Final

City of Kenai
Wastewater Facility Master Plan

Prepared for

City of Kenai

Public Works Department
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Kenai, Alaska 99611

March 2004

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This report has been prepared under the supervision of a registered Professional Engineer.

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Abbreviations

ABF	average base flow
AC	asbestos-cement
ADEC	Alaska Department of Environmental Conservation
AFD	adjustable frequency drive
BFP	belt filter press
BOD	biochemical oxygen demand
cfm	cubic feet per minute
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
GBT	gravity belt thickener
GIS	geographic information system
gpd	gallons per day
I/I	inflow and infiltration
mg/L	milligrams per liter
mgd	million gallons per day
MLVSS	mixed liquor volatile suspended solids
O&M	operations and maintenance
PLC	programmable logic controller
RAS	return activated sludge
RSD	return sludge digester
SCADA	System Control and Data Acquisition
scfm	standard cubic feet per minute
SVI	sludge volume index
TSS	total suspended solids
USDA	U.S. Department of Agriculture
WAS	waste activated sludge
WWTF	Wastewater Treatment Facility

Executive Summary

The City of Kenai (City) last prepared a Wastewater Facility Plan in 1978, during a time of rapid growth. Nearly 25 years has passed since the last update, and Kenai's rapid growth has stabilized. It is appropriate to prepare a new Wastewater Facility Master Plan to assist the City to plan for the next 20 years.

The City's present Wastewater Treatment Facility (WWTF) and sewage collection system were sized upon growth predictions from over 20 years ago, which did not entirely materialize. As a result, the City's wastewater collection and treatment systems have not yet reached their design capacities. There is, however, a need for planning to provide continued operations and maintenance (O&M) and expansion for the modest growth expected over the next 20 years.

One of the main recommendations of this study is that the City's WWTF can be upgraded to meet the modest growth predicted over the next 20 years without expanding its existing footprint. Instead of adding new structures, the WWTF capacity can be increased by improving the efficiency of the existing treatment system. In addition, certain capital improvements to the WWTF could result in substantial O&M savings with a payback period as short as 7 years.

Table ES-1 provides a recommended capital improvements summary.

Sewage Collection System Evaluation

The collection system currently includes approximately 46 miles of sewer main and 16 sewage lift stations. The available data indicates that 42 percent of the sewer main is asbestos-cement (AC) pipe while 44 percent is ductile iron. The material type for 14 percent of the existing sewer main is unknown or not included within the available geographic information system (GIS) data set.

Although the soil types within the City provide generally good bedding for AC pipe, maintenance crews find that AC pipe does break and requires occasional repairs. This is not sufficient reason for replacing all the AC pipe. Instead, it will be worthwhile to develop a tracking system to document when, where, and how a particular pipe has broken and what steps were necessary to repair it. An evaluation of this information collected over a period of time may determine trends, areas, soil types, and other valuable data for making collective system improvements.

The sewage lift stations have sufficient capacity for the current peak flows. Future growth within the City's developable land will add sewage flow. The two lift stations most impacted by growth will be the Lawton Street and Broad Street lift stations. The peak flow capacity of these lift stations can be increased by replacing the pumps with larger units. If the interior of the wet well begins to deteriorate to an unacceptable degree, the interior can be relined with grout or proprietary plastic coatings.

TABLE ES-1
Capital Improvements Summary for City of Kenai Wastewater Treatment and Collection

Phase	Description of Improvement	Capital Investment	Annual O&M Cost	Additional and/or Reduced O&M	Present-Worth Costs for 20-Year Period[a]
1	Activated Sludge System Improvements				
	Upgraded Fine Bubble Aeration	$300,000	$37,000		$900,000
	Upgraded Aerobic Digester Blower System	$200,000	$39,000		$800,000
	Subtotal	**$500,000**			
	Filament Control Improvements	$1,588,000	$400[b]		$1,800,000
	Subtotal	**$1,600,000**	[c]	**-$75,600**	
	RAS/WAS Process Improvements				
	Upgraded Waste Activated Sludge	$142,000	$4,700		$208,000
	Upgraded Return Activated Sludge	$22,000	$4,700		$89,000
	Subtotal	**$164,000**	**$9,400**[d]	**-$13,600**	**$297,000**
	Total Activated Sludge Improvements	**$2,300,000**	**$85,800**	**-$89,200**	**$3,800,000**
2	Suction/Jetter (Vactor) Truck	**$400,000**	**$3,500**	**0**	**$430,000**[e]
3	Pretreatment Process Improvements				
	New Pump House	$329,000	$3,030		$395,000
	Influent Manhole Modifications	$47,000	$840		$59,000
	Grit Removal Cyclone	$89,000	$840		$101,000
	Bar Screens	$633,000	$1,680		$657,000
	Total Pretreatment Process Improvements	**$1,098,000**	**$6,390**	**+$6,390**	**$1,212,000**
4	Aerobic Digester Solids Handling				
	Mechanical Upgrades for Aerobic Digester	$528,000	$3,400		$576,000
	Upgraded Solids Handling System	$510,000	$2,100		$539,000
	Recoating of Aerobic Digester	$350,000	N/A		$350,000
	Total Aerobic Digestion Solids Handling	**$1,400,000**	**$5,500**[f]	**0**	**$1,465,000**
Total for All Recommended Improvements		***$5,198,000***		***-$82,810***	***$6,907,000***

[a] Present value of Capital and O&M costs over a 20-year period at 4 percent interest.
[b] Approximately the same as present O&M costs in labor. The energy cost for operating the blowers are considered in Phase 3.
[c] This represents an annual O&M cost savings of approximately $76,000 over the present O&M costs for the aeration system or a 5-year payback period for the capital costs.
[d] This is an annual O&M cost savings of approximately $14,000 from the current WAS/RAS pumping system or a 12-year payback period for the capital costs.
[e] A 10-year period was used for the Present Value of the Vactor truck.
[f] Same as present O&M costs for conveying waste sludge to the aerobic digester.

O&M = operations and maintenance

Inflow and Infiltration Evaluation

Rainfall-derived collection system inflow and infiltration (I/I) is not significant through most of the system's 46-mile length. The most significantly impacted areas are served by the Golf Course, Mission Street, and Mile 14 (North Road) lift stations. In these areas, the problem appears to come from surface inflow to the manholes. This problem may be addressed by installing inflow protectors under the manhole covers for some of the lowest-lying manholes. Inflow protectors are plastic disks that sit between the manhole cover and the frame. They can reduce the amount of surface inflow through the manhole cover.

Sewage Treatment Evaluation

Changes can be made to allow the WWTF operate with lower operation and maintenance costs and greater waste loading capacity without adding new tanks or expanding the existing footprint. This can be accomplished by process improvement in the following areas:

- Aeration system and return activated sludge/waste activated sludge process improvements
- Pretreatment process improvements
- Improvements for the control of floating sludge blanket problems
- Aerobic digester and solids handling system improvements

These improvements should provide sufficient wastewater loading capacity for the next 20 years. A more detailed outline of the proposed improvements is provided in Section 5 of this report.

Sewage Rate Study

CH2M HILL prepared a Wastewater Management Financial Plan in March 2003, which recommended an across-the-board sewage rate increase of 35 percent for fiscal year 2003/2004 followed by three annual increases of 4 percent over the next 3 years. A separate report was prepared for the City's drinking water system, which is not part of this Wastewater Facilities Master Plan (CH2M HILL, March 2003, City of Kenai Water Rate Study and Financial Plan). This separate report recommended a 30 percent increase in all water-rate classes with a subsequent increase of 4 percent over the next 3 years.

These rate increases were proposed in order to cover O&M expenses, increase the operating fund reserve balance, and fund the capital improvements recommended in this wastewater facilities master plan. A conservative assumption was made that grants would no longer be available for capital construction projects so that all capital construction would be funded through loans or municipal bond sales.

By Resolution No. 2003-16, the Kenai City Council opted to increase the water rates by 10 percent and the sewer rates by 12 percent, effective June 15, 2003. While these increases are less than ideal, they will be adequate, assuming grants become available for most of the proposed capital improvements.

Improvements to the City's Geographic Information System

Some improvements to the City's GIS are incidental to this study. GIS can be a valuable tool in planning for sewage systems and infrastructure in general. Currently, the City can access an inventory of 1,305 construction drawing sheets through the GIS system. This information can have practical day-to-day use in helping City staff quickly locate sewer main and other features in a particular area. GIS can also be an effective planning and management tool.

The problems have been that GIS access to the record drawings has been awkward and the quality of some of the scanned images (TIF files) is poor. CH2M HILL staff sorted through all 1,305 scanned construction drawings and identified them by file name, plan set name, sheet title, page number, engineer of record, and other pertinent variables. A summary spreadsheet in MS Excel was compiled with these data, and scanned images were reviewed for their image quality. This spreadsheet can serve as a basis for upgrading the file access process since the record drawings can now be identified by fields other than the file name. Thirty-two images of poor quality were rescanned from originals found in the City's plan room.

SECTION 1

Introduction

1.1 Authorization

The City of Kenai (City) retained CH2M HILL to develop this Wastewater Facility Master Plan. This effort was approved by City Council resolution No. 2001-40 on June 20, 2001. The work was accomplished under City purchase order number 43081.

1.2 Purpose

The main purpose of this Wastewater Facility Master Plan is to lay out a strategy for the continued reliable and economical operation of the City's wastewater collection system and Wastewater Treatment Facility (WWTF). This plan is intended to support the City's planning and funding efforts for this goal.

The objective of this wastewater facility plan is as follows:

- Evaluate the existing wastewater facilities
- Project future waste loads
- Evaluate wastewater collection, treatment, and disposal alternatives
- Provide cost analysis of alternatives
- Recommend an alternative based upon engineering, economic, and environmental considerations
- Develop and recommend implementation and funding alternatives

1.3 Planning Area

This study includes the City of Kenai and areas that have potential for future inclusion in the City's sewer service area. Figure 1-1 shows the project planning area.

This Wastewater Facility Plan was prepared in coordination with the City of Kenai's Comprehensive Plan (Kevin Waring and Associates, 2003). Similar population projections were used for both plans.

1.4 Scope

Based on the request for proposals provided by the City, the letter proposal from CH2M HILL dated July 31, 2001, and subsequent discussions and with the City of Kenai staff, a scope of work was developed to:

- Evaluate the excess infiltration (groundwater) and inflow (surface water) to the sewage collection system and identify those sources that are practical to eliminate.
- Evaluate the sewage collection system and its potential for expansion.
- Evaluate wastewater treatment capacity, determine specific alternatives for increasing the capacity to accommodate growth over the next 20 years, and make specific recommendations for modifying the facility to satisfy the anticipated need.
- Develop a financial implementation plan for the recommended improvements. This includes an evaluation of the current sewage rates and recommendations for adjusting the rate structure to support the existing and future costs.
- Improve the City's geographic information system (GIS) to a limited extent within the available budget for the plan.

