INTERIM REPORT ENGINEERING/FINANCIAL

MILLIKEN SANITATION DISTRICT COLORADO PLAN FOR WASTEWATER TREATMENT WORKS

Water Quality Management Plan

LARIMER-WELD REGIONAL COUNCIL OF GOVERNMENTS
LOVELAND, COLORADO

13

PREPARED BY BRISCOE, MAPHIS, MURRAY & LAMONT, INC.
BOULDER, COLORADO
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LOVELAND, COLORADO MAY, 1977

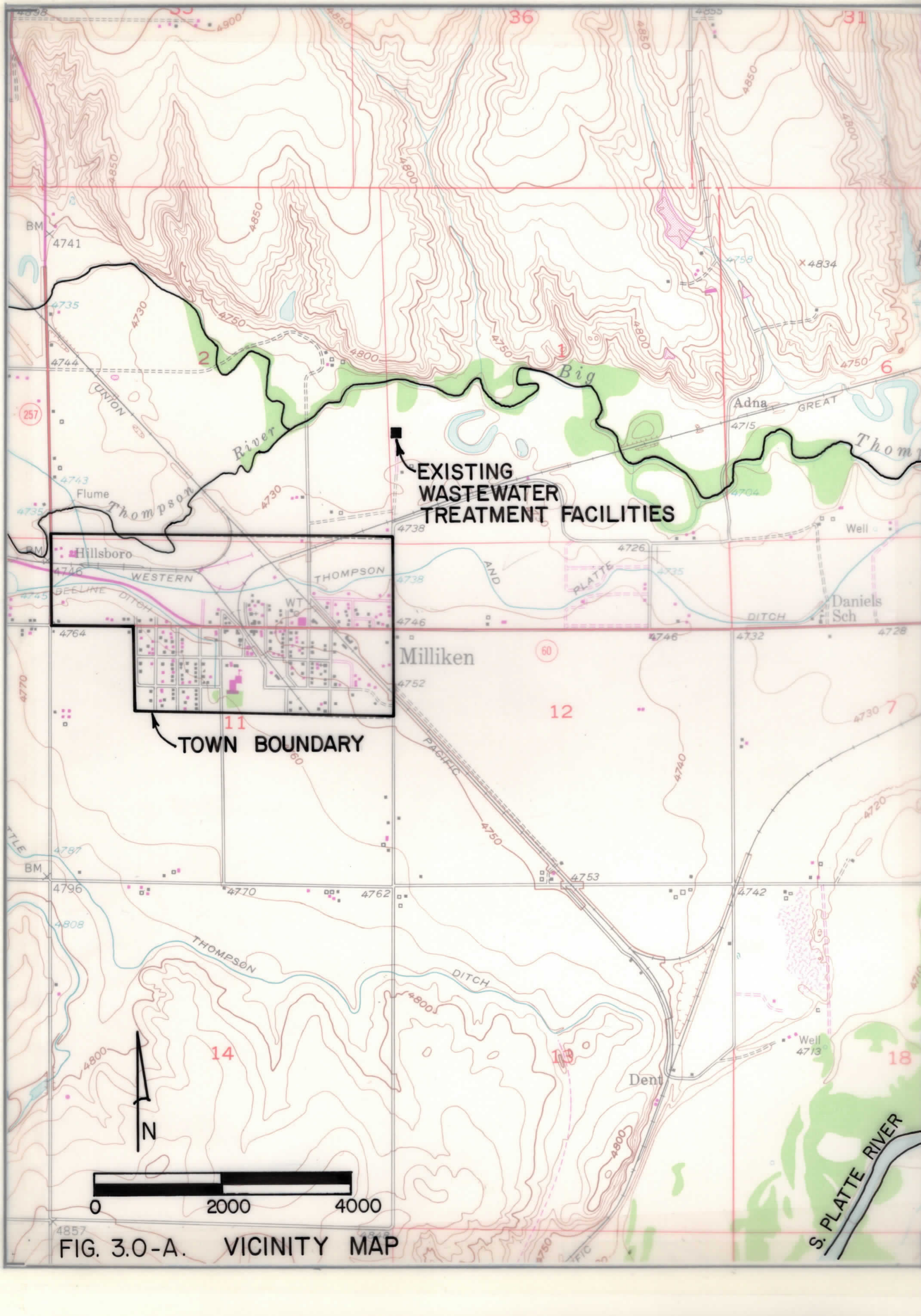

FIG. 3.0-A. VICINITY MAP

208 AREAWIDE WATER QUALITY MANAGEMENT PLAN

TECHNICAL PLANNING REPORT
WASTEWATER TREATMENT WORKS
MILLIKEN SANITATION DISTRICT

Prepared For

Larimer-Weld Regional
Council of Governments

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The preparation of this report was financed in part through a Water Quality Management Technical Assistance Planning Grant from the Environmental Protection Agency under the provisions of Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500).

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1.0 SUMMARY AND RECOMMENDATIONS

1.1 TECHNICAL PLANNING SUMMARY

The wastewater treatment facilities of the Milliken Sanitation District are both hydraulically and biologically overloaded. As a result, the effluent from the plant is not consistently in compliance with limitations stipulated in the NPDES permit.

In this Technical Plan, wastewater treatment and disposal options available to the District have been developed and analyzed. It is recommended that the District modify and expand the existing treatment facilities utilizing the completely-mixed activated sludge process. Total estimated project costs are $356,000. It is recommended that the District adopt the project implementation schedule outlined in this report.

1.2 FINANCIAL PLANNING SUMMARY

The Milliken Sanitation District has little capability to finance new wastewater improvements. At the present level of operations and debt service costs, both user fees and property taxes are required to meet expenses. There is virtually no ability to raise property taxes as the Milliken residents are currently facing a 107 mill combined levy. Service charges are presently at $72 annually, and no surplus revenues are being developed.

Problems that will arise as the District and the Town attempt to garner the necessary financing for their wastewater system will demand much attention from the existing residents. However, care should be exercised not to overlook the broader problem at hand which is how a central wastewater system should be managed in the best long-run interests of the community. Management policies regarding the utility service area, extensions, and utility operation are equally as important, and closely related to, financial policies on new hookup and service charges. Policies in these areas should be discussed early to gain citizen understanding and to set the stage for the purely financial decisions. To assist in these areas, the Town and District should obtain a copy of the Utility Management Handbook (1977) available from the LWRCOG.

The most critical financial concern of the District is how to obtain sufficient capital funds to finance the proposed improvements. The engineering analysis suggests there will be little effect on ongoing maintenance costs. Certainly substantial grant monies must be obtained. Possibly a developer can be persuaded to prepay tap fees, and some small district debt may have to be floated. The prospects for future growth should be very carefully considered as new users will both generate tap fees and share in operating costs.

Because of the financial difficulties that can be anticipated, community involvement should begin early so that support can be mustered for the policies that will be adopted, and commitments that will be made.

2.0 INTRODUCTION

2.1 AREAWIDE WATER QUALITY MANAGEMENT PLANNING PROCESS

This Technical Planning Report has been prepared as part of an overall Areawide Water Quality Management Plan (208) for the Larimer-Weld region being developed by Toups Corporation and Briscoe, Maphis, Murray, and Lamont, Inc., for the Larimer-Weld Regional Council of Governments (LWRCOG). The purpose of the Technical Planning component of the 208 plan is to assist various communities in the Larimer-Weld region by developing the best alternative project for waste treatment and disposal.

This Technical Planning Report has been prepared to provide near-term guidance for the Milliken Sanitation District. This report (along with appropriate modifications) will be incorporated into the LWRCOG Areawide Waste Treatment Management Plan following review and approval by all governmental agencies involved.

2.2 BASIS, PURPOSE, AND SCOPE OF TECHNICAL PLAN

2.2.1 Basis

The wastewater treatment facilities of the Milliken Sanitation District are both hydraulically and biologically overloaded. As a result, the effluent from the plant is not consistently in compliance with limitations stipulated in the NPDES permit. That permit requires that engineering and financial planning for expansion be initiated whenever the flowrate exceeds eighty (80) percent of design capacity.

2.2.2 Purpose

The purpose of this Technical Plan is to reanalyze all wastewater treatment and disposal options available to the Milliken Sanitation District, recommend the best alternative project, and fully describe the project. Upon completion of the report, the District may proceed to implement the project, and be assured that the District's wastewater problems will be solved in a cost-effective manner.

2.2.3 Scope

The scope of this Technical Plan includes the following phases:

- Describe the planning area characteristics;
- Determine wastewater characteristics;
- Analyze waste treatment and discharge requirements;
- Analyze existing facilities;
- Develop, analyze, and screen alternative plans;
- Prepare a detailed description of the best alternative project, including engineering, financial and institutional programs;
- Prepare a Technical Planning report presenting all data, and outlining a wastewater management program for the 20-year planning period;
- Assessment of current financial capabilities;
- Development of a procedure for establishing a financial program;
- Analysis of the ability (and risks involved) in financing the proposed wastewater treatment program.

3.0 PLANNING AREA CHARACTERISTICS

The Town of Milliken is located in the west-central section of Weld County on Highway 60 approximately 6 miles east of Interstate 25. The Little Thompson River is immediately north of the town. Milliken was established sometime prior to 1900 and was incorporated in 1910. Although the town surrounds a junction of the Union Pacific and Great Western Railroads, there are no significant industrial dischargers in the sewer service area.

Today, Milliken is primarily a residential community supplying housing opportunities to people working in the surrounding communities. Both the water distribution system and the wastewater collection-disposal system are owned and operated by Milliken Sanitation District. The location and present boundary of the Milliken S.D. is shown on Figure 3.0-A, together with the location of the existing wastewater treatment facilities.

3.1 EXISTING AND PROJECTED POPULATION

According to the U.S. Bureau of the Census, the 1970 population of the Town of Milliken was 702 people. The present population of the town is estimated at approximately 1,200. In Table 3.1-A, historical and projected populations previously developed for the town are presented [South Platte River Basin 303 Plan and Regional Planning Commission]. Also shown is a population based on the predicted future population of the Larimer and Weld Counties, and the assumption that Milliken's percentage of the future growth in Larimer-Weld Counties will be identical with that percentage which occurred between 1970 and 1975. All these projections are also graphically illustrated on Figure 3.1-A. The projected population for 1983 and 2000, which are the basis for this report, are also indicated on Figure 3.1-A. These population projections are:

1983 - 2000

2000 - 4000

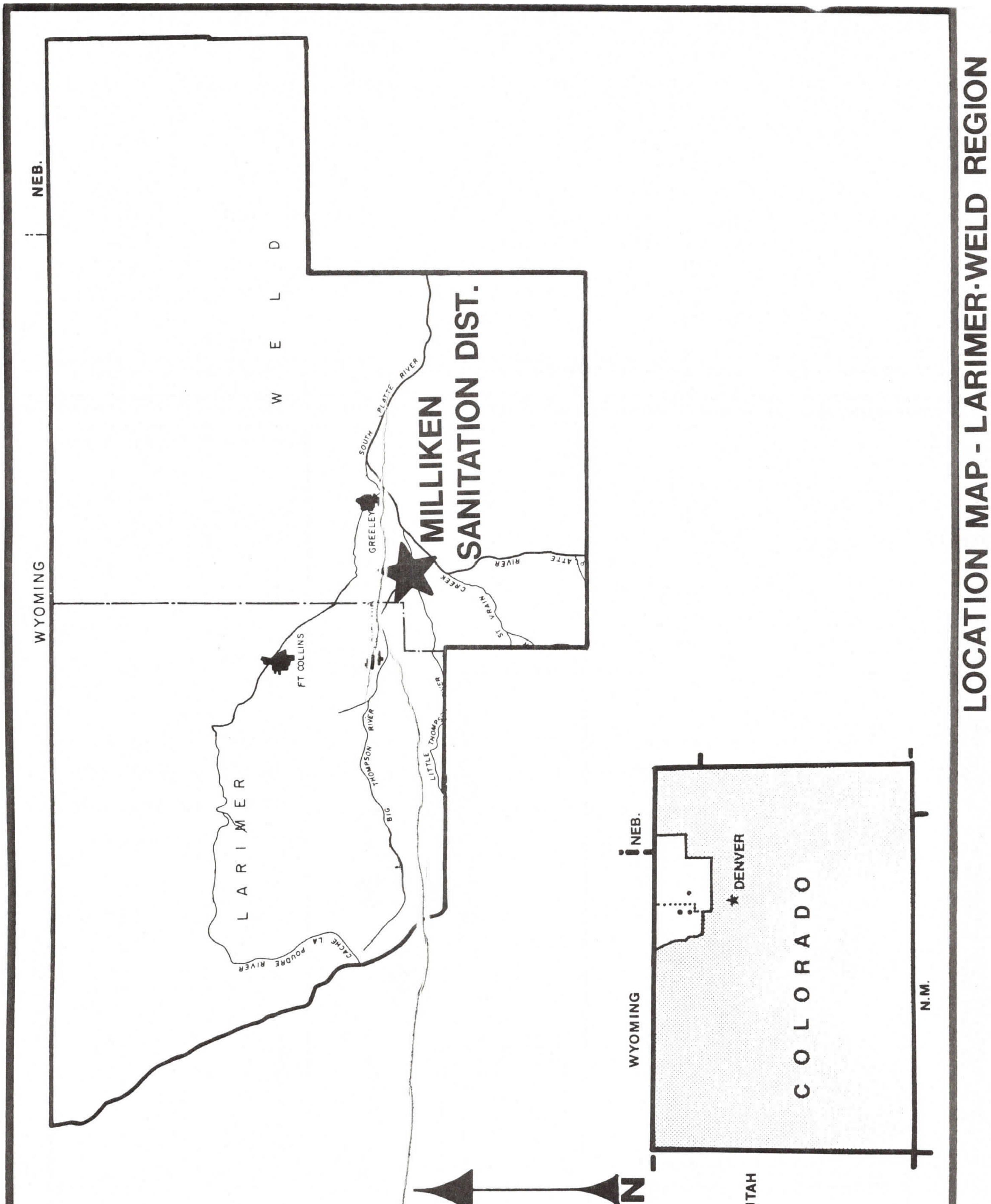

Figure 3.0-A. VICINITY MAP.

TABLE 3.1-A. POPULATION PROJECTIONS - TOWN OF MILLIKEN

DATA SOURCE	ESTIMATED POPULATION						
	1950	1960	1970	1980	1983	1990	2000
U.S. Bureau of the Census	510	630	702	-	-	-	-
South Platte River Basin 202 Plan - 1974				1200	1600	2000	3700
Regional Planning Commission Study 1972				1000	1600	3000	-
Projected Percentage Rate				1500	1800	2500	3200
Estimated Population Used in This Report				-	2000	-	4000

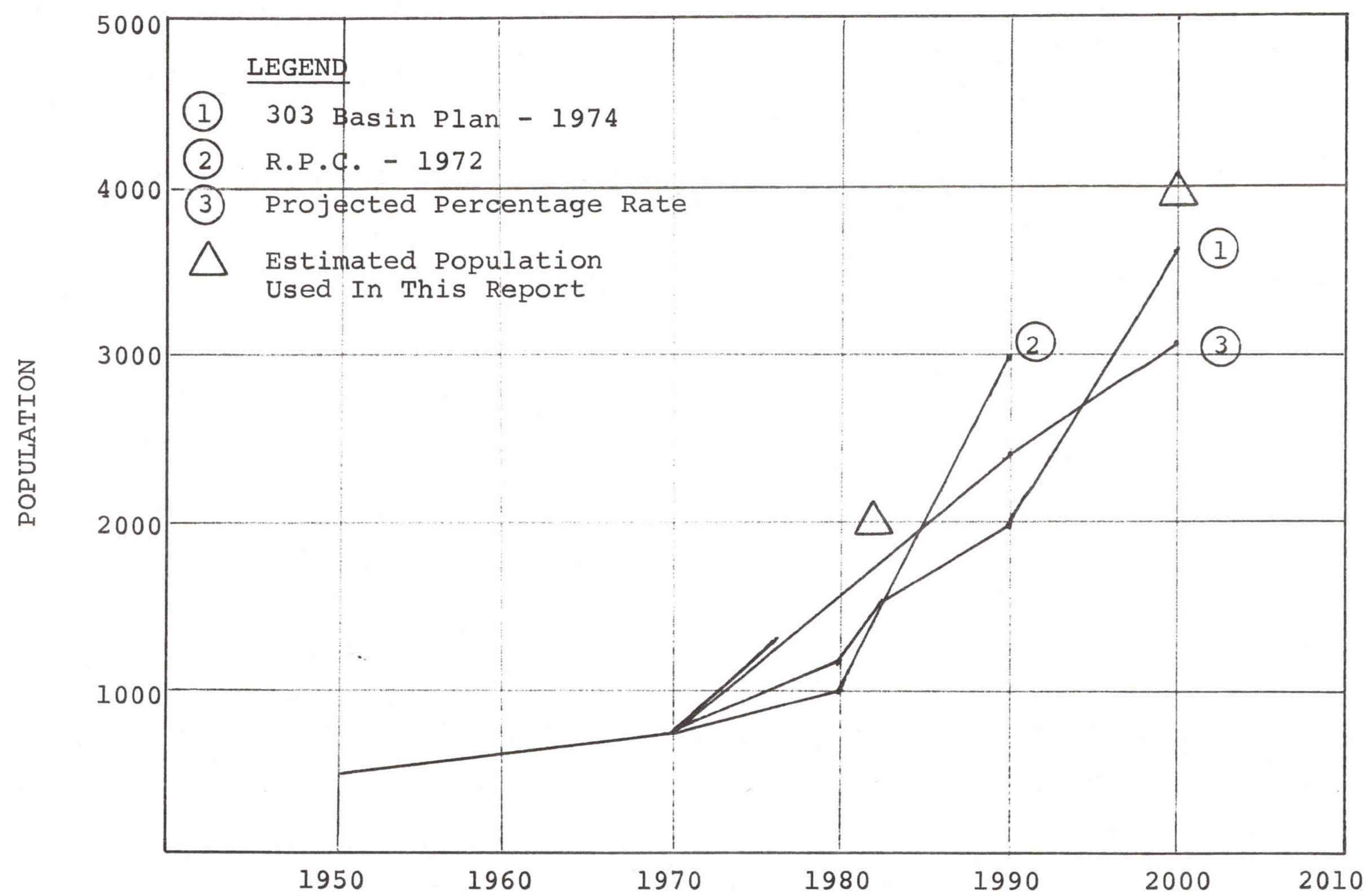

FIG. 3.1-A. PROJECTED POPULATION - MILLIKEN S.D.

