EPA-908/5-78-003

BOULDER COLORADO WASTEWATER TREATMENT FACILITIES

FINAL ENVIRONMENTAL IMPACT STATEMENT

NOVEMBER 1978

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII

EPA-908/5-78-003

BOULDER, COLORADO

WASTEWATER TREATMENT FACILITIES
FINAL
ENVIRONMENTAL IMPACT STATEMENT

Prepared by

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
DENVER, COLORADO 80203

NOVEMBER 1978

Prepared with the Assistance of

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Approved by ______________________
Regional Administrator

Date November 30, 1978

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Preface

This final Environmental Impact Statement (EIS) is documentation of an intensive review and analysis by EPA of alternative means for the City of Boulder to improve its wastewater treatment facilities. These improvements are needed in order for the City to meet State, Federal, and its own goals for improving Boulder Creek water quality to a much higher level than currently exists.

Eight different alternative means of treating Boulder's wastes have been analyzed in this EIS. Because of various technical, economic, environmental, and policy considerations only three of these alternatives have been found to possess the requisites necessary to rank them as contenders for final selection. These three alternatives are infiltration/percolation basins; activated sludge process following trickling filters; and an agricultural reuse system. A fourth alternative, aeration-polishing ponds, which was suggested as a possible candidate in the draft EIS, has since been found to be incapable of consistently meeting required treatment levels and has been eliminated for that reason.

The infiltration-percolation basin system, though promising a high level of treatment, was not selected because of factors related to location of the necessary 200+ acre site. One site that was evaluated (adjacent to 75th St.) would impact the White Rocks Natural Area and the Gunbarrel area developments to an unacceptable level. The other site (at the 95th St. - Boulder Creek area) was eliminated because of potential for ground-water pollution, transmission costs, and because it would lead to a partial dewatering of a section of Boulder Creek.

The second alternative considered in the final selection process was an agricultural reuse system. This type "land treatment" system is one potentially offering significant energy and fertilizer savings and is one that offers a very high level of treatment and other advantages. In Boulder's situation, however, it was found that problems associated with acquiring a long-term commitment of some 12,000 acres of land for this use, presence of truck farms, use of irrigation ditch water by a municipality, and other problems preclude implementation of this alternative.

The last alternative, activated sludge process following trickling filters, is the one favored by the City of Boulder, Boulder County, and most of those who responded to the draft EIS. This system is capable of providing a very high level of treatment, it avoids the siting problems associated with the other alternatives, and is one that can actually be implemented because it avoids the "institutional" problems associated with the other systems considered. Because of the problems discovered with the other alternatives, EPA agrees that this alternative best meets Boulder's particular needs and circumstances. It should be pointed out that EPA will require Boulder to pursue energy conservation measures on the design and operation of this system.

The reader should note that another part of the Boulder wastewater improvements project, land injection of sludge, which was analyzed in the draft EIS does not appear in this final. The sludge disposal analysis has been deleted because of a City of Boulder and EPA decision to look at an additional sludge injection site. This decision was made late in the final EIS preparation process and to include this analysis would have seriously delayed issuance of this document and further progress of the project. Sludge injection will now be analyzed in a separate Addendum to the final EIS which will be issued at a later date.

SUMMARY

DRAFT ENVIRONMENTAL IMPACT STATEMENT -- WASTEWATER TREATMENT IMPROVEMENTS FOR THE CITY OF BOULDER, COLORADO

Environmental Protection Agency
Region VIII
1860 Lincoln
Denver, Colorado

1. Type of Statement: Draft ( ) Final (x)

2. Type of Action: Administrative (x) Legislative ( )

3. Description of Action:

The objective of this project is to design and construct additional wastewater treatment facilities for the City of Boulder. These facilities have been proposed so that water quality in Boulder Creek will meet the goals established by the Water Pollution Control Act Amendments of 1972 (Public Law 92-500) and the more restrictive State of Colorado water quality classifications. This Environmental Impact Statement (EIS) identifies alternatives for providing Boulder with improved wastewater facilities designed to meet the needs of its residents and to maintain and improve environmental quality. The projected service area contains approximately 140 square miles and is bounded by the foothills to the west, Davison Mesa to the south and Gunbarrel Hill to the north. The City of Boulder's population was estimated to be approximately 73,000 in 1976. The 1995 population for the city is projected to be 116,700; and the planning area is projected to be 129,000.

Historically, treatment plant effluent discharges to the Boulder Creek sub-basin have been a major source of stream pollution. The city's two existing wastewater treatment plants have experienced problems with both liquid- and solids-handling processes. The long-term and cumulative effects of surface water degradation caused by all of the sub-basin's pollution sources include loss of sensitive fish and the development of simple ecosystems with only a few pollution-tolerant species in the streams.

The wastewater facilities planning process began in 1973 and is continuing at the present with the preparation of this EIS. This assessment is focused on modifications and additions to the treatment plant liquid flow processes, method of final effluent disposal and final disposal of sludge.

4. Summary of Environmental Impacts and Adverse Environmental Effects:

The type and magnitude of potential impacts vary according to the alternative proposed. Alternatives A-G represent different treatment concepts while Alternative H represents the no project situation. The impacts have been divided into: short-term impacts (construction), long-term direct impacts (operation), and long-term indirect impacts (secondary effects).

(1) Short-term impacts associated with construction include removal of groundcover, loss or transfer of soil resource, localized soil erosion, disruption of wildlife patterns, aerial pollutants, noise, visual impact, spoil disposal, traffic congestion, utility service disruption, safety hazards and water quality impairments. No short-term impacts will be associated with Alternative H.

(2) Long-term impacts associated with operation include:

a. Improvements of local water quality in Boulder Creek;
b. Lowering of groundwater table and partial diversion of flow in the vicinity of 75th Street at Boulder Creek;
c. Effects on groundwater quality at certain sites;
d. Potential odor generation;
e. Fog or aerosol formation over large ponds;
f. Increased energy demand;
g. Effects on local land-use patterns and property values;
h. Potential public health and safety problems;
i. Impacts on the visual and aesthetic environment; and
j. Effects on soil productivity.

(3) Long-term indirect impacts includes those changes from population growth accommodated by provision of sewer services such as future construction in the sub-basin leading to erosion and subsequent stream pollution, loss of natural areas and wildlife habitat, loss of scenic resources, energy, utilities and service demands, and a long-term change in life style and quality of life.

5. Alternatives Considered:

Alternative A - Land treatment by infiltration/percolation. Capital cost: 75th Street site--$9,889,000; 95th Street site--$11,171,000.

Alternative B - Activated sludge process following trickling filters. Capital cost - $10,272,000.

Alternative C - Aeration/polishing ponds. Capital cost - $7,832,000.

Alternative D - Activated sludge process prior to trickling filters. Capital cost - $11,544,000.

Alternative E - Multi-media filtration of effluent. Capital cost - $6,926,000.

Alternative F - Chemical coagulation. Capital cost - $4,681,000.

Alternative G - High-rate irrigation of effluent. Capital cost - $34,875,000.

Alternative H - No action. Capital cost - $0.

Alternative I - Agricultural reuse program. No estimate of capital cost was made.

All of the alternatives, except F, will incorporate beneficial reuse of sludge to the maximum amount possible. Twenty-five percent of the sludge will be made available for use in the community; the remainder will be injected into a 170 acre field near the 75th Street plant. Sludge from Alternative F would contain alum and be unsuitable for agricultural use, thus, necessitating disposal to the county landfill. The description and analysis of the sludge-injection system will be presented separately as an addendum to this final EIS.

6. Distribution:

The agencies and interested groups that have been requested to comment on the draft EIS are listed on the following pages.

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City Manager
City of Lafayette
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City Manager
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INTRODUCTION

The National Environmental Policy Act of 1969 (NEPA) requires that all agencies of the federal government prepare a detailed Environmental Impact Statement (EIS) on proposals for projects that may significantly affect the quality of the human environment. NEPA requires that agencies--in this case the Environmental Protection Agency (EPA)--include in their decision-making process local and regional environmental considerations, the environmental impact of the proposed project and its alternatives, and a discussion of ways to avoid or minimize adverse effects.

The action being considered by EPA is the approval of federal funding for the design and construction of additional wastewater treatment facilities for the City of Boulder, Colorado. These facilities have been proposed so that water quality in Boulder Creek will meet the goals established by the Water Pollution Control Act Amendments of 1972 (Public Law 92-500). One of the key goals of this law is to have water quality good enough to support fish and allow recreation on and in the water by 1983. Usually, secondary wastewater treatment will meet these goals. In the case of Boulder Creek, more restrictive state and regional water quality classifications require that treatment processes beyond the secondary treatment level may be needed.

To assist municipalities in meeting the stated water qulaity goals through treatment facility modifications, Congress set aside $18 billion in a Construction Grant Program to pay 75 percent of the eligible costs of publicaly-owned waste treatment works. For "innovative" treatment technology, such as land treatment, federal funding may cover up to 85 percent of the eligible costs. Facilities planning and implementation under the Constrution Grant Program provides for a three-step approach for the planning, design and construction of municipal treatment works, the majority being paid for by federal money. Step I involves the development of a "facilities plan" that evaluates treatment needs, systems capacities and alternatives, and develops a preliminary design for the project. EPA is charged with review and approval of such Step I plans before design (Step II) and construction (Step III) funds can be obtained.

EPA has determined that the proposed modifications and additions to the Boulder Wastewater treatment facilities could have significant environmental effects and has required the full-scale analysis of an Environmental Impact Statement (EIS). The EIS is to be a "full disclosure" document and must follow specific regulations of the EPA as contained in 40 CFR, Part 6, as published in the Federal Register, Vol. 40, No. 72, April 14, 1975.

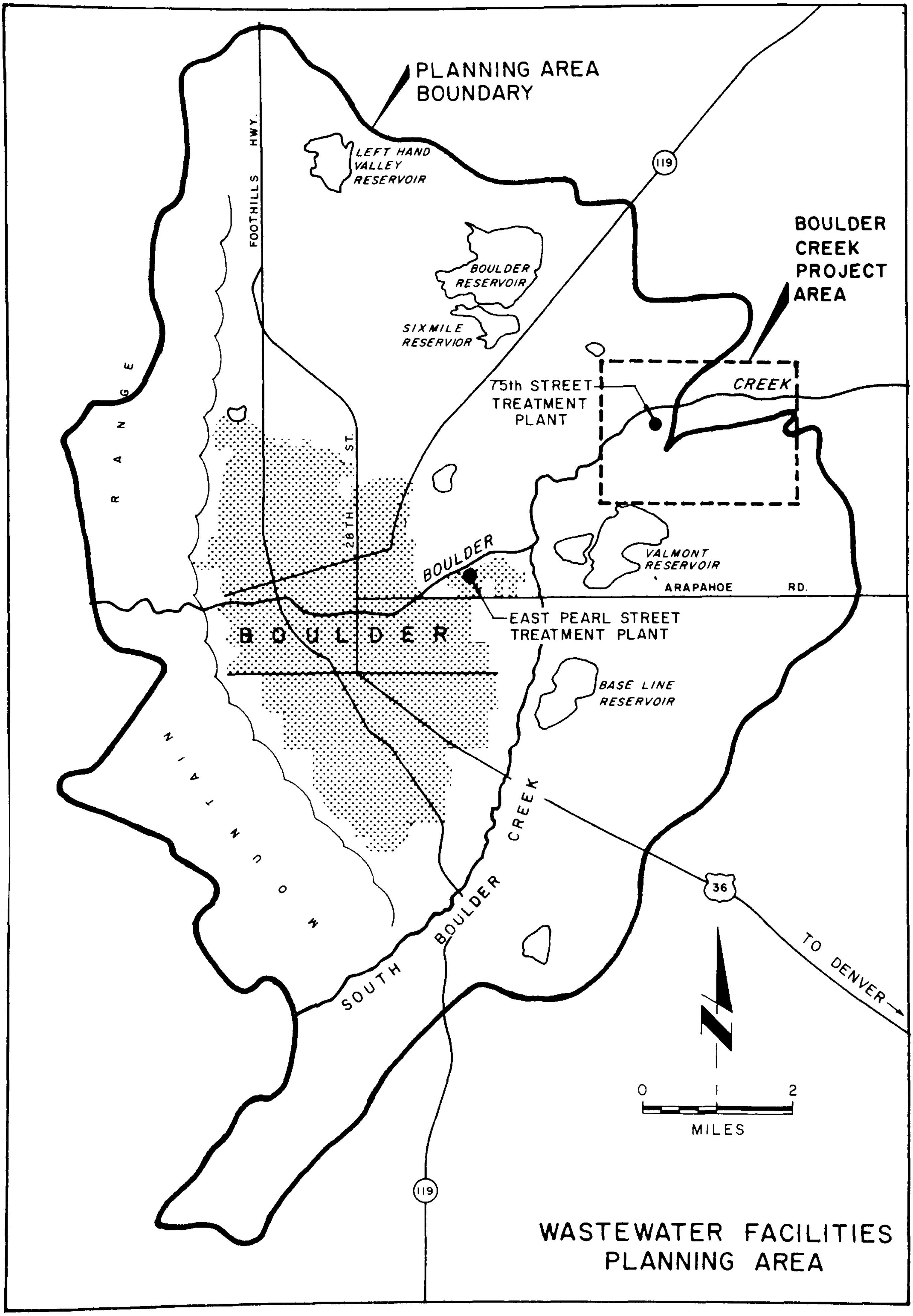
Data for this EIS was compiled from various existing studies within the Boulder area, field reconnaisance and numerous personal contacts with interested individuals and groups. A complete listing of references appears in the final section of the report. The project staff that prepared this EIS is listed in Appendix G.

BACKGROUND

The planning area of the Boulder wastewater facilities plan is outlined in Figure 1. The planning area contains 140 square miles and is bounded geographically by the foothills to the west, Davidson Mesa to the south and Gun Barrel Hill to the north. The planning area is essentially the area projected to be served by the proposed wastewater treatment facilities. This includes many areas in Boulder County which are presently unsewered and where utility provision may be an issue.

The population of Colorado has been growing at a rate greater than that of the nation as a whole. The City of Boulder has attracted a substantial portion of this new development and growth is expected to continue. On the basis of local estimates, the City of Boulder population was approximately 73,000 in 1976. Population projections for the City of Boulder and the Boulder planning area were made by the Boulder Area Growth Study Commission, and recent refinements have been made by the City and County planning departments and the Denver Regional Council of Governments (DRCOG). The projected 1995 populations for the City of Boulder and for the Boulder planning area are 116,700 and 129,000 respectively. These population estimates were used in the facilities planning study.

The City of Boulder is served by two wastewater treatment plants, located on Boulder Creek as shown in Figure 1. The East Pearl Street Treatment Plant is a small primary treatment facility handling 4.3 million gallons per day (mgd). Wastewater effluent was discharged directly to Boulder Creek above 55th Street until 1 May 1975, when the effluent was diverted to the main facility for secondary treatment. The 75th Street treatmentplant is a secondary level treatment facility with a nominal capacity of 15.6 mgd. Wastewater effluent from the main treatment plant is discharged directly to Boulder Creek, above 75th Street. Based on a future flow projection of 120 gallons per capita per day (g/c.d), the 75th Street plant could presently handle the average daily flow equivalent to a population of approximately 130,000. However, the treatment plant needs to be upgraded to meet local effluent limitations and state stream water quality criteria for Boulder Creek.



WASTEWATER FACILITIES PLANNING AREA

The existing wastewater treatment plants are experiencing problems with both liquid- and solids-handling processes. Upgrading of the liquid flow processes is under consideration in order to serve regional growth and expansion and to establish and maintain a high-quality fishery downstream of the treated effluent discharge point near 75th Street on Boulder Creek. Treatment plant effluent has historically been the major source of stream pollution within the upper Boulder Creek subbasin. High levels of organic material and dissolved nutrients from treatment plant effluents, sediment loads from agricultural return flows and industrial discharges have led to a degradation of the stream environment. Long-term effects include loss of sensitive fishes and other aquatic organisms, silt deposits, nuisance algal growths, and the development of unstable ecosystems with only a few pollution-tolerant species (Reference 1).

PROJECT DEVELOPMENT

Improvement of the water quality and stream environment of Boulder Creek is necessary to restore and maintain the scenic and recreational resources of the Boulder Creek corridor, and conform to the goals of the Boulder Valley Comprehensive Plan. The Boulder City Council committed the city to upgrade and improve the quality of Boulder Creek to allow primary water-contact recreation and the development of a sport fishery in a resolution on June 17, 1975. The primary targets were the closure of the East Pearl Street treatment plant and outfall, and the modification of the 75th Street treatment plant to a higher level of treatment.

The wastewater facilities planning process in Boulder began in November 1973, when the city contracted with two engineering firms to prepare independent reports comparing land treatment of wastewater effluent with conventional or advanced wastewater treatment methods. Three levels of treatment were evaluated; zero discharge of pollutants advanced wastewater treatment, and secondary treatment including ammonia-removal. The two parallel reports were completed in July 1974 (References 2 and 3).

The city staff evaluated the reports with the aid of a Citizen's Advisory Committee and made recommendations to the city council for future action. These recommendations became "The Clean Water Package", defining water quality goals and included a suggested plan for the realization of these goals. An additional study, to concentrate on a specific set of water quality standards and funding restrictions, was requested and was formally approved by the city council in November 1974.

The city staff then proceeded with an application for an EPA Step I Grant for facilities planning. This grant application was approved in April 1975, and the resulting facilities plan (Reference 1) was published in October 1975. On the basis of recommendations from the facilities plan, the city has applied to EPA for a two-phase Step II grant for improvements and expansion of existing wastewater facilities. Phase I is concerned only with sludge digestion processes and related facilities for control of odor problems at the 75th Street treatment plant. These additions and changes to the physical plant are not expected to create significant environmental impacts and are therefore covered separately in a negative declaration issued by EPA on 10 November 1976. (Reference 4.) Phase II, the subject of this environmental evaluation, consists of modifications and additions to the treatment plant liquid flow processes, and the method of effluent disposal. Final disposal of sludge will be analyzed in a separate addendum to this EIS to be issued at a later date. On 15 December 1976, the Regional Administrator of EPA sent a "Notice of Intent to Prepare an Environmental Impact Statement for Approval of the Boulder, Colorado Wastewater Facilities Plan" to government agencies, public groups and citizens. On 29 September 1976, EPA contracted with Engineering-Science, Inc., to undertake the studies and analysis necessary for the preparation and completion of an EIS for the proposed project under the NEPA process.

In August 1977, EPA distributed the draft EIS to federal, state, and local agencies as well as to interested groups and individuals for review and comment. Attention was focused on three specific alternatives as the most cost-effective treatment systems. After numerous public meetings, local agency meetings, and a public hearing, the majority of Boulder City and County residents favored a conventional method of wastewater treatment (activated sludge) but were undecided as to the method of sludge disposal. The conventional treatment system represented a compromise agreement; for although it would be more costly and energy-intensive, it did not have the controversial environmental impacts associated with land-based treatment systems.

In February 1978, EPA decided that further work was needed before an alternative could be recommended for design and construction under federal funding. In August 1978, additional evaluations were performed for two land-based treatment systems and sludge disposal. The treatment systems are included as Appendix D of this EIS. Sludge disposal will be described in an addendum to this EIS to be issued at a later date.

SUMMARY

The facilities plan identified seven alternative plans for the development of wastewater treatment facilities in the planning area. These alternative plans are: A--land treatment of effluent with infiltration/percolation ponds; B--installation of an activated sludge process to follow the existing trickling filter process; C--effluent treatment in aeration and polishing ponds; D--installation of an activated sludge process before the existing trickling filters; E--multimedia filtration of effluent; F--chemical coagulation; G--high-rate irrigation of effluent and I--an agricultural reuse program. All alternatives except Alternative F incorporate sludge digestion and stabilization with approximately 75 percent applied to a local field by subsurface injection and the remainder to be dried and stockpiled for reuse. Sludge digestion and stabilization are incorporated under Phase I described in the section on project development and are not discussed in this EIS. Sludge produced from system F is not suitable for agricultural reuse practices and therefore would have to be disposed of in a landfill. An additional Alternative H, was considered in this EIS and was defined as the no-project course of action.

Alternative Plans

Based on the estimated treatment effectiveness and engineering evaluation of alternatives in Section III of this EIS, two of the alternative systems proposed in the facilities plan would not be able to meet state and local water quality goals. These alternative systems are: E--multimedia filtration and F-- chemical coagulation. Modification of Alternatives E and F to bring treatment quality up to the required standards would have produced systems essentially the same as other alternatives proposed. In the same manner, Alternative H would not be able to meet state and local water quality standards and goals. Therefore, in the detailed analysis of this EIS, only those systems which had a potential to meet the desired standards and goals were considered. This narrowed range includes five alternatives: A--infiltration/percolation ponds; B--activated sludge process following trickling filters; C--aeration and polishing ponds; D--activated sludge before the trickling filters; and G--high- rate irrigation of effluent. Alternative I, an agricultural reuse program was evaluated in August 1978 and is included in this summary. Alternative H--no project, is included in the summary below for purposes of comparison. The proposed project area with the main alternative sites in the vicinity of the 75th Street treatment plant is shown in Figure 2.

Alternative A - Land Treatment by Infiltration-Percolation--

This process would use the high infiltration and permeability capabilities of the sands and gravels bordering Boulder Creek. Two sites were evaluated in the vicinity of 75th Street and 95th Street. The system would be operated all year around. A drain tile system would be installed to depress the groundwater profile and collect the filtered effluent for return to the creek. Approximately 225 acres of land would be needed for infiltration/percolation basins and a buffer zone. Wastewater would be treated by the existing 75th Street treatment plant prior to application to the basins.

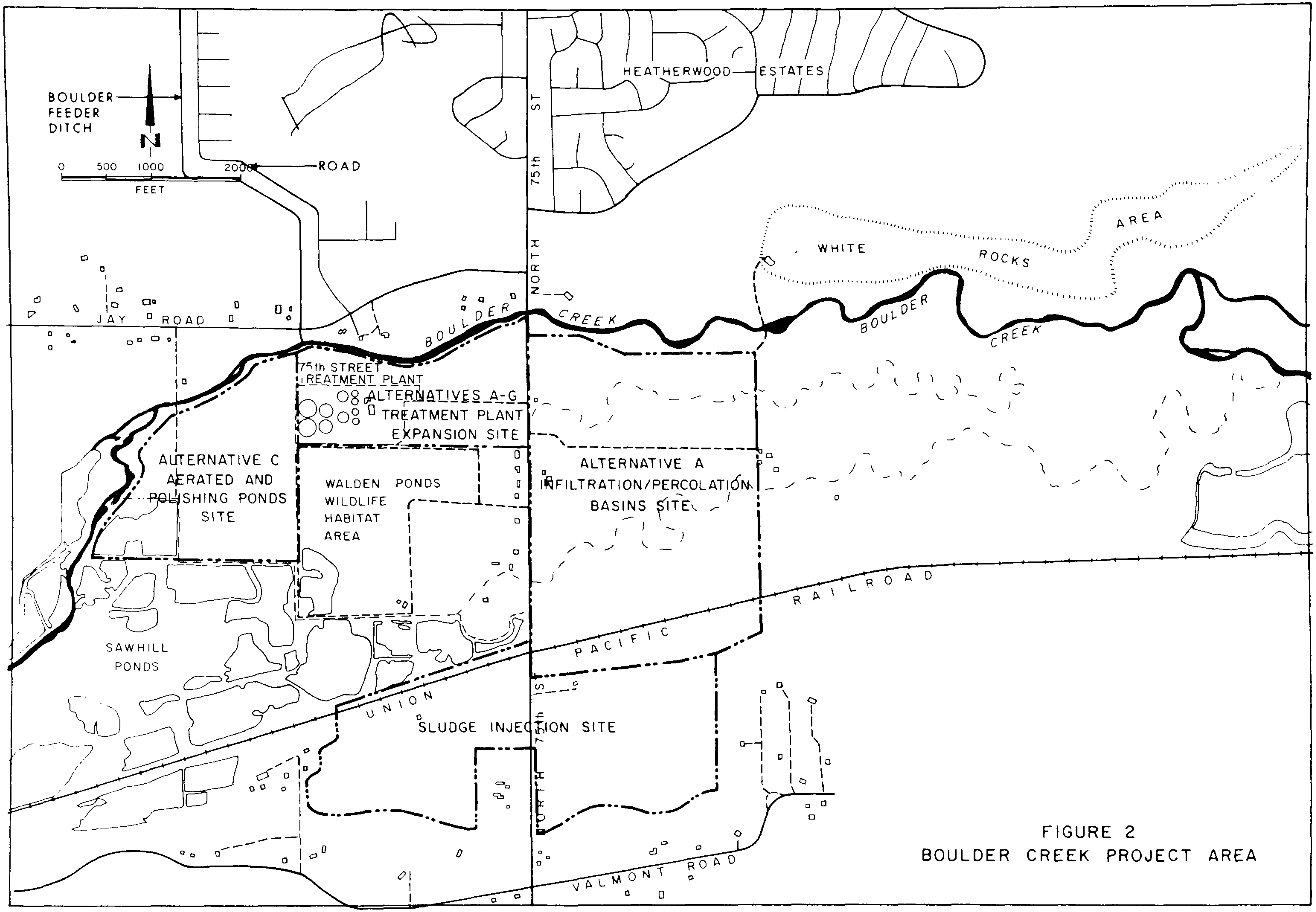


FIGURE 2
BOULDER CREEK PROJECT AREA

Alternative B - Activated Sludge Process following Trickling Filters--

This alternative would employ a complete-mix activated sludge process following existing plant treatment processes, and the addition of final clarifiers. The activated sludge basins would have a short aeration time (2 hrs) and would oxidize any organics escaping the trickling filter process. No additional land would be required, because the facilities could be constructed on the existing plant site. This alternative also includes ammonia removal.

Alternative C - Aerated and Polishing Ponds--

Treated effluent from the existing 75th Street plant would be pumped to aerated ponds with a 2-day detention time. Most of the remaining organics would be oxidized in the ponds with the effluent from the ponds overflowing into succeeding polishing ponds where suspended solids would settle out. The first polishing pond would probably have algae growths with their associated maintenance problems, while the last pond could probably support a warm water sport fishery. All of the ponds would be constructed in gravel pits that will be excavated from the site in the future. Total additional land needed, including buffer area, would be approximately 145 acres. It is questionable whether this alternative can provide adequate treatment for: (1) NH_3N in winter; (2) TSS in summer; and (3) BOD_5 in summer.

Alternative D - Activated Sludge Process prior to Trickling Filters--

A pure oxygen, complete mix, activated sludge process would be constructed ahead of the existing trickling filters to treat all the effluent entering the 75th Street plant. This process would oxidize approixmately 90 percent of the organic content before the effluent is applied to the trickling filters. The filters would then receive a wastewater low in BOD, which would permit nitrification of the wastewater. No additional land area would be required for implementing this system.

Alternative G - High Rate Irrigation of Effluent--

This system would principally be employed for wastewater treatment while utilizing the residual nutrients in the effluent for crop production. This system would include a 350-acre lagoon with an 8,800 acre-foot capacity to store the effluent for five months during the nongrowing season. Irrigation with the effluent from the lagoon would be at a rate of 10 feet/year. Fescue or smooth brome grass would be planted and harvested as hay for livestock feed. The total area of land needed would be 3,360 acres, which includes irrigation fields, buffer space and a 350 acre storage lagoon approximately 30-feet deep. Under this alternative, the city would actually own, or in some like manner, control the land involved.

Alternative H - No Action--

The existing wastewater treatment facilities at the East Pearl Street and 75th Street plants would continue operation. Phase I of the facilities plans, as discussed in the Project Development Section has already been approved by EPA and is currently undergoing engineering design. Thus, the new sludge digester and stabilization system would become part of the existing facilities and would alleviate most of the present odor problems associated with the treatment plant. The present trickling filter system is adequate for a secondary treatment level. However, discharge of this effluent to Boulder Creek will not comply with the local and state goals of primary water-contact recreation and development of a sport fishery in that creek. Organic material, dissolved nutrients, ammonia and coliform bacteria from treatment plant effluents would exceed the new upgraded stream standards. These pollutants have historically altered the ecology of Boulder Creek and would hinder restoration efforts for the Boulder Creek corridor.

Alternative I - Agricultural Reuse Program--

This program is a land-based treatment system which would involve exchanges of effluent water rights with irrigation water rights held by local ditch companies. Secondary effluent would be conveyed to privately-owned ditches and applied to private farmland during the growing season. The nutrients in the effluent would be used by crops, while the wastewater would be renovated through the soil column. Approximately 10,000-12,000 acres of farmland would be required. In winter, effluent would be conveyed to a 10,000 acre-foot reservoir for storage and release for the spring irrigation demand.

This system relies on a private irrigation and farm system and thus would require a long-term contract between the city and each ditch company. In addition, the city must either acquire the development rights to the irrigation sites in order to ensure a fixed land area for effluent application or in some other manner be able to assure that this land will remain available for irrigation use for the design life of the project (approximately 20 years).

Sludge Disposal--

All alternatives, except F, will incorporate beneficial reuse of sludge to the maximum amount possible. Not addressed in this EIS are alterations and additions to the existing facility which will include sludge thickening, anaerobic digestion, and dewatering of 25 percent of the sludge by vacuum filtration and sand drying beds. Phase II, which will be addressed in a later addendum to this EIS, includes the construction of force mains to a proposed field near the treatment plant or to another site near 95th Street currently being evaluated. The remaining 75 percent of liquid sludge from the plant will be pumped to these fields and injected below the ground surface with special equipment for beneficial reuse to crops. A potential field site of 170 acres near the 75th Street plant has been proposed for Alternatives A through G. As stated, another site of approximately the same size, is being investigated near 95th Street. Sludge produced from Alternative System F will contain large volumes of alum and will be unsuitable for crop reuse, necessitating disposal to a landfill.

Environmental Impacts

In the engineering evaluation performed in Section III and in the Appendix D, only alternatives A, B, C, D, G and I had the potential to meet regional water quality goals. The major beneficial and adverse environmental impacts of these alternatives along with feasible mitigation measures considered are summarized below. A sludge-injection site has not been finally selected and will be presented separately as an addendum to the final EIS.

Impacts on the 75th Street site are evaluated in Section IV of the EIS. Impacts associated with the 95th Street site were evaluated in August 1978 and are included in Appendix D. For most situations, impacts at the two sites were similar and are summarized below. Differences at individual sites are noted below also.

Construction of additional treatment processes will commit the nominal treatment plant capacity to 17.6 mgd. The ability to handle this volume of flow effectively allows the city to handle sewerage flows for 129,000 persons during the design period.

Alternative A - Infiltration/Percolation Ponds--

1. Construction activities will cause short-term erosion, downstream sedimentation, dust emissions and noise. These effects can be reduced by specific construction practices.

2. Removal of ground cover and pasture habitat with eventual replacement by plant and animal species that can tolerate an intermittent wet and dry cycle will occur. Water-associated bird and animal species will be encouraged.

3. Pond operations will cause a lowering of the groundwater table below and immediately adjacent to the pond sites. Groundwater flow through that area will be disrupted with diminished volumes immediately east of the site. This effect could be mitigated with a recharge system along the eastern site boundary if the effects on subirrigation are severe.

4. Minor groundwater contamination from percolates immediately east of the site when fields are saturated after heavy rain or irrigation.

5. A potential public health hazard may occur from aerosols arising from the effluent in the infiltration basins during windy periods. Certain bacteria and viruses may be transmitted through contact with the aerosols. In the event that the site becomes flooded, overflow of effluent to adjacent public and private property may expose persons in the area to bacterial and viral contamination from surface waters. This impact could be effectively mitigated by disinfection of wastewaters.

6. The infiltration/percolation ponds can produce a high quality effluent that will greatly enhance the water quality and aquatic productivity in Boulder Creek. Nitrate levels, however, are not reduced by this system and are higher than the recommended regional goals, as reviewed on pages 40 and 41 of Section II.

7. The warm effluent in the ponds may have a potential to generate steam fog during extremely cold winter days. Fog may drift over adjacent roadways and inconvenience travellers and adjacent residences.

8. Under adverse operation conditions, such as soil clogging, localized odor generation may occur and drift to downwind areas. At the 75th Street site, this may affect local housing subdivisions. At the 95th Street site, a few local residences may be affected. Plans for subdividing areas near the 95th Street site may conflict with this treatment location.

9. Construction activities at the 95th Street site may disrupt a heron rookery immediately east of the site through dust, noise, vibrations and destruction of some feeding habitat. This effect can be eliminated by scheduling construction during the fall and winter when the birds have migrated south and are absent from the rookery.

10. The 95th Street site lies within a probable recharge area which connects the shallow aquifer with the Pierre Shale Transition Zone. Effluent infiltration at the site may potentially enter the deep aquifer and contaminate it. This effect is difficult to mitigate as the exact location and character of the fault need to be confirmed by further study.

11. Diversion of effluent discharge from above 75th Street to the vicinity of 95th Street would reduce groundwater recharge by Boulder Creek and subsequent pasture sub-irrigation as well as remove the water supply from the headgates of Leggett and Lower Boulder Ditch. These effects can be mitigated by pumping the renovated wastewater back upstream to the vicinity of 75th Street or at least to headgates of Leggett and Lower Boulder Ditches.

Alternatives B and D - Activated Sludge Systems--

1. Construction activities will cause short-term erosion, dust emissions, noise and increased traffic. These effects can be reduced by specific construction practices.

2. There will be a commitment of only a small land area to the facilities construction, thereby causing a negligible impact upon vegetation and wildlife habitats.

3. There will be a production of a good quality effluent that will greatly enhance the water quality and aquatic productivity of Boulder Creek. Organic and nitrate levels, however, would be higher than the recommended regional goals, as presented on pages 40 and 41 of Section II.

4. Comparatively large expenditures of energy will be required to run an activated-sludge system, particularly the oxygen-generation unit. System D will consume 2-5 times more energy than Alternatives A or C.

5. Systems B and D have the greatest potential for energy generation. Methane gas produced from the anerobic digestor would help reduce the total amount of energy required for the system. This may account for up to one-third of the energy requirements in Alternative B and one-fifth of the requirement in Alternative D.

Alternative C - Aeration/Polishing Ponds--

1. Construction activities will cause short-term erosion, dust emissions, noise and increased traffic. These effects can be reduced by specific construction practices.

2. Creation of a continuous chain of ponds covering approximately 140 acres will increase aquatic habitat in the area. This may be attractive to waterfowl, shorebirds and other animals associated with water bodies.

3. This alternative could adequately meet the local BOD and suspended solids limitations, however, the level of assurance would be lower than Alternatives A, B, D or G. Periodically high ammonia and suspended solids levels would continue to be a problem in the creek.

4. Odors may be produced during particular periods in the spring when anaerobic waters and decaying materials are brought to the pond surface or in the summer following algal blooms and subsequent decay. The odor-causing conditions and odor situations can possibly be mitigated by a monitoring and control program to control and/or harvest excess algal growth.

5. Creation of a picnic area and bicycle path along Boulder Creek and around the final polishing ponds could increase the recreational resource of the area. The final polishing ponds could also be stocked with warmwater fish species. Public acceptability would depend upon the ability to control odors.

6. The conversion of existing and future gravel pits into well-designed ponds west of the 75th Street plant would reclaim the area into a pond and waterfowl area. This would increase the diversity of the area. However, implementation of this alternative may be counter to Boulder County reclamation plans for the Walden Ponds Wildlife Habitat area. Prior to project approval, interagency cooperation and agreement would be required.

7. Steam fog could be generated over the ponds on extremely cold winter mornings. The probability of a dense fog affecting roads would be low. Fog generation cannot be mitigated effectively.

Alternative G - High-Rate Irrigation--

1. Construction activities will cause short-term erosion, dust emissions, noise and increased traffic. These effects can be mitigated with specific construction techniques.

2. 350 acres will be irreversibly committed to the construction of a permanent storage lagoon. Permanent destruction of soil profile at the lagoon site and irretrievable loss of 17 million cubic yards of soil resource at the lagoon site will occur. Soil loss at the site cannot be mitigated; however, the soil resource can be transferred to other areas for use.

3. Crop production will utilize nitrates in the effluent, however, some quantity of nitrates and other constituents may enter the groundwater or surface runoff on the irrigation sites.

4. The existing communities at the proposed irrigation areas will be altered from mixed pastureland/agricultural to a monoculture of grass species tolerant to high-rate irrigation. Changes in wildlife numbers and composition will also occur.

5. Odors may be produced during the following conditions: a) the storage lagoon becomes anaerobic in winter and spring thaws bring the odorous material to the surface; b) large algal blooms in the summer with subsequent die-off decay; c) suspended algae in irrigation waters may dry and decompose on fields after irrigation; and, d) summer drawdown of the lagoon may bring settled decaying algae to the surface. Odor effects may be mitigated by control algae in the lagoon; however, complete odor control would be difficult to achieve.

6. Nutrient resources in wastewater effluents are conserved by recycling them to agricultural lands.

7. High-rate irrigation, under some conditions, can damage vegetation by excess hydraulic loadings or cause salt accumulations in soils. Under a properly managed system, hydraulic overloading can be controlled and salt accumulations reduced to a low level.

8. A comparatively large expenditure of energy will be required to pump the treated effluent to the storage reservoir and operate irrigation equipment. Energy commitment for this system is approximately twice the amount required for system B.

9. Pumping of the treated effluent to a regional storage lagoon and a provision of high-rate irrigation system makes this alternative compatible for a future agricultural reuse program for Boulder County. In the future, control of irrigation rates, crop selection and extension to formerly non-irrigated areas could optimize use of treated effluent in a reuse program.

Alternative I - Agricultural Reuse Program--

This alternative was evaluated in summer 1978 and the impacts discussion is presented in Appendix D.

1. Construction activities will cause short-term erosion, dust emissions, noise and increased traffic. These effects can be mitigated with specific construction techniques. Significant construction impact may occur with the construction of a new storage reservoir or the dredging of an existing reservoir to increase the storage capacity.

2. Provision of a high level of water treatment by purification through the soil column. However, high evapotranspiration associated with irrigated cropland may increase water salinity.

3. Beneficial reuse of the wastewater nutrients by crops.

4. Domestic use of the ditch company water would have to be limited. At present, the town of Frederick in Weld County draws domestic water from the Lower Boulder Ditch.

5. Nuisance odors and algal growth may occur in the storage lagoon similar to those mentioned under Item 5 of Alternative G.

6. A long-term contract for water exchange would be required between the city and each ditch company. This would severly limit options for individual water use for contracted farms within the ditch

company. An alternative may be for the city to purchase individual water rights and lease them back to the farmers. This method would be costly and require a complex administration.

7. A long-term agricultural commitment of land areas is required for effluent application. The city would probably have to institute a program such as acquiring development rights for the proposed sites to ensure that they will not be developed during the project life. Commitment of these areas to agricultural use within Boulder County would conform with the "greenbelt" concept of the Boulder Valley Comprehensive Plan. However, the majority of the land irrigated by the ditches that were evaluated in Appendix D are in Weld County and the "greenbelt" concept would not apply.

8. The city would be required to provide restitution for additional ditch and farm operation costs. To meet public health concerns, only crops not grown for direct human consumption could be grown with effluent, and the city may have to compensate growers for higher value crops that might have been grown with regular irrigation water or provide another water supply for these areas.

9. A comparatively large expenditure of energy will be required to pump the treated effluent to the fields and storage reservoir as well as operate irrigation equipment. Energy commitment for this system would be twice the amount required for system B.

10. Administration of an agricultural reuse program would be relatively complex in the event that: 1) more than one ditch company is involved; 2) if the ditch companies have junior water rights and the decreed flow is small; or 3) multiple agreements must be made between ditch companies and individual farmers. The greater the number of entities involved the less control the city will have over the final disposition of the effluent and the resultant water quality.

11. As of August 1978, several local ditch companies have been approached to determine their receptiveness to an agricultural reuse program. Major problems were anticipated with negotiating the purchase of development rights, water rights, system reliability and other considerations. As a whole, the ditch companies were reluctant to enter into any long-term agreements.

Project Costs

The present worth of all costs for each alternative in January 1977 dollars is shown on Table 1. Costs were not estimated for Alternative I (Agricultural Reuse Program) as no workable water exchange system was developed. The present worth is a combination of total capital costs less salvage values and the cumulative operation and operation and maintenance (O&M) costs during the design period. A detailed explanation is given in Section III. Alternative A is separated into two series denoting costs associated with two different sites. Alternative C is the lowest with a present worth value of $10.1 million. Alternative A, B and D are intermediate at $11.9-14.7 million and Alternative G is highest at over $44 million.

Alternative H (no action) would have no associated capital costs. Annual O&M Costs would remain similar to present levels at the treatment plant. Alternative I, the agricultural reuse program, was not developed in sufficient detail to be costed. The reuse program encountered a number of institutional problems and was not considered workable by EPA at the present time. No estimate could be made without additional information regarding costs for purchasing water and development rights.

Capital Costs--

Under the facilities plan and supplement (References 1 and 5), each alternative was costed out for two construction phases occuring in 1978-1980 and 1988-1989. Salvage values were projected in the year 2000.

Total capital costs for both phases of construction range from a low of $7,832,000 for Alternative C (Infiltration/Percolation) to a high of $34,875,000 for Alternative G (high-rate irrigation). Assuming 75 percent federal participation in capital funding, corresponding costs to the City of Boulder would range from a low of $1,958,000 (Alternative C) to a high of $8,178,000 (Alternative G). Table 1 lists the capital costs, for the total project and the Boulder portion of each alternative system. The salvage value of facilities and land conversely is lowest for Alternative C ($579,000) and highest for Alternative G ($4,053,000) due to the large amount of land involved.

Annual O&M Costs--

The average annual equivalent cost to be borne by Boulder for each alternative is shown in Table 1. The annual equivalent costs for each construction phase with a 6-3/8 percent discount factor over 30 years. The annual equivalent costs are lowest under Alternative C ($613,000) and highest under Alternative G ($2,849,000).

Table 1. PROJECT COSTS — ALL ALTERNATIVES
(In Thousands of Dollars)

	Alternative					
	A_1^d	A_2^d	B	C	D	G
Capital Costs						
Total project costs	9,889	11,171	10,272	7,832	11,544	34,875
Boulder's share of total project costs[a]	2,473	2,793	2,568	1,958	2,886	8,718
Average annual equivalent cost[b]	707	754	904	608	904	2,824
Salvage value of facilities and land	853	946	853	579	940	4,053
Net present worth[c]	11,911	13,130	13,799	10,133	14,706	44,685

[a]Assumes federal participation of 75 percent of total project costs.

[b]Represents annual O&M charges plus capital recovery costs to Boulder for each phase. For detailed explanation of costs, see Section IV, Alternatives-Project Costs.

[c]Present worth of all costs less salvage value of facilities and land. For detailed explanation, see Section IV.

[d]A_1=costs associated with infiltration/percolation basins at 75th Street site.
A_2=cost associated with infiltration/percolation basins at 95th Street site.

SECTION II

SECTION II

ENVIRONMENTAL SETTING

PHYSICAL ENVIRONMENT

The planning area is situated at the base of the eastern slope of the southern Rocky Mountains, commonly referred to as the Front Range. The mountains rise dramatically more than 2,000 ft in a distance of two miles and overshadow the relatively flat plains area of Boulder.

Climate

Climate has a direct bearing on wastewater treatment facility operations in relation to equipment performance during weather extremes. Low temperatures can limit the reliability of biological treatment systems; winds carry odors; freezing conditions and evapotranspiration rates affect land application of effluents; and rainfall affects receiving stream and wastewater flows.

In general, the Boulder area has a continental, semi-arid climate which is greatly influenced by the Rocky Mountain system located immediately to the west. The Front Range and the prevailing westerly winds modify the plains climate with generally lower daytime temperatures; narrower temperature range; warm-to-cool summer days; higher relative humidity; greater, more evenly distributed precipitation; and very strong winds in the higher, exposed areas (Reference 6).

Temperature--

The annual normal temperature is 51.8°F. The range of monthly average mean temperatures is 33.1°F (January) to 73.9°F (July). The range of record temperature extremes is -33°F (January 1930) to 104°F (June/July 1951). The average frost-free season is 152 days between 9 May and 8 October. The average number of days having temperatures above 32°F during the frost season is 83 (References 4, 7). In the context of sewage treatment plant operations, low temperatures can be significant if they limit the reliability of biological sewage treatment systems. Low temperatures can significantly retard percolation rates for percolation pond treatment systems. Freezing temperatures can halt pond operations and shut down irrigation systems. High temperatures, on the other hand, can be significant if they stimulate the growth of algae which subsequently decay, causing odors.

Precipitation and Evaporation--

The wet season in Boulder generally falls between April and September, with the peak period occurring during April through June. The mean annual precipitation is 18.42 in., with an annual maximum of 27.52 in. and an annual minimum of 10.91 in. The area is relatively arid, and the rate of evaporation is high during the summer months, as indicated in general by evaporation data at Fort Collins, 40 miles to the north. The low relative humidity of the area, rather than the summer temperature, is the major factor causing this high rate of evaporation. The Boulder area receives approximately 81.0 in. of snow annually, with most snow falling between October and May. In the context of wastewater treatment systems, precipitation and evaporation rates are important working factors in relation to reliability and efficiency of wastewater pond systems.

Winds--

During the winter and early spring, Boulder is subject to strong down-canyon winds off the eastern mountain slopes called Chinooks. As these winds descend through Boulder Canyon, their speed and temperature increases greatly. When the Chinooks enter the cooler plains area, they can cause sharp temperature increases in several hours. In addition to Chinooks, Boulder is subject to severe windstorms at least once a year during the winter. The windstorms are characterized by overall speeds in excess of 50 mph, gusts up to 90 mph, rapid and frequent fluctuation in speed and extremely low relative humidity (References 8, 9). Chinook episodes and windstorms could be of significance at construction sites and in areas with bare, exposed surfaces, such as earth berms and drying beds, where potential for blowing dust and soil is high.

In the vicinity of the 75th Street treatment plant, prevailing winds are from the southwest through west. Winds also blow occasionally from northeast and east. Generally, winds tend to parallel Boulder Creek. At night in very cold weather, southwesterly drainage winds down the valley are likely. Ambient wind conditions are important in estimating dispersal of potential odors or steam fogs generated from the alternative treatment systems.

Air Quality

Boulder forms the northwest portion of the Metropolitan Denver Air Quality Control Region (AQCR) as defined by the Colorado State Air Pollution Control Commission (Reference 10). Within this region, air pollution control priorities have been established for carbon monoxide, particulates and reactive hydrocarbons. Pollutants in the Boulder area are generated to some degree by light industry (manufacturing); however, the majority of emissions are derived from automobile traffic. Air pollution effects are often compounded by winter temperature inversions which trap pollutants in the Boulder Valley (Reference 11).

In a recent report by the Boulder City/County Health Department (Reference 12), air quality in the Boulder area was determined to be greatly influenced by traffic in the central area of the city. On days with stable atmospheric conditions and little dispersion, air pollution levels may routinely exceed National Ambient Air Quality Standards (NAAQS). Carbon monoxide concentrations are due almost entirely to vehicular traffic and exceed state and federal standards periodically in heavily travelled areas. Relief of areas with traffic congestion greatly reduces carbon monoxide levels.

Federal primary and secondary standards for particulates have often been exceeded in Boulder. Particulates can be derived from industrial activity as well as from automobile exhaust. Ozone levels measured at the National Oceanic and Atmospheric Administration building in Boulder show that the 1976 federal photochemical oxidant standard of 0.080 ppm was exceeded during 23 of the 34 months of data available from 1973 to 1976 (Reference 12). High ozone levels are expected to continue as long as the source pollutants (reactive hydrocarbons) are emitted into the air. As federal emission controls work towards reducing vehicle emissions, ozone levels may decrease. However, there are sufficient naturally occurring emissions of reactive hydrocarbons that the ozone standards may be exceeded in the future (Reference 12).

Throughout the remainder of the planning area, traffic is relatively freeflowing, resulting in less congestion, fewer emissions and better air quality. As winds pick up or other climatic activity along the Front Range takes place, temperature inversions are broken up, and pollutant levels throughout the planning area are reduced below significant levels.

Geology

Local Bedrock Geology--

Knowledge of general permeability characteristics of the bedrock formations is important in examining the potential for groundwater pollution by land-disposed effluent.

With the formation of the mountains and hogbacks to the west and the retreat of an ancient sea covering the region, Boulder County was exposed to such forces as running water, glaciation and wind. The wearing and reshaping effects of these forces on the exposed land surface have resulted in the formation of vast quantities of new (Quaternary age, less than two-million-years-old) alluvial (river-transported), colluvial (landslide-transported), eolial (wind-transported), and various glacial sediments and materials which cover much of the area. These unconsolidated surficial deposits, which are shown in Figure 3, include loose sand, silt, gravel and clay. The coarse material is quite permeable and may be more than 30 ft thick in the eastern part of the study area.

Underlying and in some places breaking through the surface of these young sediments and related materials are older, more erosion-resistant Upper Cretaceous (80-million-year-old) sedimentary rock formations known as Pierre Shale, Fox Hills Sandstone and Laramie. Pierre Shale is the most widespread formation in the study area. It is 5,000 to 8,000 ft thick and consists of gray to black clay and sandy shale. The formation is highly impermeable and generally prevents recharge of water to lower rock units. Most of the City of Boulder and both wastewater treatment plants are situated above the Pierre Shale Formation. Bedrock and surface elevation contours for the proposed project area are shown in Figure 4. The bedrock consists of gray clay and shale of the Pierre Shale Formation and buff to brown to olive silty clay derived from the Pierre Shale or the lower Fox Hills Formation.

Bedrock elevations generally rise from east to west along with the gradual rise in topography. In the vicinity of the 75th Street treatment plant, bedrock generally lies 15-20 ft below the ground surface. East of 75th Street, the bedrock layer generally lies 10-15 ft below the ground surface. The bedrock layer strongly defines the movement of the overlying groundwater aquifer. The depth to bedrock is also an important consideration in designing pond sizes and building foundations.

Unique Geologic Features--

One of the most visible areas in Boulder County where the Fox Hills and Laramie formations outcrop at the surface is the "White Rocks." These sandstone bluffs rise over 100 ft above the floodplain and are limited to a two-mile segment along Boulder Creek. The geological uniqueness of the White Rocks is due to joints in the rock which intersect to form polygons that differ from those typically found in sandstone. Two basic polygonal patterns occur. The first is characterized by right-angle intersections and bears close similarity to mud cracks and ice-wedge polygons. The second, occurring within the first, is composed of hexagonal and pentagonal figures that resemble columnar jointing in horizontal perspective. The resultant hummocky, "turtleback" topography

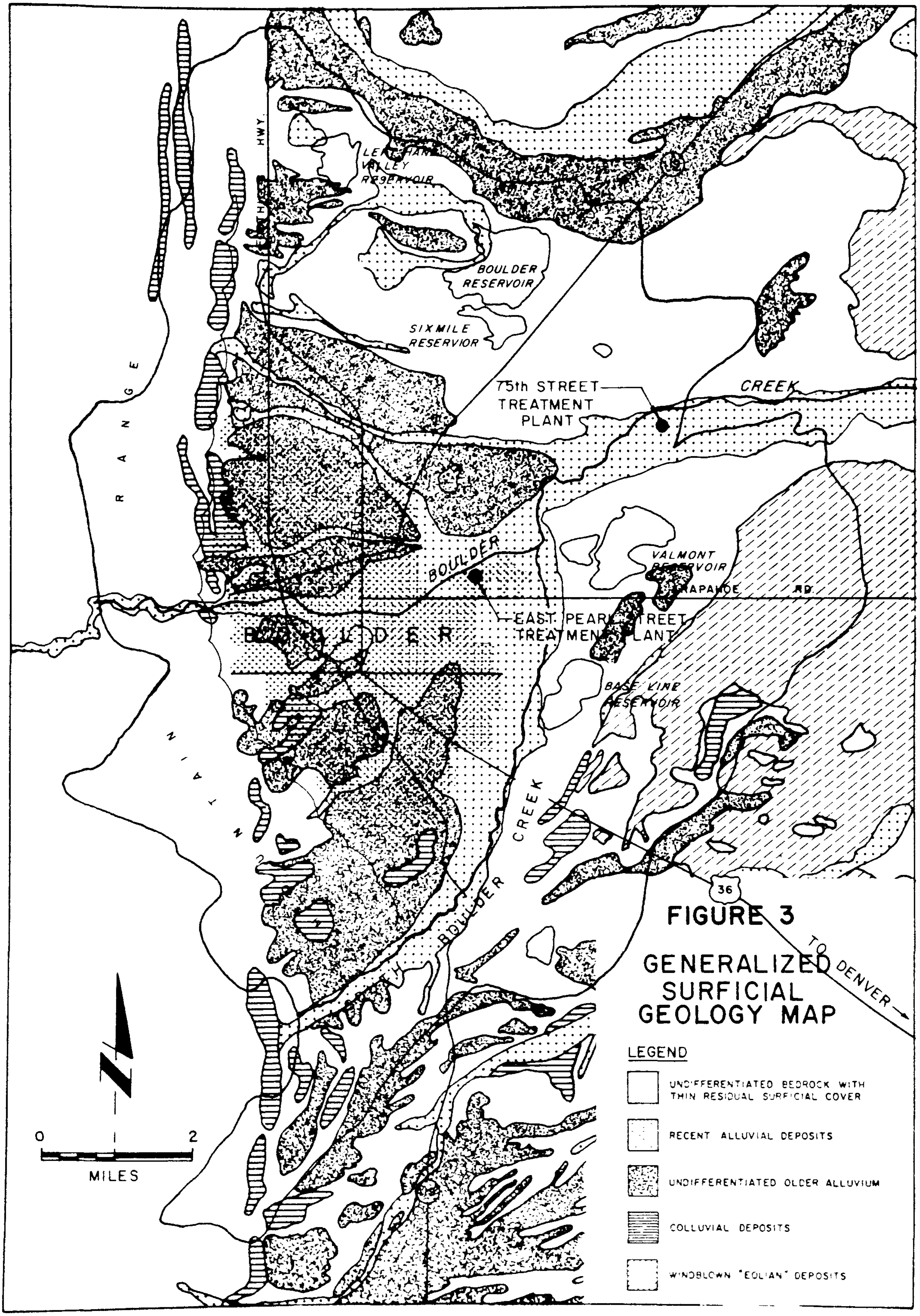


FIGURE 3

GENERALIZED SURFICIAL GEOLOGY MAP

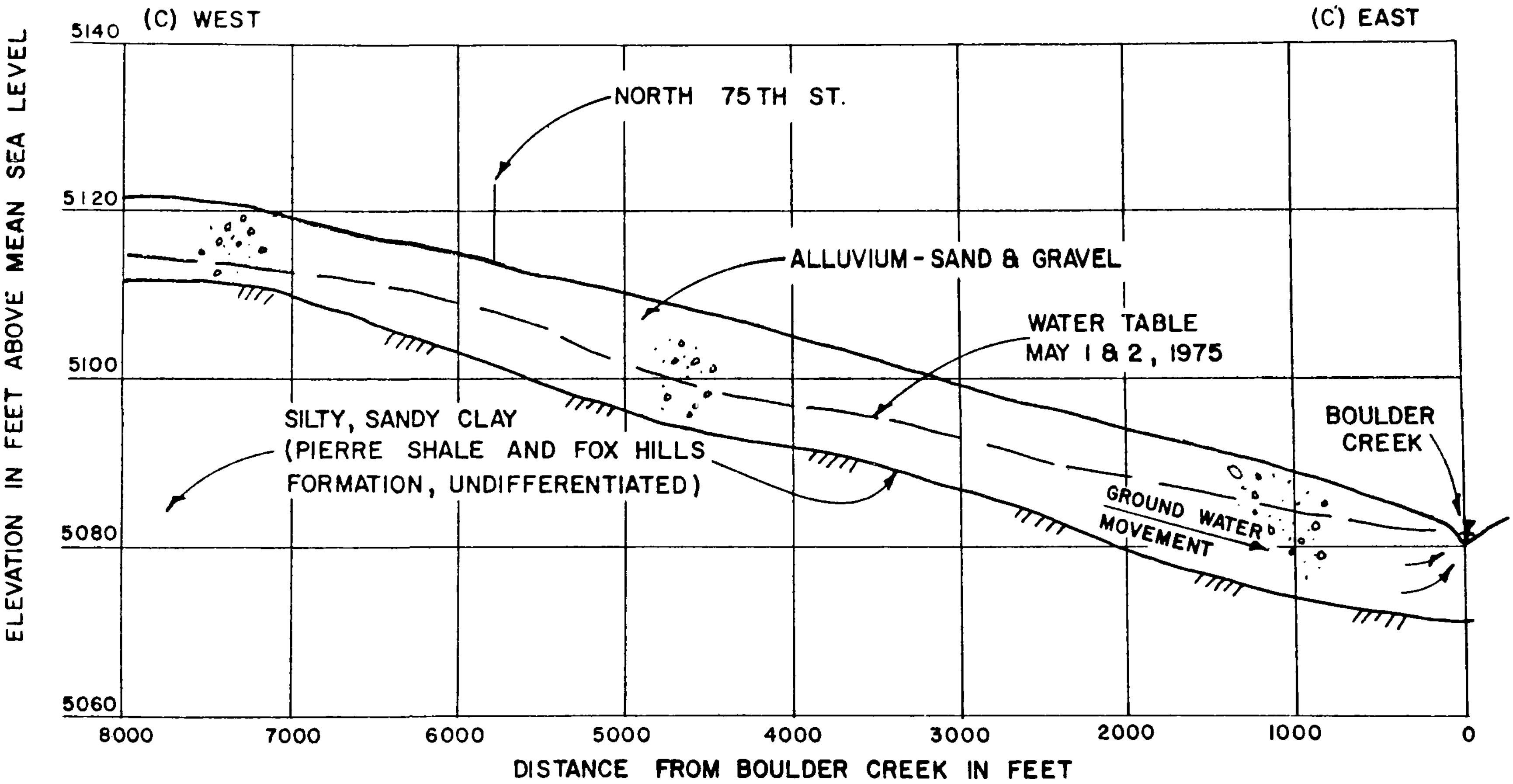
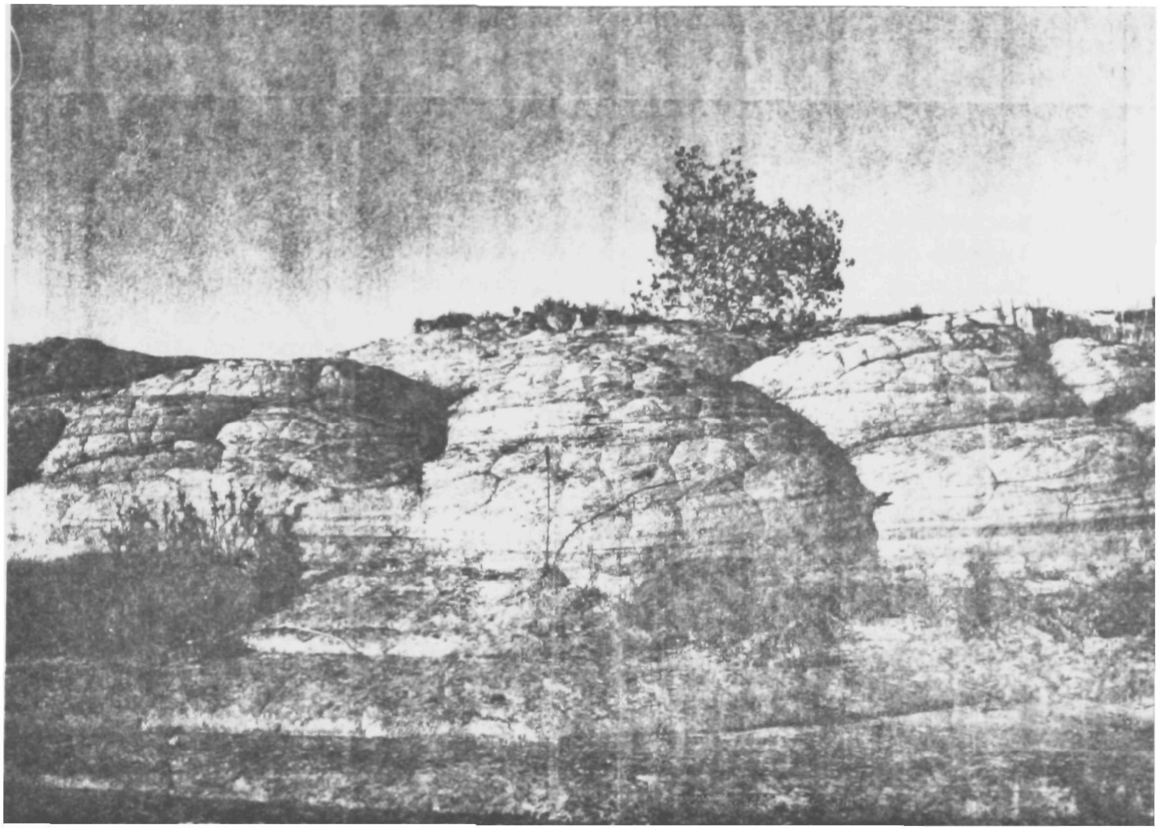


FIGURE 4
SURFACE AND BEDROCK ELEVATION - CROSS - SECTION
PROPOSED PROJECT AREA

gives a unique appearance to the surface relief and influences the distribution of a variety of common and unique local flora and fauna (Reference 13). Further discussion of the biotic and aesthetic importance of the White Rocks is given in sections to follow.



WHITE ROCKS GEOLOGIC FORMATION

Soils

Knowledge of local and on-site soil characteristics is important to project planning to avoid or minimize construction or operation problems. Also, where soils are to be an integral factor in project operations, such as sludge injection, it is important to know which are the most suitable types. Lastly, knowledge of the soils' agriculture and other productivity potential is important in assessing the long-term resource losses that may result from a given project.

The characteristics of the soils identified for the project sites are discussed in this section and in Appendix A, and a general soil map of the 75th Street proposed project areas is shown on Figure 5. This information is general in nature and should be augmented with additional field investigations by soils scientists, agronomists and/or soils engineers at the project design stage.

Niwot-Loveland-Calkins Association--

Both of Boulder's wastewater treatment plants are situated on soils of the Niwot-Loveland-Calkins association. The soils of this association, formed from loamy alluvium, occupy narrow, nearly level areas adjacent to major streams in eastern Boulder County. About 35 percent of the association is Niwot soils, and 15 percent is Loveland soils. All of the major soils of this association are mottled and have a water table that is within plant root zones at sometime during the year. Mottled soils generally indicate poor aeration and lack of drainage. The majority of soils in this association have severe limitations for septic tank use and sewage lagoon operation because of high water tables and flooding hazards. In places, soils of this association are flooded by runoff from adjacent areas. Soils of this association are not easily eroded; however, bank-cutting near channels can be a problem for the Niwot series. About half of the total acreage of this association is used for growing irrigated crops. The rest is used for irrigated pasture. Because of the high water tables, drainage practices help increase crop yields. Many areas adjacent to watercourses have been mined for their gravel resources (Reference 14).

FIGURE 5. SOIL SERIES
BOULDER CREEK PROJECT AREA
LEGEND

2	Ascalon sandy loam
3	Ascalon Otero complex
4	Hargreave tini sandy loam
5	Manter sandy loam
16	Longmont clay *
17	Loveland soils *
18	Niwot soils
19	Nunn clay loam
20	Samsil clay
21	Calkins sandy loam
22	Colby silty clay loam
23	Colby-Gaynor association
27	Valmont clay loam
28	Valmont clobby clay loam
29	Weld Line sandy loam
30	Samsil Shingle complex E=5-25%
RO	Rock Outcrop

Slope

A	0-1%
B	1-3%
C	3-5%
D	5-9%
E	9-20%

* Predominant soils of proposed project areas

Source: Soil Conservation Service
test site data from CH_2M Hill

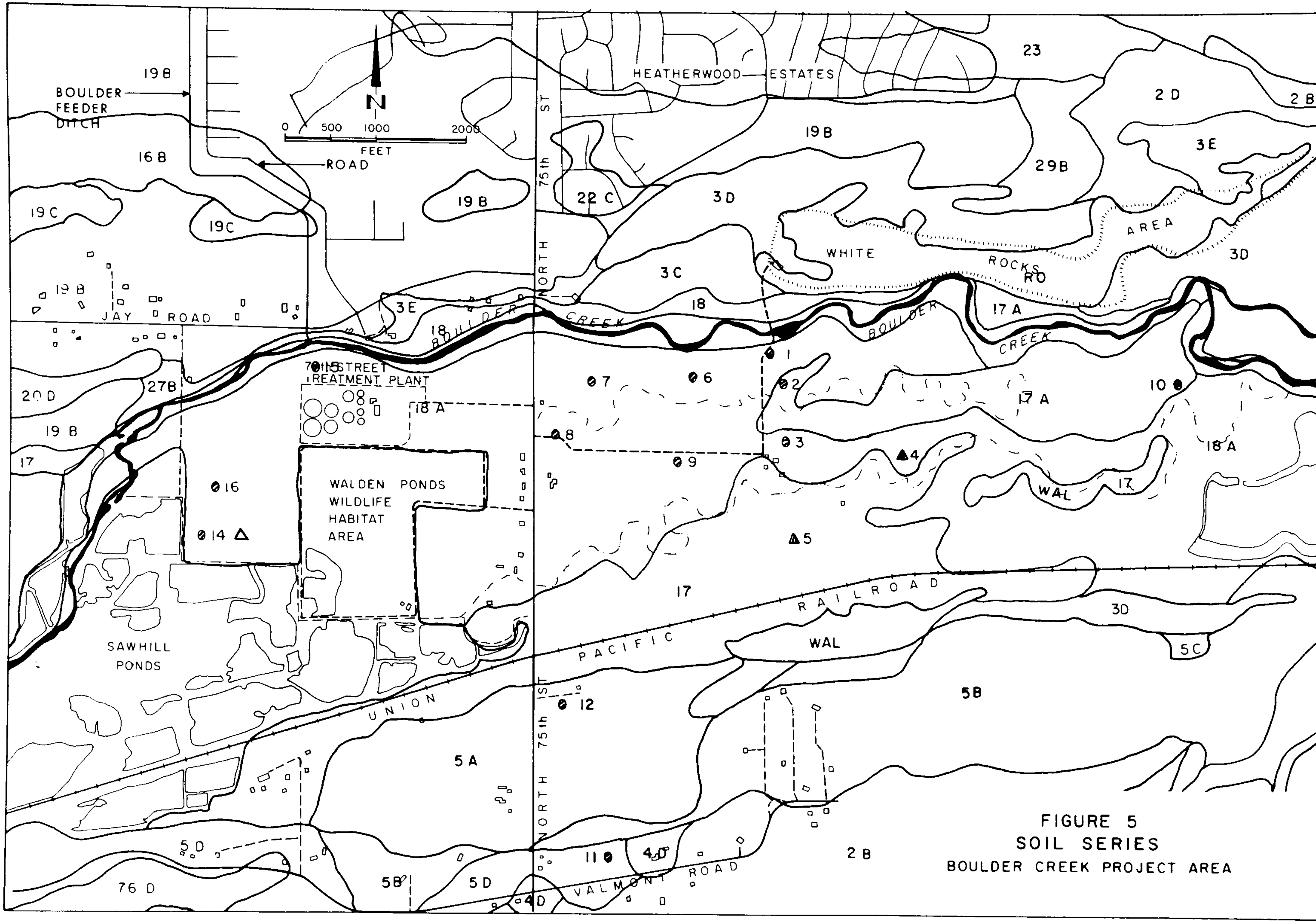


FIGURE 5
SOIL SERIES
BOULDER CREEK PROJECT AREA

Ascalan-Nunn-Manter Association--

All of the area of the proposed sludge injection site and a small portion of the proposed infiltration-percolation basin site is situated on soils of this association. These soils are on nearly level terraces and on gently sloping to moderately steep valley sides and uplands in the southeastern part of Boulder County. The soils in this association were formed in mixed alluvial and eolial materials. About 60 percent of the association is Ascalan soils, about 15 percent Nunn soils and about 10 percent Manter soils (Reference 14).

Most areas of this association are cultivated. About two-thirds of the area is used for irrigated crops. Where these soils are irrigated, good water management helps control erosion; use of crop residue helps control soil blowing on both irrigated and dry-farmed areas.

Soils Limitations for Septic Tank Use in the Boulder Area--

An important consideration in the analysis of programs for improvement of wastewater facilities is the determination of which areas have the most immediate need for service. The Boulder City/County Health Department, in conjunction with the U.S. Geological Survey, has mapped residential areas of various densities which are dependent on septic tanks for liquid waste disposal. (Reference 15).

Based upon information from the County Health Department and the U.S. Soil Conservation Service, Figure 6 displays gross areas of septic tank use and limitation. Although the areas of septic tank limitation shown on the map are likely to receive a higher degree of attention in sewer system expansion planning, it must be kept in mind that there are pockets within areas suitable for septic tank use that will also require sewer service because of site-specific soil limitations (References 14 and 15).