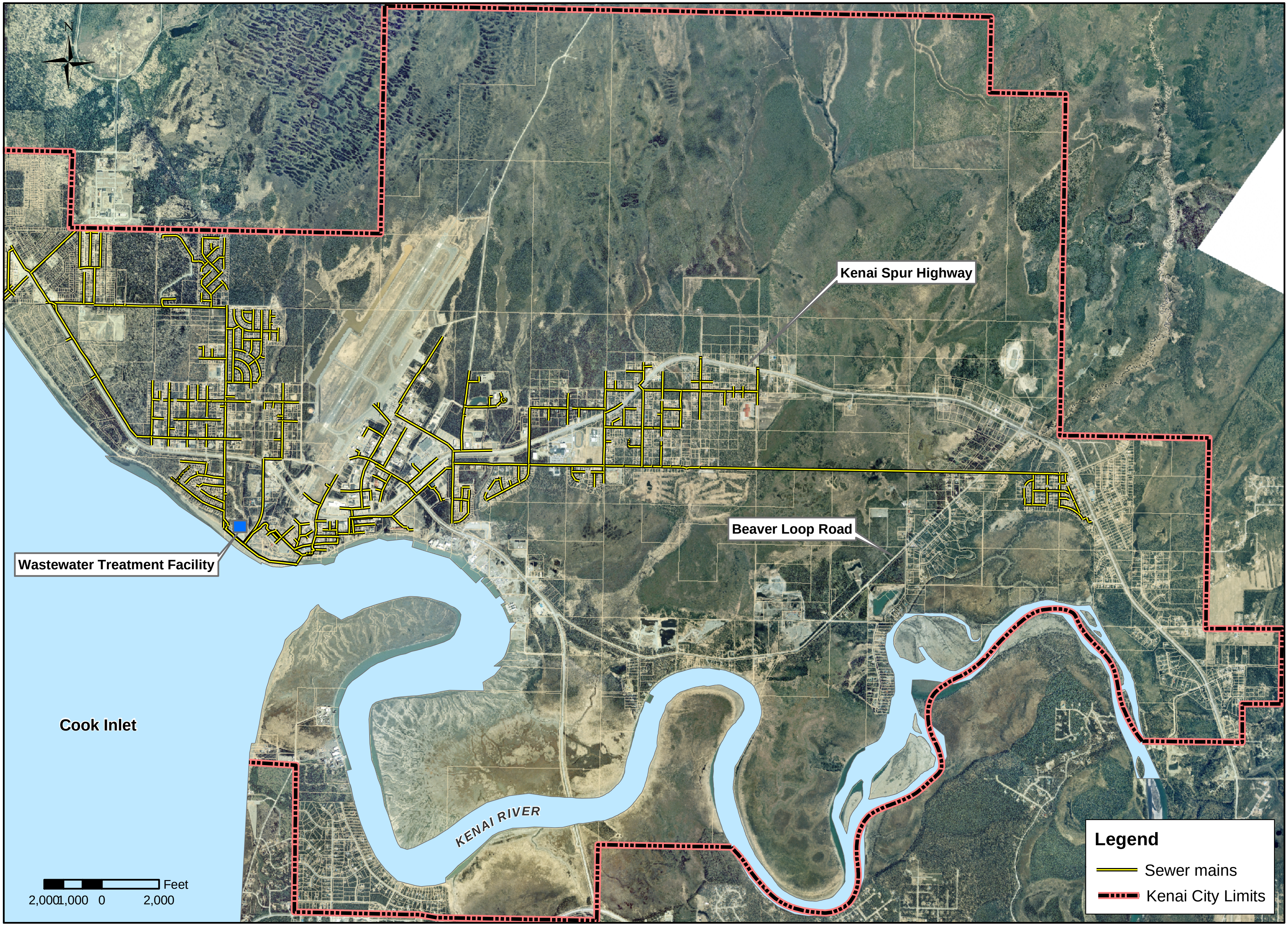

Figure 1-1
City of Kenai Planning Area

SECTION 2

Planning Environment

2.1 Location

Kenai is located on the western coast of the Kenai Peninsula where the Kenai River enters the eastern shore of Cook Inlet. It lies at approximately 60° 33' north latitude, 151° 16' west longitude (Sec. 05, T005N, R011W, Seward Meridian). Kenai lies on the western boundary of the Kenai National Wildlife Refuge on the Kenai Spur Highway. It is approximately 65 air miles south of Anchorage and 155 highway miles from Anchorage via the Sterling Highway. Kenai is located in the Kenai Recording District. The planning area encompasses 29.9 square miles of land and 5.6 square miles of water.

2.2 Historical Background

In 1741, when Russian fur traders first arrived, about 1,000 Kenaitze Dena'ina Indians lived in the village of Shk'ituk't, near the River. The Russian fur traders called the people "Kenaitze," which means "Kenai people." In 1791 the Russians settled the area and established a trading post, Fort St. Nicholas. The fortified trading post was a center for fur and fish trading. It was the second permanent Russian settlement in Alaska. In 1849, the Holy Assumption Russian Orthodox Church was established by Egumen Nicholai.

In 1869 the U.S. military established a post for the Indians in the area, called Fort Kenay. When the U.S. purchased Alaska in 1870, the military post was abandoned. In 1899, a post office was established.

Through the 1920s, commercial fishing was the primary activity. In 1940, homesteading enabled the area to develop. The first dirt road from Anchorage was constructed in 1951. In 1957, oil was discovered at Swanson River, 20 miles northeast of Kenai–the first major Alaska oil strike. The City was incorporated in 1960. In 1965, offshore oil discoveries in Cook Inlet fueled a period of rapid growth which peaked in 1970 and has since grown at a more moderate rate.

2.3 Organization

The City was incorporated in 1960 as a home rule city. It is located in the Kenai Peninsula Borough.

The City has a Council-Manager form of government. The City Council is made up of seven members who are elected from the residents at large. Two council members are elected each year and serve for three years. Regular elections are held on the first Tuesday in October. The Council meets on the first and third Wednesdays of each month.

A City Manager is appointed by the City Council to run the day-to-day affairs of the City. The City Manager also oversees the government departments (Figure 2-1).

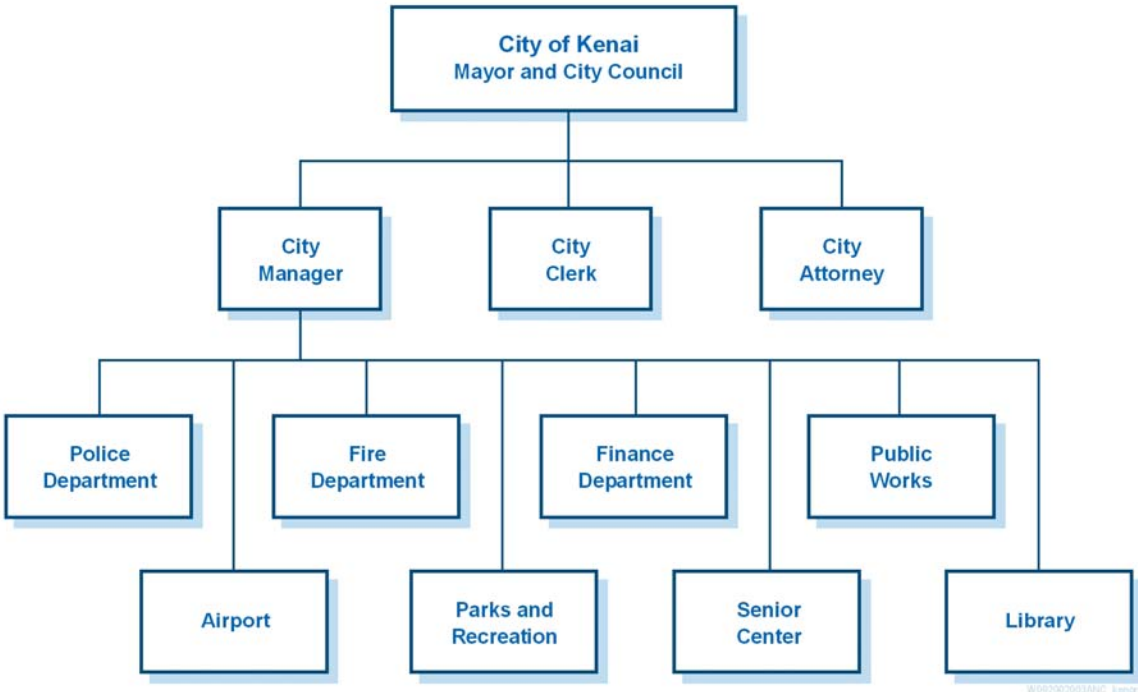

FIGURE 2-1
City of Kenai Government Structure

2.4 Land Use

A substantial portion of the land in the City is wetland. A map of the wetland areas and floodplains in the vicinity of the City is shown in Figure 2-2. To a large degree, wetlands and floodplains define what lands can be developed in Kenai. The upland areas, indicated by the white areas in Figure 2-2, are lands most suitable for future development.

2.5 The Economy

The City was the center of the oil and gas industry in Alaska during the 1970s and still provides services and supplies for Cook Inlet's oil drilling and exploration. Tesoro Alaska's oil refining operations, Agrium urea facility, and ConocoPhillips LNG facility are located in North Kenai. Tourism is estimated at $95 million per year on the Peninsula but does not play as strong a role in the City as in some other Peninsula communities.

Other important economic sectors include sport, subsistence and commercial fishing, fish processing, timber and lumber, agriculture, transportation services, construction and retail trade. A total of 226 area residents hold commercial fishing permits as of fall 2001. The largest area employers are the Borough School District, Agrium, Peak Oilfield Services, the Kenai Peninsula Borough, Central Peninsula Hospital, and Pacific Rim Institute of Safety Management.

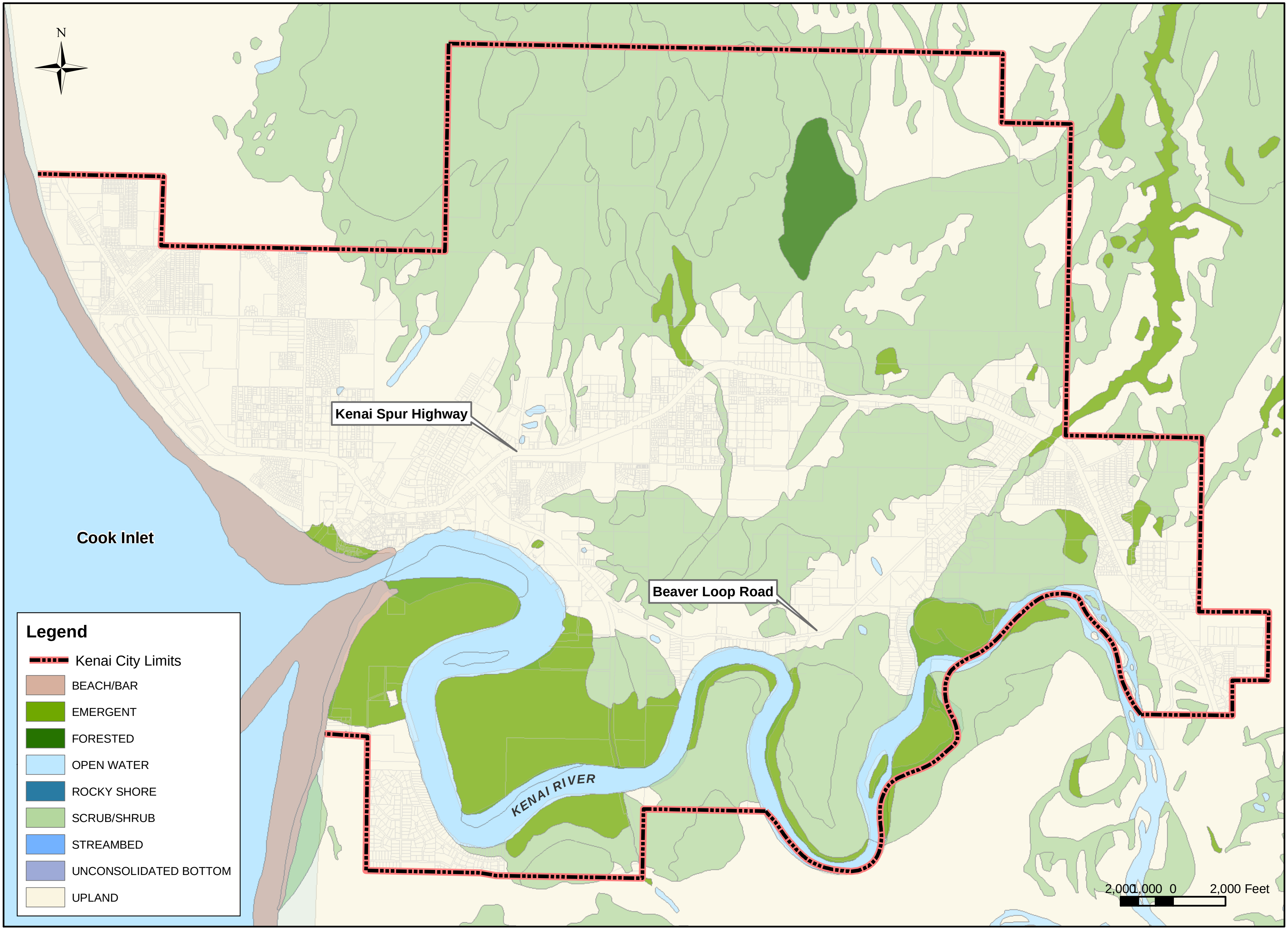

Figure 2-2
Wetland and Flood Plains

2.6 Communications

Table 2-1 shows the communication facilities in the area.

TABLE 2-1
Communications Services in the Kenai Area

Service Type	Provider
In-State Phone	ACS of the Northland
Long-Distance Phone	GCI; ACS Long Distance
Local Internet Service Providers	ACS Internet (www.acsalaska.net); Arctic.Net/TelAlaska, Inc. (www.arctic.net); Chugach.Net (www.chugach.net); Core Communications (www.corecom.net); Custom CPU (www.customcpu.com); Peninsula Internet (www.kenai.net)
TV Stations	KAKM; KIMO; KTBY; KTUU; KTVA; KYES
Radio Stations	KWHQ-FM; KPEN-FM; KWVV-FM; KDLL-FM; KZXX-AM
Cable Provider	GCI Cable, Inc.
Teleconferencing	Alaska Teleconferencing Network; Kenai Peninsula Legislative Information Office

2.7 Demographics

Table 2-2 shows the current population and demographics of the study area, as documented in the 2000 U.S. Census. Figure 2-3 shows population history.

