010 mg/l from a non-residential point source 0.01 mg/l in treatment plant effluent	
irrigation	EPA (1)	0.010 mg/l for continued use on all soils 0.050 mg/l for short term use on soils that react with Mo.	Based on toxicities to animals from molybdenum - containing forage.
	EIA (2)	0.15 mg/l	
	EIA (3)	(0.05 mg/l on acid soils with a large capacity to combine with Mo)	Proposed limit to protect against inducing Mo toxicity at a later time as a result of over-liming in humid and subhumid areas.
livestock	EPA (1)	Setting an upper allowable limit is not possible at this time.	There are many factors influencing the toxicity of Mo: chemical form of the element, uptake of copper and sulphur by the animal, and others.

MOLYBDENUM - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER 0.01 mg/l	NO. OF TESTS
plant #1 influent	6/74 - 8/74	-.008	.180	-.001	6 - 8%	53
effluent	12/74 - 5/75	-.010	.020	-.005	8%	13
plant #2 influent	6/74 - 8/74	-.012	.240	-.001	8 - 10%	50
effluent	12/74 - 5/75	-.009	.020	-.001	7%	15
Rio Grande at Barelas bridge (above plants)	12/74 - 5/75	-.015	.050	-.010	18%	11
Rio Grande at Isleta diversion (below plants)	12/74 - 5/75	-.014	.050	-.010	9%	11
New Mexico drinking water sources (5)	1962 - 1963		-.013	-.006		

Major Albuquerque contributors: State Lab

discussion

Molybdenum is a quite stable element and is available in a number of oxide forms, as well as a disulphide and as ferromolybdenum. It is not a serious pollutant, but is a biologically active metal. In fresh waters, molybdenum is a needed micronutrient for the growth of phytoplankton. It is also essential in animal nutrition, though the amounts required have not been established. Cattle may need something on the order of 0.01 ppm molybdenum in their dry diet.

There is no problem of toxicity to plants at the concentrations usually found in soils and water; however, molybdenum will accumulate in plant tissue in amounts porportional to that in the soil, making such plants toxic to animals. 0.01 mg/l of molybdenum in solution will produce legumes having 5 mg/kg or more. This is the commonly accepted limit for safe feeding of cattle. 5 to 30 ppm of molybdenum in forage is toxic to ruminants, the amount of toxicity being influenced by the presence of other elements, especially copper and sulphur. Pasturing on herbage with 20 - 100 ppm molybdenum (dry basis) produces a toxicosis called teart, which can be controlled by copper additions to the diet. 1 to 1.5 mg/kg/day had no effect on the growth rate, survival, or longevity of mice and rats. The 96 hour LC50 for fathead minnows was found to be 70 mg/l of molybdic anhydride (MoO_3) in soft water and 370 mg/l in hard water.

Molybdenum is used in the manufacture of special tool steels, in chemical applications, ceramic glazes, and photography. It may also enter the water from mining operations. Natural surface waters rarely contain concentrations of molybdenum greater than 1 mg/l.

NICKEL

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
aquatic life (freshwater)	EPA (1)	96-hr LC50#, determined using the most sensitive important species in the area, multiplied by an application factor of 0.02	Toxicity to aquatic life, such as, fathead minnows, Daphnia magna, goldfish, sticklebacks, and guppies. Reduced reproductinn.
drinking water	EIA (3)	0.05 mg/l	Toxicity.
general	Alb. stipulation	1.0 mg/l from a non-residential point source 0.1 mg/l in treatment plant effluent	
irrigation	EPA (1)	0.20 mg/l for continued use on all soils 2.0 mg/l on neutral fine-textured soils for up to 20 years.	Toxicity to a number of plants, e.g., tomatoes, flax, hop, barley, beans, and oats.
	EIA (2)	0.2 mg/l	
	EIA (3)	0.5 mg/l	Tentative tolerance level based on the depression of growth of flax at this level. Further investigation may suggest a lower limit.

The concentration which is lethal to 50% of the test organism within a 96 hour period.

NICKEL - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER .05, 0.1, and 0.2 mg/l	NO. OF TESTS
plant #1 influent	9/72 - 6/73	-.037	.350	-.010	17%, 4%, 1%	644
effluent	1/74 - 6/75	-.021	.240	-.010	5%, 2%,0.3%	291
plant #2 influent	6/72 - 7/73	-.045	1.600	-.010	17%, 6%, 1%	737
effluent	7/74 - 6/75	-.038	.190	.010	26%, 3%, 0%	239
Barelas extractable	11&12/72,2-9/73	-.025	.120	-.010	6%, 1%, 0%	98
filtrate	1&2/74,12/74-5/75	-.014	.370	.005	1%, 1%, 1%	92
Isleta extractable	same as Barelas	-.024	.080	-.010	3%, 0%, 0%	92
filtrate		-.011	.050	-.010	0%, 0%, 0%	91
Albuquerque wells (3)	1974	-.071	-.100	.070	??, 0%, 0%	60
New Mexico drinking water sources (5)	1962 - 1963		-.013	-.006		

Major Albuquerque contributors: Bumper and Supply, Duke City Bumper, Aladdin Plating, Alamo Radiator, Kaehr Plating

discussion

Nickel is a constituent in many ores, minerals, and soils, and is a relatively inert material. Nickel ions are toxic, especially to plants, and they exhibit synergistic effects with other metals. Nickel can substantially inhibit the biochemical oxidation of sewage. 0.5 to 2.0 mg/l is toxic to many plants; corn does not show toxic effects at 2 mg/l, but does at 10 mg/l. Increasing the pH of the soil will reduce the toxicity of nickel added to the soil. It was found that the greatest capacity for absorbing nickel without development of toxicity was by soils with 21% organic matter. Natural nickel toxicities are found in conjunction with high chromium levels in soils developed from serpentine rock.

Nickel salts in large doses cause gastrointestinal disturbances and can inhibit enzyme systems. Nickel reduced the growth rate of calves and caused nephritic kidneys. The chronically safe level for fathead minnows was determined to be 0.4 - 0.8 mg/l in hard water and 0.1 mg/l in soft water. 4 to 21 mg/kg/day for 200 days had no apparent effects on dogs and cats. 5 mg/l of Ni^{+2} gave a significant decrease in tumor incidence in mice when administered orally, but positive carcinogenicity was found in rats who received nickel by routes other than oral. Positive carcinogenicity has also been found in humans from working with nickel (lung and nasal sinuses) and from taking nickel containing drugs.

Sources for nickle in the water include mining wastes, electroplating plants, and industrial smoke.

SELENIUM

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
drinking water	EPA (1)	0.01 mg/l	Toxic effects on humans: gastrointestinal disturbances, hypotension, respiratory failure, death.
	EIA (2)	0.01 mg/l	May be harmful to human health.
	EIA (3)	0.01 mg/l (PHS '62)	Toxicity to humans and animals: increases dental caries, potential carcinogen.
general	Alb. stipulation	0.02 mg/l from a non-residential point source 0.01 mg/l in treatment plant effluent	
irrigation	EPA (1)	0.02 mg/l for continuous use on all soils	Low levels produce toxic levels in forages. Toxicity to plants.
	EIA (2)	0.01 mg/l	
livestock	EPA (1)	0.05 mg/l	Toxicity.
	EIA (2)	0.01 mg/l	

SELENIUM - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER[a] .01, .02, and .05 mg/l	NO. OF TESTS
plant #1 influent	6&7/74,12/74-6/75	-.017	-.050	-.001	6-67%,6-24%, 0%	49
effluent	6/74, 12/74 -5/75	-.011	.050	-.001	5-29%,5-24%, 0%	21
plant#2 influent	6&7/74,12/74-6/75	-.019	-.050	-.001	8-69%,6-25%, 0%	48
effluent	6/74, 12/74-5/75	-.011	-.050	-.001	0-32%,0-26%, 0%	19
Rio Grande at Barelas bridge (above plants)	12/74 - 5/75	-.017	-.050	-.001	0-43%,0-29%, 0%	7
Rio Grande at Isleta diversion (below plants)	12/74 - 5/75	-.017	-.050	-.001	0-43%,0-29%. 0%	7
Albuquerque wells (3)	1974	-.027	.340	-.010	61%, 39%, 10%	59
New Mexico drinking water sources (5)	1962 - 1963	-.010				

Major Albuquerque contributors: No Albuquerque industries tested have been found to produce selenium in excess of the maximum allowable concentration.

[a] Most selenium concentrations are reported as 'less than' a given amount. The first percentage is calculated using only absolute figures; the second percentage is calculated assuming that all concentrations are equal to their absolute value, e.g., -.030 = .030 (or at least is greater than .020).

discussion

Selenium occurs naturally in certain pasture areas. Elemental selenium is highly insoluble and must be oxidized to selenite or selenate before it appears at appreciable concentrations in water. This oxidation may be catalyzed by certain soil bacteria. Selenium is removed from water by precipitation with ferrous hydroxide and by microbial activity. Selenium toxicity resembles that of arsenic. Interestingly enough, the toxicity of selenium is sometimes counteracted by additions of arsenic. Organic selenium is more toxic than its inorganic forms. Selenite may be more toxic than selenate, and there is some indication that selenite is more toxic in drinking water than in the diet.

The normal human dietary intake of selenium is 200 ug/day and may be as high as 6340 ug/day in seleniferous areas. 2 to 4 mg/kg is the minimum lethal dose for humans. Symptoms of selenium toxicity include gastrointestinal disturbances, liver damage, dental caries, and other deleterious physiological effects. There is some suspicion that selenium may be carcinogenic, though evidence for this is slight.