4.0 WASTEWATER CHARACTERISTICS

The characteristics of the Milliken S.D. wastewater will be estimated based on historical data, results of a regional wastewater quality sampling program recently conducted by Toups, and on recommended design criteria published by the Colorado Department of Health (CDH). Wasteload projections will be developed based on waste characteristics and population projections.

4.1 MUNICIPAL WASTEWATER CHARACTERISTICS

In analyzing wastewater characteristics, it is necessary to investigate components affecting both the amount of wastewater and its strength and composition.

4.1.1 Flow

Milliken has extensive inflow or infiltration (I/I) problems which greatly increase the wastewater flowrate during certain periods of the year. The severity of this problem is illustrated by great variation in flowrates. In a discussion on August 6, 1976, Mr. Earl Wolfe, Milliken Sanitation District Board President, indicated that winter flows average 60,000 to 70,000 gallons per day whereas summer flows, when I/I problems are most severe, periodically exceed 200,000 gpd. A program is presently underway to replace or repair some of the sewer pipe having the greatest amounts of I/I. The I/I elimination program should reduce I/I flows by more than 50 percent.

It is assumed that future development in the city will be served by well designed and constructed sewer systems. For projected flows, a unit average flow of 100 gallons per capita per day (gcd) is a realistic value for design purposes and will be utilized in this report. This value represents typical domestic waste, including residential and normal commercial contributions, together with infiltration/inflow (I/I) expected even from well designed and constructed sewerage systems. Flows will be calculated based on the population projections presented in Chapter 3.0. Projected municipal wastewater flows are illustrated on Figure 4.1.1-A for average and peak conditions. The flow projections are based on the assumption that I/I will be reduced by 50 percent. Average wastewater flowrates are projected to be 0.2 mgd in 1983 and 0.4 mgd in the year 2000. Peak flows were based on the data presented in the 303 Basin Plan [Toups Corporation - 1974].

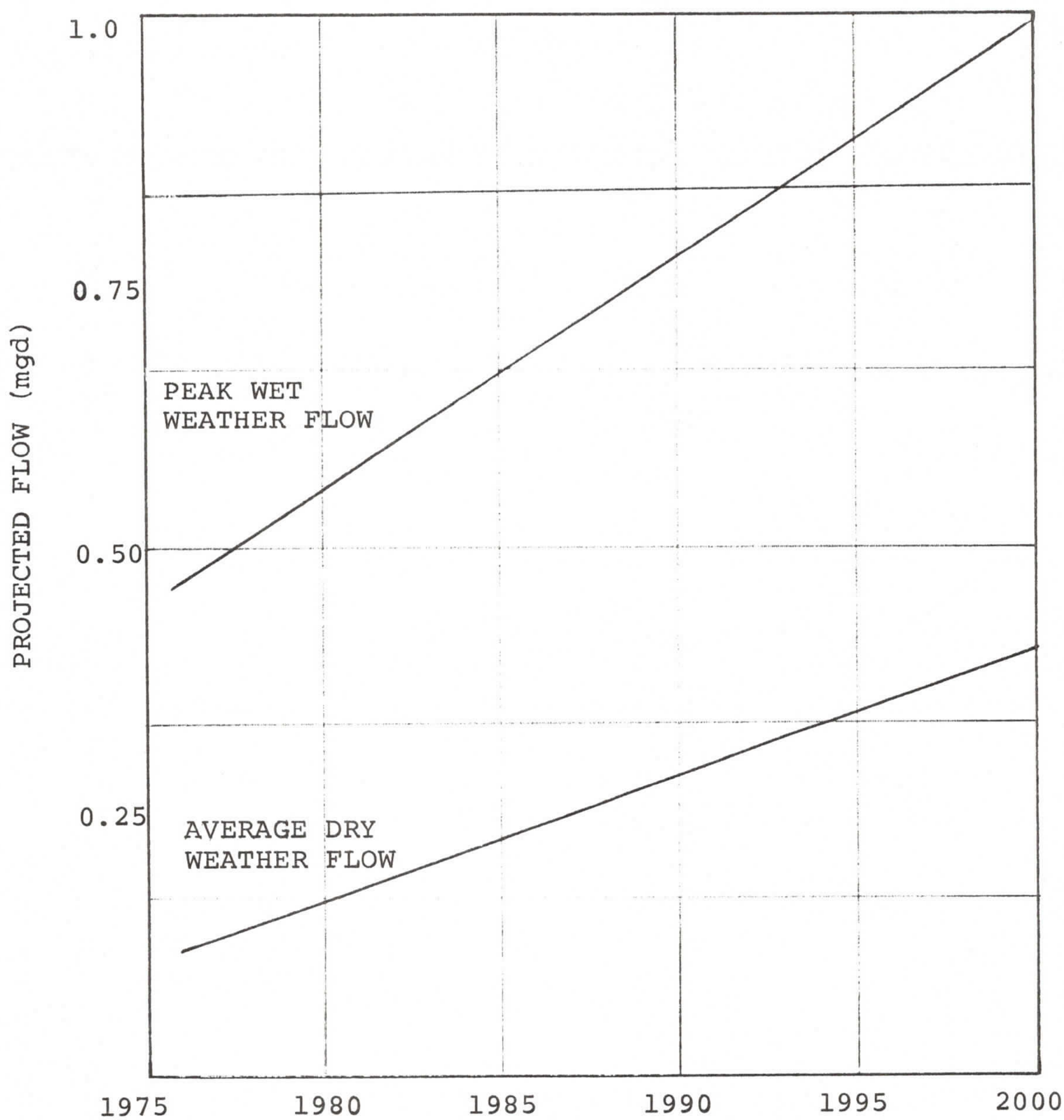

FIG. 4.1.1-A. PROJECTED WASTEWATER FLOWS

4.1.2 Composition

Wastewater strength is generally measured in terms of biochemical oxygen demand (BOD_5) and suspended solids (SS). Evaluation of other constituents such as chemical oxygen demand (COD), ammonia (NH_3), temperature and pH are necessary in particular situations.

As part of a sampling program conducted in the Technical Planning component of the LWRCOG 208 Plan, samples of influent and effluent wastewater were collected from the Milliken treatment facilities and analyzed for various constituents. The results of the influent analyses, together with a summary of the historical wastewater composition data, are shown in Table 4.1.2-A.

TABLE 4.1.2-A. RAW WASTEWATER COMPOSITION - TOWN OF MILLIKEN

CONSTITUENT (a)	AVERAGE SELF MONITORING DATA	SAMPLE SEPTEMBER 2, 1976	TYPICAL DOMESTIC WASTEWATER FOR L-W REGION
BOD_5	230	-	190
SS	140	92	140
Ammonia (as N)	-	8.2	8.5
TDS	-	1040	-

(a) All values in milligrams per liter.

4.1.3 Unit Design Factors

A summary of unit design factors for sizing various components of the proposed wastewater system is presented in Table 4.1.3-A.

TABLE 4.1.3-A. UNIT DESIGN FACTORS

ITEM	DESIGN FACTORS	
	EXISTING	FUTURE
Wastewater Flow		
Average flow (gcd)	110(a)	100(a)
Peak flow - (% of average)	350%	(b)
Wastewater Composition		
BOD_5 (pcd)	0.17	0.18
SS (pcd)	0.13	0.18

GCD = Gallons per capita per day
pcd = Pounds per capita per day
(a) Assumes existing I/I problems are corrected
(b) See Figure 4.1.1-A as peaking factor varies with flowrate

4.2 WASTELOAD PROJECTIONS

Based on the unit wastewater loading rates and the population predictions presented in Chapter 3.0, the future flowrates and wasteloads for design purposes have been developed and are presented in Table 4.2-A. The estimated future loads do not include any provisions for industrial wastes in view of the impossibility of predicting wasteloads from currently non-existent industry. The magnitude of industrial growth in small communities cannot be estimated with any degree of certainty.

Any future negotiations for the purposes of locating industry in the Milliken S.D. should include considerations of available wastewater treatment capacity at the treatment plant. Many communities and industries enter into agreements whereby industries contribute both capital and O & M costs for wastewater treatment.

TABLE 4.2-A. TOTAL PROJECTED DESIGN WASTEWATER LOADINGS

	AVERAGE DRY WEATHER FLOW (ADWF)		BOD_5		SUSPENDED SOLIDS	
	UNIT (gcd)	TOTAL (mgd)	CONCENTRATION (mg/l)	LOADING (lbs/day)	CONCENTRATION (mg/l)	LOADING (lbs/day)
1983	110	0.22	200	360	200	360
2000	100(a)	0.40	215	720	215	720

gcd = Gallons per capita per day
mg/l = Milligrams per liter
pcd = Pounds per day
(a) Lower because of reduced I/I as a result of integrity of expanded sewer system.

5.0 DISCHARGE AND TREATMENT REQUIREMENTS

Wastewater must be disposed of in a manner which will protect the public health, maintain receiving water quality consistant with its beneficial uses, and prevent nuisance at the site of disposal. These conditions, along with economic considerations, determine the degree and type of wastewater treatment necessary prior to disposal or reuse. In this section, discharge standards are delineated, treatment requirements are outlined, an overview of alternative treatment processes are presented, and an evaluation of irrigation reuse potential is given.

5.1 WASTE DISCHARGE STANDARDS

Standards promulgated by the U.S. Environmental Protection Agency (EPA) and the Colorado Water Quality Control Commission (WQCC) for the discharge of wastes to receiving waters have been extensively discussed in the South Platte River Water Quality Management Plan [Toups, 1974]. Current standards have been refined, and further changes are presently being proposed.

5.1.1 Existing Requirements

As a minimum, planning of publically-owned wastewater treatment facilities must provide for secondary treatment by 1977 or as soon as possible thereafter, and for application of Best Practicable Waste Treatment Technology (BPWTT) prior to 1983. The levels of BPWTT and various waste management techniques available to meet those levels have been defined [EPA - 1975]. Secondary treatment and BPWTT requirements apply to discharges to all surface waters of the State. The WQCC has ruled that these standards also apply to discharges to privately-owned irrigation supply waters. More stringent standards apply to discharges to water quality limited segments of State receiving waters; however, no such segments are located in the vicinity of the Town of Milliken. Current EPA secondary treatment requirements as promulgated under the Federal Water Pollution Control Act Amendments (PL 92-500), together with current standards of the Colorado WQCC, have been incorporated into the NPDES permit for the District (Appendix B), and are summarized in Table 5.1.1-A.

TABLE 5.1.1-A. CURRENT WASTE DISCHARGE REQUIREMENTS

PARAMETER	FEDERAL PL 92-500		STATE WQCC		
	30-DAY AVERAGE	7-DAY AVERAGE	30-DAY AVERAGE	7-DAY AVERAGE	SINGLE SAMPLE
BOD5 (mg/l)	30(a)	45	ns	ns	ns
SS (mg/l)	30(a)	45	ns	ns	ns
pH	ns	ns	ns	ns	(b)
Total Res. Chlorine (mg/l)	ns	ns	ns	ns	0.5
Fecal Coliform (MPN/100 ml)	ns	ns	1,000	2,000	ns
Oil & Grease (mg/l)	ns	ns	ns	ns	10(c)

ns = none specified

(a) Shall not exceed 15 percent of 30-day average influent concentration.

(b) Within the limits of 6.0 to 9.0 unless it can be demonstrated that: (1) inorganic chemicals are not added to the waste stream as part of the treatment process; and (2) contributions from industrial sources do not cause the pH to exceed the 6.0 to 9.0 limits (EPA requirements).

(c) Nor shall there be a visible sheen.

5.1.2 Proposed Requirements

EPA has recently proposed a relaxation of suspended solids limitations in discharge standards of communities which utilize stabilization pond systems. The proposed standards recognize the need to retain pond systems for many smaller communities because of their inherent economical and functional advantages. Adoption of the regulations would allow the EPA Regional Administrator or state agency to grant a variance with respect to suspended solids limitations of secondary treatment requirements defined in NPDES permits, providing the community can show that: (1) waste stabilization ponds are used as the process for secondary treatment; (2) the treatment facilities have a design capacity of 1 mgd or less; and (3) performance data indicates that the facilities cannot comply with present suspended solids limitations, even if properly operated, without the addition of treatment systems not historically considered as secondary treatment (i.e., filtration systems for algae removal).

Pond systems would still be required to meet an effluent quality achievable by "best waste stabilization pond technology" (BWSPT). BWSPT is defined as a suspended solids value which is equal to the effluent concentration achieved 90 percent of the time within a state or appropriate contiguous geographical area, by waste stabilization ponds that are achieving the levels of effluent quality established for BOD (30/45 mg/l).

5.2 OVERVIEW OF ALTERNATIVE DISPOSAL OPTIONS

There are three general classes of disposal options available today: treatment and discharge, treatment and reuse (land treatment), and land disposal. The first two alternatives will be discussed in detail while the third--land disposal--will be discussed in general.

5.2.1 Treatment and Discharge

There are many methods of treating municipal wastewater to a quality at which it can be discharged. As indicated previously, the Milliken S.D. is not situated on a water quality limited receiving water segment. Therefore, discharge levels must only comply with secondary treatment and BPWTT requirements of EPA. A thorough analysis of the numerous treatment processes available to meet these standards is presented in a later section of this report.

5.2.2 Treatment and Reuse

Four factors prerequisite to wastewater reclamation for reuse of treated wastewater are: 1) the availability of a wastewater reuser (industry or irrigated operation located in close proximity to source of reclaimed water); 2) storage facilities or alternate disposal site for wastewater during periods of non-reuse); 3) capability of producing reclaimed water of required quality; and 4) legal ownership of the wastewater by the municipality.

The State of Colorado currently does not have water quality standards for reuse of wastewater for irrigation purposes. Assuming that the applicable standards will be no less stringent than the existing recommended Federal standards, it will be necessary for the plant to produce secondary effluent. Since this standard is identical with the quality requirements for discharge, no additional treatment facilities would be required for irrigation reuse than if the water were discharged directly to a receiving water. An exception is probable higher levels of disinfection to insure the protection of public health at the reuse site.

An identical discharge standard also eliminates the requirement for effluent storage during non-irrigation periods. If it is desired to maximize the amount of wastewater reuse, a reservoir would be required for seasonal storage of reclaimed water. (This alternative will be further discussed later in the report).

5.2.3 Land Disposal

Percolation of wastewater through the soil provides additional treatment of the applied wastewater. Suspended solids, bacteria, BOD and phosphorus are all effectively removed by filtering and straining action of the soil [EPA-1975]. Nitrogen removal, however, is poor. In addition, EPA requirements for secondary treatment do not apply to this alternative. However, to control such things as odor, prudent engineering judgement requires that, as a minimum, secondary treatment as defined by EPA be achieved prior to land disposal.

If a crop is grown in conjunction with a land disposal operation, the project is effectively one of agricultural reuse. The factors which affect the cost of such a system most directly is the area of land required for the design flowrate of the community. Both the size of the application equipment and the land capital costs are directly related to the required area which is determined by the allowable hydraulic loading rate. The allowable hydraulic loading rate for a high-rate irrigation process is dependent only upon the soils' capacity for transmitting water and not on crop irrigation requirements. The maximum hydraulic loading rate is the sum of soil moisture depletion plus the quantity which can be transmitted through the root zone. The soil moisture depletion for the local climatic conditions is approximately 12 inches for the season while the soil transmission rate can range between 10 and 600 inches per year depending on soil type and surficial geology. Total hydraulic loading rates can therefore range between 22 and 612 inches per year which correspond to area requirements of 610 acres/million gallons per day and 20 acres/million gallons per day, respectively.