TABLE 2-2
City of Kenai Population in 2000

Racial Category	Number
White	5,745
Alaska Native or American Indian	607
Black	34
Asian	115
Hawaiian Native	16
Other Race	78
Two or More Races	347
TOTAL	6,942

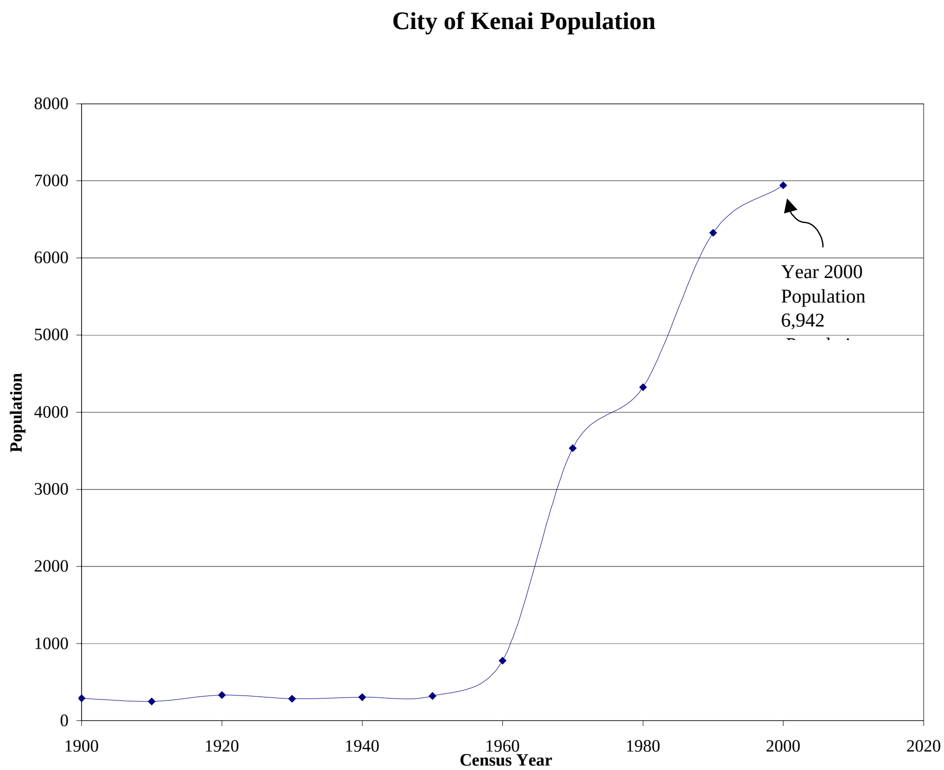

FIGURE 2-3
City of Kenai Population History

Given the maturity of the oil and gas industry in the Kenai area, and uncertainty about tourism in the near future, the population is expected to have a moderate growth rate similar to other medium-sized Alaskan communities.

2.8 Utilities, Services, and Housing

Natural gas from ENSTAR is primarily for household consumption. Homer Electric Association operates the Bradley Lake Hydroelectric Project and is part owner of the Alaska Electric Generation & Transmission Cooperative, which operates a gas turbine facility in Soldotna. The Homer Electric Association also purchases electricity from Chugach Electric. Table 2-3 shows housing information for Kenai.

TABLE 2-3
Housing Data for Kenai

Total Housing Units	3,003
Occupied Housing (Households)	2,622
Vacant Housing	381
Vacant Due to Seasonal Use	58
Owner Occupied Housing	1,583
Renter Occupied Housing	1,039
Total Households	2,622
Average Household Size	2.64
Family Households	1,787
Average Family Household Size	3.20
Non-Family Households	1,787
Population Living in Households	6,918
Population Living in Group Quarters	24

Source: U.S. 2000 Census

Table 2-4 shows the breakdown of energy sources for home heating. Table 2-5 provides electric utility information.

TABLE 2-4
Breakdown of Energy Sources for Home Heating

Electricity	4.5%
Fuel Oil, Kerosene	0.3%
Wood	0.2%
Piped Gas (utility)	94.9%
Bottled, Tank, LP Gas	0.1%

Source: U.S. 2000 Census

TABLE 2-5
Electric Utility Information

Electric Utility Name	Homer Electric Association
Utility Operator	REA Co-op
Power Source	Hydro & Natural Gas
Rate/Kilowatt Hour	11.5 cents per kilowatt-hour
Power Cost Equalization Subsidy	No

2.9 General Description of Sanitation Facilities

2.9.1 Public Water Supply

City water is supplied by three artesian wells and is treated and piped to approximately 75 percent of the City's households. A fourth production well is in the planning stages as of July 2003. Sewage is piped and receives secondary treatment before discharge to Cook Inlet. The remaining households use individual water wells and septic systems. Figure 2-4 shows the main features of the City's water and sewer systems.

On average, the City's wastewater flow is approximately 68 percent of the water produced from the City's three wells. This value is within the 60 to 80 percent typical range that is cited in the textbook *Wastewater Engineering: Treatment and Reuse*, 2nd ed. (Metcalf & Eddy, Inc., 1979). Table 2-6 presents the monthly water use and wastewater flow for 2001.

TABLE 2-6
City of Kenai Monthly Water Use and Wastewater Flows, 2001

Month	Avg. Daily WTP Flow (MG)	Daily Avg. Water Use (MG)	Ratio (percent)
Jan	0.645	0.862	75
Feb	0.625	0.813	77
Mar	0.726	0.872	83
Apr	0.717	0.919	78
May	0.642	1.158	55
June	0.658	1.540	43
July	0.718	1.215	59
Aug	0.715	1.139	63
Sept	0.683	0.966	71
Oct	0.616	0.908	68
Nov	0.681	0.903	75
Dec	0.645	0.980	66
AVERAGE			68

2.9.2 Individual Septic Systems

Individual septic systems are used by approximately 1,400 dwellings within the City limits. This value is calculated as the total number of dwellings within the city limits (3,003 per 2000 census) minus the total number of residential services. As additional homes are constructed, City ordinances require that a home within 200 feet of the public water and sewer system must connect to the system.

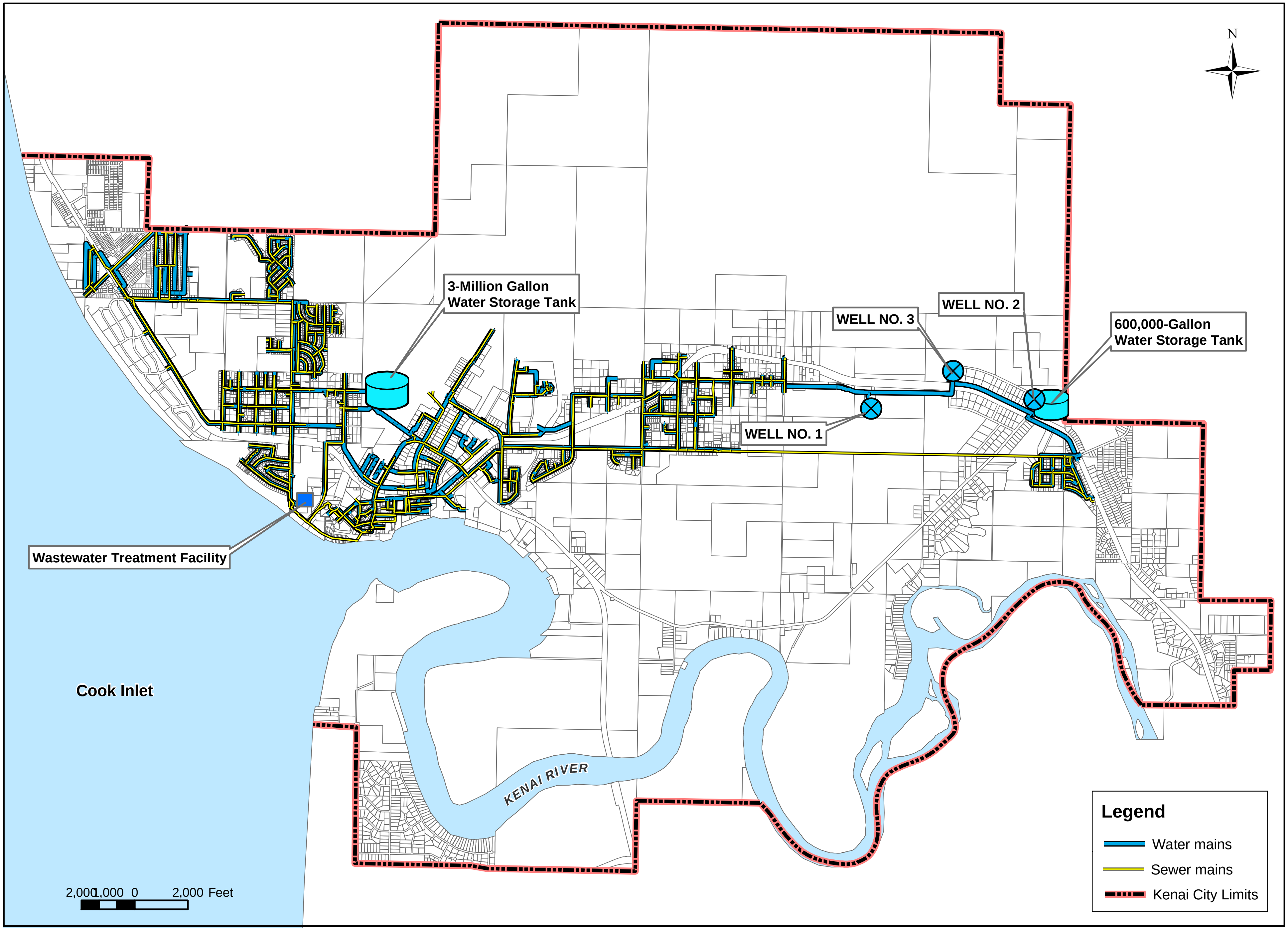

Figure 2-4
City of Kenai: Main Water and Sewer System Features

The area along Kalifornsky Beach Road, south across the Kenai river, has no community sewer service and is likely to continue with individual septic systems. Lot sizes in this area are intended to accommodate individual well and septic systems.

Similarly, the area along Beaver Loop Road is not served by community sewer. The lots in this area are of sufficient size to accommodate individual wells and septic systems.

2.9.3 Sewage Collection System

The City's sewage collection system consists of approximately 46 miles of sewage main and 16 duplex sewage lift stations. Flow to the WWTF treatment facility is from 16 lift station collection zones and one area of gravity flow. As of May 2001, 1,691 services were provided to a variety of commercial and residential customers.

The City experiences sewage overflows rarely, if ever. Other than occasional sewer main blockages, the public is not inconvenienced by the sewage collection system.

2.9.4 Existing Wastewater Treatment Facility

An annotated aerial photo of the WWTF (Figure 2-5) provides a view of the main treatment process. The existing WWTF was constructed in 1982, based on a design by CH2M HILL. The headworks and sludge processing systems are located inside the main building. The City dewatered sludge is hauled to the landfill.

2.9.5 Solid Waste Facilities

The nearest permitted landfill is operated by the Kenai Peninsula Borough and is located in Soldotna. Construction to expand this landfill is underway as of July 2003.

Five privately owned facilities for septage disposal are located within the Kenai Peninsula. Four are operated by the same owner.

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Figure 2-5

Waste Water Treatment Facility

Kenai, Alaska

SECTION 3

Sewage Planning

3.1 Population Growth and Design Capacity

In the midst of a period of booming economic growth, the City's 1978 wastewater facility plan projected a population of 13,500 people for the City by the year 1990 and a population of 19,000 by the year 2000. The actual population growth was much less. Census populations were 6,327 and 6,942 for the years 1990 and 2000, respectively (47 and 37 percent of the predicted growth, respectively), which represents a 1 percent growth rate.

When the City's WWTF was constructed in 1982, it was sized to accommodate a population of 11,650 people and an average wastewater flow of 1.3 million gallons per day (mgd). Although modifications have since been made to the treatment plant's disinfection system, the nominal design average capacity remains at 1.3 mgd.

The WWTF's design allowed areas for the future addition of new aeration basins and a new clarifier when and if the additional capacity is needed. So far, these additional treatment facilities have not been required.

Stabilized or declining trends in the energy, fishing, and tourism industries suggest that the modest growth experienced in the 1990s may continue into the foreseeable future. Population projections to the year 2020 are approached in two ways as shown in Figure 3-1. A linear projection of the 1990 and 2000 census data yields a population 7,557 in the year 2020. Alternatively, a 1.5 percent average annual growth rate, as assumed in the City of Kenai Comprehensive Plan (February 2003), yields a population of 9,350 in the year 2020. The 1.5 percent growth rate is adopted for the purposes of this wastewater facility plan.

For comparison, actual population data and projected population data are provided in Figure 3-1 for the years 1950 through 2020. The projected population from the 1978 wastewater facility plan is shown along with design population for the existing WWTF to illustrate the intended capacity of the WWTF.

3.2 Waste Loads

3.2.1 Existing Data

The WWTF influent wastewater flows and waste load have remained relatively constant over the past 8 years with a slight increase between 1998 and 2000. Typical year 2001 average wastewater flows are approximately 0.7 mgd. This can be compared to the design average capacity of 1.3 mgd. Average influent wastewater flows and waste load information for the City's WWTF are shown in Figure 3-2 for years 1993 to 2000.

Current average waste loading to the WWTF is approximately 1,500 pounds per day for both biochemical oxygen demand (BOD) and total suspended solids (TSS). This can be compared to the average design capacity of 2,097 pounds per day BOD and 1,980 pounds per day TSS.

The average monthly influent flow rate for 1993 to 2000 is 0.683 mgd (Table 3-1).