Selenium is toxic to plants at low concentrations in nutrient solutions. .025 mg/l reduced alfalfa yields. Only small amounts added to the soil will increase the selenium content of forages to levels that are toxic to livestock.

Despite its toxicity at high enough levels, selenium is a dietary essential for a number of species. 0.1 to 0.2 ppm is recommended to prevent deficiencies in poultry, ruminants, and other animals. 3 to 5 mg/kg is toxic to cattle. Ruminants may be more tolerant than monogastric animals. A good part of U.S. livestock may be receiving 0.5 ppm or more of naturally occuring selenium in their diets with no ill effects nor accumulation in their tis-

sues to levels that are toxic to humans.
3 mg/l of Se^{+4} for life significantly increased the growth rate of mice, but caused most rats to die young; on the other hand, 3 mg/l of Se^{+6} significantly decreased the mouse growth rate, but significantly increased rat longetivity.
Selenium sources include photoelectric cells, manufacture of ruby glass, photography, vulcanizing rubber, and insecticidal preparatinns. Most surface waters and well waters contain less than 0.05 mg/l of selenium.

SILVER

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
drinking water	EPA (1)	No limit recommended.	Silver in waters is rarely detected at levels above 1 ug/l.
	EIA (2)	0.05 mg/l	May be harmful to human health.
	EIA (3)	0.05 mg/l (PHS '62)*	Skin and mucous membrane discoloration. Pathological changes in the kidneys, liver and spleen.
general	Alb. stipulation	0.1 mg/l from a non-residential point source 0.05 mg/l in treatment plant effluent	

SILVER - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER 0.05 mg/l	NO.OF TESTS
plant #1 influent	9/72 - 7/73	-.010	.065	-.001	0.5%	552
effluent	1/74 - 6/75	-.015	.100	-.002	1%	199
plant #2 influent	6/72 - 7/73	-.009	.070	-.001	0.1%	734
effluent	7/74 - 6/75	-.009	.100	-.002	0.4%	236
Rio Grande at Barelas bridge (above plants)	11&12/72,2--9/73 1&2/74,12/74--5/75	-.005	.025	-.001	0%	186
Rio Grande at Isleta diversion (below plants)	same as Barelas	-.004	.025	-.001	0%	180
Albuquerque wells (3)	1974	-.036	-.050	negative	0%	59

Major Albuquerque contributors: Anna Kaseman Hospital, Presbyterian Hospital, Bataan Hospital, BCMC, Kaehr Plating

discussion

Silver is a rather rare element with a low solubility - 0.1 to 10 mg/l, depending on the pH and chloride ion concentration. Silver nitrate is sometimes used as a disinfectant. The principal effect of silver on the body is that it causes a grey discoloration of the skin, eyes, and mucous membranes. The amount needed to bring about this condition (argyria) is not known, though one study found that 1 g of silver injected intravenously caused argyria. Very little of ingested silver is absorbed; once absorbed, it is held in the tissues indefinitely. Some evidence of carcinogenicity has been found in rats and mice which received silver by routes other than oral. Sources for silver include leaching of ores, electroplating, processing of food and beverages, photography, chemical applications, and jewelry.

ZINC

WATER USE	AGENCY	STANDARD (concentration not to be exceeded)	RATIONALE (effects expected if limit exceeded)
aquatic life (freshwater)	EPA (1)	96-hr LC50#, determined using the most sensitive important species in the area, multiplied by an application factor of .005.	Toxicity to aquatic life, such as, fathead minnows, trout, Bluegills, Daphnia magna.
drinking water	EPA (1)	5 mg/l	Noticeable taste.
	EIA (2)	5 mg/l	Reasons other than human health.
	EIA (3)	5.0 mg/l (PHS '62)*	This limit is set to keep cadmium and lead, which are impurities in zinc, below allowable levels.
irrigation	EPA (1)	2.0 mg/l for continuous use on all soils, assuming the soil pH is kept above 6 10 mg/l on neutral and alkaline soils for 20 years. 20 to 30 mg/l on fine-textured calcerous and organic soils	Toxicity to plants: induces iron deficiencies. Toxicity related to soil pH.
	EIA (2)	5 mg/l	
livestock	EPA (1)	25 mg/l	This limit should provide a very large margin of safety for livestock.
	EIA (2)	5 mg/l	

The concentration which is lethal to 50% of the test organism within a 96 hour period.

ZINC - EXISTING LEVELS

LOCATION	PERIOD	(mg/l) AVERAGE	HIGH	LOW	% TEST RESULTS OVER 0.5, 2 and 5 mg/l	NO. OF TESTS
plant #1 influent	9/72 - 7/73	.249	4.000	.016	6%, 1%, 0%	550
effluent	1/74 - 6/75	.138	1.300	.030	3%, 0%, 0%	199
plant #2 influent	7/72 - 7/73	.201	3.000	.010	4%,.4%, 0%	746
effluent	7/74 - 6/75	.142	2.900	.030	2%,.4%, 0%	236
Barelas extractable	11&12/72,2-9/73	.281	.780	-.010	1%, 0%, 0%	98
filtrate	1&2/74,12/74-5/75	-.028	.230	-.010	0%, 0%, 0%	92
Isleta extractable	same as Barelas	-.077	-.600	.005	0-1%, 0%, 0%	92
filtrate		-.039	.360	-.010	0%, 0%, 0%	91
Albuquerque wells (3)	1974	-.083	.890	-.025	3%, 0%, 0%	63
New Mexico drinking water sources	1962 - 1963		-.130	-.060		

Major Albuquerque contributors: Alamo Radiator

discussion

Zinc is an essential and beneficial element in human and animal metabolism. The activity of insulin and other enzymes is dependent on zinc. A deficiency in this element will cause growth retardation in animals, and in humans may result in sizeable losses of minerals from the bones. The average daily intake of adult humans is 10 to 15 mg. 10 to 50 mg/l in the drinking water has no known effects on humans. Excessive zinc salts will cause gastrointestinal disturbances; 6000 mg of zinc chloride is lethal to humans. Zinc toxicity is very acute but transitory. 50 mg/kg in the diet is recommended for swine; 2000 ppm is toxic to swine.

Liming the soil has a large effect on the toxicity of zinc to plants. The acute lethal toxicity of zinc to fish is affected by water hardness, since zinc solubility depends on pH and alkalinity. 44 to 79 mg/l was found to inhibit mitosis and cause destructive changes in the cell structure of the gonads in rainbow trout.

Sources for zinc include galvinized pipe, hot water tanks, yellow brass, and industrial wastes. In areas where zinc is mined, it may be found in natural waters at concentrations as much as 50 mg/l. The mean concentration of zinc in a sampling of US waters was 64 ug/l.

REFERENCES

1. "Water Quality Criteria 1972" Ecological Research Series, EPA-R3-73-033 (1973)

2. New Mexico Environmental Improvement Agency, Water Quality Division, "Proposed Amendments to Water Quality Control Commission Regulations" Santa Fe, New Mexico (1975)

3. _____, Water Supply Regulation Section, "New Mexico Public Water Supplies Chemical Data" (1974)

4. Stipulation in the United States District Court for the District of New Mexico, no. 10171, 2 August, 1973.

5. "Water Quality Criteria Data Book, vol. 2: Inorganic Chemical Pollution of Freshwater" EPA Water Pollution Control Series 18010 DPV 07/71 (1971)

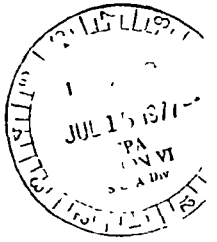
* United States Public Health Service, "Public Health Service Drinking Water Standards" (1962)

Discussion material is drawn primarily from references 1 and 5.

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT CORPS OF ENGINEERS
P O BOX 1580
ALBUQUERQUE NEW MEXICO 87103

SWAED-EP

12 July 1977



Mr. John C. White
Regional Administrator
U.S. Environmental Protection Agency
1201 Elm Street
Dallas, Texas 75270

Dear Mr. White:

1) In response to your letter of June 14, 1977, we have reviewed your Draft Environmental Impact Statement for Albuquerque Wastewater Treatment Facilities. We are in general agreement with the content of the statement. However, we question the physical ability of the Rio Grande ever to support swimming and boating, the 1983 goal notwithstanding, and the probability of contamination of deep municipal wells by on-site disposal systems. The practice of supplying municipal water before sewerage to "problem" areas is well established and could be amenable to the Comprehensive Plan.

The 201 Plan confirms that areawide municipal wastewater treatment will be accomplished at the Plant No. 2 site. Institutional analyses being conducted under Section 208 and the Urban Studies Program will furnish additional data on the governmental entities involved with water resources management in Albuquerque.

2) Odor might be considered as an important aesthetic or subjective problem in paragraph 2.7.3, Aesthetics. Oversizing, paragraph 3.3.3, should be defined. In actuality, flow analysis should determine the size and slope of the lines.

The statement presents a good evaluation of alternative programs for managing the city of Albuquerque's wastewater and a fine evaluation of the environmental consequences of the proposed action as well as alternatives considered.