Water

Groundwater--

Knowledge of local groundwater conditions is important whenever excavations are planned so that construction problems may be avoided. More specifically, when effluent treatment ponds are planned, knowledge of groundwater conditions is necessary to assure that the improvements do not inadvertently lead to a contamination of local groundwater resources. Also, land disposal of

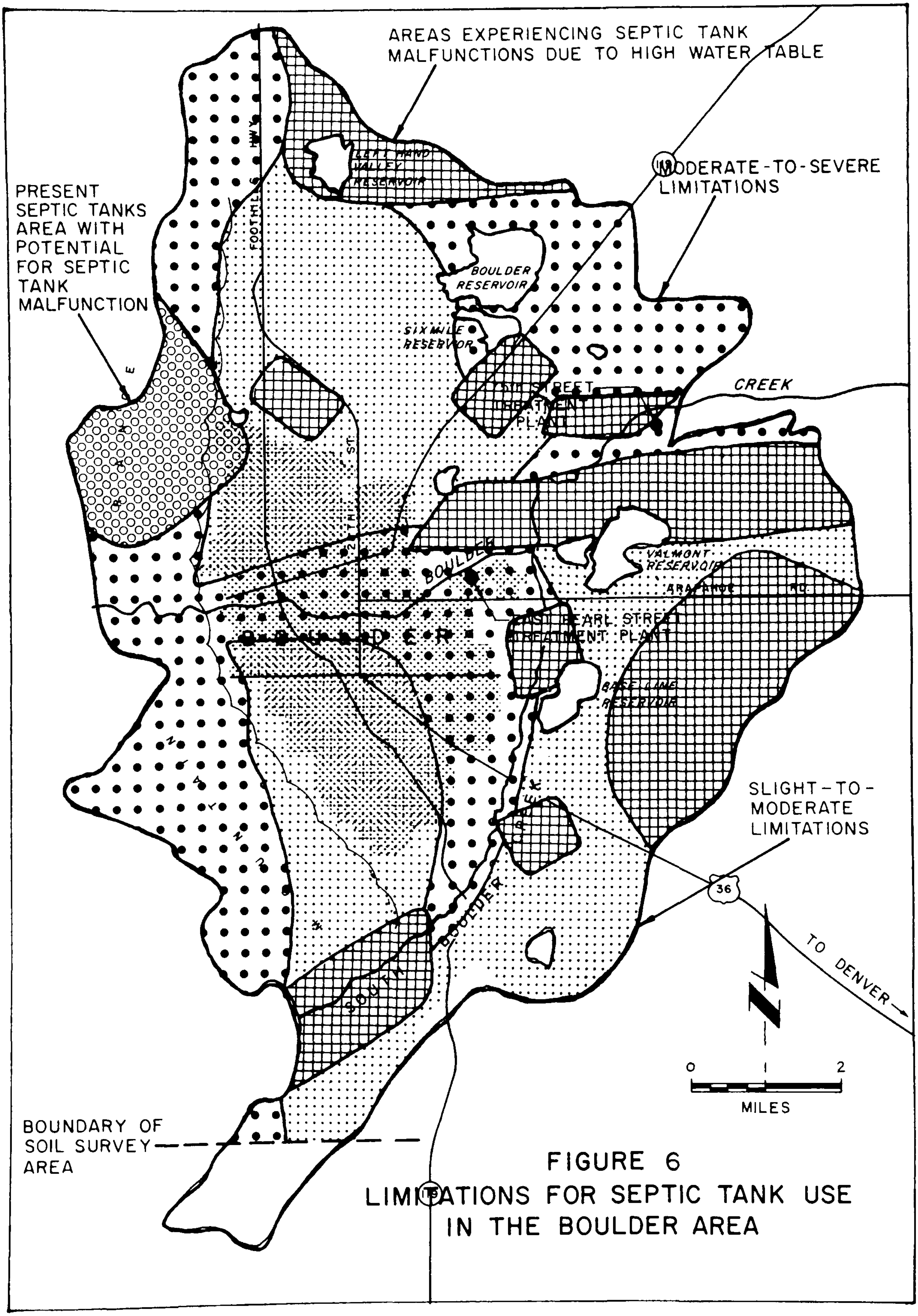


FIGURE 6
LIMITATIONS FOR SEPTIC TANK USE IN THE BOULDER AREA

sludge can contribute to the total dissolved salts (TDS) of local groundwaters. In this case, it is conceivable that highly saline groundwater could affect surface water quality.

In the vicinity of the 75th Street treatment plant, groundwater occurs in unconsolidated alluvial deposits of materials ranging in size from clay to gravel which overlie a bedrock of clay and shale. The deposits underlying the valley bottom and low terraces along Boulder Creek are approximately one-mile wide and trend east and west. While the overall thickness of the deposits range from 0 to 20 ft, the average thickness of deposits in the immediate vicinity of the site is approximately 10 ft.

Groundwater levels in the deposits fluctuate with water table conditions and are hydraulically connected to streamflow in Boulder Creek. Figure 7, based on water level measurements at 68 observation wells in May 1975, shows the configuration of the water table in the vicinity of the site. The ridge of groundwater under Boulder Creek indicates that the alluvial aquifer is receiving recharge from streamflow. The stream and aquifer are in equilibrium in the vicinity of the gravel pit east of the site. Groundwater is also moving toward the valley bottom from the terraces to the south. The general direction of flow in the aquifer is northeastward, toward and along Boulder Creek.

Figure 8 shows the depth to the water table in the area of the site. Over most of the area, groundwater is near the land surface and intersects it at many points. The depth to groundwater ranges from 0 to 7.7 ft in the bottomlands along Boulder Creek and increases to approximately 18 ft below the terraces south of the stream. Groundwater levels vary in the site area throughout the year.

During the spring, when water levels are lowest, Boulder Creek is a losing stream in the vicinity of the site, which means that water is lost to the groundwater table. Below the 75th Street bridge, stream water directly recharges the groundwater aquifer through the porous alluvium. The irrigation season, which begins in late spring, increases water levels in the aquifer. As the stream level of Boulder Creek falls after peak snowmelt runoff during July, the stream begins to receive discharged groundwater. The aquifer continues to drain to Boulder Creek during the fall, winter and early spring. The aquifer again receives recharge from Boulder Creek during the late spring, when the level of the stream is rising as a result of snowmelt.

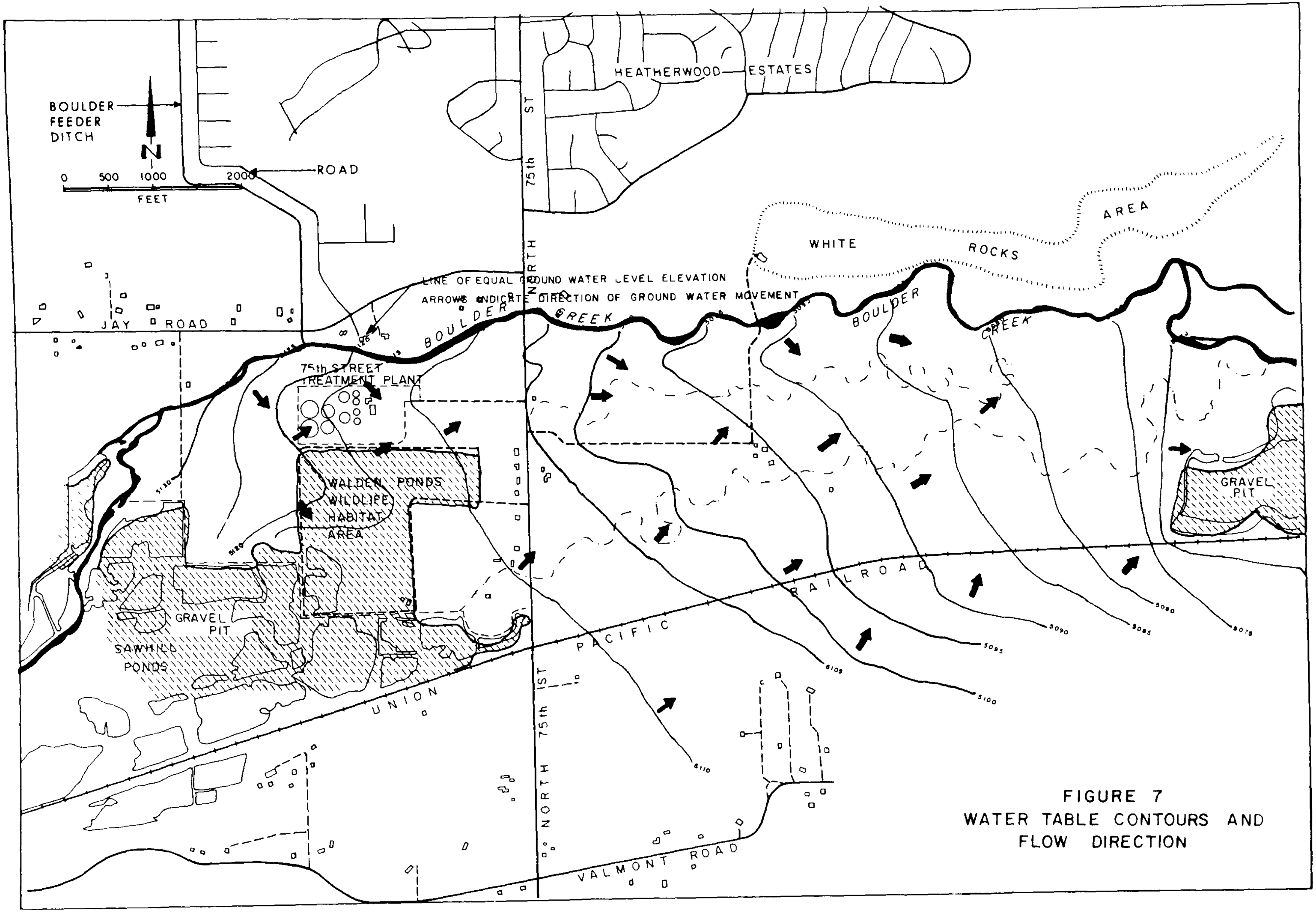


FIGURE 7
WATER TABLE CONTOURS AND FLOW DIRECTION

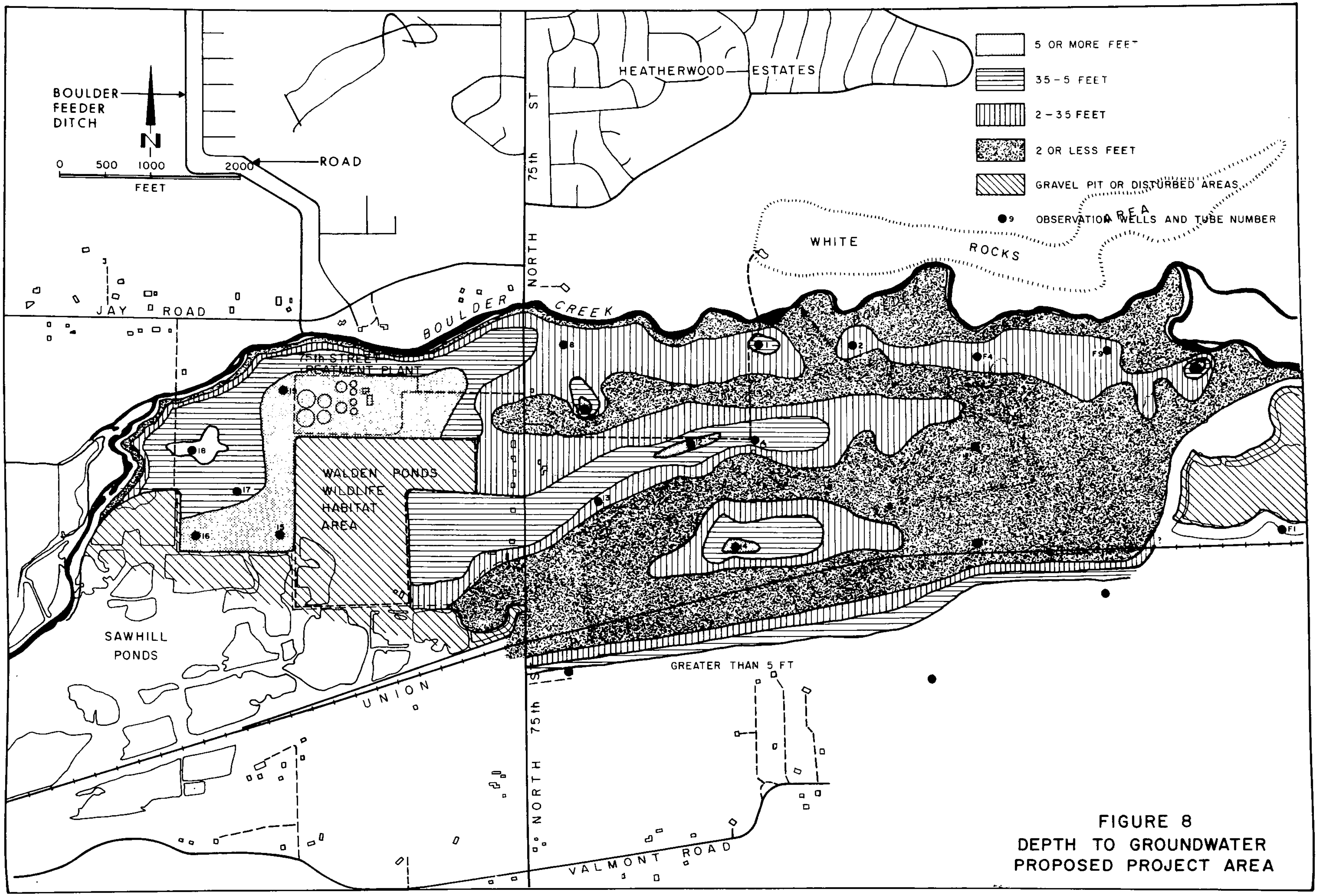


FIGURE 8
DEPTH TO GROUNDWATER
PROPOSED PROJECT AREA

Surface Water--

General Conditions. The Boulder Creek Basin forms a part of the South Platte River system. The basin extends from the Continental Divide to 22 miles east of Boulder, where it enters St. Vrain Creek. The major streams in the basin which are affected by the proposed project are Boulder Creek, draining approximately 440 sq mi, and South Boulder Creek, draining approximately 125 sq mi. These two creeks run parallel courses in the mountains. Their drainage course through the service area is shown on Figure 9. The average annual flows from the creeks are 65,000 ac ft for Boulder Creek and 55,000 ac ft for South Boulder Creek, for a combined average annual flow of 120,000 ac ft. The range of combined annual average flows is from a low of 50,000 ac ft in a dry year to a high of 175,000 ac ft in a wet year. Low flows usually occur in February, and high flows, which result from mountain snowmelt and spring rains, occur from April to July.

Many reservoirs have been constructed throughout the planning area to store water from Boulder Creek diversions and from the Colorado-Big Thompson Water Project to the west. The Boulder Valley area has been allotted 19,000 ac ft of Colorado-Big Thompson Project water. The City of Boulder has contract rights to 14,000 ac ft of this amount. About 7,000 ac ft of the City's portion is sold to farmers for irrigation. Municipal, industrial and agricultural users consume approximately 115,000 ac ft of water per year.

Effects of Water Diversions in the Boulder Creek Basin on Surface Flows. The basin is laced by large numbers of irrigation canals and ditches that fill lakes and reservoirs used for irrigation, domestic, industrial and recreational water supplies (Reference 16). Extensive user demands on the available water resource combined with the modest seasonal availability of water in this semi-arid area are responsible for the creation of a water management system that has substantially altered the natural flow cycle of the Boulder Creek Basin. During the winter months, natural streamflows in Boulder Creek are very low. Flows occurring between October and April are due primarily to releases from mountain reservoirs. The released water is diverted to Baseline, Six Mile, Marshall and Panama #1 Reservoirs situated in Boulder Valley, downstream from the City of Boulder. The diverted flows refill approximately 4,000 to 6,000 ac ft of the 11,000 to 15,000 ac ft needed for the annual first refill requirements of the valley reservoirs. This represents an average diversion rate of 11 to 17 cfs, which is a significant portion of the creek flow from fall through early spring. These winter diversions leave but a trickle of water in Boulder and South Boulder Creeks to flow through the City of Boulder.

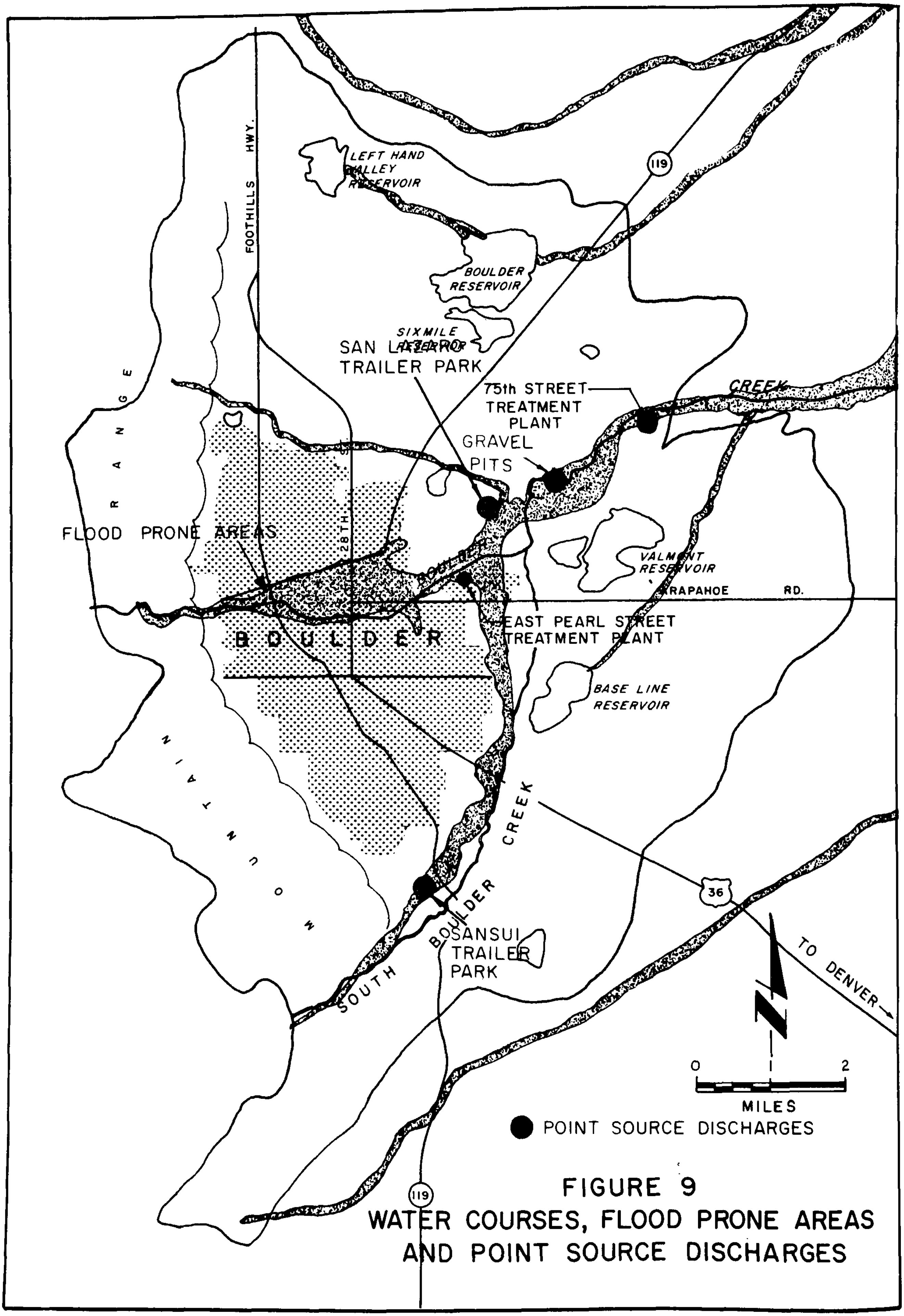


FIGURE 9
WATER COURSES, FLOOD PRONE AREAS AND POINT SOURCE DISCHARGES

Winter flows in Boulder Creek are also affected by periodic discharges from the Orodell hydroelectric power plant, operated by the Public Service Company. The plant provides supplemental service to the area during the peak morning and evening power demand periods. When it is operating, the plant discharges water at a rate of up to 150 cfs, creating extreme fluctuations in Boulder Creek's streamflow.

During the spring, when snows are melting and rainfall is high, the mountain reservoirs hold back runoff and regulate flows at rates reflecting downstream water demands for ditch diversions and the filling of storage reservoirs. Direct irrigation ditch diversions begin in early May and continue through September, depending on the availability of water and the seniority of diversion rights in individual ditches.

When late summer deficiencies occur, the 15,000 ac ft of water stored in the valley reservoirs is used along with the Colorado-Big Thompson water to augment supplies. During the late summer, Boulder Creek has a very low flow through the city. In the vicinity of the 75th Street Wastewater Treatment Plant, stream flows are increased by water from the Colorado-Big Thompson feeder ditch, by agricultural return flows, and by treatment plant effluent. Water is drawn by other users from downstream segments of the creek.

The low streamflow conditions described above are significant in understanding the need to maintain water quality downstream from the wastewater treatment plant. Without adequate streamflow for dilution of the treatment plant's wastewater discharge, body-contact and other water-oriented recreation activities are limited.

Flooding. A definite flood hazard exists at Boulder and includes central portions of the city, residential and commercial areas on Arapahoe Road, and the 75th Street treatment plant in the Boulder Creek floodplain, which are shown in Figure 9. The maximum flood that may occur in a 100-year period for Boulder Creek at Boulder is 18,000 cfs (Reference 17). Major floods have occurred on Boulder Creek in 1864, 1876, 1894, 1914, 1923, 1938 and 1969 (Reference 18).

The 75th Street plant and its various on-site facilities were constructed within the limits of the floodplain. To protect the facility, permanent structures have been flood-proofed by designing all openings with elevations two feet above the highwater line of the 100-year flood. Some temporary structures, such as that for lime treatment, have not been flood-proofed; however, the proposed improvements to the 75th Street plant will obviate the need for them, and the long-term potential for damage to these structures is thus insignificant (Reference 19).

Water Quality--

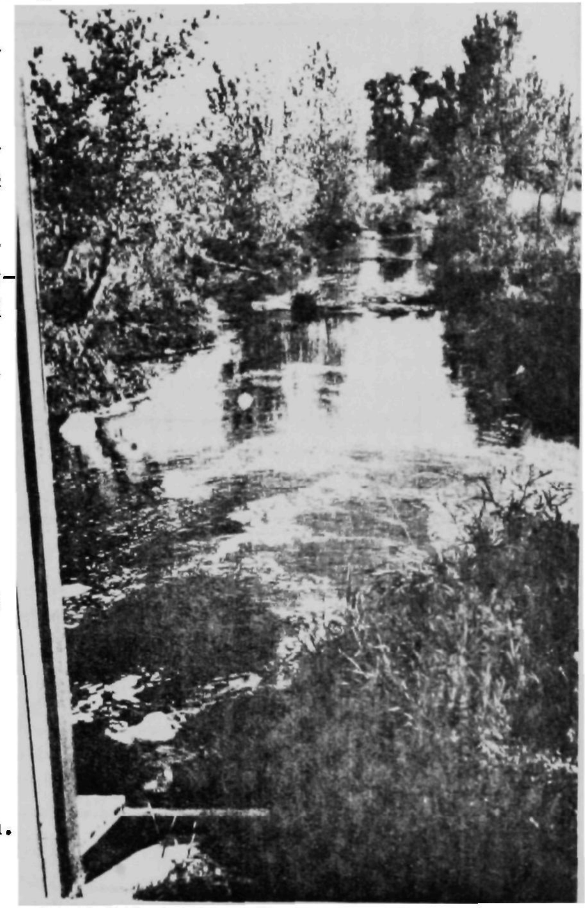
Boulder Creek and its main tributary, South Boulder Creek, are high quality streams before entering the City of Boulder. The main point sources, i.e. readily identifiable pollution discharge points, of stream pollution for the past 40 years in Boulder have been the East Pearl Street and 75th Street treatment plants. With the cessation of discharges from the East Pearl Street plant in May 1975, the 75th Street plant became the only major point source. Other, relatively minor, point sources have been the Sansui and San Lazaro mobile home parks package sewage treatment systems and the gravel extraction and processing operations of C and M Gravel and Flatiron Sand and Gravel, downstream of 63rd Street. Figure 9 shows the locations of the discharge points. The mobile home parks package systems discharge effluents of low concentration, and the gravel operations discharge inorganic silts and other materials which contribute to stream turbidity and sedimentation. Table 2 shows the flows, concentrations and wasteloads of these sources as estimated in the facilities plan.

Table 2. POINT SOURCE POLLUTION LOADINGS

Discharge Point	Flow, gpd	Concentration,[a] mg/l	Wasteload,[a] lb/day
Sansui Trailer Park	18,000	10	1.5
San Lazaro Trailer Park	135,000	15	16.5
Gravel Pits	50,000	25	10.43
75th St. Treatment Plant	10,310.000	30	2,578
Total	10,513.000	-	2,606

[a] BOD_5 and/or suspended solids.

Nonpoint sources, i.e. an activity distributed over a wide area that is a source of pollution, degrade the stream as it flows through and beyond the city. The area's nonpoint sources are typical of its urban/rural land uses. Boulder is also subject to seasonally high irrigation rates and contributions of process water from mining sites. Because of the area's semi-arid climate, irrigation is necessary to sustain crops and landscaping. With excessive irrigation, salts and nutrients are leached from soils and enter the groundwater and streams. An overabundance of salts and nutrients generally degrades the local water quality. Mining activities for coal and ores in the mountains west of Boulder may contribute nonpoint pollutants through storm water to Boulder Creek.



TREATED EFFLUENT DISCHARGE CHANNEL FROM 75TH STREET TREATMENT PLANT

Results of water quality sampling in Boulder Creek indicate two distinct stream segments. Selected parameters from 1975 sampling programs are shown in Figure 10. Biochemical oxygen demand (BOD) and ammonia are low and relatively stable in the upstream portions of Boulder Creek. Dissolved oxygen levels remain within the range 8 to 10 mg/l. Water temperatures are generally cool (13°C) but rise several degrees after 55th Street, due probably to the influence of agricultural return flows. At the 75th Street treatment plant discharge point, temperature, BOD and ammonia increase significantly. At this point, Boulder Creek is classified as a warmwater system. Ammonia levels can exceed stream standards. It has been shown that un-ionized ammonia is toxic to game fish at levels of 0.021 mg/l in the stream. The strength of total ammonia-nitrogen toxic to aquatic life is approximately 1.5 mg/l. This value was computed by EPA and based on ambient stream temperatures of 20°C and a pH of 7.5. Dilution from streamflows, agricultural return flows and water diversions reduces these concentrations the majority of the time. However, ammonia toxicity still remains a significant hazard during low streamflow periods.

Water Rights--

Boulder Creek water rights are complex in nature. A study of Boulder's water rights priorities, its problems and the potential effects from land treatment of effluent was conducted in 1974 by Blatchley Associates (Reference 21). Portions of this study are incorporated into the material that follows, to present a brief characterization of the water rights situation in Boulder.

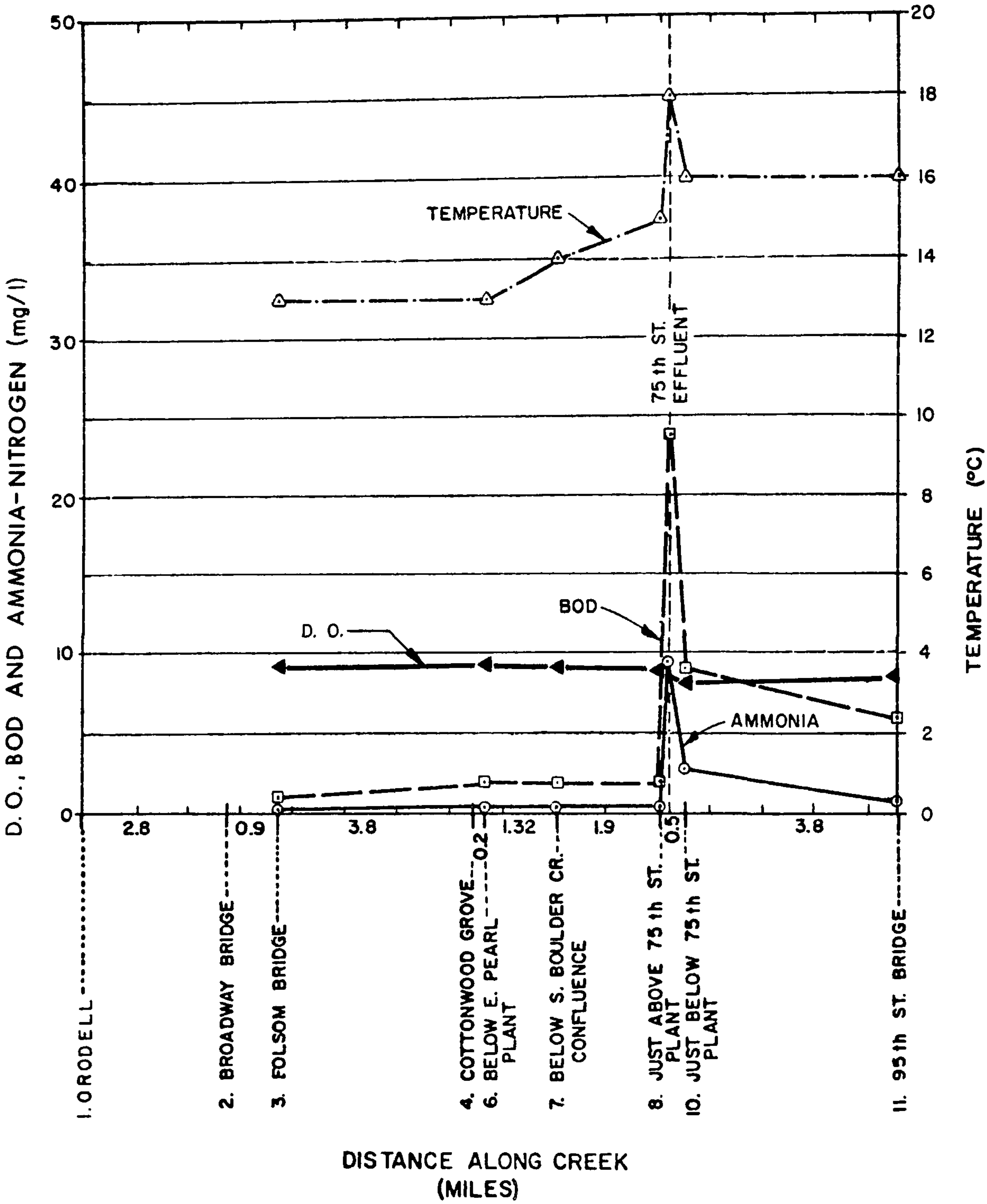


FIGURE 10
BOD, AMMONIA, D.O. AND TEMPERATURE
IN BOULDER CREEK

The City of Boulder collects its domestic water supply through a system of surface water rights and storage rights in Boulder Creek basin. This supply is supplemented by water imported from the Colorado-Big Thompson (CBT) Project of the Northern Colorado Water Conservancy District (NCWCD). Boulder continues to buy water rights and to apply for permission to change the place and nature of use of these rights in order that the water can be used in their municipal water system. Boulder is also included in a subdistrict of the NCWCD which is planning to develop additional Colorado River water for diversion through the CBT Project system. This project is known as the Windy Gap Water Supply Project and also is often referred to as the Six Cities Project.

After one use of the above water rights, Boulder collects the sewage effluent, treats and releases it back into Boulder Creek below the 75th Street treatment plant. Downstream are ditches that are dependent on this sewage effluent as a part of the water supply for their vested water rights.

Colorado's water rights laws are based on the concept "first in time, first in right." Generally, waters may be used as long as other users are not injured. Injury may be caused by a "senior" water rights holder transferring a right so as to cut off supply to "junior" water rights holders. In the Boulder Creek drainage, under certain circumstances, only junior rights are dependent upon the sewage return flows from the City; while under other water supply conditions, the senior rights are dependent, in part, on the Boulder return flows. The degree of potential injury to other Boulder Creek water users will be unpredictable for any plan to modify the disposal of Boulder's treated sewage effluent.

Any change in use that a disposal plan may impose on Boulder Creek must take into account the fact that since the inception of Boulder's sanitary system many junior water rights have been enriched by the uses, especially when storage waters are used in the low flow season. Boulder cannot, on the other hand, assume that when all junior rights are out of priority they are then free to change the regimen of the creek. On the contrary, with the Lower Boulder Ditch's 1 October 1859 decree for 25.00 cfs below both sewage plant discharge points, it will be necessary to maintain flows to insure that the Lower Boulder Ditch does not call out the City of Boulder's direct flow decrees at time of greatest need. This threat should not affect in any way the use of Boulder's reservoir or CBT water use. However, it may be proper to file on the return flow rights on waters over and above the normal historic return flows in Boulder Creek.

Water Quality Management and Regulations--

Water quality management involves the protection of water quality and existing and potential water uses from the adverse effects of wastewater and nonpoint discharges. All changes that may result from the proposed project are of concern to EPA in its facilities planning and review process. Direct land use changes include sewer line and treatment plant construction. Indirect changes, such as provision of sewer service could encourage land development in a particular area resulting in sediment and nutrients entering stream courses.

The federal, state and regional regulatory agency involvement, together with the local agency interpretations and goals, are summarized below.

Federal. The EPA administers the 1972 Water Pollution Control Act Amendments, which are aimed at achieving certain national water quality standards according to a given timetable. All surface discharges are regulated and require permits under the National Pollutant Discharge Elimination System (NPDES). This permit system is now being administered by the State of Colorado. Boulder's two treatment plants were issued permits in 1974. The effluent limitations for the 75th Street plant are shown in Table 3. A minimum streamflow of 45 cfs was assumed upstream from the discharge point, and a total discharge of 10.7 mgd in 1978 was projected. These limitations were assessed prior to the cessation of the East Pearl Street treatment plant discharge and may be modified in the future.

The schedule for treatment plant modifications authorized in the 1972 Water Pollution Control Act and promulgated by EPA is as follows:

1. Secondary treatment for all municipal discharges by 1 July 1977. As defined by EPA, secondary treatment is the removal of pollutants to the extent that the effluent does not exceed 30 mg/l BOD and suspended solids.

2. Best Practicable Waste Treatment Technology (BPWTT) to be implemented by 1 July 1983. This goal will ensure water quality capable of supporting fish and allowing recreation. As defined by EPA, this limitation implies secondary treatment plus whatever measures are necessary to meet state standards that may be more restrictive. For Boulder, the existing discharge permit requires that BPWTT be implemented by July 1977.

Table 3. FUTURE EFFLUENT LIMITATIONS, BOULDER 75TH STREET TREATMENT PLANT

(NPDES Permit No: CO-0024147)

Parameter	30 consecutive day period	7 consecutive day period	Daily	Instantaneous
BOD_5, mg/l[a]	30	45	-	-
Total suspended solids, mg/l[a]	30	45	-	-
Fecal coliform, org./100 ml	200	400	-	-
Ammonia (as N), mg/l	-	4.3	6.5	0
pH, units	-	-	-	6.0 - 9.0
Total residual chlorine, mg/l	-	0.04	-	0.5
Oil and grease, mg/l[b]	-	-	-	10

[a] In addition to the above limitations, the arithmetic mean of the values for biochemical oxygen demand and total suspended solids for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for effluent samples collected at approximately the same times during the same period (85 percent removal).

[b] In addition to the specified limitations, the discharge shall contain no visible oil and grease.

State. Water quality objectives for the State of Colorado are primarily defined by the Colorado Department of Health. State waters include both surface and groundwater supplies. The Water Quality Control Commission, appointed by the Governor, determines the four basic water quality categories for the state as shown in Table 4. Through 1976, the western segment of Boulder Creek was classified as B1, while the lower segment, below the East Pearl Street treatment plant, was classified as B2. In January 1977, the Commission approved a change in classification for Boulder Creek on the basis of a petition by the City of Boulder. From the creek's source down to the 75th Street treatment plant, the creek has been upgraded to A1. Further, from the treatment plant down to the confluence with Coal Creek, the water quality category has been upgraded to A2.

Another major function of the Commission is the determination of priorities for projects receiving federal grants and the eventual allocation of the State's portion of this federal money. Criteria for awarding priority points is given in the Department of Health Guidelines (Reference 22). The highest priority points are given to those municipalities with the most severe water quality problems. In Fiscal Year 1976, Boulder ranked 25th in priority points out of 223 grant projects. Problem areas noted were the need to remove excess BOD_5 in relation to upgrading Boulder Creek to an A1 classification, population factors and stream category factors. The Commission also took into consideration the validity of treatment requirements beyond secondary, recognizing that in some cases it may be more cost-effective to apply advanced wastewater treatment now rather than add it at a later date.

Regional. The designated regional planning agency for Boulder is the Denver Regional Council of Governments (DRCOG). This agency is presently implementing Section 208 of the 1972 Act and has recently completed a basinwide water quality management plan (Reference 70). The Section 208 study was performed independently of the Boulder Facilities Plan. However, the Regional Water Quality Management Plan of 1973 as adopted by DRCOG in August 1974 served as the regional plan upon which the Boulder Facilities Plan was based (Reference 23). The regional plan recommends the following effluent limitations for the upper Boulder Creek Subbasin:

1) Nitrification of ammonia in effluent to prevent fish toxicity which occurs at a threshold level of 1 mg/l NH_3-N.

2) Maximum effluent concentrations of 5 mg/l BOD_5, 1 mg/l nitrate-nitrogen and 8 mg/l phosphate.

Table 4. COLORADO STATE WATER QUALITY STANDARDS SUMMARY

Parameter	Standard: Class A1	Class A2	Class B1	Class B2
Settleable solids	Free from	Free from	Free from	Free from
Floating solids	Free from	Free from	Free from	Free from
Taste, odor, color	Free from	Free from	Free from	Free from
Toxic materials	Free from	Free from	Free from	Free from
Oil and grease	Cause a film or other discoloration	Cause a film or other discoloration	Cause a film or other discoloration	Cause a film or other discoloration
Radioactive material	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards
Fecal coliform bacteria	Geometric mean of < 200/100 ml from five samples in 30-day period	Geometric mean of < 200/100 ml from five samples in 30-day period	Geometric mean of < 1,000/100 ml from five samples in 30-day period	Geometric mean of < 1,000/100 ml from five samples in 30-day period
Turbidity	No increase of more than 10 JTU	No increase of more than 10 JTU	No increase of more than 10 JTU	No increase of more than 10 JTU
Dissolved oxygen	6 mg/l minimum	5 mg/l minimum	6 mg/l minimum	5 mg/l minimum
pH	6.5 - 8.5	6.5 - 8.5	6.0 - 9.0	6.0 - 9.0
Temperature	Maximum 68°F Maximum change 2°F	Maximum 90°F Maximum change: Streams: 5°F Lakes: 3°F	Maximum 68°F Maximum change 2°F	Maximum 90°F Maximum change: Streams: 5°F Lakes: 3°F
Fecal streptococcus	Monthly average of < 20/100 ml from five samples in 30-day period	Monthly average of < 200/100 ml from five samples in 30-day period	-	-

Legend:

A1: Waters suitable for primary contact recreation and a cold water fishery.
A2: Waters suitable for primary contact recreation and a warm water fishery.
B1: Waters suitable for noncontact recreation and a cold water fishery.
B2: Waters suitable for noncontact recreation and a warm water fishery.

3) Disinfection of treated secondary effluent by chlorination.

4) Effluent aeration prior to discharge to ensure adequate dissolved oxygen levels in the creek.

County. Boulder County has no articulated water quality objectives at the present time. The major involvement by the county agencies in the Boulder Facilities Plan is concern with odors and the ultimate disposal of wastewater residues. Sludge is currently disposed of in the county landfill. In 1972, the County Commissioners passed a resolution to eventually phase out disposal of raw or undigested sludge to the county landfill. Possible land disposal or reuse of wastewater sludge would be reviewed through the Special Use Review process of the County Planning Board.

Local Objectives. The City of Boulder is strongly committed to a program to upgrade and preserve Boulder Creek. Improvement of the local stream quality is integral to the long-term restoration and preservation of the Boulder Creek Corridor under the Boulder Valley Comprehensive Plan. On the basis of recommendations from the Citizens' Advisory Committee, the Boulder City Council passed a resolution on 17 June 1975 solidly committing the City to upgrade the quality of Boulder Creek to a sport fishery.

To achieve the community goals stated by the City Council, the resultant effluent limitations were developed, as shown in Table 5.

Table 5. LOCAL EFFLUENT LIMITATIONS

Pollution Parameter	Monthly Average	Weekly Average
Suspended solids, mg/l	20	20
BOD5, mg/l	20	20
Ammonia (as N), mg/l	4.3	4.3
Fecal coliform, no./100 ml	1,000	2,000
Effluent dissolved oxygen	90 percent of saturation	
Total oil and grease, mg/l	10	10
Residual chlorine, mg/l	-	-
Color, CPU	< 20	< 20
Turbidity, JTU	< 20	< 20
pH, units	6.0 - 9.0	6.0 - 9.0

Source: Facilities Plan

BIOLOGICAL ENVIRONMENT

The topography within the study area consists primarily of level and gently rolling plains, piedmont areas--where the plains meet the foothills--and the foothills themselves. Floodplains and terraces wind through the uplands, forming flat riparian corridors. The plains, while relatively flat, are on a gentle slope from west to east that decreases continuously in elevation at an average of approximately two ft/mile. Local elevation ranges from approximately 5,100 ft at the eastern edge of the study area to 5,600 ft along the western edge of the Boulder city limits.

The project area occurs within the plains grassland life zone which includes Boulder Valley and extends up to 5,600 ft (Reference 24). The plains typically experience a growing season of five to six months, and climatic conditions are relatively dry.

Natural vegetation in presettlement days was primarily sod-forming short grasses, such as blue grama and buffalo grass, and associations of mixed to tall grasses, such as wheatgrass, needlegrass, sand reed and bluestem (References 25, 26). Riparian corridors throughout the plains often supported gallery forests which consisted of well-developed stands of cottonwoods. Since settlement, the lower parts of the grasslands have been under cultivation, and the higher parts have been used for grazing.

Boulder Creek flows through the heart of the planning area, linking the Lower Montane Forest region and the Plains Grassland region. The creek passes through the city and then traverses residential, farm and pasture area before emptying into St. Vrain Creek approximately 15 miles northeast of Boulder. Since the proposed project location is within the vicinity of Boulder Creek, the detailed environmental setting will focus on Boulder Creek and the biotic communities in its immediate environs.

Ecology of Boulder Creek

Boulder Creek and its tributaries represent one of the major hydrologic systems in Boulder County and are important for economic, cultural and ecological values. Two miles west of Boulder, the water flow is harnessed in Boulder Canyon for power generation. Upon reaching the plains area, ditches and canals divert much of the streamflow for irrigation. Farther east, the creek serves as a repository for urban runoff, agricultural return flows, limited industrial flows and treated effluent from the city's sewage treatment plant. Recreational use of Boulder Creek is primarily focused on the upper portions, in Boulder Canyon; however, the natural areas of the creek within the plains are also appreciated for their aesthetic and educational value. The development of a major park along the length of Boulder Creek has been under consideration by the city and the state for many years (References 27, 28). The Boulder Creek floodplain, previously discussed under the physical environment, also has many implications for planning and environmental analysis. Floodplain features such as marshes and meandering channels are important aspects of the local ecology.

Within the study area, portions of Boulder Creek can be categorized as undisturbed (close to a natural state) and others as disturbed (altered by human activity).

Undisturbed Areas--

The areas along Boulder Creek with the least amount of physical modification are mountain areas and selected locations within the floodplain. Stream segments within Boulder Canyon are characterized by clear, turbulent waters passing through steep grades and capable of supporting a cold-water fishery. As Boulder Creek enters the plains area, it becomes slow and meandering, and the watercourse is bordered by native cottonwood trees, shrubs and herbaceous vegetation, much of which consists of introduced weeds. The typical meandering of the stream maintains pools and undercut banks with trees, shrubs and other bank vegetation, preventing excessive erosion. In other areas, the well-developed meander system has caused the formation of oxbow ponds, marsh areas and meander loops, all of which provide productive and important wildlife habitats.

One mile east of town, before 55th Street, is one of the largest remaining cottonwood groves along Boulder Creek. The broad- and narrow- leaved cottonwood trees grow to a large size rapidly and are ecologically important for their moderating influences. The trees shade the water surfaces, facilitate a shrubby understory in places and provide a habitat for bird and animal species that otherwise could not tolerate the warm climate of the plains. The aquatic ecosystem of the natural areas is complex and typically contains species requiring "clean water" such as mayflies, stoneflies and caddisflies, and cold-water fish such as trout.

Disturbed Areas--

The lower portion of Boulder Creek, from the Boulder City limits to the confluence with St. Vrain Creek, shows varying degrees of disturbance from human activity. Gravel mining, channelization, tree cutting, livestock grazing and wastewater disposal have produced profound effects on the creek. The gravel banks of the straightened and newly-formed streambeds induce a generally harsh environment colonized mainly by weeds. The loss of streamside vegetation and the trampling of banks and creekbed by livestock inhibit the formation of undercut banks, destroy aquatic habitat and increase siltation. Disposal of wastewater to Boulder Creek is important to the maintenance of stream flow; however, the addition of nutrients--particularly nitrogen and phosphorus--encourages excessive algal and bacterial growth, which degrades the aquatic environment. Effluent constituents, such as nitrites, chlorine and ammonia in high seasonal concentrations, can also be toxic to fish and other aquatic organisms.

In Boulder Creek, the aquatic environment historically has deteriorated sharply at the junction with the East Pearl Street sewage outfall. With the discontinuation of this outfall in May 1975, the creek has shown a gradual and positive improvement in types of aquatic life and numbers. Stream ecology is a dynamic process and capable of some amount of self-purification and restoration if the system is not severely damaged. Boulder Creek has achieved some degree of recovery in the vicinity of White Rocks. Livestock access is restricted in places, and as a result, undercut banks and overhanging vegetation for fish habitat have reappeared. Small dams and weirs along the stream create pools of sufficient depth to shelter fish populations during low water. However, few fish, if any, are found in these latter stream sections because of pollution levels (Reference 20). The physical improvement of the stream environment has led to the reappearance of several groups of aquatic invertebrates such as freshwater shrimp, mayflies, aquatic sowbugs and leeches in the vicinity of 95th Street.

The partially recovering and semi-natural areas of Boulder Creek retain some ecological value as wildlife habitats. With proper management, these areas could be improved in their capability for supporting a diverse and interesting flora and fauna.

Biotic Communities

Within the projected area, biotic communities can be categorized into six units: (1) pasture/agricultural, (2) riparian, (3) ponds and marshes, (4) White Rocks, (5) residential/urban and (6) gravel mining area. The general occurrence of the six biotic communities within the project area is shown in Figure 11. These units are

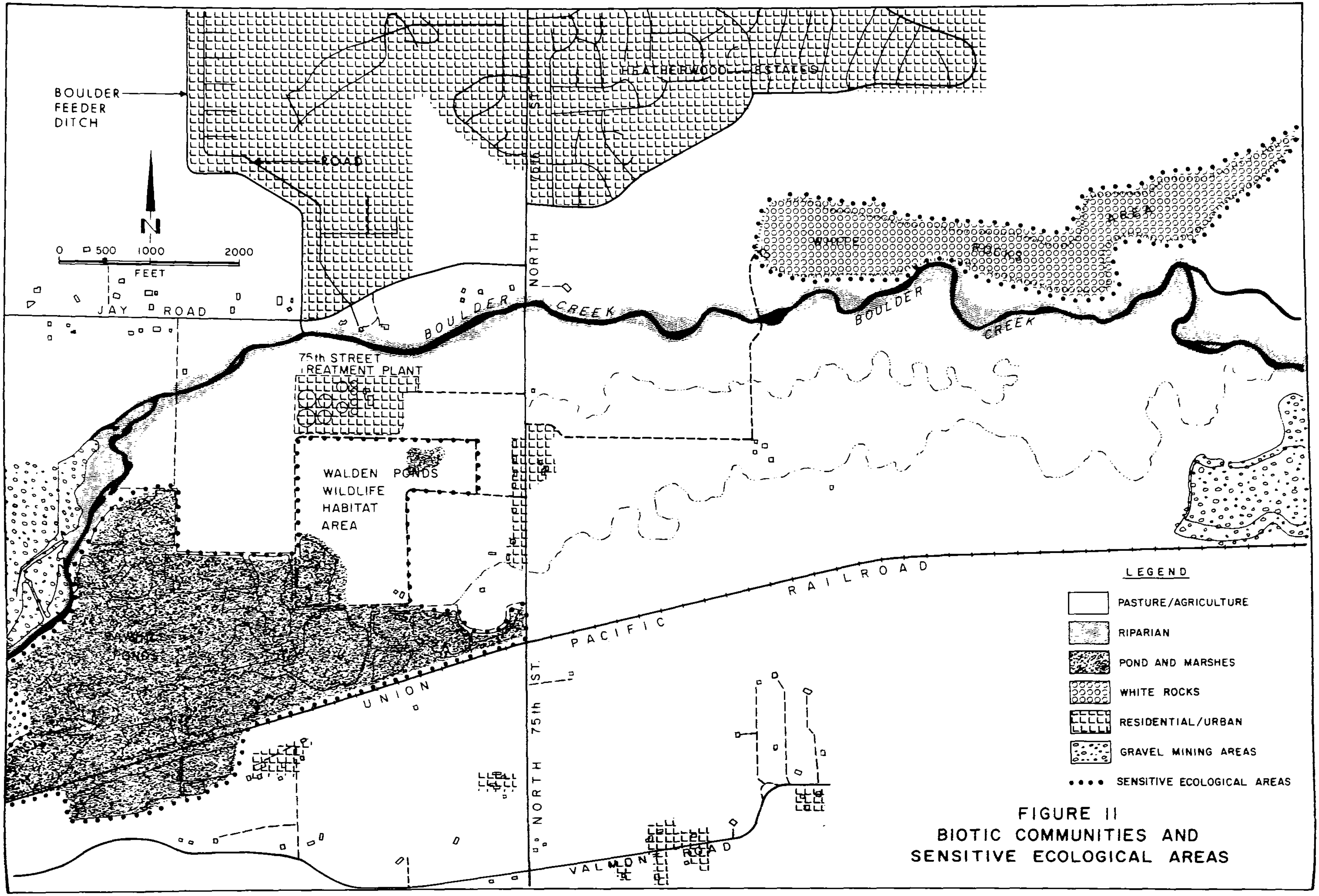


FIGURE 11
BIOTIC COMMUNITIES AND
SENSITIVE ECOLOGICAL AREAS

characterized by various vegetation and wildlife associations and in some cases may have overlapping features. The composition and extent of these units are a function of many environmental factors, of which the prime elements in the project area are: climate, soils, geology, land formations, watercourses and land use.

BOULDER CREEK NORTH OF THE 75TH STREET TREATMENT PLANT

The pasture/agriculture unit is spatially the most dominant in the vicinity of the 75th Street treatment plant and proposed project site. The riparian and ponds and marshes units supply important water-associated habitats that provide diversity within the pasture/agriculture unit. Many plant and animal species within the area occur mainly in these units, and some are entirely dependent upon it. The White Rocks area also provides diversity with steep cliffs and rock faces overlooking the flat plains area. The rocky substrate also furnished plant and wildlife habitats unique to the project area. Several rare and endangered plant species have been recognized in the White Rocks. The residential/urban units are primarily composed of structures. Most notable is the Heatherwood Estates on 75th Street which has gradually changed the face and ecology of the pasture/agriculture unit. The gravel mining area unit represents the only industrial activity within the project area. Mining activities have in the past greatly affected the surrounding pasture/agriculture, riparian and to some extent White Rocks units. Some abandoned gravel pits, on the other hand, have created new pond and marsh habitat areas and added to the local diversity. A detail discussion of the characteristic vegetation and wildlife within each community is presented in Appendix B. Lists of wildlife species and probable occurrences within the biotic communities are also given in Appendix B.

State and federal listings were examined for the status of rare or endangered species (References 29,30). No rare or endangered plant species are known to occur in those parts of the Boulder Creek floodplain and pasture/agriculture units that would be affected by the proposed project (Reference 29).

The following eight rare and endangered plant and animal species are found on the White Rocks (References 29,31):

1. *Asplenium andrewseii,* an endangered fern species of which the only other occurrence in the Western Hemisphere is in Chihuahua, Mexico (Reference 32).

2. Forktip three awn (*Aristida basiramea)*, a grass that is found in two counties in Colorado.

3. American potato bean (*Apios americana)*, a legume that occurs in two counties in Colorado.

4. *Aphaenogaster fulva* (ant species).

5. *Aphaenogaster huachucana* (ant species).

6. *Formica criniventris* (ant species).

7. *Lasius occidentalis* (ant species)

8. *Perdita opuntiae,* a mining bee, unique to the area, which drills burrows into sandstone cliffs.

Sensitive Ecological Areas

Human settlement of the plains areas has greatly changed the local ecology of the Boulder area through the introduction of non-native vegetation and animals and changes in land use by humans. Despite these changes, several areas along Boulder Creek still retain much of their natural condition. Other areas, modified by human land use, have replaced some lost habitat and increased the diversity of the local environment. These special habitat areas are important to plant and wildlife ecology and do not tolerate great changes. Along the Boulder Creek project area, three such sensitive ecological areas have been identified as meriting consideration in future planning activities in order to preserve a diverse and interesting flora and fauna. Figure 11 indicates the approximate location of these areas.

White Rocks Natural Area--

The area that is known locally as the White Rocks Natural Area (WRNA), shown in Figure 11, consists of sandstone outcroppings overlooking pasture lands, riparian zones, and small ponds and marsh areas. White Rocks is considered ecologically sensitive for the following reasons: (1) the rock outcrops support a small and fragile ecosystem with slow-growing vegetation and some ephemeral forms of biota adapted to the harsh environment; (2) the bluff areas provide the only natural nesting niches in the area for the great horned owl and barn owl; (3) the area contains several rare plant and insect species, as discussed in the Biotic Communities section; (4) ecological diversity in a small area associated with vertical variation, protected habitat, south facing cliffs, relative abundance of prey species along creek and other factors; and (5) the close proximity of urban and industrial activities may lead to a long-term degradation of the local ecology.

In total, the WRNA represents a unique landform within the local topography that harbors a distinct biotic community with many complex interactions. Its high scientific and educational value has been demonstrated in field studies and academic research, and it is used by several departments of the University of Colorado. The aesthetic qualities imparted by the White Rocks, both as a landscape feature and as a site with a panoramic view of the floodplain, contribute substantially to its value as a natural resource. This aspect is discussed in greater detail in the Visual and Aesthetics Environment Section and in Appendix C.

A 1970 study of the White Rocks area (Reference 32) proposed a one-half-mile buffer zone to protect the area from future degradation. Recently approved revisions to the Boulder Valley Comprehensive Plan designate a 450-acre Environmental Preservation area for the WRNA consisting of 210 acres of rock outcrops and a 240-acre perimeter buffer zone (Reference 34). Additional greenbelt and open space designations by the City Open Space Board of Trustees for land north, northwest and east of the WRNA satisfy the proposed buffer zone.

The future of the White Rocks Natural Area is uncertain since major changes in land use for adjacent areas are continually being considered. A 1972 request to the U.S. Department of the Interior for inclusion of White Rocks into the National Monument System was denied (Reference 35); however, the two current property owners of the area covering White Rocks have stated their commitment to the preservation and protection of the resource value of this site (References 36,37). A recent amendment to the Mined Land Reclamation Act (Colorado HB 1529) prohibits permanent developments over commercial gravel deposits and applies to parts of the WRNA and associated buffer zone.

Walden Ponds--

The Walden Ponds Wildlife Habitat area is located near Boulder Creek, immediately south of the Boulder sewage treatment plant on 75th Street. Under Alternative C, the polishing ponds will include an area slated for reclamation by the Walden Ponds Wildlife Habitat Reclamation Plan. When completed, the habitat area would cover approximately 110 acres and include 10 acres of shallow cattail marsh, a large, 50-acre water-filled gravel pit, a 40-acre pasture area and peripheral areas. In 1974, on the basis of a reclamation study by Ms. Laudia Toburen (Reference 38), a program was implemented to reclaim the gravel pit as a wildlife area. The large gravel pit has been converted into a trout pond, with initial plantings of native vegetation on banks and islands, installation of waterfowl nest boxes and stocking with rainbow trout. The perimeter of the pasture area has been planted with trees, shrubs and clusters of fruit trees to attract birds. The pasture area is left untended as a quail and pheasant habitat. A small portion is reserved as a nursery area. The area is managed by the Boulder County Parks and Open Space Department, with a full-time naturalist residing at the site. At the present time, Walden Pond is in the partial stages of reclamation, with sparse vegetation cover and many bare, exposed areas. The trout pond and smaller duck pond/marsh areas attract a large variety of waterfowl and shorebirds. Large numbers of mallards and Canada geese utilize the ponds for resting and limited nesting. The trout pond is currently being studied by the Colorado Division of Wildlife for its potential as a cold-water ecosystem.

Treatment Plant and Proposed Land Application Sites

The proposed sites for Alternatives A through H are shown in Figure 2. A comparison of the approximate biotic community composition of each alternative site is given in Table 6. The majority of land application sites are within the pasture/agriculture unit. The existing 75th Street treatment plant site, with its fencing, paving and landscaping, is considered to be within the residential/urban unit. Several facilities locations have changed from the original facilities plan. The new infiltration/percolation pond site has been moved 3,000 ft east to the 200 acres east of 75th Street below Boulder Creek. The sludge injection fields under all

Table 6. ALTERNATIVE SITES, APPROXIMATE BIOTIC COMMUNITY COMPOSITION

Alter-native	System	Site	Biotic community,[a] % 1	2	3	4	5	6	Comments
A	Land treatment; infiltration-percolation ponds	225 ac. south of Boulder Creek and east of 75th St.	95	2		8			Change in site location from that shown in Facilities Plan. Ponds now situated on fields site planned for sludge injection in Alternatives B-G. New sludge injection field moved 3,000 ft south.
	Sludge injection	175 ac. south of Boulder Creek and east of 75th Street.	95	5					
B	Activated sludge following trickling filters	Existing 75th St. treatment plant					100		
	Sludge injection	Same as Alternative A	95	5					
C	Aerated and polishing ponds	330 ac. west and south of 75th St. treatment plant	50	5	5		10	30	Polishing ponds would include the Walden Pond Wildlife Habitat area Boulder County.
	Sludge injection	Same as Alternative A	95	5					
D	Activated sludge before trickling filters	Existing 75th St. treatment plant site					100		
	Sludge injection	Same as Alternative A	95	5					
E	Multi-media filters	Existing 75th St. treatment plant site					100		
	Sludge injection	Same as Alternative A	95	5					
F	Chemical coagulation	Existing 75th St. treatment plant site					100		
	Landfill disposal of sludge	Boulder County landfill							Landfill outside of project area
G	High-rate irrigation	3,360 ac. in northeast Boulder County	80	5	10		2		Agricultural lands from 75th St. east to County Line Rd. and from Longmont south to Arapahoe Rd.
	Sludge injection	Same as Alternative A	95	5					
H	No project	Existing 75th St. treatment plant site					100		
	Landfill disposal of sludge	Boulder County landfill							Landfill outside of project area

[a]Biotic communities: (1) Pasture/Agriculture (4) White Rocks Natural Area
(2) Riparian (5) Residential/Urban
(3) Ponds/Marshes (6) Gravel Pits

alternatives have been relocated immediately south, to the area between the Union Pacific Railroad and Valmont Road.

SOCIAL AND ECONOMIC ENVIRONMENT

Visual and Aesthetic Environment

Boulder is located in an area that possesses a beautiful and distinctive scenery, and the scenic attractions associated with Boulder are among the city's greatest assets.

The proposed site for the infiltration/percolation basins under Alternative A is a low-lying, level pasture area within the Boulder Creek floodplain. This site lies between lands of higher elevation to the north and to the south and thus is visible from numerous points. The following paragraphs represent a landscape inventory (see Appendix C) of the site as observed from the northern and southern areas that overlook the floodplain.

Observer Position from White Rocks, Looking South--

With the observer standing on the White Rocks looking south toward the site, the landscape can be described as *panoramic** where the observer position is *superior* (above the visual objective). A panoramic landscape is characterized by the absence of enclosure and is a horizontally oriented arrangement of great stability. The primary field of vision from the White Rocks is the *middleground* distance. The panorama possesses a high degree of *unity, vividness* (expressed as the *similarity* of the landscape along a 180° field of vision) and *variety* (in the form of occasional trees and small farm structures which are present in scattered locations on the floodplain).

Observer Position from Valmont Road, Looking North--

With the observer in a superior position looking north toward the site from Valmont Road, the landscape can be characterized as a *feature* landscape. The white lines of the White Rocks and the gentle rise in elevation cause the eye to be led to the feature. The slight convexity of *form* of the bluffs provides a *contrast* to the adjacent level plains, although the visibility of the Heatherwood Estates structures provides an off-setting man-made contrast.

*Terms in italics are defined in Appendix C.

Recreation Areas

Public Areas--

The Boulder area has excellent year-round recreational facilities, including 14 parks and many residential areas within the city boundaries.

The Boulder Valley Comprehensive Plan seeks to preserve and enhance recreational and open space areas. The plan designates the vicinity of the 75th Street treatment plant as largely undeveloped open space and parkland, with a tennis court facility to be constructed approximately one-quarter mile west of the present plant during the last phase of plan implementation. The Plan's projection period is 1976-1991. The tennis courts would be reached by two hiking-bike- and equestrian trails as well as by Jay Road; the trails are not planned to go east of the tennis courts. A separate bikeways plan developed for the City Department of Transportation proposes a bike path, following Boulder Creek from 61st Street to 75th Street, and passing just north of the plant site (References 5, 34).

Other existing and planned recreation sites in the vicinity of the plant include the existing Boulder Reservoir recreation area approximately one mile to the northwest; tennis courts; a country club; and additional ball fields proposed for the residential area north of the treatment plant.

Wildlife Areas--

Boulder offers a wide range of natural areas for the appreciation and utilization of wildlife resources. Within the project area, the wildlife resources form the basis of waterfowl and gamebird hunting, sportfishing and nature studies (Reference 39).

Within the project area, goose hunting is prohibited west of 75th Street although the boundary may vary yearly according to overall state wildlife policies. Common gamebird species include ring-necked pheasant and mourning doves which favor open field areas. Duck and gamebird hunting is allowed in most public areas and on private property with the owner's permission. Hunting of any kind, however, is prohibited at the county-owned Walden Pond area and at the city-managed Sawhill Ponds.

Animal hunting is limited to small mammals within the project area and includes raccoons, ground squirrels, prairie dogs, jackrabbits, brushrabbits and to a lesser extent muskrats and marmots. As with gamebirds, small mammal hunting is allowed on public lands and private property with permission. No hunting is allowed at Walden or Sawhill Ponds.

Sportfishing enjoys a seasonal popularity throughout Boulder County. The warmer waters of Walden and Sawhill Ponds are generally fished for largemouth bass, shiners, crappies, bluegills and other sunfish. Walden Pond has been designated as a fishing spot for senior citizens and is stocked seasonally with rainbow trout. Boulder Creek is open to fishing wherever there is public access. However, within the project area the majority of the lands bordering Boulder Creek are privately owned and inaccessible. In addition, Boulder Creek from 55th Street downstream has poor fish productivity due to stream pollution.

Boulder Creek and the adjacent floodplain areas offer several "natural" areas for the observation and study of wildlife. Walden and Sawhill Ponds afford an excellent opportunity for year-round birdwatching. The riparian areas near Sawhill Ponds and along Boulder Creek are also utilized for observation of migratory songbirds, raptors and resident bird species. The privately-owned White Rocks area, where hunting activities are prohibited, offers unique opportunities for the observation of wildlife, particularly barn owls, great horned owls and various raptors.

Noise

Boulder has many noise sources and attendant noise pollution similar to those found in most large cities. Noise is virtually an audible form of air pollution and has always been an unavoidable by-product of population growth and the machinery of urban life.

In the rural areas beyond the city limits, noise sources are predominantly from farm machinery, industrial operations and automobile traffic. At the 75th Street treatment plant, service vehicles generate a negligible amount of traffic. However, the heavy trucks which transport sludge from the treatment plant to the landfill several times a day generate a small but noticeable noise pollution to the residents on 75th Street and Valmont Road. In the adjacent gravel mining areas near the White Rocks and at Walden and Sawhill Ponds, mining operations and gravel trucks generate a constant background daytime noise level. Gravel trucks, in particular, disrupt the farm areas with heavy traffic and loud back-up horns.

Odor

Background odors generally associated with the study area are those normally associated with urban, suburban and farming communities. Typical odorous materials are those commonly associated with farming operations in the area. For example, a chicken farm may heat-pressurize chicken manure, producing very offensive odors. These fertilizer and manure odors are generally accepted as part of normal farm operations and are therefore tolerated.

Odors are regulated by Odor Emission Regulation No. 2 of the Colorado Department of Health, Air Pollution Control Commission (Reference 40). This regulation sets forth three types of odor limits. For residential or commercial areas, odorous substances must be undetectable from beyond the property line of the emission source after having been diluted with seven volumes of odor-free air. A scentometer allows this dilution and measurement to be taken. For other areas, a dilution of 15 volumes of odor-free air must render the odor undetectable. A special regulation exempts agricultural and manufacturing processes, providing the best practicable methods have been employed to control odors. For all odor sources, however, there is an upper limit which must not be exceeded: odorous substances must not be detectable after having been diluted with 127 volumes of odor-free air.

The existing Boulder wastewater treatment plant emits odors during occasional periods of upset in the sludge handling facilities and/or during adverse climatic conditions. Studies have shown that the major sources of odor are the headworks, primary clarifiers and existing sludge handling facilities (Reference 1). Odor problems are particularly noticeable in the local area during inversion periods when there is little air movement. Residents of the adjacent areas on 75th Street and the Heatherwood Homeowners Association (Reference 41) have periodically complained of pervasive sewage odors. The 75th Street wastewater treatment plant was cited for violation of Colorado State Odor Regulation No. 2 on 9 May 1975, and as recently as 7 January 1977 (References 42, 43).

Plans for odor control facilities, sludge digesters and other associated modifications to the existing plant have been submitted to EPA. Due to the seriousness of the odor problems, the sludge-handling and odor control facilities have been divided into a separate phase from the main facilities plan in order to expedite implementation. This first phase was issued a negative declaration by EPA on 10 November 1976 (Reference 4), indicating that no major environmental impacts were anticipated. Engineering designs for these improvements are currently underway. When these facilities are completed, the changes in the sludge handling and odor control processes are expected to correct past odor problems associated with the operation of the 75th Street plant.

History

Boulder originated as a western frontier town that served as a supply center for the mining towns in the mountains to the west and for the farms to the east. An excellent account of Boulder's historical background is given by Walter B. Lovelace in *Boulder Yesterday* (Reference 44).

The Boulder Valley, particularly in those areas east of the City of Boulder, has historically been devoted to agriculture, livestock grazing and gravel mining. Historical resources in the facilities plan project area would consist potentially of pre-1900 farmhouses and structures. A survey was conducted in 1975 (Reference 45) for structures of historic or architectural significance, or environmental appropriateness. Ten buildings, mostly farmhouses, were initially identified as potential resources. The Kolb farmhouse was the only building identified within the project area. Further investigations in the 1975 study did not identify any one building or group of buildings, as being of definite historical significance.

A literature search and field reconnaissance for historical structures and landmarks was conducted for this EIS in 1977 (Reference 47). The search revealed no significant historical resources in the areas that possibly could be impacted by the proposed wastewater treatment alternative sites.

Archaeological Resources

Existing archaeological site data within the proposed project area are limited and cover only a few localized areas. Documentation of sites is largely a product of opportune surveying along road cuts and selected areas such as promontory sites, rock-sheltered areas and water bodies. Seven sites have been identified within the wastewater facilities planning area. Of these, only one site occurs in the proximity of the proposed project area. The site probably served as a campsite and rock shelter for Indian hunters. The State Archaeologist has rated the priority of this site as highly significant and indicated that it should be left undisturbed. Since the time of the original site designation, the ownership of the property has changed several times, and the status of the site is now uncertain.

An extensive literature search and field reconnaissance of proposed project sites (References 45, 46, 47) revealed no sites or artifacts of archaeological significance. However, the possibility of buried sites or artifacts in the project area exists, particularly along Boulder Creek and in the White Rocks Natural Area.

Population

In 1950 the population of the City of Boulder was approximately 20,000; this number more than tripled in the succeeding twenty years. According to U.S. Census figures, the City's population in 1970 was 66,870; that of the wastewater service area was 73,600; and of Boulder Valley, 76,500. By 1974, the City Planning Commission estimated that these figures had increased to 76,300, 81,800 and 81,000 respectively--a growth of approximately 14 percent since 1970 or 3.5 percent per year, for the City and 4.7 percent for Boulder Valley (References 1, 48).

Boulder Valley accounts for roughly half of the total Boulder County population, estimated in 1974 at 171,500. The County, itself a fairly rapidly growing component of the greater Denver area, had the second highest growth rate of the five-county Standard Metropolitan Statistical Area (SMSA) in 1974--4.3 percent compared to 2.9 percent for the SMSA as a whole. Both Boulder City and Boulder County populations nearly doubled in the 1960's (References 49, 50).

In response to this rapid growth, both city and county are reexamining goals with a view to planning and controlling future growth. As a basis for land use decisions, the Boulder Valley Comprehensive Plan was adopted in 1970, and reconfirmed in 1972, by city and county governments. Both entities also jointly appointed a Boulder Area Growth Study Commission (BAGSC), which subsequently devised several working models of population growth for the area. On the basis of these models, the BAGSC made a series of growth predictions for the year 1990, ranging from a low of 83,000 to a high of 122,000 for the City of Boulder as shown on Table 7 (Reference 1).

Present indications are that slow-growth policies will prevail. In November 1976, the voters of the City of Boulder approved an ordinance to limit the population to increases of 2 percent per annum by controlling the number of dwelling units to be built within the City for a period of five years.