TABLE 3-1
City of Kenai WWTF Average Monthly Influent Wastewater Flow Data, 1993 to 2001

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
0.632	0.640	0.662	0.697	0.678	0.702	0.755	0.742	0.714	0.664	0.663	0.647	0.683

All results in million gallons per day

While the average monthly flow rates are relatively consistent, diurnal flows vary greatly. For example, flows at night can be as low as 0.2 mgd. The WWTF experiences its greatest hydraulic loading (up to 1.9 mgd) when the aerobic digester is decanted. This flow is high but less than the WWTF peak design flow rate of 3.5 mgd, and it lasts for only a short period. The peak instantaneous flow rate of 3.5 mgd is from the 1980 Design Drawings and assumes one unit from each process out of service. In the future, after some or all of the proposed improvements are made to the facility and as peak instantaneous flow rates approach the design limit, development of a hydraulic model of the WWTF is recommended.

Table 3-2 shows the average annual flows and loadings for 1993 to 2000.

TABLE 3-2
City of Kenai WWTF Average Annual Loadings and Flows

Parameter	1993	1994	1995	1996	1997	1998	1999	2000	Avg Load (lb/day)	Avg Conc (mg/L)	Avg Conc Year 2000 (mg/L)
Average BOD (lb/day)	1,178	1,211	1,202	1,206	1,030	888	1,172	1,367	1,157	203	240
Average TSS (lb/day)	1,135	1,150	1,085	1,155	1,038	989	1,190	1,268	1,126	197	222
Average Flow (mgd)	0.685	0.665	0.695	0.681	0.670	0.633[a]	0.730	0.715	0.684		

[a] Possible flowmeter problems caused lower-than-actual reading.

Notes:

BOD = biochemical oxygen demand
lb/day = pounds per day
mgd = million gallons per day
mg/L = milligrams per liter
TSS = total suspended solids

3.2.2 Projected Waste Loadings

In 2000 there were 6,942 persons living in the City. The population is estimated to reach 9,350 persons by the year 2020 if the population grows at a rate of 1.5 percent per year. Table 3-3 summarizes the projected future waste loading to the Kenai WWTF based upon year 2000 data and the projected year 2020 population of 9,350 persons. These waste load

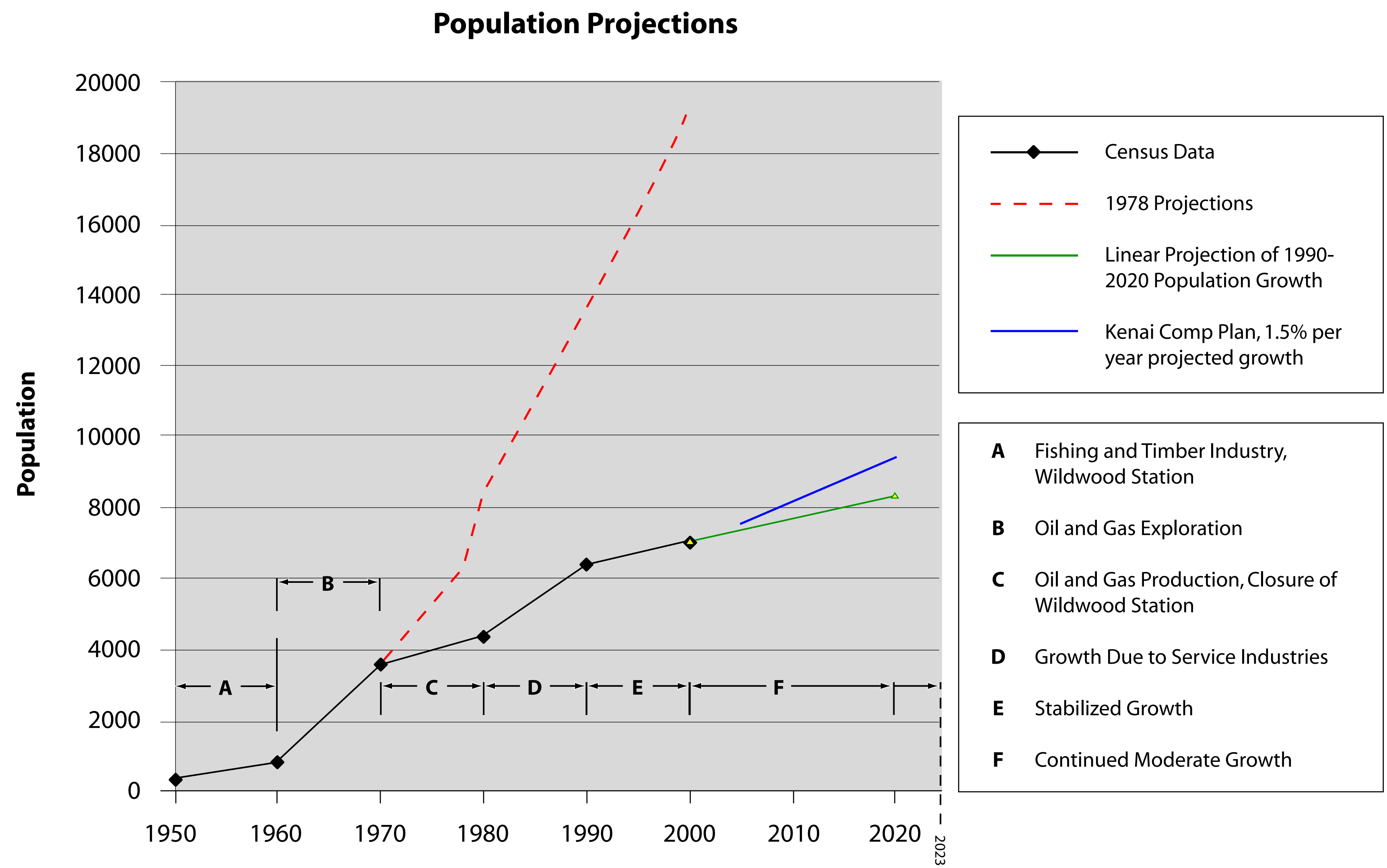

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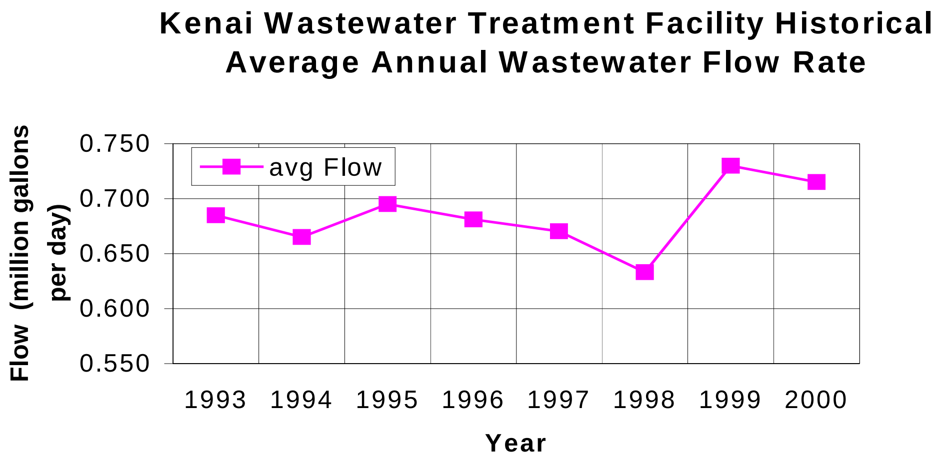
Figure 3-1
Projected Population Growth
City of Kenai



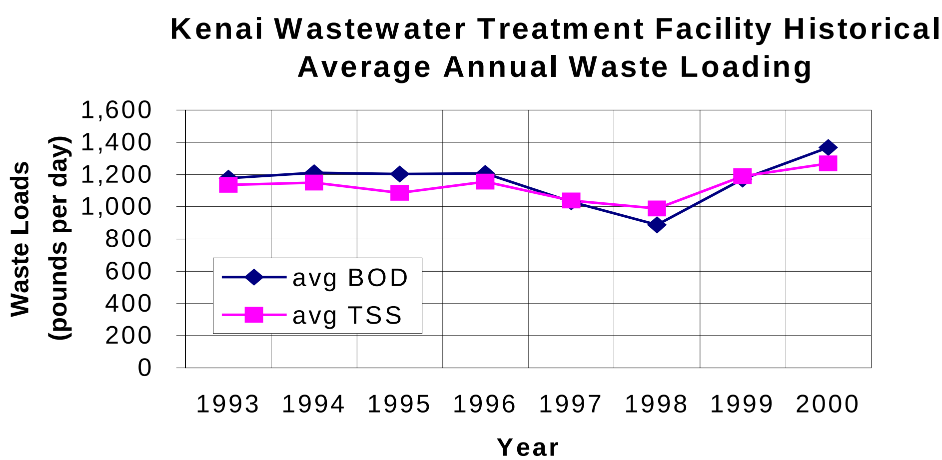


FIGURE 3-2
City of Kenai WWTF Historical Average Wastewater Flow Rate and Historical Average Waste Loading

TABLE 3-3
City of Kenai WWTF Present and Future Waste Loads

Parameter	Average Annual Design	Average 2000	Average 2020	Peak Week 2020	Peak Month 2020
Biochemical Oxygen Demand (lb/day)	2,097	1,367	1,841	2,577	2,301
Total Suspended Solids (lb/day)	1,980	1,268	1,708	2,391	1,135
Flow (million gallons per day)	1.3	0.715	0.96	1.34	1.20

Note: All 2020 values based on 1.5 percent annual growth rate

lb/day = pounds per day

projections assume that the proportions of people with and without City sewer service remain the same.

The 2000 average wastewater influent flow rate was 0.72 mgd. Based on the present per capita contribution and a 1.5 percent annual growth rate, the average wastewater influent flow rate will be 0.97 mgd in 2020. The 1982 Operation and Maintenance (O&M) manual gives an average wastewater influent flow design rate of 1.3 mgd. This value is used to determine waste load process capacity. The peak week value is calculated based on a factor of 1.4 times the average; the peak month is calculated based on a factor of 1.25 times the average. The BOD and TSS waste loads in 2020 are projected to remain less than the design capacity of 2,097 and 1,980 pounds per day, respectively.

Assuming that recommended improvements are made to the WWTF so that it operates within typical operating parameters, the data in Table 3-3 indicate that the facility should be able to accommodate average and peak loading conditions in the year 2020 with a projected rate of population growth of 1.5 percent per year. The facility improvement recommendations are presented in Section 5 of this report.

3.3 Inflow and Infiltration

Inflow and Infiltration (I/I) is surface water (inflow) and/or groundwater (infiltration) that enters the wastewater collection system. The City has separate stormwater and sewage collection systems so that stormwater is not conveyed directly to the WWTF; however, I/I is a component of the wastewater flow for any conventional wastewater collection systems.

An I/I evaluation is a component of most wastewater planning efforts because the identification and elimination of excess I/I can reduce flows through the system, reduce treatment and pumping costs, increase hydraulic capacity, and extend the design life of the treatment and conveyance facilities. An I/I evaluation was performed as part of this study and is described in Section 4 of this report.

The general approach to addressing the inflow and infiltration (I/I) issue is described in a technical memorandum in Appendix A. Historical monthly data collected from January 1999 and August 2001 suggests a correlation between months of higher precipitation and higher wastewater treatment facility flows (Appendix B).

In an effort to better monitor precipitation and I/I, the City's System Control and Data Acquisition (SCADA) system was modified to collect pump run time from 16 lift stations at 5 minute intervals. This is an economical method of collecting field data for evaluating I/I in a collection system. Data collection continued from November 2001 through summer 2002 and provided the opportunity to compare dry weather, spring breakup, and wet weather conditions.

The limitations to this approach are that the portion of the collection system that relies solely on gravity flow can not be measured, estimates of pump discharge can change if pump performance changes, and estimates can be hampered by loss of telemetry between the lift stations and the central computer.

Precipitation data are available on an hourly basis from the FAA monitoring site at the Kenai airport. Precipitation is rain, snow, sleet, or hail depending on temperature and other factors. A monthly climate summary of observations at this site is shown in Table 3-4. Winter can be generally regarded as a dry season for a collection system since precipitation tends to stay on the ground as snow or ice until it melts in the spring. In spring, meltwater can be a substantial source of inflow to the collection system.

TABLE 3-4
Monthly Climate Summary Based on Kenai Airport Observations, 9/3/1949 to 12/31/2000

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	20.4	26.1	32.6	42.3	52.5	58.3	61.7	61.5	55.0	41.7	29.2	22.1	41.9
Average Min. Temperature (F)	3.3	7.0	12.8	26.0	35.3	42.7	47.3	45.8	38.8	27.2	13.9	6.4	25.5
Average Total Precipitation (in.)	1.05	1.00	0.91	0.74	0.95	1.19	1.94	2.68	3.30	2.44	1.57	1.43	19.21
Average Total Snowfall (in.)	9.5	10.4	8.6	3.5	0.3	0.0	0.0	0.0	0.1	4.8	10.3	13.8	61.3
Average Snow Depth (in.)	12	13	12	4	0	0	0	0	0	1	3	8	7.125[a]

[a] For months with snow present (October through April)

SECTION 4

Sewage Collection System Evaluation

4.1 Summary of Sewage Collection System Evaluation

4.1.1 Sewer Main

A significant extent of the sewer main is asbestos-cement (AC) pipe, which is more breakable than the ductile iron or other sewer pipe material in the system. A tracking system is recommended to log sewer service calls as they occur so that trends in pipe breakage and other problems can be evaluated. This can help with developing a prioritized system for replacing or repairing the problems.