3) The proposed action plan seems to assume that all existing residents on on-site systems will connect to the planned sewer system. As acknowledged in the statement, many of the valley families that will receive sewer service fall within the low income level. These people, who will benefit from the

EPA RESPONSES

1) While physical conditions appear to preclude the widespread or consistent use of the Rio Grande for purposes such as swimming and boating there is potential for localized primary recreation in the river channel and adjacent areas This is demonstrated by the fact that the main river channel in the vicinity of the two treatment facilities is now used for swimming during summer periods when the flows are adequate, despite the lack of any formal facilities or good access Public input to the Facility Plan indicated that it would be desirable to avoid wastewater management actions which would foreclose continuation or expansion of such recreation use

The probability of contamination of deep municipal wells was asserted in references such as Anderson (1972) and in public input at City-sponsored hearings No quantitative evaluation of this probability was made in the environmental analysis Because of depth and location the prospect for contamination is extremely remote for many wells. However, for the other wells the contamination is possible over a long time frame Because clean-up of polluted ground water is extremely difficult and expensive, reduction of this possibility was considered an important goal of water quality management Refer also to the provisions of the Safe Drinking Water Act which stress the need to protect primary sources of public water supplies

The practice of providing water service before sewerage to problem areas can be expected to occur throughout the area However, it represents a short-term solution to the symptoms of a contamination problem, and can actually increase the amount of long-term pollution because of increased water use and discharge Therefore, it is not considered an alternative to sewerage service in meeting the goals of P L 92-500; it also does not comply with the long-term environmental objectives of the Comprehensive Plan It was for these reasons that the alternative was treated as a short-term option (page 132 of DEIS), and not evaluated in detail.

2) The referenced paragraphs have been rewritten to reflect these comments

3) A new final paragraph has been added to Section 3 3 4 to address these comments The combined influence of hook-up ordinances, lack of access to bank loans for substandard on-site systems, high failure rate of on-site systems, high replacement cost of on-site systems is expected to lead to a high percentage of connections even in low-income areas, although some hook-ups may not occur for several years after construction is completed

proposed action, may not be financially able or willing to connect to the sewer system. Connection fees, costs involved with substantial plumbing modifications, sewer fees, and higher taxes may have a significant impact on these families and the success of the proposed plan. This aspect should be recognized and discussed.

4) An alternative for disposal of sludge that might be considered if no health or aesthetic problems are involved is the sale of this material to the general public or various businesses.

5) Use of terms such as hydrologic modification may be somewhat technical for the average reader. Perhaps use of simpler and more descriptive terms would better describe actions taken to control the river. Also, a description of structural modification and those responsible for these measures would contribute to the environmental setting.

6) In describing the biological environment, the marshes south of Isleta Pueblo should be mentioned since they are probably the largest marsh areas in the general vicinity of Albuquerque. Also, the names, locations, and administration of the wildlife refuges would be appropriate in this section. The New Mexico Department of Game and Fish is currently engaged in a 3-5 year study to determine the wildlife value of different types of riparian habitat along the Rio Grande in the Middle Rio Grande Valley. Some mention of this and any recent data may be appropriate.

7) Plant, bird, and crustacean species in the general area proposed for threatened or endangered status, either federally or by the state, should be mentioned. A description of the classification used in the New Mexico State Game Commission's Regulation No. 563 and a listing of species that occur or could potentially occur in the sphere of influence under each grouping would be appropriate.

8) As part of the Albuquerque Greater Urban Area Study, the Corps is presently conducting a flood control study of the Bernalillo to Belen reach of the Rio Grande. An alternative being considered for improved flood protection is the raising and/or rehabilitation of parts of the existing levee system. The Corps is studying the idea of taking some borrow material from areas between the levees and then developing these areas into marshes. Water would be required for these marshes and it is thought the statement might consider use of treated wastewater for these areas.

We appreciate the opportunity to comment on your statement.

Sincerely yours,

James C. Veach
JASPER H. COOMBES, P.E.
Chief, Engineering Division

4) This alternative was mentioned in Section 3 5 2 of the DEIS, that section has been expanded to more fully discuss the option.

5) Some changes in terminology have been made in the final EIS However, the subject of wastewater treatment, and its interaction with environmental conditions, requires the use of some semi-technical terms which are, however, defined in conventional dictionaries. The discussion of river modifications in the environmental setting (Section 2 3 1) is largely non-technical A brief list of modification projects and agencies is given in Table 2-7, much more detail is provided in the report referenced as EPA (1977).

6) The marshes are shown on Figure 2-8 The discussion of refuges is provided in detail in the reference EPA (1977) The study being performed on riparian habitats is not completed; no data are available at this time.

7) The discussion of rare and endangered species has been modified. However, the main listing of species is in EPA (1977), as before.

8) Section 3 7 4 has been revised to include this concept

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SIX

117 U. S. Court House
Santa Fe, New Mexico 87501

July 25, 1975

IN REPLY REFER TO
HA-NM

Mr. John C. White, Regional Administrator
United States Environmental Protection Agency
First International Building
1201 Elm Street
Dallas, Texas 75270

Dear Mr. White:

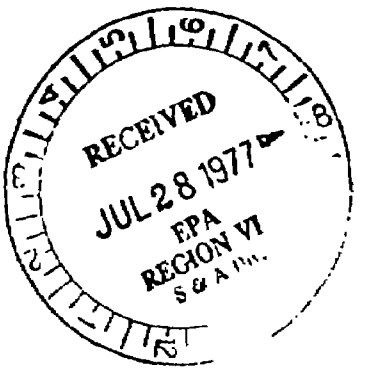
We have reviewed your draft Environmental Impact Statement and have no substantive comments to make. It appears the proposed action is needed for sewage transport and treatment to provide for the orderly growth of Albuquerque and the Rio Grande Valley urban area. If the proposed collector on Juan Tabo south of Menaul is to be constructed within the next 6 or 7 years, it should be coordinated with the upcoming highway project M-4065(1) for the reconstruction of Juan Tabo Blvd.

We appreciate the opportunity to comment on your proposal.

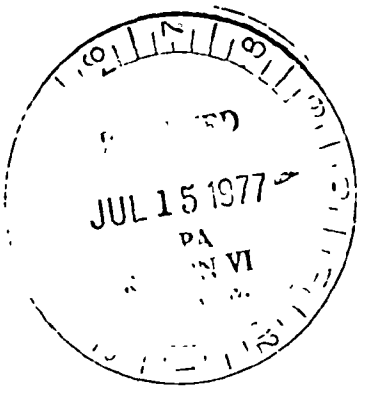
Sincerely yours,

for John F. MacAllister
Division Administrator

cc: R.O. HED-06, TES-70, Secretarial Representative, CEQ-5



Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005



July 12, 1977

Mr. Clinton B. Spotts
Regional EIS Coordinator
Region VI
Environmental Protection Agency
First International Building
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

This is in response to John C. White's request of June 14, 1977, for comments on the draft environmental statement (DES) for the proposed Albuquerque Wastewater Treatment Facilities, Project No. C-35-1020-01, Bernalillo County, New Mexico.

The Council has reviewed the DES and notes that while cultural resource studies to date indicate no properties included in or eligible for inclusion in the National Register of Historic Places will be affected by the proposed undertaking, additional cultural resource studies will be undertaken prior to project implementation. The Council also notes that the Environmental Protection Agency recognizes its responsibility pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320) should the above-cited cultural resource studies identify previously unknown cultural properties of significance. Accordingly, the Council looks forward to working with EPA in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800) in the future, as appropriate.

Should you have questions or require additional assistance, please contact Michael H. Bureman of the Council staff at P. O. Box 25085, Denver, Colorado 80225, or at (303) 234-4946, an FTS number. Your continued cooperation is appreciated.

Sincerely yours,

Louis S. Wall
Assistant Director, Office
of Review and Compliance

The Council is an independent unit of the Executive Branch of the Federal Government charged by the Act of October 15, 1966 to advise the President and Congress in the field of Historic Preservation.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Cibola National Forest
10308 Candelaria NE
Albuquerque, New Mexico 87112

8430
July 7, 1977

Mr. Clinton B. Spotts
Environmental Protection Agency
Region VI, 1201 Elm
First International Building
28th Floor Library
Dallas, Texas

Dear Mr. Spotts:

We have reviewed the Draft Environmental Impact Statement for "Albuquerque Wastewater Treatment Facilities," Project No. C-35-1020-01. We have no comments on the draft statement.

Thank you for the opportunity to review the statement.

Sincerely,

KEITH T. PFEFFERLE
Forest Supervisor

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Box 2007, Albuquerque, NM 87103

August 1, 1977

Mr. Clinton B. Spotts
U. S. Environmental Protection Agency
1201 Elm Street
Dallas, TX 7527

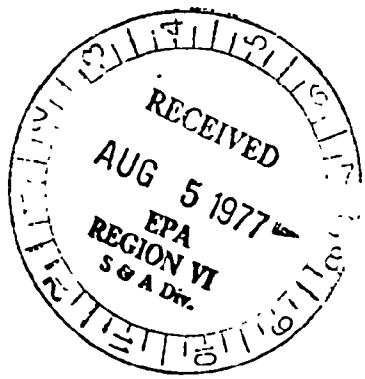
Dear Mr. Spotts:

Our office has received a review copy of DEIS for Albuquerque Waste Water Treatment Facilities, Project #C-35-1020-01. After reading the Executive Summary section of the statement, it is our opinion that the proposed project deals entirely with an urban and urbanizing area of the state. The proposal will have little impact on soil or water resources for which this agency has concern. Consequently, we have no comments applicable to the proposed project.