A study performed in 1975 (Reference 52) indicates an average household size considerably smaller than that shown by U.S. Census figures for the area. On this basis, the City Planning Department and the Denver Regional Council of Government (DRCOG) now believe that current Boulder population may be 7,000 lower than previously estimated. Assuming that this is correct, and that the Boulder Valley Comprehensive Plan will incorporate a long-range policy of discouraging high growth rates as experienced since 1950, 1990 population projections would be lower than Model 1, 3, or 4 estimates in Table 7. Long-range estimates for the City of Boulder and the service area, prepared on the basis of these assumptions, are shown in Table 8 below:

Table 7. FOUR POPULATION ESTIMATES FOR BOULDER CITY AND BOULDER VALLEY FOR 1990

	City of Boulder	Wastewater Service Area	Boulder Valley
Model 1 Continuation of existing trends	122,000	134,200	160,000
Model 2 Adoption of policy to halt growth	83,000	91,300	122,000
Model 3 Emphasis on environment quality, green belt, open space, agricultural expansion	118,200	129,800	170,500
Model 4 Diversified community, industrial expansion	122,000	134,200	205,000

Source: Exploring Option for the Future; A Study of Growth in Boulder Valley (Reference 51).

Table 8. POPULATION PROJECTIONS FOR BOULDER AND WASTEWATER SERVICE AREA BASED ON 2.5% GROWTH RATE

Year	City of Boulder	Wastewater Service Area	208 Service Area Forecast
1976	73,000	80,700	92,200
1980	80,600	89,100	98,800
1985	91,200	100,800	106,700
1990	103,000	114,000	115,500
1995	116,700	129,000	
2000			130,100

Sources: (References 52, 53).

An annual growth rate of 2.5 percent for both the city and the valley appears to be reasonable and conservative. It is assumed that pressure within the city limits of Boulder to hold down population growth will result in corresponding pressure for increased growth elsewhere in Boulder Valley. Since the population of the wastewater service area is the basis for projecting wastewater capacity needs, the exact rate of growth within Boulder's City limits is not critical here.

Population in the Gun Barrel residential development immediately north of the 75th Street treatment plant may present an exception to the above projections. This development, which may be annexed to the City of Boulder, has a present population of approximately 6,500; this could conceivably expand to 14,500 when construction of currently approved subdivisions is completed (Reference 54).

Under the Boulder Valley Comprehensive Plan, the city and county have proposed to provide water and sewer line extensions only to developments adjacent to the city limits. The Supreme Court has ruled that because Boulder is the only utility supplier in the area, it must grant new utility connections if there is enough capacity, rather than using it as a growth-limiting tool. Thus the sizing of the proposed project would set an ultimate limit on capacity for new utility connections.

Demography

The population of the City of Boulder in 1970 was predominantly young with 76 percent under 40 years of age and White with 97.7 percent of the total. Most had non-Spanish surnames with 95.2 percent of the total. Almost half of the total was under 21 years of age, due to the large university population, which has an average enrollment of approximately 20,000. Females outnumbered males very slightly: 50.1 percent versus 49.9 percent. Of all city residents 25 years of age or over in 1970, 83 percent had completed high school, compared to 52 percent for the U.S., 37 percent were college graduates, versus 11 percent for the nation (Reference 48).

Approximately half of the people in the Boulder Valley own their own homes. One-third to one-half of all residents have lived in the area for over 10 years.

Employment statistics for the Boulder area are compiled under the Denver-Boulder Labor Market Area (LMA). As of August 1976, the total labor force in the Denver-Boulder LMA was 692,800 with an overall unemployment rate of 6.5 percent. The main categories of employment were: 1) non-agricultural: 85 percent; 2) agricultural: 2 percent; and 3) self-employed: 7 percent. The main non-agricultural types of employment were: services, retail trade, government and manufacturing. Boulder has a high proportion of "professional and related services" attributable of the University of Colorado and the many private and government research-oriented agencies in the area.

According to the 1970 census (Reference 56) the median income of the 14,366 families in Boulder, was $11,437. According to a more recent estimate prepared by the Colorado Division of Housing, median family income in Boulder County in 1974 was approximately $14,550 (Reference 49).

Land Use

Regional Land Use--

Wastewater treatment plants are constructed to meet projected user demand and water quality standards. The existing plant has an in-place nominal capacity to treat 15.6 mgd, although it presently satisfies an average demand of only 65 percent of capacity. The present facility can treat overloads of up to 20 mgd, with resulting effluent of diminished quality. As elsewhere discussed, 1995 population in the service area will not likely exceed 130,000. This is well within the present nominal capacity.

The proposed project will be constructed only to raise the quality of effluent. If desired, the project could also be sized to limit the capacity of the plant, and therefore, limit future growth in the area. However, as the project is proposed, there should be no effect upon regional land use patterns. The City of Boulder is currently completing a major revision of its 1970 Comprehensive Plan (Reference 55). As discussed in the population section, the Gun Barrel residential area immediately north of the 75th Street treatment plant could sustain an increase of several thousand residents in the next 10 years. If the precedent established by the Robinson Decision of the Colorado State Supreme Court is upheld, it would appear that the City of Boulder will have to extend its service area to include these future developments (Reference 54).

Local Land Use--

In this section, "local" is defined as that land lying within an approximate one-mile radius of the existing 75th Street wastewater treatment plant. The plant is sited on the floodplain adjacent to the southerly side of Boulder Creek.

Boulder Creek constitutes a general line of demarcation between (1) suburban residential and agricultural uses to the north and (2) public works, mining and agricultural uses to the south.

Between the creek and Jay Road to the north is an unincorporated residential area that is generally rural in nature.

Immediately north of Jay Road and west of 75th Street is the Gun Barrel area and, east of 75th Street, Heatherwood. These are somewhat newer residential developments, including multi-use planned unit developments. South of the 75th Street plant, land use is typified by gravel mining west of 75th Street and agricultural and grazing lands to the east. Scattered residences are also found within the local area.

Tax Base - Assessed Values

The parcels presently being considered for purchase by the city for the infiltration/percolation beds, the sludge-injection area and plant expansion belong to tax jurisdictions 0460 and 0470. Jurisdiction 0460 covers the county fund, schools, transportation and flood control districts, and the mill levy is $86.40 per $1,000 assessed valuation. Jurisdiction 0470 includes the North Colorado Water Conservation District with an additional $1.00/$1,000 assessed valuation. Therefore, the total mill levy for parcels in that district are $87.40 (Reference 56).

Land and Property Values

The Boulder real estate market has shown an annual appreciation rate of 10 to 15 percent for a number of years. In 1975, even by conservative estimates, the average was at least 15 percent (Reference 57).

There are three types of land in the project area: agricultural, gravel mining and residential. Immediately surrounding the existing plant and proposed sludge-injection and infiltration/percolation sites are predominantly open fields with agricultural uses. Nearby are several residential developments, such as the Gun Barrel area which are among the highest property value areas in the county (Reference 54).

The 75th Street treatment plant has had a history of complaints about sewage odors from the surrounding neighborhood and the Gun Barrel area (Reference 58). In general, local real estate sales and land uses have not been greatly affected in the Gun Barrel area due to the high housing demands (Reference 59). However, in the immediate areas mostly strongly influenced by treatment plant odors, land values and housing have been affected. Residents cite increasing incidences of: 1) abandonment or rapid turnover of homes closest to the treatment plant; 2) conversion of affected homes into rental units; 3) slower rates of land and property appreciation near the plant; and 4) deterioration of some homes near the plant due to odor permeation and loss of owner or resident interest.

Bonded Indebtedness and Subsidies

The City of Boulder's December 31, 1975 Financial Statement shows a total bonded debt of $15.4 million. Of the outstanding general obligation bonds totalling $12.5 million, $6.3 million for waterworks improvements are considered to be self-supporting. In addition, $2.9 million are outstanding on sewer revenue bonds issued for projects other than the current wastewater treatment plant. In 1974, the Boulder City Council made a policy decision not to approve proposed capital projects requiring bonding (Reference 58). Therefore it is assumed that the city will finance its share of construction costs by other means. The Wastewater Utility Division of the City of Boulder maintains a capital fund for required future expenditures. Projected cash flow estimates as of December 2, 1976 indicate that there will be a total of $2,462,000 available from this fund to finance the city's share of the costs. Based on the established 75 percent federal participation, the City of Boulder is presently able to finance all alternatives except G, which will require an additional $5.6 million in capital for the first phase of construction, and another $650,000 in the second phase.

It was originally planned that the State of Colorado would participate in the financing of the project through a State Water Quality Control Commission Step II grant, amounting to approximately 5 percent of the total project capital cost. However, at this point in time, there are no grant monies available. Therefore, it can be assumed that the City of Boulder will receive no financial aid from the State of Colorado (Reference 61).

Utility Services

Electric Power and Gas--

The 75th Street wastewater treatment plant is presently being served by a primary meter, with customer ownership of all electric facilities beyond the primary meter point. The highest electricity demand by the plant since August 1975 has been 438 kW, experienced in November 1976. Demand has remained fairly steady at 385 - 430 kW. Total consumption for the 12-month period ending November 1975 was $2,657 \times 10^3$ kWh (Reference 60).

Natural gas consumption at the 75th Street treatment plant totaled 2,898 million cu ft for the 12 months ending November 1976 (Reference 60).

Water Supply--

The water utility of the City of Boulder, a city-owned utility company, supplies water from high-elevation reserviors of the watershed. The city's current direct-flow water rights from the Big

Thompson Project, the Nederland Watershed, and various irrigation ditches are adequate for current and projected needs, through raw water storage rights may be inadequate to meet demands during a drought year.

There are two existing water treatment plants: the Betasso Treatment Plant, constructed in 1963, and Boulder Reservoir Treatment Plant, constructed in 1972. These have nominal treatment capacities of 48 mgd and 8 mgd respectively. The nominal capacity of the Betasso Plant was increased from 28 mgd to 48 mgd in 1977. Five reservoirs for the storage of treated water have a total capacity of at least 35 mgd. The city water distribution systems have recently expanded and provide sufficient capacity to service a population of 150,000. Present average consumption is 15.3 mgd; peak consumption has been as high as 35 mgd, which was experienced in 1974. Since 1965, when metered rate charges went into effect, per capita use has varied from 134 to 175 gallons/day. Future per capita demand under drought conditions is estimated at 175 gallons/day. This is based on a worst-case average of approximately 26.3 mgd for a population of 150,000.

The City Water Utility services the area of the 75th Street treatment plant, as well as residential areas directly north of that plant. Distribution to the vicinity of the plant is accomplished through an existing 12" main along Carter Trail, ending at Jay Road. Construction of an additional 16" main along Jay Road has been recommended by an independent study and is considered in county objectives (References 50, 62, 63, 64, 65).

Solid Waste Disposal--

There is no municipal solid waste collection service, though the city-authorized Urban Waste Resources Company operates a sanitary landfill for disposal of such waste. Collection is handled by approximately 12 local private firms. It is estimated that the Marshall Landfill site will have reached its capacity well before 1990, and recommendations have been made for acquisition of an additional site (References 50, 66).

Storm Drain System--

Because of its topography and geographic location, the City of Boulder is extremely vulnerable to flood damage. Recognizing that existing storm drainage systems do not provide adequate protection, the city in 1973 took the first steps toward a major flood control program and Master Drainage Plan, ultimately aimed at providing facilities to handle storm and flood waters of up to

100-year intensity. The program's first major drainageway improvement project, Viele Channel, was completed in 1976 through cooperative efforts by the City and County of Boulder (References 63, 64).

Transportation

Since January 1976, the Boulder City Bus System has been under the management of the Regional Transportation District, Boulder Division. The district now operates buses on a regular basis along six routes within the city as well as into Denver. A long-range Transit Development Plan, resulting from the Boulder Transportation Study undertaken by the city in 1975, provides for several system improvements. These include new and expanded routes to major traffic generators outside the city, and inauguration of an extensive bus shelter and bus pull-out lane program. There is presently no regular service to the 75th Street wastewater treatment plant or to the Gun Barrel residential development north of the plant (References 50, 65, 66).

SECTION III

SECTION III

PROPOSED ALTERNATIVES

The wastewater facilities plan for which this EIS document has been prepared is a joint effort of the City of Boulder Wastewater Utility and CH2M-Hill, Inc. The facilities plan analyzed a wide range of unit treatment processes, presented in preliminary reports (References 2 and 3), and selected seven alternatives for further consideration on the basis of such factors as cost, environmental impacts, effluent discharge requirements and utilization of existing facilities. The facilities plan was submitted to the City of Boulder in October 1975.

CHANGES TO THE FACILITIES PLAN

Several major changes have occurred to the facilities plan since 1975. These changes were put forth in the February 1977 facilities plan supplement and have been incorporated into the alternative plans of this EIS.

In February and March 1976, at the request of the City of Boulder, the facilities planning consultant made the following major changes:

1. The infiltration and percolation basins under Alternative A were moved to the Kolb property with additional basins immediately north of the railroad tracks and east of 75th Street, and also to city property immediately west of 75th Street and adjacent to Boulder Creek. The total land area occupied by the basins was changed.

2. The sludge-injection sites under all alternatives were moved to the city-owned property west of 75th Street and south of the railroad tracks, and to the Manchester property to the east of 75th Street and south of the railroad tracks.

3. Alternative B was modified to provide nitrification (removal of ammonia).

4. Under alternative C, the three polishing ponds proposed for the Walden Ponds County Wildlife Habitat area were eliminated and an additional polishing pond was added between the main polishing ponds and Boulder Creek. The flow pattern and pond arrangements

were redesigned so that the effluent would flow in a southeastward direction to discharge to Boulder Creek approximately 4,000 feet upstream of the present discharge.

During preparation of the draft EIS in the fall of 1976, it was learned that flow meter readings used to establish a baseline wastewater generation rate had been erroneously high for several years. The errors were found only after the infiltration/inflow study (Reference 67) had been concluded. These meter readings, used as a basis for design in the wastewater facilities plan, were approximately 15 percent too high. In addition, recalculation of population growth for this EIS (explained in Section II) indicated that growth in the Boulder area would closely approximate projections made in 1975 by the Denver Regional Council of Governments (DRCOG). These new population projections, and consequently wastewater flow projections, are lower than those presented in the wastewater facilities plan.

As a result of these factors, the facilities design flows and sizes, along with the costs of alternatives, have been reduced. This EIS presents the updated values for each alternative. As a consequence of the delays associated with obtaining approval for a recommended plan and the estimated time needed to design and construct any new facility, the project planning period was redefined to begin in 1980 and end in the year 2000.

Effective 31 January 1977, the stream classification of Boulder Creek was changed from B1 to A1 above the 75th Street treatment plant, and from B2 to A2 below the treatment plant down to the Coal Creek confluence. See Section II, Water Quality Management and Regulations for explanation of classifications. Because of this, some of the wastewater treatment processes that were optional under the wastewater facilities plan have now become essential. Certain alternatives can no longer meet the required effluent standards; others, with modification, can. The descriptions of alternatives presented in this chapter include revisions necessary to meet the latest effluent discharge criteria.

DESIGN FLOWS AND POLLUTANT LOADINGS

Wastewater flows were calculated on the basis of population projections developed by DRCOG as presented in Section II. The base wastewater flow in 1975, corrected for meter error, was 12.5 million gallons per day (mgd) for a population of 92,200. This flow included groundwater infiltration and storm water inflow. The infiltration and inflow study concluded that a full-scale sewer rehabilitation program was not justified on a cost basis. Therefore, the city would continue regular maintenance and repairs on the existing sewer system. On this basis, the wastewater flows from the presently sewered population were assumed to remain unchanged. Future service connections and new sewer lines would be constructed under stringent infiltration requirements. Thus, it has been estimated that incremental population growth would have an associated wastewater flow rate of 120 gallons per capita per day (gpcd). This is a reasonable value and well within accepted standards. Table 9 presents the revised wastewater flows as calculated by the facilities planner and by the Denver Regional Council of Governments in the Areawide Water Quality Management Plan.

Table 9. EXISTING AND PROJECTED WASTEWATER FLOWS (MGD)

Year	DRCOG Population Estimates	Population Increment From 1975	Incremental Flow Using 120 gpcd (mgd)	Wastewater Flows Boulder (mgd)	Wastewater Flows DRCOG (mgd)
1975	92,200	-	-	12.5[a]	12.2
1980	98,800	6,000	0.8	13.3	13.0
1990	115,500	23,300	2.8	15.3	15.2
2000	130,100	37,900	4.6	17.1	17.5

[a]Base Flow Measured in 1975.

Source: Wastewater Facilities Plan Supplement, February 1977.

The wastewater flow rates developed by DRCOG are very similar to those calculated by the facilities planner. In order to maintain consistency with the Areawide Water Quality Management Plan, the DRCOG estimates were used as a basis for facilities sizing and will also be used for facilities evaluation.

Wastewater flow rates vary with time and season. The values presented previously (October 1975) were based upon annual averages. The facilities planner calculated that 95 percent of the wastewater flows occurring in any year would be less than 1.3 times the annual average flow and multiplied the flows (DRCOG estimates) in Table 9 by 1.3 to obtain 19.9 mgd and 22.8 for the years 1990 and 2000, respectively.

Most processes for the treatment of domestic wastewaters are designed on the basis of three parameters: flow, 5-day biochemical oxygen demand (BOD_5) and suspended solids. Table 10 presents the estimated future waste loads on the treatment system.

Table 10. ESTIMATED FUTURE WASTELOADS (LB/DAY)

Year	BOD_5	Suspended solids
1975	13,400[a]	13,100[a]
1980	14,700	14,300
1990	18,100	17,300
2000	21,000	19,900

[a]Measured values in 1975.

Source: Wastewater Facilities Plan Supplement, February 1977.

The 1975 waste loads were assumed to remain unchanged during the study period. Waste loads atttributable to increasing population were calculated on the production rates of 0.2 lb of BOD_5 per capita per day and 0.18 lb of solids per capita per day.

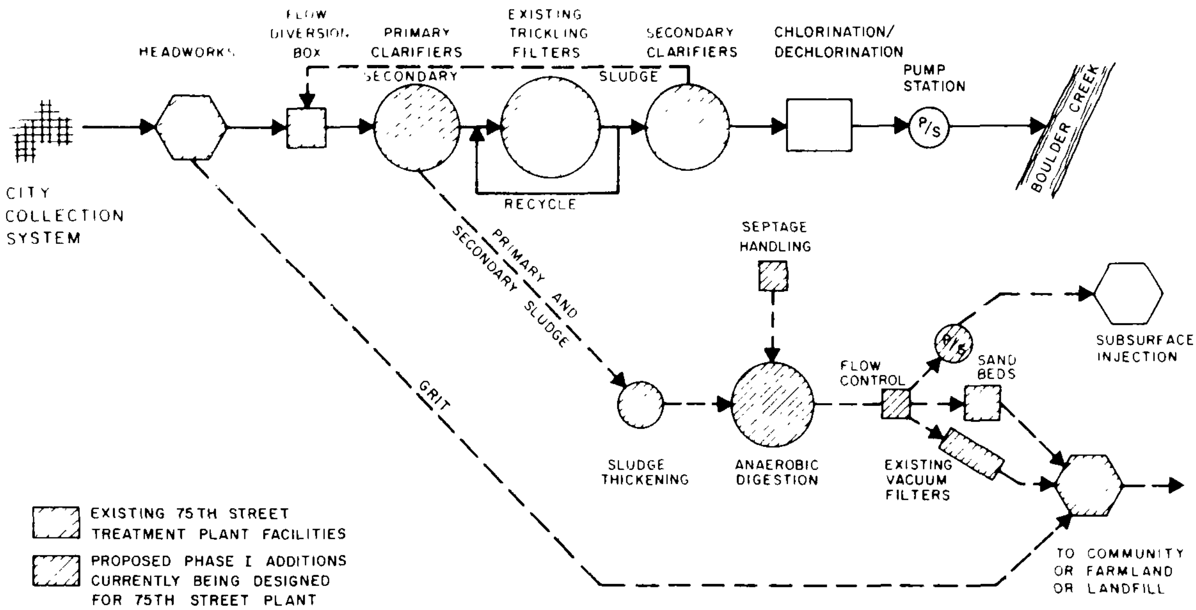
ALTERNATIVES

Following are descriptions of the updated alternatives based on those developed in the wastewater facilities plan. Preceding the descriptions is a presentation of the features shared in common by all of the alternatives. A schematic presentation of the unit processes within each alternative system is shown in Figure 12.

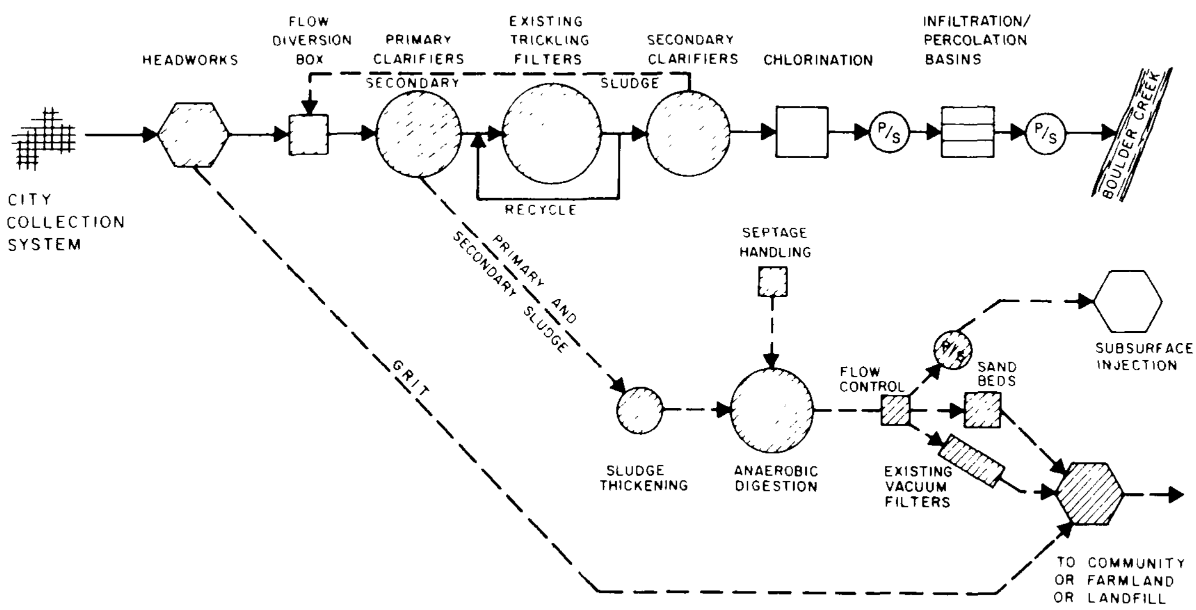
Common Features

All of the alternatives proposed would use the existing facilities at the 75th Street plant to the fullest extent possible. This plant is a secondary facility employing trickling filters. The original plant, with a capacity of 15.2 mgd., was placed in operation in 1968 and was expanded in 1972 to a capacity of 15.6

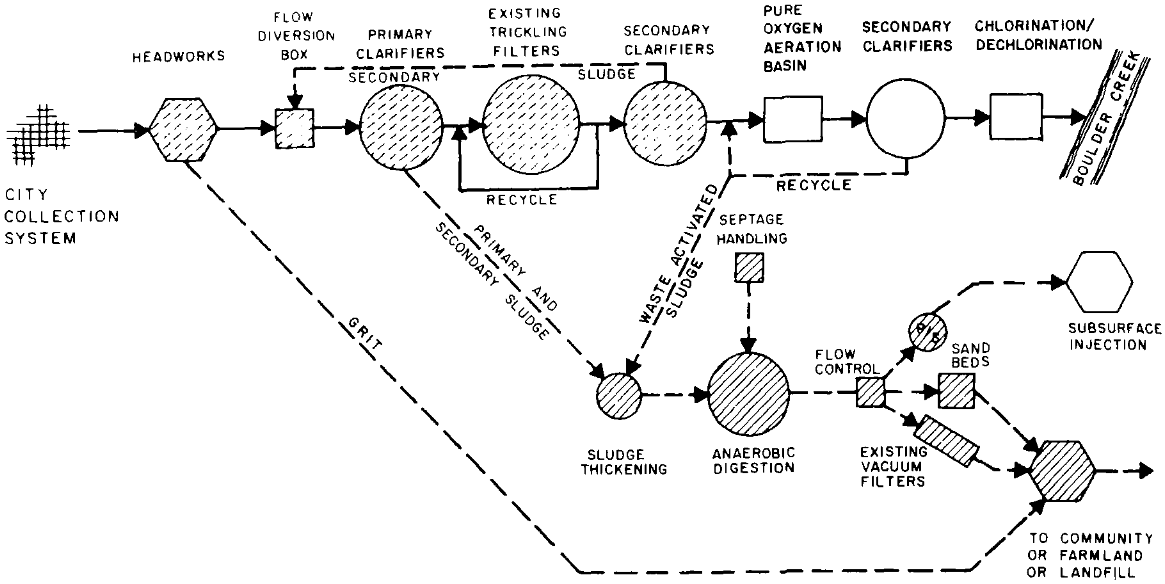
FIGURE 12



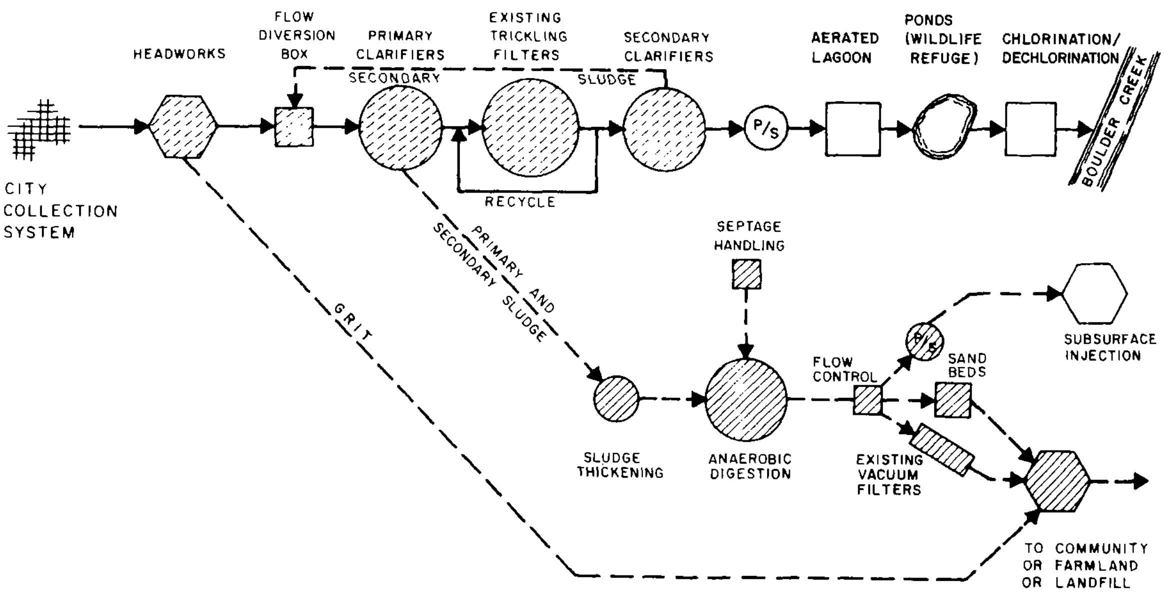
EXISTING TRICKLING FILTER PLANT
PLUS PHASE I ADDITIONS
(NO PROJECT-ALTERNATIVE H)



ALTERNATIVE SYSTEM A
EXISTING TRICKLING FILTER PLANT
PLUS PHASE I ADDITIONS AND
INFILTRATION/PERCOLATION BASINS

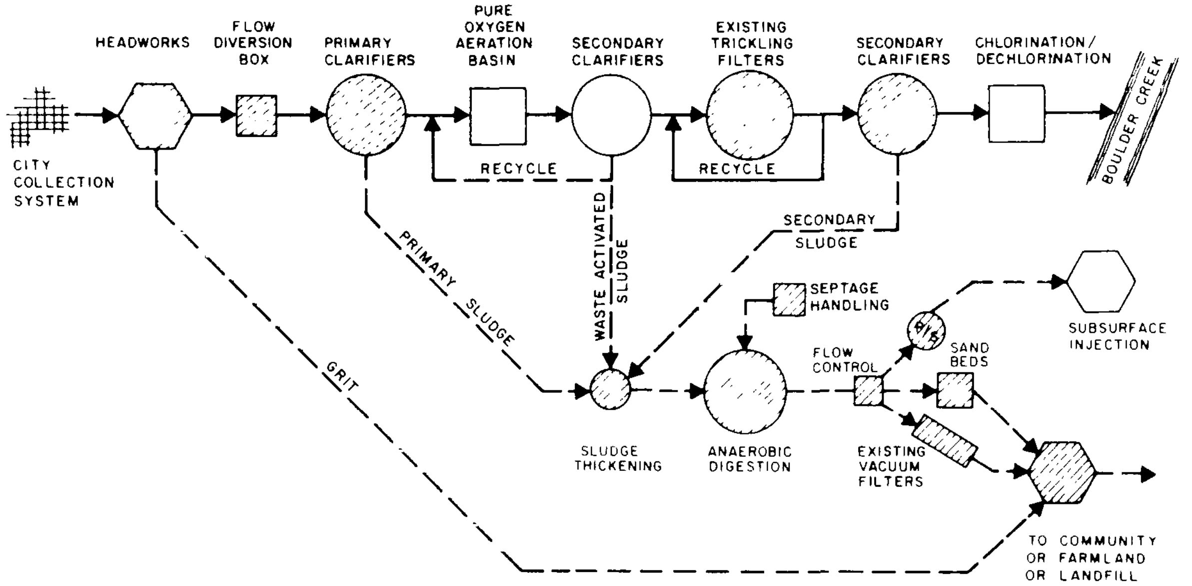


ALTERNATIVE SYSTEM B
EXISTING TRICKLING FILTER PLANT
PLUS PHASE I ADDITIONS AND
ACTIVATED SLUDGE PROCESS

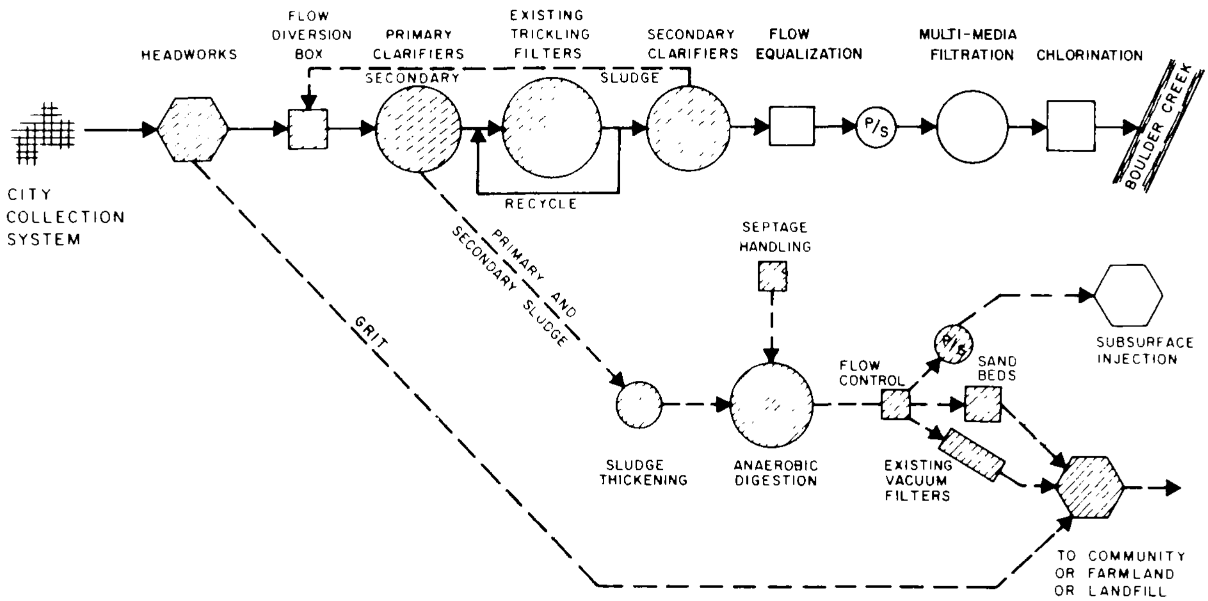


ALTERNATIVE SYSTEM C
EXISTING TRICKLING FILTER PLANT
PLUS PHASE I ADDITIONS AND
AERATED AND POLISHING PONDS

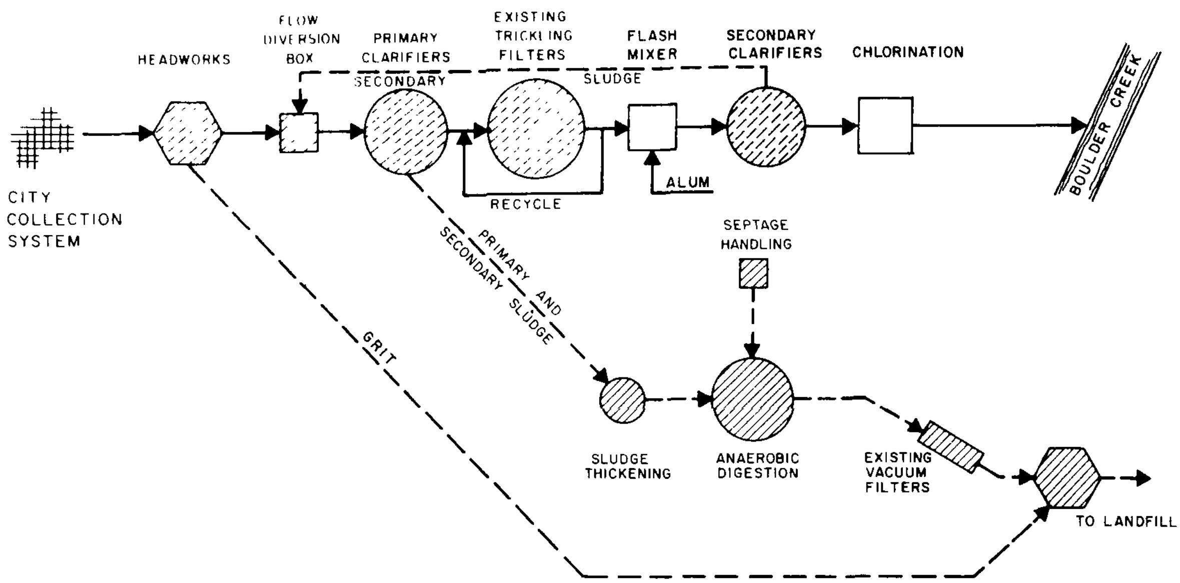
FIGURE 12 (Con'd)



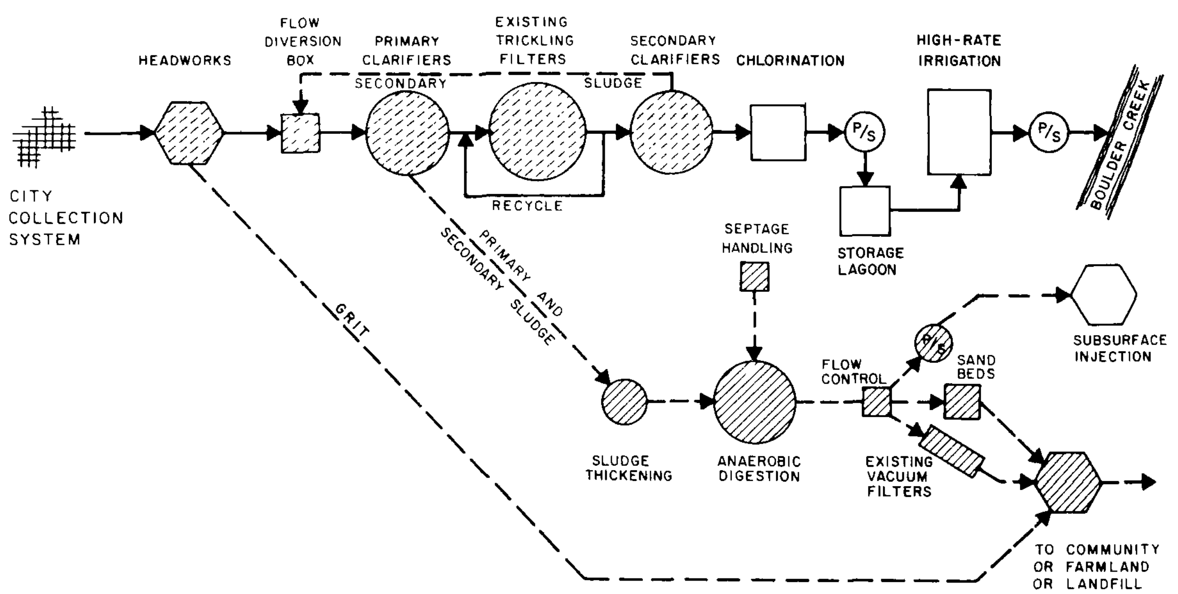
ALTERNATIVE SYSTEM D
ACTIVATED SLUDGE PROCESS AHEAD OF
EXISTING TRICKLING FILTER PLANT
PLUS DECHLORINATION



ALTERNATIVE SYSTEM E
EXISTING TRICKLING FILTER PLANT
PLUS PHASE I ADDITIONS AND
MULTI MEDIA FILTRATION



ALTERNATIVE SYSTEM F
EXISTING TRICKLING FILTER PLANT
PLUS PHASE I ADDITIONS AND
ALUM ADDITION



ALTERNATIVE SYSTEM G
EXISTING TRICKLING FILTER PLANT
PLUS PHASE I ADDITIONS AND
HIGH-RATE IRRIGATION

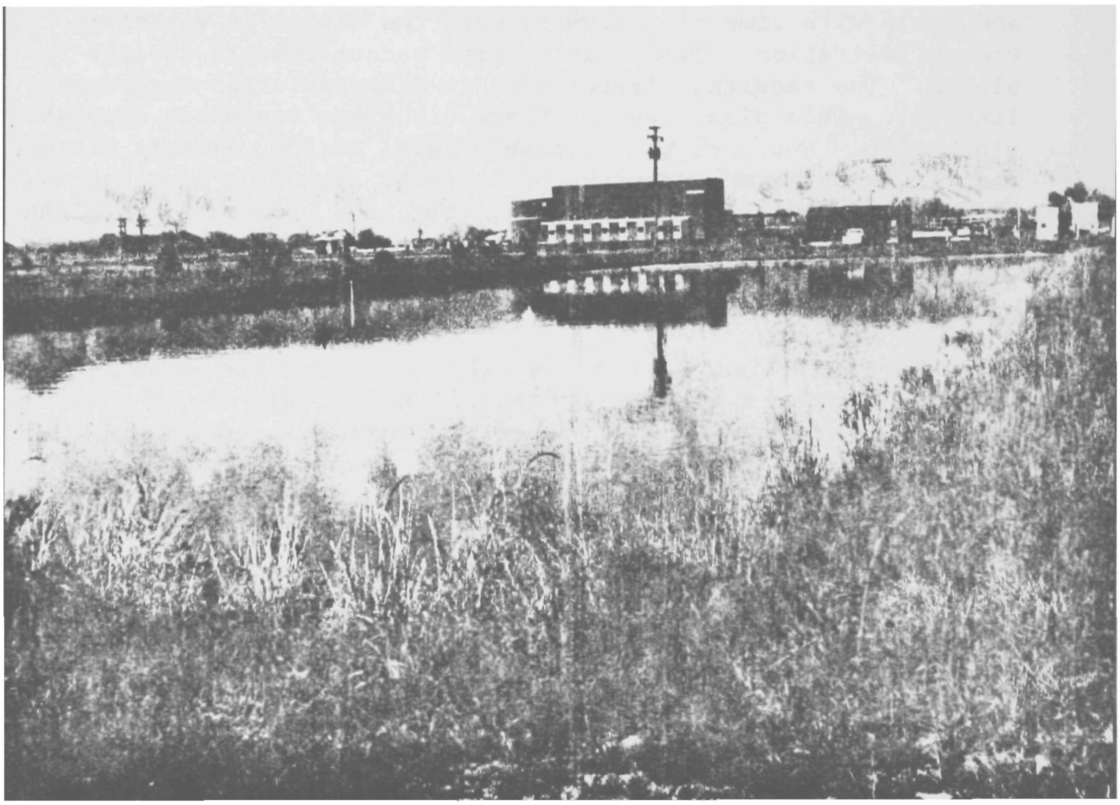
mgd. Basically, this plant consists of grit removal and shredding of larger solids, followed by primary clarification using three clarifiers which collect both primary sludge and the secondary sludge recycled through the headworks. Four trickling filters containing rock media follow the primary clarifiers. The wastewater then enters a secondary clarifier and is subsequently chlorinated prior to stream discharge. A portion of the effluent from the trickling filters is recycled through the filters. The sludge from the primary clarifiers is treated with lime in a holding tank, and again with lime and polymers when the sludge is withdrawn for vacuum filtration. Two rotating-drum vacuum filters dewater the sludge. The resultant filter cake is disposed of to the county landfill. This plant has met State discharge standards consistently since 1973. However, the allowable level of BOD, ammonia nitrogen and fecal coliforms under the previous B2 standards have had adverse effects on Boulder Creek. The existing unit processes, with the proposed additions to the sludge handling system under Phase I, are depicted in Figure 12 which would also represent the No Project Alternative.

The facilities planner has calculated that the existing primary clarifiers have an average hydraulic loading rate of 700 $g/ft^2 \cdot d$ design criterion. The facilities planner has further calculated that additional primary clarifier capacity will be needed during Phase II construction. This increase in primary clarifier capacity is envisioned for each alternative. This modification would allow the treatment plant to handle a capacity of 17.6 mgd. The balance of the existing trickling filter plant would require no expansion of existing capacity.

Each of the alternatives except Alternative A (infiltration/percolation basins) and Alternative G (high-rate irrigation) would have chlorination before discharge of the effluent to Boulder Creek. Dechlorination (in Alternatives B, C and D) would be done by a combination of aeration and treatment with sulfur dioxide. Dechlorination was not proposed for Alternatives E and F because it has assumed that any residual chlorine would combine with the ammonia in the effluent. Effluent will have to be aerated prior to discharge under alternatives A, E and F in order to meet the rather stringent effluent dissolved oxygen requirements.

All alternatives except Alternatives F would have the same solids handling system. The initial processes consists of sludge thickening and anaerobic digestion. The final processing is divided into two phases: (1) utilization of the existing vacuum filters to dewater 25 percent of the sludge; and (2) subsurface injection of the remaining 75 percent to a local field site and subsequent cropping of the site. The solids dewatered by vacuum filtration would be stockpiled for the community, municipal and agricultural reuse.

The solids handling for Alternative F would consist of sludge thickening as described above, with anaerobic digestion, dewatering by use of vacuum filters and final disposal through sanitary landfilling.



EXPERIMENTAL INFILTRATION/PERCOLATION BASIN AT
75TH STREET TREATMENT PLANT SITE

Alternative A - Land Treatment by Infiltration/Percolation

This alternative system would use the existing 75th Street treatment plant to provide the basic wastewater treatment functions. Chlorinated secondary effluent from this plant would be pumped to infiltration/percolation basins for additional treatment. This process would utilize the high infiltration and permeability capabilities of the sands and gravels bordering Boulder Creek. Thirteen basins would be formed by removal of ground cover and utilization of surface soils to build 4-ft high and approximately 55-ft wide berms around each basin. The berms will be 15-ft wide at the top and will probably have a 3:1 or 4:1 slope. The basins would be contoured to natural features wherever possible, to preserve mature cottonwood trees growing on the site. The basins would be filled on a 9- to 12-day rotation cycle. A tile underdrain system beneath the basins would collect the effluent as it filters down. This filtered effluent would flow to a main collector drain and be discharged to Boulder Creek near the 75th Street bridge.

The effluent from the trickling filter process alone could not meet local wastewater treatment effluent limitations without further processing. The facilities planner has calculated that infiltration/percolation ponds, with an area of 222 acres, would provide polishing of the effluent sufficient to meet effluent discharge criteria. The area requirements were determined by the facilities planner after a study of soil characteristics on the Kolb property, which is proposed for the infiltration basins. The storage lagoon for winter flows envisioned in the wastewater facilities plan was subsequently determined not to be necessary. The discharge temperature of the treated effluent should prevent the freezing of the percolation pond.

The basic unit treatment processes of this alternative are shown schematically in Figure 12. A site map showing the locations of the treatment plant and revised sites proposed for the infiltration/percolation basins and sludge disposal area is presented in Figure 13.

Alternative B - Activated Sludge Process Following Trickling Filters

The existing trickling filter treatment plant, with increased primary clarifier capacity, would be a part of this alternative. Effluent from the existing secondary clarifiers would flow to a new, pure-oxygen-activated sludge treatment unit, as described in the revised facilities plan. The oxygen-activated sludge would be designed to oxidize any biodegradable organic matter leaving the trickling filters and to convert the ammonia-nitrogen in the effluent to nitrate-nitrogen. This concept is a departure from the October 1975 Wastewater Facilities Plan because in that document, Alternative B was designed to oxidize organic matter but not to produce a nitrified effluent.

The new oxygen-activated sludge units would consist of an on-site oxygen-generation plant, aeration basins, and additional secondary clarifiers.

Figure 12 shows a schematic representation of the unit treatment processes of this alternative.

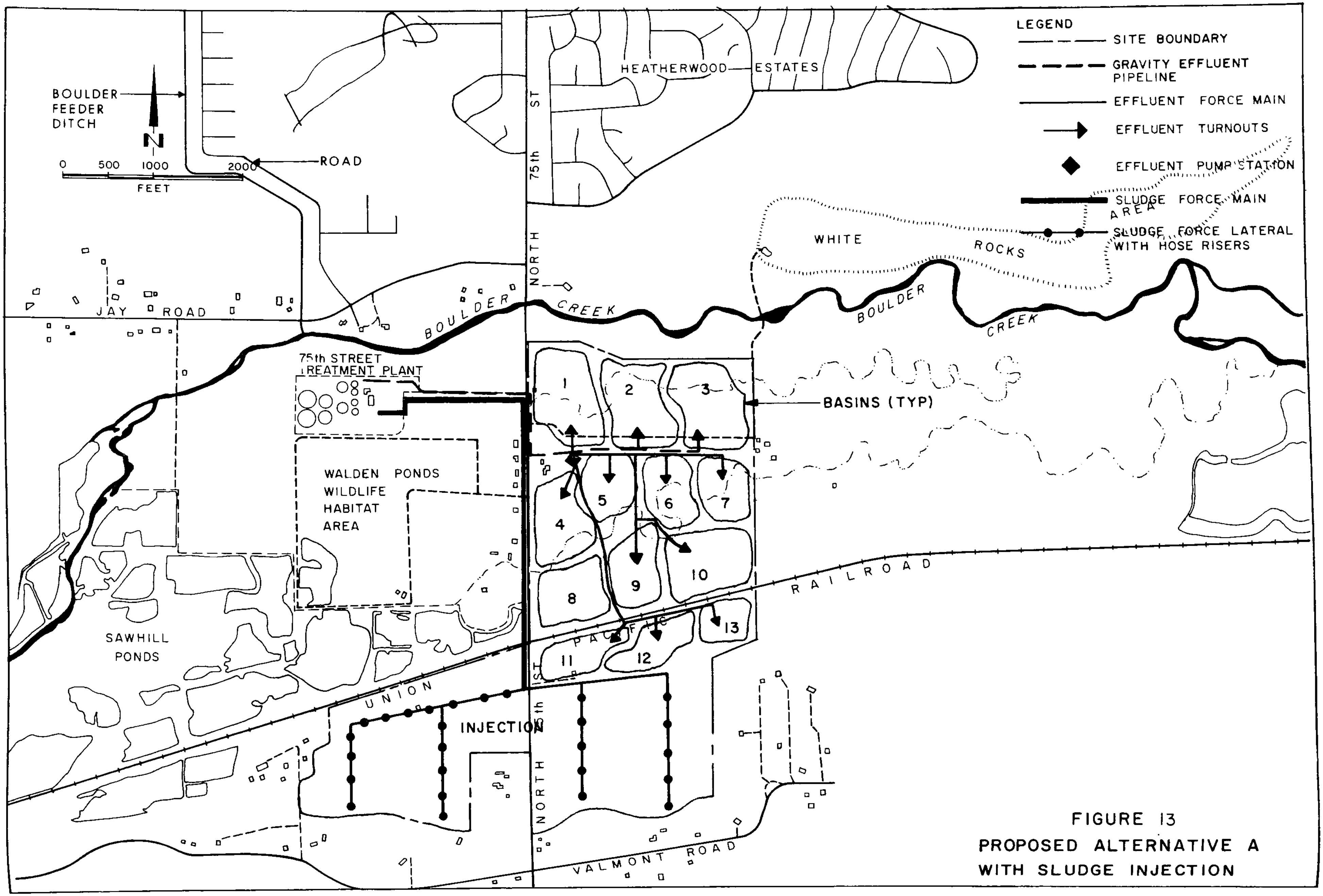


FIGURE 13
PROPOSED ALTERNATIVE A
WITH SLUDGE INJECTION

Alternative C - Aerated Lagoons and Polishing Ponds

Under this alternative, bacterial and algal ponds would be used to polish the trickling filter plant effluent. Settled sewage from the secondary clarifiers would first flow to aerated lagoons with a two-day hydraulic detention time, where bacterial and algal action would convert soluble BOD_5 to cellular material and carbon dioxide. Subsequent polishing ponds would capture residual organic matter, nutrients and suspended solids, and would convert ammonia-nitrogen to nitrate, with the intent of producing a clear effluent for direct discharge to Boulder Creek.

The polishing ponds would be constructed with submerged rock filters through which each pond's discharge would drain before passing to the next pond. It is envisioned by the facility planner that the submerged filters would capture algae, discharging a clear effluent to the next pond. Figure 12 is a schematic representation of the treatment processes in Alternative C.

The aerated lagoons, polishing ponds and a small buffer zone will require approximately 145 acres of additional land next to the existing treatment plant. The proposed pond treatment site, as shown in Figure 14 is scheduled for gravel mining in the near future. The resultant gravel pits would be suitable for conversion to a treatment pond system for Alternative C. It is envisioned by the facilities planner that the polishing ponds could be used as an aquatic wildlife habitat.

Alternative D - Activated Sludge Process Prior to Trickling Filters

A new activated sludge wastewater treatment system would precede the existing trickling filters in this alternative. The activated sludge treatment units would use pure-oxygen aeration to produce an estimated 90 percent reduction in organic pollutants. The effluent, low in carbonaceous pollutants, would be treated again in the existing trickling filters, where ammonia-nitrogen could be converted to nitrate-nitrogen and a further reduction achieved in organic matter and suspended solids.

The unit treatment processes for Alternative D are schematically depicted in Figure 12. All new treatment units could be constructed on the existing 75th Street treatment plant site.

Alternative E - Multimedia Filtration of Effluent

The basic trickling filter treatment processes would remain unchanged. The secondary clarifier effluent, which is high in suspended solids and BOD, would be subjected to multimedia filtration

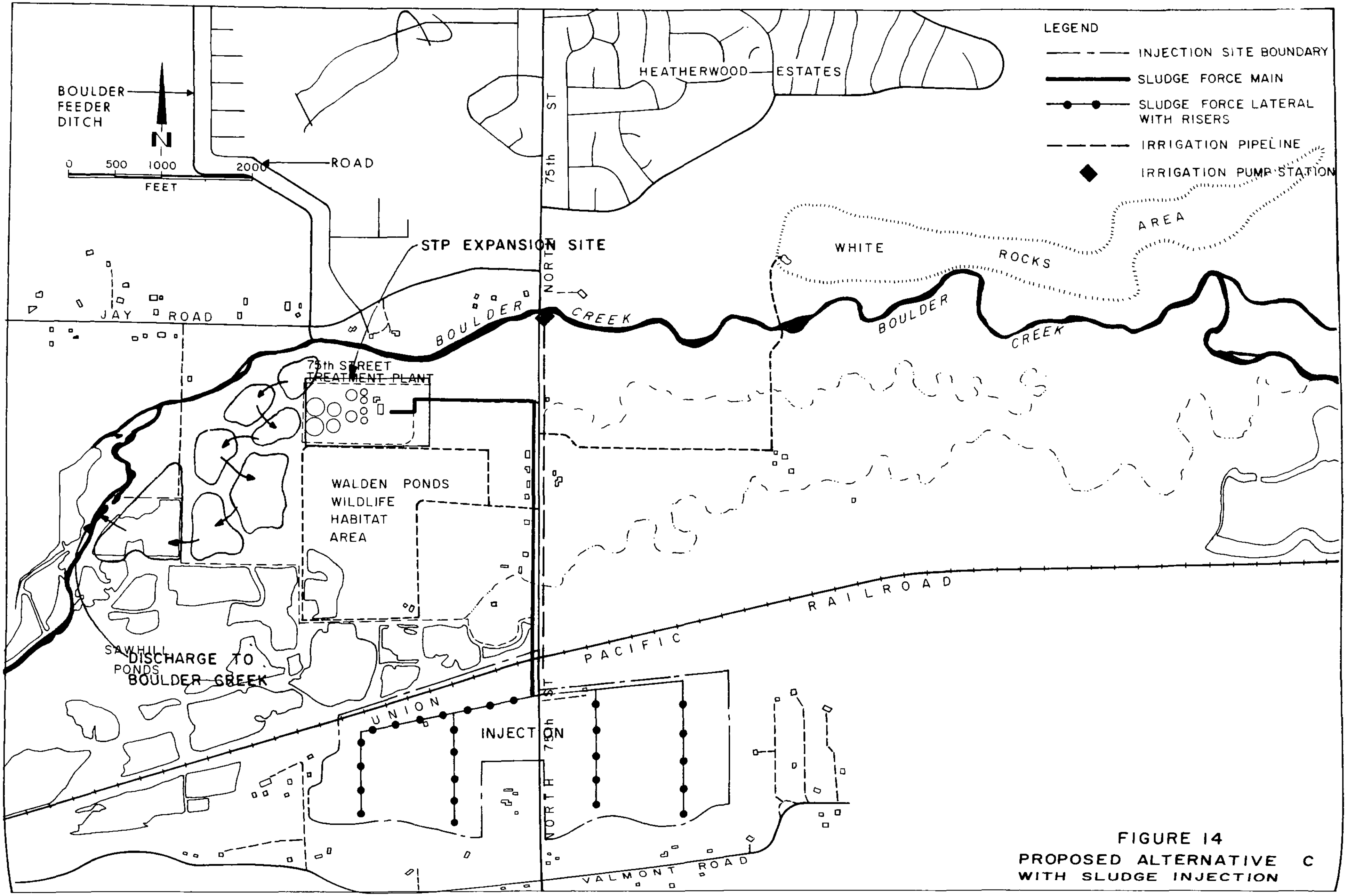


FIGURE 14
PROPOSED ALTERNATIVE C
WITH SLUDGE INJECTION

to remove the suspended solids. Since much of the effluent BOD_5 is in the form of suspended organic matter, there would also be a decrease in total effluent BOD_5. The facilities planner recommends that the multimedia filters be preceded by a flow equalization basin which would maintain a constant discharge rate to the filters and would prevent sudden, excessive hydraulic loads.

This alternative could not meet the effluent discharge requirement for ammonia-nitrogen and was developed before the stream standards for Boulder Creek were revised. Conversion of this treatment scheme to one that would remove ammonia-nitrogen would make it almost identical to one of the other alternatives. The treatment processes of this alternative are shown in Figure 12.

Alternative F - Chemical Coagulation

This alternative would present, for formal comparison with other alternatives, a practice employed for several years at the 75th Street plant, addition of aluminum sulfate (alum) to the trickling filter effluent in order to increase the efficiency of suspended solid removal in the secondary clarifier.

Alternative F, like Alternative E, was developed to meet discharge criteria less stringent than those now in existence and would not meet present ammonia standards. The ability of this system to meet suspended solids and BOD_5 criteria without additional secondary clarifiers is questionable. Also, just as with Alternative E, upgrading of this process would effectively make it identical to another alternative.

Due to the anticipated chemical content of the waste sludges, the facilities planner expects that anaerobic sludge digestion efficiency would decrease. Furthermore, the alum would preclude the use of digested sludge for agricultural purposes, and the sludge would in all probability have to be disposed to a landfill.

All wastewater treatment modification under this alternative could be accomplished on the existing treatment plant property. Figure 12 presents the process features of Alternative F.

Alternative G - High-Rate Irrigation of Effluent

The existing trickling filter treatment system would be used in this alternative. Treated effluent from the secondary clarifiers would be chlorinated and then conveyed to an 8,800 acre-ft storage lagoon. During the 7-month growing season, water from the lagoon would be used to irrigate approximately 2,100 acres of cultivated grassland. The residual organic matter in the plant effluent would

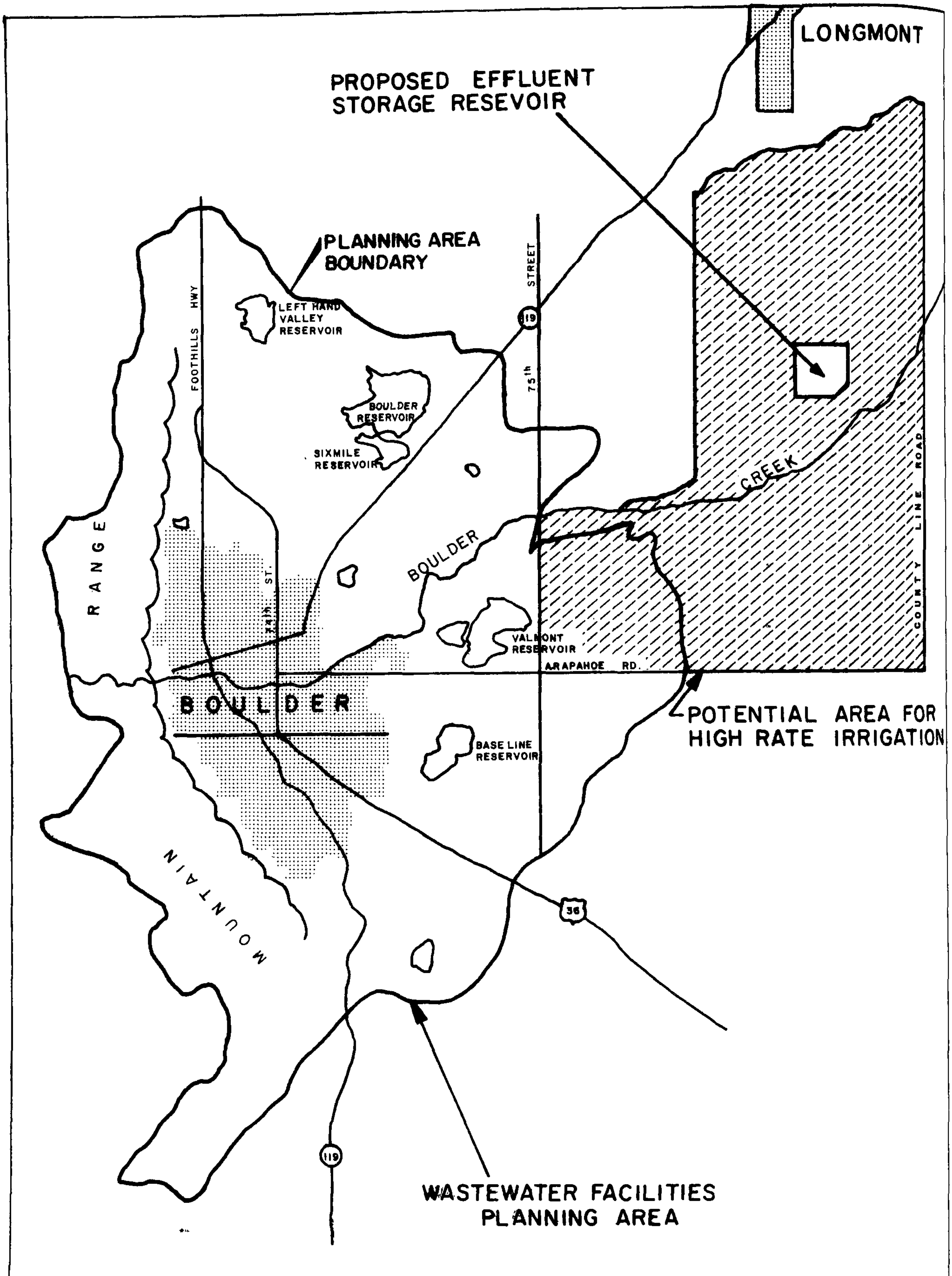


FIGURE 15

POTENTIAL AREA FOR HIGH RATE IRRIGATION

have been oxidized in the storage lagoon. Nutrients passing through the lagoon would contribute to crop growth in irrigated areas. Hay harvested from the project area would be used for livestock feed.

The facilities planner has estimated that this alternative will require an additional 3,360 acres for the irrigation fields, buffer zones and a 350-acre storage lagoon. The site proposed for this system is shown on Figure 15. The unit processes of this alternative are presented in schematic form on Figure 12.

Alternative H - No Project

This alternative explores the ramifications of failing to upgrade the existing treatment plant. Maintaining the present unit processes, this plant currently meets the standards for secondary treatment which all municipalities must comply with by 1 July 1977, as defined by EPA. However, Boulder Creek would continue to suffer from problems of poor water quality and deteriorated aquatic habitat caused in part by the present sewage effluent, as discussed in Section II under Water Quality.

Going beyond the secondary treatment goals, the State of Colorado and many Boulder Valley residents desire to reestablish stream fisheries and restore Boulder Creek close to its former pristine quality. As mentioned earlier, an A2 stream classification for Boulder Creek below the 75th Street treatment plant was adopted in January 1977. Effluent from the existing treatment plant clearly will not meet A2 stream water quality standards and would strongly deter the development of a warm-water fishery or primary-contact recreation. As the existing wastewater effluents degrade Boulder Creek below A2 standards, this no-action alternative is unacceptable and will not be considered further.

ENGINEERING EVALUATION OF ALTERNATIVES

Common Features

The continued use of the existing 75th Street wastewater treatment plant in the alternative wastewater management systems represents a continued use of a valuable resource. The original plant was constructed in 1968, with an expansion in 1972. Since the typical useful service life of a sewage treatment facility is from 30 to 35 years, the existing plant should remain functional until the end of the planning period in the year 2000.

The trickling filter process is generally less efficient than the activated sludge process in removing pollutants. However, the stringent criteria for discharge to Boulder Creek require a sequence of treatment process to achieve desired effluent quality. Under this circumstance, the existing trickling filter plant can be combined with other unit processes.

The year-200 design flow would produce a 95-percentile hydraulic loading on the clarifiers of 900 g/ft^2•d, which is higher than the design limit of 800 g/ft^2•d established by the facilities planner. Conventionally accepted mean hydraulic loading rates for primary clarifiers followed by secondary treatment range from 800 to 1,200 g/ft^2•d, average daily flow (Reference 68). This range of loading rates results in only small differences in treatment efficiency, which become insignificant after subsequent secondary and tertiary treatment processes. For this reason, expansion of primary clarifier capacity does not appear to be essential for the successful wastewater treatment in Boulder.

On the other hand, secondary clarifiers, when they represent the final pollutant separation process in a treatment train, are critical to the successful performance of a wastewater treatment facility. The secondary clarifiers at the 75th Street treatment plant are the same size as the primary clarifiers; thus their 95th percentile loading would also be 900 g/ft^2•d in the year 2000. This is substantially more than a typical loading rate of 400 to 600 g/ft^2•d for secondary clarifiers and may result in excessive carry-over of wastewater solids in the effluent (Reference 68). The facilities planner has not recommended an increase in secondary clarifier capacity in Alternatives A, C, E and G. In Alternative F the effluent from these clarifiers would be discharged directly to Boulder Creek. It may be desirable to plan for a future expansion of trickling filter secondary clarifiers for this alternative. In Alternatives B and D, the facilities planner recommends new clarifiers with 14 ft and larger surface areas than the existing clarifiers (two-145 ft diameter and one 80 ft diameter for the future).

The sewage sludge disposal systems which consist of anaerobic digestion followed by vacuum filtration or subsurface injection for various portions of the total sludge production, will probably function satisfactorily. Sludge injection, as currently practiced at the East Pearl Street treatment plant, should perform satisfactorily.

Table 11. PRELIMINARY ESTIMATES OF TREATMENT EFFECTIVENESS [a]

Category	Effluent constituent concentration									
	Suspended solids, mg/l	BOD_5, mg/l	NH_3-N, mg/l	Fecal coliform, no./100 ml	Dissolved oxygen, mg/l	Oil & grease, mg/l	Cl residual, mg/l	Color, units	Turbidity, JTU	pH
Colorado monthly standards	30	30	weekly, 4.3	200	-	10 at any time	weekly, 0.04	-	-	6-9
Boulder monthly guidelines	20	20	weekly, 4.3	1,000	90% saturation (7-10)	10	-	< 20	< 20	6-9
Raw wastewater estimate	140	147	30	high	low	20	0	high	high	6-9
Alternative effluent										
A	1-2	2-5	0.5	∿ 0	2-5	∿0	∿0	∿0	∿0	6-9
B	∿10	∿10	< 1	< 10	7-10	< 1	< 0.04	< 10	< 10	6-9
C	20 [b]	20 [b]	10-15	∿0	7-10	∿0	< 0.04	< 5	< 5	6-9
D	15	10-15	< 1	< 10	7-10	< 1	< 0.04	< 10	< 10	6-9
E	10	20	20	< 10	2-4	< 1	< 1	< 10	< 10	6-9
F	20	20	20	< 20	2-4	< 5	< 1	< 10	< 10	6-7
G [c]	< 10	< 5	< 1	< 20	7-10	< 1	0	< 5	< 5	6-9

[a] Also see discussions in text.

[b] Additional treatment between and after the polishing ponds could reduce BOD and SS to lower levels, but the amount would vary according to operational and external factors.

[c] No discharge - does not have to meet stream standards.

Alternatives

The alternatives developed for the wastewater facilities plan were generally intended to meet criteria for discharge to a creek with a stream classification of B2. The classification of Boulder Creek from the 75th Street treatment plant down to Coal Creek has been changed to A2, and most alternatives, some with slight modificiation, could meet the more stringent discharge criteria associated with the new designation.

The effluent discharge criteria being applied to Boulder wastewaters are stringent and require treatment processes or combinations of processes not in common use. Since much of sanitary engineering is still an empirical science, the data base used for predicting the performance of the alternatives under consideration is incomplete and subject to revision. Estimates of the effectiveness of each treatment system relied upon published technical information and the experience of other sanitary engineers. A compilation of these estimates is shown in Table 11, which compares the estimated effluent quality of the systems. In view of the limitations of the analysis and the large number of factors affecting treatment plant performance, minor differences for specific parameters should not be used to differentiate among alternatives; rather, all the data for a particular alternative system, taken together, may be used as an indication of the possibility of its success.

Alternative A--

Alternative A appears to provide the best effluent considering all of the criteria except dissolved oxygen. The relatively low dissolved oxygen should not be a major concern because the BOD_5 would also be extremely low. However, aeration would be required prior to stream discharge in order to meet effluent standards. The effluent quality estimates for Alternative A are based on the results from experimental basins set up and operated by the City of Boulder and the University of Colorado (Reference 69). These tests, however, were made during the summer and used effluent with low concentrations (6 to 8 mg/l) of total nitrogen. Operation with higher nitrogen levels--which is more typical during the winter--has not been reported and may not produce such a highly nitrified effluent.

Construction and operation of the 13 infiltration/percolation basins could be phased over the 20-year design period in accordance with actual population growth. Presuming that all ponds handle an equal portion of the design-year flow, then at least two-thirds of the ponds must be built during the initial construction phase to be able to handle 1980 flows. In actuality, the ponds are not uniformly sized, and small differences in soil depth may affect the percolation rates for individual ponds. The design criteria reflect loading rates which will allow adequate treatment from the types soils in the area. However, individual ponds under actual operating conditions may be able to handle greater flows and still achieve desirable results.

Alternative B--

This system has the potential to meet all of the effluent criteria. However, pure oxygen activated sludge systems do require a higher level of operational skill than conventional activated sludge systems, and a detailed evaluation of both systems should be made before final selection of the treatment process.

The activated sludge unit and accompanying facilities would be built during the initial construction phase. The units might be reduced in size to handle a smaller flow; however, future expansion would be costly.

Alternative C--

Alternative C could achieve the desired BOD_5 and suspended solids level of the Colorado monthly standards. The pond effluent would probably also meet the Boulder monthly guidelines most of the time. However, algal blooms, spillover and reductions in algal removal efficiency by the filters could occasionally lead to higher levels of these two wastewater characteristics. Under the design conditions put forth by the facilities planner, the aeration and polishing ponds system probably cannot achieve sufficient ammonia-nitrogen removal to meet discharge criteria. The projected 2-day detention times in the aerated lagoons and subsequent polishing ponds detention times appear to be insufficient to achieve nitrification down to 1 mg/l ammonia-nitrogen. Another design consideration would be lower winter temperatures and pond freezing which will greatly inhibit nitrification.

Chlorination of the pond effluent will require a dechlorination step to meet the 0.04 mg/l residual chlorine limit. However, it is not entirely certain that chlorination of the effluent would be necessary, and it is possible that the combination of aerated lagoons and ponds would effect a sufficient fecal coliform kill.

All of the new unit processes in this system require intensive initial construction effort. The number of ponds probably cannot be decreased, although their capacities may be altered if size phasing is desired. With actual operation experience, it may be ascertained that the desired performance may in fact be achieved by the use of fewer polishing ponds.

Alternative D--

There appears to be little reason for consideration of this alternative; it places major dependence on the trickling filter units as the final treatment units. It may be difficult to maintain normal growths on the trickling filter media with the little available carbon from the activated sludge unit. Nitrification of the effluent during the winter would also be difficult.

The potential need to increase secondary clarifier capacity following the trickling filters has been mentioned. The potential for phasing the size of the unit processes is similar to that of Alternative B.

Alternative E--

Alternative E does not appear capable of achieving sufficient ammonia-nitrogen removal to meet discharge criteria. Ammonia removal through nitrification occurs aftaer the bulk of the BOD_5 has been removed and is accomplished by comparatively slow-growing bacteria. The existing trickling filter does not appear to have the capacity to achieve sufficient BOD_5 removal to accomplish effective nitrification.