4.1.2 Lift Stations

The Lawton Drive and Broad Street lift stations have the largest service areas compared to other lift stations and will likely require increased pumping capacity as their service areas grow. However, the pumping capacity can be increased without replacing the entire wet well by adjusting the pump level settings, increasing the pump size, and relining the interior if wet well deterioration becomes a factor in daily operation.

4.1.3 Inflow and Infiltration

Rainfall-derived I/I is significant in the collection basins draining to the Golf Course, Mission Street, and Mile 14 (North Road) lift stations. As a first step in addressing this problem, inflow protectors are recommended for manholes in these basins, particularly those in low-lying areas. Inflow protectors are plastic disks that fit between a manhole cover and the manhole frame. They act to prevent water from draining through the holes in the cover and cracks between the cover and frame. (Inflow protectors are manufactured by F.R.W. of Midland, Texas, and distributed by Hughes Supply of Anchorage. As of October 2002, the price was $45.76 each for a standard 23-inch diameter manhole.)

4.1.4 Operation and Maintenance

A vacuum/jetter truck is a necessary piece of equipment for routine cleaning and repairs. The City plans to purchase a new and larger model to supplement the existing model that is becoming unreliable due to age.

Fats, oils, and grease have been a problem in the wastewater treatment facility and in portions of the collection system. Many utilities have established fats, oil, and grease programs to control this problem. A sample ordinance is included in Appendix F.

4.2 Existing Sewage Services

The City currently uses 13 different billing classifications for water and sewer service. These classes are assigned based on the size of the water service line and whether it is a commercial or residential service. A list of the current service classifications is provided in Table 4-1. Table 4-2 indicates the number of service types within each sewage collection basin. As of May 2001, a total of 1,691 services are provided to a variety of commercial and residential customers.

TABLE 4-1
City of Kenai Water and Sewer Classes

Class	Description
01	Residence–single-family and duplex
02	3- to 4-plex or more–multi-unit apartments
03	Commercial flat rate
04	Residential water and sewer metered with 1" line
05	Commercial water and sewer metered with 1" line
06	Residential water and sewer metered with 1.5" line
07	Commercial water and sewer metered with 1.5" line
08	Residential water and sewer metered with 2" line
09	Commercial water and sewer metered with 2" line
10	Residential water and sewer metered with 3" line
11	Commercial water and sewer metered with 3" line
12	Residential water and sewer metered with 4" line
13	Commercial water and sewer metered with 4" line

Wildwood prison is one significant load to the City's sewer system. The daily average flow for the period January through August 2001 was approximately 52,000 gallons per day (gpd). This alone represents approximately 7.5 percent of the average daily flow to the wastewater facility. There is no pretreatment of the prison's wastewater although it is common practice for many prisons to do so if they are to discharge to a community wastewater collection system.

City staff reported that they had installed a temporary screen of reinforcing bar in the first downstream manhole from the prison to aid in collecting debris but that this screen was too difficult to maintain because debris from the prison accumulated at such a rate that the screen required cleaning more than once per week. This screen has since been removed.

4.3 Sewer Pipe

Characteristics of the sewer mains are described in Table 4-3 for each collection basin and for the collection system as a whole (Figure 4-1). This information was obtained through the KenaiView geographic information system. Although data concerning the material type is

TABLE 4-2
Customer Types and Distribution

Collection Zone #	Lift Station	Contributing Lift Stations	Residential (1" Water)	Residential Service Classes						Commercial Service Classes					
				02	04	06	08	10	12	03	05	07	09	11	13
1	Beaver Loop	0	68							2	1	1			
2	Aleene Street	1	1												
3	Golf Course	1,2	3							1					
4	East Aliak	0	82	4						2	1	1	1		
5	Lawton Drive	1,2,3,4	295	19	1					1	5	0	3	1	
6	Walker Lane	0	83												
7	Granite Point	0								3					
8	Marathon Road	0											1	1	
9	Control Tower	0											1		
10	Broad Street	1,2,3,4,5,6,7,8,9	18	17		1	1			58	29	8	17	7	
11	Main Street	0	6	1		4			1	12	5	3	1	1	
12	Mission Street	0	13	3			1	1		11	3		1		
13	Mile 14 North Rd	0	29	10						9		1			1
14	Mile 13 North Rd	13													
15	Redoubt Street	0	52	13	1		1			1					
16	Inlet Woods	0	28												
17	Gravity Flow Collection Zone	13, 14, 15, 16	697	17	2		2	1		5	8	5	3		
TOTALS			1,375	84	4	5	5	2	1	105	52	19	28	10	1

TABLE 4-3
City of Kenai Collection Basin Characteristics

Basin No.	Collection Zone	Total Sewer Main (miles)	Pipe (Inch x Mile)	Pipe Segments[a]	Pipe Age						Pipe Material		
					Unknown	<1960	1960s	1970s	1980s	1990+	Unknown	DI	AC
1	Beaver Creek	1.99	15.95	53	0%	0%	0%	0%	0%	100%	0%	100%	0%
2	Aleene Street	0.00	17.14	1	0%					100%	100%	0%	0%
3	Golf Course	2.30	18.37	6	17%	0%	0%	0%	83%	0%	17%	83%	0%
4	East Aliak	1.83	17.09	41	17%	0%	0%	44%	39%	0%	15%	39%	46%
5	Lawton Drive	7.24	71.35	161	8%	0%	11%	25%	55%	0%	4%	60%	35%
6	Walker Lane	0.72	6.05	16	0%	0%	56%	0%	44%	0%	0%	44%	56%
7	Granite Point	0.15	1.20	3	100%	0%	0%	0%	0%	0%	100%	0%	0%
8	Marathon Road	0.76	6.54	35	91%	0%	0%	0%	9%	0%	51%	49%	0%
9	Control Tower	0.23	1.85	6	0%	0%	0%	0%	100%	0%	0%	100%	0%
10	Broad Street	5.93	61.36	121	16%	0%	39%	18%	27%	0%	13%	25%	62%
11	Main Street	1.09	9.24	26	31%	4%	42%	0%	23%	0%	31%	23%	46%
12	Mission Street	1.54	15.47	34	26%	0%	56%	0%	18%	0%	26%	18%	56%
13	Mile 14 North Road	1.66	17.44	32	31%	0%	0%	53%	16%	0%	13%	22%	66%
14	Mile 13 North Road	0.77	11.05	13	15%	0%	0%	0%	85%	0%	15%	85%	0%
15	Redoubt Street	2.51	15.59	32	38%	0%	16%	38%	9%	0%	31%	13%	56%
16	Inlet Woods	1.79	8.64	26	12%	4%	0%	0%	85%	0%	15%	85%	0%
17	Gravity Collection Zone	15.18	136.89	303	7%	8%	42%	10%	33%	0%	15%	35%	50%
18	Bridge Access Road	Pending											
	Totals	45.7	454.8	956	15%	3%	26%	16%	35%	6%	14%	44%	42%

[a] Totals include 48 pipe segments that were not assigned to a particular basin.

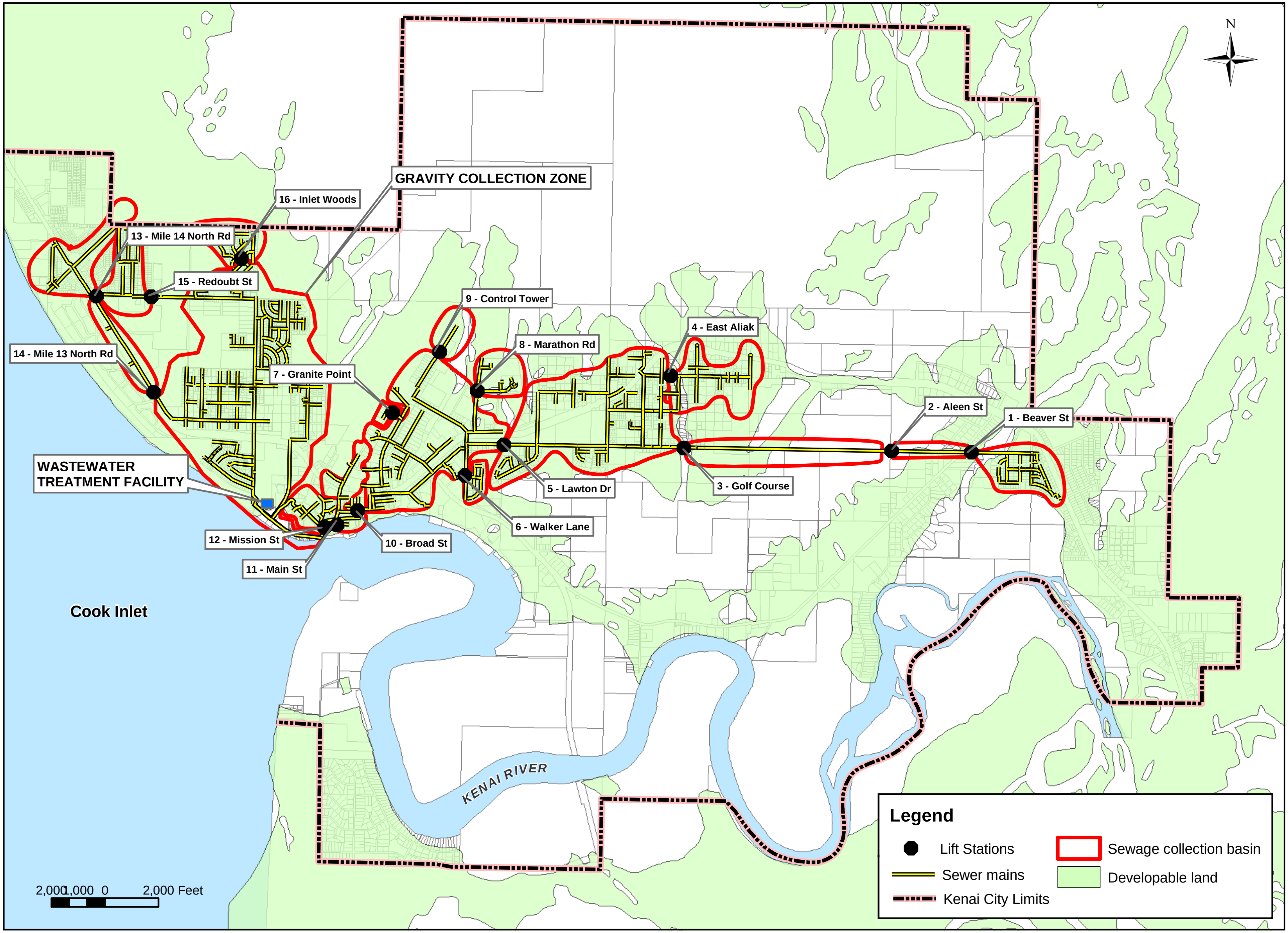


Figure 4-1
Sewage Collection System and Developable Land

missing for 14 to 15 percent of the sewer pipe sections, some useful information can be obtained.

A total of 45.7 miles of sewer main is listed in the KenaiView data.

Nearly 57 percent of the sewer main construction was completed in the 1970s. Approximately 42 percent of the sewer main is AC, or Transite, pipe. The earliest record of AC pipe includes sections installed in 1954 along Wildwood Station Road in basin 13. The latest record of installed AC sewer pipe is along Fifth Avenue in 1981.

City operators report that the AC pipe is particularly prone to breaking. Although this is certainly the case, this fact alone may be insufficient to justify the cost of replacing or relining approximately 20 miles of AC pipe.

More specific data may be worth obtaining to identify the modes of failure and the most critical AC pipe sections needing remedial action. Some of the questions worth pursing include:

- How does the crew become aware of the pipe breaks?
- What are the consequences of the sewer main breaks?
- What is the nature of the breaks–is the pipe crushed, sheared, or offset?
- What is the soil type and depth of boring?

A work order system could be helpful in tracking the number and nature of the problems that occur and could be a useful tool for evaluating O&M problems that should be addressed through capital expenditure. If this tracking system were integrated with the City's GIS system, the GIS system could produce maps showing locations of problems within the system.

4.4 Basin Flows

As of November 2002, the City operated 16 sewage lift stations. A schematic diagram of the sewage lift stations, their collection basins, and the WWTF is shown in Figure 4-2. Table 4-4 shows the flows, pumping costs, and I/I category for each basin.

The largest collection zone is the gravity flow area on the west side of the City. The next largest basin, in terms of its length of sewer main, is the Lawton Drive zone. The Aleene Street lift station (lift station 2) has no collection basin of its own but serves as an intermediate pumping station to convey sewage from the Beaver Creek collection zone. Similarly, lift station 14 conveys sewage primarily from lift station 13 with little collection area of its own.