Sincerely yours,

Harold C. McCrossen

A. W. Hamelstrom for
State Conservationist



DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

DATE June 28, 1977

IN REPLY REFER TO ABQ ADO-610

AIRPORTS DISTRICT OFFICE
P. O. Box 9253
Albuquerque, New Mexico 87119

SUBJECT Review of Draft Environmental Impact Statement for Albuquerque Wastewater Treatment Facilities, Albuquerque, New Mexico; Project No. C-35-1020-01

FROM Chief, Airports District Office

TO Mr. Clinton B. Spotts
Environmental Protection Agency
Region VI
First International Building
1201 Elm Street
Dallas, Texas 75270

We have reviewed the subject statement, and concur with the statement as submitted.

BILL J. HOWARD

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JUN 30 1977
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REGION VI
A Div.

STATE PLANNING OFFICE

GREER BUILDING
505 DON GASPAR AVE
SANTA FE 87503
(505) 827-2073

LEILA ANDREWS
STATE PLANNING OFFICER

JERRY APODACA
GOVERNOR

July 28, 1977

Mr. Clinton B. Spotts
Environmental Protection Agency
Region VI
First International Building
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

We have reviewed the draft environmental impact statement for the Albuquerque Wastewater Treatment Facilities. We feel that the expansion and upgrading of Albuquerque's wastewater treatment facilities should proceed.

Thank you for the opportunity to comment.

Sincerely,

Kate Wickes

Kate Wickes
Division of Natural Resources

KW:anne

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S & A Div.

STATE OF NEW MEXICO

STATE PLANNING OFFICE

GREER BUILDING
505 DON GASPAR AVE
SANTA FE 87503
(505) 827-2073

LEILA ANDREWS
STATE PLANNING OFFICER

JERRY APODACA
GOVERNOR

June 27, 1977

Mr. Clinton B. Spotts
Environmental Protection Agency
Region VI
First International Building
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

The Draft Environmental Impact Statement for Albuquerque Wastewater Treatment Facilities (project No. C-35-1020-01) has been reviewed by this office. It is my opinion that the assessment of known cultural resources and the outlined procedures for the location and evaluation of presently unknown archaeological sites will provide for the adequate protection of significant cultural resources that might otherwise be damaged or destroyed by the various aspects of this project.

Should you have any further questions concerning the historic preservation aspects of this project, do not hesitate to contact this office.

Sincerely,

Thomas W. Merlan
State Historic
Preservation Officer

DER:cdm

RECEIVED
JUL 5 1977
EPA
REGION VI

APPENDIX B. PUBLIC HEARING RECORD

The following represent the responses to comments made at the Public Hearing held July 20, 1977. The transcript of the hearing follows the responses. Where appropriate the responses are referenced to specific pages and lines of the hearing transcript; elsewhere they are referenced to the entire testimony of one individual. Many responses cite sections of the Final Environmental Impact Statement which have been rewritten in order to address the comments. In such cases the direct response itself is brief, and the reader is referred to the cited section for the substantive changes in the EIS which reflects the comments. Where a comment was responded to at the hearing, no further response is given below.

Testimony of Paul Robinson

Page 10, lines 14-16. The Facility Plan was available for inspection at the City of Albuquerque Water Resources Department and at the New Mexico Environmental Improvement Agency in Santa Fe. It did not differ substantially from the draft Facility Plan which had previously been distributed to Southwest Research and Information Center.

Page 10, lines 17-22. The discussions of the liquid waste ordinance have been rewritten to reflect these comments. Refer to Section 2.1.2 and 3.8.

Page 10, line 23-25, and Page 11, lines 1-2. In response to these comments a detailed description of operation and maintenance problems has been included in Section 2.1.1.

Page 11, lines 3-5. Steps to be taken to assure quality design and construction are set forth in Section 4.4.

Page 11, lines 6-12. Cost-effective is defined in the Final EIS; refer to Section 1.3.

Comments of Edmund Archuleta

Pages 13-15. Section 2.1.2 of the Draft EIS included a discussion of the major measures discussed by Mr. Archuleta. In the Final EIS the comments have been expanded, and are included in Section 2.1.2.

Comments of Paul Robinson

Pages 16-17. The Final EIS includes new Sections, 3.3 and 4.5, which set forth the specific measures which will be taken to ensure that past problems are not repeated with the new facilities, including: a value engineering analysis of the proposed design; a construction inspection program carried out by the U.S. Army Corps of Engineers; and a requirement for a Plan of Operation which includes not only procedures to be followed, but addresses questions of budget and staffing.

Comments of Stan Reed

Pages 17-20. The response to Paul Robinson, above, also addresses these comments. Specifically Sections 4.4 and 4.5 deal with measures which will be undertaken by EPA to assure that the goals of the Facility Plan are in fact realized.

Page 20, lines 15-23. No written comments were received from Mr. Read.

Comments of Gene Martinez

Page 21, lines 21-25; Page 22, lines 1-3. There was no statement in the draft EIS which attributed nitrates in the Mountainview area to a munitions cache in Sandia base. Rather these nitrates were stated to probably be related

to nitrates observed in the Tijeras area, which in turn appear to be derived from natural sources, or possibly as yet-unidentified man-made sources. In EPA (1977) a munitions dump is listed as one possibility for man-made sources. The important fact stated in the draft EIS is that the likely nitrate source is natural, and that in any case the nitrates cannot be ascribed to the impact of wastewater management practices.

Page 22, line 4-15. The nitrates observed in the Paddillas-Pajarito area have been known for a number of years, according to records in the files of the City Environmental Health Department. There is no evidence to link these nitrates to any discharges from the treatment plants. The nitrates in the Tijeras-Mountainview area were observed well before Plant #2 was constructed in the Mountainview neighborhood.

Page 22, lines 16-25; Page 23, lines 1-6. The City has no record of this odor problem and no specific response to a solution of the problem is possible. Regional odor sources may be significant (see Section 2.2.2).

Page 24, lines 12-14. No written statement was received. The comments in these paragraphs were responded to at the hearing by Mr. David Neleigh of EPA (see page 27).

Comments of Gloria Toland

Page 28, lines 10-12. Contractors engaged in dewatering will be required to advise residents in advance if analysis indicates that wells may go dry, and to provide an alternate water supply during the period of dewatering. The impacts during Phase I construction related to installation of a new inflow line and will not occur for most of the proposed new facilities.

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VI

In the Matter of:

THE

DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR

ALBUQUERQUE WASTEWATER TREATMENT FACILITIES
FOR THE CITY OF ALBUQUERQUE

PUBLIC HEARING

Pursuant to Notice and Publication, the above-entitled matter came on for Public Hearing at 7:30 o'clock p.m. on Wednesday, July 20, 1977, at the City Council Room, City Hall, Albuquerque, New Mexico.

RICHE H. EMMONS & ASSOCIATES, INC.
COURT REPORTERS
1917 Paige Place, Northeast
Albuquerque, New Mexico 87112
Telephone (505) 243-0146

I N D E X

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P R O C E E D I N G S

PRESIDING OFFICER DIANA DUTTON: Good evening. We will now call the Hearing to order. My name is Diana Dutton. I am the Regional Counsel for Region VI of the Environmental Agency in Dallas. I will be Presiding Officer for tonight's Hearing.

The other members of the panel here with me are, on my immediate left, Paul Bergstrom, Environmental Impact Statement Coordinator, and David Nealeigh, next to Paul, who is the Project Officer for the Albuquerque grant. Both of these people are with EPA in Dallas. Also at the table here with us is Lee Wilson, contractor who prepared the environmental analysis in the Environmental Impact Statement.

We are here tonight to receive public comments on the Environmental Impact Statement that has been prepared on a proposed project for the expansion and upgrading of Albuquerque's wastewater treatment facilities. In a few moments I will ask Paul Bergstrom to summarize for you the extent of the proposed project.

The National Environmental Policy Act, usually referred to as NEPA, requires that an Environmental Impact Statement be prepared for major Federal actions significantly affecting the quality of the human environment. It requires that a Federal agency include in its decision making process on such actions a careful appraisal of all

environmental effects of the project. The Hearing in which we are now engaged is a part of that deliberative process and in accordance with EPA's regulations for the implementation of NEPA, which are found in Part 6 of Title 40 of the Code of Federal Regulations.

The Environmental Protection Agency is authorized by the Federal Water Pollution Control Act of 1972 to make grants to municipalities for seventy-five percent (75%) of the cost of constructing or improving wastewater treatment facilities. Before such grants can be made, there must be prepared an environmental assessment or an Environmental Impact Statement.

The City of Albuquerque has made application for such a grant, and the Environmental Impact Statement under consideration tonight was prepared on that proposal. Copies of the impact statement have been made available for public inspection. If you wish to review the statement and have not done so, copies are available for inspection at the City's Water Resources Board at the New Mexico EIA and at EPA's office in Dallas. We also have available tonight a few extra copies that you may wish to look at. We have these for distribution. We don't have very many of them, though.

I would like to turn now to the procedures we will follow tonight. We welcome comments from anyone

relevant to the impact statement or the proposed project. The Hearing is an informal one for the purpose of receiving public comment. It is not a formal Hearing such as one under the Administrative Procedures Act. Formal rules of evidence do not apply, and cross examination of the witnesses will not be allowed. From time to time, however, members of the panel may ask questions of those testifying in order to clarify the record. If you have any evidence that you wish to submit for inclusion in the record, it should be in a form that can be included conveniently and it can be duplicated.