This alternative calls for an immediate initial expenditure for filtration basins. The number of basins could be phased according to need.

Alternative F--

Like Alternative E, this alternative probably would not achieve adequate ammonia-nitrogen removal, and the effectiveness of solids removal with alum would be marginal, particularly with the present secondary clarifier capacity. This system would expand plant capacity from the nominal 15.6 mgd to 22 mgd. It is the only alternative which includes expansion of the secondary clarifier.

Alternative G--

Alternative G does not involve direct discharge of treated effluent to any surface water course or irrigation upon food crops. It therefore does not have to meet stringent effluent quality criteria. The existing treatment facilities are adequate to produce an effluent for irrigation where no contact between the effluent and portions of the plant that are to be consumed would occur. These requirements are more strict than those previously established by the various regulatory agencies but are necessary to achievement of the goals of the community as stated by City Council.

PROJECT COSTS

Capital Costs

Project implementation, as presented by the facilities planner, will require physical construction in two separate phases. In all seven system alternatives, capital costs for the first phase will be incurred in the years 1978-1980, capital costs for the second phase will be incurred in the years 1988 and 1989, and salvage values are assumed for the year 2000. The design period allows for 20 years of operation from first phase completion and, therefore, ends in the year 2000. A discount factor of 6-3/8 percent was used by the facilities planner to make present worth calculations, and costs are presented in January 1977 dollars. All costs presented in this analysis include primary and secondary treatment, solids handling, support facilities and engineering, legal, and administrative costs (References 1 and 5).

Total capital costs for both phases of construction range from a low of $4,681,000 for Alternative F (chemical coagulation) to a high of $34,875,000 for Alternative G (high-rate irrigation of effluent). Assuming 75 percent federal participation in capital funding, corresponding costs to the City of Boulder would range from a low of $1,170,000 (Alternative F) to a high of $8,718,000 (Alternative G). Table 12 lists capital costs for each alternative system.

Operation and Maintenance (O&M)

Each project alternative represents a series of annual costs for operation and maintenance (O&M) of the facility. These costs are broken down into fixed annual charges and increasing variable charges related to increased flow. Since O&M costs increase over time and since they change after the second phase of construction, the facilities planner has chosen specific O&M costs in 1987 and 1977 as mathematically representative of annual costs in each phase. These annual costs range from a low of $426,000 (Alternative C) to a high of $1,785,000 (Alternative G) in the first phase of operation. They range from a low of $504,000 (Alternative C) to a high of $2,594,000 (Alternative G) in the second phase of operation and are presented in Table 12.

Cost Comparison of Alternatives

The present worth of all capital costs, annual operation and maintenance (O&M) costs less salvage values discounted at 6-3/8 percent annually, will range from a low of $8,896,000 (Alternative F) to a high of $44,685,000 (Alternative G). Present worth of each alternative is presented in Table 12.

Table 12. TOTAL PROJECT COSTS — ALL ALTERNATIVES
(In Thousands of Dollars)

	Alternatives						
	A	B	C	D	E	F	G
Capital Cost[a]							
1978-1980	9,247	8,341	7,244	9,515	6,524	4,033	32,263
1988-1989	642	1,931	588	2,029	402	648	2,612
Total	9,889	10,272	7,832	11,544	6,926	4,681	34,875
Annual O&M[b]							
1980-1990	487	670	426	633	524	573	1,785
1990-2000	565	786	504	766	604	669	2,594
Present worth of all costs[c]	12,764	14,652	10,712	15,646	10,889	9,336	48,738
Salvage value of facilities and land[d]	853	853	579	940	534	350	4,053
Net present worth[e]	11,911	13,799	10,133	14,706	10,355	8,986	44,685
Ranking (net present worth)	4	5	2	6	3	1	7

[a] From facilities planner.

[b] Operating and maintenance costs are calculated on the basis of certain fixed charges per year plus variable costs which reflect increased flow capacity. This method does not create a linear yearly increase. Therefore, O&M costs for the years 1987 and 1997 were picked as representative of average costs.

[c] Present worth (in January, 1977 dollars) is calculated at 6 3/8 percent for 30 years. The useful life of various components of the facilities will vary; 30 years is an average.

[d] From facilities planner.

[e] Present worth of all costs less salvage value of facilities and land.

A second method of comparing costs of alternatives is to use the average annual cost *i.e.*, the average of the annual costs of amortization of the capital costs (capital recovery) plus the annual O & M costs. These costs (assuming that 75 percent of the capital costs will be paid by a federal grant) are presented in Table 13.

The following tabulation shows the ranking of each alternative in terms of net present worth and average annual cost to the City of Boulder.

	Ranking	
Alternative	Net present worth	Average annual equivalent cost to Boulder
*C	2 ⎤	1
*F	1 ⎥	3 ⎤
*E	3 ⎦	2 ⎥
A	4	4 ⎦
B	5 ⎤	5 ⎤
D	6 ⎦	6 ⎦
G	7	7

The costs of the alternatives connected by brackets in the above tabulations are within ten percent of each other. Considering the approximate nature of the cost estimates there is no reason to differentiate between the costs of these alternatives. Alternatives marked with an asterisk will not meet effluent requirements as discussed in a previous section.

INTERACTION WITH OTHER PLANS

Regional Plans

The study area falls within the boundaries of DRCOG. This agency has completed a Section 208 basinwide water quality management plan which was released for review in May 1977 (Reference 70). The objectives of the Boulder facilities plan should meet the majority of the regional 208 goals for Boulder Creek. These 208 goals are:

1. closure of the East Pearl Street wastewater treatment plant;
2. secondary treatment with trickling filters;
3. maximum effluent concentrations of 5 mg/l BOD_5, 1 mg/l nitrate-nitrogen and 8 mg/l phosphate;
4. nitrification of ammonia-nitrogen to below 1 mg/l to prevent fish toxicity;

Table 13. CITY OF BOULDER PROJECT COSTS — ALL ALTERNATIVES
(In Thousands of Dollars)

	Alternative						
	A	B	C	D	E	F	G
Capital Cost[1]							
1978-1979	2,312	2,085	1,811	2,379	1,631	1,008	8,065
1988-1989	161	483	147	507	101	162	653
Total	2,473	2,568	1,958	2,886	1,732	1,170	8,718
Annual Capital Recovery Cost[2]							
1980-1990	175	158	137	180	123	76	610
1990-2000	187	194	148	218	131	88	659
Annual O&M[3]							
1980-1990	487	670	426	633	524	573	1,785
1990-2000	565	786	504	776	604	669	2,594
Average Annual Equivalent Cost	707	904	608	904	691	703	2,824
Ranking (Average Annual Equivalent Cost)	4	5	1	5	2	3	7

[1]Assumes federal participation of 75 percent.

[2]Annual payment required to recover Boulder's share of the capital costs at 6 3/8 percent for 30 years.

[3]From Table 12.

[4]Represents average of O&M charges plus average of annual capital recovery costs.

5. disinfection by chlorination;
6. effluent aeration to ensure adequate dissolved oxygen levels in the creek;
7. anaerobic sludge digestion, with ultimate disposal in a regional land disposal site;
8. design flows for 18 mgd for the year 2010, assuming complete elimination of infiltration;
9. establishment of Boulder Creek as a primary contact recreation and warm-water fishery from the 75th Street treatment plant east to its confluence with St. Vrain Creek;
10. estimated costs (present worth 1977 dollars) of approximately $24.2 million for facilities, interceptors and collection systems through the year 2000.

The new 208 basinwide water quality management plan recommends more stringent water quality criteria than the facilities plan to meet the 1983 national goal of achieving "fishable and swimmable" waters. These goals are more stringent than the federal, state and local standards in regards to BOD_5, ammonia-nitrogen, nitrates and phosphates.

Based on estimates made in Table 11, only Alternatives A and G could meet a BOD_5 standard of 5 mg/l. For ammonia-nitrogen, all systems except C, E and F could achieve sufficient nitrification of the ammonia to meet the recommended ammonia level of 1 mg/l.

No federal, state or local standards have been set for phosphates and nitrates in the Boulder treatment plant effluent. The 208 basin plan is the first to recommend limits for these nutrients. In general, all systems were judged capable of meeting the 8 mg/l phosphate level. Nitrates, however, represent the most difficult problem. In order to reduce ammonia, all of the systems depend upon a process whereby ammonia is converted to nitrates (nitrification). Thus effective ammonia reduction necessarily implies an increase in nitrates. With the present technology, removal of this nutrient is most effectively achieved by algal activity in lagoons, or by a denitrification process. The polishing ponds under Alternative C incorporate algal growth, however the ponds are inefficient for ammonia conversion to nitrates. The algal blooms will also increase the BOD_5 and suspended solids levels. The efficiency of the proposed submerged rock filter systems for suspended solids removal varies with operating conditions and may not meet discharge requirements all the time.

Alternative systems A and G would probably not be able to meet the recommended nitrate level and would probably have excess nitrates in the percolates and surface run-off. Infiltration/percolation under Alternative A will have no effect upon nitrate removal. High-rate irrigation under Alternative G incorporates irrigation to the greatest level that the vegetation can tolerate. Nutrients in the wastewater would exceed the amount required for plant growth and pass into the groundwater table or to surface run-off. High-rate effluent irrigation practices in California have demonstrated excess accumulation of nitrates in the groundwater (Reference 68). Alternatives B, D, E and F are also judged ineffective at removing nitrates, unless supplemented with a denitrification process.

The 208 management plan estimates the costs for Boulder to improve their facilities and interceptors at approximately $24.2 million (present worth). This amount greatly exceeds the projected present worth of all alternatives except G. Net present worth of Alternative G from Table 12 is $48.7 million. The additional estimated costs would cover the addition of nitrate-removal facilities (denitrification) to the existing Boulder system. Addition of a denitrification unit to the above alternatives was not considered by the facilities planner. Denitrification units are new, relatively untested and costly to construct and operate. They could not be installed with a high assurance of successful performance. System performance is generally not as reliable as a lagoon system. Effective nitrate removal would thus be best achieved by the addition of a lagoon system. In this respect, Alternative C, which incorporates this system would be more cost-effective and efficient.

County Goals

Boulder County has expressed no water quality objectives as of this writing. The County does control the landfill sites which may be used for ultimate sludge disposal. Possible land disposal or reuse of wastewater sludge would be reviewed through the Special Use Review process of the County Planning Board.

Implementation of Alternatives A and G requires the use of land within the County's jurisdiction; a Special Use Permit must therefore be obtained from the County. In addition, Alternative C proposes reclamation of gravel pits which are currently scheduled to be mined by the County. This alternative would commit the County to a land reclamation arrangement which differs from that planned under the Walden Ponds reclamation plan. These various land uses would be reviewed by the County Planning Board and ultimately by the Board of Commissioners.

Local Water Quality Goals and Objectives

The Boulder Valley Comprehensive Plan has designated the Boulder Creek corridor as a permanent open space and a connecting link within the Greenbelt System. The community has a great deal of interest in establishing and maintaining open areas and in preventing urban sprawl in the Boulder area. Improvement of the water quality of Boulder

Creek is essential for the establishment and maintenance of the creek as a recreational resource. The Boulder City council articulated this desire in a resolution passed on 17 June 1975 which commits the City "... to upgrade and improve the quality of the stream of Boulder Creek ... [to an] A1 or A2 classification down to the 75th Street plant, and ... it would be our hope and intention to do whatever we can to make it a sport fishery" (Reference 1).

The Citizens Advisory Committee and the City of Boulder staff, after studying the various guidelines and their financial implications, approved the general guidelines listed below.

(1) Provide treatment capacity sufficient to handle flows expected in 1985, with consideration given to the expected flows of the next decade;
(2) Provide an acceptable method for the treatment and disposal of septic tank pumpings (septage);
(3) Include odor control as a top priority in the evaluation of any alternative;
(4) Consider nitrification to allow a game fishery, but not such as to preclude further treatment to a higher quality;
(5) Provide an acceptable method of sludge stabilization and reuse of this valuable resource.

SCREENING OF ALTERNATIVES

Based on the estimated treatment effectiveness shown in Table 11 and the engineering evaluation of alternatives, three of the seven proposed alternatives would not be able to meet state and local water quality goals. These alternative systems are: E--multimedia filtration; F--chemical coagulation; and H--no project. Alternatives E and F were designed to meet the former B2 standards, and Alternative H could not meet the upgraded stream standards. Modification of Alternatives E and F to bring treatment quality up to the A2 water quality standards would have produced systems essentially the same as other alternatives proposed. Therefore, in following sections of this EIS, only those alternatives which can meet standards for the upgraded A2 stream classification for the central segment of Boulder Creek will be considered. This narrowed range will include five alternatives: A--infiltration/percolation; B--oxygen activated sludge after trickling filters; C--aeration and polishing ponds; D--oxygen activated sludge before trickling filters; and G--high-rate irrigation.

SECTION IV

SECTION IV

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The environmental impacts of the proposed alternatives are presented in this section. In Section III, eight alternatives were presented: A--infiltration/percolation basins; B--oxygen activated sludge after trickling filters; C--aeration and polishing ponds; D--oxygen activated sludge before trickling filters; E--multimedia filtration; F--chemical coagulation; G--high-rate irrigation; and H--no action. These alternatives were evaluated specifically for their anticipated effluent quality and ability to meet the new, upgraded A2 stream classification for Boulder Creek below the 75th Street treatment plant.

In the engineering analysis part of Section III, Alternatives E, F and H were judged as being unable to achieve the desired A2 water quality standards. Therefore, in this environmental impact section only those five alternatives which have a potential to meet the desired standards are considered: A--infiltration/percolation; B--oxygen activated sludge after trickling filters; C--aerated and polishing ponds; D--oxygen activated sludge before trickling filters; and G--high-rate irrigation.

These alternative courses of action will have both beneficial and adverse impacts upon the natural environmental as well as on institutions, economic factors and energy-utilization rates. These impacts were assessed on the basis of available scientific knowledge, professional experience of the environmental team, consultation with local experts in specific fields and familiarity with local conditions gained by the project team during field investigations.

The Environmental Protection Agency guidelines for the preparation of Environmental Impact Statements [40 CFS, Part 6, § 6.304 (c)] require the evaluation of primary and secondary environmental impacts for all alternatives. This section will discuss short- and long-term direct (primary) impacts and long-term indirect (secondary) impacts.

SHORT-TERM IMPACTS

The direct short-term impacts and feasible mitigation measures, shown in Table 14, are generally related to construction activities. Supporting discussions for some individual impacts can be found in Appendix E.

Table 14. SHORT-TERM IMPACTS AND MITIGATION MEASURES

Impacts	Alternative A	B	C	D	G	Comments
1) Soil erosion from construction disturbed sites	◑	◑	◑	◑	●	Greatest potential at sites requiring lagoons and earthen berms
2) Disturbance of soil profile at site or modifications reducing agricultural productivity	◑	⦶	◑	⦶	●	Greatest disturbance occurs at construction of lagoon sites, particularly Alternative G
3) Dust generation from exposed ground surfaces	◑	⦶	◑	⦶	●	Greatest potential during windy periods
4) Increased aerial pollutants (hydrocarbon emissions)	⦶	⦶	⦶	⦶	⦶	By-product of equipment operation
5) Degradation of surface water quality from erosion and runoff	◑	⦶	◑	⦶	●	Closely tied in with amount of soil disturbed and erosion potential
6) Depression of groundwater table and effects upon groundwater quality	◑	⦶	◑	⦶	◑	Strong impact with systems requiring excavation of deep lagoon(s) or trenches and subsequent dewatering or construction of barrier against groundwater movement
7) Loss of groundcover and disruption of wildlife habitats	◑	⦶	◑	⦶	◑	Alternatives A, C and G may require removal of some cottonwood trees
8) Disruption of wildlife patterns within sites and adjacent sensitive ecological areas	◑	⦶	◑	⦶	⦶	Alternative A will disrupt Walden Ponds and Sawhill Ponds. Alternative C will temporarily disrupt White Rocks area
9) Increased noise from equipment and ground vibrations	◑	⦶	◑	⦶	◑	Unavoidable effects associated with construction and earth-moving
10) Visual impact of construction equipment and construction site	⦶	⦶	⦶	⦶	⦶	Temporary but unavoidable

Table 14. SHORT TERM IMPACTS AND MITIGATION MEASURES *(Continued)*

Mitigations	Effectiveness
• Schedule construction to dry season • Confine surface disturbances to immediate construction areas • After construction, exposed soil areas should be reseeded with native grasses	Very effective for all alternatives if follow-up reseeding is conducted to eliminate bare spots
• Stockpile topsoil from site for reuse	Unavoidable impact for lagoon site, Alternative G
• Keep soil wetted down in construction area	Very effective
• All vehicles and equipment should be fitted with pollution control devices that are properly maintained	Moderate effectiveness, unavoidable short-term impact
• Interceptor ditches around construction site to catch runoff • Settling basins to catch runoff waters prior to discharge to creek • Care should be taken not to discharge petroleum or other pollutants to stream	Effective in minimizing impact if strictly enforced
• Limit areas for barrier construction and dewatering • Construct downstream recharge areas • Supplemental surface irrigation	Unavoidable adverse effect difficult to control
• Replanting with native vegetation where possible • Mature cottonwood trees should be flagged or fenced to minimize construction damage	Can be effective in speeding up recovery
• Vegetation removal should occur during late summer or fall when nesting birds are not present	Difficult to control, should consult local wildlife experts for assistance
• All equipment should have mufflers properly installed and maintained • Limit activities to daylight hours	Minor unavoidable impact
• Equipment should be stored in designated areas, all litter picked up • Fence or otherwise screen construction maintenance area	Moderately effective, minor unavoidable impact

Key to Impacts:

Beneficial impact

Moderate adverse impact

No change or minor adverse impact

Significant adverse impact

Table 14. SHORT TERM IMPACTS AND MITIGATION MEASURES *(Continued)*

Impact	Alternative A	B	C	D	G	Comments
11) Spoil disposal from excavation	⦶	⦶	⦶	⦶	◐	Includes lagoon and pipeline excavation
12) Stockpiling and storage of spoil	⦶	⦶	⦶	⦶	⦶	Increases erosion potential
13) Safety hazard	⦶	⦶	⦶	⦶	⦶	Open trenches, lagoon excavation and movement of heavy equipment
14) Construction-related traffic	⦶	⦶	⦶	⦶	◐	Truck movements associated with delivery of equipment and materials along with transport of spoil material. This will be particularly noticeable in Alternative G
15) Disruption of through and local traffic	⦶	⦶	⦶	⦶	⦶	Strongest impact during daylight hours, particularly during commute times
16) Utility service disruption	⦶	⦶	⦶	⦶	⦶	Temporary effect causing local inconvenience
17) Public fiscal effects sales tax revenue	⦶	⦶	⦶	⦶	⦶	No benefit to either City or County of Boulder (see Appendix E)
18) Project employment	○	○	○	○	○	Estimated 70 to 100 additional jobs (see Appendix E)
19) Business effects-direct (spending in Boulder County)	○	○	○	○	○	Local portion of total construction purchases between $2-14 million (see Appendix E)
20) Business effects-indirect (Employment creased by project spending)	○	○	○	○	○	Estimated 44-240 job-years of indirect employment (see Appendix E)

Table 14. SHORT TERM IMPACTS AND MITIGATION MEASURES *(Continued)*

Mitigations	Effectiveness
• Disposal of soil material should be coordinated with other ongoing projects requiring fill	No problems in Alternatives A and C which require berm construction
• Spoil material not needed for backfilling should be spread on ground and seeded or covered to prevent dust and erosion	Moderately effective
• All open trenches should be covered or fenced at end of work day • All construction equipment should be secured against unauthorized use • Construction area should be well marked and access restricted where possible	Effective in protecting all persons except tresspassers
• Scheduling to avoid peak traffic periods in area	Strongest effect on 75th Street between Jay and Valmont Roads
• Barricades and flagmen posted as necessary to guide traffic through construction zones • Notify local residents as to location, nature and duration of construction	Poor-to-moderate effectiveness in preventing traffic congestion and delays
• Advance notice of utility service disruption should be given • If disruption occurs over a long period, utility bypasses should be provided	Effective in minimizing impacts
• No mitigation measures are applicable	
• No mitigation measures are necessary	
• No mitigation measures are necessary	
• No mitigation measures are necessary	

Key to Impacts:

○ Beneficial impact

◑ Moderate adverse impact

⦶ No change or minor adverse impact

● Significant adverse impact

LONG-TERM DIRECT IMPACTS

Physical Environment

Potential Impacts Upon Soils--

Impacts on soil characteristics are closely related to the method of operation. In general, the application of secondary-treated effluent to land can provide additional nutrients such as nitrates and phosphates and can be beneficial to soil productivity. Areas of concern with this method are possible accumulation of heavy metals and salts from the effluent and variable system performance depending on loading rates.

Alternative A-- 225 acres would be committed for infiltration/percolation basins under this alternative. Soils at this site are predominately sand and aggregate overlain by a layer of topsoil. These soils are satisfactory for this method of treatment. The permeable soils would allow rapid water percolation while filtering the organic material and other constituents. Effluent application rates of 150-200 ft/yr are high enough to avoid toxic build-up of salts. However, loading of this magnitude are too high to benefit soil productivity and excess nitrates would leach through the soil column. Over the long-term, heavy metals would gradually accumulate in the soil root zone.

Deterioration of soil characteristics can result from system overloading, poor management or both. Excessive concentrations of suspended solids in effluent and organic matter loaded into the basins can lead to clogging of the soil surface through several complex mechanisms. Surface pore space can be reduced by deposition of suspended solids and bacterial growth and slimes which lead to additional severe clogging problems.

The effectiveness of the infiltration/percolation basins treatment method depends upon the permeability and filtering qualities of the predominantly aggregate soil near Boulder Creek. Utilization of this soil as a filtering medium precludes gravel mining in that area during the lifetime of the facilities operation. However, this facility should not impair the potential for gravel extraction at a future date if the ponds operations are discontinued. Gravel resources are not limited to this site, being fairly common along the Boulder Creek floodplain and other watercourses. Within Boulder County, this site would represent only a small percentage of the gravel resource.

Alternative G-- A high-rate irrigation system would be operated to maximize effluent application without causing damage to plants. Crop growth and harvesting would allow assimilation of much of the organic material and nutrients. However, the effluent application rate of 10 ft/yr provides more nutrients than can be assimilated by plant tissues. As in Alternative A, salt build-up should not be a problem although there would be a potential long-term accumulation of heavy metals. Nitrate effects are discussed under groundwater impacts.

Alternatives B, C, and D-- These alternatives require no significant commitments of soil or mineral resources. With all these systems but C, sewage treatment processes would be contained within the existing plant site. With Alternative C, Boulder County would extract gravel from the prospective site before construction of the ponds which make up this system. These ponds would be formed in the excavations remaining after the gravel extraction.

Mitigation Measures for Soils Impacts--

The infiltration/percolation basins under Alternative A and the storage lagoon under alternative G would remove 225 and 350 acres, respectively, from pasture and crop production. The pond site for Alternative A is not prime agricultural land and is suitable only for pasturelands. No mitigation measures would compensate for this loss. Similarly, the loss of agricultural productivity due to soil removed from the storage pond cannot be effectively mitigated.

Maintenance of Infiltration/Percolation Basins-- Problems of soil clogging leading to anaerobic conditions and subsequent additional clogging can be reduced or prevented by periodic drying of the basins. As the soil dries out between application cycles, the pore spaces reopen and aerobic soil conditions are reestablished. Attention to this important relationship can ensure effective operations of the basins and also reduce the potential for odor problems.

Potential Impacts Upon Groundwater--

The groundwater resources in the project area occur typically 0 to 5 ft below the ground surface and extend approximately 15 ft deep. This shallow aquifer is underlain by impermeable bedrock, generally 15 feet below the surface. The groundwater in the vicinity of the project site flows toward Boulder Creek and at some locations runs parallel to the creek. The main effects of the proposed alternatives can be divided into the direct and indirect effects.

Alternatives A and G could directly impair groundwater quality. Wastewater from the lagoons and application sites of Alternatives A and G could percolate to the groundwater. The indirect effect of improved wastewater treatment upon groundwater occurs in the zone where the groundwater interacts with Boulder Creek. The creek has been described as a losing reach (where stream water flows into adjacent groundwaters) near the 75th Street treatment plant outfall and as a gaining reach (where groundwater replenishes streamflow) near the White Rocks area. Treated effluent from Alternatives B or D would be discharged to the creek above 75th Street. Alternative A would discharge at or below 75th Street. The improved stream water quality would indirectly benefit the groundwater where it is fed by stream flows along the losing reach of Boulder Creek. Alternatives A and C, which provide the highest quality effluent, would be slightly more beneficial to groundwater quality than the other "mechanical" systems.

Alternative A-- Under Alternative A, the percolation ponds would be for the most part isolated from the groundwater system by subsurface drains. The drains would be designed to lower the water table to a depth of five feet below the existing land surface of the site to speed percolation from the ponds and prevent lateral movement of effluent into areas east of the site. As the site extends across the width of the alluvial aquifer, the drains will eliminate the majority of the underflow and recharge to areas immediately east of the site. In effect, the drains will split the aquifer. The effectiveness of the drain system in drawing out the percolated effluent depends upon the degree of soil saturation. If the ponds are full and additional loading is caused by heavy rainfall, the soil will be saturated from the surface to well below the drains. Under this condition, the hydraulic capacity of the underdrains may be exceeded and wastewater percolate may bypass the drains entering the groundwater table. Groundwater contamination may also occur during an extremely dry year. Water table drawn down below the level of the underdrains could reduce the hydraulic effectiveness of the drains. Wastewater may be drawn down to the water table past the underdrains in this situation.

Groundwater level drawdown during normal pond operations will occur in detectable amounts east of the site to a distance of 200 to 300 feet. Drawdown under the adjoining property east of the site will be accelerated by the elimination of underflow and upgradient recharge. The depth to water under the adjacent property will be lowered to as much as five feet and will average approximately three feet below the land surface. The principal factors controlling water levels under the property would be the quantity of recharge the aquifer receives from precipitation, the amount of irrigation on the property and the terraces to the south and the water level of Boulder Creek and Green Ditch.

Increasing the depth to water east of the site will reduce the subsurface irrigation of pasturelands overlying that area. At the present time, the pasture receives approximately 50 percent of its water demand through subirrigation. Reduced water levels will eliminate shallow-rooted grasses in the pasture or severely restrict their growth. Longer rooted species will survive but will exhibit reduced growth.

Alternative C-- Under Alternative C, the aeration and polishing ponds would not be lined. Groundwater movement would be controlled by a groundwater cutoff drain surrounding the site, and the facilities planner anticipates that the ponds would be self-sealing within a short time after initiation of operations. Pond operation should not have significant effects on the water table although groundwater movement could affect the ponds operation if it seeps past the cutoff drain and overloads the system.

Alternative G-- Under Alternative G, soil saturation in the upper soil zone would occur immediately after high-rate irrigation. As discussed under Alternative A, percolate may escape the drain system and pass into the groundwater under saturated conditions. The pollutant of greatest concern would be nitrates. High-rate irrigation generally supplies more nutrients than can be immediately utilized by the irrigated vegetation. Excess nitrates, in particular, would pass easily down through the soil matrix. If nitrate levels in the groundwater exceed 45 mg/l, then domestic use (drinking and culinary) of this water source should be prohibited.

Alternatives B & D-- Alternatives B and D, in their operation phase, should have no effects upon groundwater.

Mitigation Measures to Reduce Groundwater Impacts--

Supplementary Water Supply-- In areas adjacent to land application sites where the groundwater is used for domestic and livestock purposes, arrangements could be made with the local water utility (City of Boulder) to supply potable water. This would involve the installation of a city water supply system to residences. For livestock, a determination of well water quality would be made and, if necessary, water supply could be augmented by transport of water from trucks. Pasturelands may also require additional surface irrigation.

Underdrain System Design-- Collection of percolates under the infiltration basins (Alternative A) could be impaired if the soil were saturated and the hydraulic capacity of the underdrains exceeded. This effect could be greatly reduced by oversizing the underdrain system so that excess system loadings, to a certain level, could be handled.

Supplementary Recharge System-- Groundwater drawdown would occur in a shadow zone 200 to 300 ft east of the infiltration basins site. This impact could be mitigated by the addition of a recharge system placed along the eastern side of the site. The recharge facility should be designed to duplicate existing underflow across the eastern boundary of the site. The facility would be required to recharge 50 to 100 gpm. The recharge mechanism could consist of a trench, a line of injection wells or a series of recharge basins. The source of water for the facility would need to be of high quality and contain little suspended or settleable solids. A convenient water source of high quality would be the underflow intercepted along the western side of the site. Pumping would be required to transport this water to the recharge facility. Boulder Creek would probably be unable to supply water to sufficient quality. The potential for obtaining good quality water from an underlying aquifer is limited. The Pierre Shale Formation underlying the alluvial aquifer is several thousand feet thick.

This measure would raise project costs and probably be more costly than other potential mitigation methods such as supplemental surface irrigation. As the shadow zone of groundwater drawdown east of the site would probably be small, the simple mitigation measures would be adequate. If drawdown occurs to a much greater extent during operations, then a recharge system may become more feasible.

Potential Impacts Upon Surface Waters--

Under Boulder's existing wastewater treatment system, the secondary-treated effluent contains significant levels of BOD_5, ammonia-nitrogen and dissolved nutrients. These pollutants have led to a long-term degradation of water quality and of the aquatic environment.

Improvement of Surface Water Quality-- All of the alternatives under consideration would help Boulder realize its immediate wastewater treatment goal of an effluent with 20 mg/l of BOD_5 and 20 mg/l of suspended solids. As a result, the water quality of Boulder Creek below the 75th Street treatment plant would be greatly improved.

The ultimate goal in improving stream water quality is the improvement or restoration of the aquatic environment itself. The closure of the Pearl Street treatment plant outfall in 1975 represented the first step toward the restoration of Boulder Creek. Improved water quality, and other improvements such as naturalization of channelized areas, revegetation of exposed stream banks and removal of debris, would promote the potential of a trout fishery between 55th and 75th Streets. Below the outfall of the 75th Street treatment plant, the stream environment is presently not suitable for a trout fishery; the water temperature is too warm, agricultural diversions reduce streamflow, channelization has destroyed aquatic habitat and treatment plant effluent introduces excess organic material and ammonia, which is toxic to aquatic life. With the achievement of 20 mg/l BOD_5, 20 mg/l suspended solids and less than 1 mg/l ammonia-nitrogen, a warm-water fishery could be developed below 75th Street. This improvement in stream ecology would also benefit many species of birds and mammals through increases in available food sources.

Surface Water Pollution-- Overland water flow with high-rate irrigation, under Alternative G, may contribute to surface water pollution of irrigation ditches and possibly Boulder Creek. Excess effluent can run off the application site without significant treatment in the soil column and contribute to high-nutrient levels and algae growth in irrigation ditches. Under current farming practices, high dissolved solids and nutrients, along with algal growth, occur seasonally in all of the local ditches and storage reservoirs. Accidental overflow from the ponds in Alternatives A and C also contribute pollutants to surface waters, but the frequency of occurrence would be much lower than in Alternative G. As discussed in the groundwater impacts section, nitrate pollution would be of the greatest concern with run-off from these systems.

Decreased Dissolved Oxygen Levels-- Under Alternative A, renovated wastewater - collected from the underdrain system - would be pumped directly to Boulder Creek. As noted in Section III, Table 11: the percolate would contain low dissolved oxygen (D.O.) levels (2-4 mg/l). These levels are too low to sustain normal fish and invertebrate life and under certain conditions, may cause an anaerobic state in stream bottom, leading to odor-generation and wildlife health problems. Mixing of the effluent with aerated stream water, which typically contains 7-10 mg/l dissolved oxygen (or higher under saturation conditions), will reduce stream D.O. levels 20 to 25 percent, where effluent contributes one-third of the streamflow. Dissolved oxygen levels will fluctuate diurnally and seasonally depending on many factors such as flow, temperature, BOD_5, and volume of algal growth. In general, it is estimated that the D.O. level would not drop below 5 mg/l, a threshold limit for many fish and invertebrate species. However, the Boulder monthly D.O. guidelines of 90 percent of saturation may not be met consistently, particularly in the winter when the stream reaeration potential is lower.

Mitigation Measures to Reduce Surface Water Impacts--

Surface Run-off Collection System-- Construction of perimeter ditches around the irrigation areas to collect surface runoff would greatly reduce the potential for surface water pollution. The run-off would be channeled to a settling basin or lagoon for reuse or treatment prior to discharge. Under the June 1978 Colorado Dept. of Health Guidelines, as presented in Appendix F, a surface water collection and monitoring system would be required in order to obtain a permit for any land-application system.

Ponds System Design-- The ponds system under Alternatives A and C should be designed with adequate capacity to handle rainfall. System' loadings and operations should also be designed to minimize overflow and include emergency outlets and check devices.

Effluent Discharge and Mixing System-- Effluent with low D.O. levels under Alternative A should be reaerated prior to discharge to Boulder Creek. This would require an active mixing system with aerators, jets or other devices to oxygenate the effluent to a level that will not deplete the total stream D.O. level below 90 percent of saturation or some limit to be determined by the permit agencies.

Potential Impacts Upon Air Quality--

Local Climate-- Under Alternatives B and D, no change in climate is anticipated from project operation. The facilities are self-contained and do not entail a large, exposed air-water or air-heat interface.

For Alternative G, and to a lesser extent Alternatives A and C, the microclimate above the site would fluctuate continuously. Air moving over the irrigated lands or ponds would increase slightly in moisture content and decrease slightly in temperature along the downwind edge of the sites during the summer. In winter, the temperature downwind of the sites could be moderated by localized moisture differences. These microclimate effects are generally on a very limited scale and would probably not be noticeable beyond the site boundaries.

Particulate Matter-- Under Alternative A, the infiltration basins would be subject to alternate wet and dry periods. Between loadings, the soil would be allowed to dry out and reaerate to a depth of several feet. During windy periods -- especially "Chinook" episodes -- surface soils or particulates may be blown away from the basins site. This effect would decrease as vegetation develops within the basins. Once the vegetation becomes established, the roots will bind the basin surface and prevent significant transport of soil particulates.

Fog Formation-- Alternatives A, C and G are also expected to cause local fog formation when the warmer effluent is exposed to relatively cooler air. Based on calculations by McVehil (Reference 78), typical conditions in Boulder where steam fog may occur in some quantity are:

Water Temperature	Air Temperature
59°F	21°F
50	16
41	3

Steaming over open water in the pond areas proposed under Alternatives A, C and G could occur fairly frequently in Boulder's winter weather. Some steam might be observed over the ponds up to 25 percent of the time between November and March. Moderate or dense fog may occur 5 to 8 percent of the time during the winter.

The fog or steam from the ponds would normally rise and evaporate into the air or drift downwind and disappear within a short distance. Under Alternative A, the potential exists for a ground level fog of sufficient density to interfere with road visibility on 75th Street when the prevailing winds are from the northeast and from the southwest and west across open fields. The distance to 75th Street is approximately 2500 ft and much of the fog would have dissipated over that distance.

The greatest potential for fog would result from the operation of the 250-acre storage reservoir required for Alternative G. Traffic on the roadways surrounding the site may be impaired by enveloping fog. Because Alternative G involves effluent application during all of the winter months, drifting fog generated from the ponds may also affect surrounding areas. Local residents may find this condition bothersome

Aerosols-- Dispersion of spray-irrigated effluents under Alternative G into the neighboring areas would be accentuated during windy periods, particularly during "chinooks". Transmission of aerosols (microscopic droplets) of wastewater origin may pose a health hazard as well as cause a nuisance. Aerosol travel and pathogen survival rate are dependent on several factors, such as wind, temperature and humidity.

Mitigation Measures to Reduce Air Quality Impacts--

Fog formation and microclimate effects are unavoidable impacts that cannot be effectively mitigated without relocating the ponds in Alternatives A and C.

Aerosols from spray-irrigated effluent can be reduced by controlled system operations but would be difficult to eliminate completely. Specifically, spraying should be curtailed during windy periods and directed away from habitations. Night and morning irrigation would also reduce aerosol potential. Alternately, irrigation methods such as furrow or flood irrigation could be used. Irrigation practices would be subject to the Colorado Department of Health June 1978 Guidelines for land-application systems (see Appendix F).

Biological Environment

Potential Impacts Upon Vegetation and Habitats--

Alternative A-- The creation of infiltration/percolation basins under Alternative A would result in the removal of approximately 200 acres of pastureland from production. The construction of an impermeable barrier around the basin site to depress the groundwater table by approximately two feet would have some negative impacts on the pastureland adjoining the site to the east. This area currently depends on the high groundwater table to supply water for plants. The impermeable barrier would cause a "shadow zone" on the groundwater regime of the adjacent site whereby the water table would be depressed to some extent into the pasture. Some groundwater would continue to flow around the barrier, and the depressed water table would have the hydraulic effect of drawing some groundwater into the shadow zone from surrounding areas. The productivity of the pasture would probably decline within the shadow zone because of the interruption of the water supply to the shallow-rooted grasses and forbs. Deeper-rooted grasses, legumes and forbs may become more dominant in this zone. Riparian vegetation, including several mature cottonwood trees, should not be affected. A comparison of the existing pasture species and the plant species expected to colonize the percolation basins are shown in Table 15.

Alternatives B and D-- These alternatives would require only a few acres for the actual plant additions. The main impact would be during construction. The operational phase of these alternatives represents insignificant long-term changes to the local environment.

Table 15. EXISTING AND EXPECTED PLANT SPECIES AT ALTERNATIVE SITE A

Common name	Scientific name
Existing species that will be affected by construction	
Alkali sacaton	*Sporobolus giroides*
Big bluestem	*Andropogon gerardii*
Bluegrass	*Poa* sp.
Canada wild rye	*Elymus canadensis*
Clover	*Trifolium* sp.
Inland saltgrass	*Distichis stricta*
Kochia	*Kochia iranica*
Milkweed	*Asclepias speciosa*
Orchard grass	*Dactylis glomerata*
Plantain, English	*Plantago lanceolata*
Sand dropseed	*Sporobolus cryptandrum*
Smooth brome	*Bromus inermis*
Tall wheatgrass	*Agrostis elongatum*
Thistle	*Carduus nutans*
Western wheatgrass	*Agropyron smithii*
Expected species colonizing infiltration basins	
Alfafa*	*Medicago sativa*
Angelica	*Angelica* sp.
Barnyardgrass*	*Echinochloa crusgalli var. mitis*
Bindweed*	*Convoluulus arvensis*
Bluegrass	*Poa* sp.
Bluejoint	*Calamagrostis canadensis*
Bulrush	*Scirpus* sp.
Cordgrass	*Spartina* sp.
Cottonwood*	*Populus sargentii*
Cow parsnip	*Heracleum lanatum*
Curly dock*	*Rumex crispus*
Cutgrass	*Leersia oryzoides*
Dandelion*	*Taraxacum officinale*
Downy chess*	*Bromus tectorum*
Filaree*	*Erodium cicutarium*
Green foxtail*	*Setaria viridis*
Italian ryegrass*	*Lolium multiflorum*
Kochia*	*Kochia iranica*
Mannagrass	*Glyceria* sp.
Milkweed	*Asclepias speciosa*
Perennial ryegrass*	*Lolium perenne*
Plantain, common*	*Plantago major*
Plantain, English*	*Plantago lanceolata*
Poison hemlock	*Conium maculatum*
Reed canary grass	*Phalaris arundiancea*
Reed grass	*Calamagrostis* sp.
Rush*	*Juncus* sp.
Sedge	*Carex* sp.
Sloughgrass	*Beckmannia syzigachne*
Smartweed	*Persicaria* sp.
Smooth brome*	*Bromus inermis*
Spikerush	*Eleocharis macrostachya*
Sunflower*	*Helianthus annuus*
Water hemlock	*Cicuta douglasii*
Willow	*Salix* sp.

*Plant species observed on experimental basins at treatment plant site, 1976.

Alternative C-- Under Alternative C, the main impact to vegetation on the site would have already occurred during gravel extraction prior to construction. Operation of the polishing ponds would remove 30 to 50 acres from the agricultural/pasture unit. However, the productivity in this area is marginal due to the high water table and disturbed surroundings. Under this alternative, the perimeter areas would be landscaped and planted. Particularly, the planting of cottonwood trees and other vegetation would increase the diversity of the area. Reclamation plans for this alternative, however, would not provide as diverse and rich an environment as the Walden Ponds Wildlife Habitat area presently planned for the site.

Alternative G-- Operation of Alternative G would effect the greatest change upon local vegetation. The 350-acre storage reservoir site would be lost from future crop or pasture production. An even greater effect would be the high-rate irrigation (10 ft/yr) of effluent over 2,100 acres. A marked change in plant composition would occur with the application of water and wastewater nutrients. The current upland grassland species would be replaced by a monoculture of water-loving forage crops such as fescue or coastal bermuda grass.

The possibility exists for harm to plant growth from excess hydraulic loadings or poor soil aeration, or a combination of the two, if the sprinkler system is not adequately maintained and properly operated. Heavy metals, bacteria and viruses from effluent can enter the ecosystem and food chain. This hazard is somewhat reduced by wastewater stabilization and the filtering effects of the soil. However, the nutrient resource in wastewater would promote a beneficial increase in agricultural productivity. This could be maximized by proper crop selection and control of irrigation rates to limit excess buildup of heavy metals and salts.

Mitigation Measures to Reduce Vegetation and Habitat Impacts--

Construction Practices and Reclamation Program-- Construction of treatment facilities under all alternatives, particularly those which are land intensive such as Alternatives A, C and G, will involve extensive removal of natural and introduced vegetation from construction sites. Wildlife utilizing these areas would also be disturbed from their normal patterns.

The population growth and land development which would be accommodated as a result of availability of sewerage capacity in the planning area would have an even greater destructive impact on local vegetation. Not only would removal of existing vegetation be an adverse impact, but the ensuing increased erodibility of the soils would further reduce aesthetic qualities of the utilized sites and degrade stream water quality with transported sediments and nutrients. Mitigation measures to reduce this impact or facilitate habitat restoration are listed below. The first three are fairly specific to the wastewater facility construction.

site, while the fourth measure applies to overall construction within the planning area.

1. Limit construction activities, stockpiling of materials and construction personnel to the construction site. This action would minimize adverse effects on adjacent areas.

2. Design and place structures in areas of marginal habitat or areas that are already committed to human uses. This type of planning minimizes disturbance of natural areas by using existing roadways and urbanized areas.

3. Construction practices which preserve on-site vegetation and habitats to the maximum extent possible should be employed. The integration of existing natural vegetation into the project area would preserve some wildlife habitat as well as facilitate recovery after construction. Retention of trees and groundcover, where possible, would also help stabilize the soil structure. Channel work, where necessary, should not be based on "high" velocity flows, but in general upon design velocities similar to the natural stream characteristics.

4. A reclamation program for construction sites should be required. As soon as it is feasible after completion of construction, the exposed terrain could be regraded to a natural or semi-natural land form and revegetated. Restoration of groundcover, particularly native species would facilitate return of some wildlife species. Due to the initial construction disturbance, sensitive species may migrate permanently to other areas. Thus, the level of success for this mitigation action is dependent on the return and colonization of species tolerant to an altered human environment.

Moisture Tolerant Species Selection-- High-rate irrigation upon croplands in Alternative G would lead to the selection of moisture tolerant herbaceous plants. The shift from crop and pasture species to predominantly water-tolerant grasses also implies a shift in the associated invertebrate and wildlife species. This effect would be reduced slightly during winter when no irrigation would occur but is, nevertheless, unavoidable.

A similar situation exists under Alternative A where operation of the infiltration/percolation ponds would tend to select plant species that would be tolerant of intermittent wet and dry cycles. Some species may exhibit rapid growth rates, producing a large biomass and subsequent die-off and impairing system operation. Mitigation of this effect would include careful selection of vegetation species and, in the event of heavy biomass accumulation, the basins should be periodically cut or scraped.

Potential Impacts Upon Wildlife Patters--

Alternative A would alter present low-lying pasture areas into moist meadow and wetland areas with moderate to tall vegetation. During the wet stages, shorebirds such as killdeer and sandpipers would be attracted to the perimeter areas. Waterfowl would utilize the wetlands for resting and supplemental feeding areas although the changing water levels would not be suitable for protection during nest-building. Amphibians such as leopard frogs and chorus frogs may also utilize the ponds although breeding would not be possible. During the semi-dry and dry stages, raccoons and muskrats would be occasional visitants. Cottontail rabbits and meadow voles would temporarily be found in these areas as they have been observed frequenting dry irrigation ditches. For all of the species mentioned, during both the wet and the dry stage, nesting and breeding would be highly unlikely in the percolation pond areas due to variable water levels. Small mammals in particular would not tolerate well the 8- to 12-day fluctuating cycles within the 13 compartmentalized pond-meadow environments. The necessity for frequent migration between basins would probably preclude the settlement of permanent inhabitants. The compatibility of these ponds with the nearby White Rocks Natural Area (WRNA) and the on-going reclamation project by Flatiron Sand and Gravel Company adjacent to the site is difficult to ascertain. The constantly fluctuating percolation basins would contrast sharply with the proposed riparian and meadow environment planned for the gravel mining area. The WRNA ecology would also depend upon the type of vegetation growing in the basins and the type of maintenance, such as mowing or harvesting. Annual or seasonal maintenance operations in themselves could have a strong detrimental impact on the reestablished vegetation and wildlife. At the present time, hay grown on the site is harvested twice a year. If vegetative cover is not established, the infiltration/percolation basins would provide no valuable wildlife habitat.

Operation of the polishing ponds under Alternative C should not cause significant wildlife disease problems. During the winter, when waterfowl may be confined in large numbers to shallow, poorly circulating or anaerobic pond margins, the potential for "limberneck" disease to occur among waterfowl is present. This disease is caused by toxins from the bacterium *Dostrium botulinum* and occurs when an infected bird is introduced into an area where large numbers of waterfowl are congested in unsanitary conditions. Limberneck disease is generally not a problem in large deep pond system. The polishing ponds should be designed to maintain a minimum flow through the system to reduce conditions for the production of this bacterium. Further design of the ponds to incorporate relatively steep banks, minimizing shallow waterfowl standing areas, would preclude large concentrations of waterfowl along the pond margins. Thus, the operation of the polishing ponds should not contribute a greater potential for limberneck disease than is already present in the area with other existing ponds.

Spring and summer algal blooms present another problem for wildlife usage. Heavy algal blooms and the consequent decrease in water quality as the algae decay degrades the aquatic environment significantly and reduces wildlife habitat. Extreme conditions may lead to large fish kills in ponds and depletion of food supply.

Alternatives B and D-- These alternatives would involve only small portions of land around the existing 75th Street plant. This area is presently affected by noise, vibrations, vehicular movements and visually dominant structures. Operation of these alternatives would not effect significant differences in wildlife patterns or numbers.

Alternative C-- This proposed system would create a series of pond environments attractive to waterfowl and semi-aquatic wildlife. The downstream polishing ponds would be suitable for fish stocking and would draw significant numbers of mallards, Canada geese, redheads, teals, gadwalls and pin-tail ducks. The landscaped and revegetated berm and buffer areas would provide shelter for small mammals and songbirds. Because portions of the project would be open to the public, wildlife species tolerant of human presence would be most likely to occur.

Alternative G-- This system calls for the operation of a 350-acre storage lagoon surrounded by approximately 3,000 acres of cropland. The large, moderately deep storage lagoon has the potential to experience algal blooms as in Alternative A. With the steep banks of the lagoon, waterfowl congestion and limberneck disease are not likely to occur. The commitment of a large acreage in northwestern Boulder County to high-rate irrigation ensures the preservation of the open space amenity and facilitates a large wildlife refuge. A monoculture of forage grasses would attract primarily rodents, small birds and associated predators. Operation and harvesting of the field areas, however, would deter the optimum wildlife production potential.

Mitigation Measures to Reduce Wildlife Impacts--

Alternative A will result in vegetated basins with an altered wildlife community tolerant to wet and dry cycles. Some reduction of rodent species and numbers will occur while an increase in aquatic bird species may be experienced. The reduction of some cottonwood trees will remove perching and nesting sites for birds. Mitigations for this effect are the same as those discussed under the Disturbance or Loss of Vegetation Section.

In winter, pond environments utilized heavily by waterfowl have the potential to develop limberneck disease. The potential for this disease in the polishing ponds can be greatly reduced by eliminating the causitive factors. Control measures to eliminate shallow areas where waterfowl may become congested such as steep bank areas and adequate circulation within the pond system.

Potential Impacts Upon the Aquatic Environment--

All of the proposed alternatives would improve the water quality of Boulder Creek and benefit the riparian zone to varying degrees. Discontinuation of the Pearl Street outfall in May 1975 has already resulted in a demonstrated improvement in water quality, as discussed in the section on environmental setting. Invertebrate and fish sampling conducted since May 1975 confirms the improvement in stream conditions. The appearance of largemouth bass and crappies in waters near Boulder Creek (such as the Flatirons gravel pits) also confirms the presence of warmwater fish species.

Alternatives A, C and G-- These alternatives would produce the highest quality effluents, with BOD_5 and suspended solids ranging from 5 to 10 mg/l or less. The high quality effluent would be compatible with the development of a warmwater fishery below 75th Street in Boulder Creek. However, nitrates from runoff and percolates in Alternatives A and G may continue to cause a seasonal stimulus to algal growth. Improved water quality, in itself, is not enough to restore the creek to its original state. Full restoration of Boulder Creek requires the revegetation of disturbed banks, naturalization of channelized areas, correction of agricultural pollution and restraints on water diversions in addition to the improvement of stream water quality. These actions are beyond the scope of this project but would fit in with a regional plan.

The polishing ponds in Alternative C could also provide a limited aquatic habitat. The initial pond receiving secondary treated effluent would not be suitable for fish culture. The intermediary and final polishing ponds, however, could support a warm-water fishery. Ammonia levels from Alternative C may be seasonally high enough to be toxic to aquatic life. The success of these ponds would also be dependent upon the control of algal growth and preclusion of anaerobic conditions. The large storage reservoir under Alternative G receives secondary-treated effluent as in the initial polishing pond and therefore would not be suitable for fish culture.

Alternative G would result in the selection of moisture-tolerant vegetation species as discussed above. The conversion of varied crop and pasturelands to limited types of monoculture would alter the habitat and lead to a shift in wildlife species. Although the habitat type would be altered, some agricultural techniques could be utilized to mitigate this impact to the benefit of wildlife. Residual and surplus areas, such as streambanks, road edges, fencerows, corners and woodland patches, when left uncultivated, provide important wildlife habitat (Reference 93). Unharvested strips, stubble and fallow areas would also provide an important supplement.

Alternatives B and D-- These alternatives would produce an improved quality effluent, with BOD_5 and suspended solids ranging from 10 to 15 mg/l. The suspended solids load would lead to warmer ambient temperatures in the summer and promote a warmwater fishery. The BOD_5 load would also cause a localized degradation in stream habitat downstream of the outfall during low flow periods. Nitrates from the effluents would also promote seasonal algal growth. As in Alternative A, the ability to restore a viable fishery to Boulder Creek is not solely dependent upon improved water quality but rather on a combined improvement of physical, chemical and biological stream factors. As streambanks, road edges, fencerows, corners and woodland patches, when left uncultivated, provide important wildlife habitat (Reference 93). Unharvested strips, stubble and fallow areas would also provide an important supplement.

Social and Economic Environment

Noise Impacts--

The operating equipment and treatment processes associated with all the treatment alternatives would be relatively quiet and should not significantly increase the ambient sound level. Construction activities with their attendant noise generation would last up to 18 months. Mitigations should include use of vibratory hammers instead of pile drivers, where practical, and silencers on compressors and other equipment. Construction activities would generally be scheduled during the daylight hours, although dewatering pumps and other equipment may operate for extended periods.

Odor Impacts--

As mentioned in the section on environmental setting, the existing 75th Street treatment plant causes intermittent odor problems in the vicinity of the plant site. These odors emanate mainly from the sludge processing facilities and to a lesser degree from the trickling filters. Phase I of the Boulder wastewater facilities improvement project is the addition of an anaerobic digestor and other sludge-handling facilities to control odor. This phase has received a separate negative declaration on environmental impacts (Reference 4) and should be implemented in the near future. All the proposed systems would continue to use the existing trickling filters. The odors presently associated with the treatment plant should be greatly reduced. Further control will include covering the trickling filters.

Alternatives A, C and G involve components that could cause additional odor problems. These alternatives are significant because they involve the greatest exposure of wastewater effluent to land and air. The remaining physical and chemical treatment alternatives would have a low potential for producing additional odors.

Alternative A-- Odor problems from an infiltration/percolation basin are usually associated with system overloading, poor management, or both. Excessive concentrations of suspended solids and organic matter in the wastewater loaded into the basins can lead to clogging of the soil surface through several complex mechanisms. Surface pore space is reduced by deposition of suspended solids and bacterial growth which results in the development of slimes and leads to more severe clogging and odor problems. Also, excessively long application periods can lead to the development of anaerobic conditions in the soil with the resulting odor and infiltration problems. These problems can be prevented by periodic drying of the basins which allows the clogged pore spaces to reopen and aerobic conditions to be maintained (Reference 80).

Odors should not be a significant problem in this alternative for two reasons. The quality of the influent to the basins will be relatively good (effluent from a secondary-treatment plant). Secondly, nitrification will be necessary in order to meet NPDES permit requirements. This means that application periods must be short in order to maintain oxygen levels in the soil sufficiently high for nitrification of the ammonium in the wastewater. By monitoring the ammonia level in the discharge and the percolation rates in the basins, the treatment plant operators should be able to anticipate any problems in the basins and take corrective action before any odor problems develop.

Another potential source of odor may be derived from vegetation growing within the basin. Some plant species with a fibrous or matted root system could reduce the soil percolation rate. Other plants have a rapid life cycle and produce a large biomass within a short period of time. Their subsequent decay, if they are not removed, could also affect percolation rates and produce odor. Clearly, the type of vegetation growing in the infiltration basins would play an important role in this alternative and should be studied carefully.

Alternative C-- The polishing ponds required for Alternative C may produce odors during two periods. During the winter, pond water may become stratified and an anaerobic layer form on the pond bottom. As the ponds thaw out in the spring, the turnover of the bottom layer could bring odorous elements to the surface. The second period for odor generation would be during the summer. The ponds would be rich in nutrients and could develop heavy algal blooms. The subsequent algal decay and deterioration of water quality may cause objectionable odors. The magnitude of this impact would be dependent on temperature and wind. Harvesting and removal of algae during peak growth period would reduce the potential for odor.

The odor dispersion potentials for Alternatives A and C would vary with the season and the time of day. In the winter, winds are from the east during the day 65 percent of the time and from the west during the night 75 percent of the time. During these periods, wind movement parallels the valley and could possibly carry odors to the southern fringe of Heatherwood when it blows from the east. During the day and night, southerly winds prevail 15 percent of the time, while northerly winds prevail 10 percent of the time. Southerly winds would have the greatest potential for carrying odor toward the Heatherwood development, but effects on Gunbarrel Green are anticipated to be limited. Residences and farms to the south of the ponded areas could be affected by northerly winds.

During the summer, wind distribution remains much the same, with a slight percentage increase in northerly and southerly winds. The most serious odor condition would occur on a summer day accompanied by a southerly wind and unstable air. The condition could occur daily, but for limited time periods. This condition, however, would affect the area of development surrounding the site. Once again, source strengths are not known, and it may be that concentrations perceivable to the human nose would occur only a few hundred feet from the downwind edge of the source. An estimate of odor movement by an air quality consultant (Reference 81) indicated a minimum 100-fold dilution of odors between the site for Alternative A and the southermost row of homes in Heatherwood.

Alternative G-- Three principal odor sources are associated with the storage lagoon required for Alternative G. First, the 350-acre impoundment would be 30 feet deep, so maintenance of aerobic conditions throughout the water column would be difficult. Consequently the anaerobic status of the lower strata of water would generate odor during fall and spring pond turnovers. Second, because the water would be nutrient-rich, odorous algal blooms would develop. The algae would cause odorous conditions not only in the vicinity of the impoundment but throughout the irrigation area as well. Because no economical way has been devised to remove algae from the irrigation water, algae would be spread on the application site. As the algae dry and decompose on the land, odors may be expected, especially during warm weather. Third, algae produced in the reservoir would die and settle to the bottom. During pond drawdown (in summer), these and other settled deposits may be exposed, possibly causing objectionable odors.

Mitigation Measures to Reduce Odor Impacts--

Even the most sophisticated wastewater treatment facilities can emit unpleasant odors if precautions are not taken. Mitigation measures that may be considered are discussed with each alternative.

Alternative A - Infiltration/Percolation Ponds-- The infiltration basins themselves should emit minimal odors under proper operation. If ponds become inoperative due to soil clogging and wastewater remains long enough to allow an algal bloom, adverse odor conditions may result. Similarly, excessive vegetation growth and die-off in the basin may produce odors. Control measures include harvesting vegetation in the basins or scraping the upper soil and vegetative layer of the site. The pond operations should be closely controlled on a cyclical schedule. Allowing the ponds to dry out and reestablish aerobic conditions will greatly minimize odor problems. Monitoring of ammonia levels to determine the extent of nitrification and bacterial growth would also allow early control of potential odor conditions.

Alternatives B and D, Activated Sludge Systems-- Some of the mitigative design features for odor control include:

1. Scrubbing air from the influent pump station wet-well by

pumping it into the aeration basin, the activated sludge process or into oxidizing baths;

2. Provision of covers over primary clarifiers, drawing air from under the cover and scrubbing, as above;

3. Provision of separate enclosures over trickling filter or activated sludge units with scrubbing or ventilation of the air space;

4. Use of deodorizing mists downwind of the wastewater treatment plant during periods of particularly bad odor formation or during malfunctions. These mists have been used in the past at the Boulder treatment plant with limited success. In some cases, the scented mists were repellant also to the public. This may be used as an emergency measure, but is no substitute for an actual solution or consideration prior to proper design.

Alternative C - Aeration/Polishing Ponds-- The ponds may become anaerobic in the lower depths during winter. Subsequent spring thaws and mixing could bring odors to the surface. The ponds would also be rich in nutrients and develop algal blooms in summer, possibly causing objectionable odors. Odors may be partially controlled by the addition of aeration units to preclude anaerobic conditions and filtering systems to remove filamentous algae where practicable. With rigorous control on algal mass in the ponds, odor problems can be greatly controlled. No mitigation measures exist to completely control or limit the dispersion of generated odors.

Alternative G - High-Rate Irrigation-- This system suffers the same odor problems as mentioned under Alternative C. In addition, algae generated from algal blooms applied with the irrigation water to crops may cause widespread odors as it dries and decomposes on the application site. Settled and decaying algae in the storage lagoon may also be exposed during pond drawdown in summer. The mitigation effects discussed under Alternative C are effective for smaller systems. However, odor conditions are much harder to control in large systems and are unavoidable.

Potential Energy Consumption Effects--

Fuels used directly to operate the proposed facilities or indirectly to generate electricity for treatment equipment must be considered a limited resource. Wastewater treatment facilities generally use both electricity and natural gas as opposed to fuel oil, gasoline or coal. About 35 percent of the electric power used in Colorado is generated by burning natural gas. Thus both directly and indirectly, wastewater treatment plants are dependent on natural gas. Supplies of this fuel in particular will not be sufficient to meet user demand in Colorado by 1980 with a shortfall of as much as 15 percent by 1985.

In the 1975 facilities plan, an estimate of energy demand by the various alternatives was made based on higher population estimates than those used in this EIS. Although the population and resultant wastewater flows were revised downward in 1977, energy use estimates were not revised. Table 16 presents these estimates based on the higher 1985 population of 116,300 and a 1995 population of 154,000. The energy requirement could be adjusted downward to account for lower population and flows; however, the ranking of the alternatives would remain the same.

The alternatives with the lowest energy demand are A and C which are estimated within 10 percent of each other. Based on relative comparisons with the projected demand at the existing facility, Alternatives A and C would require 50-60 percent more energy while Alternative B would require 138 percent more energy. Alternatives D and G would be most energy intensive requiring 4-5 times more energy than projected operations for the existing facility.

Table 16. MARGINAL ENERGY CONSUMPTION (KWH/YR x 10^3, ESTIMATED)

System Alternative	Gross Energy Consumption[a]	Ranking
Existing Treatment Plant 1965	3,663	-
A - Infiltration-Percolation Basins		
1985	5,300	
1995	6,100	(1)
B - Activated Sludge after Trickling Filters		
1985	7,000	(2)
1995	8,700	
C - Aerated/Polishing Ponds		
1985	4,300	(1)
1995	5,600	
D - Activated Sludge before Trickling Filters		
1985	15,600	(4)
1995	19,900	
G - High-rate Irrigation		
1985	9,400	(3)
1995	14,500	

[a]Total operating energy dry weather flow.

However, peak demand, rather than total consumption, is the critical factor to be considered in evaluating impact on the electric utility system. The highest demand by the 75th Street treatment plant in the past 14 months has been 438 kW. The existing facility of the Public Service Company of Colorado can fully accommodate a demand of up to 2,000 kW, or over 4-1/2 times the peak to date. According to advice from PSC, it is unforeseeable that demand under any of the proposed systems, even System D, could rise to such a level. Therefore, none of the proposed alternatives would be expected to have a significant negative impact on the electric utility system.

Mitigation Measures to Reduce Energy Consumption--

The anaerobic digestion process produces methane gas which can be used directly as a fuel or to generate electricity. Although Alternatives B and D would generate the largest amounts of methane, their total energy demand would still be high. The Alternative with the largest percentage reduction in total energy demand attainable through use of process-generated methane gas is Alternative C.

Potential electric energy generation with process-generated methane gas could contribute up to 3,000 kWh/yr in 1995, which would supplant as much as 50 percent of the energy demand of Alternatives A and C. If Alternatives B and D utilized an aerobic digestion process, no methane would be generated.

Since Colorado faces a potential shortage in natural gas supply, serious consideration should be given to replacing natural gas use with methane gas generated from the treatment facility. Natural gas use in 1995 would be projected in the order of 4-5 million cu ft/yr. This amount could be significantly reduced by using the methane gas for space heating and for process operations such as heating of the anaerobic digesters.

Local Land Use Impact--

Land use in the vicinity of the 75th Street treatment plant is characterized by single-family residences to the north, sparsely settled and agricultural uses immediately east and west, and a mixture of agricultural and mining to the south. Northeast Boulder County is predominantly agricultural with some residential and mining areas. The Boulder Valley Comprehensive Plan recommends generally that land in the vicinity of the Boulder Creek floodplain be maintained for open space uses. The 75th Street treatment plant was constructed prior to the open space recommendation. Under present criteria, it has been considered by some persons as marginally compatible with surrounding land uses. Some of the proposed alternatives would have an effect on agricultural and mining land uses, while the others generally would not affect existing land use.

Alternatives B & D-- These systems call for physical additions to the present treatment plant and are mostly within the existing site. Their presence should not affect adjacent land uses although additional structures may to a limited degree reduce the open-space usage. Potential odor problems would be negligible except in the case of a plant upset. If the condition were recurrent, then the facility would not be compatible with residential land uses north of the plant. Monitoring and control of operations could reduce this effect.

Alternative C-- The project site has been scheduled for gravel mining by Boulder County. Upon the completion of mining activities, the Boulder County Parks and Open Space Department has proposed a reclamation plan in conjunction with the Walden Ponds Wildlife Habitat Area. The proposed alternative would convert this site at the completion of gravel mining into a series of polishing ponds that may be suitable for waterfowl and warmwater fish. While these ponds would provide additional wildlife habitat to the area, they would not be as productive as the plan proposed for the Walden Ponds area. In the context of the local environs, the ponds would be compatible with agricultural and open space uses. Potential odor from the ponds, as discussed in the odor impact section, may have indirect adverse effects on residential land use to the north of the facility. Rigorous control of potential odor situations and the visual appearance of the facility would reduce this effect.

Alternative G-- The operation of a large 350-acre lagoon and extensive irrigated crop areas would generally be compatible with surrounding land uses in northeastern Boulder County. The area is predominantly under agricultural and pasture usage and would not undergo a significant land use change. If the city and county determined that purchase of the proposed irrigation lands is necessary to ensure system operation, then existing land uses should be reconsidered. The purchase and incorporation of private farms into the high-rate irrigated cropland would ensure the continuation of open-space/agricultural land uses. However, some landowners may not agree with these land use goals, while others may have alternate plans such as commercial development or gravel mining.

Impacts Upon Local Water Supply--

Operation of the proposed alternative systems would generally have a negligible impact on properties within the proposed area drawing upon the municipal water supply system. Residences and farms depending on groundwater supplies (wells) however, may be affected under Alternatives A and G.

Alternative A-- Operation of underdrains in the infiltration basins would depress the groundwater table several feet and have a tendency to draw out groundwater from a small area around the site as well. This could slightly lower the well water level on the property east of the infiltration basin and reduce the amount of pasture subirrigation as discussed in groundwater impacts. Potential contamination of the well water supply to this residence, which is also discussed in groundwater impacts, may render this well unsuitable for domestic use and require a conversion to municipal water supply.

Alternative G-- High-rate effluent irrigation and collection by drain pipes would have similar effects to those described under Alternative A. Since this alternative covers a much greater area and could affect more than one residence dependent on well water supplies, facilities planning should be more extensive. In the event that leachates cause local wells to exceed drinking water quality standards, the city may have to consider extension of municipal water supply to this area.

Impacts Upon Municipal Service Costs - Utilities--

Based on EPA guidelines, operation and maintenance costs for the wastewater facility will be financed through increased user charges. The present cost is $2.86 per household per month for sewer services. This figure is an average based on a flat $1.50 charge plus 18¢ per thousand gallons (Reference 58).

Rate increases will vary, depending on population growth and inflation rates. In current dollars, billing increases will range from $0.96 to $4.45 per household per month, depending on which alternative is selected. The plant investment fee, a one-time service fee for hookup, will also be adjusted accordingly. It currently stands at $450 per hookup. This money is for capital investment (Reference 58).

Impacts Land and Property Values--

Although it is difficult to generalize from the experience of other wastewater treatment plants, land values have not historically decreased as a result of project implementation (Reference 82). The proposed project will upgrade the existing treatment plant, rather than introduce a new plant; therefore, the impact on land values should not be significant.

The main concerns voiced by local residents focus upon potential odor problems of the alternatives. The degree to which each alternative addresses the odor abatement for these situations will largely determine the effect on land values, if any (Reference 54, 58). Under Phase I of the facilities plan, which is not covered in this EIS, sludge digestion and stabilization facilities are currently being designed to control the existing odor problems. All of the alternatives may have the potential to produce odor as discussed in the odor impacts section, with Alternatives A, C and G being of greatest concern.

If land values can be affected by odor problems, Alternatives C and G would have the greatest adverse effect. In contrast, Alternative D would have the least effect. For a more detailed analysis, see the impact section on Odor.

The overall question of land values in the immediate and surrounding areas will be affected by a recent ordinance passed by the City of Boulder intended to effectively reduce population growth in the city through limitation of residential building permits. Included in the ordinance is a recommendation that the city work directly with the county commissioners to extend this "growth-limiting" policy to the entire Boulder Valley. In a market which has recently seen low vacancy rates (Reference 57, 83), a slowdown in construction will produce higher market values throughout the valley. Project implementation should cause no significant net reduction in the value of surrounding property.

Property Tax Impacts--

Implementation of the proposed project will result in a net reduction of land from the tax rolls. For all of the alternatives which use more land than is presently available, the City of Boulder will purchase the necessary parcels from private individuals, thus making this land tax exempt (Reference 84).

The exact land areas which will be purchased cannot be determined until actual negotiations have been completed. Therefore, for the purpose of this analysis, three assumptions have been made:

(1) That entire parcels will be purchased, not portions thereof;
(2) That the improvements and personal property presently on those parcels will be removed; and
(3) That a worst case will apply to Alternative G requiring city purchase of all necessary land.

Table 17 presents the potential loss in assessed valuation (AV) and the associated reduction in tax revenue. Boulder County Assessors' Office 1976 assessments were used for the parcels involved and tax rates for 1975 were applied (References 58, 85, 86). Some parcels are not taxed by the North Colorado Water Conservation District Jurisdiction, therefore the AV reductions in that column are smaller than the figures for the other jurisdictions.

Table 17. POTENTIAL LOSSES IN ASSESSED VALUATION AND TAX REVENUES TO AFFECTED JURISDICTIONS

	Alternatives[c]				
	A	B	C	D	G[d]
Assessed valuation of facility sites in Tax Jurisdiction 0460[a]	$23,200	$12,000	$16,550	$12,000	$298,984
Revenue loss in Tax Jurisdiction 0460 ($86.40 Total Mill Levy)	2,004	1,036	1,430	1,036	25,832
Assessed valuation in North Colorado Water Conservation District (NCWCD), Tax Jurisdiction 0470[b]	9,760	-	-	-	297,544
Revenue loss to NCWCD ($1.00 District Mill Levy)	10	-	-	-	298
Total Revenue Loss	$2,014	$1,036	$1,430	$1,036	$26,130

[a]The assessed valuations for parcels not subject to taxation by this district have been subtracted.

[b]1975 Abstract of Assessment and Summary of Taxes, Boulder County, Colorado.

[c]Boulder County Assessor's Office. These figures reflect assessed valuations as of November, 1976 of actual parcels under consideration.

[d]Because the land for this alternative has not been selected, an average of $85.65/acre assessed valuation was applied to the 3,360 acres required in the Facilities Plan. The average is based on assessment figures for 3,154 acres in tracts 23 and 24 of Township 1N40 and tracts 16-21 of Township 1N69 which include the other potential sites and surrounding area.