The cost of conveying the sewage is related to distance from the WWTF and terrain. The least expensive energy costs for sewage conveyance are associated with the gravity collection zone. The most expensive energy costs are associated with the Beaver Loop collection basin where each gallon of sewage must pass through five sewage lift station to reach the WWTF.

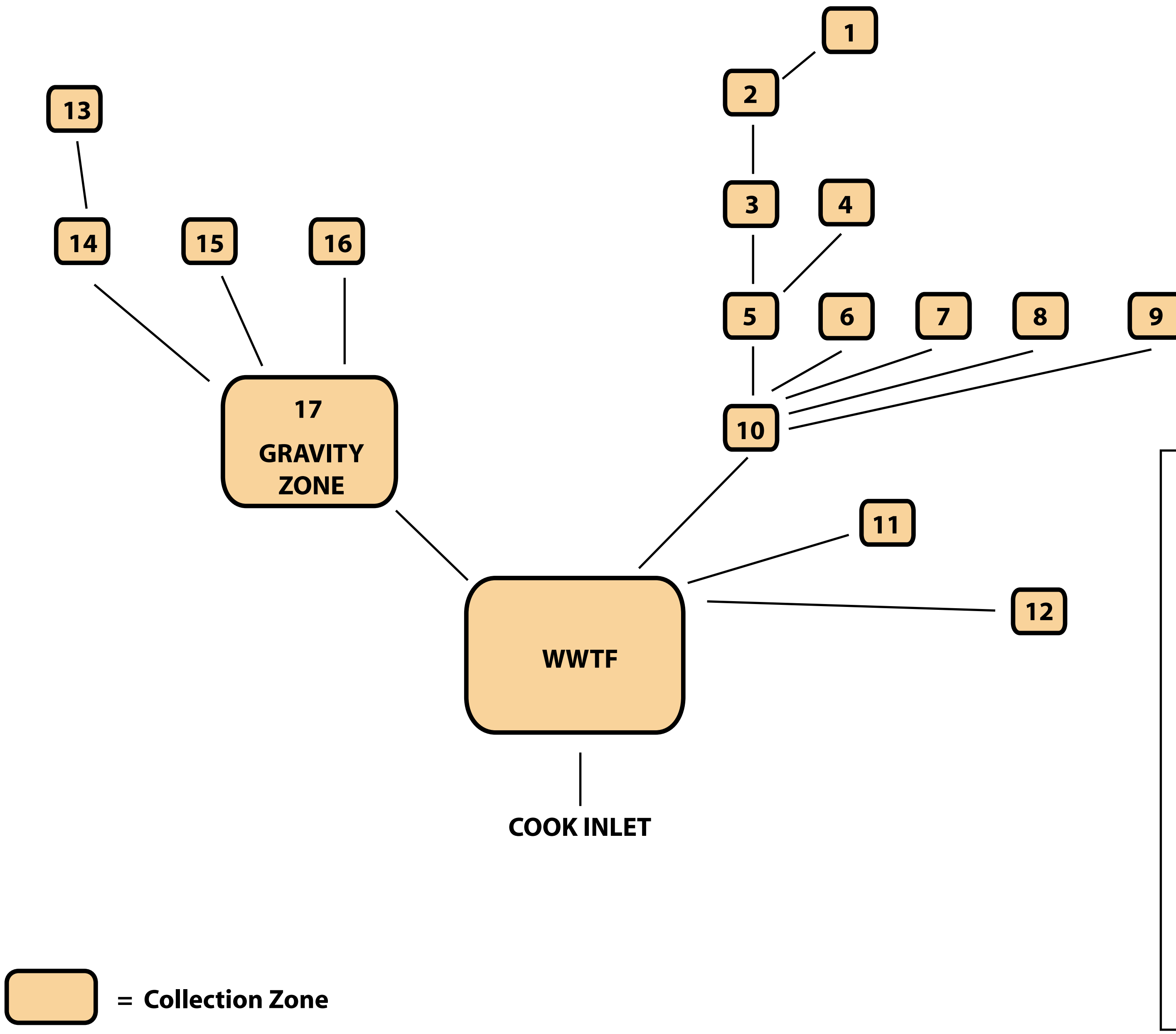
The total annual flow currently conveyed to the WWTF is approximately 261 million gallons based on the year 2000 annual average flow of 0.715 mgd. The proportion of base sanitary

TABLE 4-4
City of Kenai Current Basin Flows, Pumping Costs, and I/I Category

Basin No.	Collection Zone	Total Sewer Main (miles)	Pipe (inch x mile)	Downstream Lift Stations	Approximate Proportion of Total Flow	Estimated Average Annual Flow (million gallons)	Pumping Costs per Million Gallons	Estimated Average Annual Pumping Costs	Basin I/I Category[a]
1	Beaver Creek	1.99	15.95	1,2,3,5,10	3%	8.0	$174	$1,401	2
2	Aleene Street	0.00	17.14	2,3,5,10	0%	0.0	$139	$0	4
3	Golf Course	2.30	18.37	3,5,10	4%	9.9	$62	$617	1
4	East Aliak	1.83	17.09	4,5,10	6%	15.2	$55	$831	2
5	Lawton Drive	7.24	71.35	5,10	15%	38.9	$40	$1,566	2
6	Walker Lane	0.72	6.05	6,10	1%	2.5	$74	$185	6
7	Granite Point	0.15	1.20	7,10	0%	0.2	$38	$6	3
8	Marathon Road	0.76	6.54	8,10	0%	0.2	$44	$9	3
9	Control Tower	0.23	1.85	9,10	1%	2.7	$52	$140	3
10	Broad Street	5.93	61.36	10	22%	57.4	$22	$1,252	2
11	Main Street	1.09	9.24	11	2%	5.2	$22	$117	2
12	Mission Street	1.54	15.47	12	4%	9.4	$16	$151	1
13	Mile 14 North Road	1.66	17.44	13,14	10%	25.6	$77	$1,984	1
14	Mile 13 North Road	0.77	11.05	14	0%	0.0	$52	$0	5
15	Redoubt Street	2.51	15.59	15	7%	17.3	$18	$303	2
16	Inlet Woods	1.79	8.64	16	1%	1.4	$35	$49	2
17	Gravity Collection Zone	15.18	136.89	None	26%	67.0	$0	$0	5
	Total	45.7	454.8		100%	261		$8,612	

[a] Table 4-6 contains descriptions of I/I categories.

I/I = inflow and infiltration



Lift Station ID	Collection Zone
1	Beaver Creek
2	Aleene St.
3	Golf Course
4	East Aliak
5	Lawton Dr.
6	Walker Ln.
7	Granite Point
8	Marathon Rd.
9	Control Tower
10	Broad St.
11	Main St.
12	Mission St.
13	Mile 14 North Rd.
14	Mile 13 North Rd.
15	Redoubt St.
16	Inlet Woods
17	Gravity Collection

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Figure 4-2
Schematic Diagram
City of Kenai Wastewater Collection System

flow originating from each basin was estimated by comparing the total flow estimated through the lift stations with the total flow measured through the WWTP over the period from November 2001 through August 2002.

The gravity flow zone (basin number 17) on the west side of Kenai provides the single largest contribution to the WWTF at approximately 26 percent of the total annual flow. This contribution does not include flows from collection zones 13, 14, and 15 that are pumped to the gravity flow zone. The single largest collection basin that requires pumping is the Broad Street basin (basin 10) that contributes approximately 22 percent of the total WWTF flow. The Broad Street lift station must also pump sewage flow originating from basins 1 through 9 that make up almost all of the east side of Kenai's collection system. The second largest basin size is Lawton Drive basin (basin number 5), which accounts for nearly 15 percent of the total annual flow and itself discharges to the Broad Street basin.

The last column in Table 4-2 provides the I/I category for each basin. The significance of the I/I category is discussed in the following section.

4.5 Inflow and Infiltration

4.5.1 Background and Methodology

An I/I evaluation of Kenai's wastewater collection system can be found in Appendix G of this report. The findings of this evaluation are summarized here.

Kenai's sewage collection system is separated from the stormwater drains so that there are relatively few situations in which stormwater is piped directly to the sewer system. Sanitary sewer systems, although constructed to convey wastewater, also inevitably convey a certain quantity of extraneous clear water from I/I. I/I can originate as groundwater or surface runoff. Surface runoff typically results from rainfall or meltwater.

Excessive quantities of I/I can cause hydraulic overloading of both the sewage collection system and wastewater treatment facilities. In extreme situations, overloaded sewer systems are evidenced by surcharging and overflow conditions.

In more moderate circumstance, I/I presents an added cost in conveying and treating an excess volume of wastewater. In addition, some portion of the sewage collection and treatment capacity is used by I/I. When planning for the future, an evaluation of the I/I is worthwhile to determine what additional capacity can be recovered through practical measures to reduce these excess flows.

4.5.2 Inflow and Infiltration Study Approach

I/I studies can involve an extensive program of flow monitoring, field testing, and analysis. Since preliminary indications were that the City's I/I problem was not extreme, a broader and more efficient methodology was used to identify problem areas.

Daily and hourly rainfall data were obtained from the recording station at the Kenai Municipal airport. The central location of this station and its long-term use as a weather observation site made this an ideal source of weather data.

Daily total wastewater flow was obtained from the effluent meter at the WWTF. Flows were also estimated at individual lift stations by monitoring pump run times. Although this method allows a substantial amount of information to be collected at relatively little cost, the following limitations apply:

- The method depends on an estimate of pump discharge rate to calculate the volume of discharge. The estimate can become inaccurate due to clogging or impeller wear over time.
- The analysis is complicated by the fact that 5 of the 16 lift stations convey wastewater from more than one collection basin. For these basins, the flow from one or more upstream basins must be subtracted from the flows measured at the downstream monitoring point (lift station) of the target basin.

4.5.3 Average Base Flows

To begin the evaluation, flows were monitored at the lift station during the winter months of November 2001 through January 2002. During these months, surface water inflow and groundwater infiltration were minimal such that the flow conditions approximate the average base flow (ABF) conditions for sanitary sewage alone.

4.5.4 Rainfall-Derived Inflow and Infiltration

To investigate the effect of rainfall on I/I, the collection basins were evaluated over the summer period from June 1 to August 31, 2002. Graphs of rainfall and discharge are provided for each collection basin. The exception is the gravity collection zone; daily WWTF flows needed to calculate this were not available for July and August 2002.

The sewage collection basins were placed into one of six categories (Table 4-5). A summary description of these categories is provided in Table 4-6. Most basins show some response to rainfall. The response is considered significant when the volume of peak flow exceeds the ABF by a factor of 4. The increase was significant in only four basins. The basins having a significant response to rainfall were assigned to category 1. Six basins were found to have an insignificant response to rainfall and were assigned to category 2.

Lift stations serving the Granite Point, Marathon Road, and Control Tower areas operated intermittently due to the relatively small volume of flow originating from these basins. These lift stations appear to have sufficient capacity. These three basins were assigned to category 3.

Category 4 includes the Aleene Street and Mile 14 North Road lift stations (basins 2 and 14, respectively), which act primarily as transfer stations with little or no collection basin of their own. However, the significant I/I conditions of the upstream basin (number 13) equally affect the pumping requirements at lift station number 14.

Category 5 is for basins in which the flow was indeterminate. The gravity flow zone (basin 17) falls in this category. The I/I from this basin would be estimated by subtracting all other contributing daily flows from the daily WWTF flow. Daily flow data for the WWTF were unavailable for July and August 2002, so this estimate is omitted. There are no pumping costs associated with I/I from this basin.

TABLE 4-5
City of Kenai Current Capacity and Projected Flows

Lift Station No.	Lift Station/Basin	Current Peak Flows (gph)	Current Peak Flow Capacity (gph)[a]	Current Basin Flow as Percentage of Total	Future Basin Flow as Percentage of Total[b]	Upstream Basins[c]	2020 Projected Average Lift Station Flow (gpd)[d]	2020 Projected Peak Hour Flow (gph)[e]	Ratio of Future Peak to Current Capacity	Need for Capacity Increase
1	Beaver Creek	3,760	16,038	3%	6%	1	57,600	9,600	0.60	low
2	Aleene St.	1,544	10,368	0%	0%	1,2	57,600	9,600	0.93	low
3	Golf Course	16,174	16,848	4%	4%	1,2,3	96,000	16,000	0.95	medium
4	East Aliak	3,060	32,400	6%	5%	4	48,000	8,000	0.25	low
5	Lawton Dr.	11,984	31,536	15%	12%	1,2,3,4,5	259,200	43,200	1.37	high
6	Walker Ln.	[f]	11,178	1%	1%	6	9,600	1,600	0.14	low
7	Granite Point	[g]	12,960	0%	1%	7	9,600	1,600	0.12	low
8	Marathon Rd.	[g]	11,610	0%	1%	8	9,600	1,600	0.14	low
9	Control Tower	[g]	19,710	1%	1%	9	9,600	1,600	0.08	low
10	Broad St.	21,206	50,490	22%	20%	1,2,3,4,5,6,7,8,9,10	489,600	81,600	1.62	high
11	Main St.	13,240	12,528	2%	2%	11	19,200	3,200	0.26	low
12	Mission St.	3,675	18,900	4%	3%	12	28,800	4,800	0.25	low
13	Mile 14 North Rd.	11,670	45,900	10%	10%	13	96,000	16,000	0.35	low
14	Mile 13 North Rd.	10,758	22,464	0%	1%	13,14	105,600	17,600	0.78	medium
15	Redoubt St.	7,085	33,210	7%	6%	15	57,600	9,600	0.29	low
16	Inlet Woods	909	8,100	1%	1%	16	9,600	1,600	0.20	low
17	Gravity Flow Zone	N/A	N/A	26%	26%	13,14,15,16,17	422,400	70,400	N/A	
	Totals			100%	100%					
	Total Average Flows (MG)			0.715	0.96		0.96	0.960	0.96	0.96

[a] Estimated as the discharge capacity of one pump X 0.9 such that one lead pump can operate without activating the lag pump for an extended period.
[b] Total average flow is projected to increase to 0.96 MGD by the year 2020 (by a factor of 1.3). The percent of total flow contribution from each basin is a rough estimate.
[c] Upstream basins contribute their flow to the lift station.
[d] The lift station flows do not total 0.96 MG because the same gallon of sewage may be pumped by several lift stations.
[e] The projected peak flow is estimated as the average flow times 4.
[f] Flow monitoring problems - a clogged pump interfered with flow estimates
[g] Pumps operate intermittently for small service areas - peak flow concept does not apply.