The suspended solids concentration of the water also affects the hydraulic loading rate by clogging the soil. The rates discussed above must be considered maximum. There is also a "buffer area" requirement which increases the necessary amount of land.

The estimated cost of a land application system designed for a flowrate of 400,000 gpd is presented in Table 5.2.3-A. It has been assumed that the existing extended aeration facilities could be expanded to a conventional activated sludge plant which would provide pretreatment to land disposal. A total of 290 acres would be required--230 for the treatment and 60 as a buffer zone. The buffer zone would not be required if the treatment site is surrounded by agricultural lands. Using a capital recovery factor of 0.09785, the annual costs are:

Capital recovery		$112,600
Crop revenue	(-)	23,000
Operation & Maintenance		78,000
Total		$162,600

A crop revenue of $23,000 has been assumed based on alfalfa having a net profit of $25.00 per ton and a yield of 4 tons per acre. The total annual cost is equivalent to $1.01 per 1000 gallons. The primary basis for this cost analysis is the Boulder, Colorado, land treatment project which has similar climatic, geological, and soil characteristics. A comparison of the costs of a land disposal system with the costs of the other alternatives presented in Chapter 8.0 indicates that a land application system is relatively expensive. As a result, no additional considerations were given to specific details such as water rights to effluent, sludge disposal, or specific site selection.

TABLE 5.2.3-A. COST ESTIMATE - LAND APPLICATION SYSTEM

1. Upgrading Existing Facility Conventional Activated Sludge New Clarifier Sludge Disposal	$ 260,000
2. Storage	145,000
3. Transmission + Pumping (1.5 miles)	47,500
4. Land Preparation & Surface Runoff Control ($450/acre)	103,500
5. Irrigation System ($435/acre-Center pivot)	100,000
6. Subsurface Drainage ($200/acre)	46,000
7. Land ($1800/acre x 290 acres)	522,000
	$1,224,000
Plus engineering, legal, contingencies (on non-land costs only)	210,000
TOTAL CAPITAL COSTS	$1,434,000

Q = 400,000 gpd
ENRCCI = 2350 June, 1978
* Application Rate = 1"/week and 26 week season/year
230 acres irrigated plus 60 acres buffer zone.

6.0 ANALYSIS OF EXISTING FACILITIES

This section will describe the existing Milliken Sanitation District facilities, identify present deficiencies, determine their capacity for future growth, and evaluate effluent quality.

6.1 FACILITIES DESCRIPTION

6.1.1 Collection System

The wastewater collection system currently has 280 taps which service approximately 1200 people. An outline of the service area is illustrated on Figure 3.0-A. In anticipation of future growth, the Milliken S.D. has recently acquired water rights for an ultimate development of 1,100 water taps which would represent servicing a population of approximately 4,400 people.

The wastewater collection system consists of over 16,000 feet of various sized pipe. Over 15,000 feet of this system is made up of 2 ft. sections, open joint pipe which was installed by the WPA back in the 1930's. A recent study by Larry Faulkner and Associates of Littleton, Colorado, indicates that significant infiltration-inflow problems do exist. There is currently an infiltration-inflow rehabilitation problem which involves replacing or repairing the most severely affected sector of the sewer pipe and relocating the sewerage lift station to an area directly adjacent to the wastewater treatment plant. This rehabilitation program should be completed by late spring of 1977.

The magnitude of the infiltration-inflow is indicated by comparing the summer flow of 200,000 gallons per day with the average winter flow of 60,000 to 70,000 gallons per day. Successful rehabilitation of the sewer collection system to eliminate this three-fold variation flowrate is prerequisite to expanding or upgrading the treatment facilities.

6.1.2 Treatment Facilities

The existing treatment facilities consist of an extended aeration activated sludge plant. A schematic flow diagram is presented on Figure 6.1.2-A and characteristics of the facilities and equipment are tabulated in Table 6.1.2-A. Basically, wastewater is pumped from a lift station approximately 1500 feet due south of the plant through a barminutor and into the aeration tank where biological degradation of the wastewater occurs due to the presence of a high concentration of microorganisms. From the

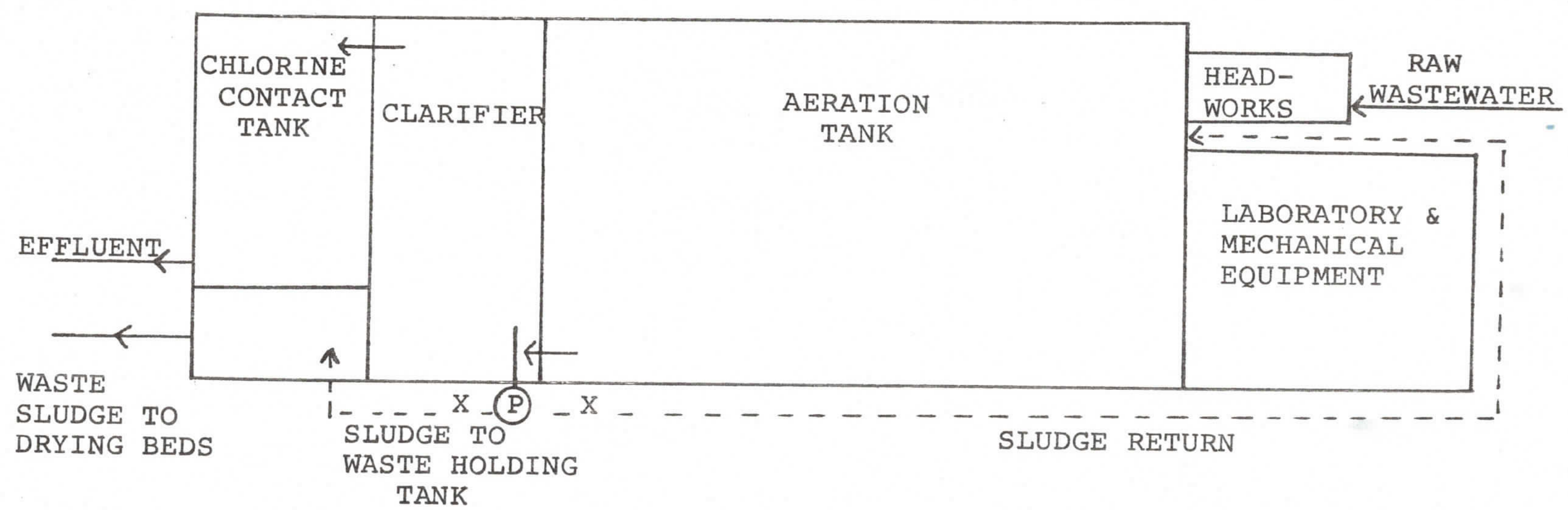

FIG. 6.1.2-A. SCHEMATIC FLOW DIAGRAM AND LAYOUT OF EXISTING FACILITIES.

aeration tank, the wastewater flows into a clarifier and then into a chlorine contact tank where disinfection occurs. Settled sludge consisting of microorganisms is pumped from the clarifier back into the inflow end of the aeration tank. Excess sludge is wasted into a tank where it is stored until enough accumulates for discharge into a sludge drying bed. The chlorinated effluent is discharged into an algae-laden slough which is tributary to the Big Thompson River.

6.2 INADEQUACIES OF TREATMENT FACILITIES

There are significant problems with the existing facility which makes it difficult to produce an acceptable effluent. The clarifier does not have mechanical sludge scraping devices; sludge collected by means of two hoppers which underlay the entire tank. Control of the return activated sludge (RAS) flowrate is almost impossible with the existing return sludge pumps and the control valves. The return sludge flowrate was recently estimated to be approximately 10 times the wastewater flowrate. This high hydraulic rate greatly overloads the clarifier which is designed for approximately a 100 percent RAS flowrate. The large amount of sludge drawn from the bottom of the clarifier results in mixing of the entire clarifier contents and greatly increases the difficulty of achieving suitable settling. It is also difficult to balance or control the amounts of sludge drawn out of each of the two hoppers.

A flow meter to measure the flow through the plant is located in the channel directly upstream of the aeration tank. This inflow channel feeds an intermittent flow only when the wastewater lift station is in operation. The intermittent nature of the inflow at this point makes it difficult to measure the flowrate with a V-notch weir monitored by a flow gage. The plant flowrate could be more easily measured at the effluent end of the plant where the flowrate varies gradually throughout the day and is not experiencing the frequent intermittent peaks due to operation of the lift station.

6.3 CAPACITY FOR FUTURE GROWTH

6.3.1 Collection System

Analysis of the main pumping station indicates that its maximum hydraulic capacity is insufficient for future peak flowrates. Therefore, the station must be expanded for the future. The existing pumping station does not have emergency pumping facilities which would enable operation during periods of power outages.

Discussions with Mr. Earl Wolf and Mr. John Measner revealed dissatisfaction with the existing pump station due to maintenance difficulties and equipment failure. It is recommended that the pump station be replaced and relocated at the plant site during the proposed expansion program.

6.3.2 Treatment Plant

The existing extended aeration activated sludge plant is currently both hydraulically and organically overloaded. The limiting capacities of the major treatment units are presented in Table 6.1.2-A. The existing facilities must be expanded for treatment of future flows.

Most of the existing facilities, except for the clarifier, can be utilized in most of the viable expansion schemes. The lack of mechanical scrapers in the clarifier makes it almost impossible to upgrade the existing clarifier to treat increased flowrates. The current Colorado Department of Health criteria for review of wastewater treatment facilities do not permit the installation of hopper-bottom gravity sludge collection settling tanks.

6.4 EFFLUENT QUALITY

A review of the Colorado Department of Health files indicate that in the first six months of 1976, the effluent did not generally meet the discharge requirements. Effluent quality characteristics of samples taken by the Colorado Department of Health are presented in Table 6.4-A, along with results for a sample taken by Toups Corporation on September 2, 1976. The great variation in effluent quality characteristics and the sporadic compliance with the discharge standards are indicative of a plant which has operating problems due either to inadequate control facilities or inadequate level of operation. From the data it is apparent that after June, 1976, the effluent was in compliance with the discharge requirements. This compliance is due to improved operation resulting from concerted efforts by District personnel.

TABLE 6.1.2-A. DESCRIPTION OF EXISTING FACILITIES

UNIT	CHARACTERISTICS	CAPACITY HYDRAULIC (mgd)	CAPACITY ORGANIC (lbs/BOD5/day)
Aeration Tanks (1)		0.095	1425
Dimensions	24' x 44' x 12'		
Volume	95,000 gallons		
Clarifier (2)		0.072	N/A
Dimensions	12' x 24' x 12'		
Volume	25,800 gallons		
Surface Area	288 sq. feet		
Chlorination Basin (3)		0.072	N/A
Dimensions	19' x 10.5' x 3'		
Volume	4,500 gallons		

(1) Based on 24-hour hydraulic detention time and 15 lbs. BOD5/day/1000 CF.

(2) Overflowrate 500 gpd/ft^2 including 100% return sludge.

(3) Minimum detention time 30-minutes; peak flowrate = 3 times average flowrate.

TABLE 6.4-A. MILLIKEN EFFLUENT QUALITY

PARAMETER	TOUPS SAMPLES 9/2/76	CDH SAMPLES (1976)						
		7/22	6/24	5/24	4/22	3/25	2/26	1/22
BOD5 mg/l	5	12	42	41	102	134	27	6
COD mg/l	22							
SS mg/l	7	10	105	89	197	148	51	20
Fecal Coliforms per 100 ml	20	2100	14,100	400	100	2100	100	100
Oil & Grease mg/l	0.4	1.3	7.2	3.6	12.8	15.6	6.5	6.5
Ammonia mg/l	8.3	14	18.9	20.9	23.7	20.5	20.9	12.1
Nitrate mg/l	0.3	-	-	-	-	-	-	-
Phosphate mg/l	2.5	-	-	-	-	-	-	-
Sodium mg/l	137	-	-	-	-	-	-	-
Alkalinity, total mg/l	244	-	-	-	-	-	-	-
TDS mg/l	1040	-	-	-	-	-	-	-
pH	7.0	7.5	-	-	-	-	7.2	7.3
Temperature °C	20	18	-	-	-	-	9	8
Dissolved Oxygen mg/l	4.0	5.3	3.5	-	-	-	5.8	6.5
E.C. u mho/cm	1150							
Chlorine Residual	0.2	0.2	0.3	0.8	-	0.0	0.4	0.3

6.5 BASIS OF PROJECT DEVELOPMENT

Prior to the development of alternative plans, specific criteria must be established to insure the proper comparison of plans and resultant selection of the apparent best project. Information required includes design criteria for facilities, and basis of cost estimate for facility construction and operation.

6.5.1 Design Criteria

Design criteria and cost data presented in this report apply to preliminary design and layout of facilities. In layouts of this type, it is necessary to make a reasonably close approximation of the size, location, type of construction, route, and cost of the various facilities to be developed. In addition, this information must be given in sufficient detail to permit comparison of alternative plans. Obviously, some relocation and resizing of a portion of the facilities will be required at a later date, as a result of the detailed engineering studies which are made during the preparation of construction drawings and specifications.

Because a significant amount of usable facilities exist at the Milliken treatment facility, the availability, capacity, and condition of those facilities have been assessed, with a view to their incorporation into the various alternative plans. Existing facilities have been retained in the layout of alternative plans when their use is compatible with required functions and is economically justified.

6.5.2 Basis of Cost Estimates

The cost of constructing and maintaining the facilities required for each of the alternative plans considered in this report includes the capital outlay necessary for initial funding plus continued expenditures for operation throughout the lifetime of the project. The data presented in the following sections will provide sufficient information for comparison of alternative plans developed later in this report.

6.5.2.1 Construction and Project Costs

Unit construction cost prices given in this report include contractor's overhead and profit, but do not include engineering, construction and contingencies, right-of-ways, or legal costs. Separate allowances are made to cover these items. Because these unit prices represent average bidding conditions for many projects, actual construction bids for a given project may not correspond to the unit prices used herein. Although additive or deductive items are applied where believed necessary to cover special conditions, the preliminary estimates presented are not presumed to be as accurate as those prepared during final design.

Because costs of construction undergo significant changes in accordance with corresponding changes in the national economy, a cost index is usually presented to reflect the conditions for which the estimates are made. The best and most widely used index is the Engineering-News-Record (ENR) Construction Cost Index, which is computed from prices of construction materials and labor and based on a value of 100 in the year 1913. Based on conditions in the northern Colorado area expected at mid-construction (Fall, 1977) of the recommended plan, cost data in this report are based on an ENR Construction Cost Index of 2200. Although this value may not reflect future conditions, costs of future construction can be related to cost data presented herein by applying the ratio of the ten-current ENR Construction Cost Index to 2200.

Project or capital costs include construction costs plus expenditures required to cover engineering services, contingencies for uncertainties unavoidably associated with preliminary design, and overhead items such as legal and administrative fees. Thus, to predict the total project cost of an alternative, an additional 30 percent of construction costs are added to each alternative's total cost.

6.5.2.2 Annual Costs

Economic evaluation of alternative projects requires consideration of annual as well as project costs. Annual costs include expenditures for capital recovery plus operation and maintenance. Operation and maintenance costs include expenditures for labor, repairs, power, chemicals, supplies, administration, and additional costs which vary from project to project. Operating costs presented herein are based on an ENR Construction Cost Index of 2200.

6.5.2.3 Interest Rates

Interest rates, generally applied as a compounded percentage per year, are an expression of the time value of money. Interest rates must be assumed for purposes of computing the annual costs of capital and for estimating the total cost of prospective bond issues. Based on current data, a rate of 7.0 percent is used in this report for public works construction financing and annual cost calculations.

6.5.2.4 Depreciation and Amortization

Most bonds sold for sewerage projects have redemption periods of about 25 years. However, an estimate of the average economic life of each project is used in computing the annual cost of capital. The annual fixed cost is computed by applying a capital recovery factor to the project's capital cost. The economic life of projects and facilities will vary. Ponds, pipelines, and storage reservoirs are assumed to have a 50-year economic life. Pumping facilities and wastewater treatment facilities are assumed to have an economic life of 30 years.

7.0 ALTERNATIVE PLANS FOR TREATMENT AND DISPOSAL

7.1 PROCESS SELECTION CRITERIA

The selection of the optimum process for an individual community should not be based exclusively on the economics of the individual processes capable of satisfying discharge requirements. Many of the technical and social factors should be considered in evaluation of viable alternatives. Community characteristics such as growth rate, land cost and availability, proximity of treatment facilities to residential or commercial areas, available operator capabilities, and treatment facility aesthetics effects (visual and odor) on community all have a bearing on the treatment facilities best suited for a given community.

There are a great number of alternative treatment processes capable of satisfying BOD and suspended solids (SS) discharge requirements of 30 mg/l. The alternatives discussed in the following sections are those which have been found suitable for small communities. Processes requiring extremely sophisticated operator capabilities generally unavailable in small communities such as continuous operator monitoring, etc., are not considered in this report.