Although the revenue figures involved are less than one-tenth of a percent of the total collected for each jurisdiction, a relative comparison of the alternatives is possible. Alternative G represents the largest potential dollar charge and Alternative A the second largest, corresponding with relative estimated capital costs. Alternative G, however, creates the third largest change in AV because it involves purchase of some land at the 75th Street site. Alternatives B and D both utilize existing city property and require land purchases for the sludge-injection site only. These two alternatives represent the smallest assessed valuation losses.

Employment Impacts--

The 75th Street plant currently employs twenty-two people. The Pearl Street facility, which will be phased out, employs one person. Below are the additional personnel requirements projected for each alternative (Reference 58).

Alternative	Additional Personnel Required
A	One person
B	Two to four people
C	No new employment. However, the city would like a county environmental employee to transfer to the facility.
D	Two to four people
G	No net new public employment. However, additional private manpower may be required by additional farming activity. The city will lease the land and not be directly involved in the agricultural reuse operation.

Net new employment would be relatively low and would probably have a negligible effect on unemployment in the Boulder area.

Impacts Upon Loans, Bonds and Subsidies--

In 1974, the Boulder City Council expressed the objective not to approve proposed capital projects requiring bonding (Reference 58). Therefore it is assumed that the city will finance its share of construction costs by other means. The Wastewater Utility Division of the City of Boulder maintains a capital fund for required future expenditures. Projected cash flow estimates as of December 2, 1976 indicate that there will be a total of $2,462,000 available from this fund to finance the city's share of the costs. This projection indicates that, by 1977, service charges will no longer be sufficient to cover operating expenses. A rate increase will be considered. Modification of the existing rate structure will be affected by the choice of alternative and the city's current ability to finance its portion from the reserve fund (Reference 58). Based on the established 75 percent federal participation, the City of Boulder is presently able to finance all alternatives except G, which will require an additional $5.6 million in capital for the first phase of construction and another $650,000 in the second phase.

The facilities plan indicates that the State of Colorado may participate in the financing of the project. Discussions with the State indicate that funds are not now available for this purpose. Consequently, State participation is not incorporated into this analysis.

Impacts Upon Public and Social Services--

In the event of a major accident at the treatment plant site--whether in the course of construction or during operation--the private ambulance service would be augmented by the Fire Department's rescue squad, the Emergency Preparedness Program, the community hospitals, and other disaster response groups.

Despite the potentially large quantities of methane to be handled, the likelihood of explosion during operation is small. This is due in part to the advanced state of container tank and gas-collection system design. Further, the gas is produced in anaerobic digester tanks where no combustion can occur. If leakage should develop in the tanks, it would result in outflow of methane rather than inflow of air, since the gas pressure would be higher than the atmospheric pressure. Additional safeguards are provided by flame traps to prevent the spread of fire within the gas collection system after it leaves the digester tanks (Reference 87).

Therefore, regardless of the alternative selected, operation of the proposed project should not have any significant impact on local health care facilities, given the present capability of the community health service systems.

Public Health Impacts--

Provisions of sewerage systems and modern methods for sewage treatment are aimed at the basic goal of public health protection. Health hazards associated with sewage treatment, although greatly reduced by processing and treatment, are always of concern. Several fungi present in sewage are capable of causing disease in humans. Pathogens involving bacteria, viruses and parasites, which are found in both sludge and effluent, can be spread through air transmission, vectors, water, or direct contact.

The major bacterial diseases are satisfactorily controlled by the secondary-treatment processes. Statements about viral health problems must be more guarded because of the difficulty in detecting viruses and the lack of standards for virus levels. In general, however, viruses are more short-lived than bacterial pathogens (References 88, 89). Intestinal parasites may also be present in various forms of sludge. Parasites and their eggs or cysts are only partially destroyed by traditional treatment processes. Other biological hazards associated with sludge are such disease-carrying vectors as flies, mosquitoes and rats.

The possibility of the contraction of disease through any of the alternative sewage treatment methods is relatively low. Incidents of disease contraction related to sewage treatment have been undocumented, even for personnel working around municipal treatment works. Chlorination of effluents, digestion of sludge and limited survival of pathogens in soil are some of the factors that reduce the threat of pathogens to humans. Nevertheless, some pathogens, even in very small numbers may survive over long periods of time. Therefore, all systems which incorporate sludge and effluent recycling should consider potential public health problems.

The potential for pathogen transmission would be greater under Alternatives A, C and G because these alternatives allow the greatest exposure of effluent to land and air. Of the three, Alternative C would present potential health problems because public use of the site would be allowed in the proposed park. Pathogens from blowing soil particulates within the basins in Alternative A would be insignificant when the basins become vegetated. However, in the history of treatment plant operations in Boulder, no personnel have ever contracted diseases of sewage origin. Alternatives B and D, which are basically enclosed systems, would present the least chance of pathogen transmission.

<u>Mitigation Measures to Reduce Public Health Hazards</u>--

Pathogen transmission through the air and through surface runoff waters and nitrate contamination of groundwaters are the main threats to public health. They can be detected through continuous monitoring of pathogen longevity and goundwater quality under the land application sites. Mitigation measures for public health hazards could include:

1. Provision of special medical services for the employees at the facility;

2. Restriction of public access to the site;

3. Maintenance of optimal digestion conditions in anaerobic digestors;

4. Provision of special medical monitoring and preventive treatment

to persons frequenting the site for taking delivery of sludge loads.

Potential pollution of groundwater could pose a public health hazard under several alternatives. The primary chemical constituent of concern is nitrate. Nitrate levels over 45 ppm (measured as nitrate) in drinking water are considered to be harmful to infants (Reference 91). As indicated in the section on water quality, groundwater contamination would require serious consideration under Alternatives A and G where wells are used for domestic water supply.

Recreation Impacts--

Without the improvement of the existing wastewater treatment facilities, effluent with excessive BOD_5 and suspended solids would continue to enter Boulder Creek. This would continue to degrade the creek near 75th Street and endanger its recreational resource value. The City of Boulder in its 1975 and 1976 recommendations has strongly sought to restore this resource.

Alternatives A through G would upgrade the water quality of Boulder Creek through discharge of a higher quality effluent. Limitation of BOD_5 and suspended solids in the effluent would be a strong step toward restoration of the warmwater fishery recreational potential below 75th Street. However, the successful restoration of fisheries to these stream segments depends not only upon improved water quality but upon an improved stream habitat as well.

In terms of commitment of land resources, Alternatives A, C and G require large parcels of land for wastewater treatment, with limited or no recreational usage. The final polishing ponds in Alternative C would be capable of supporting a warmwater fishery and may be open to the public. The buffer zone around the pond areas and along Boulder Creek may be suitable for wildlife observation. Application areas within Alternatives A and G would probably have limited public access because of the potential for exposure to secondary effluent. The maintenance of these areas as wildlife refuges would probably also preclude hunting of waterfowl and small mammals. The slight potential for development of an odor problem, as discussed in the odor impact section, under any of these alternatives would negatively affect the local recreational potential.

Alternatives B and D, require little or no land commitment beyond the existing treatment plant site.

A possible benefit from the implementation of the facilities plan is the provision of a public recreation area along Boulder Creek immediately above the 75th Street bridge. This area is relatively flat and affords a good view of the creek. Small picnic facilities, fishing and lookout areas would encourage public usage of the area. Fishing access is particularly important since Boulder Creek is surrounded typically by private lands which limit public access.

Visual and Aesthetic Impacts--

Minor visual changes would accompany most of the alternatives. Two alternatives, A and C, however, could visually influence a large area. Alternatives B and D would generally increase the infra-structure within the 75th Street treatment plant site and would not have any significant effects on the existing visual and aesthetic setting.

Alternative A-- As presented in the system layout in Figure 13 (Section III), the infiltration basins would be clustered within 225 acres on the Kolb property east of 75th Street. From 75th Street, the panorama would be characterized by a series of low 4-ft berms encasing ponds of varying small acreages. Within the ponds would be thick vegetation such as tall grass or sedge simulating to some degree a marsh or sedge meadow area. The basins would be designed to integrate the existing mature cottonwood trees. Basin operation would have a varying 8-12 day cycle where the basins would have water in them for 2-3 days. The layout of the basins and the temporal change in water levels would definitely present a conspicuous man-made feature to the landscape. Viewed from the Heatherwoods and White Rocks area to the north, the basins would also present a cluster of artifically-produced pond areas. Some persons may view the pond and tall grass system as variety to the existing landscape while others may consider it incompatible.

Alternative C-- The polishing ponds would be between Boulder Creek and the Sawhill Ponds area. In comparison to the rough gravel pits in the Sawhill Pond area, the polishing ponds would probably have a "softer" appearance with ponds contoured around existing trees and plantings. Although the polishing ponds would not have a natural wildlife setting as in the riparian zone, it would still present a park-like setting with open views and walkways. As the ponds would be behind the treatment plant, they would be removed from sight of the nearest road (75th Street). Viewed from the Gunbarrel area above Jay Road, the polishing ponds would probably be similar to the Sawhill Ponds in perspective and provide relief from the gravel mining areas.

Mitigation Measures to Reduce Visual/Aesthetic Impacts--

Alternative A - Infiltration/Percolation Ponds--

1. The shape of the basins should be contoured so as to appear more natural. Where possible, existing cottonwood trees should be retained. While this would reduce the visual impact of straight and abrupt edges, the basins would still exist as a conspicuous man-made feature because of their water surface and clustered appearance.

2. The planting of vegetation in the basins would diminish the

visual surface contrast when dry. Vegetation would not provide a significant reduction in surface contrast when the basins were filled.

3. Cottonwoods and willows could be planted around the edges of the basins to provide screening and variety.

Alternative C - Aeration/Polishing Ponds-- The ponds would be contoured to harmonize with natural features where possible. Mitigation measures would include retention of cottonwood trees where possible and plantings to accent the pond areas. Buffer zones around the pond will be allowed to grow native vegetation species that would also benefit wildlife.

Alternative G-- The storage lagoon for this alternative would represent the greatest change in the visual setting. Operation of the lagoon would have the appearance of a large irrigation pond or diversion storage reservoir. High-rate irrigation and growth of seasonal crops would not present a change in visual and aesthetics greater than irrigated farmland.

Potential Impacts in Archaeological/Historical Resources--

There is always the possibility that subsurface or buried archaeological resources may be within a project area, especially when that project area is adjacent to a stream or river where fluvial deposits can quickly obscure a resource.

Construction and operation of the infiltration/percolation basins would require the removal of some or all of the buildings on the Kolb property. These buildings may be eligible for inclusion in the National Register.

Mitigation Measures to Protect Archaeological/Historical Resources--

If any indicators of archaeological resources (artifacts, human remains, concentrations of ash, charcoal, thermally-fractured rocks, bones, etc.) are encountered during project activities, all work should be halted within a 50-yard radius of the find. A qualified archaeologist should be retained or the Office of the State Archaeologist should be contacted to ascertain the nature of the discovery and recommend mitigation measures as necessary.

Archaeological resources encountered during project-related activities should be reported to the Office of the State Archaeologist. This would put the responsibility for reporting archaeological resources on the individuals concerned with completing project activities. If this is done, the construction workers and tractor operators should be familiarized with indicators of archaeological resources. This measure may be the most desirable considering that there is a low probability of any archaeological resources within those unexamined portions of the survey area. Provision for recovery of archaeological resources or measures to protect them would be part of the EPA grant condition.

Should it be determined that the Kolb buildings need to be altered, removed, or modified in any way because of the proposed project, they should be examined by a qualified historic architect to determine if they are in any way significant because of their architecture. The Baldwin Report (Reference 45) would suggest that the structures are not significant, and the project plans as proposed would not appear to create any impacts on the buildings.

LONG-TERM INDIRECT IMPACTS

Long-term indirect impacts of the proposed action are those resulting in new growth made possible by an expanded and improved wastewater treatment facility. Modification of the treatment plant to provide advance treatment meeting the upgraded effluent and stream standards would facilitate growth up to the limit of treatment capacity.

Based upon the 1974 Robinson Decision under the Colorado Supreme Court, the City of Boulder must provide utility hook-ups to new construction developments within the county that are within the proximity of existing utility feeder lines. This implies a continued short-term impetus for secondary growth until areas within the proximity of existing utility lines are developed fully. For the remaining areas, the possibility of continued land development and population expansion, especially in the northern and eastern parts of the planning area, depends in part upon the ability of the wastewater treatment facilities to handle these additional waste flows. Hence, even though wastewater facilities may not have a direct growth-inducement potential, they are nonetheless essential for such growth. The potential future service area of such facilities therefore necessarily becomes the scene of the secondary impacts described below. In the following paragraphs, the secondary impacts of greatest significance are discussed.

Soils

The construction of residential communities and the associated parks, schools and other land uses necessarily consumes open space and, in most cases, agricultural lands. Productive agricultural lands are a dwindling resource in Boulder County as well as in Colorado. The main control on conversion of agricultural lands are city and county zoning ordinances and the development of a regional land-use plan. The Boulder Valley Comprehensive Plan, which identifies the integrity of subcommunities and the preservation of open space by greenbelts and greenways, has taken strong steps towards the conservation of agricultural soils.

Another secondary effect of the continued provision of sewer services is the improvement of local soils and water tables by the discontinuance of septic systems. As identified in the environmental setting, several areas in Boulder County experience septic systems problems. Orderly growth and provision of sewerage services to these outlying areas would remove the public health hazard and soil degradation potential of septic tanks and drain fields.

Water Quality

All alternatives will have similar potential for secondary water quality impacts. Additional residential development in the Boulder area will cause some pollution due to nonpoint sources of runoff. For example, the runoff from streets and other paved areas will contain pollutants. Erosion from graded hillside and valley areas that are not stabilized by vegetation will cause sediment to be discharged into the drainage network. Measures can be employed to reduce these effects through land use controls such as density and slope restrictions. Generally, secondary impacts upon water quality will be amenable to mitigation with proper design of the conveyance structures and treatment of runoff. It is important that regulatory controls be established, implemented and rigorously enforced so that the necessary mitigative measures are actually designed and built into the developments that are permitted. The Areawide Water Quality Management Plan (Reference 70) that has been recently completed for the Denver Metropolitan area addresses these issues and offers a plan to accomplish these needs

Biotic Communities

The construction and operation of a wastewater treatment facility with nominal capacity of 17.6 mgd would make available an important utility for future developments and subdivisions in the Boulder area. Secondary effects resulting from the proposed action would be impacts associated with development and human habitation of valley areas and the potential for future development of open space areas.

Developments, such as land subdivision, generally involve the division of large areas into small parcels, with open space and recreational sites interspersed among clustered homesites. Heatherwood, Gunbarrel Greens and the Table Mesa area are examples of this type of subdivisions are briefly described below.

1. Lands suitable for urban development are frequently areas of agricultural potential with fertile, well-developed soils. Although they may not currently be under agricultural use, these areas are effectively removed from the agricultural land base by subdivision and development. A further impact of subdivision involves the removal of open space lands from the Boulder Valley.

2. Subdivision and development can lead to changes in the visual

and aesthetic quality of the surrounding agricultural areas by the creation of buildings and structures in former open and undisturbed areas. The replacement of natural features by man-made structures causes a general decrease in visual and aesthetic quality.

3. Soil erosion resulting from vegetation removal during road construction, building site clearing and fire-control activities is a major short-term impact of subdivision. This impact is compounded in steeply sloping areas. Soil erosion may become a long-term effect in the highly erodible areas which are graded and not stabilized.

4. Loss of wildlife habitat because of the reduction of food and shelter available to wildlife as well as increased population density is a long-term secondary impact.

5. Increased population density causes an increase in the potential for accidental wildfires. In dry agricultural areas with a high fire potential, wildfires are difficult to control and can result in the destruction of human life and property as well as in the loss of vegetation and wildlife. On the other hand, increased population will result in higher priority being given to fire prevention and protection.

6. Sediments and fertilizer leachates can enter streams, particularly where housing sites and park areas are located near watercourses. Fertilizer and pesticide residues, such as nitrates and phosphates, provide a nutrient source for algae and can lead to stream pollution.

7. Several areas along the Boulder Creek floodplain are important vegetation and wildlife habitat areas. These habitats, discussed in the Sensitive Environmental Areas section, include the White Rocks Natural Area, Sawhill Ponds and Walden Ponds. Of these, the White Rocks Natural Area represents the most fragile unit due to its unique characteristics and presence of several rare and endangered plant and animal species. All of these environmentally sensitive areas are recognized in the City and d County Master Plans and specifically reserved as permanent open-space areas. However, the surrounding lands may be zoned agricultural, 'light' industrial or even residential, depending upon the area. Thus, encroaching human occupation or disturbance from human activities may have an indirect effect upon sensitive vegetation and wildlife areas.

Even if sensitive environmental areas have been degraded, the absolute effect on wildlife is not known. For example, if 20 percent of the White Rocks buffer zone is used for human purposes, it is not clear that the raptors or endangered fern species inhabiting the cliffs may be reduced by 20 percent. The effect of the habitat loss may not become apparent until a severe winter or exceptionally dry spring occurs. Even if the raptors did decrease by 20 percent, it is not known if the birds have actually died or migrated to new areas with a suitable habitat. However, it may generally be stated that as sensitive areas are consumed or de-

PROPOSED INFILTRATION/PERCOLATION PONDSITE
WITHIN PASTURE/AGRICULTURE UNIT

graded, greater pressure may result in a lowering of habitat quality in adjacent areas. This trend is often difficult to assess and its potential to occur should be recognized by the local planning agencies.

Air Quality

Air quality in the Boulder area at the present time is greatly influenced by traffic in the central area of the city. On days with stable atmospheric conditions air pollution will generate to a point that exceeds the standards in this area. Throughout the remainder of the study area, traffic is relatively freeflowing resulting in less congestion, less emissions and better air quality. Carbon monoxide (CO) levels in excess of the standards are normally unexpected. As winds pick up or frontal activity takes place, pollutant levels, even in the central city, are reduced with the standards being met through the area.

This trend is expected to continue through 1980 after which vehicle emissions will result in a sharp decline in CO concentrations. Based on information developed in the Denver area, the decline in CO levels should be well established and the standards met by 1985.

Oxidants such as ozone frequently exceed the standards in the Boulder area. However, since these data are not available at this time, a photochemical oxidant simulation model could not be used. These high ozone levels are expected to continue as long as the source pollutant (reactive hydrocarbons) are emitted into the air. As EPA emission controls reduce vehicle emissions, ozone levels will be reduced similar to CO. However, there are sufficient reactive hydrocarbons naturally emitted into the air that the ozone standards may be exceeded in the future.

Resources

The secondary effects caused by increased population growth in the area accommodated by the improved treatment facilities implicitly involve the gradual loss or deterioration of the following resources:

1. Soils eroded from construction sites;

2. Wildlife habitats altered by the presence of residences and commercial activities;

3. The aesthetic quality of the valley and mesa areas marred by structures built for residences and other activities;

4. Use of fossil fuels and other non-renewable resources in the development and maintenance of new communities; and

5. The quality of rural life in the outlying areas gradually changing toward an urban condition with its associated problems.

Socio-Economic Conditions

Growth-inducing impacts are secondary effects of a project which either (1) lead directly to growth, such as by attracting a large work force to an area, or (2) remove an obstacle to growth, such as construction of a highway which provides physical access for development.

The proposed project will employ 70 to 100 people during the construction. It will further create indirect local employment through project spending depending on the alternative selected and the proportion of construction materials purchased locally. With current unemployment in excess of 45,000 in the Denver-Boulder area, the proposed project should have a beneficial impact in reducing unemployment.

Wastewater flow capacity for the 20-year project planning period was determined from the service area population projections used by the Denver Regional Council of Governments (DRCOG) for the ongoing Water Quality Management Plan. The City of Boulder is attempting to limit growth within the city through a building permits limitation (see section on Population Setting). Sizing the improvements to the Boulder wastewater facility to handle a specified flow volume could set the capacity of the plant to an arbitrary level.

For several of the alternatives, the limiting factors are the primary and secondary clarifiers in the treatment process. Present nominal plant capacity is 15.6 mgd. With modifications to the clarifiers, plant efficiency would be ensured, and the capacity could be increased to 17.6 mgd. This capacity would be adequate to handle the 1995-2000 DRCOG projections. The additional treatment facilities proposed under each alternative are also sized to handle this capacity. As discussed in Section III, the majority of the alternative systems could be phased or reduced in size to accommodate only planned growth. Reduction in treatment plant capacity could imply that sewer connections may become limited in the Boulder area by the year 2000. This may severely limit growth within the City of Boulder. However, growth within areas under county jurisdiction may continue independently of this project.

SECTION V

SECTION V

UNAVOIDABLE ADVERSE IMPACTS

Environmental impacts and feasible measures to mitigate or eliminate adverse effects of each alternative were presented in Section IV. Those impacts which cannot be avoided, even with the implementation of mitigation measures are presented in Table 18. Alternatives A and C have many similar types of impacts as systems utilize shallow ponds in the vicinity of the 75th Street treatment plant. Alternative G would have the most significant impacts of all the proposed systems.

ALTERNATIVE PLANS

Alternative A - Infiltration/Percolation Basins

Construction and operation of this land-treatment system would depress the groundwater table to approximately 5 ft below the site surface. Groundwater would also be drawn down 3 to 5 ft in a 200- to 300-ft "shadow" zone east of the site. Pastureland within this shadow zone would lose the natural subirrigation and suffer adverse effects. Domestic wells within this shadow zone would be drawn down as much as 5 ft below ground surface. In the event that wastewater bypasses the system underdrains under certain conditions, groundwater quality may be degraded.

Pond operation during the winter could generate localized steam fogs that may be a nuisance to motorists and nearby residences. Aerosol generation during windy periods is also a possibility. Odor potential is generally low, but may be significant if a pond becomes clogged and anaerobic conditions arise. Nitrate levels in the effluent will not be significantly reduced by this land treatment system.

The existing pastureland habitat will be altered to a continuously changing wet and dry condition with attendant vegetation and wildlife shifts. The site occurs within the county-designated White Rocks Natural Area and the project may effect changes in the local ecology.

Public acceptance of this alternative varies widely. The system could perform effectively with low energy and capital requirements. However, many local residences are concerned about the odor generation potential and side-effects of groundwater drawdown. The proximity of the ponds system immediately south of a major housing development will be visually prominent and incompatible with community desires.

Table 18. ENVIRONMENTAL SUMMARY OF UNAVOIDABLE ADVERSE IMPACTS OF PROJECT ALTERNATIVES

Impacts	Infiltration/Percolation Basins A	Activated Sludge After Trickling Filters B	Aeration/Polishing Ponds C	Activated Sludge Before Trickling Filters D	High-rate Irrigation G
Soil stability and erosion hazards	⦶	○	⦶	○	⦶
Changes in groundwater quality/quantity	◑	○	◑	○	⦶
Surface water quality (ditches etc.)	⦶	○	⦶	○	◑
Local air quality/climate	◑	○	◑	○	◑
Vegetation and wildlife habitats	◑	○	⦶	○	⦶
Wildlife patterns	◑	○	⦶	○	⦶
Odor generation potential	◑	⦶	◑	⦶	◑
Impact on land and property values	◑	⦶	◑	⦶	●
Loss in property tax revenues	⦶	⦶	⦶	⦶	●
Increase in municipal service costs	◑	◑	⦶	◑	●
Consumptive use of energy	◑	●	◑	●	●
Impact on recreation facilities	⦶	○	⦶	○	○
Impact upon aesthetic qualities	⦶	⦶	⦶	⦶	⦶
Public health concerns	⦶	○	⦶	○	⦶
Community acceptance	◑	⦶	◑	⦶	◑

Degree of Impact: ● Major impact ⦶ Minor impact

◑ Moderate impact ○ No impact

Alternatives B and D - Activated Sludge Systems

Adverse impacts associated with these two alternatives are similar and addressed together in this section. The most significant impact associated with this alternative will be the large expenditure of gas and electricity to run the activated-sludge system. System D will consume 2 to 5 times more energy than the other alternatives. Gas consumption can be reduced by recycling methane gas generated by the digestors, but nevertheless, energy and resource use will still be significant. In terms of treatment efficiency and reliability, alternative system D would be more energy-intensive and methane gas reclamation would be lower than Alternative B. Capital costs for these systems would be 15-30 percent higher than the land-treatment systems.

Alternative C - Aeration/Polishing Ponds

The major unavoidable impact associated with this system is the potential for algal growth in the ponds and subsequent odor problems. Due to the large air/water interface, winter occurrences of steam fog from the ponds would become a nuisance to local residences and motorists.

The polishing ponds would also be incompatible with Boulder County reclamation plans for the Walden Ponds Wildlife Habitat Area and would require a special use permit from the county.

As with Alternative A, public acceptance of a ponds system in the vicinity of 75th Street treatment plant is variable. The greatest concern is the odor potential and aesthetic impacts for the residences adjacent to the site. Due to these large housing developments downwind, any odor production would probably be incompatible with community interests.

Alternative G - High-rate Irrigation

The major impact of this system is the high capital expenditure required to purchase the 3360 acres for facilities and irrigation. This would be 3 to 4 times greater than the other alternatives.

Construction and operation of a storage reservoir would commit 350 acres of farmland. The reservoir would experience significant algal blooms and attendant odor problems. Steam fog generation in the winter would also be significant. However, the location of the reservoir in a rural area would tend to make these effects less noticeable.

High-rate irrigation of crops would require intensive management. Excess hydraulic loadings can lead to surface water runoff and pollution, as well as salt accumulations in soils. Pumping of effluent to the storage reservoir and later to the irrigation sites, would require twice as much energy use compared to Alternatives B or D.

Public acceptance for this plan would be mixed. While wastewater could effectively be recycled with this system, massive land purchases would essentially put the city into the farming business and reduce individual farm ownership. A new and complex administration would be required to handle purchases, water rights, leasing and other activities related to system operations.

SECTION VI

SECTION VI

IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

The creation and construction of an advanced wastewater treatment system for the Boulder Wastewater Facilities Planning Area will impose on future generations the necessity for a strong commitment to the maintenance, potential expansion and continuation of the wastewater management systems now being developed. The selection of future alternatives for wastewater collection, treatment and disposal will, to a large extent, be limited by implementation of the selected plan.

Four major commitments of resources have been identified with the implementation of a wastewater treatment facilities plan. The extent of resource commitments varies among the alternatives considered and is discussed below.

IRRETRIEVABLE LOSS OF WILDLIFE HABITAT

Alteration and loss of wildlife habitat will be least for the construction of an additional activated sludge unit (Alternatives B and D) and greatest for the high-rate irrigation system proposed under Alternative G.

The land application alternatives will effect great changes in wildlife habitat. Alternatives A and C both involve pond systems that will be significantly different from the former habitat. The loss of pasture habitat will be traded for an increase to aquatic and semi-aquatic habitat. There is already much aquatic habitat in the adjacent Walden and Sawhill Ponds. Under Alternative G, the 350 acres required for the storage lagoon will permanently remove that area from the natural environment. The impacts of spray irrigation of wastewater on vegetation are discussed in Section IV. Short-term vegetation changes are largely reversible. However, the long-term practice of wastewater irrigation could physically, as well as functionally, change the composition of the local biotic community.

The secondary impacts of all alternatives include increased population growth and its resultant effects upon the environment. Development of outlying areas would lead to physical habitat degradation such as erosion and functional deterioration of habitats due to barrier construction, excessive noise, alterations in predator-prey relationships, vegetation changes and human presence.

IRREVERSIBLE DESTRUCTION OF SOIL PROFILE

Destruction of the soil profile on 350 acres of land at the site of the proposed storage lagoon under Alternative G is irreversible. These areas would be forever altered as agricultural areas.

IRREVERSIBLE AND IRRETRIEVABLE ENERGY AND ECONOMIC RESOURCE COMMITMENT

Alternatives B and D are the most energy-intensive with the operation of a pure-oxygen activated sludge treatment unit. The land treatment alternatives are the least energy-intensive; of these, Alternative G requires the most energy, requiring sewage to be pumped several miles to a storage lagoon at a higher elevation. This alternative will require increasing amounts of energy as population, and thus sewage volume, increases.

Any wastewater treatment system requires a commitment of energy resources for operation. Electricity would be used to power equipment and, in some plants, generate gases for wastewater disinfection. This commitment is permanent for energy expended. However, if a dollar value could be placed upon the improved stream water quality, such commitment of resources would be easily viewed as, at least in part, transferable.

The proposed project will require permanent commitments of construction materials and a 1 1/2 year commitment of construction workers for a combined value of \$8 - \$12 million under Alternatives A through D and \$34 million under Alternative G. The materials would consist of concrete, steel, fabricated machinery, electrical components, wood forms, framing and pipe. The supply of these materials is not known to be critically short, and their purchase and use would be beneficial to the regional and national economies.

The employment of construction workers for the regional facility would draw on a large labor pool at a time of high national unemployment in the construction trades. It cannot be predicted from where the workers might come, but their employment would be of national and state benefit, and they would reinvest some portion of their earnings in the City and County of Boulder.

SECTION VII

SECTION VII

RELATIONSHIP BETWEEN SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mechanical and land treatment systems proposed in the Boulder Wastewater Facilities Plan will probably have a duration of 20 or more years. This is a rather long period of time, given the rapidity of change in today's technology. Nevertheless, fair and important questions to ask are: What might be the implications of the project for the next few hundred years? What are the total benefits? What are the potential long-term damages that may occur to the specific sites? What would be the net effect upon the environment?

The three land treatment alternatives (A, C and G) would probably require the most in-depth evaluation with the broadest perspective. All of the proposed alternatives incorporate various advanced wastewater treatment methods that will produce a high quality effluent deemed consistent with the long-term interests of environmental preservation. However, these solutions that seem efficient for long-term productivity at this time might not be viewed as such by the year 2000. There will be progressively improved technology and, perhaps, breakthroughs that could alter our whole perspective of wastewater management. Several considerations regarding productivity of the existing and future environment are discussed below.

ENHANCEMENT OF SOIL PRODUCTIVITY

Recycling of wastewater under Alternative G represents an initial step toward the conservation of non-renewable and renewable resources. In the long term, the recycling of nutrients to the soil represents a forward-looking step for a society that will have to recognize the finite limitations of its natural resources. At present, the bulk of our commercial fertilizers is produced from fossil fuels, particularly natural gas and, to some extent, coal.

At present, the primary source of phosphorus fertilizer is deposits of phosphate that are extremely limited. Because phosphates in wastewater are concentrated in sludge as a result of the treatment process, land recycling can be an important long-term mechanism for reuse of this element, providing soils with one of the macronutrients essential for crop production.

POTENTIAL CUMULATIVE LONG-TERM ENVIRONMENTAL DAMAGE

A long-term view of land application of effluent must include potential harmful effects. Because wastewater contains elements that may be toxic or harmful if accumulated in significant quantities, the potential exists for some long-term damage to the productivity of that soil for growing crops.

An undesirable aspect of high-rate irrigation with effluents is the addition of salts to the soil profile. Over long periods of time, salts can have an inhibitory effect on plant growth. This problem is not confined to the Boulder operation but is common to all irrigated agriculture. Increased salinity of soils has an extremely harmful effect on the food-producing capability of a region. It is generally recognized in irrigated agriculture that proper long-term maintenance of an irrigated soil includes a leaching requirement for flushing these salts below the root zone. This is accomplished through application of additional irrigation water which commonly is subsequently collected in subsurface drains.

The chief measure for avoiding the detrimental long-term effects of soil salinization is control of wastewater application to levels considered safe for that type of soil and land use. Recommended safe levels are still somewhat tentative; any long-term assessment of this project must recognize that some effects may occur in a manner different from that stated here. However, an on-going monitoring program and assessment of effects will provide the basis for any changes necessary during the project life.

THE LONG-TERM ENVIRONMENTAL PERSPECTIVE

None of the alternatives considered here can be viewed strictly as a short-term use of the human environment. Any unmitigated adverse impact of an action, no matter how small, will be incorporated into the ecosystem and may be magnified over time. Thus, it is necessary to view the utilization of stream and/or land as receiving media not in terms of short-term use of the human environment, but in its true perspective. An immediate consequence of such a view is that there must be minimal conflict between effluent disposal practices and environmental productivity.

The Boulder Valley Comprehensive Plan, the Areawide 208 Water Quality Management Plan and the 1972 Water Pollution Control Act Amendments all incorporate a serious analysis of long-term water quality and environmental goals. The primary goal to restore Boulder Creek to its original high quality stream environment is a short-term goal with potential long-term benefits. Restrictive limits on treatment plant effluent discharge quality and receiving water quality have been set

URBAN GROWTH ALONG BOULDER SKYLINE

for this purpose. Implementation of treatment and control measures at the present time requires considerable capital investment to effect an immediate improvement in the stream environment. Maintenance of these immediate short-term improvements into long-term enhancement and productivity require careful future area-wide planning to ensure compatible land uses.

SECTION VIII

SECTION VIII

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND RESPONSES

PUBLIC HEARING

The Environmental Protection Agency held a public hearing on the Boulder Wastewater Treatment Facilities Draft Environmental Impact Statement on October 3, 1977 at the Boulder City Council Chambers in Boulder, Colorado. The hearing was attended by approximately 15 people of which seven presented testimony for the record on the EIS. Because of the length of the official hearing record and the printing costs involved, it is not reproduced here. The document is available for public review at the City of Boulder Wastewater Utilities and at the EPA Region VIII Office in Denver, Colorado.

A brief summarization of the major concerns voiced at the hearing are presented below:

1. Mr. Phil Stern, a Boulder resident (parts of his presentation were endorsed by PLAN-BOULDER and P.U.R.E.), expressed his concerns about flood-proofing of the present 75th Street plant, inadequate descriptions of flood hazards in the EIS and the ability of the project to meet President Carter's Executive Order 11988 - "Flood Plain Management" and Governor Lamm's Executive Order - "Evaluation of Flood Hazard in locating state buildings, roads and other Facilities and in reviewing and approving Sewage and Water Facilities and Subdivisions". Mr. Stern pointed out that the EIS needed an in-depth discussion of the ability of each alternative to meet the A2 stream standards. Land treatment costs, as developed by the facilities planner, did not appear to be accurate for some alternatives based on previous reports, and should actually be the most economical. He also questioned the sludge generation rates and consequent high disposal rates that could lead to sludge dumping rather than beneficial reuse. Mr. Stern concluded by endorsing the Alternative C lagoon system.

2. Mrs. Martha Weiser, a Boulder County resident, called for a more accurate description and definition of the White Rocks Natural Area in the EIS and read the legal description in the recently revised Boulder Valley Comprehensive Plan along with the definition of "environmental preservation" in the plan. Mrs. Weiser opposes Alter-

natives A and C for environmental reasons and supports Alternative B. She questioned the sludge injection method and expressed difficulty in comprehending Appendix F in the EIS on effects of sludge application. A letter was presented from the District 6 Water Users (February 22, 1977), stating their opposition to sludge injection for reasons of: 1) water quality degradation; 2) health hazards associated with pathogens in sludge; and 3) potential changes in groundwater flow patterns and volumes from the sludge injection practice. Mrs. Weiser emphasized the potential long-term effects of sludge injection and questioned some of the City of Boulder's statements. She suggested a compromise solution to the sludge injection problem: wherein, sludge injection could be allowed on the existing city-owned property for a short-term (3-5 years) to test impacts before making it into a full-scale project. Mrs. Weiser concluded by clarifying her opposition to Alternative C due to potential odor problems, problems with the county wildlife refuge area and inconsistency of the project with adjacent land uses such as the Celebrity Homes north of Jay Road.

3. Ms. Nancy Sheffield, a representative of the City of Boulder, stated the position voted on by the Boulder City Council to: 1) adopt Alternative B - activated sludge nitrification and explore methane recovery to reduce the greater energy costs associated with this alternative; and 2) to support the sludge injection proposal.

4. Mr. A. W. Nelson, a Boulder County resident, questioned the effects of sludge injection on the local groundwater and property values; as well as right-of-way restrictions and proximity to his property. Mr. Nelson stated that his home on the east side of 71st Street has not been affected by odor problems from the 75th Street treatment plant. He concluded by restating his concerns for groundwater contamination and the need to know more about groundwater flow patterns prior to sludge injection.

5. Mr. James R. Williams, a Boulder County resident, lodged a strong complaint against the location of the existing treatment facilities and the associated odor problems. He suggested that any treatment facilities should be located farther east and be isolated from homes and people. Based on the past performance of the 75th Street plant, Mr. Williams questioned the reliability of any new facilities on the same site and the credibility of the City's claim that they could control the odor problem. He concluded by restating Mr. Nelson's concerns about groundwater contamination and its effects on local wells and their users.

6. Ms. Shelly Murphy, a representative of the League of Women Voters of Boulder, expressed concerns about Alternative B regarding: 1) ineffectiveness at removing nitrate-nitrogen down to 1 mg/l; 2) energy consumption that would be twice as much as Alternatives A or C; and 3) higher capital and annual costs than Alternatives A or C.

Ms. Murphy questioned the appropriateness of funding an expensive tertiary treatment facility at Boulder when many communities in Colorado still need funds to upgrade their facilities to the secondary treatment level. She stated that the odor discussion was unclear for the various alternatives and that they should be compared against odor potential from reclaimed gravel pits as well. The wildlife potential between the proposed project and Walden Ponds also needed clarification. In conclusion, Ms. Murphy, on behalf of the League of Women Voters urged the Environmental Protection Agency to fund Alternative C as the best choice for Boulder's future wastewater facilities.

7. Mr. Keith Bell, a Boulder resident, stated that he supported Alternative B and brought up two points regarding treatment alternatives: 1) more attention was needed on potential groundwater problems with Alternatives A and C relating to bedrock geology; and 2) more concise comments were needed on the odor potential of Alternative C with a reference to Chapter 9 of the facilities plan. Mr. Bell also related, in his experience as a sanitary engineer, icing problems in aerated lagoons that had damaged aeration equipment and disrupted treatment systems for weeks at a time. He suggested an analysis for this type of problem should also be included in the EIS.

The Environmental Protection Agency Region X wishes to express its appreciation to all commenting agencies, groups and individuals for the time and effort spent in reviewing the draft EIS. Issues raised at the public hearing have been readdressed in the final EIS. All comments were presented to the Regional Administrator and were considered by him in EPA's decision making process.

LETTERS OF COMMENT

This section contains letters of comment from individuals and groups to the Boulder Wastewater Facilities Plan Draft EIS. Whereever a response is required of EPA to the letter, a response page follows that letter.

Table 19 presents a listing of the comment letter received during the 45-day review period, the page in this section in which the letters appear, and a general category listing of their contents. Comment categories are shown in an attempt to indicate those aspects of the proposed action about which the commentors were most interested and concerned.

Table 19. COMMENTS RECEIVED, BOULDER WASTEWATER FACILITIES PLAN — DRAFT EIS

1977 Date	From	EIS Page No.	COSTS	RELIABILITY	ALTERNATIVES	MITIGATIONS	SLUDGE INJECTION	ODORS	FLOOD PLAIN	GRAVEL RESOURCE	SURFACE WATER	GROUNDWATER	PATHOGENS	SOIL PRODUCTIVITY	LAND USE	WHITE ROCKS	ARCHAEOLOGY	OTHER
9/24	Denver Regional Council of Governments	151			●													
9/28	Department of Housing and Urban Development	152	●						●		●						●	Format
9/29	Boulder County Planning Department	161				●	●	●	●				●			●		
10/3	Roger Fell	164		●			●	●		●	●	●	●	●	●			Format
10/4	United States Department of Interior	175			●					●		●					●	Sawhill Ponds
10/8	Mr./Mrs. A. W. Nelson	181					●					●			●			
No Date	Mrs. Martha Weiser	184	●		●	●	●		●	●		●	●			●		
10/12	Colorado Department of Highways	195							●									Air Quality
10/19	Office of the State Archaeologist	197				●											●	
10/24	Colorado Department of Health	199			●			●					●					
10/25	Department of the Army Corps of Engineers	203							●									

DENVER REGIONAL COUNCIL OF GOVERNMENTS

1776 SOUTH JACKSON STREET . DENVER, COLORADO 80210 . 758-5166

September 24, 1977

John A. Green
Regional Administrator
United States Environmental Protection Agency
1860 Lincoln Streeet
Denver, Colorado 80203

Re: EIS/021-77, Boulder Wastewater Treatment Facilities - Draft EIS

Dear Mr. Green:

In accordance with Office of Management and Budget Circular A-95 procedures, the Denver Regional Council of Governments' staff has reviewed the above captioned project and offers the following comments:

The Denver 208 Plan, as prepared by the DRCOG, calls for upgrading and expansion of the Boulder Wastewater Treatment Plant between 1977 and 1980 and again in 1986 to 1990. The Draft EIS appears to adequately address the environmental impacts for a number of alternative methods for plant expansion and upgrading.

The Council of Governments appreciates this opportunity to be of service to you.

Sincerely,

Robert D. Farley
Executive Director

RDF/bjs

cc: Richard Brown, Colorado State Division of Planning
The Hon. Robert G. Trenka, Councilman, Boulder COG Representative

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
EXECUTIVE TOWER • 1405 CURTIS STREET
DENVER, COLORADO 80202

REGION VIII

September 28, 1977

IN REPLY REFER TO:
8DE

Mr. Alan Merson
Regional Administrator
Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Merson:

We have reviewed a copy of the Draft Environmental Impact Statement (EIS) dated August 1977, prepared by the U.S. Environmental Protection Agency (EPA) on the city of Boulder's proposed project for expansion and additions to the city's waste water treatment facilities.

We have determined from this draft EIS that expansions and additions must be made to the city of Boulder's waste water treatment facilities. Your justification for this expansion and addition to the present system has been necessitated by projected population increases and the desire of the local population to upgrade Boulder Creek. However, the Draft EIS does not include the fact that this proposed project will stimulate growth. This impact of growth should be addressed. Additionally, we feel it would be appropriate to include the justification for upgrading Boulder Creek so that it will support cold water fish. This discussion should include increased benefits (recreational or other) which will occur with this stream upgrading. The adverse impact to downstream water users of encouraging phreatophytes (cottonwoods) to continue along this stream should also be discussed.

We feel that the following items should be clarified in the Final EIS:

1. Your planning area boundary, first mentioned on page 3 of the draft EIS, does not agree with the service area described in your Regional EIS (Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program, June 1977). Specifically, the Gun Barrel Area has been overlooked. 3

2. On page 66 you dismissed repair to the sewer lines as too costly to reduce infiltration and eliminate the need for enlargement to the treatment plant. However, no estimates of cost are included to form the basis of this statement. 4

3. On page 33 of the draft EIS you state that "A definite flood hazard exists at Boulder, and includes a portion of Central Boulder, residential and commercial areas of Arapahoe Road..." Please clarify whether this proposal will allow or support incompatible development within these known flood hazard areas. Also, describe how you have complied with the requirements of Executive Order 11988, Section 2-(2)(3)(4) regarding floodplain management. 5

4. On page 56 you mentioned doing a "literature search and field reconnaissance for historical structures." It is recommended 6 that the State Historic Preservation Officer (SHPO) be contacted concerning this project. We understand that the SHPO has the most current information available.

5. On pages 14, 15 and 16 a discussion of capital costs is presented, using 1995 population, salvage values for the year 7 2000, and a discount factor for 30 years. Shouldn't all figures have the same base year?

6. On page 63 you mention that the Betasso Plant is "expected to be increased by 20 mgd by the Spring of 1977." Since this 8 date has passed, the current status should be included.

Thank you for the opportunity to provide these comments.

Sincerely,

Robert J. Matuschek
Assistant Regional Administrator
Community Planning and Development

Response to Department of Housing and Urban Development, letter of 28 September 1977:

1. Based on estimates of projected population and flow in Section III, Table 9 of the EIS, the Boulder Wastewater treatment plant served 92,200 persons with an average flow of 12.5 mgd in 1975. Assuming that all future growth would generate wastewater at the rate of 120 gpcd and that the nominal capacity of the plant - without any changes - is 15.6 mgd, then the remaining average capacity of 3.1 mgd would support an additional 25,800 persons or roughly 10 percent lower than the 2000 projection of 130,000 by DRCOG.

   It should be kept in mind that the year 2000 projections were developed by DRCOG accounting for many complex exogenous and endogenous growth factors in the Boulder planning area. The design flows for the proposed project would accommodate DRCOG population projections and would not necessarily have a stimulatory effect. The contention that this or any other single service can function as a stimulant to unbridled growth, ignores the realities of the growth-regulating, decision-making processes operating in Boulder.

2. Upgrading of the Boulder Creek Stream classification was approved in January 1977 by the Colorado Water Quality Control Commission. The new A2 stream classification was promulgated by the strong desire of many interest groups in Boulder and their written and spoken testimony is recorded in the Boulder Wastewater Facilities Plan and Public Participation Records. There appears to be some confusion in your statement referring to a cold water fishery. Class A2 is a warm water fishery with primary contact recreation. The new Stream classification had legal status prior to the Draft EIS and thus discussion of its justification was not considered relevant. Recreational effects of the project are discussed in the Environmental Impacts Section. Encouragement of phreatophytes (cottonwoods) downstream of the treatment plant would not be considered to change significantly from the present conditions and processes.

3. The planning area boundary in the EIS and the facilities plan has been officially designated as the 201 planning area for the DRCOG Water Quality Management Plan. Your reference to Figure IV-B in the Denver Regional EIS for Wastewater Facilities and the Clean Water Program.

is for "Future Service Areas". These are recommended service areas, many of which are not officially recognized. Also, "Service Areas" as discussed in the Regional EIS, refers to areas that may be considered for utility, public and social services, and does not specifically imply sewer services throughout.

4. Based on the report "Infiltration/Inflow Analysis, Sanitary Sewer System - Boulder, Colorado" (EIS, Reference 67), the following 1975 present worth values were made:

    1) Treatment of I/I with existing treatment Plant: $21,873,700

    2) Improvement of sewerage system to remove I/I: $22,033,900

    Although these figures are no longer current, nevertheless, by comparison, it can be seen that continuation of the present sewerage system is less costly than removal of I/I.

5. Development accommodated by the proposed project, such as structures and roads, would be subject to Boulder Valley Comprehensive Plan. Types of compatible, as well as incompatible development, would be controlled by the local planning authorities.

    A copy of Executive Order 11988 is included at the end of this response. In the planning stage of the facilities plan, the general public and interest groups were notified of the project and its location in the flood plain. This was prior to Executive Order 11988, but in essence, fulfills Section 2(2). For all alternatives, except alternative G, location in the flood plan was most cost-effective as well as essential for treatment effectiveness.

    The Boulder Wastewater Facilities Plan and the Draft EIS were both submitted to the State Division of Planning which serves as the state and areawide A-95 clearinghouse. Both reports identified project locations in the flood plain and design considerations to withstand the "base flood". The facilities plan also identified the alternative project locations and the rationale for their selection. This in essence, fulfills Section 2(3) of Executive Order 11988.

Section 2(4) of the Executive Order relates to appropriate planning, regulations and procedures by agencies to effect flood plain management. The Boulder Valley Comprehensive Plan and other related policies of Boulder City and County have identified flood plain areas and appropriate land use designations and regulations. All existing buildings and proposed structures at the 75th Street treatment plant have or will be designed to meet the 100-year flood conditions. In addition, design of structures to withstand 100-year flood conditions is requisite for EPA grant conditions and federal flood insurance programs.

6. The SHPO has been contacted regarding this project and an archaeologist's report has been submitted to them. The comment letter from the SHPO appears in this section of the EIS.

7. Project cost figures on pages 14, 15 and 16, are based on the February 1977 supplement to the Boulder Wastewater Facilities Plan (EIS, Reference 5). These costs were revised for the 2000 population and salvage values were estimated for the year 2000. The facilities planner chose a 30-year period to calculate capital recovery costs, as this was the estimated useful life of the facilities. The present worth values for several of the alternatives would change slightly if the capital costs were discounted over 20 years. In the cost comparison of alternatives, project costs are considered accurate within 10 percent. Thus, ranking of alternatives would remain at roughly the same level.

8. The Betasso Plant was increased from 28 mgd to 48 mgd in 1977, and has been revised in the final EIS.

FOR IMMEDIATE RELEASE MAY 24, 1977

Office of the White House Press Secretary

THE WHITE HOUSE

EXECUTIVE ORDER -11988

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FLOODPLAIN MANAGEMENT

By virtue of the authority vested in me by the Constitution and statutes of the United States of America, and as President of the Uni ed States of America, in furtherance of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.), the National Flood Insurance Act of 1968, as amended (42 U.S.C. 4001 et seq.), and the Flood Disaster Protection Act of 1973 (Public Law 93-234, 87 Stat. 975), in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative, it is hereby ordered as follows:

Section 1. Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Sec. 2. In carrying out the activities described in Section 1 of this Order, each agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain; to ensure that its planning programs and budget requests reflect consideration of flood hazards and floodplain management; and to prescribe procedures to implement the policies and requirements of this Order, as follows:

(a)(1) Before taking an action, each agency shall determine whether the proposed action will occur in a floodplain -- for major Federal actions significantly affecting the quality of the human environment, the evaluation required below will be included in any statement prepared under Section 102(2)(C) of the National Environmental Policy Act. This determination shall be made according to a Department of Housing and Urban Development (HUD) floodplain map or a more detailed map of an area, if available. If such maps are not available, the agency shall make a determination of the location of the floodplain based on the best available information. The Water Resources Council shall issue guidance on this information not later than October 1, 1977.

(2) If an agency has determined to, or proposes to, conduct, support, or allow an action to be located in a floodplain, the agency shall consider alternatives to avoid adverse effects and incompatible development in the floodplains. If the head of the agency finds that the only practicable alternative consistent with the law and with

more

the policy set forth in this Order requires siting in a floodplain, the agency shall, prior to taking action, (i) design or modify its action in order to minimize potential harm to or within the floodplain, consistent with regulations issued in accord with Section 2(d) of this Order, and (ii) prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

(3) For programs subject to the Office of Management and Budget Circular A-95, the agency shall send the notice, not to exceed three pages in length including a location map, to the state and areawide A-95 clearinghouses for the geographic areas affected. The notice shall include: (i) the reasons why the action is proposed to be located in a floodplain; (ii) a statement indicating whether the action conforms to applicable state or local floodplain protection standards and (iii) a list of the alternatives considered. Agencies shall endeavor to allow a brief comment period prior to taking any action.

(4) Each agency shall also provide opportunity for early public review of any plans or proposals for actions in floodplains, in accordance with Section 2(b)of Executive Order No. 11514, as amended, including the development of procedures to accomplish this objective for Federal actions whose impact is not significant enough to require the preparation of an environmental impact statement under Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended.

(b) Any requests for new authorizations or appropriations transmitted to the Office of Management and Budget shall indicate, if an action to be proposed will be located in a floodplain, whether the proposed action is in accord with this Order.

(c) Each agency shall take floodplain management into account when formulating or evaluating any water and land use plans and shall require land and water resources use appropriate to the degree of hazard involved. Agencies shall include adequate provision for the evaluation and consideration of flood hazards in the regulations and operating procedures for the licenses, permits, loan or grants-in-aid programs that they administer. Agencies shall also encourage and provide appropriate guidance to applicants to evaluate the effects of their proposals in floodplains prior to submitting applications for Federal licenses, permits, loans or grants.

(d) As allowed by law, each agency shall issue or amend existing regulations and procedures within one year to comply with this Order. These procedures shall incorporate the Unified National Program for Floodplain Management of the Water Resources Council, and shall explain the means that the agency will employ to pursue the nonhazardous use of riverine, coastal and other floodplains in connection with the activities under its authority. To the extent possible, existing processes, such as those of the Council on Environmental Quality and the Water Resources Council, shall be utilized to fulfill the requirements of this Order. Agencies shall prepare their procedures in consultation with the Water Resources Council, the Federal Insurance Administration, and the Council on Environmental Quality, and shall update such procedures as necessary.

Sec. 3. In addition to the requirements of Section 2, agencies with responsibilities for Federal real property and facilities shall take the following measures:

(a) The regulations and procedures established under Section 2(d) of this Order shall, at a minimum, require the construction of Federal structures and

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facilities to be in accordance with the standards and criteria and to be consistent with the intent of those promulgated under the National Flood Insurance Program. They shall deviate only to the extent that the standards of the Flood Insurance Program are demonstrably inappropriate for a given type of structure or facility.

(b) If, after compliance with the requirements of this Order, new construction of structures or facilities are to be located in a floodplain, accepted floodproofing and other flood protection measures shall be applied to new construction or rehabilitation. To achieve flood protection, agencies shall, wherever practicable, elevate structures above the base flood level rather than filling in land.

(c) If property used by the general public has suffered flood damage or is located in an identified flood hazard area, the responsible agency shall provide on structures, and other places where appropriate, conspicuous delineation of past and probable flood height in order to enhance public awareness of and knowledge about flood hazards.

(d) When property in floodplains is proposed for lease, easement, right-of-way, or disposal to non-Federal public or private parties, the Federal agency shall (1) reference in the conveyance those uses that are restricted under identified Federal, State or local floodplain regulations; and (2) attach other appropriate restrictions to the uses of properties by the grantee or purchaser and any successors, except where prohibited by law; or (3) withhold such properties from conveyance.

Sec. 4. In addition to any responsibilities under this Order and Sections 202 and 205 of the Flood Disaster Protection Act of 1973, as amended (42 U.S.C. 4106 and 4128), agencies which guarantee, approve, regulate, or insure any financial transaction which is related to an area located in a floodplain shall, prior to completing action on such transaction, inform any private parties participating in the transaction of the hazards of locating structures in the floodplain.

Sec. 5. The head of each agency shall submit a report to the Council on Environmental Quality and to the Water Resources Council on June 30, 1978, regarding the status of their procedures and the impact of this Order on the agency's operations. Thereafter, the Water Resources Council shall periodically evaluate agency procedures and their effectiveness.

Sec. 6. As used in this Order:

(a) The term "agency" shall have the same meaning as the term "Executive agency" in Section 105 of Title 5 of the United States Code and shall include the military departments; the directives contained in this Order, however, are meant to apply only to those agencies which perform the activities described in Section 1 which are located in or affecting floodplains.

(b) The term "base flood" shall mean that flood which has a one percent or greater chance of occurrence in any given year.

(c) The term "floodplain" shall mean the lowland and relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year.

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Sec. 7. Executive Order No. 11296 of August 10, 1966, is hereby revoked. All actions, procedures, and issuances taken under that Order and still in effect shall remain in effect until modified by appropriate authority under the terms of this Order.

Sec. 8. Nothing in this Order shall apply to assistance provided for emergency work essential to save lives and protect property and public health and safety, performed pursuant to Sections 305 and 306 of the Disaster Relief Act of 1974 (88 Stat. 148, 42 U.S.C. 5145 and 5146).

Sec. 9. To the extent the provisions of Section 2(a) of this Order are applicable to projects covered by Section 104(h) of the Housing and Community Development Act of 1974, as amended (88 Stat. 640, 42 U.S.C. 5304(h)), the responsibilities under those provisions may be assumed by the appropriate applicant, if the applicant has also assumed, with respect to such projects, all of the responsibilities for environmental review, decisionmaking, and action pursuant to the National Environmental Policy Act of 1969, as amended.

JIMMY CARTER

THE WHITE HOUSE,
May 24, 1977.

# # # #

planning department
p.o. box 471 13th and spruce st. boulder, colo. 80302 441-3930

edward a tepe
planning director

September 29, 1977

RECEIVED
OCT 04 1977
Water Division

Mr. Alan Merson
Regional Administrator
Environmental Protection Agency
1860 Lincoln Street
Denver, CO 80295

RE: Draft Environmental Impact Statement of August 1977/Boulder Wastewater Treatement Facilities

Dear Mr. Merson:

Please be informed that the Boulder County Long Range Planning Commission, following public hearing on September 28, 1977, approved the following recommendations in response to your August 11, 1977 invitation for comments on the draft environmental impact statement on the City of Boulder's proposed project for expansion and additions to the City's wastewater treatment facilities:

1. That Alternative B, activated sludge process following trickling filters (as amended to provide nitrification), is recommended to the EPA for funding. 1

2. That the final EIS and "Wastewater Facilities Plan" emphasize the need for a comprehensive program for odor control to include minimally: the identification and monitoring of all odor-producing sources associated with the sewage treatment facilities; a plan and schedule for odor abatement; the evaluation of sludge handling and disposal systems for odor-producing elements; and an expanded public information and input process in order to effectively relate to all problems associated with the operation of sewage treatment facilities. 2

3. A great deal of public concern has been expressed over the location of a relatively new sludge disposal technique so close to existing residential development and the White Rocks Natural Area. Items of major concern include odor control, vector control, groundwater contamination, heavy metals buildup, and pathogen transmission. Sludge injections of the site(s) proposed cannot be endorsed without the resolution of the specific and technical concerns to the satisfaction of the City/County Board of Health, 3

City of Boulder Planning Board, Boulder City Council, Boulder County Long Range Planning Commission, and Boulder County Board of Commissioners.

4. That the selected treatment alternative(s) include provisions so that constructed facilities will absorb unexpected shock loadings and provide backup during system failure, so that the primary emergency procedure during system failure will be other than wastewater plant bypass and sewage flow directed into Boulder Creek. 4

5. Facilities must be designed to be in compliance with Section 18.5 of the Boulder County Zoning Resolution, Flood Plain. Particular attention should be given to protection against erosion, backwater and downstream effects. Water rights issues should be resolved prior to Use by Special Review, with emphasis placed on maximizing the opportunities for agricultural reuse of municipal effluent. 5

6. That the EIS depiction of the wastewater facilities planning area and White Rocks Natural Area be changed to be consistent with the '77 Boulder Valley Comprehensive Plan. 6

7. That it be noted in the environmental impact statement that the Boulder 201 EIS is not intended to and does not satisfy the requirements of PL 92-500, Section 208 relating to Boulder County. 7

I would be happy to discuss these recommendations with you further, if necessary, and look forward to working with the EPA on this matter.

Finally, I would like to take this opportunity to express our appreciation for the efforts of Mr. Gene Taylor, project officer, in facilitating public and local government response on this project.

Sincerely,

Ed Tepe
Planning Director

ET/JB/da
xc/Mr. Doug Smith, Director - Utilities Division - City of Boulder
Mr. Bryan Miller, Director - Environmental Health - Boulder City/County Health Department

Responses to Boulder County Planning Department
letter of 29 September 1977:

1. Recommendation has been noted.

2. The need for a comprehensive program for odor control has been noted in the Final EIS. Recommendations for odor control will become part of the EPA grant conditions.

3. Items of major concern regarding the sludge-injection technique such as odor control, vector control, groundwater contamination, heavy metals build-up and pathegon transmission will be addressed in a newly-revised addendum to the Final EIS to be issued at a later date. An additional sludge injection site is currently being investigated.

4. Provision for facilities to absorb shock loadings and include back-up systems will be part of the EPA grant conditions.

5. Ability of the project to meet Boulder County Flood Plain Zoning requirements and resolution of water rights will be made as part of EPA grant Conditions.

6. The text and figures depicting the White Rocks Natural Area have been changed to conform to the 1977 Boulder Valley Comprehensive Plan.

7. This has been noted in the Introduction of the Final EIS.

October 3, 1977

Mr. John A. Green
Regional Administrator, EPA
1860 Lincoln Street
Denver, Colorado 80295

Re: EIS - Boulder Waste-water Treatment
August 1977

Dear Sir:

This letter is written in response to EPA letter 8W-EE dated August 8, 1977 regarding modifications to the City of Boulder's 75th Street sewage plant and the addition of a sludge disposal system to a land area near the present plant.

On September 20, 1977 the City Council of Boulder approved modification Plan B which includes a sludge disposal system by injection on a land area located 1-1/2 miles from the present plant designated by paragraph 5 of the EIS Summary as a field of "170 acres" including City owned property west of 75th Street and south of the UPRR tracks (Page 65-EIS, Para 2).

According to this plan 50% of the sludge will be pumped to the injection site as a slurry and injected below the ground surface using a series of force mains, pipelines, underground drains and an expensive pumping system.

As a peripheral land-owner immediately adjoining the "Manchester" property which has been designated as a sludge injection site I would like to express my objections and those of other landowners so situated to the inclusion of sludge injection disposal systems to any land areas near or adjoining the present sewage plant.

In reviewing the details of the EIS regarding the proposals for sludge injection on adjacent land area sites the following comments are submitted for consideration:

1. Past planning by the City of Boulder for treatment of sewage has generally been short-sighted and restricted by factors of expediency and pressures by political interest groups.

The present 75th Street sewage plant on a site of approximately 80 acres was newly constructed and became operative in 1968. 1
In only 9 years of existence it has proved to be grossly inadequate to function properly, to meet the needs of the service area and to conform to State and Federal standards regarding air and water pollution.

2. There is little reason to believe that the proposed new

planning by the City of Boulder and their consultants, CH_2M-Hill, offer any assurance that the proposed modification alternatives will result in a plant operation that will meet either the Odor Emission Regulations of the Colorado Department of Health or the stringent water pollution controls imposed by the highly restrictive Federal Regulations of the EPA under Sections 208, 402 and 303 of the Water Pollution Control Act of 1972. 1

Rather than providing an effective long range solution to present problems the plan to add a sludge injection disposal system merely distributes the treatment activity from an enclave of 80 acres to a noncontiguous land area of an additional "170 acres" which happens to be undeveloped and is nearby.

This is another example of expediency and short-term planning based on an experimental unproved sludge disposal system which will be expensive to develop, to operate and which well may be in direct conflict with all of the provisions of Sections 208, 402 and 303 of the Water Pollution Control Act of 1972. 2

Consideration has to be given to the question of how much liquid sludge can be imposed on a finite amount of land over an infinite period of time. In a continually expanding service area the amount of sludge produced will increase year by year to be injected on a limited designated site.

If the present sewage plant which has already been modified (1973) and cannot presently meet current State and Federal standards only 9 years after initial construction it is impossible to believe that the proposed modifications can be effective through the next 18 years until 1995--the projected planning date to accommodate a population of 129,000.

It must be noted that during the planning stages of the present 75th Street sewage plant an offer was made to the Boulder City Council to provide a substantially larger site on the "Cannon" property approximately 2 miles further downstream immediately west of 95th Street. This proposed site in a large open undeveloped area was rejected as being "too expensive" by the City Council because it required the construction of an additional 2 miles of sewage trunk line.

However at a meeting of the Boulder County Health Board held on September 13, 1977 the Utilities Director of the City of Boulder offered direct assistance to Board of Health Members in resolving sewage problems along South Boulder Creek adjacent to Eldorado Springs by proposing to submit a request for an EPA grant of approximately $1,000,000.oo to construct a sewage trunk line connecting directly to the present inadequate 75th Street sewage plant. 3

It is difficult to reconcile the goals of the City of Boulder who on one hand are now asking for Federal funding to upgrade the present sewage plant to meet required standards and are at the same time offering to provide facilities that will encourage immediate urban growth to further strain an already overloaded, inadequate sewage plant.

The proposed site for field injection of liquid sludge was not included in the original Wastewater Facilities Plan of October 1975 CH_2M-Hill, but was changed by the City of Boulder during March and April of 1976 and the designated area varies from "170 acres" to "225 acres" (EIS - Page 104, Para 4) depending on the EIS reference reviewed. **4**

The EIS draft does not address the problems generated by the sludge injection disposal system as a separate concise topic, but scatters various comments throughout the 160 pages and appendices in at least 25 references running from 1 to 4 or more paragraphs.

In reviewing these references it is not possible to cite a single example where the EIS concerns itself with successful operations of sludge injection disposal systems initiated by other municipalities within the State of Colorado or even on an experimental basis by any agency within Colorado or at any other location.

Relocation by the City of Boulder of a sludge disposal system on the "Manchester" property immediately adjacent to my farm and residential property imposes adverse conditions to me and the surrounding residential owners that did not exist under the location proposed by CH_2M-Hill when this system was designated for the "Kolb" property in a less developed area. **5**

If this system of sludge disposal is approved at this site designated by the City of Boulder it will have to be considered as an expedient, experimental process limited in useage by the land available, the continual increase of sludge produced and the capacity of the land for sludge assimilation.

The EIS has addressed its review to a number of factors which affect this process of sludge disposal with very few positive or clear-cut resolutions of problems generated by the plan.

It is highly important to me and to those Boulder valley residents similarly situated that due and fair consideration be given to positive solutions of problems created by the imposition of any experimental plan of sludge disposal on the areas near which we live.

Specific concerns which do not seem to be clearly resolved are itemized below along with comments on specific notations in the EIS along with reference pages: **6**

1. Odor

   Merely an extension of the present problem from the 75th Street plant to the sludge injection site.
2. Alteration of surface and groundwater flows:

   a. Amount - Decrease in present flows by installation of underground drains.

   b. Quality - Deleterious effects of heavy metal, salts and nitrates.

c. Effect on intermittant stream flow in pastures. Reduction of flow and possible contamination.

d. Effect on grass production in sub-irrigated pastures. Reduction in growth.

e. Effect on domestic and stock wells. Contamination and reduction of water quantity available.

3. Pathogens

Sludge injection sites become pathogen transmission areas. 6

4. Reduction in land values and re-sale value of farm and farmstead and adjacent residential areas.

A careful study and review of the EIS does not indicate that the proposal for sludge disposal by injection has been endorsed positively in any way as a proven, practical method of secondary sewage treatment by the EPA.

To the contrary most of the comments dwell at length on the negative aspects of sludge disposal by injection.

Because of the limited scope of the study and the absence of proven practical data along with the need for longer range planning it is hoped that funding to the City of Boulder will not be approved or granted for any system of sludge injection.

There are a few portions of the Boulder Valley that still retain the high quality natural rural environment once common to all of Boulder County. The City of Boulder's plans would only add to the continuing degradation of this beautiful area.

Very truly yours,

Roger C. Fell
7861 Valmont Drive
Boulder, Colorado

Addenda enclosed

cc: Jack Murphy, Chairman--Boulder Co. Commissioners
Edward A. Tepe, Planning Director, Boulder Co
Frank Buchanan, Mayor, City of Boulder

Addenda

Comments on EIS Draft

EIS - Page 13, Para 1, Items 3, 4 and 5 -- Sludge Injection

Item 3. "Long-term sludge application to the site will result in the build up of heavy metals and salts within the soil."

Conflicts with Sec. 303, PL 92-500. RCF

Page 14, Items 4 and 5 -- Sludge Injection

Item 4. "Heavy metals concentration and potential contamination by pathogens may render some crops grown on the sludge--amended field unsuitable for human consumption etc ------."

Item 5. "Soluble salts, particularly nitrates will gradually leach into the groundwater reservoir, etc ------." 6

In direct conflict with Water Pollution Control Act of 1972 (PL-92-500). The sludge injection sites become sludge dump areas. RCF

EIS - Pages 54 and 55, Paras 1 through 5 -- Odor

Para. 5. "When these facilities are completed, the changes in the sludge handling and odor control processes are expected to correct past odor problems associated with the operation of the 75th Street plant."

Citizens have a right to expect positive solutions for odor control which conform at least to regulatory standards. Approval of plans and funding grants for odor control should be based beyond "expectancies."

EIS - Page 63, Para 2 -- Sludge Disposal

"The East Pearl Plant utilizes soil injection and soil conditioning." 5

No pilot study of this operation by the U.S.E.P.A., no monitoring, no results, conclusions or useful recommendations. Why not? RCF

EIS - Page 82, Para 1 --Sludge Disposal

"The sewage sludge disposal systems ----- i.e. subsurface injection for various portions of the total sludge production will probably function satisfactorily."

"As the City experiments with each system and selects a preferred methodology, a future commitment will probably be made to one or two systems." 6

There is nothing positive in the above statements that warrants any approval of expenditure of taxpayer's funds for proposals based on probabilities. RCF

EIS - Page 91, Para 1 - Removal of Nitrates

"Alternatives B, D, E, and F are also judged ineffective at removing nitrates."

Conflicts with Sec. 208 and 303, PL 92-500.
How can this plan be approved if it does not meet required standards? -- RCF

7

EIS - Page 91, Para 3 - County Goals

"The County does control the landfill sites which may be used for ultimate sludge disposal. Possible land disposal or reuse of wastewater sludge would be reviewed through the Special Use Review process of the County Planning Board."

This is an important recommendation. The power of review should be carefully exercised by the County before any site approval or system plan is ever granted. RCF

EIS - Page 99, Para 2 through Page 104, Para 1 -- Soils at Sludge Inspection Sites.

Describes adverse impacts of sludge injection on land site in terms of concentration of salts, heavy metals and ground water impairment in terms of quality and quantity.

Details limitations of sludge site to absorb impact of 1500 tons of sludge per year. (This is a conservative estimate of sludge production. Sludge production will increase each year as service area is expanded.)

6

EIS - Page 103-104, Paras 4 through 7 -- Groundwater below Sludge Injection Sites.

Describes adverse impacts of sludge injection on groundwater quality.

The injection site becomes a point source of pollution in direct conflict with the provisions of Public Law 92-500, Water Pollution Control Act of 1972.

EIS - Page 115, Para 1 -- Sludge Injection Fields

"Subsurface injection of liquid sludge under all alternatives (except F) would produce minimal odor."

There is no experimental or current operational evidence presented in the IRS to substantiate this statement. RCF

EIS - Page 123, Para 4 -- Public Health

"Health hazards associated with sewage treatment, although greatly reduced by processing and treatment, are always of concern."

I am in accordance with this statement and it is one of many reasons that disposal of sludge by injection is not a desirable plan. RCF

EIS - Page 124, Paras 1 through 4 -- Pathogens 6

A four paragraph description of the presence and possible deleterious effects of pathogens associated with sewage treatment.

Para 4.
"The sludge injection fields proposed under all alternatives except F, present a greater concern because of the more concentrated elements in the sludge and their cumulative effects."

I share the concern of both the City/County Board of Health and Boulder County Long Range Planning Commission who have published concerns regarding the methods and sites for sludge injection.