Notes:

gpd = gallons per day
gph = gallons per hour

TABLE 4-6
City of Kenai Summary of Inflow and Infiltration Evaluation

Category	Basin Number
1: Inflow Response–Ratio of Peak Flow to Average Base Flow Greater than 4.0	
Mission Street	12
Mile 14 North Road	13
Golf Course	3
2: Inflow and Infiltration Not Significant	
Beaver Creek	1
East Aliak	4
Lawton Drive	5
Broad Street	10
Main Street	11
Redoubt Street	15
Inlet Woods	16
3: Intermittent Pumping–Inflow and Infiltration Not Significant	
Granite Point	7
Marathon Road	8
Control Tower	9
4: Transfer Stations	
Mile 13 North Road	14
Aleene Street	2
5: Indeterminate Basin	
Gravity Flow Zone	17
6: Flow Measurement Problems	
Walker Lane	6

For the collection system as a whole, the daily effluent flow at the WWTF was plotted against daily rainfall for a number of significant storm events. Storm events were considered those that had rainfall greater than 0.5 inches in 24 hours and occurred under snow- and ice-free conditions. There is a reasonable correlation (correlation coefficient of 0.7) of increasing WWTF flow rainfall with increasing rainfall.

In other states (such as Washington), the 5-year, 24-hour rainfall is used as an evaluation point for stormwater collection systems. Stormwater collection systems that are not overloaded at the 5-year, 24-hour storm are considered satisfactory. It is also useful to evaluate the sewage collection system performance with this statistical storm event.

Extrapolating to the 5-year, 24-hour rain event of 1.47 inches, the facility effluent would be approximately 1.14 mgd, which is well within the current WWTF peak flow capacity of 3.5 mgd and below the current design average capacity of 1.3 mgd.

4.5.5 Groundwater Infiltration

Groundwater infiltration rates can be estimated in several different ways. One method is to estimate the sanitary flow through water consumption records over a period with minimal rainfall and subtract the estimated sanitary flow from total recorded wastewater flow. In winter months, the sanitary flow can be estimated as 90 percent of the water usage.

Another method is to obtain average total wastewater flows over a period that is free of precipitation and calculate the per capita sewage flow. High values of per capita sewage flow may indicate an infiltration problem.

Observations of two rain-free free periods during May 1 through May 14, 1997, and May 24 through June 14, 2000, indicate that a total volume of sewage over this combined 36-day period was 25.2 million gallons. With a service population near 3,600, a per capita wastewater flow of 190 gallons per capita per day can be calculated. This value is not particularly high.

4.5.6 Meltwater Inflow

I/I analysis up to this point has considered only ice-free conditions with temperatures above freezing and no snow on the ground. However, melting ice and snow–particularly during the spring breakup–can be a significant source of inflow to the collection system and WWTF.

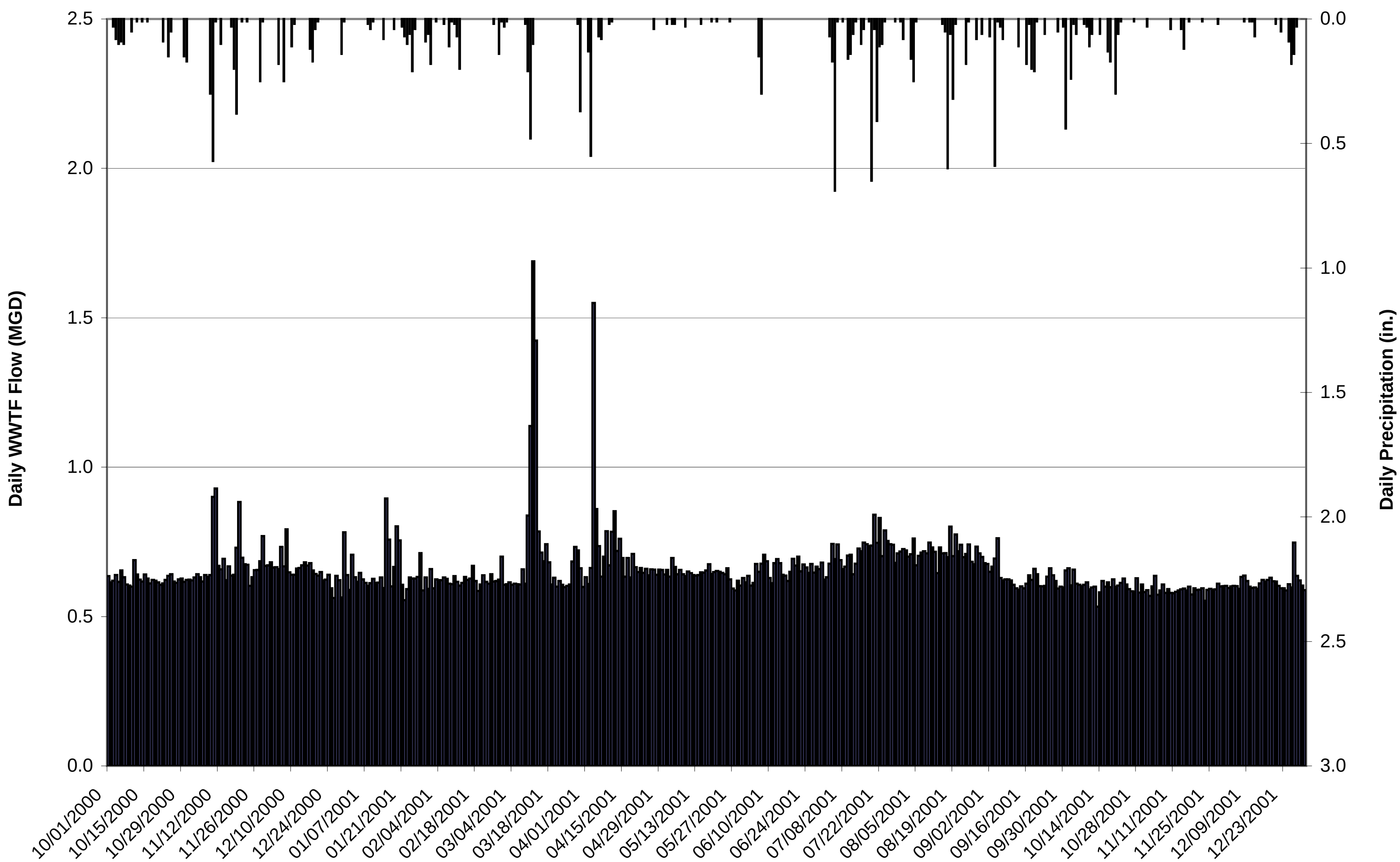
A review of available WWTF daily flow data over the period January 1996 through April 2002 indicates that the 20 highest recorded flows all occurred in the months of March and April. These daily peaks ranged from 1.312 to 1.693 mgd. Occasionally, the sanitary sewer system has been used to drain meltwater that has accumulated on streets. The hydrograph shown in Figure 4-3 shows a significant spike in WWTF and the meltwater event that caused it. By coincidence, the *Peninsula Clarion* reported the event with a story headline "Breakup Blues" and featured a photograph of meltwater pouring through an open sewer manhole on Lake Street. Another spike occurred earlier during the same month, except it was not documented by a newspaper story. Sewage collection systems, particularly those with separate storm sewers, are not designed to handle such flow.

4.6 Present Capacity and Future Growth

The current peak flows and estimated pumping capacity for each lift station are shown in Table 4-5. The current peak hourly flows were based on flows logged June 1 through August 31, 2002. This can be compared to the peak flow capacity in the adjacent column of Table 4-5.

The peak flow capacity is calculated here as 90 percent of the maximum estimated hourly pump discharge rate without the use of the lag pump. By this approach, there is still additional reserve pumping capacity available if the lag pump is activated.

Figure 4-3. Daily WWTF Hydrograph and Meltwater Events



During the summer of 2002, only the Main Street lift station received flow in excess of the peak pumping capacity. The excess was only 5 percent above the calculated peak capacity and is well within the reserve capacity with the lag pump activated.

Given the current percentage of the total wastewater flow contributed by each basin and the total future wastewater flow to the WWTF developed earlier in Section 3.2.2 of this report, projections were made for each basin flow in the planning year. Basins with available developable land were projected to have a larger proportion of growth.

It is difficult to accurately predict what long-term development may occur in each individual basin. The result of this analysis is a prediction that certain lift stations will need capacity upgrades before others. These predictions should be reevaluated if any significant single source of commercial, industrial, or institutional wastewater is to be developed within a given basin.

The Lawton Drive and Broad Street lift stations (numbers 5 and 10, respectively) are the largest lift stations and most likely to require increased capacity as the City develops. The Main Street lift station is currently subject to high peak flows due to I/I and has the potential to increase future capacity if I/I were reduced.

4.7 Operations and Maintenance

4.7.1 Routine Sewer and Lift Station Maintenance

Operation and maintenance for the sewage collection system includes annual sewer cleaning using the City's Vactor sewage pump/jetting truck. As with most municipalities, it is not possible to clean every sewer main each year. The maintenance staff has prioritized problem areas so that they are cleaned each year while the rest of the sewer lines are cleaned every other year on a rotating basis.

Sewage lift stations require monthly inspection, access during winter months, record keeping for pumps and pump performance, and annual cleaning of problem lift stations. The 16 lift stations range in size from 1.75 to 14 horsepower. The pumps are either Flygt or ABS brand. A summary of lift station data is provided in Appendix D.

4.7.2 Grease and Solids Buildup

A review of monthly O&M records for the lift stations reveals a pattern of grease and solids accumulation. The data is summarized in Table 4-7. Although the information was not collected with the intent of performing a detailed grease and solids study, it shows qualitatively where problems have occurred.

Lift station 14, downstream of the Wildwood prison accumulated a significant amount of grease and solids. Since the installation in 2001 of lift station 13 with its grinder pumps, the occurrence of significant grease and solids problems has diminished. Lift stations 4, 5, and 6 also experience grease and solids buildup. Restaurants and institutions within these collection basins may be contributors to this problem.

Fats, oils, and grease are a problem both for the conveyance and treatment of wastewater. Accumulations of solids and grease can foul sewage pumps. The WWTF experiences problems with solids and grease as discussed in Section 5 of this report.

Other municipalities have programs to reduce fats, oils, and grease loading to the sewage system. The City of Soldotna also pursues fats, oils, and grease reduction but with limited enforcement capability. Appendix F contains a sample ordinance.

TABLE 4-7
City of Kenai Lift Station Maintenance–Grease and Solids Problems

Lift Station No.	Lift Station	11/05/1999	11/25/1999	12/26/1999	03/01/1999	04/28/1999	05/27/1999	06/29/1999	07/29/1999	08/31/1999	09/30/1999	11/01/1999	11/29/1999	12/30/1999	03/01/2000	03/30/2000	04/28/2000	05/31/2000	06/24/2000	07/31/2000	08/31/2000	09/28/2000	10/31/2000	11/28/2000	12/28/2000	01/31/2001	02/28/2001	03/30/2001	04/30/2001	03/30/2001	06/29/2001	05/30/2001	08/31/2001	09/28/2001	10/31/2001	11/30/2001
1	Beaver Creek																																			
2	Aleene Street																																			
3	Golf Course																																			
4	East Aliak					S	S	G	G						G	G					S		S	G						G						
5	Lawton Drive					S	S	S	G									S			S		S							S		S				
6	Walker Lane							S											G						S											
7	Granite Point																				S															
8	Marathon Road						[a]																													
9	Control Tower																																			
10	Broad Street																																			
11	Main Street																																			
12	Mission Street						G	G	G										G		G		G													
13	Mile 14 North Road															Lift Station #13 came on line in summer 2001																				
14	Mile 13 North Road	S										S	S		S	S		S	G				S	S	S		S	S		S	G					
15	Redoubt Street																							S			S									
16	Inlet Woods																																			

[a] Fire retardant accumulated in wetwell from fire training exercise at PRISM

Notes: Data collected by maintenance staff were somewhat subjective; nonetheless, the presence of grease or solids problems was usually noted in monthly maintenance reports.