There are two major treatment plant classifications: biological and physical/chemical. Both types of processes have the same objective--removal of dissolved and particulate organic material. Biological treatment processes, some of which have been used since the turn of the century, depend on microorganisms to convert putrescible substances to less noxious chemical forms which are compatible with the environment. Controlled biological processes are those such as activated sludge or biofilter in which the biological growth conditions are artifically controlled; stabilization ponds or aerated lagoons are considered uncontrolled biological processes. Physical/chemical treatment consists of the addition of various chemicals to aggregate and to aid settling particulate matter and to oxidize organic substances. Depending on the particular effluent quality goals, physical/chemical plants may employ multimedia filtration, activated carbon adsorption, ozonation or any one of several other processes. While there are several small physical/chemical package plants currently on the market, none will be considered in view of their stringent operational requirements.

There are several other processes which will not be considered as viable alternatives. For example, biofiltration, which consists of spraying or trickling settled sewage (primary effluent) over synethetic plastic media or rocks which provide a large surface area for growth of attached organisms has design or operational characteristics which are generally unsuitable for small communities. Biofiltration requires both primary and secondary clarifiers which greatly increase both capital and O & M costs for small plants. Primary sludges also have a much greater potential for odor problems than do secondary sludges which are partially stabilized by the secondary biooxidation process. Another characteristic is that while the biofiltration process can produce a relatively high degree of treatment, it is difficult to consistently produce biofilter effluent that meets the 30 mg/l suspended solids limitation of the secondary treatment required. Therefore, the biofiltration process will not be considered in this report.

Likewise, the conventional activated sludge process and those of its modifications which require primary clarification will not be considered in view of the disadvantages discussed above.

7.2 ALTERNATIVE TREATMENT PROCESSES

7.2.1 Alternative No. 1 - Extended Aeration

Extended aeration is a modified activated sludge process suitable for use by small communities. Basically raw wastewater is aerated for 24 hours in a tank containing a high concentration of activated sludge microorganisms which break down the waste substances. The mixture of water and sludge is then sent to a clarifier or settling tank where the activated sludge organisms are separated from the liquid phase. The settled sludge is returned to the aeration tank and the clear wastewater is discharged. Depending on the discharge quality requirements, disinfection of the final outflow may be required.

The major mechanical equipment required for an extended aeration plant are aerators (diffused or mechanical) and sludge return pumps. External separate sludge digestion facilities are not required since digestion occurs while the sludge is in the aeration circuit (internal digestion). A relatively small aerated sludge holding tank enabling uniform wasting of sludge from the aeration circuit would be required in Colorado. Depending on local conditions, sludge is generally pumped to sludge drying beds for dewatering and subsequent trucking to sanitary landfills, disposed of by land treatment, or trucked as a liquid to an appropriate disposal site.

The primary advantage of extended aeration over conventional activated sludge is that extended aeration is more stable biologically and thus requires less operation and maintenance. Proper operation will require the services of a relatively highly-trained operator for several hours each day. It has generally been found that a well-operated plant does not result in any odor problem. Additional characteristics of the extended aeration process and the other alternatives considered are presented in Table 7.2.1-A.

The capital cost of an extended aeration plant which would make maximum use of the existing treatment facilities is estimated to be $544,000. This cost is for an ENR Construction Cost Index of 2200. The annual costs for O & M of the treatment plant are estimated to be $35,000.

The capital costs presented in both the text of this chapter and Table 7.2.1-A include 30 percent for engineering, construction contengencies, and legal fees based on construction and equipment costs (excludes land costs).

7.2.2 Alternative No. 2 - Oxidation Ditch

The oxidation ditch is a modification of the extended aeration-activated sludge process which utilizes a closed loop channel as an aeration chamber. The process was originally intended to be a low cost system requiring non-sophisticated construction methods and mechanical equipment. The process flow scheme consists of aeration of raw wastewater in the loop channel followed by the sedimentation of the activated sludge in a clarifier. The activated sludge (active microorganisms) is returned from the clarifier back to the aeration tank. Brush aerators are used to supply oxygen and to retain solids in suspension in the aeration channel.

Internal sludge digestion occurs and eliminates the requirement for external sludge digestion facilities. Depending on land availability for sludge drying beds, it may be cost-effective to provide for external sludge digestion in plants having design flowrates greater than 0.5 mgd. Sludge also can be disposed of by other methods such as land treatment or liquid sanitary landfill.

TABLE 7.2.1-A. COMPARISON OF ALTERNATIVES.

	EXTENDED AERATION	OXIDATION DITCH	STABILIZATION POND	AERATED LAGOON	COMPLETELY MIXED ACTIVATED SLUDGE
1. COSTS					
A) Capital (Including 30% for construction contengencies, legal & engineering)*	$544,000	$525,000	$386,000	$368,000	$353,000
B) Annual Operation & Maintenance	30,000	26,000	15,000	17,000	28,000
C) Total Annual Costs**	73,000	67,000	45,000	46,000	56,000
2. ENVIRONMENTAL ACCEPTABILITY					
A) Visual aesthetics	Good	Good	Poor	Poor	Good
B) Odor generation potential (minimum)	Good	Good	Poor	Poor	Good
C) Disposal of residue sludges	Average	Average	Good	Good	Average
D) Overall plant acceptability	Good	Good	Worse	Poor	Good
3. OPERATION & MAINTENANCE					
A) Time requirements	Poor	Average	Best	Good	Poor
B) Complexity	Average	Average	Best	Good	Average
4. RELIABILITY					
A) Mechanical equipment	Average	Average	Best	Good	Average
B) Biological stability	Average	Good	Average	Good	Average
C) Effluent acceptability	Good	Good	Poor	Average	Good
D) Cold weather operation	Average	Average	Poor	Average	Average
5. ENERGY & RESOURCE UTILIZATION					
A) Power	Average	Average	Good	Average	Average
B) Chemicals	Average	Average	Average	Average	Average
C) Area Requirements	Average	Average	Poor	Poor	Good
6. FLEXIBILITY					
A) Successful operation until attainment of design flow	Good	Good	Good	Good	Good
B) Expansion for future growth	Average	Average	Average	Good	Average
C) Operation	Average	Average	Poor	Poor	Average
D) Upgrading	Average	Good	Poor	Average	Good

* Except on land costs.

** CRF = 0.0785.

The biological stability of the oxidation ditch process causes it to have one of the lowest operation and maintenance requirements of any of the controlled biological treatment processes such as activated sludge or bio-towers. This is a significant advantage for small communities where highly trained operators might not be readily available. Land requirements are typical of controlled biological processes. Table 7.2.1-A compares other characteristics with those of all the alternatives considered.

The capital costs of an oxidation ditch are estimated at $525,000 (ENR 2000), and the annual O & M costs are $26,000.

7.2.3 Alternative No. 3 - Stabilization Ponds

Domestic wastewater may be effectively stabilized when stored in shallow pools by natural biological processes involving symbiosis between bacteria and algae. Bacteria degrade the wastewater and produce carbon dioxide; algae utilize the carbon dioxide and produce oxygen which is required by the bacteria. This symbiotic relationship requries the presence of a healthy growth of algae which occurs when pond depths are less than 6 to 10 feet. The algae which supply oxygen for the biodegradation of the wastewater do not completely settle and are present as suspended solids in the pond effluent. In consideration of the fact that algae are inherently different from wastewater solids in composition, the Environmental Protection Agency has recently recommended that the suspended solids effluent requirement for lagoons be made more lenient. The EPA has recommended that each state set the maximum allowable suspended solids concentration for lagoon systems under their jurisdiction. This level has not been set for Colorado at the present time.

A stabilization pond is basically a shallow pond (3 to 10 feet deep) in which the wastewater is stored for 30 to 120 days. In some cold climate areas where freezing of the receiving streams occurs, it has been practice to provide for pond storage of all wastewater through the winter until the spring thaw when adequate dilution water is available in the receiving stream. The maximum BOD loading per unit volume of pond is limited by the amount of available oxygen produced by the algae and supplied by surface reaeration. Both of these sources of oxygen are directly related to the surface area of a lagoon since algae growth in deep ponds is limited by light availability.

A stabilization pond is considered an uncontrolled biological treatment process since the amount of active biomass in the system cannot be adjusted or regulated.

In cold climates where lagoon water approaches freezing, maximum BOD loading rates are approximately 15 to 20 pounds BOD per acre per day. This is equivalent to approximately 100 people per acre.

Operation and maintenance requirements for stabilization ponds are the lowest for any secondary treatment process. It is this O & M factor combined with low capital costs that causes the wide use of stabilization ponds by small communities. Stabilization ponds do, however, have several disadvantages including: 1) large land requirements; 2) odor problems two or three times a year when temperature inversions occur and cause the ponds to "turn over" bringing up septic odorous liquid from the lower depths; and 3) the effluent is usually with algae and may be unsuitable for certain reuse. A significant advantage of waste stabilization pond systems is that no sludge is produced and all sludge handling and disposal problems are eliminated. The power and chemical requirements are also minimal (see Table 7.2.1-A).

Although it is improbable that stabilization ponds will be required to meet the 30 mg/l suspended solids discharge requirement, the 30 mg/l BOD requirement does remain in effect. It is doubtful that a constantly discharging pond could meet the BOD discharge requirement during the winter months when an ice cover would develop on the pond and decrease the available oxygen supply. Based on this probability of non-compliance with the discharge standards, the stabilization pond system is not recommended.

The capital costs of a stabilization pond system including land costs are estimated at $386,000 (ENR 2200). The annual O & M costs would be approximately $16,000.

7.2.4 Alternative No. 4 - Aerated Lagoon

Increased BOD loading rates and therefore smaller land requirements are possible in a pond system if a supplemental supply of oxygen can be provided. Such systems commonly referred to as aerated lagoons, aerated ponds, aerated oxidation ponds, etc., are generally provided with supplemental oxygen by either mechanical surface aerators or a diffused aeration system. Supplemental oxygen can increase maximum BOD loading rates into the range of 100 to 200 pounds BOD per acre per day depending on the temperature of the lagoon water. Even with the supplemental oxygen supply, aerated lagoons, like stabilization ponds, are considered uncontroled biological processes.

Aerated lagoons have several advantages over stabilization ponds, including: 1) much smaller land requirements due to the greater maximum BOD loading rate, 2) lower probability of odor problems since supplemental oxygen is supplied and the pond liquid is completely mixed, and 3) production of better quality effluent during the winter months when an ice layer may develop. Aerated lagoons do have slightly greater O & M requirements than stabilization ponds due to the energy requirements and maintenance associated with the aeration equipment. See Table 7.2.1-A for additional characteristics of aerated lagoons. Aerated lagoon effluents, like those of stabilization ponds, contain large amounts of algae which cause the effluents to exceed the suspended solids discharge requirement of 30 mg/l. While the suspended solids discharge requirement required in the State of Colorado has not yet been set forth, it is possible that some type of post-treatment of lagoon effluent will be required.

A capital cost of $368,000 is estimated for construction of an aerated lagoon (ENR - 2200). The annual O & M costs are estimated at approximately $17,000.

Many different methods for upgrading lagoon effluent to remove algae have been proposed, including air flotation, dietmacious earth filtration, micro-screening, rapid sand filtration, intermittent slow sand filtration, rock filters, and polishing ponds. Several of these systems have high capital and O & M costs and will not be considered in the following discussion.

Characteristics of the three lagoon upgrading processes considered are presented in Table 7.2.4-A. It should be noted that each of the processes produces an effluent of a different characteristic at a different cost. In general, the best quality effluent is the most costly to produce. The optimum upgrading process would be the one satisfying the discharge requirements at the minimum cost.

A rock filter is basically a submerged permeable dike consisting of one to two inch rock placed directly before the final system outlet. Although several rock filters have been constructed in Colorado, they are currently under evaluation to better determine design standards and process capabilities. Preliminary results indicate that the effluent quality is highly dependent upon the influent quality. In other words, an acceptable effluent (25-40 mg/l SS) can only be produced when the lagoon effluent is of relatively good quality (50-80 mg/l SS).

A polishing pond is an unaerated pond with a relatively deep depth (5 to 15 feet) and a minimum surface area which is able to improve the lagoon effluent by acting as a quiescent settling basin. The rate of algae growth is reduced in the polishing pond by designing for minimum light penetration-algae require light for growth, i.e., photosynthetic. There is also evidence which indicates that two or more ponds in series operated on a batch or fill and draw basis can produce relatively good effluents, 30 to 60 mg/l SS.

TABLE 7.2.4-A. CHARACTERISTICS OF LAGOON EFFLUENT UPGRADING PROCESSES

PROCESS	CAPABLE OF CONSISTENTLY SATISFYING 30-30 STANDARDS	PROBABLE EFFLUENT SS LEVEL (mg/l)	NITRI-FICATION	RELATIVE CAPITAL COSTS	RELATIVE O & M COSTS
Rock Filter	Possibly	20- 60	No	Low	Low
Polishing Pond	No	30-100	No	Low	Low
Intermittent Slow Sand Filter	Yes	10- 20	Yes	High	High

It is believed that proper batch operation keeps the pond in a state of biological upset which reduces algae growth.

Intermittent slow sand filters consist of 4 to 6 foot deep beds of fine sand which are dosed periodically. Successful operation of the system requires that the surface be completely dried in between dosing. Drying restores the infiltration rate which is reduced by the matt of algae and suspended solids which accumulate at the filter surface. A gradual clogging of the filter occurs which can only be eliminated by scarification or removal of the upper one or two inches of filter media. The rate of this gradual clogging process increases with increased dosing rates.

7.2.5 Alternative No. 5 - Completely Mixed Activated Sludge

The facilities of the existing, overloaded extended aeration plant can be modified and expanded to handle future increased flowrates. The optimum expansion process flow scheme should utilize the existing facilities to the greatest possible extent.

The process scheme selected for expansion of the existing facilities utilizes the completely mixed modification of the activated sludge process. Completely mixed activated sludge processes do not require clarification of the raw sewage before introduction into the aeration tank. This has the definite advantage of eliminating primary clarifiers and the production of primary sludge which complicates sludge disposal.

The major capital items of the expansion scheme are a new secondary clarifier, aerobic sludge digester, and new headworks. The existing clarifier has two hoppers for sludge removal and cannot be expanded to handle increased flowrates. The economy of scale for clarifiers is such that the existing clarifier capacity can be replaced with additional capacity in a new clarifier at a relatively small increase in capital cost. In other words, the existing clarifier should be abandoned in view of the greater ease and dependability of operating a single clarifier.

Aerobic sludge digestion consists of additional biological stabilization of the sewage solids settled in the final clarifier. An aerobic digester (oxygen present) is recommended over an anaerobic digester which has greater capital costs and operational requirements. Anaerobic digesters are generally favored in larger plants where the decreased power requirements offset the increased operator requirements.

The only other major addition is replacement of the existing headworks which is necessitated by their inadequate capacity. Additional details and recommended design parameters of the expansion scheme are presented in Chapter 8.0.

The estimated cost for expanding the existing facilities into a completely mixed activated sludge plant is $353,000. The estimated total annual cost is $56,000, which is broken into $28,000 for capital recovery and $28,000 for operation and maintenance.

7.3 SELECTION OF RECOMMENDED ALTERNATIVE

Selection of facilities should not be based solely on an economic comparison of the various alternatives. Each process has certain inherent advantages and disadvantages. Generally, the optimum facilities for a given area are those which are consistent with or satisfy the environmental, social and legal requirements of the affected community at the lowest cost.

Of the parameters and characteristics presented in Table 7.2.1-A, there are several which are especially important in the selection of the optimum treatment facilities for the Milliken Sanitation District.

7.3.1 Odors

The close proximity of the existing sewage treatment plant to the northeastern section of Milliken requires that the recommended facilities have a low potential for odor generation. The aerated lagoon and stabilization pond both have periods when odor problems occur. The controlled biological alternatives have a much lower possibility of odors and are, in general, less objectionable to owners of adjacent properties.

7.3.2 Land Availability

The alternative treatment schemes presented have greatly varying area requirements. In view of the fact that the treatment site is in a flood plain and that the existing treatment plant was built above ground level, suitable land is not readily available. The existing property is not sufficient for accommodation of any of the alternatives. Stabilization ponds have the greatest area requirement (approximately 40 acres), followed by aerated lagoons, oxidation ditch, extended aeration, and completely mixed activated sludge. While it might be possible to construct all the extended aeration and completely mixed activated sludge facilities except for the sludge drying beds on the existing plant property, such plants would require relocation of some of the existing wastewater and utility conduits which could increase the capital costs.

7.3.3 Potential for Reuse

If at a future date it is decided to reuse the treated wastewater, greater degrees of treatment may be required than are possible with aerated lagoons or stabilization ponds. The controlled biological processes have the definite advantage of producing superior effluents over the uncontrolled secondary processes. Also, tertiary processes which might be required for industrial or municipal reuses are generally quite difficult to add to pond or lagoon systems. Reuse potential greatly favors alternatives 3, 4, and 5 over alternatives 1 and 2.