As you see, there is a transcript being made of tonight's Hearing. The transcript will be on record in the offices of the Environmental Protection Agency and will be available there for inspection. If you wish to obtain a copy of the transcript, I would suggest that you talk with the Court Reporter during a break.

In the interest of time if we have many speakers tonight, I would ask that each speaker limit remarks to ten (10) minutes. If you have written comments, you may summarize those and include the full text of your remarks in the record. If you have written comments at all, the Court Reporter requests that you provide a copy to her. You may also make written comments subsequent to the Hearing. Those comments will be included in the Hearing record, along

with any comments made here tonight, and will be considered if they are received by EPA in Dallas by August the 8th of this year.

We have asked that each of you register tonight. If you wish to make a comment and have not registered, I ask that you do so now. Otherwise, we have no way of knowing that you wish to speak. I will call on those who have registered in the order that they registered. We wish to give everyone here an opportunity to speak and to say whatever he feels is relevant. If we have time after the speakers, we will try to answer any questions you may have, but I first want to ensure that everyone who would like to speak does have an opportunity to do so.

I'd like to call now Mr. Bergstrom to explain the scope of the project that we have under consideration tonight.

MR. PAUL BERGSTROM: Thank you, ma'am. My notice of intent dated April 29th, 1976, EPA informed the public that an Environmental Impact Statement would be prepared for the expansion and upgrading of Albuquerque's wastewater treatment facilities. The draft of the Environmental Impact Statement was mailed to all interested agencies, public groups and officials on June 14th, 1977. A notice of availability of the draft statement appeared in the Federal Register dated June 24, 1977. The Council on Environmental

Quality's due date for receipt of the comments on the draft statement is August 8th, 1977. Comments should be sent to Mr. Clinton V. Spotts, Environmental Protection Agency, Region VI, First International Building, 1201 Elm Street, Dallas, Texas 75270.

The draft Environmental Impact Statement for Albuquerque wastewater treatment facilities was prepared by EPA and the City of Albuquerque through a joint contract preparation method. The City's consultant who performed the environmental analyses in the Environmental Impact Statement was Lee Wilson and Associates. This draft statement covers a proposal by the City to expand and upgrade their wastewater treatment facilities under EPA grant C-35-1020-01. Proposed actions discussed in the draft statement include the following:

Construction of approximately one hundred and five (105) miles of interceptor and collector lines to serve the following areas: Arenal District, South Valley; south and eastern part of the North Valley; portions of the Southeast Valley near Treatment Plant No. 2, including Mountainview; developing portions of the West Mesa; developed and developing portions of the Candelaria and North Industrial Parks and North Albuquerque Acres and Four Hills and other parts of the Northeast Heights.

Conversion from Chlorine to hydrogen peroxide for

odor control in sewer lines at various points throughout the City.

Renovations of lift stations including monitoring alarm systems and stand-by power at various points throughout the City.

Construction of mechanical dewatering facilities to replace sludge drying beds at treatment plant number 2 near Mountainview.

Completion of preliminary treatment facilities for raw sewage which flows to the activated sludge facilities at plant number 2.

Construction of an administration and laboratory building located within the boundaries of treatment plant number 2.

Provision of facilities for scum handling at plant number 2.

Overhaul and expansion of the gas recycling system at plant number 2.

Overhaul of trickling filter units at plant number 2.

Construction of rail siding for bulk delivery of chlorine at plant number 2.

Expansion of treatment capacity at plant number 2 to 76.6 mgd.

And, the elimination of plant number 1 which is

located in the South Barelas neighborhood.

The Court case, Mountain View Community Improvement Association, et al, versus Robert W. Fri, et al, resulted in a legal document, the Stipulation dated August of 1973. The Stipulation required that the EIS consider odors and metals and the evaluation of alternative methods of utilizing phosphorus and/or nitrogen as nutrients from wastewater effluents. These areas are addressed in the draft environmental statement.

The project total cost is approximately forty-four million eight hundred and seventy-two thousand dollars ($44,872,000). EPA's share will be thirty-three million six hundred and fifty-four thousand dollars ($33,654,000). State and local shares will be five million six hundred and nine thousand dollars ($5,609,000) each.

The EIS does not address the previously approved projects known as Phase 1 and Phase 1A.

PRESIDING OFFICER: Thank you. The comments made tonight on draft Environmental Impact Statement will be considered by EPA, and the comments will be addressed in the final Environmental Impact Statement. What we are considering here tonight is a draft. We will take all the comments we receive tonight, as well as any written comments that are submitted, addressing to those and make appropriate changes in relevant portions of the final Environmental

Impact Statement.

I would like to begin now to call on those who wish to make a statement tonight. Again, I say, if you wish to make a statement and have not so indicated by registering, please do so. When I call your name, I'd like you to come to the front. You can stand either here (indicating) or at the podium, which is probably more convenient. Would you please state your name and your affiliation, if any, for the record.

Mr. Paul Robinson.

MR. PAUL ROBINSON: I'm with the Southwest Research and Information Center, and we have several problems that we want to outline.

One, we were long-standing interested parties in this case and didn't receive a facility plan until Monday, and that was only from the Liquid Waste Division.

Another problem we have is with the discussion of the Industrial Liquid Waste Ordinance. They discuss progressive enforcement but really don't go into any details of what that would be. They also don't discuss in the impact statement the present and historical lack of enforcement and its effect on the future.

Another problem we have is with the lack of discussion of operation and maintenance of the new facilities. These have been problems in the past and must be remedied

in order for the plant to be operating successfully in the future.

We have problems with the quality design and the insurance of quality design in the future plants, again, based on the past performance of plant number 2.

We have a problem with the discussion of cost effective in the Environmental Impact Statement. It's mentioned numerous times and is never defined in terms of the -- cost effective is never defined as a concept. It's only used as a justification, and, again, we haven't seen the facility's plan long enough to really know what that means.

And, we will be making written comments by August 8th.

PRESIDING OFFICER: All right. Thank you, Mr. Robinson. To clarify your remarks, can I ask you a question? You have indicated that you have problems with several areas. Do you have problems with the substance of what is contained in the Eivironmental Impact Statement or with the fact that it's not included?

MR. ROBINSON: Both.

PRESIDING OFFICER: O.K. When you submit written comments, can you give us more detail with regard to the substance?

MR. ROBINSON: Yes, we would be probably more

detailed at that time.

PRESIDING OFFICER: Very good. Thank you.

Katherine Montegue, you have an indication that you might want to make a statement.

MS. KATHERINE MONTEGUE: I don't have one right now. I might later on.

PRESIDING OFFICER: O.K. William Tryon.

MR. WILLIAM TRYON: I'm here more or less as a spokesman for the City spotting problems.

PRESIDING OFFICER: You don't wish to make a formal statement?

MR. TRYON: No, not at this time.

PRESIDING OFFICER: O.K. I have no further cards. Is there no one here who wants to make a statement? I will wait a moment and let you think about this. I really hate to close the Hearing at this time.

MR. TRYON: I would like to suggest a five minute recess.

PRESIDING OFFICER: I think that's an excellent idea. Let's take a short break and think about this. This is your opportunity to comment on this project, and I really would like for everybody to have ample opportunity to say whatever they feel about this project. And, I hesitate to close the Hearing fifteen (15) minutes after it has begun. So, let's take a five minute break. Please think about it,

and we'll reconvene and see what happens then.

(Brief recess.)

PRESIDING OFFICER: Could we reconvene again? Our break was somewhat productive. We did come up with two more people who would like to make statements.

Ed Archuleta, if you would come forward and state your name for the record and your affiliation.

MR. EDMUND ARCHULETA: My name is Ed Archuleta, and I'm with the Liquid Waste Division, City of Albuquerque Water Resources Department.

I'd like to respond to point number three which Mr. Paul Robinson made in regard to an apparent problem with the lack of discussion at least, as I understand it, in the impact statement concerning the operation maintenance of the wastwater treatment facilities.

I think Mr. Robinson is well aware in recent meetings that we've had, one in particular in the South Valley about two months ago, when we discussed with the citizens of the South Valley our plans for an odor control program at the wastwater treatment facilities. This information was discussed in detail at that time, and we did provide a list of the planned program of the Liquid Waste Division Water Resource Department at that time to Lee Wilson and Associates.

In part, while the program and discussion that

evening dealt with odor control, there were, I think, three items that indirectly referred to improved operation and maintenance of the facilities as indirectly effecting odor control.

So, I would like to clarify and submit for the record of that odor control program which deals with the operation maintenance facilities. Item number one is that we have retained this past January a special consultant to study sludge handling, noise and odor control at plant number 2 and, also, the odor control or need for odor control at plant number 1. This consultant, among other things, examines short-term, long-term, low cost and more expensive programs to accomplish the odor control program.

Part of this report, part one, was submitted in March of this year which dealt with the noise and odor control, at least part of the temporary type or more immediate type odor control programs.

Part two of the report we anticipate will be submitted next week. This particular report, among other things, deals with the operation and maintenance staffing requirements of these facilities. We have gone into quite a bit of detail in working with this consultant on that, and it is our intent to implement those recommendations such that we do have the proper staffing to operate and maintain our plants.

Prior to that we have a number of people -- I believe there's ten (10) people at plant number 2, two people at plant number 1, seven people indirectly in the electrical instrumentation maintenance that have been budgeted for this fiscal year and will be coming on the line very shortly in the operational maintenance of our plant.