EIS - Page 136, Para 3 -- Loss of Gravel Resource

Random acquisition of sludge injection sites may impair the potential for gravel extraction and conflict with mining laws, State of Colorado. 8

EIS - Page 137, Para 1 through 6 -- Accumulation of Salts and Heavy Metals

An eight paragraph description of the adverse impact on sludge injection sites caused by discharge of salts and heavy metals into the sub-soil and leaching into the groundwater system.

This operation conflicts with Sections 208, 402 and 303 of PL 92-500. RCF 6

EIS - Page 148, Para 2 -- Sludge Injection Site Soil Commitment.

Irreversible damage to sludge injection site caused by impact of heavy metals and soluble salts.

In direct conflict with Section 303, PL 92-500. It must be noted that all of the proposed sludge injection sites are located on remnants of highly porous, permeable alluvial terraces of sand, gravel and rocky rubble with only a thin top-soil layer overlying an impermeable layer of shale approximately 20' below the surface. (Figure 5, Page 25 EIS).

Under these conditions there will be continual leaching of the disposal sites with soluble salts, heavy metals and nitrates returned directly by underground water flows back to the stream basin.

EIS - Pages 150 and 151, Paras 1 through 4 -- Potential Cumulative Long-term Environmental Damage.

Para 1. "A long term view of sludge injection to fields must include potential harmful effects." Etc.

These paragraphs detail the adverse effects of sludge injection caused by the addition of soluble salts and heavy metals into a permeable soil site.

While there is no positive endorsement of this process by the EIS it must be noted that there must be consideration given to the conflict of such process with Sec. 303, PL 92-500. 6

EIS - Page 149, Para 3 -- Enhancement of Soil Productivity

Throughout the EIS and in all of the public presentations by the City of Boulder there are continual allusions to the beneficial uses of sludge in application to agricultural lands as a substitute for commercial fertilizers and as method of conservation of natural resources.

Members of the City/County Board of Health and the Boulder County Long Range Planning Commission have suggested that additional study and planning be given to processes that effectively dry and modify sludge to provide a fertilizer product that can be effectively used by farmers on agricultural lands throughout eastern Colorado and which will compete with commercial fertilizers now used.

Response to these suggestions by the City of Boulder has been less than enthusiastic although statements have been made that there is a great demand by City and County entities for sludge to be used in governmental park systems.

The EIS should insist that full consideration be given to all of the long range implications of any sludge disposal system and be reluctant to approve the sludge injection system which obviously has serious limitations.

It is felt that technology does exist to provide advantages for approval of a sludge product that does have potential for resolving the present enigma of the high cost of commercial agricultural fertilizers produced from petroleum derivatives. 6

It seems that much more consideration has been given to the quality of sewage effluent resulting from plant discharge into Boulder Creek and the provisions of Sec. 208 than to the consequences of sludge injection and the potential pollution to Boulder Creek in conflict with Sec. 303 of Public Law 92-500.

Roger C. Fell

Responses to letter from Mr. Roger C. Fell of 3 October 1977

1. Past short-range planning and operational problems regarding Boulder wastewater treatment have been less than desirable. The task of EPA, prior to awarding grant monies for wastewater improvement projects, is to determine the most cost-effective, reliable and environmentally acceptable treatment method under the given conditions. Where adverse effects can be mitigated by recommendations in the EIS, EPA can make these part of the grant conditions. The role of the wastewater facilities plan and the EIS is thus to work out the most reasonable and effective solution.

2. The amount of sludge that will be generated in the future and land requirements for disposal will be discussed in the sludge-injection addendum to be published separately after the final EIS. As far as long-term reliability, EPA requires, under P.L. 92-500, that the proposed project must adequately meet federal water quality standards through the planning period ending in the year 2000.

3. The Boulder City Council voted to accept the 75th Street treatment plant under conditions at that time. Reference to the sewage trunk line extension to El Dorado Springs at the Board of Health meeting on 13 September 1977, would be for a separate project with a separate EPA grant. The ability of the present 75th Street treatment plant or of the proposed project to handle the additional load from a possible El Dorado Springs sewer extension is not considered in this EIS. This would be the subject of a separate facilities plan and EIS.

4. "170 acres" is the correct figure and has been revised in the final EIS. Evaluation of sludge injection and its impacts will be gathered into a separate addendum to the final EIS to make discussion of this item more concise.

5. Citation and comparison of other sludge-injection operations are presented in a separate addendum to the final EIS.

6. Specific concerns regarding sludge-injection that you have mentioned, particularly: odor, alteration of surface and groundwater flows, pathogens and effects on land values, will be gathered together and readdressed in a separate addendum to the final EIS.

7. At the time that the draft EIS was prepared in July 1977, the Denver Regional Council of Governments came out with a new set of water quality standards for the Denver 208 planning area. These standards were rather stringent and at the end of 1977,

the final adopted standards pertaining to Boulder Creek had dropped the 1 mg/l nitrate-nitrogen limitation in wastewater effluent. Thus, the statement on Page 91 of the draft EIS is no longer applicable and has been revised.

8. The proposed sludge injection site, south of the railroad tracks, has a potential for gravel extraction. No detailed studies have been made of the quality or quantity of the gravel resource on that site. Based on information from other mining areas in the flood plain, the gravel resource could be 7- to 10- feet thick with an overlying soil layer of 5- to 10-ft. The area between the Sawhill Ponds and White Rocks generally contains a good-quality aggregate. The feasibility of mining this resource would have to be based on further detailed testing.

   Colorado mining laws prohibit development over gravel resources that would preclude extraction of this resource. The sludge injection operation is essentially an agricultural crop usage and does not involve conversion of land use. Thus, at any time after sludge injection is discontinued, the land could be mined for its gravel resource.

United States Department of the Interior
OFFICE OF THE SECRETARY

MISSOURI BASIN REGION
DENVER, COLORADO 80225

ER 77/814

October 4, 1977 19840

Mr. Alan Merson
Regional Administrator
Environmental Protection Agency
Region VIII, Suite 900
1860 Lincoln Street
Denver, CO 80203

Dear Mr. Merson:

This is in response to your August 11, 1977 request for Department of the Interior review of the Draft Environmental Statement for the Boulder Wastewater Treatment Facilities, Boulder, Colorado. We have completed the subject review and have the following comments:

General Comments

1. The Environmental Impact Statement (EIS) adequately addresses the potential impacts on fish and wildlife for all alternatives presented. From the information presented it would appear that Alternative B (activated sludge process following trickling filters) would have the least impact on such resources. 1

2. Infiltration rates for the various soils are not mentioned nor is the method of irrigation with the effluent, e.g., sprinkler, gravity. In addition, at least minimal downgradient monitoring of ground-water quality should be included in planning—just as surface—effluent monitoring will be required—in order to provide a basis for detecting impacts before downgradient ground-water users suffer damage. This monitoring will be especially needed if well owners in the vicinity reject the offer of a municipal water supply. 2

3. You should be aware that Sawhill Ponds has received matching assistance monies from the Land and Water Conservation Fund (L&WCF). Encroachment upon Sawhill Ponds would constitute a conversion of recreation use under Section 6(f) of the L&WCF Act, as amended. Section 6(f) requires that any change from recreational land use be approved by the Secretary of the Interior and also requires the substitution of other properties of at least equal fair market value and reasonably equivalent usefulness and location for the recreation lands to be taken. There is no provision under this section for acceptance of cash in payment for recreation lands converted to other uses. 3

Information presented in the statement indicates that Alternates A and C could adversely impact the Sawhill Ponds. If either alternate is selected, we suggest that you consult with the Boulder City Parks Department concerning project impacts on this area.

4. The statement fails to evidence consultation of either the National Register of Historic Places or the State Historic Preservation Officer for Colorado, Mr. Stephen H. Hart, Chairman, State Historical Society, Colorado State Museum, 200 14th Avenue, Denver, Colorado 80203, concerning the effects of the proposed action on archeological or historical properties that are listed on, or may be eligible for, the National Register of Historic Places. Documentation of such consultation is required by the Code of Federal Regulations, both Title 36, Part 800.2 and Title 40, Part 1500. Evidence of such consultation, including relevant appended correspondence, should appear in the final environmental statement. The final statement should also provide documentation of compliance with the Advisory Council on Historic Preservation's "Procedures for the Protection of Historic and Cultural Properties" (36 CFR, Part 800), as necessary. 4

The discussion of archeological and historical resources in the project area, particularly the pertinent paragraphs on pages 55-56 and 144, is confusing and fails to clearly describe the nature of cultural resources in or near the project area and define their relationship to the proposed action.

Also, the extent of earlier archeological and historical surveys of affected areas is not delineated, nor is the methodology employed in such surveys described. We suggest that information of a more specific nature be extracted from the referenced archeological and historical reports (reference 45, 46, and 47 on page 156) and be incorporated in subsequent draft and final versions of this environmental statement to facilitate review.

5. The environmental impact statement almost completely ignores the potential mineral impacts of the proposed action. It is true that the amount of land involved is small—a maximum of 3,360 acres under one alternative—and that the amount of minerals involved is likely to be correspondingly limited. Nevertheless, the proposed action involves a flood plain that is known to have a sand and gravel resource, is currently being mined for sand and gravel in the project area, and is immediately adjacent to a rapidly growing city with a strong demand for construction minerals. 5

Half a dozen references in the statement pertain to past and present gravel mining activity in the project area, but they all seem to be rather offhand and to be related to things such as environmental aspects of gravel pits, using gravel pits as settling ponds or trout ponds, etc. Nowhere is the question of potential loss of a mineral resource squarely and adequately addressed. In the most extensive reference to minerals, one short paragraph on page 136 titled "Loss of Gravel Resources," it is stated that ". . . utilization of this soil as a filtering medium precludes gravel mining in that area during the lifetime of the facilities operation.", and that gravel resources are ". . . fairly common along the Boulder floodplain and other watercourses." These statements are true enough, but are simply not adequate by themselves.

Good-quality aggregate is somewhat limited in the Boulder area, and the fact that sand and gravel is currently being mined in the project area implies that good-quality gravel occurs there. The environmental statement does not indicate that any attempt has been made to assess the quality and quantity of the resource that would be affected by the project. Irreversible and irretrievable resource commitments are identified as loss of wildlife habitat, destruction of soil profile, sludge injection site soil commitment, and energy and economic resource commitment. Adverse impacts are considered on soils, landforms, water, biotic communities, noise, odors, and air quality. We believe that sand and gravel should be included. 5

To be complete, this statement should include an evaluation of the type and volume of gravel (and other possible minerals) underlying the proposed project site, the extent to which this resource will be mined before the project is constructed, the potential mineral values foregone in construction of this project, and the relative level of importance the affected mineral resource might play in the Boulder market for construction minerals.

6. The Draft Environmental Impact Statement addresses seven alternatives. The final environmental statement should address the impacts of the selected alternative. In this way the impacts would be more site specific and could be more fully addressed.

Specific Comments

1. Page 9, Alternative G: There is the beginning of an inconsistency here. It is stated that the total land requirement for the project is 360 acres, including the lagoon, buffer zone, and irrigation lands. On page 79, it is stated that irrigation lands would total 3,360 acres, which is more realistic. On page 107, the requirement is given as 2,500 acres. 6

2. Page 17, paragraph 3: This discussion should be clarified. The second sentence presents several comparatives; however, it is unclear as to what is being compared.

3. Page 34, Table 2: The footnote to this table indicates that the waste loads are a total of either or both BOD_5 and suspended solids. Since the two are not exactly additive, the waste loads are meaningless. The amounts of each should be delineated and two separate totals given.

4. Page 34, last paragraph: Excessive irrigation also causes surface erosion, carrying soil particles and adsorbed salts and nutrients to streams.

5. Page 35, 2nd full paragraph: The inference here is that the instream BOD_5 rises to 28 mg/l. While this may meet effluent standards, these are not applicable to the receiving stream. Based on this, the effluent would have to be considerably greater in BOD_5 than 28 mg/l, and most likely more important than temperature, which was discussed in the preceding paragraph, in maintaining D.O. levels above the instream standard.

6. Page 37, 1st full paragraph: The Colorado-Big Thompson was built by and is operated and maintained by the Bureau of Reclamation, with the repayment obligation undertaken by the NCWCD.

7. Page 37, last paragraph: This discussion is extremely confusing and should be revised.

8. Page 40, 3rd full paragraph: The DRCOG 208 Plan is not basinwide, in that the mountain South Platte reach is included in the State's 208 Plan for nondesignated areas, while downstream the Larimer-Weld COG is conducting the 208 planning. The 1973 DRCOG effort was conducted under the authority of Section 303.

9. Page 43, 1st paragraph: This discussion would be more appropriately included in the preceding description of the physical components of the environmental setting.

10. Page 107, Alternative G: Irrigation application rates of 10 acre-feet/acre are mentioned here. The irrigated crops mentioned are fescue and bermuda grass. At the application rate mentioned above, it might be desirable to consider more hydrophytic plants as the principle crop. In addition, it may be necessary to consider subsurface drains, since the application rate will be so great.

11. Page 145, paragraph 1: Particular attention should be paid to assessment of both (1) the significance of the "Kolb buildings" and the archeological site mentioned on page 45, and (2) the specific effects of the proposed action of these properties.

12. Also, the discussion on pages 144-145 of measures to be taken in the event the previously unknown archeological resources are encountered during construction should be modified to state in more positive terms those actions that will be taken in such a case, rather than retaining the present terminology reflecting measures that should be implemented.

Sincerely yours,

John E. Raybourn

JOHN E. RAYBOURN
Regional Environmental Officer

Responses to U. S. Department of Interior letter of 4 October 1977:

1. Statement noted, no comment necessary.

2. Infiltration rates for the infiltration basin site in Alternative A are documented in the facilities plan - Appendix C, Table 4. Infiltration rates along the periphery of Boulder Creek vary from 3.7 to 36 in./hr. In the central portion of the site, the rates vary from 31 to 50 in./hr. In the south portion, near the railroad tracks, the rates vary from 26 to 50 in./hr. These rates are based on laboratory tests from individual observation wells and may vary a great deal throughout the site according to soil composition and thicknesses.

   High-rate irrigation of effluent, under Alternative G, would be accomplished with a pump system and spray irrigation.

   Downgradient groundwater monitoring, as mentioned in your statement, would be appropriate for Alternatives A and G. This has been added to the final EIS.

3. Alternative A would not encroach upon the Sawhill Ponds or require changes in recreational land use. Alternative C would utilize one pond within the northwest corner of the Sawhill Ponds area. This would be incompatible with the Land and Water Conservation Fund Act, unless an acceptable trade-off was made. In the course of this EIS, Alternative C was not selected.

4. The SHPO has been contacted regarding this project and an archaeologist's report submitted to them. The comment letter from the SHPO appears in this section of the EIS.

   The description of potential historical resources on pages 55 and 56 has been revised to include information relevant to the project area. Archaeology resource information is generally sketchy and difficult to define. All surveys mentioned in the EIS covered all of the alternative project sites except for the 3,360-acres outlined in Alternative G. The methodology employed in all surveys was an examination of the site surface, where accessible. Due to the low potential for archaeological resources at the sites, no soil cores or excavations were made. The text of the archaeologist's report is added to the final EIS as Appendix H.

Detailed site descriptions and location of the archaeological site mentioned on page 56 is not included in this EIS. The State Board of Archaeologists wishes not to release survey data for public reports in order to protect these resources. In relation to the proposed project, qualified archaeologists have determined no existing cultural resources within the facilities site and a low potential for their occurrence.

5. An assessment of the gravel resources in the project area has been added to Section II of the final EIS. Additional discussion on impacts upon gravel resources and long-term commitments have also been added to the final EIS.

6. Specific comments 1 through 12, referring to text clarifications, have been noted and will be corrected and incorporated in the final EIS.

7101 Valmont Drive
Boulder, Colorado 80301
October 8, 1977

Regional Administrator
Environmental Protection Agency
Lincoln Towers Building
1860 Lincoln
Denver, Colorado 80295

Dear Sir,

We are strongly opposed to the possibility of having a sludge injection site on the city owned property west of 75th street. Should this become a reality, it would lower our property value and contaminate our two shallow wells. They are scooped wells, one is 15' deep and the other 18' deep and are located 45' and 180' from the city property line. Every year the city property is irrigated for farming purposes at least one time and every year the wells are contaminated. We bring in water for domestic use until we get them cleaned up.

We would also like to bring out the following points:

1. Our neighbors received copies of the Draft Environmental Impact Statement in the mail but we did not. Our East and South property lines adjoin the city property. We have 4.4 acres. 1
2. The map on the other side of this page does not show a study has been made on water table contours and flow direction for the proposed sludge injection site on city owned property West of 75th. 2
3. The Public Service Co. has two high towers on the right of way that cuts through the city owned property. Soil erosion could become a problem for these towers. 3
4. How many acres does the city actually own? Reference is made to City owned property but how many acres are left when you deduct the right of ways for the Union Pacific Railroad and the Public Service Co? Also there is a big drainage ditch that cuts into the city property. On Oct. 7, 1977, I went to the Assessors office to find out how much land the City of Boulder bought (from L. A. Biddle) west of 75th Street. This information was not readily available. The description on the micro film did not have this information on the record. 4
5. The maps in the Impact Statement do not even come close to showing the number of homes on land that adjoins the city property. Directly across the road in Section 23 there are two homes, a trailer, a duplex, an apartment building, and a church. The population of that area ranges from 20 to 25 people....none of whom wish to live across the street from a sewage injection site. 5
6. Do the Manchester's have any say as to whether they want to give up their property East of 75th Street? They say all they know is what they read in the news media and that they have not been contacted by anyone as yet...it is hard to believe that situations such as this exist. 6

Thank you for your interest in this matter.

Sincerely,

Mr. & Mrs. Arthur W. Nelson
by Irene E. Nelson

Mr. & Mrs. A. W. Nelson, 7101 Valmont Drive, Boulder, Colorado 80301 Oct. 8, 1977

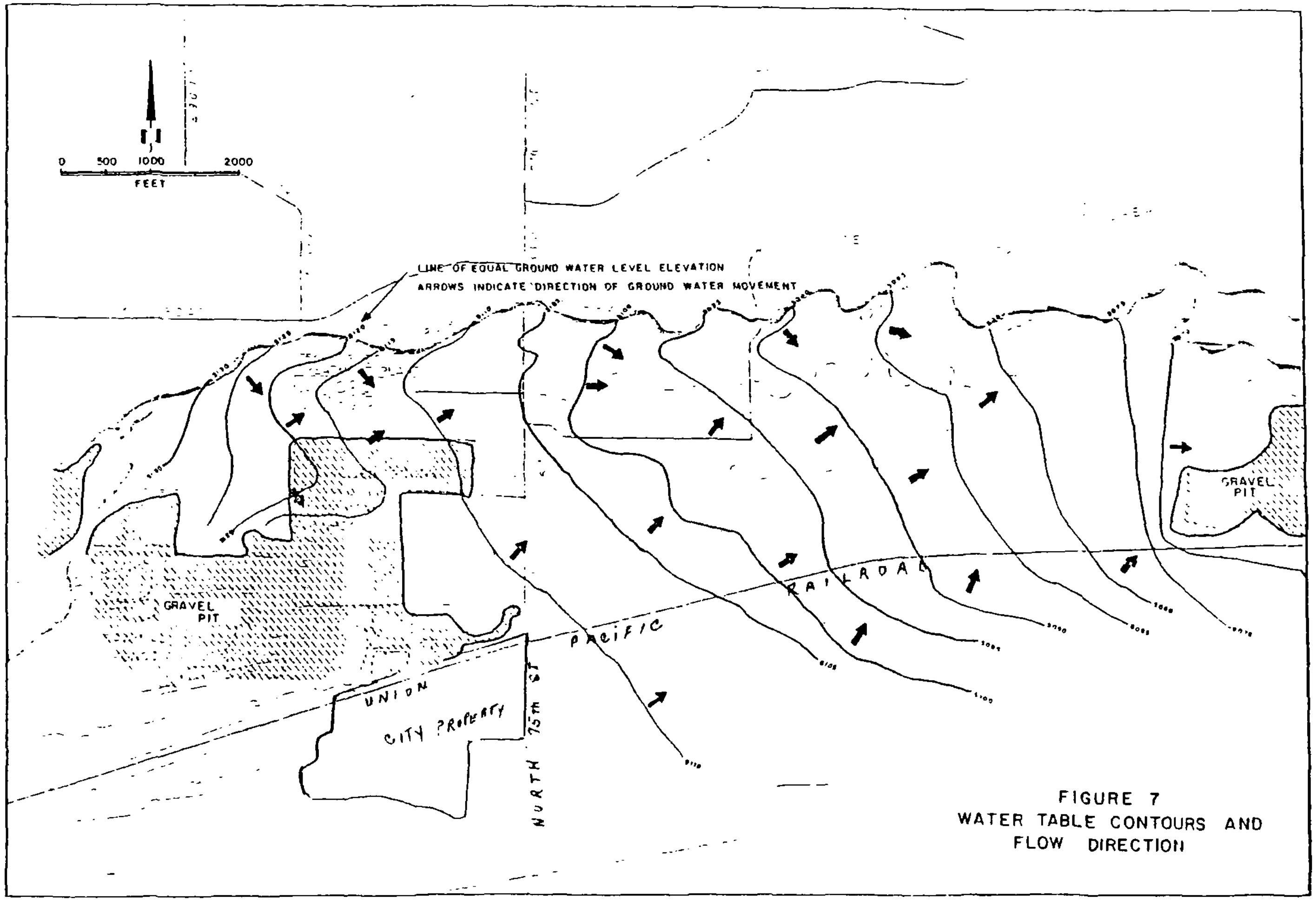

FIGURE 7
WATER TABLE CONTOURS AND FLOW DIRECTION

Responses to Mr. and Mrs. A. W. Nelson letter of 8 October 1977:

1. Your name has been added to the mailing list to receive reports and information on the Boulder EIS. Thank you for bringing this to our attention.

2. Additional studies on water table contours and flow direction have been performed to augment the data shown in Figure 7. This additional information will be presented in an addendum to the final EIS and should give more specific information on groundwater characteristics under the sludge injection site.

3. Sludge injection as proposed in the facilities plan is similar to normal farming operations involving discing or tilling, irrigation and harvesting. The sludge injection operation should not cause any erosion problems for the two electrical transmission towers near the site.

4. The map of the project area has been revised to include all dwellings adjacent to the proposed treatment and sludge injection sites.

6. If the Manchester property is used for sludge injection, the City of Boulder will make arrangements to purchase the necessary acreage from the Manchesters at fair market value. Residents will probably not be required to relocate as house and farm building sites will probably not be acquired. In the event that the owners do not wish to negotiate, the City would exercise its right of eminent domain.

1

To: John A. Green, Regional Administrator
EPA, 1860 Lincoln St., Denver, Co. 80295
Re: Draft EIS, Boulder Wastewater Treatment Facilities

Dear Sir,
The following notes represent certain errors, omissions and questions which I believe should be corrected or answered in the final document. I offer them in addition to the testimony which I will present at the Public Hearing in Boulder on 10/3/77.

Page ¶
7 Figure 2, base map (in green) used throughout document, is very misleading in including a selected few residences and omitting many others - especially those in or downstream of the proposed Alt. A. and Sludge Injection (hereafter abbreviated S.I.) sites. I note particularly the house on Weiss farm immediately E of the Alt. A. site, Manchester, Fell and others due East of S.I. site, homes S of Jay road and close to Alt. C., and heavily built-up Celebrity Homes area N of Jay Rd. If correction of this omission is wastefully expensive, I would hope that some textual reference to it could be made, and perhaps one correct map. 1

13 8 Final sentence. I find it hard to reconcile this sentence with warnings of long-term dangers which seem to call for long-term monitoring. 2

23 1 Polygonal jointing has little if anything to do with "distribution of a variety of common + unique local flora + fauna." 3

26 1 Line 1, omit "Alt. A"
31 3 All reservoirs mentioned are downstream of the City.
44 2 Heading "Natural Areas" and definition thereof is misleading. There are Natural Area programs in 4

both Boulder County (The six officially designated Natural Areas, one of which is the White Rocks Natural Area) and the State of Colorado (The recently passed ~~Bill~~ Senate Bill 480, Colorado Natural Areas Program.) By ~~so~~ defining Natural Areas in such a way as to omit the White Rocks from this category, a confusion arises. I would suggest another term here, such as "Undisturbed Areas." 4

45 2 Since White Rocks Natural Area has been defined as "recovering", I take exception to the dismissive tone of this ¶. Portions of this area are undisturbed, and its value as wildlife habitat is higher than implied, even without further improvement.

45 3 Here begins a problem which pervades this document. White Rocks is defined only as the actual geological formation rather than as the <u>White Rocks Natural Area</u> (hereafter WRNA). This area should be considered as a unit, as it is considered by County, State, City, owners, and representatives of the various scientific disciplines interested in its preservation. The area includes "pasture/agricultural", "riparian" and small segments of "ponds + marshes", and it is precisely this variety which makes the area valuable. The vertical variation, protected habitat, south-facing cliff reflecting winter warmth, relative abundance of prey species in the creek meander areas all contribute to the importance of the WRNA. By separating out the rocks themselves, the overall value of this ecosystem is downplayed. I urge the correction of this error, in line with the area designated for ~~pm~~ Environmental Preservation in the recently adopted Boulder Valley Comprehensive Plan 5

46 Figure 11 has several errors. First, as noted above, the WRNA extends well into the floodplain and includes that reach of Boulder Creek to which it is adjacent. The "sensitive ecological area" designation should follow this definition. Second, there is a swath extending NW of the actual White Rocks to the Heatherwood Area which seem unjustified by any definition. Third, Gravel Mining Areas are inadequately shown, with County pits W&S of Walden Habitat omitted, and extent of Flatiron operation not shown (entire area is now surrounded by dewatering trench, to just E of my property line which is center line of Sec. 18.) Fourth, residential/urban should extend farther W along both sides of Jay Road, should include Fell and adjacent homesteads N of Valmont Rd., 4
Nowell house, Manchester, and residences S of Jay Rd. and W of 75th. These omissions clearly arise from the misleading base map.

49 2 Area consists of 210 a (WRNA proper) plus a 660' buffer on all sides (240 a) with total area included 450 a. See comments to 45.3

4 Recently adopted Boulder Valley Comprehensive Plan revision, approved by both City and County, includes entire 450 a Environmental Preservation designation, plus Greenbelt/Open Space designation by City Open Space Board of Trustees for additional land to NW, N and E of the area, which satisfies the proposed buffer zone.

5 Reference to the recent (2-3 yrs.) amendment to the Mined Land Reclamation Act (State) known as HB 1529 might be useful. This prohibits development over commercial gravel deposits. Controversial, but worth including.

57 Table 6 needs revision to reflect proper definition of WRNA] 4

53 1 Parks plan which purports to show recreational facilities mention was specifically NOT adopted as part of the Comp Plan. Also, County (specifically Commissioner Wally Toevs) not City has proposed & is implementing the Bikeway mentioned.] 6

63 4 Goose hunting prohibition varies each year, with boundaries changed to reflect overall State Wildlife policies. Unfortunately.

54 4 Please add gravel mining & transport noise (especially OSHA-required back-up horns.) There are many more gravel than sludge trucks.

60 4 I take exception to this statement. Within a one-mile radius, agricultural uses S of Boulder Creek are more important & more extensive than N of Creek.

5 "Unstructured grazing lands" - Crops are grown on several farms (Manchester, for example) & there are both crops & grazing W of 75th. Also, there are houses which aren't part of farms S of the plant, especially W of 75th.] 4

61 4 I take great exception to "none of the areas land uses have suffered in terms of land values ..." One real estate agent is hardly adequate to determine such a sweeping conclusion. I have seen the deterioration of the immediate neighborhood, houses abandoned or turned into rental units because of the odor. I, myself, have lost one tenant on my farm. If values have risen, they should be compared to how they might have risen without the sewer plant problems.] 7

73 4 Update to reflect no sand drying beds; explain about winter treatment of to-be injected sludge.] 8

75 1 Should be some discussion about what may happen if ponds do freeze.

79 5 Proposed site is brand new, and was not the one designated in the City's previously submitted plans. I did not realize that such changes were to be made. I object to the location of Alt. A.

81 1 While I'm mentioning areas of personal concern rather than corrections, I must object to the State and City being prime determinants of what happens to the creek downstream of the plant at 75th ST. This is an area outside of their services (see fig 1, p. 3) and I have resented the battle which I have been required to fight to get City to listen to County. That I seem to be "winning" doesn't change the anger I have felt. I do not object to cleaning up the water – only to the concept that State, Fed & City are the only important entities involved.

82 1 I hope the final document will include revised cost figures, as presented by City staff. In addition, for comparison purposes, I'd like to see cost of increased secondary clarifier capacity added to A + C

82.3 Cost comparison, (in addition to note 82.1) should include costs of reclamation when site is exhausted or abandoned. Gravel operators are required to reclaim; so should the city be. If not costed, at least it should be mentioned. I believe it would be significant for Alt A. I also find nowhere any costing out of necessary changes affecting my access road, irrigation rights, or construction of "mitigation" measures. Loss of my tenant house might even be mentioned, since I can't imagine renters willing to live next to sewage lagoons.

102 2 If underdrains have effect mentioned in Alt. A., why not similar problem for underdrains at S.I. site? Needs ~~more~~ more detail (re: S.I.) **14**

103 3 Line 2 change "225" to "170"

103 6 Last line – rest of word (which I presume is "gradually") omitted. **4**

106 4 200 acres doesn't include part of my property damaged + thus removed from production **15**

108 Table 16. 5 of the existing species also occur in the colonizing list. This seems to indicate an error. **16**

109 2 "White Rocks reclamation project" is mentioned (This is the Flatirons operation) but nowhere is WRNA, the closest habitat, mentioned. A clear omission.

109 3 Line 1 - Change "A" to "C": Error.

117 5 Note that county open space includes agricultural uses, especially those on "marginal" land which are often the most desirable as open space.

125 1 Line 1 - is the word "not" accurate? It doesn't seem compatible with the public health hazards detailed in the following sentences.

133 4 Some words left out after line 2. Error.

137 1 Isn't there a danger to domestic + livestock wells as well as irrigation wells? **4**

139 3 What about wells below S.I. site? Effect of draining (removal) on sub-irrigated pastures? **17**

143 4 Deodorizing mists are not – or at least have not been so far – a successful or acceptable mitigation method. They are quite repellent. **18**

143 7 Dust blowing from scraped basins Alt. A. could carry pathogens. Ditto dust from ~~—~~ normal farm operations on land heavily injected with sludge. **19**

147 4 Mention that there is already ample aquatic habitat

148 2 Long-term monitoring / affect on future use - discuss. **4**

149 3 Line 1 - "of" - shouldn't it be "or" (or "and")?

151 1 Is it ~~too~~ valid to assume no change in content? What does "completely irreversible" mean - is there such a thing as incompletely irreversible? Is the intent of this sentence to say maybe? Isn't it more appropriate to expect the applicant to prove it won't damage than to use this sort of backward statement ("There's nothing now to say it will") As a member of the public, I find this hedging reassurance not very reassuring. 20

B-3 2. Also badger, marmot, ~~[illegible]~~, skunk, prairie dog, rabbit

3 Audubon Society members question the species listed as "predominant." They're there, but others are there more. Suggest re-check. Note that White Rocks listing pp B-9-16 includes species sighted at WRNA, which includes riparian.

4 Change Alt A to C (or else it's not a true statement)

B-4 4 White Rocks = WRNA; it overlaps Alt A, not just borders it.

B-5 1 Add plum, currant, chokecherry. Many more plant species on rocks. Add notes re: riparian vegetation since White Rocks = WRNA 4

2 Ability of fern to survive - qualify this statement; we don't know for sure why it has survived here, or what could destroy it. Moisture in air, for example, might change with many open pits (gravel + Alt A). Other pollution (smog, fog) might affect it. It's probably not dependent only on soil + light. Serious objection to this flat statement.

3 Birds - add kestrel, wren; to hawks, add redtail (resident), Harlan's hawk, occasional immature eagles (both golden + bald.) Omit Coopers Hawk.

4 Add marmot, badger, skunk, raccoon, etc. ~~Somewhere~~, mention fairy shrimp in solution pits (most interesting)

8

B-6 1. Send Jardanel green also heavily residential (Celebrity Homes). Small farm homes also along Jay Rd. NOT ALL FARM HOUSE ARE SMALL.

E-4 3. Error. Sludge site same for all alts.

E-5 4. " " " " " " "

F-5 Figure is "F-1", not "E-1" } + both are very hard to interpret in terms of text. Awkward mix

F-6 " " "F-2" " "E-2" } of standard American and metric units.

4

Thank you for your patience in reading this far.

For the record, and as I have stated and will state in public hearings, I approve Alt. B, disapprove Alts A + C (especially A) and am highly suspicious of the safety and effect on my property of the Sludge Injection site. All technical basis for my opinions comes from material in this Draft EIS (or other material produced by the City of Boulder or its consultants.)

Sincerely,

Martha R. Weiser

4020 N. 75th
Boulder, Co. 80301

Responses to letter from Martha Weiser:

1. The base map in Figure 2 and subsequent figures have been revised to include all houses around all of the alternative treatment and sludge injection sites.

2. Except for the short period when sludge is being injected, the site will be used as a conventional agricultural field with periodic soil and groundwater monitoring. After discontinuation of sludge injection, the site will continue to be monitored periodically.

3. Text revision - the resultant topography of the White Rocks is what influences plant and animal distribution.

4. Corrections, additions and recommendations were noted and revised in the final EIS.

5. The description of the WRNA has been expanded to include pasture and riparian elements in the text and Appendix B. The discussion on page 45 is necessarily brief as it presents an overview of biotic communities in the area. The separate discussion of the WRNA as a Sensitive Ecological Area on pages 49-50 was viewed as an appropriate place for more detail.

7. Your comments on treatment plan effects on local land values are valid. That section of page 61 has been rewritten to reflect those concerns.

8. The sand-drying beds have been removed from the Phase I design of odor and sludge handling facilities. The City plans to use the existing vacuum filtration units and surface spreading on land to dewater sludge for reuse.

9. Winter wastewater volumes are generally the lowest and thus, loading rates on the infiltration basins would be lower. In order to prevent ground freezing and obstruction to infiltration, the operation cycle would be shortened. The City estimates that the effluent would be 8-9°C or greater. Smaller loading rates on a shorter cycle - 3-4 days - would be used to prevent the ground from freezing completely. The effluent itself would be warm enough to thaw out the surface partially. Operation of this system in the winter would require close attention to temperature and percolation rates. Excessive loadings or a longer time between loading cycles could allow the basins to freeze sufficiently to disrupt infiltration.

10. The proposed site of Alternative G is the same area as that depicted in Figure 9.2 of the facilities plan with some exclusions for residences and existing ponds and reservoirs.

11. The Boulder County Planning Department and the County Commissioners also play an active role in determining the goals for Boulder Creek. This has been added to the text of the final EIS.

12. The EIS reflects the most recent costs, as revised by the facilities planner in the February 1977 Supplement to the facilities plan (EIS, Reference 5). Although an increase in secondary clarifier size would be advisable, Alternatives A and C would function satisfactorily with the existing clarifiers. The pond systems at the end of the treatment system for Alternatives A and C would compensate for the inadequate secondary clarifiers.

13. No reclamation costs have been developed for the sludge injection site. With appropriate operation procedures, no site restoration activities were planned. With a periodic monitoring program, the site would be discontinued if direct pollution effects were resulting from the operations. It would seem appropriate, however, for the City to continue a monitoring program on the site after the termination of sludge injection operations.

    The facilities planner did not develop specific costs for items such as changes in access roads and purchase of irrigation rights. These were assumed to be covered by an estimate of "contingency costs" worked into each alternative. In the event that costly mitigation measures are required with the recommended plan, this would change project costs.

14. The groundwater level under the sludge injection site is not as shallow as the pond sites under Alternatives A and C. Operation of the sludge injection fields also does not involve massive water infiltration as with Alternative A and would not necessarily have the same characteristics. More discussion on this topic will be presented in an addendum to the final EIS.

15. The 200 acres mentioned is specifically the percolation pond site. No estimate was made of additional acreage in adjacent fields that would be lost to pasture production, although a discussion is included estimating the potential extent of groundwater effects.

16. Three of the existing pasture vegetation species were observed colonizing the experimental infiltration basins near the 75th Street plant. The two other species: bluegrass and milkweed, are of such ubiquity, that they could be expected to colonize the basins. The fact that these 5 species are already in pasture areas should not preclude them from colonizing the infiltration basins.

17. The effect of underdrains at the sludge injection site will be discussed in a separate addendum to the final EIS.

18. Comments on deodorizing mists have been added to page 143. It should be noted that mists are a temporary solution that cannot substitute for proper consideration during project design.

19. The effect of pathogen hazards from blowing dust is negligible as the infiltration basins would be vegetated and, thus, have little exposed soil surfaces.

20. Your comments are valid. Since few systems can be absolutely proven to have no damaging effects, the role of the EIS is to make the best assessment of the given situation.

    The statement "assuming no change in sludge heavy metal content" is unclear and should read: "assuming that the type and concentration of heavy metals in the sludge remains the same throughout the project". This assumption is reasonable, considering that the Boulder treatment plant is projected to receive mainly domestic sewage which has a relatively constant, low heavy metals content.

STATE DEPARTMENT OF HIGHWAYS

JACK KINSTLINGER EXECUTIVE DIRECTOR

DIVISION OF HIGHWAYS
E. N. HAASE
CHIEF ENGINEER

STATE OF COLORADO

COLORADO STATE PATROL
COL. C. WAYNE KEITH.
CHIEF

4201 EAST ARKANSAS AVENUE • DENVER, COLORADO 80222 • (303) 757-9011

October 6, 1977

RECEIVED
OCT 12 1977
DIV. OF PLANNING

Mr. Philip H. Schmuck, Director
Colorado Division of Planning
520 State Centennial Building
1313 Sherman Street
Denver, Colorado 80203

Dear Mr. Schmuck:

The Colorado Department of Highways has reviewed the Boulder Wastewater Treatment Facilities Draft Environmental Impact Statement prepared by the U.S. Environmental Protection Agency and has the following comments.

The project does not cause any conflicts with the State Highway system in this area. There does, however, appear to be an error in the definition of 100-year flood on page 33, paragraph 5. 1

Thank you for the opportunity to review this document. We would appreciate receiving future information which is relevant to our interests regarding this project.

Very truly yours,

Jack Kinstlinger
Executive Director

By Harvey R. Atchison
Harvey R. Atchison
Staff Environmental Manager

BSC/rg

Response to State Department of Highways letter of 6 October 1977:

1. The 100-year flood, was calculated by the Army Corps of Engineers in 1969 to be 11,000 cfs at the Boulder treatment plant. Based on later studies in 1976 by the Corps, the 100-year flood was re-calculated to be 18,000 cfs. This has been revised in the final EIS.

OFFICE OF THE STATE ARCHAEOLOGIST

1300 Broadway
Denver, CO 80203
303-892-3391,2,3

October 7, 1977

Mr. Philip H. Schmuck
Department of Local Affairs
Colorado Division of Planning
520 State Centennial Bldg.
Denver, CO 80203

OCT 14 1977
DIV. OF PLANNING

RE: DEIS Boulder Wastewater Treatment Facilities (EPA): archaeological resources

Dear Mr. Schmuck:

The Office of the State Archaeologist of Colorado has received and reviewed the Draft Environmental Impact Statement for Boulder Wastewater Treatment Facilities.

Archaeological resources have been adequately addressed, and the mitagative measures outlined on pages 144 and 145 are generally appropriate.

It should be noted that this Office's role is consultive, and the Environmental Protection Agency (EPA) is responsible for arranging the proper evaluation of any archaeological resources identified by encounter (v. 36 CFR 800.4(a)(2); cf. p. 144). After developing the eligibility data, EPA should seek our consultation—for the State Historic Preservation Officer—in determinations of eligibility or effect (36 CFR 800.4(b)), or in planning for the avoidance or mitigation of adverse impacts (36 CFR 800.5(e) and (f)). 1

If we can be of continued assistance, please call upon Staff Archaeologist David R. Stuart. (The State Historical Society's Department of Historic Preservation will independently comment regarding architectural/historical resources.)

For the State Historic
Preservation Officer

Bruce E. Rippeteau, Ph.D.
State Archaeologist Colorado

BER(DRS):ng
cc: Hart, SHPO

Response to the Office of the State Archaeologist letter
of 7 October 1977:

1. The archaeologist's survey report of the project site has been included in the final EIS as Appendix H. No eligible archaeological or historical sites were found during the literature search or field survey of the sites. Provisions for the evaluation of archaeological resources that may be encountered during construction and appropriate mitigation measures will become part of the EPA grant conditions.

COLORADO DEPARTMENT OF HEALTH

4210 EAST 11TH AVENUE · DENVER, COLORADO 80220 · PHONE 388-6111

Anthony Robbins, M.D., M.P.A. Executive Director

October 24, 1977

Mr. Phil Schmuck
Division of Planning
Dept of Local Affairs
INTERDEPARTMENTAL

RECEIVED
OCT 25 1977
DIV. OF PLANNING

RE: DEIS, Boulder Wastewater Facilities

Dear Mr. Schmuck:

The Colorado Department of Health has reviewed the above mentioned document and offers the following comments:

Air Pollution Control: The DEIS adequately addresses the primary air pollution impacts associated with the construction and operation of the alternative wastewater treatment facilities studied for the city of Boulder. However, minimal discussion is provided with respect to secondary or growth related impacts.

Although the Division does not question this level of discussion, it should be noted that it represents a marked contrast to the discussion of secondary impacts for other wastewater facility proposals in the Denver AQCR and AQMA.

More specifically, discussions in the Boulder DEIS emphasize odorous emissions and the available control measures for the alternative facilities studied. The discussion of secondary impacts in the Boulder DEIS is limited to the following on page 144, "Air quality caused by the secondary impact of induced growth can be considerable." Also, on page 19 an interesting indication of the air pollution levels to be expected in the future is given. That is, "there are sufficient naturally occurring emissions of reactive hydrocarbons that ozone standards may be exceeded in the future."

A very limited discussion was given to primary air quality (1)
impacts in the DEIS prepared by EPA for wastewater treatment facilities in the Denver region. However, over $200,000 was spent in evaluating secondary air quality impacts caused by growth induced by the availability of adequate wastewater treatment facilities. This study also duplicated, to some degree, the Denver region Air Quality Maintenance analysis efforts of the APCD which were requirements of EPA. Neither of the studies performed for the Denver region concluded that there are sufficient naturally occurring emissions of reactive hydrocarbons that could cause ozone standards to be violated in the future. Further, it is not clear how EPA's position on the Foothills project is reflected in the Boulder DEIS.

The Division does not fault the level of discussion of secondary
impact in the Boulder DEIS since: (1) the growth projections utilized (2)
were consistent with local and regional planner's projections; and

(2) indications are that Boulder city and county growth control policies will prevail. The Division seriously questions the apparent inconsistency in EPA's requirements for the treatment of air quality impacts from one EIS to another, for similar projects, which are located in the same AQCR and the same AQMA. 2

Radiation and Hazardous Wastes Control: The sludge injection fields proposed in the DEIS should comply with the Department's "Guidelines for Sludge Utilization on Land" (Draft copy) until the adoption of regulations by the Departments of Health and Agriculture. 3 The objectives of these guidelines are to insure stabilization of the sludge and to allow for its beneficial use.

Water Quality & Engineering Division: (1) The main environment to be impacted by any alternative will be the human population which is in sparse to moderate density within a half mile radius of the plant site. Therefore, any selected alternatives' main secondary function will be to minimize to the maximum extent possible, offensive odor generation. Since Phase One has already been funded to include covering the existing trickling filters with air scrubbers, the most predictable and reliable alternative would be one which includes conventional, mechanical treatment processes in which odor generation is controllable, in this case Alternative B or D.
(2) The advanced ammonia treatment required by the A_2 stream classification eliminates Alternative A as a viable alternative since its ammonia reduction capability is questionable. Also, the design life of these basins can be highly variable and the odor generation 4
potential is high.
(3) While being the lowest cost alternative, Alternative C has odor generation potential during extended periods of ice cover and eventually as nutrient levels rise in the ponds during algae decay after a bloom. Also, the effluent quality remains questionable with this Alternative for the effectiveness of algae harvesting has thus far not proved effective.
(4) Considering the plant setting and the upgraded stream classification, the only viable alternative would be B or a conventional advanced treatment process. Going further with the conventional treatment alternative, the activated sludge process is less compatible to the trickling filter and anaerobic digestion process; the use of the rotating biological disc process would be a more compatible and reliable advanced treatment process.

Sincerely,

Ron Simsick
Program Administrator

Responses to Colorado Department of Health letter of 24 October 1977:

1. The statement: "There are sufficient naturally occurring emissions of reactive hydrocarbons that ozone standards may be exceeded in the future", refers to turpenes and other reactive hydrocarbons that are naturally emitted from conifers and other trees. These natural emissions typically result in background reactive hydrocarbon levels of 0.02 ppm or greater, depending on the location. This effect was considered by the Colorado Department of Highways, to be more significant in the Boulder area than in the Denver region due to Boulder's close proximity to the Rocky Mountains and forest ranges.

   The most recent and pertinent air quality projection for the Boulder area was published in 1976: "Air Quality Analysis for the Boulder Metropolitan Area", (EIS, Referench 12). Base conditions were taken from local air quality monitoring data recorded from 1974 through 1976. Air quality projections were based on the year 2000 population projections developed by DRCOG. Carbon monoxide was simulated with an APRAC model, while ozone data which was incomplete for model use, was evaluated qualitatively, assuming proportional relationships between emissions and concentrations. This covered a slightly larger planning area than the EIS over the same planning period and gives a good indication of secondary air quality impacts caused by urban growth that had been accommodated by utilities expansions projects such as sewer and water service. Discussion of air quality impacts related to increased growth in the Boulder Valley has been added to Section IV under Long-Term Indirect Impacts (Page), and also in the summary in Section I.

2. The Boulder Wastewater Facilities EIS cannot be directly compared with the recently completed Denver Regional EIS, although both projects are located in the same AQCR. The Boulder EIS covered a single facility in an area non-contiguous with the Denver area. The Denver Regional EIS evaluated eight separate wastewater projects in the Denver metropolitan area as well as the 208 areawide non-point source pollution control program. The Denver EIS presented an opportunity to evaluate regional growth and development impacts cumulatively for the Denver region. For this reason, a large-scale analysis of secondary air-quality impacts from growth induced by provision of utilities was undertaken in the Denver EIS.

For the Boulder EIS, EPA evaluated the local conditions and on-going comprehensive planning activities and decided that the Boulder wastewater facilities warranted a separate EIS. The assessment of air quality projections in the previously mentioned air quality analysis report was considered acceptable for evaluating secondary impacts in the Boulder EIS.

3. Design of the sludge injection fields and operations specifications to comply with the Department's "Guidelines for Sludge Utilization on Land" will become part of the EPA grant conditions.

4. Comments on the treatment efficiency of alternatives A, B and C have been noted and have been considered by EPA in the selection process.

DEPARTMENT OF THE ARMY
OMAHA DISTRICT, CORPS OF ENGINEERS
6014 U.S. POST OFFICE AND COURTHOUSE
OMAHA NEBRASKA 68102

MROPD-M

25 October 1977

Mr. John A. Green, Regional Administrator
United States Environmental Protection Agency
Region VIII, 1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

This responds to your letter notice of 29 August 1977 with which you transmitted a copy of the draft EIS for the Boulder Wastewater Treatment Facilities, Boulder, Colorado for our review and comment.

We have completed our review of the draft EIS and have the following comments.

Details are not provided on infiltration-percolation ponds, aeration ponds or the storage lagoon. If these facilities are diked above the existing ground level, it should be recognized they will create an obstruction to flood flows and that flood levels may be raised. We recommend that flood obstructions, if any, be analyzed and designs developed that will not raise flood elevations more than 1 foot above flood elevations without the facilities. 1

On Page 33 of your report, you state that the 100-year flood discharge at the 75th Street sewage treatment plant is 12,000 c.f.s. Our 1972 flood hazard information report for the portion of Boulder upstream of 28th Street is referenced as the source. Our 1969 Flood Plain Information Report for the Boulder Metropolitan Region is the correct source for the vicinity of the sewage treatment plant. The 1969 report indicates a 100-year discharge of 11,000 c.f.s. at the sewage treatment plant. 2

We performed a new hydrology study for Boulder Creek upstream of Boulder in 1976, and have determined that our 1969 discharge estimates are too low. Although discharges downstream of Boulder have not been reevaluated, preliminary indications are that the 100-year flood discharge may be on the order of 18,000 c.f.s. in the vicinity of the sewage treatment plant. However, this number has not been verified and the final figure may be somewhat lower. We do not anticipate that flood elevations for the revised discharge would be more than 1 foot higher than our 1969 report indicates. 2

The draft EIS is environmentally acceptable and mitigative measures have been adequately addressed. Since the proposed project is located in the flood plain and not in a wetland area, no permit will be required; however, the discharge structure may involve a subsequent permit.

We appreciate having had the opportunity to review this draft document. We would also appreciate a copy of the final environmental statement when it becomes available.

Sincerely yours,

JOHN E. VELEHRADSKY, P.E.
Chief, Planning Division

Inclosure
Special Note

SPECIAL NOTE

Our review notes that this proposed project may involve work in or adjacent to one or several streams or wetlands. Either under Section 10 of the River and Harbor Act of March 3, 1899 (30 Stat. 1151; 33 USC 403) or under the provisions of Section 404 of the Federal Water Pollution Control Act Amendment of 1972, a permit may be required from the Corps of Engineers prior to the start of construction.

Neither our letter of review nor this special note is intended to convey or give Corps of Engineers approval to the document or the proposed projects therein you submitted for our review.

Additional project details and other information may be needed to make an environmental assessment and/or prepare or supplement an environmental impact statement in connection with the permit process. If you are not familiar with the permit regulations, additional information can be obtained from this office upon request.

Please write to: District Engineer
Omaha District, Corps of Engineers
ATTN: Operations Division
P. O. Box 5
Omaha, Nebraska 68101

Responses to Department of the Army, Corps of Engineers letter of 25 October 1977:

1. The infiltration-percolation ponds would be diked above the existing ground level on the north end of the site nearest Boulder Creek. In ponds that are farther to the south, the berms would be designed so that the top would not significantly exceed existing ground levels. Thus, in total, the percolation ponds would be designed not to raise flood elevations more than one foot above flood levels without the ponds. To a small degree, this would increase flood velocities in the lowest part of the flood plain due to the restrictions of dikes from the percolation ponds near Boulder Creek. However, as the flood level rises, flood water would overtop the percolation pond berms and extend through the natural flood plain area.

   The aeration ponds under Alternative C would have similar effects to those discussed under percolation ponds. The aeration ponds would be designed to allow flood flows to exceed the berms and inundate the pond area.

   The storage lagoon site under Alternative G will not be within the Boulder Creek flood plain.

2. The 100-year discharge of 11,000 cfs from the 1969 report has been noted and revised in the final EIS. The revised 18,000 cfs figure has also been noted and will be included in the final EIS.

   The 75th Street treatment plant was designed with all doors and openings at least 2 feet higher than the maximum 100-year discharge of 11,000 cfs. This would still be able to meet a revised flood elevation of one foot higher than that projected for 11,000 cfs. Additional facilities under Alternative B - construction of a new activated sludge unit would be designed to withstand a maximum discharge of 18,000 cfs.

SECTION IX

SECTION IX

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APPENDICES

APPENDIX A
SOIL CHARACTERISTICS OF THE PROPOSED PROJECT AREA

CHARACTERISTICS OF SOIL SERIES AT THE 75TH STREET PLANT

Soils of the Niwot series are made up of deep, somewhat poorly drained soils that are shallow over gravelly sand. These soils, like the Loveland series soils, were formed on low terraces and bottomlands in loamy alluvium superimposed over sand and gravel. Slopes are 0 to 1 percent. The native vegetation is mainly brome and water-tolerant grasses. These soils are best suited for use as pasture or meadow because of high, seasonal water table and shallow depth (10 to 20 in.) to sand or gravel. Some small areas are used for irrigated crops, and an increasing number of areas are used for sand and gravel pits.

The dark-grayish-brown and grayish-brown surface layer is variable in texture. It ranges from sandy clay loam to light clay loam or loam and is about 14 in. thick. The underlying material, extending to a depth of 60 in. or more, is pale-brown gravelly sand containing many mottles. In the surface layer, soil reaction is mildly alkaline; below the surface it is neutral.

Niwot soils have moderate permeability. Available water capacity for the profile is low to moderate. Roots can penetrate to a depth of 60 in. or more, and the seasonal high water table is at a depth of between 6 and 18 in. Runoff is slow, and the erosion hazard is slight except for bank-cutting near channels. Because of their position in the landscape, these soils are frequently flooded. The soils are interspersed with small, almost barren gravel bars and small areas of Loveland soils as well as some unnamed sandy soils (Reference A-1).

CHARACTERISTICS OF SOILS AT THE INFILTRATION-PERCOLATION BASIN SITE PROPOSED FOR THE 75TH STREET PLANT

Nearly all of the area of the infiltration-percolation basins is made up of the Niwot and Loveland soils described above. However, the Loveland soils of the southern edge of the basin area are adjacent to Manter sandy loam, 0 to 1 percent slopes, and the two thus are likely to be found together in a transitional complex. Manter sandy loam (0 to 1 percent slopes) is described in the succeeding section (Reference A-1).

CHARACTERISTICS OF SOILS AT THE SLUDGE INJECTION AREA SITE PROPOSED UNDER ALTERNATIVE A

Manter Series

The Manter series is made up of deep, well-drained soils. These soils were formed on terraces and uplands in loamy eolian and outwash materials. The native vegetation is mainly short grasses. These soils are used for irrigated and dryland crops and for pasture.

In a representative profile, the surface layer is brown sandy loam about 6 in. thick. The subsoil, about 10 in. thick, is brown and pale-brown sandy loam. The substratum is strongly calcareous, very pale-brown sandy loam and loamy sand extending to a depth of 60 in. or more. In the surface layer and subsoil, soil reaction is neutral; in the underlying material, it is moderately alkaline.

Manter soils have moderate permeability, and available water capacity for the profile is moderate. Roots can penetrate to a depth of 60 in. or more (Reference A-1). The Manter soils can further be differentiated into Manter sandy loam 0 to 1 percent, 1 to 3 percent, and 3 to 9 percent slopes.

Ascalon Series

The Ascalon series is made up of deep, well-drained soils. These soils were formed on terraces and uplands in loamy mixed alluvium and wind-laid materials. The native vegetation is mainly blue grama. Most of the acreage of these soils is used for irrigated and dry cropland.

In a representative profile, the surface layer is grayish-brown sandy loam about 8 in. thick. The subsoil reaches to a depth of 26 in. It is brown sandy clay loam in the upper part and strongly calcareous, light yellowish-brown sandy loam in the lower part. The substratum, to a depth of 60 in. or more, is strongly calcareous, very pale brown sandy loam. In the surface layer, soil reaction is neutral, but with increasing depth the reaction becomes moderately alkaline.

Ascalon soils have moderate permeability. Available water capacity for the profile is high. Roots can penetrate to a depth of 60 in. or more (Reference A-1). Ascalon soils can further be differentiated into Ascalon sandy loam 1 to 3 percent and 3 to 5 percent slopes.

Calkins Sandy Loam, 1 to 3 Percent Slopes

The Calkins series is made up of deep, somewhat poorly drained soils. They were formed in loamy alluvium. This soil is found on stream terraces and bottoms. In most places, it occurs as long, narrow areas more than 20 acres in size. The native vegetation is mainly meadow grasses. All of this soil is used for irrigated crops.

In a representative profile, the surface layer, about 40 in. thick, is grayish-brown sandy loam. Underlying this to a depth of 60 in. or more is light brownish-gray coarse sandy loam that contains many brown mottles. Soil reaction is neutral.

Calkins soils have moderate to rapid permeability. Available water capacity for the profile is moderate to high. Roots can penetrate to a depth of 60 in. or more, and the seasonal high water table is at a depth of three ft or less. Runoff is slow on this soil. The erosion hazard ard is moderate (Reference A-1).

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Table A-1. ENGINEERING INTERPRETATIONS OF SOIL PROPERTIES

Soil series and map symbols	Soil features affecting: Pond reservoir areas	Embankments and dikes	Drainage of cropland and pasture	Irrigation
Ascalon	Moderate permeability; 0 to 3 percent slopes.	Medium to low permeability; fair to good compaction; medium piping potential.	Moderate permeability.	Rapid intake rate; high available water capacity; 0 to 3 percent slopes.
Calkins	High water table; moderately rapid permeability.	Medium permeability; fair to good compaction; medium to high piping potential.	High water table; moderately rapid permeability.	Rapid intake rate; high available water capacity.
Loveland	High water table; rapid permeability below depth of 3 feet; 0 to 1 percent slopes.	High compacted permeability below depth of 3 feet; medium to low shear strength; fair compaction in the upper 3 feet.	Rapid permeability below depth of 3 feet; some outlet problems.	Moderate intake rate; moderate available water capacity.
Manter	Rapid permeability below depth of 3 feet; 0 to 3 percent slopes.	Medium compacted permeability; medium shear strength; fair compaction; high to medium piping potential.	Moderately rapid permeability.	Rapid intake rate; moderate available water capacity; 0 to 3 percent slopes.
McClave	Rapid permeability below depth of 3 feet; 3 to 9 percent slopes.	Medium compacted permeability; medium shear strength; fair compaction; high to medium piping potential.	Moderately rapid permeability.	Rapid intake rate; moderate available water capacity; 3 to 9 percent slopes.
Niwot	Water table at depth of 1/2 to 1 1/2 feet; rapid permeability below the surface layer.	High permeability; medium shear strength; good compaction.	Water table at depth of 1/2 to 1 1/2 feet; outlet problems; subject to flooding.	Water table at depth of 1/2 to 1 1/2 feet; low available water capacity; subject to flooding.

Source: Reference A-1.

Table A-2. LIMITATIONS OF THE SOILS FOR USES RELATED TO WASTEWATER TREATMENT PLANTS

Soil series and map symbols	Degree and kind of limitation for: Septic tank absorption fields	Sewage lagoons	Shallow excavations	Local roads and streets	Sanitary landfill
Ascalon	Slight.	Moderate: moderate permeability; slopes.	Slight.	Moderate: moderate shrink-swell potential.	Slight.
Calkins	Severe: water table at depth of 2 to 3 feet.	Severe: water table at depth of 2 to 3 feet.	Moderate to severe: water table at depth of 2 to 3 feet.	Moderate: water table at depth of 2 to 3 feet.	Severe: water table at depth of 2 to 3 feet.
Loveland	Severe: flooding hazard; water table at depth of 2 to 4 feet.	Severe: flooding hazard; rapid permeability below a depth of 3 feet.	Severe: flooding hazard; water table at depth of 2 to 4 feet.	Moderate: flooding hazard; moderate shrink-swell potential.	Severe: flooding hazard; sand and gravel at depth of 20 to 40 inches.
Manter	Slight.	Severe: rapid permeability in substratum.	Slight above depth of 3 feet; severe below depth of 3 feet; sandy substratum.	Slight.	Slight: pollution hazard in some places because of rapid permeability.
McClave	Moderate to severe: water table at depth of 2 1/2 to 5 feet.	Moderate to severe: water table at depth of 2 1/2 to 5 feet; moderate permeability.	Moderate: clay loam texture; water table at depth of 2 1/2 to 5 feet.	Moderate: moderate shrink-swell potential.	Severe: clay loam texture; water table at depth of 2 1/2 to 5 feet.
Niwot	Severe: flooding hazard; water table at depth of 1/2 to 1 1/2 feet.	Severe: flooding hazard; water table at depth of 1/2 to 1 1/2 feet; rapid permeability.	Severe: water table at a depth of 1/2 to 1 1/2 feet.	Moderate to severe: flooding hazard; water table at depth of 1/2 to 1 1/2 feet.	Severe: flooding hazard; water table at depth of 1/2 to 1 1/2 feet.

Source: Reference A-1.

APPENDIX B
BIOLOGICAL ENVIRONMENT

BIOTIC COMMUNITIES

Pasture/Agriculture

Vegetation--

Much of the plains area in eastern Boulder County is currently under agricultural use. Dryland wheat farming is practiced on upland sites which are sloping or unsuitable for irrigation by gravity flow (Reference B-1). Irrigated cropland is used for the production of corn (grain and silage), alfalfa, beans, barley, beets, hay and oats. Irrigated pastureland comprises the third major agricultural land use in the country.

The low-lying land south of Boulder Creek and east of 75th Street is situated within the floodplain, and much of this area is currently being utilized as pastureland. Approximately 200 acres of this unit is under consideration for land treatment facilities under the proposed project. Areas within the floodplain are generally not suitable for use as cropland because of poor drainage, stoniness and related problems (Reference B-1). The high groundwater table and the generally moister floodplain conditions cause some of these pastures to be sub-irrigated, which fosters good plant growth and allows for a greater grazing pressure than on drier areas. Other parts of the pasturelands are served by irrigation ditches. Further toward the south, between the Union Pacific Railroad tracks and Valmont Road, the soil is deeper, and there is a change in land use from pasture to irrigated cropland.

Wildlife--

A large variety of animals is associated with the Pasture/Agriculture unit, which serves primarily as a feeding and resting area. The most abundant animals are small rodents such as the eastern and desert cottontail rabbits, thirteen-line ground squirrels, deer mice, pocket mice and meadow voles. These form the typical diet of predator species such as the coyote, great-horned owl, barn owl, red-tailed hawk and other raptors. Other mammals which depend on the Pasture/

Agriculture unit are the plains pocket gopher, western harvest mouse, black-tailed prairie dog and striped skunk.

The Pasture/Agriculture habitat in the study area is often bordered by the Riparian habitat and shares many of its bird species. Common species occurring in the Pasture/Agriculture unit are the western meadowlark, black-billed magpie, grasshopper sparrow, savannah sparrow, house finch and lark bunting. The lark bunting is the official Colorado State Bird. Migrant birds common in the spring and early summer include the American goldfinch, western and mountain bluebirds, kingbirds and the predatory sparrow hawk.

Riparian

Boulder Creek and the tributary seasonal streams and ditches represent the main Riparian habitat areas. All alternatives will consider some form of wastewater discharge to Boulder Creek. Some construction activity may occur immediately adjacent to Riparian zones.

Vegetation--

Riparian vegetation occurs along Boulder Creek and is characterized by the presence of cottonwoods, willows, shrubs and herbaceous plants. Cottonwoods generally grow along watercourses, and their large size provides shade and thus modifies the microclimate in the understory. Willows frequently become established on exposed, moist or sandy sites, stabilizing the soil and allowing for the later establishment and growth of cottonwoods. Other tree species such as box elder, alder, hackberry and ash are characteristic of the Riparian zone. Major shrub species include hawthorn, chokecherry, golden currant and snowberry. Herbaceous vegetation is often dense and consists of many native and introduced mesophytic species. In those riparian areas where grazing occurs, vegetation is subject to trampling and other disturbances that often result in a poorly developed groundcover and stream bed erosion.

Wildlife--

The Riparian habitat generally provides an interface between aquatic and terrestrial ecosystems. This "edge" effect is important not only for its diversity but also for its value as food, shelter and a corridor for wildlife passage. The creek traverses several distinct areas as it flows from the foothills through the city and down onto the plains and agricultural areas. Thus, in a regional context, the narrow watercourse, lined with trees and shrubs, serves as a corridor for wildlife movements by provision of water and shelter. Boulder Creek has been the subject of recent as well as historical investigations (References B-2, B-3).

Insect and fish populations within Boulder Creek depend strongly upon stream conditions and the seasonal quality and quantity of waters entering the creek. Within the upper reaches of Boulder Creek above the Pearl Street treatment plant, the bottom substrate consists of gravel and rock, with some siltation in the pools. Benthic insects are fairly diverse, with up to 15 species, dominated by *Ephemerella* mayflies, midge larvae, caddis fly nymphs and aquatic beetles (Reference B-2). A record of benthic invertebrate sampling is presented in the latter part of Appendix B. Fish habitat is abundant, and predominant fishes are white sucker, long-nose dace and rainbow trout. A listing of fish in the study area is also given in the latter part of Appendix B. Historically, the Boulder Creek environment changes markedly after 55th Street. When the Pearl Street treatment plant outfall was operational, excess organic matter, nutrients and other pollutants depressed the dissolved oxygen level and encouraged infestations of sewage fungus, degrading the stream habitat. Fish and several major categories of insects typically disappeared from these polluted areas, leaving mainly tolerant organisms such as moth fly larvae, midge larvae and sludge worms, which tolerate low dissolved oxygen levels. With the cessation of effluent disposal from the Pearl Street outfall in May 1975, Boulder Creek has shown signs of recovery. However, organic and sediment loads from agricultural return flows, channelization and the 75th Street sewage outfall continue to make the creek a shallow, turbid, warm-water ecosystem.

Mammals living within the Riparian habitat include the beaver, muskrat, badger, marmot, skunk, prairie dog, rabbit and raccoon. While the beaver is rather rare in Boulder Creek, the muskrat and raccoon appear to utilize even highly polluted watercourses and water bodies. Other mammals favoring the Riparian zone include the harvest mouse, deer mouse, red fox and occasional mule deer.

The Riparian habitat harbors a wide diversity of bird species. A detailed listing of species probably occurring in Boulder Creek is given in Appendix B. Common species include several swallow species, loggerhead shrike, song sparrow, belted kingfisher and migrant warblers. Copper's and sharp-shinned hawks nest in the cottonwood trees near the creek and hunt small birds and rodents.

Ponds and Marshes

Former gravel mining operations along the Boulder Creek floodplain have left numerous water-filled gravel pits that have created an extensive pond and marsh environment. Within the project area, the major pond areas are the Walden Pond Wildlife Habitat Area and the Sawhill Ponds area. Both pond areas border the 75th Street treatment plant and Alternative C treatment site from the south.

Vegetation--

The pond areas are characterized by large areas of standing water, peripheral zones of emergent vegetation and steep banks. Principal plant species include cattails, bulrushes, sedges and rushes. The lack of topsoil adjacent to the ponds has led to the development of many bare areas consisting of compacted sandy soil and gravel. Vegetation is sparse in these areas and, where present, consists mainly of reeds such as Russian thistle and summer cypress.

Wildlife--

The extensive pond areas, maintained by the high groundwater levels, provide a stable year-round aquatic environment for waterfowl and other water-associated birds and animals. Records from the Walden Pond area (Reference B-4) indicate a large resident population of pied-billed grebes, Canada geese, mallards and American coots. Great blue herons are also common year-round visitants. Common shorebirds include killdeer, solitary and spotted sandpipers, greater yellowlegs and several gull species. Migrants and visitants from other ponds and reservoirs include the blue-winged teal, redhead, pin-tail and gadwall ducks.

Few mammal species utilize the pond areas because of the steep banks and sparse shore vegetation. Animals tolerating this environment are the muskrat and raccoon. Species which occasionally frequent the periphery of the pond areas may include the coyote, red fox and striped skunk. Reptiles and amphibians observed in the Walden Pond areas are the snapping turtle, painted turtle, garter snake and, rarely, the northern water snake.

Walden pond is artificially stocked with rainbow trout. Other fish species which have been introduced into the ponds are white sucker, plains sand shiner and western gambusia.

White Rocks Natural Area (WRNA)

The area known locally as the White Rocks is located north of Boulder Creek between 75th Street and 95th Street. The steep 100-ft bluffs rising directly above the creek bed contrast sharply with the flat pasturelands. This is a unique and ecologically sensitive area recognized for its unusual geologic formations and as an ecological asylum for several species of rare and endangered plants and animals. The western portion of the White Rocks area overlaps the proposed land treatment site under Alternative A.

Vegetation--

The White Rocks have been the subject of many ecological and monitoring studies in recent years (References B-5, B-6, B-7). The White Rocks area is generally within the plains grassland region, although its expansive sandstone outcroppings and its abrupt transition to the riparian zone at Boulder Creek provide many varied habitats for plant life. Typical dry uplands vegetation occurs along the upper reaches of the White Rocks where there is adequate soil development. Extensive exposed sandstone areas provide a harsh environment for plant growth, with hardy plants such as yucca, prickly pear, big bluestem and needle grass precariously established in pits, cracks and other areas of soil accumulation. A few ponderosa pine and some shrubs such as skunkbrush, fourwing saltbrush plum, currant, chokecherry and Bessey cherry are found in scattered locations along the bluffs. Many more plant species are found on the rocks. At the base of the White Rocks, cottonwoods and other riparian vegetation occur within the WRNA.

The extremely rare fern *Asplenium andrewseii* occurs underneath overhanging ledges of a particular stratum on the cliffs. Formerly identified as *Asplenium adiantum-nigrum*, this fern was recently recognized by the Department of the Interior, Endangered Species Program in 1977 as an endangered species. Its occurrence is dependent on the unique environmental conditions found at this site. Human activities such as generation of dust and gaseous pollutants (smog), changes in microclimate or physical disturbances may affect this species ability to survive. Two other rare plants, forktip three awn grass (*Aristida basiramea*) and American potato bean (*Apios americana*) also occur at the WRNA (References B-8, B-9).

Wildlife--

The White Rocks area provides a distinct wildlife habitat within the project area. The juxtaposition of tall bluffs overlooking the lowlying Boulder Creek and pasture areas creates an important "edge" effect. Resident cliff-nesting species include the barn owl, great horned owl, kestrel, and several swallow species. The two owl species are not common to the area, depending largely upon the White Rocks for nesting sites. The bluffs are also used as resting and surveillance points by resident red-tailed hawks and migratory hawks such as Swainson's hawk, ferruginous, rough-legged and Harlans hawks as well as immature golden and bald eagles. (Reference B-10). Cottonwood trees at the base of the White Rocks, adjacent to the creek, also harbor flickers, eastern kingbirds, western meadowlarks, numerous migrant warblers and sparrows, kestrels and wrens. (Reference B-8).