7.3.4 Potential for Expansion

Generally the most economical scheme for treating increased flows due to population growth or extension of the sewer collection system is expansion of the existing wastewater treatment facilities. The change in discharge standards for lagoon systems recently proposed by the EPA includes a provision which limits the use of the less stringent discharge standards to lagoon systems having average wastewater flowrates less than 1 mgd. If a community utilizing lagoons experiences growth resulting in total flowrates greater than 1 mgd, the lagoon system will have to be either upgraded by addition of filters or other tertiary processes, or the entire lagoon system will have to be replaced by a controlled biological system. From land requirements, general environmental compatibility, and O & M viewpoints, a controlled biological process would be superior to the upgraded lagoon system for the Milliken Sanitation District.

While the probability that Milliken's flowrate will exceed 1 mgd is relatively small, considering the projected year 2000 flowrate of 0.40 mgd, the possibility of an industry with a significant waste flow locating in the service area does exist.

Based on the previous discussion concerning process advantages and disadvantages and environmental characteristics, alternative 5--expansion and modification of the existing facilities into a completely mixed activated sludge process--is recommended.

8.0 BEST ALTERNATIVE PROJECT

8.1 RECOMMENDED FACILITIES

Expansion and modification of the existing Milliken Sanitation District wastewater treatment plant, using the completley-mixed activated sludge process, is the most cost-effective alternative considering economic, environmental and social factors. The proposed project consists of expanding the capacity of the existing facility to 0.4 mgd average dry weather flow (ADWF).

8.1.1 Project Description

The recommended improvements required for the expansion project are:

(a) Relocation and replacement of influent lift station;
(b) Construction of new inlet works;
(c) Upgrading of existing aeration facilities;
(d) Conversion of existing clarifier to an aeration basin;
(e) Construction of new clarifier;
(f) Construction of an aerobic sludge digester;
(g) Expansion of sludge drying-percolation beds;
(h) Construction of new chlorine contact tank, and modification of chlorine feed system;
(i) Expansion and modification of operations-laboratory building;
(j) Electrical improvements;
(k) Purchase of additional land.

8.1.1.1 Plant facilities

A schematic flow diagram of the expanded Milliken S.D. wastewater treatment plant is presented on Figure 8.1.1-A. The plant processes consist of pretreatment, grit removal, flow measurement, biological oxidation by the completely mixed modification of the activated sludge process, clarification, disinfection, aerobic digestion of waste sludge and drying beds for sludge disposal.

A proposed plan for the layout of the facilities is illustrated on Figure 8.1.1-B. This layout is contingent upon availability of land. The clarifier and aerobic sludge digester alternately could be located immediately east of the existing facilities with minimal increases in construction costs or in operation difficulties. The sludge drying-percolation beds can be relocated to various alternate sites which are compatible with the hydraulic grade requirements for gravity sludge transfer from the digester.

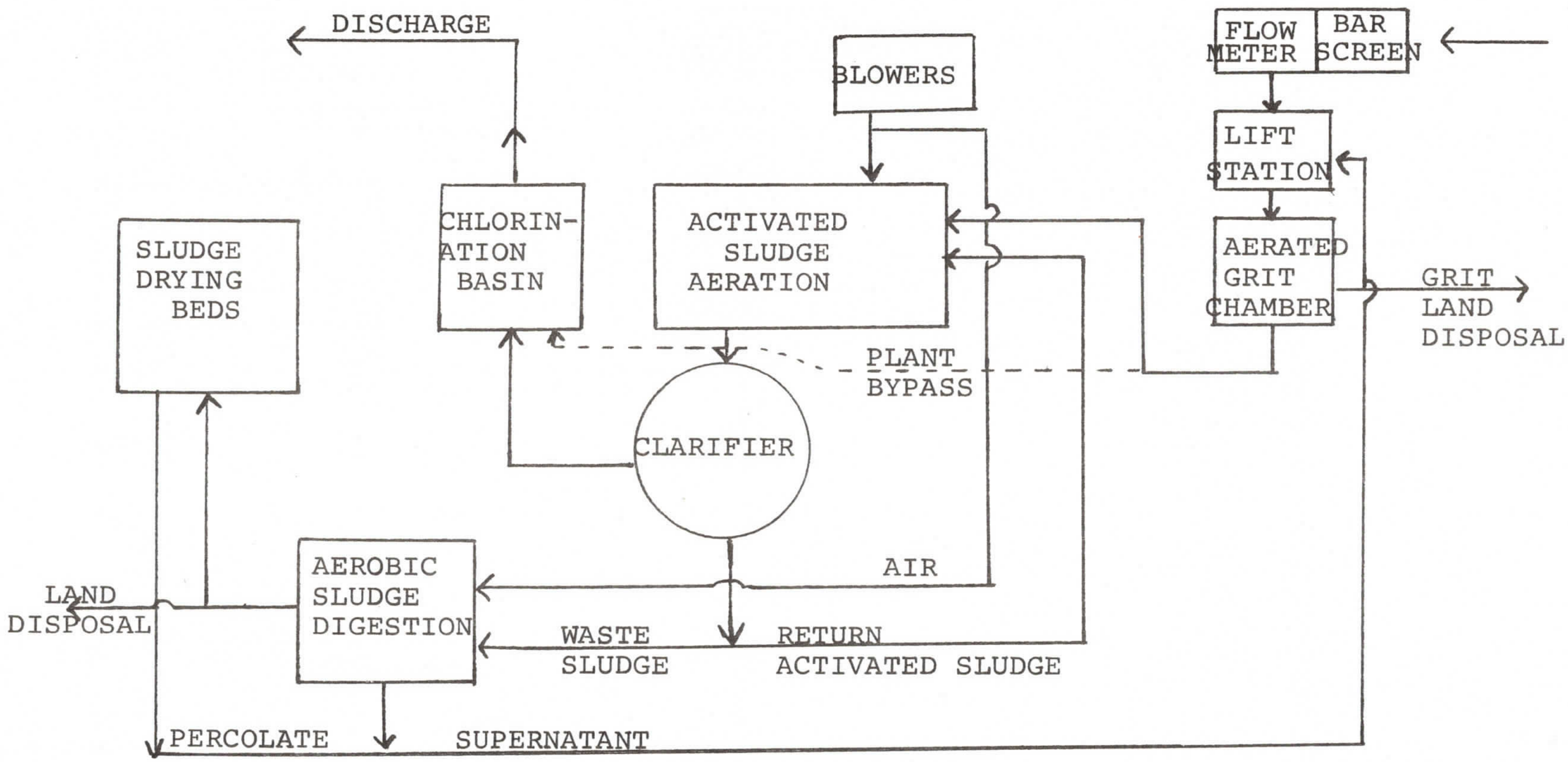

FIG. 8.1.1-A. SCHEMATIC FLOW DIAGRAM OF EXPANDED MILLIKEN S.D. WASTEWATER TREATMENT PLANT.

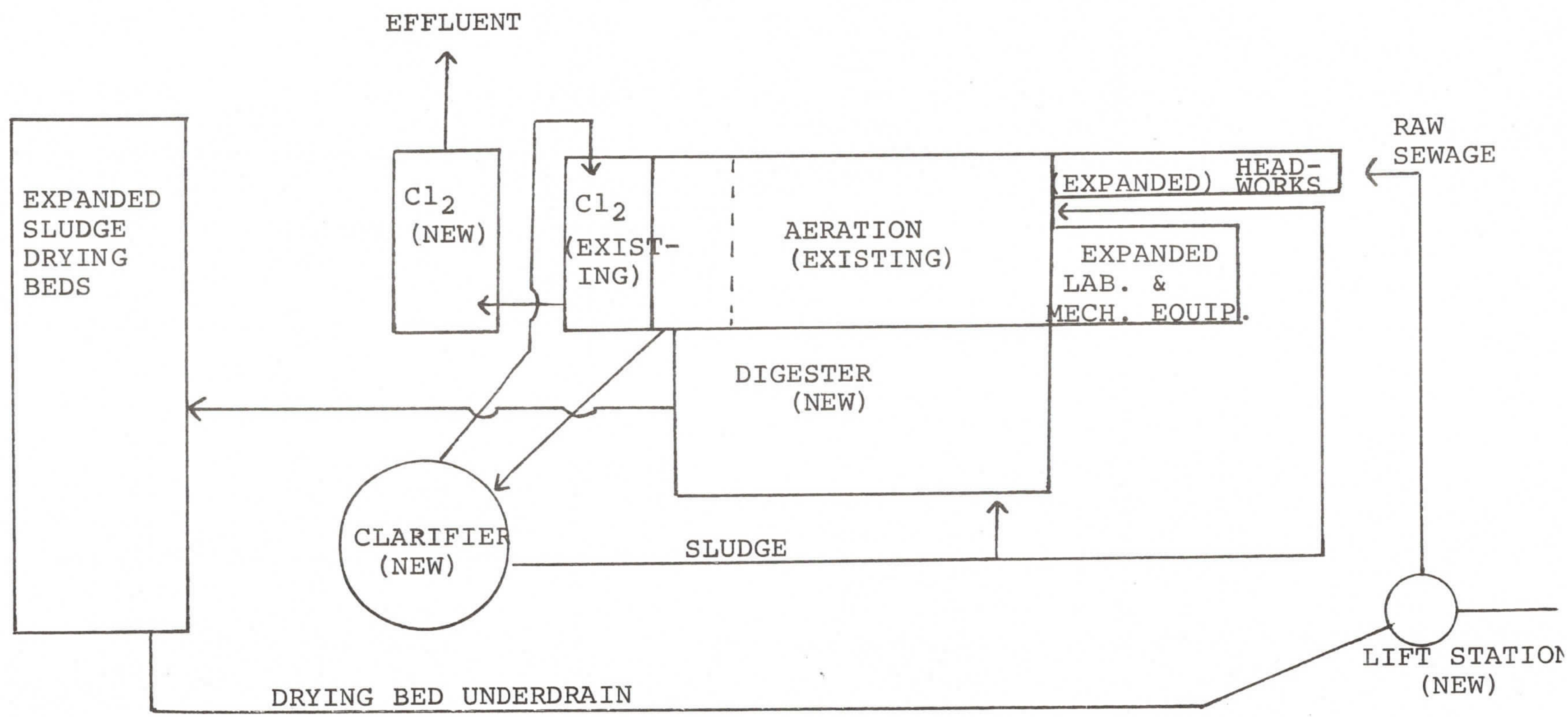

FIG. 8.1.1-B. SCHEMATIC FLOW AND POSSIBLE LAYOUT FOR RECOMMENDED COMPLETELY MIXED ACTIVATED SLUDGE EXPANSION.

Design of the plant is based on consideration of performance efficiency, process reliability and flexibility, ease and economy of operation and maintenance, and environmental acceptability. Process efficiency and reliability are governed primarily by proper design with regards to certain critical design criteria. The design criteria for the major processes of the treatment plant are presented in Table 8.1.1-A. The design criteria which are considered critical to satisfactory operation of the plant are the aerator organic loading, the clarifier surface overflow rate, and the digester solids loading. A relatively low organic loading rate and a long hydraulic detention period in the aerator ensures the high degree of treatment required by the discharge standards.

Where consistant compliance with high effluent quality standards is required, a high degree of process reliability and operability must be built into the plant. This requires incorporation of alarm systems, automatic control for important functions, back up power supplies, duplicate equipment for back up, and designing the system for peak wet weather flows. Operational flexibility and dependability is achieved by providing all processes and plant with by-pass provisions.

8.1.1.2 Influent Pumping

The existing lift station should be removed and replaced by a pump station directly adjacent to the treatment plant. Preliminary design calls for salvaging the existing lift station or replacement with a factory-built unit. The new location would be directly north of the main access gate at the existing treatment plant. One hundred percent standby capacity would be provided to insure continued operation in the event of equipment failure. Standby electrical power would be provided by connection with the main standby generator facility. On and off operation of the pumps would be controlled by a mechanical level switch in the influent wet well. The force main to be abandoned could possibly be used for distribution of reclaimed water.

8.1.1.3 Inlet Works

The new inlet works will consist of a barminutor, flow measurement, bypass channel with bar screen, and an aerated grit chamber. Optimum location of the flow meter and barminutor would be ahead of the lift station. Location of the barminutor upstream of the pumps would offer protection and insure longer life for the pumps. After being pumped to the surface, the raw wastewater would enter the aerated grit chamber where the heavy inorganic material would be settled out. An aerated grit chamber would be used to prevent

TABLE 8.1.1-A
TREATMENT PLANT DESIGN CRITERIA

DESIGN PARAMETER	VALUE
Design Loadings	
Population	4000
Flow, mgd	
Average dry weather (ADWF)	0.4
Peak dry weather (PDWF)	0.7
Peak wet weather (PWWF)	1.0
BOD_5 lbs/day	720
Suspended Solids, lbs/day	720
Activated Sludge Aeration	
Tank dimensions, width x length x depth, feet	24 x 56 x 12
Total volume, 1000 cu. ft.	16
Detention time, hours (a)	7
BOD_5 loading lb/lbMLVSS	0.30
Max. air supplied, cu ft/lb BOD_5 removed	1500
Max. air requirement cfm	1200
Average air requirement cfm	750
Secondary Clarification	
Tank dimensions, diameter x depth, feet	36 x 8
Volume, 1000 cu. ft.	8.1
Area, sq. ft.	1020
Overflow rate gal/sq.ft./day	
ADWF (a)	400
PWWF (a)	1000
ADWF + return sludge (b)	600
PWWF + return sludge (b)	1200
Detention time, hours	
ADWF (a)	3.7
ADWF + return sludge (b)	2.5
Aerobic Digester	
Tank dimensions, width x length x depth, feet	24 x 50 x 12
Total volume, 1000 cu. ft.	14
Loading, lbs/VSS/cu ft/day (c)	0.05
Detention, days (d)	13
Air requirement, cfm	700
Air, cfm/1000 cu. ft.	45
Chlorination Basin	
Total volume, 1000 cu. ft.	2.8
Detention time, hours	
ADWF	1.25
PWWF	0.5
Maximum chlorine consumption, lbs/day	40
Average chlorine consumption, lbs/day	13
Sludge Drying Beds	
Number of basins	4
Total area, acres	0.25

(a) Based on average raw wastewater flow.
(b) Return sludge flowrate equals 50 percent ADWF.
(c) 0.18 lbs. VSS wasted per person per day.
(d) Assumes 1.3% solids and 75% volatile solids in waste sludge.

removal of the lighter putrescible solid material during periods of low flow when a long detention time would occur in the grit chamber. Provisions for bypassing the aerated grit chamber would be provided. After passing through the aerated grit chamber, wastewater would enter the aeration basin in the channel which has provisions for multiple inflow to the aeration basin.

8.1.1.4 Biological Oxidation

Utilization of the currently used extended aeration modification of activated sludge with its inherent biological stability and ease of operation would require more than a three-fold increase in aeration tank capacity. Continued use of this process at the present plant site is considered infeasible because of the space limitations and cost. Full utilization of the existing facilities is possible by utilization of alternate activated sludge process modification. The best alternate activated sludge modification is the completely mixed process which does not require primary sedimentation and is quite stable with regards to biological shock loads. Elimination of primary clarifiers have several advantages, including: 1) lower costs, 2) simpler operation, 3) easier sludge handling, and 4) reduced potential for odors. Completely mixed activated sludge processes are resistant to shock loads since a slug of concentrated waste is rapidly diluted throughout the entire tank. Shock loads are common in small systems where great fluctuations occur in flow rates.

The existing clarifier would be converted into part of the aeration basin by filling the existing hoppers with concrete, installation of air diffusers along one side, and interconnection with the existing aeration tank by construction of openings in the common wall between them. No modifications to the existing aeration tank would be made other than repair or replacement of the existing diffuser system. This modification would provide a total aeration basin volume of 16,100 cubic feet divided between two separate tanks. The wall separating the two aeration basins would not be completely removed in that two completely mixed basins in series would provide better quality effluent than one single large basin since the possibility for short circuiting has been greatly reduced.

8.1.1.5 Clarifier

A 36-foot diameter, 8-foot deep peripheral feed circular clarifier will be constructed. The mixed liquid entering the clarifier will be obtained from the second aeration tank. Settled sludge will be returned to the aeration tank by pumps; waste sludge will be pumped to the aerobic digester. The treated effluent will be removed from the clarifier through a launder which will deliver water to the existing chlorination basin. Systems for positive control of return and waste sludges will be provided.

Provisions for scum collection will be provided in the clarifier. Scum collection on secondary clarifiers is important in those plants not having primary clarifiers. Accumulated scum will be pumped to the aerobic digester.

8.1.1.6 Aerobic Digester

An aerobic digester will be constructed for stabilization of the waste activated sludge. Additional compressors will be installed for providing the required air. Conventional non-clogging diffusers will be utilized.

Typical operation will involve turning off the aerators, permitting the sludge to settle, and withdrawal of supernatent which will be discharged back to the inlet lift station. Digested sludge will be transferred by gravity to the sludge drying beds. Provisions will be made for the future installation of a rack for filling sludge trucks if land sludge disposal is feasible in the future.