So, in addition, the City has provided additional funding through a liquid waste division this fiscal year for the increased operator training to ensure that our people have a -- currently have a certification requirements, but to ensure that currently the people that are on board now and people that are to be hired are well trained, educated so that we can properly operate these facilities.

So, in summary, I would like to submit this for the record, but I wanted us to set the record straight. If it's not completely covered in the impact statement, that we feel that we have made and are making great strides to ensure that we operate and maintain these facilities in accordance with state, local and federal requirements. Thank you.

PRESIDING OFFICER: Thank you, Mr. Archuleta. That would be helpful.

(The document referred to was marked Hearing Exhibit 1 for identification and attached hereto.

Do any of you panel members have questions?

(No response.)

PRESIDING OFFICER: O.K., thank you very much.

MR. ROBINSON: May I respond to that?

PRESIDING OFFICER: You may respond after I call on the next speaker, and you're certainly welcome to make additional comments if you choose to do so.

Stan Read.

MR. STAN READ: In order to make sense or continuity, I would ask Mr. Robinson to speak before me in response to what was said.

PRESIDING OFFICER: I have no objection to that as you're the only other speaker.

Please state your name again so that we can get it on the record.

MR. ROBINSON: Paul Robinson is my name.

Like Mr. Archuleta said, this area was not completely covered in EIS and needs to be further filled out. He mentioned plans that they had and an intent to deal with these problems. And, I believe -- but the problems are systematic and have occurred in the sewage treatment efforts of the City for the past fifteen (15) years. And, in order to think about the next twenty (20), this past has to be dealt with in a fairly detailed way. This history is very relevant to the environmental impact idea of what

has been going on in the past has effect on the future, and particularly when you're talking about running these forty-four million dollars ($44,000,000) worth of equipment.

We've been assured that this stuff would be done in these meetings that he's discussed, but our point is that the Environmental Impact Statement should treat these in detail in order to fulfill their job according to NEPA.

Thank you.

PRESIDING OFFICER: Thank you.

Mr. Stan Read.

MR. STAN READ: My name is Stan Read, R-e-a-d. I live approximately one half mile south of City Sewage Treatment Plant Number 2. My address is 218 Sunnyslope, one word, Southwest, Albuquerque, New Mexico 87102.

I've lived in the area approximately five years. I was a Plaintiff in the suit brought against the City in 1973, as I remember, to block the use of federal funds without some assurances and, at that point, an impact statement about the City sewage treatment plants, wastewater plants. The result of that 1973 case was a Stipulation that has not yet been met in terms of the acceptance, as I understand it, by the Federal Government of all of plant number 2. And, so the Stipulation, I keep hearing, is essentially in abeyance, the details of it, until acceptance of the facility -- the new ten million dollars ($10,000,000) or whatever facility

is accomplished.

I was also at the meeting Mr. Archuleta mentioned and received a copy that he has submitted for the record, the Summary of Odor Control Program. The problem that I have with all of the plans at this point, including the Odor Control Program as presented on paper and in parts orally at that meeting, is much the same as mentioned briefly by Mr. Robinson.

My neighbors, and I think I can speak for them on that point -- we've discussed it frequently -- and I are sceptical of plans and projects and even of the best laid, best made, Environmental Impact Statements because of the history of that particular plant and, to our knowledge, plant number 1, especially as regards odor control.

I dearly hope that Mr. Archuleta is correct, Mr. Nolan is correct, and that the control programs that they have talked about and the control programs that they are instituting or planning for will take care of the problem of odor control. However, the history, even as I've been in that neighborhood, does not suggest that the efforts of the City in the past, should they be repeated in the future, would be sufficient for that task.

So, I think we regard some of the details in the impact statement regarding the alternatives for odor control, for example, with -- we regard those statements with a great

deal of scepticism. The meeting Mr. Archuleta refers to was a very loud meeting. I think that the officials of the City came down to tell us something, and I do not think they were pleased to have the citizens telling them that they didn't trust them.

And, after some time and some statements -- I, in fact, left and went home and fed my animals, finding that a more productive endeavor than saying anything more or hearing anything more from the City. At the same time, I did not leave assuming that the City would not do what it could, could not do what it could, but my neighbors who called later in the evening were very sceptical. Some of them had been fighting that particular battle for many years.

And, the promises are almost always good promises when heard, and not delivered on. One of my neighbors commented that "If they do it, they don't have to tell us about it and if they don't do it, we'll tell them about it." I think that's essentially where most of us left that meeting. I know that the City had an agenda, and that they wanted that agenda followed, and I don't think they were particularly pleased that that agenda was not what the citizens wanted at that particular time. And, the comments made were not really answering the questions that had been posed for some time.

As I understand the procedure, we have until August the 8th to submit written comments, is that correct?

PRESIDING OFFICER: That's correct, yes, sir.

MR. READ: And, the specific problems that my neighbors and I have with it -- I just got my EIS back today. It's made the rounds of the neighborhood. There are some written comments in the margin. Some of them would be possible to repeat here. Others may have to be put -- couched in different language, but that's understandable.

Whatever the case may be, I think that it would be better with our general comments about distrust of the projects in the past and scepticism about the ability of the City to carry them out in the future, although strong hopes -- we live there -- strong hopes that it would, in fact, be accomplished in a forthright manner. We will make comments about the EIS in detail in writing.

I recently reviewed one on a project in the north, and the written comments seem on the whole to be better understood by those responding to them and perhaps more saliently put than the oral ones.

So, I think that's the way we will approach it, and we will mail them to you by the 8th of August. Thank you.

PRESIDING OFFICER: Very good. Thank you, Mr. Read.

Gene Martinez.

MR. GENE MARTINEZ: Gene Martinez, 1800 Corte Eduardo S.W., Albuquerque, New Mexico, President of the Southwest Valley Area Council.

Ladies and gentlemen, I want to thank you for the opportunity that you're giving us to appear before you and make some comments on the EIS in regards to the sewer treatment facilities. I'm sorry we're a little bit late in getting here, but just picking up on some of the testimony that was just presented, I would concur with the statements that, best, in the past it has been extremely difficult to accept what has been told and what actually has transpired in reality.

Yet, we are now hopefully seeing some accomplishments and solving some of the problems that we were encountered with in the Southwest Valley by the operation of the treatment plants number 1 and 2. It seems like the odor at times is, at best, extremely unbearable.

There are other areas that have concerned us deeply within the South Valley community in close proximity to the sewer treatment plants. This is the area of nitrates. It's a little bit confusing to me as a lay person to try to read through this material and find that in one page they will state that the nitrates in the Mountainview area, adjacent to Sewer Treatment Plant Number 2, are caused by some unknown buried munitions cache in the Sandia base and

that no one has the authority or the opportunity to check this source out. So, this is what they attribute the nitrates.

But, yet, a couple pages further down it says that within the last couple of years they have identified nitrate concentrations in the Padillas Pajarito area which is across the river west and south of the sewer treatment plants. This -- to me it came as a surprise that nitrates had been discovered in that area, where before in the years past the only sources, traces, of nitrate had been east of the river and south of Rio Bravo in the Mountainview close to where the sewer treatment plants are at. So, this is an extreme concern that we look at now, did the treatment plant cause filtration of nitrates to the west and south of the present treatment plant number 2?

The other question we have is the odors that we are, say, forced to live with, that -- about the 2300 block of South Isleta, if you're driving by, say, in the late afternoon, early evening, the odor is unbearable, that this is a few miles -- I'd say about three miles north and west of treatment plant number 2. It is about two miles south and west of treatment plant number 1. There is a force main running along that area. My understanding is that there has been problems with the chlorination stations in various parts of the City. I would say if this is a

problem attributed that we do not have sufficient chlorination stations throughout these force mains, that something should be done to look into, say, updating a system on chlorinating or, say, implementing more chlorinating stations throughout the system to alleviate some of these odor problems that we are faced with in the South Valley.

We do not at present time derive any direct benefit by the use of either treatment plant number 1 or 2. The only benefit we do have is the benefit of the odors that permeate from these two facilities. It is real difficult for myself, personally, to try to bring forth some of the problems we encounter realizing that if we get too hot and heavy, it might jeopardize the EIS that is being presented to you people tonight, and this might further delay sewer treatment plant expansions on Sewer Treatment Plant Number 2, and then, in itself, would delay the North and South Valley sewer hookup, which in my estimation has been delayed for too many years already. It should have been constructed long before this.

I'm not trying to place the blame on any one individual or groups of individuals, but we have seen within the last few months that a step forward and a positive step has been taken. We're gratified to see that the City Fathers in their wisdom did increase the budget for the Water Resources Department, at long last realizing

that there was problems faced by the community in the less affluent segment of the community. So, hopefully these will take care of our problems. And, the other question I would have -- I received a copy of a memorandum from Mr. Sonny Aragon (phonetic) that he picked up in Dallas, who is an employee of the Water Resources Department, from a Douglas M. Costell of the National Office of the United States Environmental Protection Agency to all Regional Administrators. The letter is dated the 21st of June, 1977. This establishes policies on collection lines and interceptors under Public Law 92-500.

There are some areas I do have some concern with, and we shall submit formal written statement in regards to those. But, the question I want to ask now under one of the provisions is the -- under paragraph -- subsection C, public disclosure of cost, that the memorandum states that there shall be a public disclosure as to the operational and maintenance and rates, hookup charges, monthly rates to be charged to the people who would be hooking up to this system.