Small rodents such as mice, squirrels and rabbits are common. These mammals occupy niches along the cliff base and under brush and fallen trees in the floodplain. Other mammals include skunks, marmots, badgers and raccoons. The main predators are the red fox and coyote. The red fox has been observed in the WRNA and probably nests within sheltered rock hollows.

Several unusual and rare animals have been found at White Rocks. Dr. Robert Gregg, an entomologist at the University of Colorado, has collected several rare ant species at the WRNA (Reference B-11). *Aphaenogaster fulva*, an ant species common east of the Mississippi River, occurs along the bluffs. Three other rare western species found in the area are *A. huachucana, Formica oriniventris and Lasius occidentalis*. The mining bee, *Perdita opuntiae,* is also found along the lower rock faces. This species is unique to the area, drilling narrow burrows into the sandstone cliffs to accommodate its hives (Reference B-12). The face of the White Rocks is marked by numerous depressions which gather rainwater and dry up shortly afterwards. Due to evaporation, water in the pits becomes relatively saline. An interesting phenomenon is the ephemeral fairy shrimp found in these pits which complete their life cycle in the duration of a few days to a few weeks when these "solution pits" occur.

Residential/Urban

Vegetation--

The Residential/Urban unit refers to that land which is currently being utilized for some form of human activity other than agriculture or mining. Within the vicinity of the proposed project, areas that can be characterized as Residential/Urban are the Heatherwood Estates Gunbarrel Greens and the 75th Street sewage treatment plant. The Heatherwood Estates is a recent development occupying approximately 200 acres within a former dryland farming area. The 75th Street sewage treatment plant is situated south of Boulder Creek within a floodplain meadow that consists of grasses, weeds and a few cottonwoods along the riparian interface. Several farm homes scattered along 75th Street Road and Valmont Road supplement the Residential/Urban unit. In the past, residential areas, particularly Heatherwood Estates and Gunbarrel Greens, have been subject to odor problems downwind of the 75th Street treatment plant.

Wildlife--

Birds and animal species found within the proximity of residential or urban developments are generally those species which are either (1) tolerant of human disturbances, (2) dependent upon human activities, (3) introduced by humans or (4) some combination of the three. Bird species occurring near residential and urban areas are Stellar's jay, robin, mockingbird, starling, house finch and several sparrow species.

Small mammals occasionally found in and around buildings include the house mouse, Norway rat, plains pocket gopher and fox squirrel. The raccoon, striped skunk and red fox are infrequently observed in populated areas.

Gravel Mining Areas--

Within the project area, gravel mining operations are currently conducted by the Flatiron Sand and Gravel Company on approximately 250 acres east of 75th Street within the Boulder Creek floodplain. Much ecological and monitoring study has preceded the present operations, and the principals are firmly committed to restoring that part of the floodplain to an ecologically sound condition (References B-7, B-8). The proposed land treatment site under Alternative C will be subject to gravel mining by a private firm prior to usage as a treatment area.

Vegetation--

The gravel mining operations by Flatiron generally proceed from October through March. Reclamation of the bare gravel pits with trees and grasses occurs annually during March and April. The master plan for the reclamation project will be staged over nine years and calls for the recreation of riparian woodlands, dry grasslands, wet sedge meadows and numerous lakes. At present, the revegetation program has had limited success, with scanty cottonwood regeneration and numerous bare areas. In the last two years, young tree plantings have been subject to beaver depredations. A portion of the site has been reserved as a nursery area for cultivating native trees and shrubs.

Wildlife--

The gravel mining area represents a highly disturbed environment. Mining activities, equipment noise and particulate emissions during the operating season are partial wildlife deterrents. From March through September, when mining operations are idle, wildlife move more freely from the adjacent areas. Annual wildlife monitoring programs and maintenance of test plots are conducted on the reclamation sites.

Aquatic bird species frequenting the groundwater-filled gravel pits are the pied-billed grebe, blue-winged teal, ring-necked duck, killdeer, spotted sandpiper and several gull species. Birds observed in the vicinity of the pond areas include red-winged blackbird, western meadowlark, barn swallow, mourning dove and several sparrow species (Reference B-7).

Within the gravel pits area, mammals are represented by species tolerant to human presence such as muskrats and raccoons. Prairie dogs have colonized one dry gravel pit area where the water table was lowered and vegetation succeeded toward upland grassland species. These rodents have been reported in numbers of 10 per acre and appear to be a stable population (Reference B-13). Some concern has been expressed by the local residents and by Flatiron Company that these animals may be a reservoir for "prairie-dog plague," which can also affect humans. Future control measures may include dusting the animals to kill plague-carrying fleas. Reptiles and amphibians recorded in the gravel pit ponds are the leopard frog, western chorus frog, snapping turtle and northern water snake. Fish species successfully introduced into the ponds include the largemouth bass, white sucker, green sunfish, bluegill and pumpkinseed (Reference B-7).

Table B-1. BENTHIC INVERTEBRATES OF BOULDER CREEK

Sample Locations	Upstream E. Pearl WWTP		Downstream E. Pearl WWTP		Upstream 75th St. WWTP		Downstream 75th St. WWTP		95th St. Bridge	
	N/m^2 (1)	g/m^2	N/m^2	g/m^2	N/m^2	g/m^2	N/m^2	g/m^2	N/m^2	g/m^2
Mayflies Ephemeroptera										
Ephemerella sp.	270	6.930	7	0.360	5	0.145				
Baetis sp.	7	0.530							5	0.040
Rhithrogena sp.	10	0.190								
Stoneflies Plecoptera										
Isoperla sp.	7	0.017								
Pteronarcella sp.	7	0.850								
Acroneuria sp.	7	0.327								
Caddisflies Trichoptera										
Hydropsyche sp.	67	1.050	3	0.040					•	
Brachycentrus sp.	3	0.003								
Lepidostoma sp.	10	0.010	3	0.003						
Diptera										
Midges Tendipedidae	690	0.307			270	0.590	145	0.175	375	0.765
Snipe flies Atherix sp.	17	0.343								
Moth flies Psychodidae			257	0.423						
Crane flies Tipula sp.									5	8.120
Freshwater shrimp Amphipoda										
Hyalella azteca	3	0.020			20	0.115			370	2.045
Beetles Coleoptera										
Stenelmis sp. (larvae)	53	0.040								
(adult)	23	0.030								
Elmidae (larvae)							5	0.130		
Annelida										
Sludgeworms Tubificidae	13	0.007	3	0.007	400	2.645	80	0.130	525	0.215
Sowbugs Isopoda										
Asellus militaris					5	0.240			90	2.190
Leeches Hirudinea										
Helobdella nepheloidea							10	1.565	225	26.830
TOTAL	1187	10.177	273	0.833	700	3.735	240	1.880	1585	40.230

(1) N/m^2 number per meter square; g/m^2 grams per meter square

Source: From Stoecker-Keammerer & Associates, "The Ecology of Boulder Creek: Environmental Inventory and Evaluation of Sewage Treatment Alternatives," prepared for CH2M HILL.

Table B-2. BIRD SPECIES AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA[a]

		Biotic communities					
Common name	Scientific name	Pasture/Agric. 1	Riparian 2	Ponds/Marshes 3	White Rocks[b] 4	Residential 5	Gravel Pits 6
GREBES	*PODICIPEDIFORMES*						
Horned grebe	*Podiceps auritus*			O			
Eared grebe	*Podiceps caspicus*			R			
Pied-billed grebe	*Podilymbus podiceps*			C			O
Western grebe	*Aechmophorus occidentalis*			O			
WATERFOWL	*ANSERIFORMES*						
Canada goose	*Branta canadensis*			A	C		
Snow goose	*Chen hyperborea*			R			
Mallard	*Anas platyrhynchos*	R	O	A	C		O
Pintail	*Anas acuta*		O	O	O		
Gadwall	*Anas strepera*			C			
American widgeon	*Mareca americana*			O	O		
Northern shovelor	*Spatula clypeata*			O			
Blue-winged teal	*Anas discors*			C	O		O
Cinnamon teal	*Anas cyanoptera*			O			
Green-winged teal	*Anas carolinensis*		O	O	O		O
Wood duck	*Aix sponsa*			R			
Redhead	*Aythya americana*			C			
Canvasback	*Aythya valisineria*			R			
Ring-necked duck	*Aythya collaris*			O			O
Common goldeneye	*Bucephala clangula*			O			
Barrow's goldeneye	*Bucephala islandica*			R			
Bufflehead	*Bucephala albeola*			O			
Greater scaup	*Aythya marila*			O			
Lesser scaup	*Aythya affinis*			O			
Ruddy duck	*Oxyura jamaicensis*			O			
Common merganser	*Mergus merganser*			O			
Red-breasted merganser	*Mergus serrator*			O			
VULTURES, HAWKS	*FALCONIFORMES*						
Turkey vulture	*Cathartes aura*	O	O	O	O	O	O
Cooper's hawk	*Accipiter cooperii*	O	O		O	R	
Sharp-shinned hawk	*Accipiter striatus*	O	O		R	R	
Marsh hawk	*Circus cyaneus*	O	O	C	C		
Swaison's hawk	*Buteo swainsoni*	O			O		
Rough-legged hawk	*Buteo lagopus*	O	O		O		
Ferruginous hawk	*Buteo regalis*	O	R		R		
Red-tailed hawk	*Buteo jamaicensis*	C	R		C		
Golden eagle	*Aquila chrysaetos*	R	R		O		
Osprey	*Pandion haliaetus*			R			
Prairie falcon	*Falco mexicanus*	R	R		O		
Pigeon hawk	*Falco columbarius*	R	R		R	R	
Sparrow hawk	*Falco sparverius*	A	R		C		
Harlan's hawk	*Buteo harlani*	R	R		R		
Bald eagle	*Haliaeetus leucophalus*				R		
GALLINACEOUS BIRDS	*GALLIFORMES*						
Ring-neck pheasant	*Phasianus colchicus*	O	C	C	C		

Table B-2 (continued). BIRD SPECIES AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA[a]

Common name	Scientific name	Biotic communities: 1 Pasture/Agric.	2 Riparian	3 Ponds/Marshes	4 White Rocks[b]	5 Residential	6 Gravel Pits
HERONS	*CICONIIFORMES*						
Common egret	*Casmerodius albus*			R			
Snowy egret	*Leucophoyx thula*		O	O	R		
Great blue heron	*Ardea herodias*		O	C	O		
Green heron	*Butorides virescens*		O	C	O		
Black-crowned night heron	*Ncyticorax nycticorax*			C	O		
Yellow-crowned night heron	*Nyctanassa violacea*			R			
American bittern	*Botaurus lentiginosus*			C			
Least bittern	*Ixobrychus exilis*			R			
White-faced ibis	*Plegadis chihi*			R			
CRANES, RAILS	*GRUIFORMES*						
Virginia rail	*Rallus limicola*			C			
Sora	*Porzana carolina*			C			
Yellow rail	*Coturnicops noveboracensis*			R			
Common gallinule	*Gallinula chloropus*			R			
American coot	*Fulica americana*		O	C	O		
SHOREBIRDS, GULLS	*CHARADRIIFORMES*						
American avocet	*Recurvirostra americana*			O	O		
Killdeer	*Charadrius vociferus*	O	O	A	O		O
Solitary sandpiper	*Tringa solitaria*			O			
Spotted sandpiper	*Acitis macularia*			O			O
Willet	*Catoptrophorus semipalmatus*			O			
Greater yellowlegs	*Totanus melanoleucus*			C			R
Lesser yellowlegs	*Totanus flavipes*			O			
Long-billed dowitcher	*Limnodromus scolopaceus*			O			
White-rumped sandpiper	*Erolia fuscicollis*			C			
Semipalmated sandpiper	*Ereunetes pusillus*			O			
Western sandpiper	*Ereunetes mauri*			O			
Baird's sandpiper	*Erolia bairdii*			R			
Red phalorope	*Phalaropus fulicarius*			R			
Wilson's phalarope	*Steganopus tricolor*			R			
American woodcock	*Philohela minor*			R			
Common snipe	*Capella gallinago*			C	C		R
Herring gull	*Larus argentatus*		R	O	O		O
California gull	*Larus californicus*			O			O
Ring-billed gull	*Larus delawarensis*		R	C	O		O
Franklin's gull	*Larus pipixcan*	O		C	O		O
Forster's tern	*Sterna forsteri*			R			R
PIGEONS, DOVES	*COLUMBIFORMES*						
Band-tailed pigeon	*Columba fasciata*	R					
Rock dove	*Columba livia*	O		O	C		
Mourning dove	*Zenaidura macroura*	A	O	A	C	O	O

Table B-2 (continued). BIRD SPECIES AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA[a]

Common name	Scientific name	Biotic communities: Pasture/Agric. 1	Riparian 2	Ponds/Marshes 3	White Rocks 4	Residential 5	Gravel Pits 6
OWLS	*STRIGIFORMES*						
Screech owl	*Otus asio*	O	O		R	O	
Great horned owl	*Bubo virginianus*	O	R		C	R	
Long-eared owl	*Asio otus*	R	R		O		
Short-eared owl	*Asio flammeus*	R		R			
Barn owl	*Tyto alba*	O			O		
Burrowing owl	*Speotyto cunicularia*	R		R	R		
NIGHTHAWKS	*CAPRIMULGIFORMES*						
Common nighthawk	*Chordeiles minor*	C			O		
Lesser nighthawk	*Chordeiles acutipennis*	O					
HUMMINGBIRDS, SWIFTS	*APODIFORMES*						
Broad-tailed hummingbird	*Selasphorus platycercus*	O	O			O	
KINGFISHERS	*CORACIIFORMES*						
Belted kingfisher	*Megaceryle alcyon alcyon*		C	O	O		O
WOODPECKERS	*PICIFORMES*						
Red-shafted flicker	*Colaptes cafer collaris*	O	O	O	C	C	
Yellow-shafted flicker	*Colaptes auratus*		R		R		
Red-headed woodpecker	*Melanerpes erythrocephalus*		R		O		
Lewis' woodpecker	*Asyndesmus lewis*	O	R		R		
Yellow-bellied sapsucker	*Sphyrapicus varius*		R				
Hairy woodpecker	*Dendrocopos villosus*		O				R
Downy woodpecker	*Dendrocopos pubescens*	R	O		R		O
PERCHING BIRDS	*PASSERIFORMES*						
Eastern kingbird	*Tyrannus tyrannus*	C			C	O	
Western kingbird	*Tyrannus verticalis*	C			O	O	
Cassin's kingbird	*Tyrannus vociferans*	O					
Eastern wood peewee	*Contopus virens*	O					
Western wood peewee	*Contopus sordidulus*	O					
Say's phoebe	*Sayornis saya*	O	O		O		
Dusky flycatcher	*Empidonax obholseri*	R	R		R		
Horned lark	*Eremophila alpestris*	O	R		R		
Barn swallow	*Hirundo rustica*		C	C	C		C
Cliff swallow	*Petrochelidon pyrrhonota*		O	O	C		O
Violet-green swallow	*Tachycineta thalassina*		C	C			
Tree swallow	*Irodoprocne bicolor*		C	C			
Bank swallow	*Riparia riparia*		C	C			
Rough-winged swallow	*Stelgidopteryx ruficollis*		C	C	O		R
Black-billed magpie	*Pica pica*	C			A	O	O
Stellar's jay	*Cyanocitta stelleri*				R	O	
Common raven	*Corvus corax*	O		O	O		
Common crow	*Corvus brachrhynchos*	O	O		O		

Table B-2 (continued). BIRD SPECIES AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA[a]

Common name	Scientific name	Biotic communities: 1 Pasture/Agric.	2 Riparian	3 Ponds/Marshes	4 White Rocks	5 Residential	6 Gravel Pits
Black-capped chickadee	*Parus atricapillus*	R	O		C	O	
Mountain chickadee	*Parus gambeli*		O		O	R	
Dipper	*Cinclus mexicanus*		R		R		
Brown creeper	*Certha familiaris*		O		O		
Pygmy nuthatch	*Sitta pygmaea*		O		O		
Red-breasted nuthatch	*Sitta canadensis*		R		R		
White-breasted nuthatch	*Sitta carolinensis*		O		O		
Long-billed marsh wren	*Telmatodytes palustris*			R			
Winter wren	*Troglodytes troglodytes*		O	O	O		
Mockingbird	*Mimus polyglottos*			O		O	
Catbird	*Dumetella carolinensis*			O			
Robin	*Turdus migratorius*	C	R	O	C	C	O
Townsend's solitaire	*Myadestes townsendi*	C	C		O	R	
Hermit thrush	*Hylocichla mustelina*		O		O		
Swainson's thrush	*Hylocichla ustulatia*		O		O		
Western bluebird	*Sialia mexicana*	O			O		
Mountain bluebird	*Sialia currucoides*	O			R		
Ruby-crowned kinglet	*Regulus calendula*		O	O	O		
Golden-crowned kinglet	*Regulus satropa*		R		R		
Water pipit	*Arthus spinoletta*	O					
Bohemian waxwing	*Bombycilla garrulus*		O		O	O	
Cedar waxwing	*Bombycilla cedorium*		R		R	R	
Water pipit	*Arthus spinoletta*	O					
Northern shrike	*Lanius excubitor*	C	C	C	O		R
Loggerhead shrike	*Lanius ludovicianus*	C	C	C	C	O	R
Starling	*Sturnus vulgaris*	C	R	C	A	C	O
Red-eyed vireo	*Vireo olivaceus*		O				
Warbling vireo	*Vireo gilvus*		O				
Bell's vireo	*Vireo bellii*		O				
Tennessee warbler	*Vermivora peregrina*		O	O			
Orange-crowned warbler	*Vermivora celata*		O	O			
Nashville warbler	*Vermivora ruficapilla*		O	O	O		
Virginia's warbler	*Vermivora virginiae*		O	O	R		
Yellow warbler	*Dendroica petechia*		C	C	C	O	
Myrtle warbler	*Dendroica coronata*		O	O	O		
Audobon's warbler	*Dendroica auduboni*		O	O	O		
Yellowthroat	*Geothlypis trichas*		C	C	O	O	
Wilson's warbler	*Wilsonia pusilla*		O	O	O		
Ovenbird	*Seiurus aurocapillus*		O		O	O	
Northern waterthrush	*Seiurus noveboracensis*	O		O			
Yellow-breasted chat	*Icteria virens*		O		O	O	
Macgillivray's warbler	*Oporornis tolmiei*		O		O		
Hooded warbler	*Wilsonia citrina*		R		R	R	
American redstart	*Setophaga ruticilla*		R	R	R	R	
House sparrow	*Passer domesticus*	C			C	C	
Western meadowlark	*Sturnella neglecta*	A			A	O	O
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*		O	C	R		
Red-winged blackbird	*Agelaius phoeniceus*	O	O	C	A	O	O
Brewer's blackbird	*Euphagus cyanocephalus*	O	O	C	C		R
Common grackle	*Quiscalus quiscula*		R	O	O		R

Table B-2 (continued). BIRD SPECIES AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA[a]

Common name	Scientific name	Biotic communities: Pasture/Agric. 1	Riparian 2	Ponds/Marshes 3	White Rocks 4	Residential 5	Gravel Pits 6
Brown-headed cowbird	*Molothrus ater*	O	O		O		
Bullock's oriole	*Icterus bullockii*	C			C		
Western tanager	*Piranga ludoviciana*	O	R		R		
Scarlet tanager	*Piranga olivacea*	O	O		O	O	
Blue grosbeak	*Guiraca caerullea*	O	R		R		
Evening grosbeak	*Hesperiphona vespertina*		O		O	R	
Indigo bunting	*Passerina cyanea*	O					
Lazuli bunting	*Passerina amoena*	O			O		
Cassin's finch	*Carpodacus cassinii*	O	R		O		
House finch	*Carpodacus mexicanus*	C	O		C	C	
Pine siskin	*Spinus pinus*		O		C		
American goldfinch	*Spinus tristis*	C	C		C	O	
Lesser goldfinch	*Spinus psaltria*	O	O		O		
Rufous-sided towhee	*Pipilo erythrophthalmus*		O		O	O	
Green-tailed towhee	*Chlorura chlorura*		O		O		
Savannah sparrow	*Passerculus sandwichensis*	C					
Grasshopper sparrow	*Ammodramus savannarum*	C					
Baird's sparrow	*Ammodramus bairdii*	R					
Lark bunting	*Calamospiza melanocorys*	O			R		
Vesper sparrow	*Pooecetes gramineus*	O					
Lark sparrow	*Chondestes grammacus*	O					
Slate-colored junco	*Junco hyemalis*	O	R		O	R	
Oregon junco	*Junco oreganus*	O	A		C	A	
Gray-headed junco	*Junco caniceps*		R		O	R	
White-winged junco	*Junco aiken*		O		O		
Tree sparrow	*Spizella arborea*	A	A		C	R	O
Chipping sparrow	*Spizella passerina*	O				O	
Clay-colored sparrow	*Spizella pallida*		O		O		
Brewer's sparrow	*Spizella breweri*	O					
Harris' sparrow	*Zonotrichia querula*					O	
White-crowned sparrow	*Zonotrichia leucophrys*	R	A		O	R	O
Gambel's sparrow	*Zonotrichia leucophrys gambeli*		R		O		
Le Conte's sparrow	*Passerherbulus caudacutus*		O	C	O		
Fox sparrow	*Passerella iliaca*		O		R	O	
Lincoln's sparrow	*Melospiza lincolnii*		O	C	O		
Song sparrow	*Melospiza melodia*	R	A	A	C		O
Swamp sparrow	*Melospiza georgian*		R		R		

[a]Key to occurrence: A = abundant C = common O = occasional R = rare

[b]White Rocks Natural Area as Defined in Boulder County Comprehensive Plan

Table B-3. ANIMAL SPECIES AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA

Common name	Scientific name	Biotic communities: 1 Pasture/Agric.	2 Riparian	3 Ponds/Lakes	4 White Rocks	5 Residential	6 Gravel Pits
RABBITS	*LAGOMORPHA*						
Blacktail jackrabbit	*Lepus californicus*	x			x	x	x
Eastern cottontail	*Sylvilagus floridanus*	x			x		
Desert cottontail	*S. audubonii*	x			x		
Mountain cottontail	*S. nuttalli*				x		
RODENTS	*RODENTIA*						
Yellow-bellied marmot	*Marmota flaviventris*		x		x		
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	x			x		
Rock squirrel	*S. variegatus*		x		x		
Black-tailed prairie dog	*Cynomys ludoricianus*	x			x		
Fox squirrel	*Sciurus niger*		x		x	x	
Colorado chipmunk	*Eutamias quadrivattus*				x		
Plains pocket gopher	*Geomys bursarius*	x			x		
Hispid pocket mouse	*Pergonathus hispidus*	x			x		
Beaver	*Castor canadensis*		x		x		
Western harvest mouse	*Reithrodontomys megalotis*	x	x	x	x		
Deer mouse	*Peromyscus maniculatus*	x	x	x	x		
Mexican woodrat	*Neotoma mexicana*		x		x		
Meadow vole	*Microtus pennsylvanicus*	x			x		
Prairie vole	*M. ochrogaster*	x			x		
Muskrat	*Ondatra zibethicus*		x	x	x		x
House mouse	*Mus musculus*	x			x	x	
Norway rat	*Rattus norvegicus*		x		x	x	
CARNIVORES	*CARNIVORA*						
Coyote	*Canis latrans*	x	x	x	x		x
Red fox	*Vulpes vulpes*		x	x	x		
Raccoon	*Procyon lotor*		x	x	x	x	x
Badger	*Taxidea taxus*		x		x		
Striped skunk	*Mephitis mephitis*		x	x	x	x	x
HOOFED ANIMALS	*ARTIODACTYLA*						
Mule deer	*Odocoileus hemionus*		x		x		

Table B-4. REPTILES AND AMPHIBIANS AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA

Common name	Scientific name	Biotic communities: Pasture/Agric. 1	Riparian 2	Ponds/Lakes 3	White Rocks 4	Residential 5	Gravel Pits 6
FROGS AND TOADS	*ANURA*						
Leapord frog	*Rana pipiens*				C		O
Western chorus frog	*Pseudacris triseriata*						O
Rocky Mountain toad	*Bufo woodhousei woodhousei*			R	R	R	
SALAMANDERS	*URODELA*						
Utah tiger salamander	*Ambystoma tigrinum nebulosum*		R	R	R		
TURTLES	*CHELONIA*						
Snapping turtle	*Chelydra serpentina*			O	C		O
Painted turtle	*Chrysemys picta*			O	O		
SNAKES AND LIZARDS	*SQUAMATA*						
Six-lined racerunner	*Chemidophorus sexlineatus*						
Red-lipped rock lizard	*Sceloporus undulatus crythrocheilus*				R		
Garter snake	*Thamnophis sirtalis*		O	O	O		
Bull snake	*Pituophis catenifer*	O			C	O	O
Northern water snake	*Natrix sipedon*			R	R		R
Prairie rattlesnake	*Crotalus viridus*	R			C		R
Hog-nosed snake	*Heterodon nasicus hasicus*	O			O		
Western smooth green snake	*Opheodrys vernalis blanchardi*			R	R		
Wandering garter snake	*Thamnophis elegans vagrans*		R	R	R		
Western plains garter snake	*Thamnophis radix haydeni*		R	R	R		

Table B-5. FISH SPECIES AND THEIR PROBABLE OCCURRENCE WITHIN STUDY AREA

Common name	Scientific name	1 Boulder Creek-north[a]	2 Boulder Creek-75th St.[a]	3 Boulder Creek-95th St.[a]	4 Walden Pond Area[b]	5 Gravel Ponds[c]
Rainbow trout	*Salmo gairdneri*	x			x	
Brown trout	*Salmo trutta*	x				
Largemouth bass	*Micropterus salmoides*					x
White sucker	*Catostomus commersoni*	x			x	x
Longnose dace	*Rhinichthys cataractae*	x				
Northern creek chub	*Semotilus atromaculatus*	x				
Plains sand shiner	*Notropis deliciosus*				x	
Green sunfish	*Lepomus cyanellus*					x
Pumpkinseed	*Lepomus gibbosus*					x
Bluegill	*Lepomus macrochirus*					x
Western gambusia	*Gambusia affinis*				x	

[a]Based on records of Stoecker-Keammerer Associates, 1974.

[b]Based on records and personal communication with Boulder County Parks and Open Space Department, 1975-1976.

[c]Based on data from ERTL property special use permit, 1976.

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APPENDIX C
THE AESTHETICS OF A LANDSCAPE AS A RESOURCE COMMODITY

The National Environmental Policy Act of 1969 clearly expressed the objective of treating aesthetic resources on an equal level with natural and social resources. The Act states that all Federal agencies shall "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment" (Reference C-1). Unlike the natural and social resources (such as soils, vegetation, wildlife, air quality, population, traffic circulation, etc.), aesthetic resources are difficult to measure in standard or meaningful units that not only describe the aesthetic resource, but that also enable a specific determination to be made of a project's impact on that resource. Aware of this difficulty and reemphasizing its objective of equal treatment of aesthetic resources, NEPA goes on to state that all Federal agencies shall "identify and develop methods and procedures...which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations" (Reference C-1).

Techniques for measuring the aesthetic resource are still evolving. A recent Forest Service bibliography entitled "Measuring Scenic Beauty" (Reference C-2) lists 165 entries, of which 95 percent were written after 1965. The aesthetic consequences of public land management decisions are often the most immediate and noticeable, yet planners have difficulty assessing scenic resources equally with natural and social resources because the latter are more easily measured (Reference C-2). An additional practical concern with aesthetics in project planning stems from two primary sources: (1) the planner's concern to ensure the ultimate success or acceptance of the project by the community; and (2) the concern to meet the requirements outlined in regulatory guidelines for publicly funded projects (Reference C-3).

A starting point for the measurement of the aesthetic resource, as developed by Litton (References C-4, C-5 and C-6), comes from the recognition of the landscape as a resource in its own right. Thus, as with other natural resources, such as timber, soil and wildlife, the landscape is inventoried and thereby integrated into the overall land management plan. Litton has developed parameters for studying the landscape as a resource, and a brief outline of these is presented in the following paragraphs (Reference C-4).

In discussing the landscape as a visual resource, certain land management terms suggest the scope of objectives available to the planner. These terms include: Preservation, Protection, Maintenance, Enhancement, Degradation, Rehabilitation, Restoration and Remodeling. Within the context of these general land-management concepts, the following Attributes of the Landscape are identified:

A. Factors of Recognition

1. Form 2. Space 3. Time Variability	Primary
4. Observer Position 5. Distance 6. Sequence	Secondary

B. Landscape Compositional Types

1. Panoramic
2. Feature
3. Enclosed
4. Focal
5. Forest or Canopied

Primary factors of recognition are those which are beyond the capacity of the observer to change, but can be degraded. Secondary factors describe relationships between the observer and the landscape, and can be manipulated. Form relates particularly to the convex elements of land form, and space is made up of concave elements. Some kind of contrast must be present if form or space are obvious. Kinds of contrast include: Isolation, Dominance by relative size or scale, Contour Distinction and Surface Variance. Space is further modified by four factors: Proportions, Constitution, Configuration and Scale or Relative Size. Time Variability represents the primary factor of short-term change and includes (1) Light and Color and (2) Ephemeral Influences, which are seasonal, diurnal or momentary.

Observer Position can be characterized as (1) observer inferior, (2) observer normal and (3) observer superior, these terms indicating, respectively, whether the observer is below, level with or above the visual objective. Distance relationships are relative and can be expressed as Foreground, Middleground and Background. Middleground is critical as the area where man-made changes may blend in or intrude upon the landscape. Sequence describes the way in which the landscape is seen bit by bit.

A Panoramic landscape is characterized by the absence of enclosure, and is a horizontally-oriented placid arrangement of great stability. A Feature landscape is one in which a single thing or cohesive set of related elements dominates their surroundings. The Enclosed landscape is marked by its concavity, and the Focal landscape is composed of elements that appear to converge upon a point. The Forest or Canopied landscape refers to that arrangement within the forest itself, under the envelopment of the leaf canopy and upon the ground plane.

Having established the above Attributes of the Landscape, Litton presents several means of evaluating the landscape for aesthetic quality. Three basic aesthetic criteria are recognized: unity, vividness and variety.

Unity is that quality of wholeness in which all parts cohere as a unit. The five Landscape Compositional Types represent compositions that illustrate this cohesive state. Man-made changes have the potential for breaking unity and diminishing quality. The absence of unity (i.e., fragmentation) indicates the absence of aesthetic quality.

Vividness is that quality in the landscape which gives it distinction and makes it visually striking. Similarity and Contrast are two ways vividness can be expressed. Similarity involves the repetition of like or similar characteristics. Man-made changes that depend upon concepts of similarity have maximum potential of maintaining this particular kind of vividness. Contrast puts sharply different things or qualities together. Man-made changes in the landscape are apt to be noticed for their contrast, but are often negative in quality. Litton states that the greatest care must be exercised in designing changes that will become conspicuous because of contrasts.

Variety represents how many different objects and relationships are present in a landscape. Greater variety often is an indication of higher aesthetic quality. The five Landscape Compositional Types represent frameworks into which variety may be visually integrated.

The above presentation of Litton's methodology is not intended to be a definitive summary of his work, nor does it represent a summary of the state of the art. This methodology has been used in this EIS to evaluate the Aesthetic Resources as they are affected by the proposed Boulder Wastewater Facilities Plan.

REFERENCES FOR APPENDIX C

C-1 The National Environmental Policy Act of 1969, Public Law 91-190, Sec. 102, January 1, 1970.

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APPENDIX D
EVALUATION OF INFILTRATION/PERCOLATION BASINS AT THE 95TH STREET SITE AND AN AGRICULTURAL REUSE PROGRAM

INTRODUCTION

This appendix presents additional detail on two areas of investigation in response to comments made on the August 1977 Draft Environmental Impact Statement (EIS) on Wastewater Treatment Facilities, Boulder, Colorado. This new information, in conjunction with the earlier analyses in the EIS, will be used by the City of Boulder, Boulder County and the U. S. Environmental Protection Agency (EPA) to select a new wastewater treatment system for the Boulder Wastewater Facilities Planning Area.

Background

The draft EIS evaluated eight alternative projects to modify existing treatment facilities to meet newly-upgraded water quality standards in Boulder Creek. The eight alternatives were: (A) infiltration/percolation basins, (B) activated-sludge process following existing trickling filters, (C) aeration/polishing ponds, (D) activated-sludge process prior to trickling filters, (E) multi-media filtration, (F) chemical coagulation, (G) high-rate irrigation upon agricultural land, and (H) no action. Except for alternatives F and H, all projects involved sludge injection for agricultural reuse. A preliminary screening eliminated E, F, and H from further consideration since they were technically unable to meet state and local water quality goals. Thus, the draft EIS primarily examined the five remaining alternatives and their environmental impacts.

In August 1977, EPA distributed the draft EIS to federal, state, and local agencies as well as to interested groups and individuals for review and comment. Attention was focused on Alternatives A, B and C as the most cost-effective treatment systems. After numerous public meetings, local agency meetings, and a public hearing, the majority of Boulder City and County residents favored Alternative B for the wastewater treatment processes but were undecided as to the acceptability of sludge injection. Alternative B represented a compromise agreement; for although it would be more costly and energy-intensive, it did not have the controversial environmental impacts associated with Alternatives A or C.

In February 1978, EPA decided that further work was needed before one alternative could be recommended for design and construction under federal funding. Subsequently, EPA contracted Engineering-Science to perform the necessary follow-up.

Project Development

The review process revealed two areas requiring further work. They are: (1) an investigation of a new site for infiltration/percolation basins, (2) the development of an agricultural reuse program.

The draft EIS shows Alternative A, infiltration/percolation basins, to be a cost-effective method of providing high quality effluent; the proposed site, however, was unacceptable to local residents and probably to units of local government. EPA believed that relocation of the basins could possibly resolve this conflict without sacrificing the technical or economical effectiveness of this alternative.

An agricultural reuse program, which uses treated wastewater for irrigating agricultural land, is being developed because it is an attractive solution that can satisfy both water quality and reuse goals. The Boulder facilities plan discusses this landbased system only as a possible upgrading process to follow any of the more conventional treatment alternatives. Boulder County residents and district water users, however, feel that such a system warrants further study at this time. Feasibility of the reuse program should be based on water exchanges rather than on massive land purchases as evaluated in the preliminary assessment.

Description of Alternative Sites and Systems

The three alternative wastewater and sludge management systems evaluated in this appendix are:

1. Infiltration/Percolation Basins, 95th Street Site--Secondary effluent from the existing plant would be pumped 2-1/2 miles to infiltration/percolation basins where further polishing would occur before discharge to Boulder Creek. The basic unit processes are the same as those in Alternative A in the EIS; only the site of the basins differ. Soil characteristics at the new 95th Street site will determine the need for a tile underdrain system and area requirements.

2. Agricultural Reuse Program--A pump station and force main would convey secondary effluent from the existing plant to one or more local irrigation ditches. Individual farms within the ditch companies would then draw treated effluent for crop irrigation. During the non-irrigation season, treated effluent would be conveyed along the irrigation ditch(es) and/or pipeline(s) to a new storage reservoir or to an existing one such as Panama Reservoir for future irrigation uses. The City of Boulder would thus exchange treated effluent for water that would normally have been drawn from Boulder Creek by the ditch companies. This agricultural reuse program would work towards fulfilling the EPA goal of zero discharge to surface waters.

INFILTRATION/PERCOLATION BASINS AT 95TH STREET SITE

System Description

Treatment Processes--

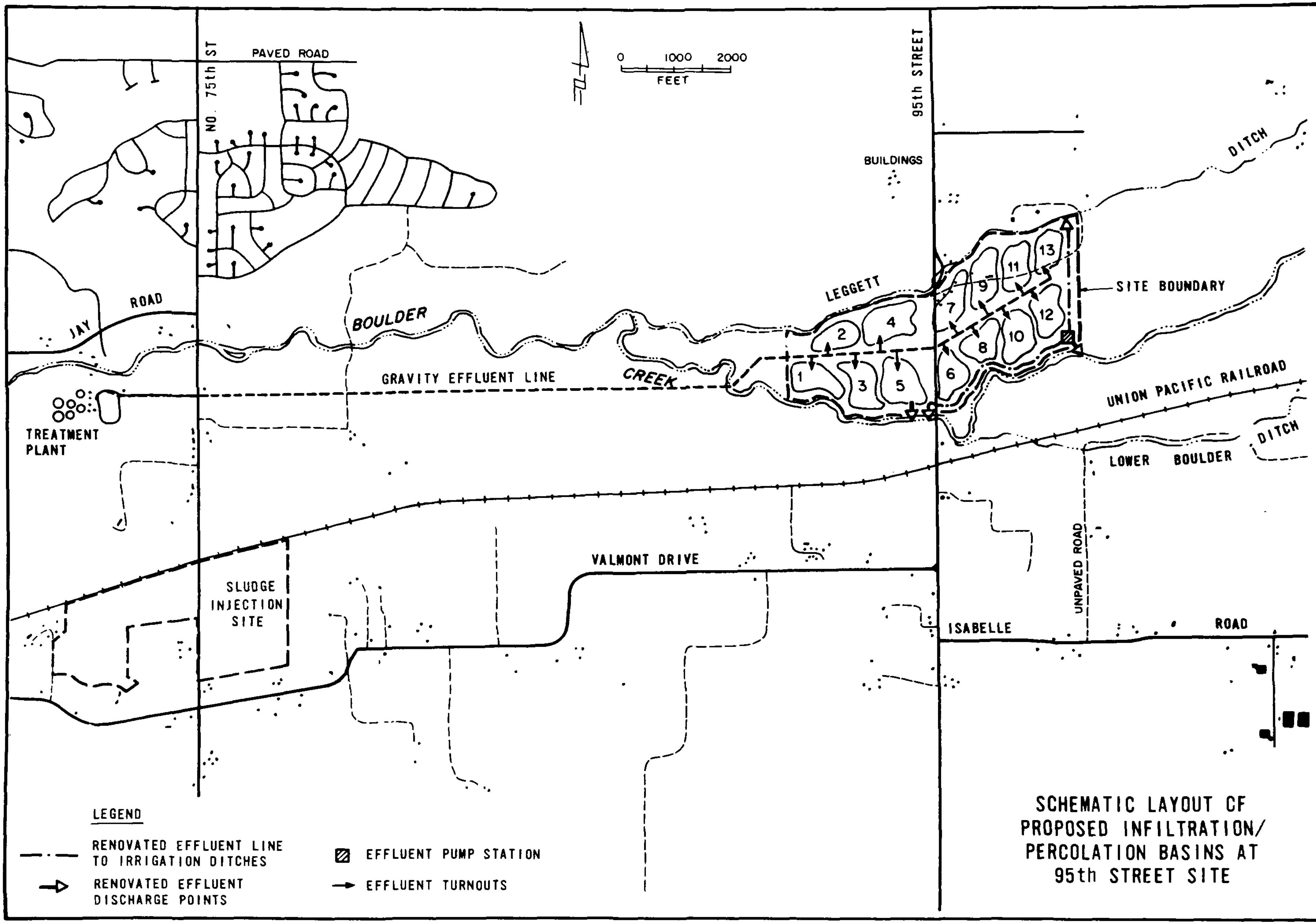
This system would use the existing facilities at the 75th Street plant to the fullest possible extent for primary and secondary wastewater treatment. This consists basically of grit removal, primary clarification, trickling filters, and secondary clarification. Further treatment of liquid wastes, however, will be necessary to meet the upgraded stream standards.

This alternative proposes to convey secondary effluent from the existing treatment plant 2-1/2 miles east to infiltration/percolation (I/P) basins near 95th Street for land treatment. A schematic layout is shown in Figure D-1. As the effluent percolates through the basins, the high infiltration and permeability capabilities of the sand and gravel bordering Boulder Creek would provide the additional polishing necessary. This "renovated" effluent would then be collected in an underdrain system and discharged to Boulder Creek.

The I/P basins site covers approximately 228 acres between Leggett Ditch and Boulder Creek. This acreage includes not only the basins, but 50-ft. wide perimeter berms between basins and a buffer zone around the entire site. Thirteen basins will be formed by removing the ground cover and using the excavated surface soil to build protective berms around each basin. Wherever possible, basins will be contoured to conform with natural features and to preserve mature cottonwood trees growing on the site. In addition, hydrophilic vegetation may be planted in the basins for visual appearance. Underdrains would probably be installed at intervals of 80 feet to depress the groundwater table and to collect the filtered effluent. Discharge will occur in Boulder Creek above the 95th Street Bridge and at the east end of the site as shown in Figure D-1.

Shifting the point of effluent discharge from above 75th Street to near 95th Street would significantly reduce the flow in that reach of Boulder Creek and affect legal water rights. This alternative would have to include water replacement to meet the decreed water rights of the two ditch companies immediately west and east of 95th Street. A separate pump station and pipeline would be constructed to convey renovated effluent to the ditches as shown in Figure D-1.

The system would operate year-round on an 8 to 12 day loading/drying rotation cycle, allowing time for soils to dry between loadings. The discharge temperature of the effluent should be warm enough to prevent freezing during the winter and to eliminate the need for cold weather storage.



SCHEMATIC LAYOUT OF PROPOSED INFILTRATION/PERCOLATION BASINS AT 95th STREET SITE

FIGURE D-1

System Evaluation--

Successful infiltration/percolation systems have been operating throughout the United States for many years. However, variations in many factors such as climate, soil, and pre-application treatment make it difficult to compare the performance of other systems with the one proposed for Boulder.

Lake George, New York has been successfully applying 0.3 - 1.0 mgd of unchlorinated trickling filter effluent to a 644-acre I/P system since 1936 (References D-1, D-2). Both ground and surface water in the vicinity of the plant have consistently met local and state water quality standards. In this system, rocks and glacial till sands interspersed with bedrock range from 20- to 72-feet deep beneath the percolation beds; the annual loading rate is 65 ft/yr. In comparison, the proposed system for Boulder will have to handle design flows up to 22.8 mgd; chlorinated secondary effluent would percolate through seven to fifteen feet of underlying sand and gravel, with an annual loading rate of about 101 ft/yr. Thus, despite the similarities in climate and quality of applied effluent, the differences in soil types and loading rates invalidate a comparison of engineering effectiveness.

Fort Devens, Massachusetts has also been operating an I/P system for more than 30 years to treat unchlorinated primary effluent. Investigations done in 1973 showed that the treatment process greatly reduces levels of COD, BOD, organic nitrogen, ammonia-nitrogen, phosphorus, and total coliform bacteria, although nitrate removal was not as successful (Reference D-3). Climatic conditions are comparable to Boulder, but the difference in quality of applied effluent again makes it difficult to compare systems.

Another successful I/P system is at Whittier Narrows, California in which chlorinated tertiary effluent mixed with imported water percolates through 10-20 feet of sandy loam and enters the groundwater table (Reference D-4). Here renovated wastewater meets drinking water standards. However, this sytem is designed to recharge the groundwater, rather than to polish wastewater, and is much more sophisticated than Boulder's proposed system.

Results from existing systems, nevertheless, show that infiltration/percolation basins can be a technically feasible method for meeting Boulder's water quality goals.

To determine the effectiveness of I/P basins under local climatic and soil conditions, the City of Boulder is conducting a pilot program adjacent to Boulder Creek at the 75th Street treatment plant. In the initial two years, unchlorinated secondary effluent was applied twice a week to three experimental I/P basins ranging in sizes between 0.6 and 0.9 acres. To date, results of this study have shown that an I/P system has excellent treatment capabilities for polishing secondary effluent and for meeting water quality goals year-round, provided that appropriate hydraulic loading rates and loading/drying cycles are maintained.

During the first year of operation of the experimental basins, the following data on the quality of the renovated wastewater were collected:

1. Suspended solids and coliform organisms were consistently reduced by over 96%. (Reference D-5.)

2. Organic and ammonia-nitrogen removal was nearly complete. (Reference D-6.)

3. Phosphorous removal was generally excellent; concentrations in renovated wastewater collected in the underdrains were consistently less than 1.5 mg/l PO_4-P. (Reference D-5.)

4. Concentration of wastewater organics (measured as chemical oxygen demand) was effectively reduced by 70 to 80% throughout the study period. (Reference D-5.)

5. Total nitrogen removal was highly variable, between 9 to 59%, during the study period. Quality of influent, weather conditions, and seasonal vegetation affected nitrification, denitrification, and volatilization processes which caused wide variations in treatment effectiveness. (References D-5, D-6.)

6. I/P treatment did not demonstrate any salt removal capabilities during the study period; salt concentrations generally increased as the wastewater percolated through the soil. However, the leaching out of salts naturally present in the soil seemed to decrease over the study period, possibly indicating that equilibrium conditions can be achieved. (Reference D-6.)

Significant seasonal variations were observed in the treatment performance during the first year, particularly for nitrogen and phosphorous removal. Extremely high nitrate discharges were recorded during April and May, apparently due to the accumulation of ammonia-nitrogen in the soil during the winter. During the spring the ammonia is oxidized and then released as nitrate. Phosphorous removal was also inhibited during the winter when the adsorptive capacity of the soil is saturated, so that increased levels of phosphate leached through the soil. Nevertheless, water quality of the renovated wastewater was maintained above current and projected discharge standards throughout the entire one-year study period.

Appropriate hydraulic loading rates and loading/drying cycles were critical for successful operation of the I/P basins. (Reference D-7.) Two of the experimental basins initially exhibited ponding conditions due to hydraulic overloading. To correct this, it was necessary to remove the surface layer of soil which had a high clay content. Other hydraulic characteristics of the basins were also highly site-specific. Loading rates for two basins only 500 feet apart varied four fold. During the loading portion of the cycle, accumulation of suspended solids and low temperatures slowed the infiltration rates. Drying and scarification of the basins between loadings reliably resotred high initial infiltration rates. (Experimental basins had no vegetative cover.)

The soils at the 95th Street site are generally suitable for I/P basins based on the Soil Conservation Service Survey (Reference D-8). Depending on the loading rate and presence or absence of a vegetative cover, limitation of the soils on the proposed site are only slight to moderate.

At this time, there is no way to assess long-term reliability of I/P basins at the proposed site. If results of the pilot studies are indicative, then usefulness of the I/P basins may extend beyond the 20-30 year design period. Success of the first two years of the pilot study has instigated another study to test effectiveness of I/P treatment on primary effluent.

Project Costs--

The project implementation schedule for I/P basins at the 95th Street site is projected to remain the same as outlined in Section III of the EIS. Construction would occur in two phases: 1978-1980, and 1988-1989. Salvage values are assumed for the year 2000 and the design period is 1980-2000 or 20 years. To be comparable with costs estimates made by the facilities planner, a 6-3/8 percent discount factor was used and costs are presented in January 1977 dollars.

The cost estimate for I/P basins at the 95th Street site was calculated using the costs developed for the former 75th Street site as a base and adding new costs for the additional facilities required. The physical details of the I/P basins at the new site was assumed to be roughly the same as those described in pages 11-30 and 11-31 of the original facilities plan. (Reference D-1.) Pertinent changes to the system will be as follows:

1. Rather than a 6000-ft., 36-in. diameter force main from the plant, there will be a 14,600-ft. force main (additional 8,600 ft.).

2. Rather than a 575 horsepower (hp) pump station, there will be a 715 hp pump station--in order to overcome additional friction loss in the longer pipeline.

3. In addition to the underdrain/low-lift pump stations proposed in the original report, additional pumps and lines would probably be necessary to return flow from the I/P basins to the Leggett and Lower Boulder Ditches. It will be necessary to return 12,600 acre-feet (AF) of flows (3,800 AF to Leggett and 8,800 AF to Lower Boulder at design flow) to satisfy water rights.

4. The additional pipeline length will require construction of a stream crossing for the 36-in. force main that was not included in the facilities plan.

The additional capital costs associated with the above-mentioned changes are presented in Table D-1. The incremental increase in capital cost at the 95th Street site is $1,115,000. With an allowance of 15 percent for legal, engineering and administrative costs, the actual incremental cost would be approximately $1,282,000.

The estimated incremental annual operation and maintenance (O&M) costs for the revised facilities are:

Main plant pump station	$11,500
Pumping to Leggett Ditch	7,300
Pumping to Lower Boulder Ditch	3,800
Additional pumping costs total	$22,600

For estimation purposes, the additional O & M cost is assumed to be $25,000/year. This reflects basically increased electrical energy usage for pumping and maintenance required for the new transmission lines. Using the revised figures presented above, the new costs for Alternative A --including a sludge-injection system -- are presented in Table D-2. Project costs for the City of Boulder are shown in Table D-3. The net present worth of $13,130,000 represents an approximate 10 percent increase over the 75th Street site. Correspondingly, Boulder's average annual equivalent cost of $754,000 represents an approximate 7 percent increase.

Table D-1. CONSTRUCTION COST ESTIMATES, INFILTRATION/ PERCOLATION BASINS - 95th STREET SITE (In Thousands of Dollars)

Item	Estimated Costs
Construction of I/P basins[a]	$3,639,000
(includes effluent transmission and distribution, site preparation, basin construction, underdrains and effluent pumps, water quality monitoring and miscellaneous)	
Additional facilities required for 95th Street site	
Effluent transmission (includes larger pump, additional pipeline and structure for creek crossing)	672,000
Renovated effluent return pipelines and pumps to irrigation ditches	443,000
I/P basin construction subtotal	4,754,000
Legal, administrative and engineering fees (15%)	713,000
I/P Basin Construction Total	$5,467,000

[a]Based on February 1977 Facilities Plan Supplement for 75th Street Site (Kolb property). (Reference D-9.)

Table D-2. TOTAL PROJECT COSTS, INFILTRATION/ PERCOLATION BASINS - 95th STREET SITE (In Thousands of Dollars)

Item	Feb. 1977 Estimate[a]	Increment[b]	Total (95th St Site)
Capital Cost			
1978-1980	9,247	1,282	10,529
1988-1989	642	0	642
Total	9,889		11,171
Annual O & M			
1980-1990	487	21	508
1990-2000	565	24	589
Present Worth of All Costs[c]	12,764	1,312	14,076
Salvage Value of Facilities and Land	853	93	946
Net present worth[d]	11,911		13,130

[a]From Table 12 of EIS, based on 75th Street site costs.

[b]See text for development of costs.

[c]January 1977 dollars at 6-3/8 percent for 30 years.

[d]Present worth of all costs less salvage value of facilities and land.

Table D-3. CITY OF BOULDER PROJECT COSTS, INFILTRATION/ PERCOLATION BASINS - 95th STREET SITE (In Thousands of Dollars)

Item	75th Street Site	95th Street Site
Capital Cost[a]		
1978-1979	2,312	2,632
1988-1989	161	161
TOTAL	2,473	2,793
Annual Capital Recovery Cost[b]		
1980-1990	175	199
1990-2000	187	211
Annual O & M		
1980-1990	487	508
1990-2000	565	589
Average Annual Equivalent Cost	707	754

[a]Assume 75 percent federal grant.

[b]Annual payment required to recover Boulder's share of capital costs at 6-3/8 percent for 30 years.

[c]From Table D-2.

[d]Represents average of O & M charges plus average of annual capital recovery costs.

Site Setting

Physical Environment--

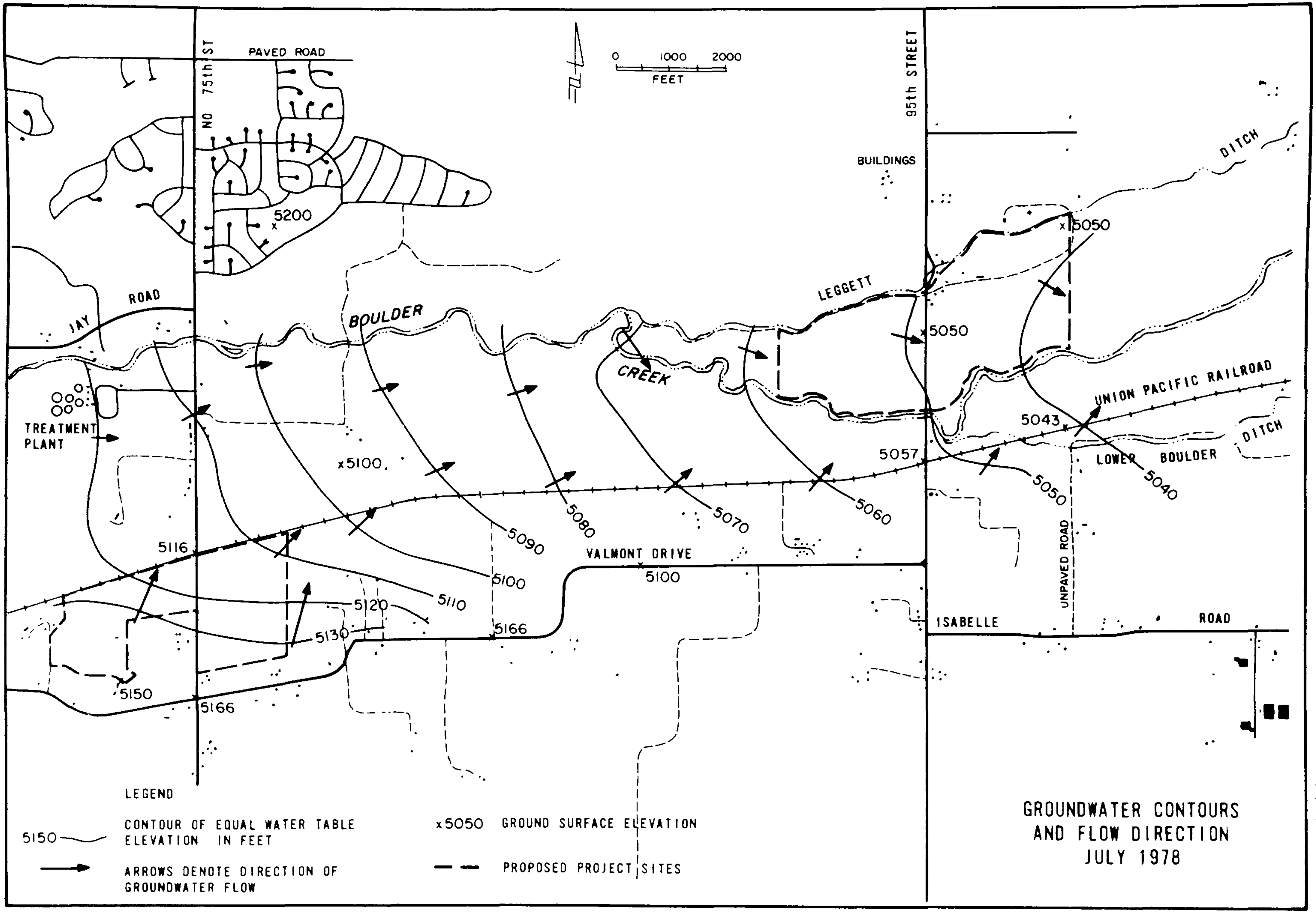
The proposed site for I/P basins lies in the floodplain of Boulder Creek, encompassing areas north of the creek up to Leggett Ditch and extending one-half mile to the east and to the west of 95th Street. The land slopes gradually downward from the 75th Street treatment plant to the site, averaging about 0.5% slope. The site covers 228 acres and is relatively flat with occasional depressions and mounds from previous gravel mining.

The floodplain is composed of sands and gravels overlain by 3.5 to 6.5 feet of fine-grained alluvial soils. Soils on the site are of two main types, Loveland and Niwot soils, which are characterized in Appendix A of the EIS. The underlying sands and gravels originated from igneous and metamorphic rocks eroded from the mountains west of Boulder. They range in thickness from as little as seven feet to as much as fifteen feet. Under the 228-acre site, is an estimated 3.3 million cubic yards of aggregate. According to the U. S. Geological Survey report on aggregate materials in the Front Range Urban Corridor Area, terrace and floodplain deposits of Boulder Creek contain the best quality gravel for concrete aggregate and road metal (Reference D-10).

The Pierre Shale bedrock formation underlies the sands and gravels. The Pierre Shale can be as thick as 4500 to 5000 feet. The upper part of the Pierre Shale contains interbeds of shale and siltstone. The upper siltstones are known locally as the Pierre Shale transition zone (Reference D-11).

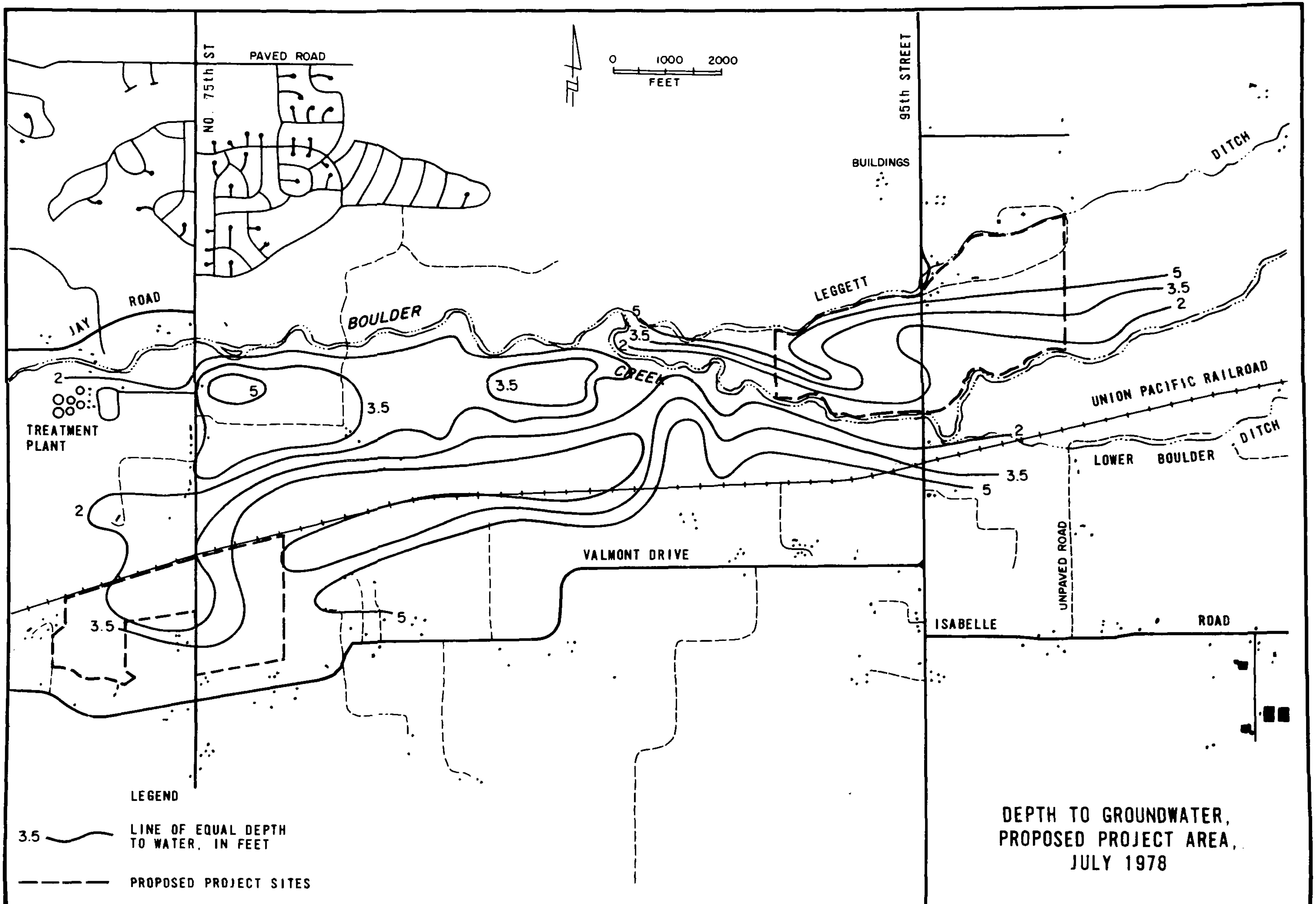
The sands and gravels beneath the floodplain contain large amounts of groundwater in storage. Recharge to and discharge from the sands and gravels supports water levels in Boulder Creek, wells, and lakes on the floodplain. Recharge to the groundwater system occurs principally by leakage from irrigation ditches and laterals and by infiltration of precipitation. The direction of groundwater flow is generally to the east, parallel to Boulder Creek, as shown in Figure D-2. Depths to groundwater on the site range from less than one foot to as much as five feet beneath the land surface. Water levels will be highest during the irrigation season and lowest during the late winter and early spring months. Annual fluctuations as much as four feet have been recorded in other similar hydrologic situations. The depth to groundwater, based on observations in July 1978 is shown in Figure D-3.

The permeability of the sand and gravel aquifer is low and varies from less than two feet per day to as much as 60 feet per day. The average permeability of the material on the site is probably on the order of 33 feet per day. As a result of this low permeability, wells completed in the sands and gravels yield only 20-30 gal/min or enough water for stock and domestic purposes.



GROUNDWATER CONTOURS AND FLOW DIRECTION JULY 1978

FIGURE D-2



DEPTH TO GROUNDWATER,
PROPOSED PROJECT AREA,
JULY 1978

FIGURE D-3

There are wells registered with the Division of Water Resources permitted for as much as 700 gal/min. These "wells" are not vertical tube wells but are pumps set into sand and gravel excavations. The "wells" pump large amounts of water because of a large effective radius.

The siltstones in the upper part of the Pierre Shale subcrop in the valley of Boulder Creek east of Boulder. The siltstones are considered an aquifer in the eastern part of Boulder County and are believed to be present in the vicinity of the infiltration/percolation pond site. There is evidence of a fracture in the bedrock formation and that there is a commingling of the alluvial water with the deeper siltstone water. The State Water Resources Department and the U. S. Geological Survey have initiated a study of groundwater flow and losses in the 95th Street area. A report describing aquifer coefficients of the siltstones is in preparation (Reference D-11).

Boulder Creek is the predominant surface water on the site. Flow ranges from approximately 5 cubic feet/second (cfs) to 1,000 cfs during peak spring and summer runoff. During the dry season, much of the flow is controlled by upstream uses, including the 75th Street plant which can contribute up to one-third of the total flow. The quality of the stream formerly complied with the Class B2 Standard (waters suitable for non-contact recreation and warmwater fishery), but does not meet the newly revised A2 Standard (primary contact recreation and warmwater fishery). Other surface waters include several shallow ponds which are remnants of former gravel mining operations.

Biological Environment--

The proposed I/P basins site is situated within a Pasture/Agriculture biotic community* along the Boulder Creek floodplain. In spring 1978, approximately one-fourth of the site on the northern end was planted to alfalfa hay production while the remainder was used as pasture. The pasturelands support two distinctive types of groundcover depending on the relative elevation on the floodplain. In low-lying areas where land contours are nearly equal to or several feet above Boulder Creek, lush vegetation occurs. Sedges, particularly Nebraska sedge (*Carex nebraskensis*) and prairie cordgrass (*Spartina pectinata*) flourish in these areas where the groundwater table is within 2 feet or less of the ground surface. This "sedge meadow" locally provides nearly 100 percent groundcover and is most dominant west of 95th Street adjacent to Boulder Creek. Wildlife associated with the wet sedge meadow are typically red-winged blackbirds, barn swallows, rough-winged swallows, meadowlarks, cottontail rabbits, and meadow voles.

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*As defined in Appendix B of the EIS

The second type of groundcover along the topographically higher portions of the floodplain is a short grassland dominated by Kentucky bluegrass (Poa pratensis). This grassland covers the largest areal extent and is subject to light to moderate cattle grazing. In closely-cropped areas, considerable amounts of bare ground are exposed, and numerous weed species such as filaree, prickly lettuce, plantain and mullein are present. Near fenceposts and in isolated spots, weed species are dominant, particularly Russian thistle, milkweek, gumweed, dock and various thistle species. A listing of plant species observed on the site is shown in Table D-4. Due to the low groundcover, wildlife diversity is limited, and in all cases, is dominated by domestic cattle and their grazing activities. In areas where tall weeds provide some cover are found cottontail rabbits and several mice species. Isolated small prairie dog colonies exist on the fringes of the pasture area where the groundcover is low and the earth not severly trampled by cattle. A listing of wildlife species that probably occur within the area, although not necessarily at the site, is shown in Table D-5. Within the project area, no rare, endangered or threatened plant or wildlife species have been recorded.

Within the pasture area are several small ponds formed during previous gravel mining operations. The ponds are frequented by cattle and are generally shallow and filled with algae. Black-crowned night herons and killdeer have been observed in these ponds; however, use appears to be limited.

Social/Economic Environment--

The proposed 95th Street site lies in eastern Boulder County, approximately six miles east of the City of Boulder. This rural area is predominantly agricultural with a few scattered residences and intermittent gravel mining along the floodplain. The I/P basin site is part of Boulder Valley Farm, Inc. and is currently used as pastureland for raising purebred cattle. Approximately 10 to 15 residences are within a one-half mile vicinity of the site.

In the past, sand and gravel mining has occurred at isolated locations on the site, and recently, the owner of Boulder Valley Farm has entered into a contract for more extensive mining of the gravel resources. As of July 1978, the mining company is awaiting state approval to start sand and gravel extraction on the 97-acre parcel of land to the west of 95th Street. In addition to the mining operation, the owner of the property has long-term plans to construct a 50-unit housing development on the terraces to the north, overlooking Boulder Creek (Reference D-12).

Neither the State Historic Preservation Office nor the Boulder County Comprehensive Plan has identified any part of the proposed site as an archaeologically sensitive area. However, the White Rocks area, immediately northwest of Boulder Valley Farm, has been designated

Table D-4. VASCULAR PLANT SPECIES WITHIN PROJECT AREA[a]

Scientific Name	Common Name	Scientific Name	Common Name
Agropyron elongatum	Tall Wheatgrass	*Melilotus* sp.	Sweetclover
Agropyron smithii	Western Wheatgrass	*Oenothera caespitosa*	Evening Primrose
Andropogon gerardii	Big Bluestem	*Opuntia polyacantha*	Prickly Pear Cactus
Arctium minus	Burdock	*Panicum virgatum*	Switchgrass
Artemisia ludoviciana	Sagewort	*Plantago lanceolatum*	Narrowleaf Plantain
Asclepias speciosa	Showy Milkweed	*Plantago major*	Common Plantain
Bromus tectorum	Cheatgrass	*Poa pratensis*	Kentucky Bluegrass
Carduus leiophyllus	Thistle	*Polygonum* sp.	Knotweed
Carex nebraskensis	Nebraska Sedge	*Populus sargentii*	Plains Cottonwood
Carex spp.	Sedges	*Prunus americana*	Wild Plum
Cirsium arvense	Canada Thistle	*Rosa woodsii*	Wood's Rose
Distichlis stricta	Inland Saltgrass	*Rumex* sp.	Dock
Elaeagnus angustifolia	Russian Olive	*Salix amygdaloides*	Peach-leaved Willow
Erodium cicutarium	Filaree	*Salix exigua*	Coyote Willow
Glycyrrhiza lepidota	Wild Licorice	*Salsola iberica*	Russian Thistle
Grindelia squarrosa	Curly-cup Gumweed	*Sorghastrum nutans*	Indian Grass
Iva xanthifolia	Marsh Elder	*Spartina pectinata*	Prairie Cordgrass
Kochia iranica	Summer Cypress	*Symphoricarpos occidentalis*	Snowberry
Lactuca serriola	Prickly Lettuce	*Taraxacum officinale*	Dandelion
Lepidium densiflorum	Peppergrass	*Tragopogon dubius*	Salsify
Medicago sativa	Alfalfa	*Typha latifolia*	Cattail
		Verbascum thapsus	Common Mullein

[a]Based on observations on 15 March 1978, as presented in vegetation report for Boulder Valley Farms Pit Mining Application and EIS staff observations on 18-21 July 1978.

Table D-5. WILDLIFE SPECIES PROBABLY OCCURRING WITHIN PROJECT AREA[a, b, c]

Scientific Name	Common Name	Scientific Name	Common Name
MAMMALS		BIRDS	
Canis latrans	Coyote	Agelaius phoeniceus	Red-winged blackbird
Castor canadensis	Beaver	Anas discors	Blue-winged teal
Citellus tridecemlineatus	Thirteen-lined ground squirrel	Anas platyrhynchos	Mallard
		Ardea herodias	Great blue heron
Cynomys ludovicianus	Blacktail prairie dog		
		Branta canadensis	Canada goose
Geomys bursarius	Plains pocket gopher	Bubo virginianus	Great horned owl
		Buteo jamaicensis	Red-tailed hawk
Marmota flaviventris	Yellowbelly marmot	Buteo swainsoni	Swainson's hawk
Mephitis mephitis	Striped skunk		
Microtus ochrogaster	Prairie vole	Calamospiza melanocarpa	Lark bunting
Microtus pennsylvanicus	Meadow vole	Cathartes aura	Turkey vulture
Mus musculus	House mouse	Charadrius vociferus	Killdeer
		Colaptes cafer	Red-shafted flicker
Odocoileus hemionus	Mule deer	Columba livia	Rock dove
Ondatra zibethica	Muskrat		
		Corvus brachyrhynchos	Common crow
Perognathus hispidus	Hispid pocket mouse		
Peromyscus maniculatus	Deer mouse	Falco sparverius	Sparrow hawk
Procyon lotor	Raccoon		
		Geothlypis trichas	Yellowthroat
Rattus norvegicus	Norway rat		
Reithrodontomys (megalotis?)	Western harvest mouse	Hirundo rustica	Barn swallow
Sylvilagus auduboni	Desert cottontail	Icterus bullockii	Bullock's oriole
Sylvilagus (nuttali?)	Mountain cottontail		
Sylvilagus floridanus	Eastern cottontail	Megaceryle alcyon	Belted kingfisher
		Melanerpes erythrocephalus	Red-headed woodpecker
Vulpes fulva	Red fox		
		Nycticorax nycticorax	Black-crowned night heron
REPTILES AND AMPHIBIANS			
		Paserina amoena	Lazuli bunting
Chelydra serpentina	Snapping turtle	Phasianus colchicus	Ring-necked pheasant
Chrysemys picta	Painted turtle	Pica pica	Black-billed magpie
Pituophis melanoleucus	Bull snake	Quiscalus quiscula	Common grackle
Rana pipiens	Leopard frog	Stelgidopteryx ruficollis	Rough-winged swallow
		Sternella neglecta	Western meadowlark
Thamnophis sirtalis	Common garter snake	Sturnus vulgaris	Starling
		Troglodytes aedon	House wren
		Turdus migratorius	Robin
		Tyrannus tyrannus	Eastern kingbird
		Tyto alba	Barn owl
		Xanthocephalus xanthocephalus	Yellow-headed blackbird
		Zenaidura macroura	Mourning dove

[a]Species list taken from Wildlife Report in Boulder Valley Farms Pit Mining Application.