8.1.1.7 Chlorination Basin

An additional chlorination basin is required to achieve the design criteria presented in Table 8.1.1.1-A. The basin can be located north of the existing facilities.

8.1.1.8 Sludge Drying Beds

Additional sludge drying beds will be constructed to expand the total area to approximately 12,000 square feet. An underdrain system discharging to the plant inlet pump lift station will be provided in view of the high ground water of the area. The total area will be divided into a minimum of four basins to allow operation flexibility.

8.1.1.9 Chlorine Feed System

The existing chlorine feed system will be modified or replaced by a proportional chlorination feeder. The existing chlorinator operates at a constant chlorine feed rate which results in over-chlorination at periods of low flow and when the feeder is set to peak flow conditions. It is doubtful that the existing system could meet the coliform discharge requirements at all times without exceeding the 0.5 mg/l maximum chlorine residual requirement standard. A proportional chlorinator matches the chlorine feed rate to the plant discharge flowrate.

8.1.1.10 Operations-Laboratory Building

The existing laboratory will be removed from the operations building which will be converted to a blower building to house the additional compressors required for the aerator expansion, and the aerobic digesters. A new structure which will contain the laboratory and office space will be located directly adjacent to the existing operations building to enable use of the existing toilet and shower facilities. Necessary laboratory equipment will also be provided in this project.

8.1.1.11 Electrical Improvements

Expansion of the existing electrical system is required to accommodate the additional air compressors, and the relocated lift station. Improvements include a motor control center, conduits and conductors, and instrumentation equipment.

8.1.2 Project Cost Estimate

Construction costs were estimated on the basis of an engineering news record (ENR) construction cost index of 2200 which is expected to be reached by Fall, 1977. Estimated construction and project costs for expansion and modifications of the existing facilities for a flowrate of 0.4 mgd are presented in Table 8.1.2-A. Project costs include an allowance of 30 percent to cover construction contingencies and engineering services. As indicated in Table 8.1.2-A, the total project cost is $356,000.

8.2 OPERATION BEFORE ATTAINMENT OF DESIGN FLOWRATE

The successful operation of a biological treatment plant before attainment of the design flowrate is sometimes complicated by excessive detention times in aeration basins and clarifiers. During this period of increasing flows, the plant can be considered to be overdesigned.

The control of biological metabolic processes is frequently a problem of overdesigned contact aeration modifications of the activated sludge process. The recommended biological stabilization process, completely mixed activated sludge, is only slightly affected by variations in detention periods ranging between 5 and 12 hours. Consideration must also be given to proper selection of the sludge handling equipment to enable return of the optimum amounts of return sludge before design capacity is reached.

TABLE 8.1.2-A ESTIMATED COST - TREATMENT FACILITIES

ITEM	COST ($) (a)
Influent Pumping Station	30,000
Inlet Works (Bar rack, aeratred grit removal facilities, flow meter)	41,000
Replace Diffuser System and Additional Blowers	10,000
Aeration Tank and Clarifier Modifications	5,000
Clarifier and Sludge Control Systems	61,000
Aerobic Sludge Digester and Blowers	52,000
Sludge Drying Bed Modifications	28,000
Chlorination Basin; Feed System Modifications	20,000
Operations Building-Laboratory Modifications	18,000
Laboratory Equipment	9,000
Subtotal - Construction Cost	$274,000
Allowance for Construction Contingencies and Engineering, 30 percent	82,000
Total - Project Cost	$356,000

(a) Based on an ENR Construction Cost Index of 2200 (Fall, 1977).

Excessive detention of a nitrified effluent in a final clarifier can result in production of nitrogen gas (denitrification) which causes poor settling of the sludge (bulking). The lack of proper clarification results in excessive suspended solids in the final effluent.

These problems and others which could occur during the initial periods of operation were considered in the selection of both the optimum treatment scheme and the recommended design parameters of the individual processes. The characteristics of the recommended processes for the 1983 and 2000 flowrates are presented in Table 8.2-A.

TABLE 8.2-A PROCESS CHARACTERISTICS BEFORE ATTAINMENT OF DESIGN FLOWRATE

PARAMETER	YEAR 1983	YEAR 2000
Population	2200	4000
ADWF, mgd	0.20	0.40
PWWF, mgd	0.64	1.0
Aeration Basin		
Volume, 1000 gallons	121	121
Detention Time, hours (a)	14	7
Secondary Clarifier		
Volume, 1000 gallons	61	61
Area, sq. ft.	1020	1020
Sludge return flowrate, mgd	0.20	0.20
Overflow rate, gpd/sq ft. (b)	400	600
Detention period, hours (b)	3.7	2.5
Aerobic Digester		
Volume, cubic feet	12,000	12,000
Volume/capita, cubic ft./capita	5.4	3.0
Chlorination Basin		
Volume, 1000 gallons	21	21
Time at PWWF, minutes	45	30

(a) Based on ADWF
(b) Based on ADWF + return sludge flow

8.3 IMPLEMENTATION PROGRAM

Successful implementation of the proposed project calls for a well-organized program to ensure effective achievement of the project goals. Complete coordination of all activities including planning, design, and construction activities must necessarily be maintained throughout all portions of the project. To provide a time frame upon which project financing and coordination can be based, and to indicate approximate time-span requirements for the major project activities, a project implementation schedule is presented in Table 8.3-A and shows that construction of the proposed facilities is anticipated to occur from March, 1978, to July, 1978. Startup and initial operation of facilities, together with compliance with NPDES permit requirements, is anticipated by July, 1978.

The schedule presented in Table 8.3-A sets forth the minimum practicable timetable for the proposed project, given present requirements for review and comment by governmental agencies. Delays in implementation may also occur due to unforeseen delays in equipment delivery by manufacturers. Past experience has shown that delays are inevitable and therefore must be anticipated.

TABLE 8.3-A IMPLEMENTATION PROGRAM FOR PROPOSED PROJECT

PROJECT TASK	IMPLEMENTATION DATE
. Review and approval of Technical Planning Report by the District	May, 1977
. Technical Planning Report submittal to Colorado Department of Health, together with site application	May-July, 1977
. Finalize Financial Program	June, 1977
. Prepare engineering plans and specifications	July-November, 1977
. Review and approval of plans and specifications by Colorado Department of Health	November, 1977
. Advertise and award construction contracts	December, 1977-January, 1978
. Construction of proposed facilities	March-July, 1978
. Operator Training	July, 1978
. Review and approval of construction by Colorado Department of Health	July, 1978
. Startup and initial operation of facilities	July, 1978
. Compliance with NPDES permit requirements	August, 1978

9.0 FINANCIAL PROGRAM

9.1 EXISTING CONDITIONS IN MILLIKEN

9.1.1 Financial Capabilities

The estimated population of Milliken by 1977 was 1,200, about 500 more than the 1970 census figure--a 71% increase, a very rapid growth rate which taxes all public services which must also keep pace.

The community's current (1977) financial picture can be summarized as follows:

- Assessed Valuation: $1.07 million
- Anticipated Town Revenue from Property Tax (1977): $26,750
- Anticipated District Revenue from Property Tax (1977): $8,560
- Combined Mill Levy on Milliken Taxpayers: 106.91 mills

Town	25.00 mills
Sanitation District	8.00 mills
County	21.13 mills
School District	52.78 mills

- Total Milliken Sales Tax: 3% (State only)
- Additional Sales Tax Capability (Town and County): 4%
- District's Bonded Indebtedness (January 1, 1977):

General Obligation Bonds	$ None
Revenue Bonds (Sewer)	70,000
Total	$70,000

- Town's General Obligation Bond Capacity (10% of assessed valuation): $106,876
- Median Family Income: $7,028

The Milliken Sanitation District must rely on property taxes, service charges, and tap fees for its income. With a combined mill levy on the Town of nearly 107 mills, there is little opportunity for any jurisdiction's further use of property tax for project financing. At present, the Town of Milliken levies no sales tax. Rather, it relies rather heavily on property taxes with a 25 mill levy for 1976. It is possible that further revenue could be developed, or perhaps substituted for some property tax, if the Town were to levy some sales tax. This would provide some opportunity for the district to increase its mill levy but they are already high for a special district. For 1976, the state collected $12,630 per penny of tax from Milliken accounts. However, as the state includes taxes collected on deliveries made by

Town accounts outside the Town limits, this is more than the Town would collect per penny. Only a detailed account-by-account review would reveal a more accurate figure. Nevertheless, it is apparent that some capacity to improve both Town and District finances exists with the Town's unused sales tax authority.

9.1.2 Sewage Handling Facilities and Proposed Improvements

In June, 1976, there were 329 sewer taps on the system. Service charges total $72 per year; tap fees are $650.

There is now a total principal amount of $70,000 in outstanding sewer revenue bonds, requiring an annual debt service of approximately $8,800 in 1977; this debt service cost will increase each year to a total of $10,550 in 1988, the year in which the bonds will be retired.

Operations and maintenance costs for 1976 totalled $25,800. Thus, the District is facing the need for ongoing cash payments ranging upward from $35,000/year, including the debt service noted above. Estimated 1976 operating revenues were budgeted at $35,500 with $13,000 of this in tap fees. These amounts were supplemented with income from the property tax, used in part to retire outstanding indebtedness. Only a small fund balance is available to the District.

The technical analysis recommends expansion and modification of the existing plant. It is estimated that this will cost $356,000. That analysis estimates that operations and maintenance (O&M) costs will not increase due to these improvements.

9.2 RECOMMENDATIONS FOR SEWER UTILITY MANAGEMENT

The following are suggested general principles for a balanced utility program. This management process has proven successful in preventing construction and operation of sewer systems from posing an unreasonable burden on residents of growing communities, and is the basis for determining optimum financing capabilities.

9.2.1 Utility Service Area

The community should lead, not merely follow, development. The community should decide where it is most economical and efficient to provide services, and make known where it prefers growth to take place. By not annexing or extending utility lines outside the Town into areas it does not want to see grow, it can avoid having to serve those areas. Conversely, for those areas in which it wishes to encourage growth, it can build trunk lines into them and save potential developers that front end cost. This approach must be tied to other community goals, programs, and strategies in order to be successful.

9.2.2 Financial Policies

Utility financing for growing communities should be designed so that "he who benefits pays." This approach may be tempered by other community policies, such as a desire to keep or attract an industry unable to pay its fair share, or to assist development of low income housing which could not be built if a full tap fee were required.

This philosophy can be implemented by applying the following policies:

- Establish service fees based on all costs of operation, including employees' wages and benefits, maintenance, and depreciation. Additional costs may be included, such as a reasonable fee paid into the General Fund for services or facilities, provided to the sewer utility by other municipal departments, such as office space and vehicles.

- Establish plant investment or tap fees (PIF) for all new customers or expansions of service, proportionate to treatment plant and trunk capacities the customer is expected to use. (See 9.3.1.1)

- Charge all direct costs of attaching to the system directly to the customer; e.g., costs of tapping into the line, and laterals and pipe from the street to the building.

9.2.3 Service for New Developments

Internal or lateral lines or pumps required to serve new developments should be provided by the developers. They may directly finance and build them, passing on costs to future occupants; or, where occupancy is relatively assured, the community may permit a special improvement district to be formed with the bonds paid back over an extended period of years through added mill levies on the properties benefiting. The cost of these localized facilities should not be borne by the community at large.

All extensions of lines past undeveloped areas to a development should be financed by the development seeking the service. Some of these costs can be paid back as intervening property is developed and attached to the system. The community should not be committed to providing such lines on request.

9.3 ANALYSIS OF MILLIKEN'S ABILITY TO UPGRADE ITS SEWAGE SYSTEM

The major questions a community must ask itself when considering its capabilities to finance and operate a sewer utility are:

- Can the community raise enough money to cover capital cost requirements?

- Can the community support the system on a continuing basis (operating and maintenance costs)?

- What are the utility financing implications of whether or not the population in the community increases?

In developing a financing program, sewer utility needs for financing should always be placed in the context of total community funding needs. Because locally generated funds all come from the same taxpayer or user, a more moderate commitment to sewer costs may be necessary in order to achieve other community goals. Considering that there are many ways to accomplish funding goals, financing strategy must be used to develop the most equitable system for the users with a minimum of future risk.

Table 9.3-A illustrates the basic financial picture. The residents of Milliken will have to pay an estimated $33,000 annually by 1981 to maintain the improved system, plus some amount to retire whatever borrowing for construction is required. The table shows how much cost for these two items would fall upon each system user (tap) annually under various assumptions about future growth and required borrowing.

The remainder of this section addresses questions of how capital and operating funds for the system might be raised and, in particular, the implications of various population growth rates.

9.3.1 <u>Financing the Proposed Capital Improvements</u>

A total capital investment of $356,000 would be required to implement the improvements proposed earlier in this report. Major sources of capital funding are plant investment fees (PIF's), grants, and borrowing.

9.3.1.1 Plant Investment Fees

A plant investment fee is normally set by dividing the total capital cost of the system by its capacity, and determining the pro rata share. For example, a $100,000 system to serve 100 units would indicate a PIF of $1,000 per unit. Where a community is large and wealthy enough to generate proportionate shares of the capital cost, PIF's could fully finance its system.

Since Milliken's present residents are already hooked up to the existing sewer system, revenue from PIF's will be
(9.3.1.1 continued on page 54 .)

TABLE 9.3-A*

TYPICAL ANNUAL COST FOR EACH UNIT ON THE SYSTEM

Annual Growth Every Year Through 1996

Growth Rate Relative to 1975 Population	New Population Each Year	New Taps	Funds Borrowed By Town For Sewer System Improvements				
			$ 0	100,000	200,000	300,000	400,000
0%	0	0	128	157	186	217	247
2	16	5	111	139	166	195	223
3	32	10	96	123	150	176	202
5	48	15	83	108	134	158	184
7	64	20	71	95	119	143	167
8	80	25	60	83	105	129	151
10	96	30	50	72	93	116	137
11	112	35	41	62	82	104	125
13	128	40	33	53	73	93	113
15	144	45	25	44	64	83	102
16	160	50	18	37	54	74	92
ANNUAL COSTS:							
Operations and Maintenance			33,000	33,000	33,000	33,000	33,000
Existing Debt			8,800	8,800	8,800	8,800	8,800
New Debt			0	9,812	19,624	29,436	39,248
TOTAL			41,800	51,612	61,064	71,236	81,048

* See notes page 53.

Source: Murray; Briscoe, Maphis, Murray & Lamont, Inc., March, 1977

NOTES ON TABLE 9.3-A

- Annual costs to each user must be covered by service charges and/or taxes.

- New taps are $650 each; existing taps = 329.

- All costs are calculated for 1981, but nevertheless are close enough estimates of any year through 1996.

- The operation and maintenance (O&M) costs are inflated for price and wage increases to 1981.

- New debt is figured at being retired in 20 years and paying an interest rate of 7-1/2%. Actual terms will be closely related to local financial conditions and bond market conditions upon issue.

- Tap or Plant Investment Fees are used to retire as much new debt as possible. For instance, with the addition of 30 taps at $650 each, as much as $19,500 in new debt could be retired. In some cases where the growth rate is high and borrowing low, tap fees are applied to the cost of old debt and/or O&M costs.

- The yearly growth rate necessary to achieve the annual costs shown on the chart would have to occur every year. For example, if $100,000 were borrowed, 20 new taps would have to be added every year for the next five years (or a total of 100 new taps added to the system over the five-year period) for the annual cost to be $95 per unit by 1981. To maintain that annual charge, the growth would have to continue by that rate beyond 1981.

- The source of revenue to pay the annual costs is a local decision. The table simply indicates the amount needed.

- The table may be adjusted as new information becomes available by using the following basic formula:

$$\text{Annual Cost Per Unit} = \frac{\text{Annual O\&M + Annual Debt Service - Tap Fees}}{\text{Number of Units on the System}}$$

- Note that the table shows the remaining cost, over and above that paid by tap fees, to be shouldered by system users. It may be determined that the maximum or "worst case" figure shown in the top row of the table is not unreasonable in terms of user's ability to pay. This is the case if no growth occurs and only current residents are available to pay the full cost. If the figure is unreasonable, funds from other sources should be sought to cover the total cost. An alternative would be initially to scale down the amount of borrowing, if possible.

limited to new development, and will depend on the extent of development that occurs. The District may wish to generate some immediate capital funds by requesting proposed developers to prepay some of their PIF's. In any event, Milliken cannot expect PIF's to provide a major portion of the capital funding that will be required.

9.3.1.2 Grants and Subsidized Loans

Grant funds are likely to be available to assist with the costs of capital construction. Because the availability of such funds will be important in figuring the remaining burden on the local residents, this source of funding should be investigated early in the process of deciding if and how the District should proceed.