The frustrations that we have faced in the past is trying to get any information at all, guesstimates or otherwise, as to what type of financial investment we, the residents of the county outside the City, would be facing when and if the sewer system does come in. That, since there

is a mandatory requirement that if said collection lines come within a hundred and fifty feet (150') of your property, you are mandated or required to hook up. This, in itself, we believe will not be a small investment in itself, but we are looking at the additional investment that people will be facing since we are, say, utilizing ceptic tanks, cesspools, or whatever, that this will be just the cost up to our property line. Then, we are faced with further costs of going from our property line to the residence, itself, pumping out our ceptic tanks, cesspools, fill them up with sand and breaking physical connections to said ceptic tanks or cesspools.

And, the closest guesstimate that we have been able to pick up from talking to various people who deal in this type of service is approximately twelve hundred dollars ($1,200) that we will be facing inside our own property line. So, not knowing the unknown cost that we are facing, it's really quite a burden on us.

I would ask if there is any funding method within the EPA tnat would assist, say, our senior citizens or people on a fixed income to help defray some of these costs, we would not be asking, say, for gratis gift. We would be willing to, say, if a revolving type loan fund could be established that people could borrow from this loan and pay it back a little bit at a time. And, this way the financial

burden really wouldn't be so great, but the money would be coming back and it would be there in the future for less fortunate people who did not have the financial resources with which to hook up to utilize this system without having to go to a loan company and be charged an outrageous interest charge.

So, if you people could see if you do have this type of capabilities within your organization and filter the message back to us, we would greatly appreciate it, and we would be greatly indebted. So, with that, I thank you.

PRESIDING OFFICER: Thank you, Mr. Martinez. I think you've raised several very good questions. And, as I mentioned earlier, the issues that you raised will be addressed by EPA in the final statement. I would like to correct one thing that you said. You indicated that the EIS would be presented to us, and I'd like to make clear that we're presenting the EIS to you.

And, we also don't want to delay a project that the City of Albuquerque needs. But, on the other hand, we're very interested in the problems that people have with the impact statement and with the project, and we want to be able to address those.

So, I thank you for your comments, and we certainly will address those.

MR. MARTINEZ: Well, thank you for your clarification, and I'm sorry for being so misinformed on that one particular point. Thank you.

MR. NEALEIGH: I think I can answer one of your concerns. First of all, that primary requirements memorandum will require that before another grant is issued to the City of Albuquerque for collection systems, that those costs are identified as well as possible.

And, secondly, there is no mechanism within EPA for any type of assistance with hookup costs. The regulations prohibit any assistance whatsoever for services to individual homes. So, EPA cannot assist the individual home owners on the hookup fee or run the line at all toward the individual home. We'd be glad to do whatever we could, you know, to help you find assistance somewhere else through another agency, but we can't do it.

MR. MARTINEZ: Thank you, Mr. Nealeigh, and we will appreciate your efforts and your information that you will forward on to us. Thank you.

PRESIDING OFFICER: Thank you.

Gloria Tolan.

MS. GLORIA TOLAN: Is it all right if I speak from here?

PRESIDING OFFICER: I think the Reporter can hear you much better over here, and we're trying to make a

transcript.

MS. TOLAN: My name is Gloria Tolan. I reside at 106 Abelene S.E. in the South San Jose area. I also am one of the parties that filed a lawsuit against the City in 1973. One of the reasons that I was party to this suit is because our area was and is effected by a tremendous, horrible smell. This has not been taken care of.

I ran for State Representative in 1972, I believe. I was in the Mountainview area where the plant number 2 is. At that time I was getting a lot of complaints about drying wells that were caused by the new plant, which is plant number 2. These people were very concerned. A lot of them were minorities. There were Spanish. I don't know whether the fact that the area is, you know, resided by Spanish people or Mexicans or whatever minority that the Government, you know, will take it, you know -- it seems to me that they take advantage of people that cannot defend themselves. These people are pretty bad off, you know. They need help. They need their water, and yet their wells are running dry.

I would ask why these meetings are not held where the areas are effected. And, those are really my main comments. I'm really disturbed. I think that if you had your meetings where the people live that are involved and -- in essence, you might have a good turnout, but I doubt that

you'd have people that understand your Environmental Impact Statements and what have you, because we also have a problem of education. They're very -- you know, they're not very educated. They go up as high as grade school. Some of them graduate from high school, and they're lucky they do that. So, these people do live in a sort of poverty area, you know, under a poverty guideline or what have you. And, the plant does effect these people, and I wish that this would be considered. Thank you.

PRESIDING OFFICER: Thank you for your comments. We certainly hope to reach everybody in holding these Hearings, and it's certainly not our intent to exclude anybody by having the Hearing one place or another. We had hoped that this was a centrally located place here at City Hall.

I have no further cards indicating that anyone else wishes to make a statement. Is there someone in the audience who would like to speak?

Yes, would you come up and identify yourself please?

MR. BILL TRYON: My name is Bill Tryon, and I'm presently Assistant City Attorney.

To open my remarks which will be brief, I would like to say that in addressing and commenting on Stan Read's remarks, I have known Stan for many years. As a matter of fact, he's a friend of mine. But, even more than that, he's

an honorable person, and I think his comments were well taken. One of the major points that he had was a certain feeling of scepticism. Well, at this time, I don't think it's appropriate for me to address the foundation of that scepticism. However, right now and through these type of Hearings, what we have attempted to do is to increase information about what the City of Albuquerque is doing.

Only tonight we've heard a further example of how apparently there's been evidence that the facility planning report didn't get into the proper hands with enough time. That was Paul's remarks.. To address that, I would ask the EPA to certainly give any written comments that Paul and his group have added weight, because that would certainly reflect the fact they'd had more time to study the facility's planning report and, thereby, address it in their written comments.

Perhaps one of the things that's dearest to me, as Assistant City Attorney, is the Liquid Waste Ordinance. I've been involved in this project for five months, and I would like to assure everybody in this audience the City of Albuquerque is committed to the enforcement of the Liquid Waste Ordinance. Things that we've done in the past that show that we have been enforcing this ordinance include identification of the five major industrial pollutants. Likewise, one of those five, Duke City Bumper, was identified

as having caused some problems with the influent at Waste Treatment Plant Number 2. The City of Albuquerque took steps and -- lawyer is an acronym, I suppose, but literally on the Courtroom steps we placed Duke City Bumper on a schedule of compliance, whereby they were brought within the effect of our Liquid Waste Ordinance. And, they are still being monitored on a daily basis.

On a daily basis the ordinance in enforced by the testing of influent coming into the plant. The influent is tested, and this is in response to some of the concerns about the metals. The influent is tested on a daily basis. The nine metals that are tested, probably more properly addressed by either Mr. Ed Archuleta or Mr. Galen Roumpf. But, again, I'd like to assure you that this is being done. These metals are being tested for -- and, it's being done on a daily basis.

No system is perfect. And, only last Friday when the Environmental Protection Agency sent a fact finding team down to the City, one of the individuals that came down to Albuquerque suggested a method of better enforcement of our Liquid Waste Ordinance. His suggestion called for the setting up of treatment -- what's the proper phrase? -- actually setting an on-site inspection for all the areas that could be contributing to industrial pollutant problems in Albuquerque.

I will be rewriting this ordinance, and we will attempt to do this. And, this is, again, an attempt to progressively apply our ordinance.

The final point I wanted to make, again, deals with some of Paul's comments, and that -- in his discussion of the maintenance plans and the operating plans. And, again, I've suggested to your attorney, Denise Court (phonetic), tonight in order to simplify what is an obvious communication problem. I would suggest, one, that any request for information, whether technical or legal, be addressed to me in my office. I feel this will certainly simplify your procedures because you only have one person to get it to.

Likewise, Mr. Paul Nolan has assured me and he has since he has taken over the Water Resources Department, has assured the public that maintenance plans and operating plans will be available. In the past, I am quite convinced that there has been confusion as to the availability, where this information can be found and, perhaps, a little sluggishness on the part -- or the perception of sluggishness on the part of City officials.

I, personally, am committed, and I know the entire Water Resources Division is committed to end this communication problem.

So, with no further ado, I have no more comments.

Thank you.

PRESIDING OFFICER: Thank you. I would like to point out again, there was a reference made to written comments, that when we consider the record on this Environmental Impact Statement, we will consider together any comments made here tonight and the written comments submitted later.

Yes, do you wish to make another statement?

MR. ROBINSON: Yes, if I may.

PRESIDING OFFICER: All right.

MR. ROBINSON: My name is still Paul Robinson. I want to thank Mr. Tryon for his comments. I appreciate it, and we will be trying to work through you.

I wanted to also comment on your statement about the commitment to enforce the Liquid Waste Ordinance. We have -- I talked to Galen Roumpf, who is with the Liquid Waste Division of the City, last week in order to get compliance monitoring information on this Liquid Waste Ordinance, because we're trying -- as I said before, we don't feel that the ordinance had been enforced, so we're trying to get data to see if it's been enforced. We've been trying for a week and a half to get the data, and Mr. Roumpf was on vacation and it seems to have a little trouble getting it out of the computer. And, we haven't seen the numbers and, therefore, I don't know whether to

believe what Mr. Tryon says and have, again, been trying to get this information.