[b]Nomenclature follows Burt and Grossenheider (1964).

[c]Nomenclature follows Robbins et al (1966).

as a state archaeological site which probably served Indian hunters as a campsite and rock shelter (References D-13, D-14).

Based on 1978 information (Reference D-15), the assessed value of the 228-acre site is estimated to be $18,000 or less than one percent of the total project cost. Revenues from property tax for this land parcel accounts for $1,500 or less than one tenth of the assessed value.

Water rights in Boulder Creek are divided between senior and junior rights, based on the concept "first in time, first in right." Lower Boulder Ditch (senior right) and Leggett Ditch (junior right) both draw water from Boulder Creek in the reach between the treatment plant and the site for irrigation purposes. The junior water rights are largely dependent upon the discharge from the treatment plant, although during low streamflow, senior rights may also be partially dependent on Boulder's wastewater effluent. A detailed discussion by Blatchey Associates on water right aspects of Boulder's proposed land treatment systems can be found in "Comparative Study of Wastewater Treatment, City of Boulder" (Reference D -16).

Regional Setting

Land Use--

The proposed I/P basin site lies within the Lefthand/Niwot/ Boulder Creek Subregion, as defined in the Boulder County Comprehensive Plan. In March 1978, County policy officially designated the existing land use character as being "agricultural in nature" (Reference D-17). County policy discourages further subdivision of lands and aims to preserve agricultural lands within the subregion. In addition, the site itself has been identified as significant agricultural land of local importance, surrounded almost entirely by significant agricultural land of statewide importance. The site has also been identified in the Open Space Element of the Boulder County Comprehensive Plan as a critical wildlife habitat/ wetland area and part of the Boulder Creek scenic corridor.

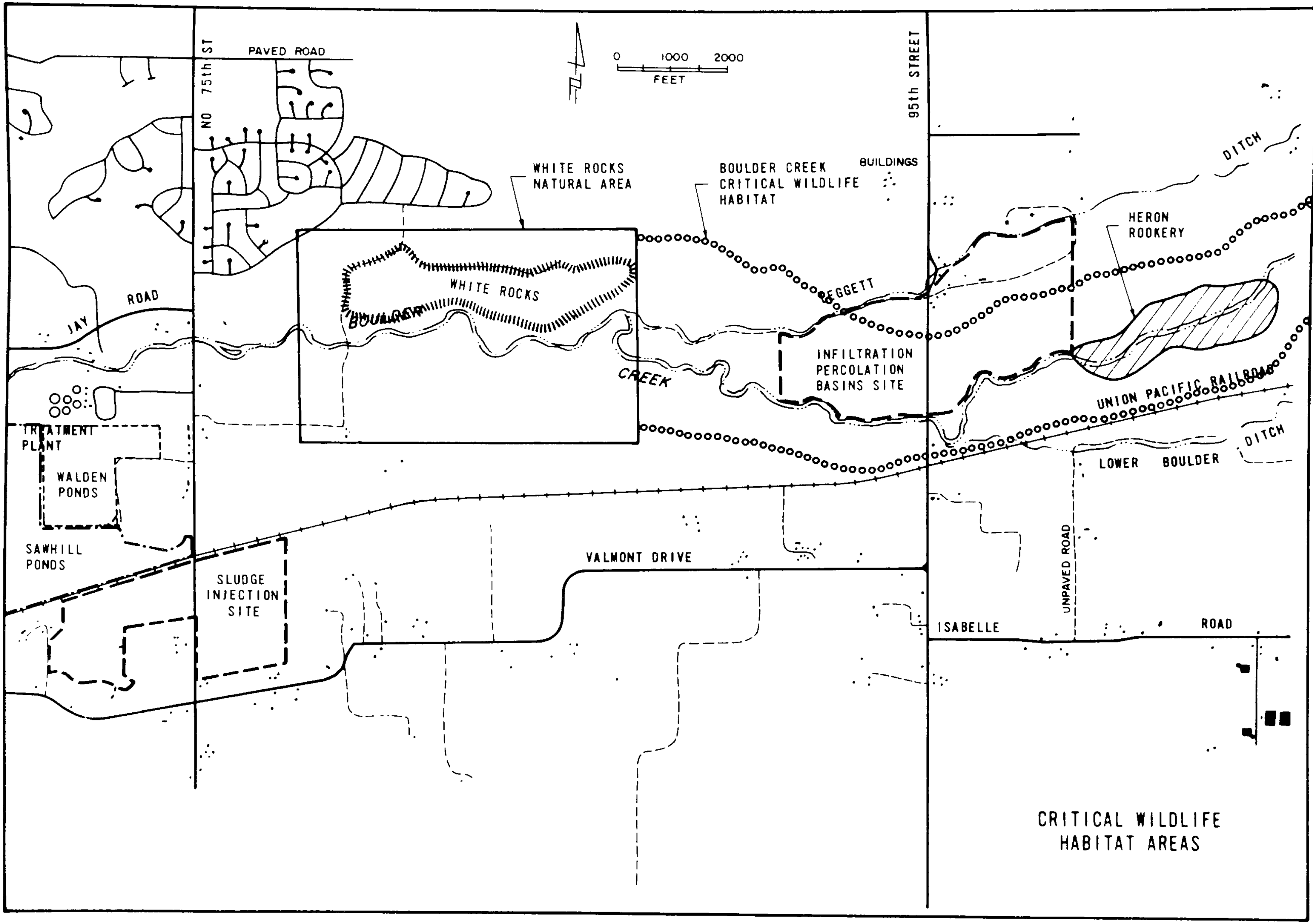
Residents in the Boulder Creek area near 95th Street receive their water from Lefthand Water Supply Company. Use of wells for domestic supply is limited because of the erratic watertable level, and potential contamination from nearby septic disposal systems. Community services are primarily provided by the cities of Longmont, Brownsville and Niwot as well as by Boulder County (Reference D-18). (The proposed site lies immediately outside the boundaries of the Boulder Valley Comprehensive Plan.)

Environmental Features--

The project site occurs within an area designated as a "critical wildlife habitat" in the March 1978 Boulder County Comprehensive Plan. The environmental features within the area of significance (Figure D-4) are the Boulder Creek watercourse and riparian zone to the south, a heron rookery or colony on Boulder Creek, immediately southeast of the site, and the White Rocks Natural Area 3/4 miles east of the site.

Boulder Creek forms the southern boundary of the site. West of 95th Street, the stream banks are low with overhanging vegetation and small segments support thick growths of cottonwood and willow trees which shade the streamcourse. The interface of water and bank vegetation provide an important wildlife habitat. East of 95th Street, the northern bank rises 3 to 8 feet above the creek and is relatively exposed with no overhanging vegetation. The stream channel has been straightened by the county in some areas leaving high cut banks and oxbow ponds. Boulder Creek typically sustains thick algal mats in the summer due to upstream nutrient enrichment and supports limited aquatic fauna due to historic discharges of wastewater effluent from the 75th Street treatment plant upstream. Characteristic riparian vegetation and wildlife are discussed in Appendix B of the EIS.

A heron rookery is established in a large cottonwood grove immediately east of the project site. The grove extends approximately one-half mile along Boulder Creek with mature cottonwood trees standing 60- to 80-feet tall and a relatively open understory. The grove sustains a large nesting population of great blue herons and black-crowned night herons. Approximately 100 nests are occupied by each species, making this rookery the largest one in the state (Reference D-19). The great blue herons migrate from the south and nest in the rookery from March through early August. The black-crowned night herons arrive somewhat later and leave by late-August. Both species subsist predominantly on fish supplemented by small animals and insects. The herons utilize a large feeding area that extends beyond the project site to nearby ponds and reservoirs such as Sawhill Ponds and Valmont Reservoir. The birds have adapted to many changes in the area including stream channelization activities beneath the rookery, gravel mining upstream, and vehicular traffic on 95th Street. The limit to their tolerance is difficult to determine but would probably be greatly affected by human activities such as land development and destruction of nesting areas.



CRITICAL WILDLIFE
HABITAT AREAS

FIGURE D-4

The White Rocks Natural Area (WRNA) has been discussed in detail in Section II of the EIS and consists of approximately 210 acres of sandstone outcroppings and bluffs overlooking the Boulder Creek floodplain. The WRNA contains unique local landforms harboring a distinct biotic community with eight rare and endangered plant and animal species. The White Rocks also form an integral part of the floodplain ecosystem providing nesting, resting and observation sites for predatory birds and animals as well as an important land/water interface area for resident wildlife.

Near the White Rocks formation south of Boulder Creek and southwest of the project site is a current gravel mining and reclamation operation. The ambient noise level is increased during mining operations by haul trucks on 95th Street and an on-site rock crusher. The mining activities are conducted with stringent air and water quality control measures and followed-up by an intensive reclamation program to transform the gravel pits into a high quality wildlife habitat. As of spring 1978, the reclamation of the gravel pits and revegetation program were proceeding well and attracting great blue herons to feed in the area.

In total, the designation of the project area and the local region as a "critical wildlife habitat" recognizes a number of significant environmental conditions. Preservation of these resources implies that they should be considered in the early phases of local planning activities where careful planning can minimize disturbances and in some cases enhance the environment.

Potential Impacts and Mitigation Measures

Environmental impacts and mitigation measures are discussed in two groups: short-term impacts associated with construction activities and long-term impacts which accompany operation of the treatment system.

Site-specific Impacts--

Site preparation for the infiltration/percolation basins and the installation of a 2½ mile pipeline to the site would cause moderately adverse impacts during the limited period of construction activities, some of which can be effectively mitigated. Excavation of groundcover and topsoils on 228 acres will expose large areas for possible erosion and dust generation. Water quality downstream in Boulder Creek may be affected by the increased sedimentation caused by erosion on the site. Removal of groundcover will also destroy the pasture/agriculture habitats on the site, and construction dust, noise, and activities may temporarily disrupt wildlife habitats adjacent to the site. This includes the aquatic and riparian communities along Boulder Creek, the heron rookery to the east, and to a minor extent, the White Rocks Natural Area to the west. Mature cottonwood trees on the site may also be jeopardized.

Construction of the underdrain system would require dewatering to a depth of eight- to ten-feet and installation of an impermeable barrier around the perimeter of the site. This would divert groundwater flow and depress groundwater levels on and near the site, particularly areas to the east. Groundcover and vegetation may suffer from the lowered groundwater table.

When construction is completed, the initial start-up of operations may create some difficulties. Since hydraulic characteristics are site-specific, as demonstrated in the pilot study, loading rates, capacities, and drying times will have to be determined for individual basins. Hydrophilic vegetation, planted in the basins, will also be considered in the loading rates. Overloading may occur, resulting in a ponding condition and soil clogging which in turn could lead to temporary problems with algal growths and odors. In addition, initial applications of effluent are expected to leach out salts naturally present in the soils and cause increased salinity in the final effluent This effect, however, should decrease with repeated use of the basins and eventually disappear as equilibrium is achieved.

Longer term impacts will result from continued operation of the infiltration/percolation system and, in the immediate vicinity of the site, can affect groundwater, soils, Boulder Creek, habitats and gravel resources.

Groundwater at the site will be impacted in several ways. Underdrains, designed to prevent groundwater contamination, will depress the groundwater table several feet. This will alter flow patterns, eliminating much of the underflow and recharge to areas immediately east of the site. To some extent, this decrease in available water will affect vegetation in these adjoining areas. Also, the underdrains will intercept precipitation runoff over the 228-acre site and further hinder natural recharge of the alluvial aquifer. During a heavy rainfall, when the basins are filled, infiltration rates are highest, and soils are saturated, some of the wastewater may percolate past the underdrains and enter the groundwater table. A more serious problem is the further possibility of wastewater seeping beyond the alluvial aquifer, into underlying bedrock aquifers. The infiltration/percolation site is a possible recharge area for the siltstones in the transitional Pierre Shale. If poor quality water is introduced to the site, poor quality water may be recharged to the siltstones. The quality of water in the siltstone aquifer may be impacted.

Productivity of soils on the site may be decreased due to the high rate of loading and the continuous leaching of nitrates through the soil profile. Over the long-term, there is danger of heavy metals gradually accumulating in the soil root zone.

Seasonal variation in treatment efficiency is expected due to variations in both influent quality and ambient weather conditions and type and volume of vegetation growing within the basins. Ammonia-nitrogen is stored within the soil column during the winter, is oxidized into nitrate in the spring, and then discharged. Winter conditions will also reduce phosphorous removal, and significantly higher discharge concentrations of phosphate can be expected from November through January. This uneven loading may disrupt stream habitats and lead to sporadic algal grows. High spring flows, however, may dilute the peak discharges and mitigate any adverse effect.

Water quality in Boulder Creek downstream of 95th Street would be significantly improved with the additional land treatment; however, relocating the point of discharge from 75th Street to 95th Street would decrease the flow in the 2½-mile reach. This could amount to a substantial portion of the flow during the dry season and alter riparian and aquatic habitats if remedial measures are not taken.

The creation of infiltration/percolation basins would remove about 220 acres of pastureland from production, as well as a small area to the east of the site which would be affected by the depressed groundwater table. A different habitat, consisting of intermittently wet and dry areas, will replace the pastureland. This habitat would be likely to attract the nearby bird populations, several species of frogs and other amphibians, as well as insects and animals tolerant of wet conditions. Moderate to tall vegetation should become established in the area of the basins.

The proposed mining of sand and gravel on this site would be halted during the lifetime of the infiltration/percolation basins, presently being designed for 20 years. Future options of continuing this method of treatment at the site would postpone mining even further. The treatment system, however, should not affect the quality of the gravel for mining at a later date.

During cold weather, the moisture from the warm effluent may create fog at the site and inconvenience travelers on 95th Street.

Site-specific Mitigation Measures--

Many of the short-term impacts can be effectively abated by proper scheduling of construction activities. Both soil erosion and disruption of bird habitats can be minimized if construction occurs during the late summer and fall, when the dry season coincides with the non-nesting time of year. Restricting construction activities to the daytime would lessen the disturbances to local residents from noise and vibration, but a temporary disturbance is unavoidable.

Dust generation can be controlled by wetting the soil in the construction area. Careful grading control and constructing interceptor ditches around the site would protect Boulder Creek from any erosion problems. Use of mufflers on the equipment and machinery would reduce noise. Temporary impacts on vegetation and wildlife can be diminished by phasing construction activities. Supplemental irrigation on land adjacent to the site can compensate for the depressed water table and maintain vegetation. Proper planning in the design of the basins would not only preserve the mature cottonwood trees on the site but also enhance the aesthetic appearance of the treatment system.

Start-up of the I/P basins should occur only after intensive soil surveys and preliminary tests to avoid overloading and soil clogging. Design of loading rates, capacities, and drying times should be flexible to allow for variations in weather, vegetation in basins, influent quality, and soil capacities. In addition, an intensive geohydrologic study is needed to assess impacts on the deep aquifers before regular operation begins.

Long-term impacts can be mitigated by periodic and/or continuous monitoring of water and soil resources. Effluent quality, Boulder Creek, alluvial and deep groundwater should all be monitored to assure water quality goals are maintained. Soil should also be analyzed regularly for salt content, build-up of heavy metals, and stability of general soil characteristics. Loading rates and drying times can be adjusted as necessary to reduce and possibly eliminate adverse effects.

Vegetation lost due to the lower groundwater table can be replaced by species with longer roots or species requiring less water. If necessary, supplemental irrigation can restore some of the vegetation.

Regional Impacts--

Beyond the immediate vicinity of the 95th Street site, regional effects of I/P basins will occur. Social and economic as well as environmental aspects must be considered.

In the short-term, construction of such a large facility would benefit the local economy by creating jobs (see Appendix E in EIS) and by directly and indirectly supporting local businesses. In the long-term, the major beneficial effect would be the significant improvement of water quality in Boulder Creek downstream of 95th Street, making waters suitable for primary contact recreation and a warm water fishery.

Another long term social impact will be the aesthetic aspects of the I/P basins, including odors, visual appearance and noises. Because the effluent will be chlorinated and infiltration rates are rapid, odor should not be a problem. Only malfunctioning of the basins caused by hydraulic overloading would create the possiblity for unpleasant odors. From 95th Street the basins should appear as large ponds, possibly with tall grasses growing in them, and conform with the open, rural character of the area. Once construction is complete, there will be little machinery on site other than a few scattered pump stations. Noises should be minimal.

Downstream water rights will be impacted by the operation of infiltration/percolation basins at the 95th Street site. The water rights will be impacted because evaporation from the ponds will decrease groundwater flow to Boulder Creek which, in turn, will deplete streamflows. Assuming net evaporation rates in the Boulder area to be 1.6 ft/yr, evaporation from 228 acres of basins is estimated to be 363 acre-feet annually.

The evaporation of sewage effluent from the pond will be an additional use of water from the Boulder Creek system. Historically, sewage effluent was returned directly to Boulder Creek from the 75th Street treatment plant and no evaporation or additional losses to the system occurred. The use of the infiltration/percolation basins will increase the total water use in the stream basin by allowing an additional 360 acre-feet of water to be evaporated each year.

Other water rights on Boulder Creek, specifically Leggett and Lower Boulder Ditches, will be altered by the change in treatment plant effluent return flows to Boulder Creek. Diversion of wastewater discharge to 95th Street will significantly reduce flows in Boulder Creek between the existing treatment plant and the 95th Street bridge. Historically, the effluent was available to the Leggett and Lower Boulder Ditches for diversions. The new point of return flow from the ponds is downstream of the two ditches and transporting the effluent in a pipeline for treatment in the ponds will make less water available to the two ditches. The amount of depletion is equivalent to the design flow, or approximately 20,000 acre-feet per year.

The project design would incorporate a subsystem to replace ditch diversions during the irrigation season. Renovated water from the I/P basin underdrains would be collected at several points for discharge to Boulder Creek. During the irrigation season, a separate pump and pipeline system would convey renovated water north to Leggett Ditch and upstream to Boulder Creek at the 95th Street bridge as shown in Figure D-1. The headgate/stream diversion point for Leggett Ditch is actually 1½ miles east of the proposed replacement point; however, no irrigation use occurs in that interval. The second replacement point, at the 95th Street bridge, will assure adequate stream flow for downstream diversions to the Lower Boulder Ditch. The volumes of renovated water pumped to these two replacement points would vary with irrigation demand and stream flow, equaling at least 60 percent of the system design flow. Thus, Leggett Ditch will receive water at a slightly different point than the historical intake point, but this should not greatly affect the ditch operations. With an efficiently functioning flow replacement system, Lower Boulder Ditch flows should not be affected.

Environmental conditions in the local area that may be affected by the operation of the I/P basins are the Boulder Creek watercourse and riparian zone, and the heron rookery east of the site. Operation of the I/P basins as mentioned earlier, will require that: 1) wastewater formerly discharged to Boulder Creek near 75th Street will now be diverted to the new I/P basin site, treated and discharged near 95th Street; and 2) underdrains below the I/P basins will split the groundwater table and remove the upper layer to a surface discharge.

The first condition leads to a reduction in stream flow between 75th and 95th Streets. Depending on the season and system loadings, the reduction would be 12 to 17 mgd, which in the summer would comprise 1/3 to 1/2 of the total stream flow. Aquatic flora and fauna would probably be stressed or reduced in this 2½ mile stretch. The flow reduction would not only reduce stream levels but also diminish stream flow into the groundwater table and subsequent subirrigation of adjacent low-lying pasturelands. The area of land most likely to be affected are pasturelands south of Boulder Creek up to approximately the Union Pacific Railroad tracks. Reduction of subirrigation by several inches to a few feet could dry up some of the shallow-rooted forage species and lead to the selection of deeper-rooted plant species. Patchiness in the ground cover would also be likely to occur. This impact is offset partially by the current irrigation practices on the terraces above the floodplain. Intermittent flood irrigation on local farm and pastureland contribute to the variable groundwater level in the low-lying floodplain area.

The second condition of groundwater diversion at the site, would reduce subirrigation of pasturelands in a "shadow" zone of 200 to 300 feet east of the site. Within close proximity to the site is the cottonwood grove which provides critical habitat for the heron rookery. Potential groundwater drawdown of 5 to 8 feet would reduce subirrigation of the cottonwood grove. However, the effect on the trees from the proposed I/P basins is anticipated to be minor as the root system for mature cottonwood trees extends beyond that depth, and the trees also draw water from the adjacent Boulder Creek. An example of effects on a heron rookery through damage to nesting trees occurred in 1974-1975 at Chatfield Reservoir, south of Denver. Dewatering of gravel pits in an adjacent mining area (300 to 400 feet from the rookery) lowered the groundwater table 30 feet leading to seventy-five percent mortality among the trees. The rookery was small (initially 9 herons) and managed to survive the habitat damage with meassurable population increases through in-migration. In a larger colony, debilitation of over three-quarters of the nesting sites would have a serious effect on a rookery.

Day-to-day operation of the I/P basins, which would be manifested in a series of full, partially full and dry water basins, would probably have minor effects on the adjacent heron rookery or the farther White Rocks Natural Area. Predator food supply for the herons and local raptors (hawks and owls) would be reduced by the removal of the small mammal population on the site, particularly mice, rabbits and prairie dogs. While the site represents only a small percentage in the feeding territory of local predators, nevertheless it is a reduction. The presence of the basins themselves, while a great departure from the former pastureland, would be similar in form to local ponds and wet meadow areas. The basins and the changing water levels should not adversely affect the rookery. The attraction of insects and amphibians to the basins would probably form a new food supply for the herons. This heron rookery near 95th Street has been shown in the past to be remarkably adaptable to changes in local conditions. In 1966, Boulder Creek beneath the rookery was channelized extensively for flood control. Figure D-4 shows the former stream meanders. The rookery was well-established at that time and did not appear to be affected. Since 1962, gravel mining--forming seven lakes within a one-half mile vicinity of the rookery-- has occurred. Most, if not all of the mining was done, in the spring and summer and has not appeared to alter the birds' residency. The herons also appear to have adapted to cattle grazing at the base of the trees, irrigation water jets, occasional trespassers and even lowflying helicopters.

Regional Mitigation Measures--

Impacts on water rights will have to be addressed in some form of replacement water. Evaporative losses, estimated to be 363 acre-feet/year, should be replaced to Boulder Creek on a one-to-one basis to compensate downstream users. Since most of the evaporation occurs during the growing season, about 313 acre-feet of water should be released to Boulder Creek during the summer and about 50 acre-feet released during the winter. To compensate Leggett and Lower Boulder Ditches, the projected streamflow between April and October, or about 12,600 acre-feet/year, would have to be replaced. This volume may be reduced if water derived from outside of the Boulder Creek basin was used in the City's system.

No winter replacement water is required because the Leggett and Lower Boulder Ditches do not divert water during the winter months. Return flows from the ponds will ensure that the flows of Boulder Creek will remain intact below the 95th Street bridge. Replacement water would also serve to recharge the groundwater and make up for the diverted flows in the surrounding areas. The reduction in flow in the 2½-mile reach between 75th and 95th Streets is unavoidable.

Interactions with Other Plans

Currently, there are four entities with future plans involving the 95th Street site: (1) the owner of the property, (2) a sand and gravel company, (3) City of Boulder, and (4) Boulder County.

The property owner has done extensive studies on future uses of Boulder Valley Farm, including studies by a planning consultant. His detailed plans include mining the gravel resources, enlarging a 25-acre tree farm to 50 acres, and building a 50-unit housing development. All of this is in addition to the ongoing cattle breeding (Reference D-12). With the I/P basins alternative, the city would purchase all or part of the property for the basins site. Purchase of the entire Boulder Valley Farm would require a higher capital expenditure by the city. Purchase of only the 228 acres for the basins site would curtail the mining options on that site and may require modification of future use plans on the other parts of the Boulder Valley Farm.

The sand and gravel company has also established detailed plans at the proposed I/P basin site. The sand and gravel company has bought the gravel rights from the property owner and performed extensive studies on the western half of the site as part of a formal mining application to the state (Reference D-13). To use the area west of 95th Street, the City of Boulder would have to acquire the gravel rights from the sand and gravel company through purchase and/or exchange of properties and mining rights. The Company also has intentions to mine the eastern portion at a later date (Reference D-20). Though use of the soils for I/P basins would not damage the quality of the sands and gravels, it would delay any mining operations by a minimum of 20 years.

The Boulder Valley Comprehensive Plan (BVCP) provides policies for future growth and development in the City of Boulder and surrounding areas (Reference D-21). Though under County jurisdiction, the site is within the influence of the Boulder Valley Comprehensive Plan and is not planned to accommodate urban development. If the I/P basins were established, it could alter or eliminate future housing development plans and would conform with the rural character of the area.

The Boulder County Comprehensive Plan which incorporates the BVCP, has identified the Boulder Creek area, including the proposed site, as a critical wildlife habitat/wetland area and as a proposed area to be maintained as open space (Reference D-22). Design of the I/P basins could be coordinated with the County Parks and Open Space Department and possibly achieve this open space goal.

Other Environmental Considerations

Irreversible/Irretrievable Commitments of Resources--

With the construction of the I/P basins, irreversible destruction of vegetation and habitat will occur. The present pasture/agriculture habitat will be replaced by a cyclic wet-and-dry ecosystem of vegetated basins. The pasture/agriculture habitat is important for wildlife forage, cover and hunting range for predators and covers much of Boulder County. Loss of the pasture resource at this site is considered irreversible, but would have only a small effect on the local system.

Short-term Human Use vs. Long-Term Productivity--

Short-term human use of the 95th Street site for I/P basins may have three implications on the long-term productivity of the floodplain environment: (1) possible contamination of deep aquifers; (2) temporary loss of gravel resources; and (3) possible disruption of the heron rookery adjacent to the site.

The State Water Resources Division has evidence of a fault in the bedrock formation near the 95th Street site and suspects there is a commingling of waters from the alluvial zone with the deeper groundwater (Reference D-23). The possible contamination of the deeper siltstone aquifer was the reason for eliminating this site in the original investigation for the facilities plan. The State Engineers have installed a series of wells to determine volumes of groundwater entering the siltstone aquifer. Since this area is not well understood, damage would be difficult to assess, if contamination were to occur. The Water Resources Division is interested in protecting the vested water rights for each aquifer zone.

The postponement of gravel mining may constitute a short-term loss to the economy of the region. The future value and quality of gravels on the proposed site is uncertain, and present availability of comparable gravels is also not known.

The existing heron rookery adjacent to the proposed site is considered a critical wildlife habitat which both the City and County of Boulder wish to preserve. Similar experiences with other heron rookeries in the past have exhibited varying impacts. In one case, a heron rookery was unaffected by the construction of a highway closeby, and in other cases, herons have abandoned their nesting spots (Reference D-24). Construction and operation of the I/P basins near the heron rookery should be coordinated with the state and county wildlife authorities to maintain the long-term productivity of the rookery.

AGRICULTURAL REUSE PROGRAM

The facilities plan put forth a beneficial reuse system as a long-range program that could be used in conjunction with the conventional wastewater treatment alternatives. Effluent reuse for crop application would not only renovate the wastewater, but also meet the 1985 zero discharge goal of P. L. #92-500. Under this alternative evaluation, consideration will be given to the development of a reuse system as the main treatment system to be implemented within the present planning period.

Under this land-based treatment system, secondary effluent would be distributed through existing irrigation ditches to privately-owned farmland. The effluent would be applied by surface irrigation--predominantly furrows--during the growing season. The nutrients in the effluent would be used by crops, while the effluent would be further cleansed through the soil column and ultimately recharge the groundwater table. During the winter, effluent would be delivered directly to a storage reservoir where it will be held until late spring to supply peak irrigation demands. Approximately 10,000-12,000 acres for irrigation and a 10,000 acre-foot storage reservoir(s) would be required.

The irrigation ditches and all irrigated land would remain under private ownership, with the ditch company maintaining management and operation of the system. This contrasts with the high-rate irrigation alternative (G) in the EIS where a municipal corporation purchases the required land and essentially enters into the farming business. Massive local government land purchases would be relatively costly and less acceptable to the public. However, the long-term success of this program would require fixed land areas to utilize the wastewater effluent and a long-term contract between the city and the ditch company. The city could be required to purchase development rights on the application sites and provide restitution for additional costs incurred such as: increased maintenance, increased reservoir capacity, control of return flows from canals and irrigated farms, and correction of drainage problems developed as a result of increased water supplies.

Agricultural Alternatives

Two alternative agricultural reuse systems for the City of Boulder have been studied. Both envision piping of effluent from the 75th Street wastewater treatment plant to irrigation ditches and reservoirs for placement on the land. Reservoir storage of winter effluent for later use during the irrigation season is required for both alternatives, along with substantial replacement water which must be released to the stream to compensate out-of-priority depletions.

The first alternative for agricultural reuse was studied by the facilities planner in 1974 (Reference D-16). The plan considered the Boulder and White Rocks, Boulder and Left Hand, Leggett, Howell, and Godding Daily and Plum Ditches and the Six-Mile, Panama No. 1 and Leggett Reservoirs. In the 1974 study, the ditch and reservoir companies were not contacted, and their reaction to a program involving the exchange of treated effluent for direct irrigation water was not determined.

The current investigation includes a review of the 1975 plan and a study of an alternative ditch and reservoir system for inclusion in the exchange program. The concept of an exchange program for land treatment of the city's effluent by exchanging water with irrigation ditches has been discussed with representatives of two Boulder Creek ditch companies. One of these companies, the Boulder and White Rocks Ditch, was included in the 1975 study. The second company contacted was the Lower Boulder Ditch Company, which has been selected for study in this report. The reaction of the ditch companies to an exchange program was cooperative but not enthusiastic. The companies were reluctant to discuss details without additional information and expressed reservations relative to any long-term agreement with the city which would limit the use or sale of their water rights.

The second alternative for an agricultural reuse system focuses on the Lower Boulder Ditch Company. This ditch company was selected for the current study because it has the physical capacity to accept the City of Boulder's effluent at design flow, is the number one water right on the stream, and has sufficient land under irrigation to absorb the effluent. A meeting was held with the Lower Boulder Ditch Company president and engineering consultant in August 1978 and included representatives of EPA, City of Boulder and the EIS consultant. The ditch company showed some interest in an exchange plan but requested additional information before considering a possible agreement. It appeared doubtful that any exchange program could be designed to the satisfaction of the ditch company. The primary concerns were the effect of a long-term agreement between the city and the ditch company and the restrictions that may be placed on truck farming under the ditch. In addition, public health concerns were expressed regarding use of ditch water for domestic purposes by the Town of Frederick.

The problems of regulation of effluent application, limitation of application to forage crops only, prohibition from domestic use and long-term commitments of water and development rights would require extensive negotiations and contractual agreements. Under these conditions, EPA concluded that a comprehensive and workable reuse plan could not be achieved at this time without considerable difficulty and expense.

The following section reviews the basic requisites for an agricultural reuse system in Boulder County and the design parameters that must be considered. A description of the potential problems and issues associated with this system is also presented.

Agricultural Reuse for Boulder--

Any program involving the exchange of municipal wastewater effluent with agricultural irrigation water must be accomplished in accordance with the laws of the State of Colorado and water rights administration under the priority system. A comprehensive review of water rights law and administration is beyond the scope of this report. For an analysis of water rights and land treatment alternatives in Colorado, reference is made to the 1974 CH2M-Hill report, "Comparative Study of Wastewater Treatment, City of Boulder", (Reference D-16). Appendix B of that report titled, "Water Rights Aspects of Boulder's Proposed Land Treatment Sewage Effluent" contains a thorough description of Colorado water rights administration and analysis of a land treatment program.

Agricultural reuse of Boulder's wastewater effluent will require construction of one or two storage reservoirs and related pumping and transmission facilities. At design flow the Boulder plant will have an average discharge of 17.6 mgd or 20,000 acre-feet per year. Because the effluent can be used for irrigation only during the four- or five-month irrigation season, winter effluent must be stored. During the irrigation season all of the effluent will be pumped from the storage reservoir to the ditch. In addition to storing winter effluent, the storage reservoir will allow regulation of the flow diverted to the ditch. In exchange for the effluent supplied to the ditch, the ditch company will not divert water under its water rights.

The winter storage of effluent that historically returned to Boulder Creek will deplete the stream and lessen the amount of water available to downstream users. To offset these depletions, the city must provide replacement water in an amount equal to the effluent being stored. Replacement water can come from a number of sources, including storage rights that can be released to the stream instead of being stored and the construction of a second reservoir for storage of water rights during the irrigation season. The replacement water, whether it is decreed winter water or stored irrigation water, must be released at locations and times that will not interfere with winter appropriations. Evaporation losses from the winter effluent reservoir and the replacement reservoir must also be replaced by water rights owned or to be acquired by the city.

To operate an agricultural reuse system, the city will require a long-term agreement with the ditch company. The agreement must encompass the continued use of water for agricultural purposes and ensure that land is available for irrigation. This agreement is essential because the city will require that the entire annual supply of effluent be placed on land for treatment purposes. This type of agreement could take three forms: (1) an outright purchase of water and land rights under the ditch company with a leaseback arrangement, (2) an outright exchange of water rights with a provision that water and land under the ditch will be retained in irrigation, or (3) a "first right of refusal" in which the effluent is exchanged for water in the ditch and the city has the first option to purchase the right should an irrigator wish to sell his water right.

Land Treatment Issues--

Both alternatives for land treatment of Boulder's WWTP effluent involve the delivery of effluent to an irrigation ditch for application to the land, storage of winter effluent, and replacement of out-of-priority depletions. Operation of such a program will be dependent on an agreement between the city and the ditch company and compliance with all applicable state and federal laws and regulations, including those governing water rights administration and water quality.

Discussions with representatives of two Boulder Creek ditch companies raised the following issues:

1. Agreement - The ditch companies were not interested in a long-term agreement with the city that would restrict the use and sale of water from the ditch. The ditch companies stated that they wanted flexibility in the use of their water to allow them to sell either water or land at a future date. It is doubtful that the City of Boulder would enter into an agreement that would offer this flexibility.

2. Truck Farming - There are approximately 500 to 1000 acres of truck farms under the ditches studied in the two alternatives. Under current guidelines prepared by the Colorado Department of Health, secondary treated effluent cannot be applied to vegetables that may be eaten raw. For a land treatment plan to operate under either alternative, truck farming cannot be permitted.

3. Domestic Water - While there is no domestic use of water under the land treatment scheme using the Boulder and White Rocks and other ditches proposed by CH2M-Hill, there is domestic water in the Lower Boulder Ditch Company. The Town of Frederick diverts water from the ditch into a small reservoir and uses the water in its municipal system. Replacement water for this domestic use will have to be found to make this alternative feasible.

Because of the above issues, a land treatment alternative for the City of Boulder could not be completed within the time frame of this report. An agreement between the City of Boulder and the ditch company would require lengthy negotiations and EPA is pessimistic that such an agreement can be worked out. For these reasons, EPA does not recommend this system for Boulder.

Recommendations for Future Reuse Systems--

Though the particular set of circumstances involved in the Boulder situation do not lend themselves to the institution of an agricultural reuse program, EPA continues to believe that such systems have much merit and should be encouraged. For this reason, the following recommendations are offered so that other cities or wastewater agencies interested in land treatment can benefit from the results of this investigation. To lessen the time and the cost required to implement a land treatment plan, it is recommended that future agricultural reuse studies consider the following factors:

1. The amount of effluent to be treated by land application should be less than the ditch's total flow. By offering to replace only part of the ditch company's water with secondary-treated effluent, the ditch company has flexibility in that not all of the water is committed to agricultural use. Ditch water not committed to replacement may be sold or transferred outside the system. In addition, it is possible that the exchange part of the ditch's decreed water may be accomplished by a vote of the Board of Directors whereas commitment of all of the water often requires a vote by the stockholders.

2. There should be no truck farming or domestic water use under a ditch receiving wastewater effluent. A plan can be developed to purchase replacement water for truck farmers or domestic users but would increase the cost of using that particular ditch.

3. The minimum yield of a ditch company msut be determined to ensure that the effluent will be treated in a dry year. The amount of effluent exchanged should be limited to the dry year yield of the ditch. The dry year yield in many ditch companies is less than average yearly yield. An exception to this generalization occurs for ditches with very senior rights which usually get their full supply in every year.

4. Only the most senior rights in an over-appropriated stream basin should be considered for exchange of water. It is important that water be available for exchange on a continuous basis. The use of moderately senior or junior water rights in an exchange plan increases the possibility that effluent will have to be pumped directly into the stream to meet downstream calls.

5. A physical site for a reservoir must be available within a short distance of the waste treatment plant. Effluent can

be piped considerable distances from a treatment plant and piped back to a ditch company, but this increases the cost of using the ditch involved.

6. A single ditch company with existing reservoirs is preferable to a group of separate ditches. The use of a single ditch company minimizes the administrative requirements of transporting effluent from a waste treatment plant to a ditch. If more than one ditch is involved, not only would there be problems associated with transporting different amounts of water to each ditch, but also, the ability of the ditch to receive certain amounts of effluent may be limited during parts of the year. To ensure that all ditches can receive the same amount of water year in and year out would require that the city purchase additional replacement water which increases the cost. If a single ditch company has existing reservoirs with sufficient storage, the cost of land treatment alternative is considerably lessened.

To make a land treatment exchange attractive to a ditch company, the city or wastewater agency needs to be aware of its bargaining position. The city/agency can make an exchange attractive to a ditch company by providing water of good to excellent irrigation quality, a firm yield of water rights, a single source of water for the ditch company, and a bonus of additional water to make more water available to users in the ditch company. Senior water rights, particularly the first water right of a stream system, will require more negotiations to reach an agreement because they essentially have enough water and a firm supply of water. Less senior water rights will be more interested in such a plan but are subject to calls in dry years. Thus the city/agency will be required to provide additional replacement water to ensure downstream water rights.

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APPENDIX E
SHORT-TERM ENVIRONMENTAL IMPACTS

PHYSICAL ENVIRONMENT

Soils

Alternatives B and D would have a minor destructive impact upon properties of soils at the construction site and along pipeline routes for sludge injection. These alternatives are generally confined within the existing treatment plant site; therefore, the area affected would be limited.

Alternative A entails the construction of 13 ponds and their associated conveyance and drainage pipelines. Installation of underdrains requires the excavation of 8- to 10-ft deep trenches while the larger gravity collection lines require trenches 10- to 30-ft deep. Conveyance lines would be constructed within the earthen berms. Removal of several inches to several feet of the topsoil would be required to prepare the basin surface. Construction of the basins would require large-scale earthmoving activity to form the 4-ft-high, 55-ft-wide tapered berms. In addition, clay soils would be imported to line the basin walls.

Alternative C requires the construction of seven polishing ponds. The proposed pond areas fall within gravel mining sites along Boulder Creek. The County is planning to extract gravel from these area; the initial impact of gravel mining will have a far greater effect than the secondary effects of formation of polishing ponds from gravel pits. As in Alternative A, the basins require construction of wide earthen berms and importation of clay soils to line the entire basin.

Alternative G requires large-scale earthmoving to construct the 8,800 ac-ft storage lagoon. Approximately 16,940,000 cu yd excavated soil would be used to construct the perimeter berms, but the remainder would probably be transported from the site. Even though part of the disturbed soil mass would remain at the site, soil profile characteristics, structure and other physical properties would be so thoroughly destroyed or modified that an agricultural substratum would no longer exist. Additional clay soils would be imported to line the entire storage lagoon.

Alternatives A through D and Alternative G consider sludge injection into nearby croplands. Construction of conveyance lines would have a minor effect upon soils. Preparation of the fields for sludge injection requires only the installation of feeder lines, at approximately 1,500 ft intervals.

Land Forms

Alternatives B and D would have a negligible effect on land forms in the vicinity of Boulder Creek. These alternatives call for the construction of specific facilities within the existing treatment plant site. The addition of these structures to the site would be almost unnoticeable due to the prominence of the existing large, red-brick treatment plant.

Construction under Alternative A would lead to a series of wide, 4-ft high earthen berms, visible at eye level. The bottom of the ponds will be close to the existing grade, forming broad, shallow basins. Viewed from the same elevation at 75th Street or along Boulder Creek, the earthen berms would probably be no more prominent than the basins themselves.

Alternatives C and G embody many of the final effects upon land forms that would be experienced under Alternative A. The polishing ponds and storage lagoon, however, would be 10 to 30 ft deep and would have steeper sides within the basins.

Preparation of the sites for sludge injection in all alternatives would have negligible effect on land forms.

Air Quality

All alternatives require earthmoving to some degree. Alternatives A, C and G require substantial grading activities during construction. Depending upon seasonal conditions, the generation of suspended particulate matter is unavoidable. Dust raised during site preparation, and engine emissions from the construction equipment--generally lacking in air pollution emission controls, comprise the sources of air pollution during a maximum period of two years. These activities will not have a severe or long-lasting effect upon local air quality although they may cause a noticeable nuisance effect.

Under normal conditions, dust picked up by the wind could be expected to settle out within 300 ft from the site. In the project area, winds typically are from the east during the day and reverse to the west at night. As the areas are sparsely populated, the magnitude of the impact is small. Under Alternative A, however, a small home situated at the eastern boundary of the pond site between the creek and the railroad tracks would experience blowing dust and particulate fallout. Control measures such as spraying water on the ground surface would reduce this to some extent. Precautionary measures during construction should also include scheduling of activities in a manner that will avoid windy periods.

Vehicular emissions from diesel and gasoline engines would be another source of air pollution during construction. Increased traffic during the construction period would contribute a localized deterioration in air quality which sould disperse gradually. However, under any alternative, the number of vehicles involved is not large, and attendant effects upon air quality would have only a minor impact.

Groundwater

Alternatives B and D are largely confined to the existing treatment plant site and would have only minor impacts on the local groundwater during construction. Within a limited area, the groundwater table may be slightly depressed due to dewatering during construction of building foundations.

In Alternative A, construction of the underdrains require dewatering to a depth of 8 to 10 ft. To preclude groundwater flow under the site during construction, an impermeable barrier--such as a clay or plastic liner--would probably be placed around the site's perimeter. This would tend to divert groundwater flow around the basin site and depress the groundwater levels in the immediate vicinity of the site. Groundwater flow to the pasturelands immediately east of the infiltration/percolation basin site would also be reduced during the construction period, which may last up to two years. Existing ground cover east of the basin site would probably suffer from the diminished availability of groundwater for subirrigation.

The pond sites for Alternative C will undergo an extensive gravel-extraction process prior to preparation for land treatment facilities. Gravel mining generally entails construction of barriers to groundwater movement, excavation, dewatering, processing, discharge of silt-laden waters and other such activities. The impacts of gravel mining vary with the degree of environmental protection incorporated into the mining process. However, the main impacts on ground and surface waters will have occurred during gravel mining prior to construction of the treatment facilities for Alternative C. The existing plant site is surrounded by open ground covered predominantly with weed species and has few trees. Removal of ground cover would not represent a significant loss.

The aeration and polishing pond site under Alternative C would initially be subject to gravel mining. Mixed pasture grasses and weed species are found in this area and would be already greatly disturbed or destroyed by the gravel mining process.

The construction of a large storage reservoir under Alternative G would initially destroy 350 acres of cropland. The remainder of the irrigation area would undergo crop preparation and planting procedures similar to agricultural operations.

Alternatives A-D and G would require approximately 170 acres for sludge injection. Some cottonwood trees may be removed to aid the operational efficiency of the injection apparatus; however, the existing mixed pasture grasses and weeds would not be significantly different from adjacent vegetation types. This area is presently under cultivation and would experience a type of land use essentially the same as now exists.

Wildlife Patterns

Alternatives B and D are generally confined to the existing treatment plant site. Construction effects would deter wildlife from the immediate area but would generally have a short-term impact.

Alternatives A, C and G would disrupt approximately 225, 145 and 350 acres, respectively, of pasture/agricultural habitats. The removal of ground cover and topsoil for basin preparation would destroy existing small-mammal habitat. Most greatly affected would be ground squirrels, moles and gophers, which would lose a food source as well as shelter. Dust, noise and vibrations during construction would also depreciate the quality of neighboring riparian and pastureland/agricultural habitats.

Concomitant with the loss of habitat, a cessation of the present wildlife community in the proposed site would occur. The majority of the ground-dwelling wildlife would necessarily be displaced to other areas. The main animals displaced would be ground squirrels, mice and jack rabbits. One might be tempted to dismiss this displacement, reasoning that the animals would migrate to neighboring areas. However, since most biological systems operate at or near capacity, the displaced animals would have difficulty in finding a niche in an already well-established ecosystem. In reality, the overloading of animals in any area will lead to mortality or migration. Thus, predatory birds and animals will initially experience a surplus food supply from displaced animals; later, as the population comes to equilibrium, they will find the former concentration of small animals, but the area of habitation will be smaller.

Loss of space among territorial species will lead to migration to more remote areas or to marginal habitats. For example, urban development has destroyed red-winged blackbird habitats in some counties. As a result, some birds are now strutting and vocalizing their territorial songs in unusual areas such as roadway border strips. Similarly, invasions of squirrels and mice cause competition with other species such as native harvest mice. The Norway rat, in particular, has been very successful at invading other established ecosystems.

SOCIAL AND ECONOMIC ENVIRONMENT

Historical and Archaeological Resources--

The proposed alternative treatment systems will have no direct impacts upon archaeological resources within the areas that were visually examined for archaeological remains unless subsurface or buried remains are encountered during project development or related activities. This would also be an accurate assessment should there be no archaeological resources in the areas which could not be examined. Should there be any archaeological resources within those areas which were not visually inspected, they could be damaged or destroyed by project-related activities such as facility construction, pipeline trenching and plowing for sludge injection.

It does not appear that facilities construction will have any direct impacts on historical resources. The Kolb house and out-buildings are adjacent to an area that would be utilized for sludge injection, and there would be no necessity for removing the structures. If, however, it is determined for any reason that the Kolb buildings must be altered or removed, steps recommended in the mitigation section could be implemented.

Noise

Construction activities under all alternatives will increase background ambient noise levels for a short period of time in the vicinity of the site proposed. On some occasions, heavy equipment will produce louder noise, audible at great distances from the site. In Alternative G, where the construction site is removed from human habitation, noise at these levels will not be felt by local residents. Under Alternatives A through D, however, a significant degree of short-term annoyances will be experienced by residents along 75th Street, Jay Road and Heatherwood Estates.

Odor

The primary construction activities will be grading, trenching, excavation and compacting. These activities, involving soil movements and water drainage, are not anticipated to cause significant odor effects in the immediate area or its vicinity.

Traffic and Circulation

Alternatives A through D all depend upon 75th Street as a main access route. This road is two lanes wide and currently handles about 4,000 automobile trips per day. An addition of 50 to 100 automobile trips per day during construction would be well within the capacity of this road. Some disruption of traffic flow would occur if specific off-road parking areas reserved for construction workers were not provided on the site. Traffic circulation would also be impeded during delivery of materials and transport of equipment to the site. This can be reduced by providing the necessary access and turn-around space on the site.

The site for Alternative G is located in the eastern portion of the county. The proposed effluent storage reservoir would be reached mainly by North 107th Street or Mineral Road. These roads presently handle a small to moderate traffic load and would be able to accommodate the additional vehicle traffic generated during construction.

Project Employment

It is estimated that an average construction workforce of 70 employees will be required for both phases of construction for the various alternatives. Alternative G could require a larger workforce, but it is not expected to be more than 100 employees. Discussions with the local construction trade council representative indicates that the Boulder labor market has substantial unemployment in the skills required for the project and will not be strained by project construction, but local hiring will depend on the location of the contractor chosen (Reference E-1).

According to the facilities planner, approximately 30 percent of all capital costs other than land represents labor costs, including payroll burden and all indirect labor such as mainte-

Table E-1. ESTIMATED LAND, LABOR AND MATERIALS COST - FOR CONSTRUCTION OF EACH ALTERNATIVE ($1000)

	A	B	C	D	G
Capital Costs[a]	$9,889	$10,272	$7,832	$11,544	$34,875
Less Land Costs[a]	1,206	298	432	298	9,348
Cost of Improvements[a]	8,683	9,974	7,400	11,246	25,527
Labor Cost @ 30% of Improvements[b]	2,605	2,992	2,220	3,374	7,658
Payroll Spent in Boulder @ 70% of Labor Cost[c]	$1,824	$ 2,094	$1,554	$ 2,362	$ 5,361
Materials Cost @ 70% of Improvements[b]	6,078	6,982	5,180	7,872	17,869
Maximum Materials Purchased in Boulder @ 50%[d]	$3,491	$ 3,491	$2,590	$ 3,936	$ 8,935
Minimum Materials Purchased in Boulder @ 10%[d]	608	698	518	787	1,787
Maximum Spending in Boulder	$4,863	$ 5,585	$4,144	$ 6,298	$14,296
Minimum Spending in Boulder	2,432	2,792	2,072	3,149	7,148

(a) From Section III, EIS - Project Costs - Capital Costs.
(b) From Facilities Planner
(c) Assumes all local employment.
(d) According to the facilities planner and local contractors, a minimum of 10 percent and a maximum of 50 percent of all construction materials will be purchased in the City of Boulder.

nance and security. On this basis, payroll costs will range from $2.2 million (Alternative C) to $7.7 million (Alternative G) for both phases of construction.

Municipal Service Costs

It is not expected that construction of any of the alternatives will create any measurable impacts on municipal services. The only municipal cost attributable to the project is that of construction itself. For a discussion of the financing of the alternatives see Section IV of the EIS under Long-Term Impacts-Loans, Bonds and Subsidies. Project costs are discussed in Section III of the EIS under Project Costs - Capital Costs and Project Costs - Operation and Maintenance (O&M).

Direct Business Effects

Table E-1 presents an estimated allocation of capital costs for each alternative. It is estimated that capital costs less land costs represent approximately 30 percent labor and 70 percent materials. If a non-local (outside Boulder Valley) contractor is used for construction, a minimum of 10 percent of materials would be locally purchased. This represents a "worst case." The maximum, or "best case" represents 50 percent of construction materials purchased in Boulder.

Project payroll, including indirect labor (security and maintenance), is expected to range from $1.4 million (Alternative F) to $7.7 million (Alternative G) for both phases of construction. Most of this payroll will probably be paid to Boulder residents.

Indirect Business Effects

Both phases of project construction will generate indirect business effects in the Boulder economy, as the result of (1) local spending by the contractor for materials and (2) local spending by the construction workforce. This spending will create additional jobs locally.

Assuming a "best case" example, 50% of construction materials purchased in Boulder (Reference E-2), additional employment of from 70 job-years (Alternative C) to 240 job-years (Alternative G) would result locally. (See Table E-2 for details for each alternative.) This assumes a Boulder-based firm would be awarded the construction contract. Assuming a worst case example, only 10 percent of construction materials purchased locally (Reference (E-1), additional employment of from 38 job-years (Alternative C) would result locally. Details of the assumptions used for the best case and worst case examples can be found in the preceding Direct Business Effects. Both examples assume that all construction manpower will be hired from the local Boulder labor market (Reference E-3). Since current unemployment in the Denver-Boulder area stands at 45,300, projected employment would have a beneficial effect upon the local labor resources.

This analysis assumes that 30 percent of construction costs less land purchases represents labor and 70 percent represents materials. Maximum and minimum job-years of local employment generated by construction activities are projected in Table E-2 for each alternative including both phases of construction. Details of the analysis discussed above can be found in Table E-3.

Table E-2. PROJECTED LOCAL EMPLOYMENT
BOULDER, COLORADO

Alternative	Job-Years of Employment	
	Maximum	Minimum
A	82	44
B	94	51
C	70	38
D	106	57
G	240	130

An update of the 1972 U. S. Department of Commerce Census of Business suggests that $52,000 of retail spending will create one job-year of employment in the Denver-Boulder area. It further suggests that $65,000 of spending for building materials will create one job-year of employment presented above. Retail sales employment was applied to payroll spending and building materials employment was applied to construction materials spending.

Public Fiscal Impacts

Construction of the wastewater treatment plant will generate revenues to the City and County of Boulder. Retail spending by the construction workers in Boulder will result in use tax revenues collected by the City. Total collections for both phases could range from $31,000 for Alternative C to $107,000 for Alternative G for both phases. (See Table E-4 for the details on all alternatives). The City of Boulder collects a $0.2 tax on all

Table E-3. INDIRECT JOBS CREATED BY LOCAL SPENDING FOR CONSTRUCTION OF EACH ALTERNATIVE

	Alternatives				
	A	B	C	D	G
Payroll Spent in Boulder ($1,000) [a]	$1,824	$2,094	$1,554	$2,362	$5,361
Job-Years of Employment Created by Payroll Spending [b]	35	40	30	45	103
Maximum Materials Purchased in Boulder @ 50 percent ($1,000) [a]	$3,039	$3,491	$2,590	$3,936	$8,935
Job-Years of Employment Created by Spending [c]	47	54	40	61	137
Minimum Materials Purchased in Boulder @ 10 percent ($1,000) [a]	$ 608	$ 698	$ 518	$ 787	$1,787
Job-Years of Employment Created by Spending [c]	9	11	8	12	27
Maximum Job-Years of Employment Created	82	94	70	106	240
Minimum Job-Years of Employment Created	44	51	38	57	130

(a) From Table E-2.

(b) Assumes $52,000 of retail sales represents one job-year of employment; from U.S. Department of Commerce Census of Business.

(c) Assumes $65,000 of sales of building materials represents one job-year of employment; from U.S. Department of Commerce Census of Business.

retail transactions. These revenues were estimated by applying this rate to the projected local purchases (70 percent of payroll).

Boulder County does not collect either a sales tax or a use tax. The City collects its tax only if the ultimate delivery point of the item is within the city limits. When the City receives its building permit from the County, that permit serves to prove that materials purchased for the project are going to be used outside city limits and that vendors do not collect the tax. Therefore, no local agency will benefit from the sale of construction materials. (Reference E-4).

The County of Boulder will receive from $8,000 for Alternative C to $26,000 for Alternative G in revenues when the building permit is issued. The permit fee is based on the total cost of labor and materials estimated at the beginning of the project. A charge of $887 is levied against the first $500,000 of construction costs, plus an additional $1.00 for every $1,000 above that amount. For details on all alternatives, see Table E-4. (Reference E-5).

Table E-4. PROJECTED REVENUES TO THE CITY AND COUNTY OF BOULDER DURING CONSTRUCTION ($1,000)

	A	B	C	D	G
Payroll Spent on Taxable Items[(a)]	$1,824	$2,094	$1,554	$ 2,362	$ 5,361
Use Tax Collected by the City of Boulder[(b)]	$36	$42	$31	$47	$107
Capital Costs (Excluding Land)[(c)]	$8,683	$9,974	$7,400	$11,246	$25,527
Building Permit Fee (Revenues to the County of Boulder)[(d)]	9	10	8	12	26

(a) From Table E-3, Indirect Business Effects.
(b) The City of Boulder collects a $0.2 use tax on every dollar of retail sales within the City.
(c) From Table E-3, Project Costs - Capital Costs.
(d) Building permit fees are charged on labor and materials as follows: $887 for the first $500,000 and a dollar for every additional $1,000.

REFERENCES FOR APPENDIX E

E-1 Ulrich, Don, Economic Regional Planner, CH2M Hill, Personal communication, March 1977

E-2 *Draft Environmental Impact Statement on Management Plan for Wastewater Sludge by Metropolitan Denver Sewage Disposal Distroct No. 1, Denver, Colorado,* May 1976. Engineering-Science, Inc.

E-3 Westerberg, George, Business Representative, Colorado Building and Construction Trades Council. Personal communication, October 1976.

E-4 Manzanares, Dave, Sales Tax Administrator, City of Boulder. Personal communication, October 1976.

E-5 Wages, John, Chief Building Inspector, County of Boulder. Personal communication, March 1977.

APPENDIX F
COLORADO WATER QUALITY CONTROL COMMISSION

JUNE 6, 1978 GUIDELINES FOR WASTEWATER DISCHARGE ENFORCEMENT POLICIES

COLORADO DEPARTMENT OF HEALTH

4210 EAST 11TH AVENUE DENVER, COLORADO 80220 PHONE 320-8333

Anthony Robbins, M.D., M.P.A. Executive Director

WATER QUALITY CONTROL COMMISSION

S P E C I A L   N O T I C E

Pursuant to the provisions of C.R.S., 1973, 25-8-101, as amended,

NOTICE is hereby given that the Water Quality Control Commission adopted the attached guidelines as an enforcement policy to be used in assuring water quality control for discharges of domestic type wastewater.

The effective date of this policy is June 6, 1978.

Dated this 24th day of August, 1978, at Denver, Colorado.

Evan D. Dildine, P.E.
Technical Secretary
Water Quality Control Commission

EDD:rr

Attachment

COLORADO DEPARTMENT OF HEALTH
Water Quality Control Commission
4210 E. 11th Avenue
Denver, Colorado 80220

Adopted: June 6, 1978

ENFORCEMENT

COMMISSION POLICY

Section 25-8-501(6) C.R.S. 1973 reads as follows: "Every permit issued for a sewage treatment works shall contain such terms and conditions as the division determines to be necessary or desirable to assure continuning compliance with applicable control regulations. Such terms and conditions may require that whenever deemed necessary by the division to assure such compliance the permittee shall:

(a) ...
(b) ...
(c) ...

(d) Initiate engineering and financial planning for expansion of the sewage treatment works whenever throughput and treatment reaches eighty percent of design capacity;

(e) Commence construction of such sewage treatment works expansion whenever throughput and treatment reaches ninety-five percent of design capacity or, in the case of a municipality, either commence such construction or cease issuance of building permits within such municipality until such construction is commenced, except that the building permits may continue to be issued for any construction which would not have the effect of increasing the input of sewage to the sewage treatment works of the municipality involved; ..."

When the municipality's self-monitoring or the division's monitoring data indicates that a sewage treatment works has reached 80% of capacity and the division determines that no action has been taken by the municipality to initiate engineering and financial planning for expansion of the sewage treatment works, the division will notify the appropriate municipal authorities by certified letter of the necessary action. The municipality will also be notified that failure to proceed with planning may cause the commission to cease any further action on site location application for sewer extensions for that municipality until the necessary planning is pursued.

The provision of Section 25-8-501(6) has been inserted in each municipal discharge permit and when the division determines that a municipality has not started construction on the expansion of their waste treatment works after the facility has reached 95% of its (designed) rated capacity, they will be notified by certified letter that if construction of the sewage treatment works is not started and if a compliance schedule satisfactory to the division for accomplishing the construction start is not submitted within sixty days, the division may seek an injunction prohibiting the issuance of any further building permits until such time as construction of the sewage treatment facility expansion begins.

"Commencement of construction" means the actual physical effort to construct the project, excluding engineering, architectural, legal, fiscal and economic investigations and studies and surveys, and which would include any expenditure of effort which would commit the contractor to completion of the project or which if abandoned would cause significant financial loss. Such efforts may include, but not be limited to, site clearing, excavation, construction or moving an office, construction building onto the site or obtaining a performance surety bond.

In order to provide support to the division in exercising these provisions of the Act, the Water Quality Control Commission will cease to take action on any site location applications in the municipal service area in question during the time that the building permit moratorium is in effect.

OTHER REQUIREMENTS (continued)

LAND APPLICATION PROGRAM - Existing Sites

The permittee shall submit within sixty (60) days from the effective date of this permit for existing land application sites, a design report on the existing land application site to the permit issuing authority. The continuance of this land application program will be subject to approval of this design report by the permit issuing authority.

This design report shall include any proposed and/or existing groundwater monitoring program designed to monitor any movement of pollutants into the groundwater in the area of the land application site. Monitoring wells should be situated so as to monitor groundwater quality inside the site, in each dominant direction of groundwater movement away from the site, and background water quality for groundwater entering the site. The design report shall also contain the following information as a minimum:

1. A large scale topographic map of the land application site and surrounding area. This map shall show the location and estimated water levels of the proposed and/or existing groundwater monitoring points, including an estimate of the rate of groundwater movement and the direction of the groundwater gradient.

2. A description of the proposed and/or existing monitoring wells including casing size and the perforated zone of the casing and the method of installation.

3. A description of the method of sampling and listing of the analyses performed on the applied wastewater plus water removed from background and down-gradient groundwater quality monitoring points. As a minimum, the following analyses shall be performed on a basis and reported on a basis for each monitoring point:

    a) Nitrate and Ammonia Nitrogen, mg/l
    b) Total Dissolved Solids, mg/l
    c) COD, mg/l
    d) Fecal Coliform, #/100 ml
    e) Chlorides, mg/l

   Before sampling, all monitoring wells must be pumped for a minimum of ten minutes. Wells should be capped and locked when not sampling.

4. Groundwater uses in the area. Show location of all wells (domestic, irrigation, etc.) in and within one-half mile (1/2 mile) of site.

5. Operating procedures, including as a minimum:

    a) Type of irrigation used
    b) Application rates
    c) Available acreage & type of vegetation
    d) Rotation schedule

OTHER REQUIREMENTS (continued)

LAND APPLICATION PROGRAM - Existing Sites

6. SCS soil classification of surface layer and soil profile to a 10-foot depth.

The first monitoring report shall be submitted within one hundred and twenty (120) days from the date of approval of the design report by the permit issuing authority and on a   basis thereafter. Each   report shall contain, at a minimum, the following information:

1. The required analyses and the date the sample was taken for each monitoring point.

2. The average volume used per application day and quality of effluent during the reporting period.

3. The static water level in each well.

In addition to the above information, the first monitoring report shall contain the following:

1. Monitoring point location and number (consecutive numbering), date completed, depth, surface elevation, depth to static water level, date of measurement.

OTHER REQUIREMENTS (continued)

LAND APPLICATION PROGRAM -Proposed Sites

The permittee shall submit within ninety (90) days prior to the planned commencement date for proposed land application sites, a design report including plans and specifications for the proposed land application site to the permit issuing authority. The commencement of this land application program will be subject to approval of this design report by the permit issuing authority.

This design report shall include a proposed groundwater monitoring program designed to monitor any movement of pollutants into the groundwater in the area of the land application site. Monitoring wells shall be situated so as to monitor groundwater quality inside the site, in each dominant direction of groundwater movement away from the site, and background water quality for groundwater entering the site. The design report shall also contain the following information as a minimum:

1. A large scale topographic map of the land application site and surrounding area. This map shall show the location and estimated water levels of the proposed groundwater monitoring points, including an estimate of the rate of groundwater movement and the direction of the groundwater gradient.

2. A description of the proposed monitoring wells including casing size and the perforated zone of the casing and the method of installation.

3. A description of the method of sampling and a listing of the analyses to be performed on the applied wastewater plus water removed from background and down-gradient groundwater quality monitoring points. As a minimum, the following analyses shall be performed on a basis and reported on a basis for each monitoring point:

   a) Nitrate and Ammonia Nitrogen, mg/l
   b) Total Dissolved Solids, mg/l
   c) COD, mg/l
   d) Fecal Coliform, #/100 ml
   e) Chlorides, mg/l

   Before sampling, all monitoring wells must be pumped for a minimum of ten minutes. Wells should be capped and locked when not sampling.

4. Groundwater uses in the area. Show location of all wells (domestic, irrigation, etc.) in and within one-half (1/2 mile) of site.

5. Proposed operating procedures, including as a minimum:

   a) Type of irrigation to be used
   b) Application rates
   c) Available acreage & type of vegetation
   d) Rotation schedule

OTHER REQUIREMENTS (continued)

LAND APPLICATION PROGRAM - Proposed Sites

6. SCS soil classification of surface layer and soil profile to a 10-foot depth.

The groundwater monitoring points shall be installed and the first monitoring report shall be submitted within one hundred and twenty (120) days from the date of approval of the design report by the permit issuing authority and on a basis thereafter. Each report shall contain, at a minimum, the following information:

1. The required analyses and the date the sample was taken for each monitoring point.

2. The average volume used per application day and quality of effluent during the reporting period.

3. The static water level in each well.

In addition to the above information, the first monitoring report shall contain the following:

1. Monitoring point location and number (consecutive numbering), date completed, depth, surface elevation, depth to static water level, date of measurement.

2. The required analyses taken prior to the commencement of the land application program.

OTHER REQUIREMENTS (Continued)

GROUNDWATER DISCHARGES (Leach Fields, Exfiltration ponds, subsurface filtration, etc.)

The Colorado Water Quality Control Acts specifies that "state waters" include groundwater for discharge permit requirements. However, wastewater treatment facilities utilizing final unit processes such as stated above do not discharge directly to subsurface waters. Therefore, the permittee is directed to install a groundwater monitoring program to insure that groundwater degradation is not occurring at the site.

Within sixty (60) days from the effective date of the permit, the permittee shall submit a design report for this program to the Colorado Water Quality Control Division.

This design report shall include any proposed and/or existing groundwater monitoring program designed to monitor any movement of pollutants into the groundwater in the area. Monitoring wells should be situated so as to monitor in each dominant direction of groundwater movement away from the site, and background water quality for groundwater entering the site. The design report shall also contain the following information as a minimum:

1. A large scale topographic map of the treatment plant site and surrounding area. This map shall show the location and estimated water levels of the proposed and/or existing groundwater monitoring points, including as estimate of the rate of groundwater movement and the direction of the groundwater gradient.

2. A description of the proposed and/or existing monitoring wells including casing size and the perforated zone of the casing and the method of installation.

3. A description of the method of sampling and a listing of the analyses performed on the applied wastewater plus water removed from background and down-gradient groundwater quality monitoring points. As a minimum, the following analyses shall be performed on a basis and reported on a basis for each monitoring point:

   a) Nitrate and Ammonia Nitrogen, mg/l
   b) Total Dissolved Solids, mg/l
   c) COD, mg/l
   d) Fecal Coliform, #/100 ml
   e) Chlorides, mg/l

   Before sampling, all monitoring wells must be pumped for a minimum of ten minutes. Wells should be capped and located when not sampling.

4. Groundwater uses in the area. Show location of all wells (domestic, irrigation, etc.) in and within one-half mile (1/2 mile) of site.

OTHER REQUIREMENTS (continued)

GROUNDWATER DISCHARGES (Continued)

5. SCS soil classification of surface layer and soil profile to a 10-foot depth.

The first monitoring report shall be submitted within one hundred and twenty (120) days from the date of approval of the design report by the permit issuing authority and on a basis thereafter. Each report shall contain, at a minimum, the following information:

1. The required analyses and the date the sample was taken for each monitoring point.

2. The static water level in each well.

In addition to the above information, the first monitoring report shall contain the following:

1. Monitoring point location and number (consecutive numbering), date completed, depth, surface elevation, depth to static water level, date of measurement.

APPENDIX G
ENVIRONMENTAL TEAM

GENE TAYLOR, M.A., M.P.A.	EPA Project Officer, Coordination of Public Meetings and Notices
*EMY CHAN	Project Manager, Alternatives Evaluation, Biotic Communities, Noise, Graphic Arts
TARAS A. BURSZTYNSKY, M.S., P.E.	Sanitary Engineering, Alternatives Evaluation, Odor
*SAMUAL B. EARNSHAW, B.S.	Vegetation, Visual and Aesthetics (Appendix C)
*BAHMAN SHEIKH-OL-ESLAMI, Ph.D, P.E.	Soils, Sludge-Injection System
*WILLIAM BORGES, B.A.	Geology, Soils, Climate, Surface Water
JOYCE S. HSIAO, M.S.	Infiltration/Percolation Basins
*THOMAS T. JONES, M.S.	Alternatives Evaluation
ALAN UDIN, M.S., P.E.	Project Cost Evaluation
PHILIP N. STORRS, M.S., P.E.	Technical Direction
ROBERT E. BROGDEN, M.S.	Agricultural Reuse, Water Rights
GUY LEONARD, B.S.	Groundwater, Water Rights
*GEORGE A. JOHNSON, M.B.A., M.S.	Economics, Project Costs, Statutory Impacts
SHERRI CANN, M.I.M.	Economics, Public and Social Services, Socio-Cultural Impacts
*JULE FISCH, M.A.	Land Use
STEPHEN A. DIETZ, M.A.	Archaeology and Historical Resources
JANE L. ANDERSON, M.A.	Archaeology and Historical Resources

*Member of the Association of Environmental Professionals.

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(Please read Instructions on the reverse before completing)

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Final Environmental Impact Statement.

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Region VIII
1860 Lincoln Street
Denver, Colorado 80295

13. TYPE OF REPORT AND PERIOD COVERED
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15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document describes the proposed EPA action regarding wastewater treatment facilities for the City of Boulder, Colorado. Alternative facilities involving advanced waste treatment techniques were considered to meet NPDES permit requirements for Boulder Creek. Principal alternatives considered include land treatment by infiltration/percolation, modified activated sludge/trickling filters, chemical treatment, aeration/polishing ponds, and agricultural reuse. A form of activated sludge followed by trickling filters was chosen.

Environmental reports were assessed for this plan including effects on water quality, groundwater levels, groundwater quality, odor generation, fog or aerosol formation, increased energy demand, land use patterns, public health problems, soil productivity and visual effects. Sludge treatment will be the subject of a supplemental EIS.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Wastewater treatment; advanced wastewater treatment; activated sludge; White Rocks; Boulder Creek; groundwater quality; growth impacts; percolation basins; agricultural reuse	Boulder, Colorado; final EIS; 201 Facilities Plan	

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