Determine the approximate amount of grants (and/or subsidized loans) available from various government sources. For smaller communities such as Milliken, these are the most likely sources at this time:

- Farmers Home Administration
- The Colorado Department of Local Affairs
- HUD Community Development discretionary funds for service lines

In order to gauge a community's eligibility, these funding agencies typically evaluate the locality's ability and efforts to finance its own system. For example, for each community requesting assistance the Colorado Department of Local Affairs takes into consideration the following:

- Legal ability to tax
- Assessed valuation
- Median family income
- Current bonded indebtedness
- Total tax effort
- Number of people on fixed incomes
- Level of user charges

The key element considered by the Department of Local Affairs and the Farmers Home Administration, other factors being equal, is the state guideline that a community's annual user charge for sewer service should be at least 1-1/2% of the median family income. This guide is used to determine if a community is doing its fair share to pay for the system. The figure can be lowered for a number of reasons: for example, if a town is in a weak financial condition, or has a large number of people on fixed incomes. But as a general guide, this tells a community how it will stand in potential aid levels from the various funding sources.

The state guideline that 1-1/2% of a community's median family income represents a reasonable annual user fee, indicates that Milliken's fee level would be $105.42 per tap per year (1-1/2% X $7,028). Comparing this figure with annual costs projected in table 9.3-A indicates that Milliken would clearly qualify for some grant assistance. How much assistance might be received will depend on funding agencies' priorities and fund availability. It is unlikely that a 100% grant would be received from any given agency.

All potential sources should be checked for assistance. A summary of sources of financial aid can be found in Table 9.3.1-A. Funding availability varies from month to month as new revenues are made available or previously obligated funds are returned for redistribution.

9.3.1.3 District Borrowing

To determine estimated borrowing needs, deduct anticipated grant amounts and any immediate local funds that might be allocated to the project from the capital cost estimates for the proposed system.

Whenever possible, revenue bonds should be used to finance sewer system improvements. If a community must borrow to finance utility improvements, it is desirable to protect its general obligation bonding capacity (tied by state law to assessed valuation) for uses where revenue bonding is not feasible. This is because numerous community needs usually cannot be financed from revenue bonds (e.g., parks, libraries, or police facilities). Therefore, any revenue generating operation, such as a sewer system, should borrow on the direct ability of the system to retire the debt.

There are limitations to this financing method; i.e., cases where the cost of the system exceeds its ability to generate revenue, or where general obligation bonds are not limited by state statute (e.g., bonds for water improvements). Even in these cases, the maximum reasonable revenues should be raised from PIF and user fees to retire at least a portion of the debt. Other sources must then supplement system revenues if the project is to occur.

Because there are no general obligation bonds outstanding, Milliken has the ability to borrow up to $106,000. The question of where they will find the revenues to repay such a debt is the more significant issue.

9.3.2 <u>Sources for Financing System Operating Costs</u>

Funds to pay annual operating costs can be obtained from a number of sources. Most typically, these sources are service or user rates, property taxes and sometimes other general fund revenues.

Service or user rates can be the most equitable source of

TABLE 9.3.1-A
SOURCES OF POTENTIAL FINANCIAL AID

	FHA COMMUNITY FACILITY LOANS/GRANTS - FEDERAL	CONSTRUCTION GRANTS FOR SEWERAGE WORKS (STATE OF COLORADO) STATE	FOUR CORNERS REGIONAL COMMISSION, SUPPLE-MENTAL GRANT-REGIONAL	COMMUNITY DEVELOPMENT ACT (HUD)-DISCRETIONARY FUNDS FEDERAL	EPA CONSTRUCTION GRANTS - FEDERAL	PREDESIGN ENGINEERING GRANTS (STATE OF COLORADO) STATE	ECONOMIC DEVEL MENT-ADMINISTI (EDA) - FEDER
PROGRAM DESCRIPTION							
FUND USAGE	TO CONSTRUCT, ENLARGE, EXTEND, OR IMPROVE SEWERAGE SYSTEMS.	TO CONSTRUCT, EXPAND, OR MODERNIZE SEWAGE TREATMENT FACILITIES	PROGRAM IS GEARED FOR ECONOMIC DEVELOPMENT TYPE PROJECTS. HOWEVER ECONOMIC DEVELOPMENT HAS A VERY BROAD DEFINITION.	TO CONSTRUCT SEWAGE COLLECTION LINES NOT TREATMENT FACILITIES.	TO PLAN, DESIGN, AND CONSTRUCT SEWERAGE COLLECTION AND TREATMENT FACILITIES.	PREDESIGN ENGINEERING FOR THE EXPANSION, CONSTRUCTION, OR MODERNIZATION OF SEWAGE TREATMENT SYSTEMS INCLUDING COLLECTION OF FACILITIES	THE PROGRAM I RENTLY BEING SIDERED BY THE GRESS. IT IS CIPATED THAT QUALIFICATION QUIREMENTS WI CHANGE. THE B REQUIREMENT B HIGH UNEMPLOY RATE AND HIGH BER OF UNEMPL
FORM OF ASSISTANCE	MAY BE EITHER LOAN OR GRANT. GRANT OR LOAN 50% OF PROJECT, LOAN 40 YEARS AT 5%.	ASSISTANCE IS GIVEN IN THE FORM OF A GRANT. THE AMOUNT VARIES UPON THE FINANCIAL NEED OF THE COMMUNITY	ASSISTANCE IS IN THE FORM OF A GRANT. MAXIMUM SUPPLEMENTAL GRANT IS 63% OF OTHER FEDERAL FUNDING OR $150,000.	GRANT FROM DISCRETIONARY FUNDS FOR ALL PORTION OF PROJECT.	ASSISTANCE IS IN THE FORM OF A 75% GRANT.	NORMAL STATE GRANT OF 30%, APPLICANT MATCHING FUNDS OF 20%. THE APPLICANT'S SHARE IS VARIABLE DEPENDING UPON FINANCIAL NEED.	
AMOUNT OF ASSISTANCE	LOAN/GRANT RANGE: $20,000-$200,000.	AVG. GRANT: $50,000 MAX. GRANT: $500,000	AVG. GRANT: $75,000	AVG. GRANT: $130,000 GRANT RANGE: $50,000-$300,000	AVG. GRANT: N/A GRANT RANGE:	AVG. GRANT: $3,000	
CURRENT FISCAL YEAR APPROPRIATION	$4.8 MIL LOANS, .9 MIL GRANTS	$2.3 MIL	$2.5 MIL	$2.5 MIL FISCAL YEAR 1977 (COLORADO NONMETROPOLITAN)		$200,000	
ANTICIPATED APPROPRIATION NEXT FISCAL YEAR	ABOUT THE SAME AS PRIOR YEAR.	$2.0 MIL	$1.7 MIL	MINOR INCREASE FOR FY 1978		$200,000	
ELIGIBILITY REQUIREMENTS							
ELIGIBLE ENTITIES	MUNICIPALITIES AND DISTRICTS	ANY MUNICIPALITY OR SPECIAL DISTRICT	ANYONE WHO CAN GET FEDERAL BASIC FUNDING	A FORM OF GENERAL PURPOSE GOVERNMENT, E.G. INCORPORATED MUNICIPALITIES, COUNTIES, THE STATE OR INDIAN TRIBES.	SEE ATTACHED NOTICE OF FINAL ADOPTION OF FEDERAL CONSTRUCTION GRANT PRIORITY SYSTEM, DATED AUG. 20, 1975.	ANY MUNICIPALITY OF SPECIAL DISTRICT.	
ELIGIBILITY REQUIREMENTS	MUST NOT HAVE THE CAPABILITY TO FINANCE THE PROJECT THROUGH AVAILABLE COMMUNITY RESOURCES. HAVE POP. LESS THAN 10,000 AS OF LAST CENSUS	APPLICANT'S POPULATION MUST BE 5,000 OR LESS, AS OF THE LATEST CENSUS.	MUST HAVE RECEIVED ANOTHER SOURCE OF FEDERAL AID.	N/A	N/A	APPLICANT'S POPULATION MSUT BE 5,000 OR LESS, AS OF THE LATEST CENSUS.	
DISCRIMINATING FACTORS	FINANCIAL NEED. THE ENTITY MUST BE AT OR NEAR THEIR LIMIT ON BONDING INDEBTEDNESS.	FINANCIAL NEED, BONDED INDEBTEDNESS, ASSESSED VALUATION, MEDIAN INCOME, ETC.	THE PROJECT MUST PROMOTE ECONOMIC DEVELOPMENT.	EXTENT TO WHICH: COMMUNITY HAS POVERTY, SUBSTANDARD HOUSING, BENEFITS LOW-MODERATE INCOME HOUSING, NEEDED FOR HOUSING STOCK, ALLEVIATING HEALTH, SAFETY, & WELFARE PROBLEMS AND GRANTS FROM OTHER AGENCIES.	N/A	FINANCIAL NEED, SERIOUSNESS OF POLLUTION PROBLEM.	
APPLICATION MECHANICS							
APPLICATION PROCESS	BEGIN WITH COUNTY FHA REPRESENTATIVE.	A. SUBMIT GRANT APPLICATION TO DIRECTOR OF LOCAL GOVERNMENTS AND APPLY FOR SITE APPROVAL FROM THE COLORADO WATER POLLUTION CONTROL COMMISSION. B. DIVISION OF LOCAL GOVT. THEN ISSUE A CERTIFICATE OF FINANCIAL NEED STATING AMOUNT OF GRANT AND THAT THE APPLICANT MUST OBTAIN SITE APPROVAL. C. SUBMIT SITE APPROVAL, FINAL PLANS AND SPECIFICATIONS TO THE DIVISION OF LOCAL GOVERNMENTS. D. SUBMIT TWO SETS OF FINAL PLANS AND SPECIFICATIONS TO COLORADO DEPARTMENT OF HEALTH.	DETERMINE A SOURCE OF FEDERAL FUNDING OR POSSIBILITY THEREOF, ARRANGE A PRE-APPLICATION CONFERENCE WITH THE FOUR CORNERS REGIONAL COMMISSION REPRESENTATIVE, ARRANGE FOR AN A-95 REVIEW OF PROJECT.	APPLICATION PROCESS WAS PUBLISHED IN THE FEDERAL REGISTER ON OCT. 13, 1976. COMPETITION IS VERY STIFF FOR THESE FUNDS.	THE STATE HEALTH DEPARTMENT WILL CONTACT THE MUNICIPALITY WHEN FUNDING BECOMES AVAILABLE.	A. OBTAIN LETTER FROM LOCAL HEALTH DEPARTMENT OFFICIAL CERTIFYING THAT SYSTEM IS CURRENTLY IN VIOLATION OF STATE STANDARDS. B. OBTAIN ENGINEERS PROPOSAL FOR WORK. C. OBTAIN APPLICATION FORM LG-PS275. SUBMIT ALL OF THE ABOVE TO THE DIVISION OF LOCAL GOVERNMENTS.	
APPLICATION DEADLINES	FIRST COME, FIRST SERVED UNTIL APPROPRIATION RUNS OUT.	FUNDING IS ON A FIRST COME, FIRST SERVE BASIS.	NO DEADLINES. FUNDING IS ON A FIRST COME, FIRST SERVE BASIS.	TO BE DETERMINED	N/A	FUNDING IS ON A FIRST COME, FIRST SERVE BASIS.	
TIME REQUIRED TO EVALUATE APPLICATION	3 MONTHS	1-3 MONTHS. THIS INCLUDES TIME REQUIRED FOR HEALTH DEPARTMENT REVIEW OF PLANS AND SPECIFICATIONS.	VERY FAST. AS FUNDING IS TIED TO ALREADY APPROVED FEDERAL FUNDING.	TO BE DETERMINED 5-6 MONTHS, EXCEPT FOR EMERGENCY SITUATIONS	N/A	2 MONTHS	
MISCELLANEOUS		IF FUNDING IS NOT RECEIVED UPON INITIAL APPLICATION, IT IS REVIEWED MONTHLY UNTIL IS IS FUNDED OR THE APPROPRIATION IS EXHAUSTED. THESE FUNDS MAY BE USED IN CONJUNCTION WITH OTHER LOANS OR GRANTS. THE COMMUNITY MUST BE PREPARED TO USE 1.5% OF ITS MEDIAN FAMILY INCOME PER CUSTOMER PER ANNUM TO OPERATE ITS EXISTING SYSTEM AND/OR PAY FOR ITS SHARE OF THE NEW PROJECT.			CURRENTLY THERE IS A LARGE EMPHASIS ON STEP 1 AND 2 GRANTS. HOWEVER, AS COMMUNITIES BECOME READY FOR STEP 3 GRANTS, THE AMOUNTS AVAILABLE FOR STEP 1 AND 2 GRANTS WILL BE GREATLY DIMINISHED.	THESE FUNDS MAY BE USED IN COMBINATION WITH OTHER LOANS/GRANTS.	
CONTACTS	JOHN MEIKLE, FHA, 337-4717	BILL PEED, STATE OF COLORADO, DIVISION OF LOCAL GOVERNMENTS 392-2156 JEB LOVE, STATE HEALTH DEPT. 388-6111	IVO ROOSPOLD, DEPT. OF LOCAL AFFAIRS, RURAL DEVELOPMENT 392-2631	ARMAND SEDGELEY, HUD-DENVER 837-4666	RON SCHUYLER, STATE DEPT. OF HEALTH, 388-6111 JERRY BURKE, SAM BERMAN FEDERAL EPA, 837-3961	BILL PEED, STATE OF COLORADO DIVISION OF LOCAL GOVERNMENTS 392-2156	PAUL RENNE, GRAMS, JOHN LOCAL PUBLIC ACT, 337-471

BRISCOE, MAPHIS, MURRAY & LAMONT, INC. MARCH 3, 1978 funds. The beneficiary pays in proportion to the amount of benefit received. Rates should be pegged to reflect the full cost of operation, maintenance, and depreciation, and perhaps some portion of debt service where borrowing to provide a plant for existing customers remains unpaid. Tap or plant investment fees can also be used if necessary, but this is not considered a desirable practice for paying operating costs, as it defeats the purpose of the tap fee. Rather, tap fees should be applied to repay bonds issued to finance the added plant capacity serving the new taps.

Because of historical precedent, many communities do not charge users in proportion to their use, but keep a low user rate by subsidizing costs with mill levies on property. This is particularly true in special districts where high user rates would discourage potential hookups. The argument against this use of property tax revenues is that it depletes an important source of funding general purpose, non-revenue producing facilities.

A community can choose to subsidize rates from its general fund monies. These might be composed, for example, of revenue sharing funds, sales tax, fees or licenses, or cigarette taxes. The same drawback as with using property taxes applies.

Most generally, however, operations and maintenance costs are covered by annual user rates. To determine if a community can generate sufficient user rate revenue to support the system, the state guideline of 1-1/2% of the median family income can be used as a general guide. While a community can certainly charge more than 1-1/2%, anticipated user fees far in excess of this figure may indicate that the residents of the community will find the sewer utility extremely difficult to support.

Using the $105 as the limits of a reasonable user fee level, Table 9.3-A indicates that it would take a combination of high growth rates and fairly low borrowing conditions to keep user fees "reasonable". Unless significant grant assistance can be received, supporting the proposed improved system might present a very serious burden for the District's existing residents. Whether the Town chooses to go to a sales tax to provide more mill levy flexibility for the sanitation district is almost immaterial. The same people will be called upon to increase their tax burden. The funds will essentially come from the same sources.

9.3.3 Effects of Population Growth

Consider the implications of population growth. Increased population can provide increased revenue through PIF's, user fees, and taxes, all of which can ease the burden of supporting the sewer utility on existing residents.

A realistic anticipation of growth might encourage the community to borrow more money to finance its system, and will influence the size and/or type of system the community decides to use.

However, bear in mind that increased population may also generate needs for system expansion (necessitating further borrowing) and that projected growth which does not occur on schedule may seriously burden existing residents with higher annual payments than had been planned. Recognizing the possibility for growth--without counting on it to carry the community's financing needs--is a necessary component of evaluating the community's capabilities to support the sewer utility.

Table 9.3-A illustrates impacts for Milliken of various combinations of borrowing levels and growth rates. It can be used to evaluate risk and anticipated cost per user should the District borrow money to upgrade its system.

9.4 CONCLUSIONS AND RECOMMENDATIONS FROM FINANCIAL ANALYSIS

9.4.1 Conclusions

A combination of funding sources will be required to finance costs identified as essential to upgrade Milliken's sewer facilities. The community should follow the process previously outlined in this chapter to decide if it can develop a financial program suited to Milliken's capabilities and circumstances.

Table 9.3-A indicates that Milliken should seek a full grant of $356,000 to finance improvement costs. However, there may not be enough grant money available and a smaller grant may have to be used. In that event, the way the local financing package is developed becomes much more important. Longer term borrowing, or ballooning the loan so there are smaller payments in the near term with larger payments later so that growth will help to provide a base, become considerations. The table can show what to expect in this regard.

For instance, suppose the maximum available in grant monies is $156,000. In this case the table indicates that each user may be required to pay as much as $186 annually by 1981, in the event no growth occurs. On the other hand, with annual growth of 25 taps, the table shows the annual cost to be $105, which is within the income-based guidelines.