The other comment you made about influent testing. The influent testing on a daily basis sufficient to test to see if the Industrial Liquid Waste Ordinance is in compliance. It's these -- all the industrial point sources and effluent are needed to assess whether the Industrial Waste Ordinance is being complied with. There's numbers for the individual point sources as well as for effluent from the plant.

I just wanted to make those comments and, again, reiterate thank you for making yourself available as a source for information.

PRESIDING OFFICER: O.K., thank you. Is there anyone else who would like to make a statement? It appears that there are none. We would be happy to try and answer any questions that you might have. If we can't answer them tonight and you'll give us your name, we'll try to give you a response.

Does anyone have any questions?

(No response.)

PRESIDING OFFICER: This is too easy. Nobody has a question? It appears that there are no questions -- yes, there is one. We would appreciate your standing up and stating your name so that we will have it for the record.

VOICE FROM AUDIENCE: My question is, what is your schedule as far as your time period -- what things will happen in the future from here?

PRESIDING OFFICER: From here we will have a time period in which we receive comments. Those are due to EPA by August the 8th. After that we will analyze the comments, make any appropriate changes that need to be made in the Environmental Impact Statement, finalize it and there is opportunity following that for comment on the final Environmental Impact Statement, assuming that there are no major objections to the project, can proceed following the filing of the final Environmental Impact Statement with the Council on Environmental Quality. And, after those procedures have taken place, the project can be funded.

MR. ROBERT SPALDING: I missed the very end of what you said, the dates as far as the final -- (interrupted).

PRESIDING OFFICER: I'm going to let Mr. Bergstrom respond to that question as this is his field.

MR. BERGSTROM: Once we receive all comments after the August 8th date, we will begin preparation of the final statement. During this time period we will be responding to all comments, and we estimate that this process would take approximately thirty (30) to forty-five (45) days to complete the final environmental statement. At that time we will send copies back to people who made major

comments on the draft environmental statement. And, once the -- at that same time we will also forward copies to the Council on Environmental Quality. Once the Council on Environmental Quality receives the final Environmental Impact Statement, there is a thirty (30) day comment period from the time they publish receipt in the Federal Register.

PRESIDING OFFICER: Yes?

MR. NOLAN: I'm Paul Nolan, Director of Water Resources for the City of Albuquerque. I'm somewhat concerned by your comments on your schedule. We've been informed by the State EPA that our environmental Impact Statement must be approved by the time they approve our grant applications by October 1. In other words, the Environmental Impact Statement must be approved and our facility's plan approved before they will award us any grants for the next year. And, it's my understanding the deadline is October 1. And, if you take forty-five (45) days, plus an additional month, you're not going to make that.

MR. BERGSTROM: I just might add that we do have a process. It's a -- which gives us the legal, I guess, right to waive the thirty (30) day period at the Council on Environmental Quality. We -- our present time schedule, though, we believe that we can meet and get final approval on the final statement by that October 1st date with no

problems. So, we don't see this to be a problem at this point. This is without our requesting a thirty (30) day waiver from Council on Environmental Quality also.

PRESIDING OFFICER: Are there any further questions? It appears that no one else has a question, therefore, I'm going to adjourn the Hearing for tonight, and I certainly appreciate all of you coming. Thank you.

(WHEREUPON, the Hearing in the above-entitled matter was closed.)

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Submitted by Edmund G. Brown

SUMMARY OF ODOR CONTROL PROGRAM

Program	Objectives and/or Anticipated Results	Schedule	Estimated Cost
A. Plant No. 2			
1. Special Consultant Retained	1. Identify problems 2. Make recommendations on: a. Plant Operations b. Short-Term, Long-Term, Low Cost and more expensive programs.	1. Consultant hired 1/77 2. Part I Report submitted 3/77. 3. Part II Report submitted 6/77.	$35,000
2. Anaerobic Digester Cleaning-Rehabilitation	1. To restore eight digesters to full useful capacity.	1. Two digesters March-June 1977 2. Two digesters September December 1977 3. Two digesters March-June 1978 4. Two digesters September-December 1978	$300,000
3. Centrifuge Pilot Plant Program	1. Pilot Plant to determine feasibility of thickening waste activated sludge.	1. Work conducted during Fall 1977	Minimal cost to the City; most costs at the expense of the equipment manufacturer
4. Construction of Dissolved Air Flotation System	1. To thicken waste activated sludge and thus minimize amount of water handled	1. Consultant began work 4/77 2. Equipment to be pre-purchased July 1977. 3. Construction to begin 11/77 4. Start-up to begin June 1978	$1,150,000
5. Hauling of Liquid Sludge	1. Eliminate significant amount of sludge until Item 4 above can be completed.	1. Program began in May 1977 and will continue until at least July 1978.	$100,000 annually
6. Disposal of Excess Stockpiled Dry Sludge	1. To eliminate the excess stockpiled sludge above and beyond the needs of the Parks and Recreation Dept.	1. Specifications have been written. 2. Program expected to begin July 1977 and continue indefinitely.	----------

Hearing Exhibit No. 1

	Program	Objectives and/or Anticipated Results	Schedule	Estimated Cost
7.	Construction of temporary Sludge Drying Beds	1. To provide additional beds to help relieve the existing 82 beds	1. Beds constructed Fall 1977 by City Forces	$10,000
8.	Design and Construction of Phase IA	1. Increase plant capacity from 39 mgd to 47 mgd. 2. Add 30 additional sludge drying beds	1. Design complete by Oct. 1977. 2. Construction to begin January 1978. 3. Construction complete January 1980.	$3,000,000
9.	Addition of Polyelectrolyte Chemicals	1. To help capture excess solids and thus clarify effluent. 2. To accelerate dewatering of sludge poured to beds.	1. Program conducted Jan.-April 1977. 2. Program partially successful and will continue to further evaluate sludge dewatering.	$25,000 (to date)
10.	Chlorination Improvements	1. To replace two existing chlorinators which provide odor control to the "supernatant" and for "pre-chlorination." 2. Will provide increased capacity and reliability.	1. Chlorinators ordered April 1977. 2. Installation complete by July 1977.	Part of current construction program.
11.	Increased Staffing and Budget	1. To provide additional personnel in certain operation and maintenance areas. 2. To provide additional monies for improved preventative maintenance programs.	1. Programs to begin July 1, 1977.	Amount dependent on Budget Approval
12.	Operator Training	1. To continue program of Operator Training so that fully qualified and certified personnel operate and maintain facilities.	1. On-going	Amount depends on Budget Approval
13.	Additional Facilities	1. Planning calls for the following: a. All treatment to take place at Plant No. 2 after 1983. b. Plant 2 to be expanded to 59 mgd by 1983. c. Mechanical sludge dewatering will replace most open air drying beds.	1. Anticipated completion by 1983 but dependent on Federal funding program.	$12,000,000

Program	Objectives and/or Anticipated Results	Schedule	Estimated Cost
B. Plant No. 1			
1. Special Consultant Retained	1. Identify Problems. 2. Make recommendations on: a. Plant Operations b. Short-Term, Long-Term low cost and more expensive programs	1. Consultant hired in Jan. 1977 2. Part I report submitted March 1977 3. Part II report submitted June 1977.	$35,000
2. Low-Cost Measures identified in Item 1 above	1. To cover certain open channels, boxes, structures, etc. and treat the collected gas prior to discharge to the atmosphere.	1. Program evaluation underway. 2. Recommended program to begin after July 1977, and complete July 1978.	$50,000 plus (Amount dependent on budget approval)
3. Anaerobic Digester Rehabilitation	1. To restore digesters to full useful capacity.	1. Program evaluation underway.	Amount dependent on recommended program and budget approval.
4. Disposal of Excess Stockpiled Dry Sludge	1. To eliminate excess stockpiled sludge above and beyond the needs of the Parks and Recreation Department.	1. Specifications have been written. 2. Program expected to begin July 1977 and continue indefinitely.	----------
5. Increased Staffing and Budget	1. To provide additional personnel in certain operation and maintenance areas. 2. To provide additional monies for improved preventative maintenance programs.	1. Program to begin July 1, 1977.	Amount dependent on budget approval.
6. Operator Training	1. To continue program of Operator Training such that fully qualified and certified personnel operate and maintain facilities.	1. On-going	Amount dependent on budget approval.
7. Equipment Replacements	1. To replace and/or rehabilitate certain digester mixers, pumps, bar screens, trickling filters, and other mechamical equipment.	1. On-going	Amount commensurate with available Capital Improvements Funds

Program	Objectives and/or Anticipated Results	Schedule	Estimated Cost
C. Other Factors			
1. Additional Staff added since Summer 1976	1. To provide eight additional personnel for improved operation and maintenance of both facilities	1. All personnel budgeted have been hired.	$85,000 annually
2. Employment of Temporary and Part-Time Personnel	1. To assist at both Plants in the Operation and Maintenance of both Facilities	1. Three students from NMSU will be employed for 12 weeks this summer 2. Temporary employee to be hired May 1977 for six-month period	----------

C E R T I F I C A T E

I HEREBY CERTIFY THAT the proceedings of which this is the transcript were held at the time and place hereinbefore written and;

THAT the foregoing pages 1 through 37, inclusive, are a complete and correct transcript of my stenographic notes and electronic tape recordings taken at the proceedings and;

THAT Hearing Exhibit 1 was marked for identification and attached hereto.

RICHE H. EMMONS & ASSOCIATES, INC., Certified Shorthand Reporters

By: Riche H. Emmons
(Mrs.) Riche H. Emmons

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