Even if a full grant is received the cost to the user by 1981 may continue to be fairly high at the equivalent of $128 annually (distributed among tap fee, user fee, and mill levy). Population growth would bring this figure down but it is wise to be cautious in projecting growth to take on financial burdens which will that much greater if projected growth does not occur. Given the record of the last seven years it would appear that continued growth is a reasonable expectation.

9.4.2 Summary of Major Problems

The financial analysis has identified several problem areas for Milliken in financing the improvements proposed.

- The proposed improvements are beyond the capacity of the community to finance by themselves.
- Even with a 100% grant, costs to system users could be as high as $128 per year unless growth continues at a good rate.

9.4.3 Recommendations

The amount of grant(s) available is an essential starting point for the consideration of the improved system. Prepayment of PIF's by developers should be looked to for raising necessary local funds to complement whatever grant money is available. Finally, an increase in user fees appears inevitable if the system is to be improved.

The community should refer to the Utility Management Handbook (1977) available from the Larimer-Weld Regional Council of Governments which discusses in detail a program of planning, setting up management policies, and encouraging competent operational management.

APPENDIX A

BIBLIOGRAPHY

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Environmental Protection Agency, Alternative Waste Management Techniques for Best Practical Waste Treatment, EPA 430/9-75-013, October, 1975.

Faulkner and Associates, Infiltration/Inflow Studies for Milliken Sanitation District.

Goleta County Water District, Feasibility Study - Wastewater Reclamation by Irrigation, Toups Corporation, August, 1975.

Larimer-Weld Regional Planning Commission, Interim Water and Sewer Planning for Region II - Larimer and Weld Counties, 1972.

Nelson, Haley, Patterson and Quirk, Inc., Sanitary Sewer System Improvements (Plans), Milliken Sanitation District, March, 1968.

APPENDIX B

NPDES WASTE DISCHARGE PERMIT - MILLIKEN SANITATION DISTRICT

NOV - 8 1976

COLORADO DEPARTMENT OF HEALTH

4210 E. 11TH AVENUE DENVER 80220 PHONE 388-6111

ANTHONY ROBBINS, M.D., M.P.A. EXECUTIVE DIRECTOR

October 28, 1976

CERTIFIED MAIL:
991497

Milliken Sanitation District
P. O. Box 158
Milliken, Colorado 80543

Re: Final Permit, NPDES Permit Number: CO-0026808 (Weld County)

Gentlemen:

Enclosed please find a copy of the permit issued under the Federal Water Pollution Control Act and Colorado Water Quality Control Act.

Issuance of this permit constitutes a final determination by the Division of Administration of the Colorado Department of Health, in conjunction with the U.S. Environmental Protection Agency and may be subject to administrative review proceedings pursuant to the State Administrative Procedure Act, including an adjudicatory hearing. You are advised to consult this act and particularly to consult Sections 24-4-104, 24-4-105, 24-4-102(7), and 25-8-401, C.R.S. 1973 for more information. In addition, the Regulations for the State Discharge Permit System contains material that is pertinent to any administrative review of the issuance of this permit.

Your NPDES Waste Discharge Permit requires that specific action be performed at designated times. Failure to meet these requirements constitutes a violation of this permit and can result in civil and/or criminal actions(s). Please read the permit very thoroughly.

1. All municipal and industrial facilities are required to submit self-monitoring information. (PART I. B. Monitoring and Reporting.) Frequencies and types of self-monitoring are summarized in PART I A. Effluent Limitations and Monitoring Requirements.

2. Monitoring and reporting requirements for feedlots are described in PART I. A. Effluent Limitations and Monitoring Requirements (see 2.c.) and in PART 1. B. Monitoring and Reporting.

3. In some instances a schedule of compliance is to be submitted if required by your permit. Please note that the required date of submittal as specified in PART 1, Page , is None

4. PART II A. Management Requirements and B. Responsibilities, contain information that explains further requirements which are enforceable as are all other provisions of the permit.

5. PART III Other Requirements specify certain reports that are required and/or notifications that are necessary.

If you have any questions, please contact the Permits Program, Water Quality Control Division of the Colorado Department of Health at 303+388-6111, Ext. 231, or write to this office.

Very truly yours,

FOR DIRECTOR, WATER QUALITY CONTROL DIVISION

Paul E. Williamson

Paul E. Williamson, P.E.
Acting Chief
Monitoring & Enforcement Section

PEW: mgc

enc.

cc: U.S. Environmental Protection Agency
District Engineer - Mr. Boyd Hanzon
Health Department - Weld County Health Department
208 Planning Area - Larimer-Weld Council of Governments

RENEWAL

Permit No. CO-0026808

County: Weld

NOV 5 1976

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq; the "Act"), and the Colorado Water Quality Control Act (25-8-101 et. seq., CRS, 1973 as amended)

Milliken Sanitation District,

is authorized to discharge from its wastewater treatment facility,

located at Milliken, Colorado,

to receiving waters named Little Thompson River,

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective thirty (30) days after the date of receipt of this permit by the Applicant. Should the Applicant choose to contest any of the effluent limitations, monitoring requirements or other conditions contained herein, he must comply with Section 24-4-104 CRS 1973 and the Regulations for the State Discharge Permit System. Failure to contest any such effluent limitation, monitoring requirement, or other condition is consent to the condition by the Applicant.

This permit and the authorization to discharge shall expire at midnight, June 30, 1981.

Signed this 29 day of October, 1976

COLORADO DEPARTMENT OF HEALTH
Division of Administration

[signature]

Robert D. Siek
Assistant Director, Department of Health
Environmental Health

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - SEE ANY ADDITIONAL REQUIREMENTS UNDER PART III.

1. Effluent Limitations

During the period beginning immediately and lasting through June 30, 1981, the permittee is authorized to discharge from outfall serial number: 001.

Effluent Parameter	Discharge Limitations Maximum Concentrations mg/l 30-day avg.	mg/l 7-day avg.	mg/l Daily Max.
Flow - m^3/Day (MGD)	N/A	N/A	N/A
BOD_5	30 a/	45 b/	N/A
Total Suspended Solids	30 a/	45 b/	N/A
Fecal Coliforms-Number/100ml	1,000 c/	2,000 c/	N/A
Total Residual Chlorine	N/A	N/A	0.5 d/h/

pH - units shall remain between 6.0 and 9.0 d/.

Oil and Grease shall not exceed 10 mg/l d/ in any grab sample nor shall there be a visible sheen.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (Continued)

2. Monitoring Requirements

In order to obtain an indication of the probable compliance or non-compliance with the effluent limitations specified in Part 1, the permittee shall monitor and report all effluent parameters at the following required frequencies.

Effluent Parameter	Measurement Frequency e/i/	Sample Type f/
Flow - m^3/Day (MGD)	Weekly	Instantaneous or Continuous
BOD_5 g/	Monthly	Composite
Total Suspended Solids g/	Monthly	Composite
Fecal Coliforms-Number/100 ml	Monthly	Grab
pH	Weekly	Grab
Total Residual Chlorine	Weekly	Grab
Oil and Grease	Weekly	Visual Observation

Self-monitoring samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): 001, prior to mixing with the receiving stream. Outfall 001 is located at junction of Alice Street and the Little Thompson River.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (Continued)

3. Footnotes

a/ This limitation shall be determined by the arithmetic mean of a minimum of three (3) consecutive samples taken on separate weeks in a 30-day period (minimum total of three (3) samples); not applicable to fecal coliforms - see footnote c/.

b/ This limitation shall be determined by the arithmetic mean of a minimum of three (3) consecutive samples taken on separate days in a 7-day period (minimum total of three (3) samples); not applicable to fecal coliforms - see footnote c/.

c/ Averages for fecal coliforms shall be determined by the geometric mean of a minimum of three (3) consecutive grab samples taken during separate weeks in a 30-day period for the 30-day average, and during separate days in a 7-day period for the 7-day average. (minimum total of three (3) samples).

d/ Any discharge beyond this limitation as indicated by any single analysis and/or measurement shall be considered a violation of the condition of this permit.

e/ Quarterly samples shall be collected during the months of March, June, September, December, if a continual discharge occurs. If the discharge occurs on an intermittent basis, all the samples shall be collected during the period when that intermittent discharge occurs.

f/ See definitions, Part B.

g/ In addition to monitoring the final discharge, influent samples shall be taken and analyzed for this parameter at the same frequency as required as for this parameter in the discharge.

h/ Monitoring is required only when chlorine is used for disinfection.

i/ Monitoring is required only during periods of discharge. If "no discharge" occurs, this shall be reported at the specified frequency. (See Part B).

B. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Monitoring results obtained during the previous 3 months shall be summarized for each month and reported on applicable discharge monitoring report forms, postmarked no later than the 28th day of the month following the completed reporting period. The first report is due on October 28, 1976. If no discharge occurs, "No Discharge" shall be reported. Duplicate signed copies of these, and all other reports required herein, shall be submitted to the Regional Administrator and the State at the following addresses:

Colorado Department of Health
Water Quality Control Division
4210 East 11th Avenue
Denver, Colorado 80220

U.S. Environmental Protection Agency
1860 Lincoln Street - Suite 900
Denver, Colorado 80203
Attention: Enforcement - Permit Program

3. Definitions

a. A "composite" sample, for monitoring requirements, is defined as a minimum of four (4) grab samples collected at equally spaced two (2) hour intervals and proportioned according to flow.

b. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

c. An "instantaneous" measurement, for monitoring requirements, is defining as a single reading, observation, or measurement using existing monitoring facilities.

4. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(g) of the Act, and Colorado State Effluent Limitations (400), under which such procedures may be required.

5. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The dates the analyses were performed;

c. The person(s) who performed the analyses;

d. The analytical techniques or methods used; and

e. The results of all required analyses.

6. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1), or other forms as required by the Division. Such increased frequency shall also be indicated.

7. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the State Water Quality Control Division.

A: MANAGEMENT REQUIREMENTS

1. Change In Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated change in discharge location and/or facility expansions, production increases, or process modifications which will result in new, different, or increased discharges or pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the State Water Quality Control Division of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Noncompliance Notification

If, for any reason, the permittee does not comply with any maximum effluent limitation specified in this permit the permittee shall provide the Regional Administrator and the State Water Quality Control Division with the following information, in writing, within five (5) days of becoming aware of such condition:

a. A description of the discharge and cause of noncompliance; and

b. The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

3. Facilities Operation

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to waters of the State resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. Bypassing (see additional requirements under Part III)

Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Regional Administrator and the State Water Quality Control Division in writing of each such diversion or bypass.

6. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the State.

7. Power Failures

In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

a. Provide an alternative power source sufficient to operate the wastewater control facilities;

or, if such alternative power source is not in existence, and no date for its implementation appears in Part I,

b. Halt, reduce or otherwise control production and/or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

8. Any discharge to the waters of the State from a point source other than specifically authorized is prohibited.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Director of the State Water Quality Control Division, the EPA Regional Administrator, and/or their authorized representatives, upon the presentation of credentials:

a. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in the permit; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Regional Administrator and the State Water Quality Control Division.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Act and Regulations for the State discharge permit system (506), all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State Water Quality Control Division and the Regional Administrator.

As required by the Act, effluent data shall not be considered confidential Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act and CRS (1973) 25-8-610.

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

5. Toxic Pollutants

Notwithstanding Part II, B-4 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" (Part II, A-5) and "Power Failures" (Part II, A-7), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

10. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

PART III

OTHER REQUIREMENTS

Additional Bypassing Requirements

If, for other reasons, a partial or complete bypass is considered necessary, a request for such bypass shall be submitted to the State Water Quality Control Division and to the Environmental Protection Agency at least sixty (60) days prior to the proposed bypass. If the proposed bypass is judged acceptable by the State Water Quality Control Division and by the Environmental Protection Agency, the bypass will be allowed subject to limitations imposed by the State Water Quality Control Division and the Environmental Protection Agency.

If, after review and consideration, the proposed bypass is determined to be unacceptable by the State Water Quality Control Division and the Environmental Protection Agency, or if limitations imposed on an approved bypass are violated, such bypass shall be considered a violation of this permit; and the fact that application was made, or that a partial bypass was approved, shall not be a defense to any action brought thereunder.

Testing

Test procedures shall conform with those procedures specified in the Federal Register, Volume 38, Number 199, October 16, 1973. These procedures involve the use of one of the following references:

1. "Standard Methods for the Examination of Water and Waste Water," 13th Edition, 1971.

2. "ASTM", Annual Book of Standards, Part 23, Water, Atmosphere Analysis, 1973.

3. "Methods for Chemical Analysis of Waters and Wastes," 1971, Environmental Protection Agency.

OTHER REQUIREMENTS (Continued)

Within three (3) months after the date of permit issuance, a flow-measuring device shall be installed to give representative values of effluent volume at some point in the plant circuit, if not already a part of the wastewater plant.

At the request of the Regional Administrator of the Environmental Protection Agency or the Director of the State Water Quality Control Division, the permittee must be able to show proof of the accuracy of any flow-measuring device used in obtaining data submitted in the monitoring report. The flow-measuring device must indicate values within ten (10) percent of the actual flow being measured.

The limitations stated in PART I, Section A, are calculated on the basis of gross measurements of each parameter in the designated discharge regardless of the quantity and quality of these parameters in the plant inflow, unless otherwise specified.

If the permittee desires to continue to discharge, he shall reapply at least one hundred-eighty (180) days before this permit expires.

Within sixty (60) days of the issuance of this permit, the permittee shall file a statement with the Environmental Protection Agency and the State Water Quality Control Division which shall contain the names of the person or persons who are designated to report conditions as noted in PART II, Section A, Paragraph 2a (Noncompliance Notification), and as noted in PART II, Section B, Paragraph 7 (Oil and Hazardous Substance Liability). The permittee shall continually update this list as changes occur at the facility.

The permittee is required to submit an annual fee as set forth in Section 25-8-502 C.R.S. 1973 as amended. Failure to submit the required fee is a violation of this permit and will result in the suspension of said permit and enforcement action pursuant to Section 25-8-601 et. seq., 1973 as amended.

OTHER REQUIREMENTS (Continued)

Percentage Removal Requirements (Applies to Sewage Treatment Plants only)

If not presently being complied with, effective as soon as reasonable and practical, but no later than July 1, 1977, the arithmetic mean of the total BOD_5 and the Total Suspended Solids concentrations for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the concentrations for influent samples collected at approximately the same times during the same period (85 percent removal). This is in addition to the concentration limitations on Total BOD_5 and Total Suspended Solids.

Expansion Requirements

Pursuant to Colorado Law, C.R.S. 1973 25-8-501(6), the permittee is required to initiate engineering and financial planning for expansion of the treatment works whenever throughput and treatment reaches eighty (80) percent of design capacity. Whenever ninety-five (95) percent of either the hydraulic or organic capacity of the treatment works is met, the permittee shall commence construction of the necessary treatment expansion.

In the case of a municipality, construction may be commenced, or building permit issuance may be terminated, until such construction is initiated, except that building permits may continue to be issued for any construction which would not have the effect of increasing the input of sewage to the municipal treatment works.

OTHER REQUIREMENTS (Continued)

Industrial Wastes

A. Each major contributing industry, if not previously identified, must be identified as to qualitative and quantitative characteristics of the discharge and production data. Such information shall be submitted within one hundred-twenty (120) days of the issuance of this permit. A major contributing industry is defined as an industrial user discharging to a municipal treatment works that satisfies any of the following: (1) has a flow of 50,000 gallons or more per average work day; (2) has a flow greater than five (5) percent of the flow carried by the municipal system receiving the waste; (3) has in its waste a toxic pollutant in toxic amounts as defined in standards issued under Section 307(a) of Public Law 92-500 (not published as of December 1, 1975).

B. The permittee must notify the State Water Quality Control Division of any new introductions by new or existing sources or any substantial change in pollutants from any major industrial source. Such notice must contain the information described in "A" above and be forwarded no later than sixty (60) days following the introduction or change.

C. Pretreatment Standards (40 C.F.R. Part 128) developed pursuant to Section 307 of the Act require that under no circumstances shall the permittee allow introduction of the following wastes into the waste treatment system:

(1) Wastes which create a fire or explosion hazard in the publicly owned treatment works.

(2) Wastes which will cause corrosive structural damage to treatment works, but in no case, wastes with a pH lower than 5.0, unless the works are designed to accommodate such wastes.

(3) Solids or viscous substances in amounts which would cause obstruction to the flow in sewers, or other interference with the proper operation of the publicly owned treatment works.

(4) Wastewaters at a flow rate and/or pollutant discharge rate which is excessive over relatively short time periods so that there is a treatment process upset and subsequent loss of treatment efficiency.

Violations Resulting from Overloading

Should there be a violation of any conditions of this permit, the Environmental Protection Agency has the authority under Section 402(h) of the Federal Water Pollution Control Act Amendments of 1972 to proceed in a court of competent jurisdiction to restrict or prohibit further connections to the treatment system covered by this permit by any sources not utilizing the system prior to the finding that such a violation occurred. It is intended that this provision be implemented by the Agency (or the State Water Quality Control Division) as appropriate.