G = Grease was noted in the monthly inspection.
S = A significant amount of solid material was noted in the monthly inspection.

SECTION 5

Wastewater Treatment Improvements

5.1 Overview

Several process enhancements at the Kenai WWTF will result in increased treatment facility capacity and efficiency (Figure 5-1). In this section, the various improvements are described and a cost is estimated for each. Also where applicable, the payback period is provided.

Process areas that can benefit from improvements include:

- Pretreatment
- Aeration system
- Return activated sludge (RAS)/waste activated sludge (WAS)
- Aerobic sludge digestion and solids handling

A schematic of the existing treatment processes is shown in Figure 5-1 along with the proposed areas of improvement. A cost summary of these improvements are reviewed and summarized in Section 5.6 of this report. A more detailed description of the proposed improvements is provided in the following sections.

5.2 Pretreatment Process Operation Improvements

5.2.1 Summary of Pretreatment Process Operations

The existing pretreatment process operations include the following :

- Influent manhole
- Rotary screens
- One screenings belt conveyor for truck haul operations
- Bypass bar screens

Table 5-1 lists the existing rotary screen design criteria.

TABLE 5-1
City of Kenai WWTF Existing Rotary Screen Design Criteria

Parameter	Criteria
Number of Screens and Type	2, Rotary Type
Screen Opening Size	0.30 inch
Hydraulic Capacity	1,850 gallons per minute at 200 parts per million total suspended solids (5.3 million gallons per day)
Screenings Volume Capacity	2.4 cubic yards per day
Motor Size (each unit)	3/4-horsepower, 480-volt, two-speed motor

5.2.2 Influent Manhole Improvements

The influent manhole collects the wastewater from the City collection system's three primary pipelines. The inlet manhole is approximately 22 feet high and extends approximately 12 feet above grade. The inlet manhole collects grease at the top of the water surface. The grease must be removed using a vacuum truck and hauled to the landfill. Currently, the landfill is not accepting the grease from this manhole. This poses a disposal problem for the City operations crew. Photo 5-1 shows the outside of the manhole. Photo 5-2 shows the grease buildup inside the manhole.

PHOTO 5-1
City of Kenai WWTF Influent Manhole

PHOTO 5-2
City of Kenai WWTF Influent Manhole Grease

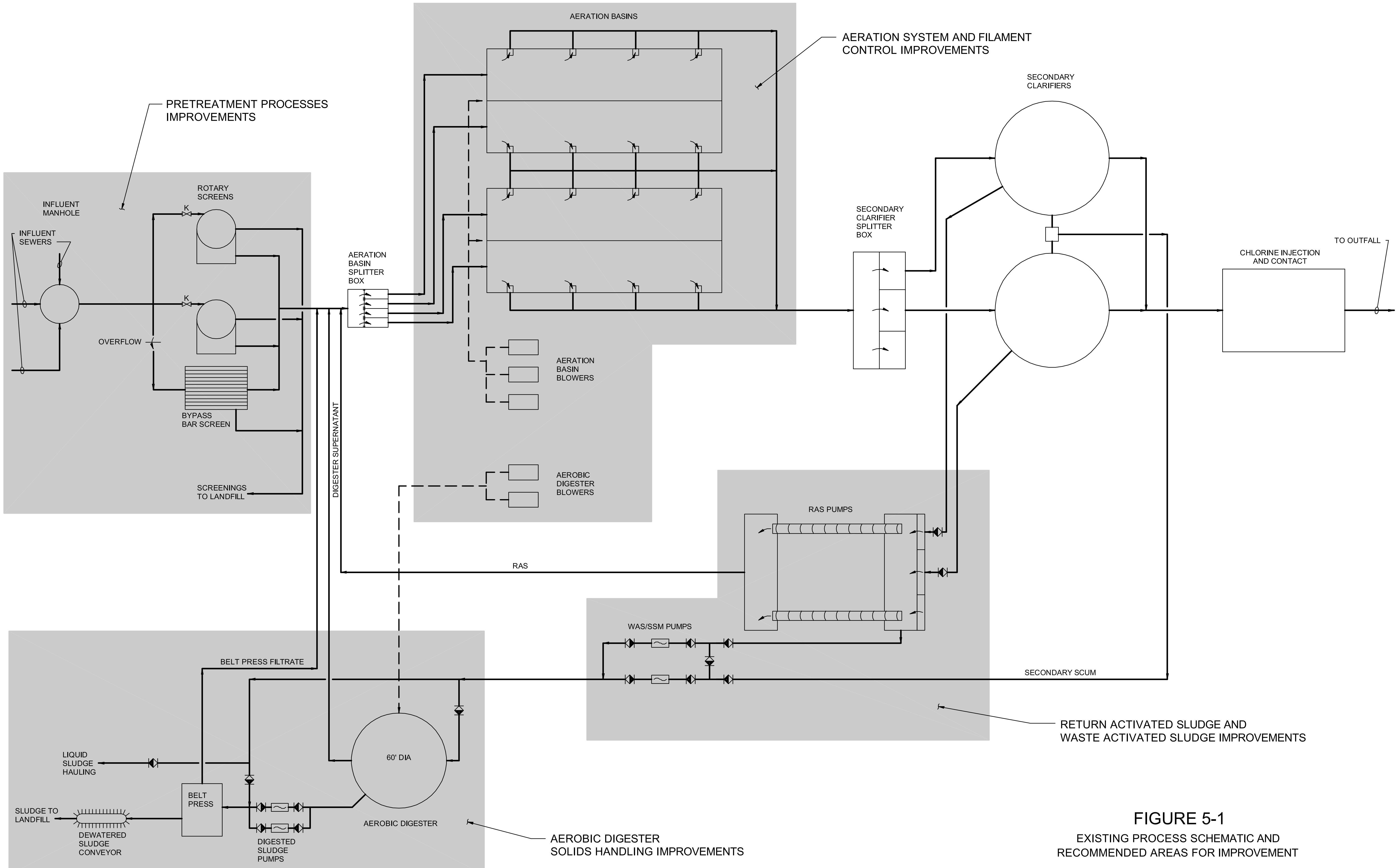


FIGURE 5-1
EXISTING PROCESS SCHEMATIC AND RECOMMENDED AREAS FOR IMPROVEMENT
KENAI WASTEWATER TREATMENT PLANT

CH2MHILL

The first step in reducing the grease is to provide effective enforcement of the grease ordinance. This will help reduce the grease in the collection system and at the WWTF.

Currently, a contract septic pumper truck haul operator pumps out the influent manhole on a regular basis and disposes of the fats, oils, and grease at the licensed disposal site. If this operation were to cease in the future, other alternatives, discussed below, should be considered.

Another, more expensive option that eliminates the need to dispose of the grease offsite is for the grease to be pumped to the aerobic digester on a timed or level control basis. The pump discharge pipe could be extended to the existing return sludge digester (RSD) pipeline that runs from the heat exchanger to the digester. This pipeline is currently not being used as the temperature in the digester does not warrant the use of the heat exchanger. The grease would be digested effectively in the sludge digester thus eliminating the need to haul the grease offsite. Figure 5-2 shows a schematic of the piping routed from the manhole to the aerobic digester.

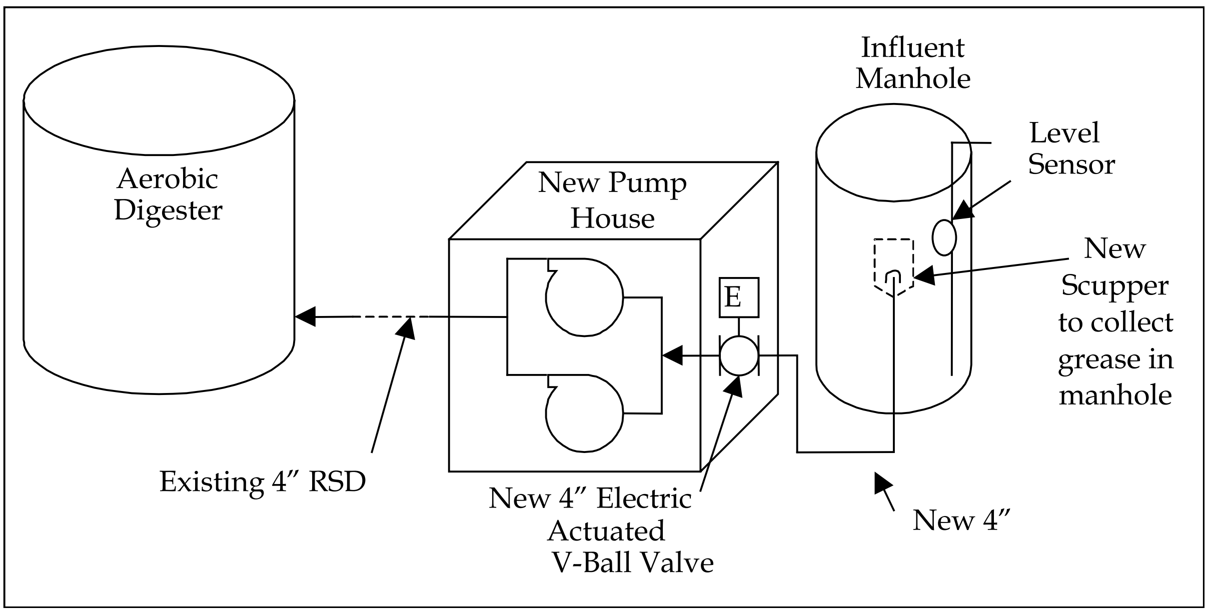


FIGURE 5-2
Schematic of Grease Collection and Transfer from Influent Manhole to Aerobic Digester

To collect the grease, a scupper is fitted to the inside of the influent manhole. Also, a level sensor is installed in the influent manhole. A new pump house is constructed in the vicinity of the influent manhole. Piping is constructed from the influent manhole scupper to the new pump house. The pump house ties into the existing RSD yard piping which connects to the aerobic digester.

To transfer the grease from the influent manhole to the digester, the level sensor relays the water level back to a programmable logic controller (PLC), which would be located in a new pump house. When the water level in the manhole reaches a set level above the scupper, for example 4 inches, the electric actuated V-ball valve opens, and one of the new pumps turns on. When the level in the manhole drops to a predetermined set point, the pump shuts off and the actuated V-ball valve closes.

5.2.3 Influent Screening Area Improvements

The WWTF has two rotary screens rated at a capacity of 1,830 gallons per minute, or 2.6 mgd, each (Photo 5-3). A bypass screen allows the wastewater to bypass the rotary screens when they are not in operation or the influent flow is greater than the screens' capacity. Screenings are scraped off the rotary screens and fall onto a belt conveyor. The belt conveyor transfers the screenings to a truck dump area. Screenings are then transported to the landfill. Screenings must be dry enough to pass the "Paint Filter Test," U.S. Environmental Protection Agency (EPA) Method 90-95 in *Reference Test Methods for Evaluating Solid Waste, SW-846*, in order to be landfilled.

Currently, the facility does not use the existing two rotary screens, the bypass screen or the screenings conveyor. Rags and grit build up in the collection system until a large rainstorm or snowmelt flushes the debris down to the WWTF, disrupting the operation of the screens and conveyor.

PHOTO 5-3
City of Kenai WWTF Existing Screens and Conveyor

Screening upstream of the aeration, clarifier, and digestion processes is very important for reducing fouling problems due to rags and large debris. This debris can plug pipelines, foul pump suction intakes, and cause unnecessary maintenance.

Screenings should be washed and compacted to satisfy landfill requirements. There is currently no method for compacting the screenings prior to disposal.

New, larger-capacity screens and a screenings washer/compactor would reduce the problems that staff is currently experiencing. The washer/compactor washes the fecal matter from the screenings and squeezes the water out of the screenings prior to disposal in a landfill.

5.2.4 Grit Handling Improvements

There is no grit removal system at the Kenai WWTF at this time. Grit thus accumulates in the quiescent areas of the facility, such as the aeration basins and the aerobic digester. The staff takes a basin out of service for grit removal on a regular basis. The grit is removed by shovel and hose. The remaining grit then settles in the aerobic digester.

To prevent grit from settling in the aeration basins and the aerobic digester and increasing maintenance time, grit removal should be considered for the treatment facility. Grit removal also helps to reduce wear on downstream mechanical equipment, such as pumps. Grit generally consists of sand, gravel, and cinders but may also include egg shells, bone chips, and coffee grinds. **Grit removal can be achieved with the installation of a grit cyclone.**

5.3 Aeration System Modifications

5.3.1 Summary of Aeration System

The City's WWTF has four 130,000-gallon complete-mix aeration basins in operation. Three 60-horsepower centrifugal blowers supply air to a coarse bubble aeration system in the complete-mix designed aeration basins. Photos 5-4 and 5-5 show the aeration basins.

The aeration system that supplies air to the aeration basins lacks blower control and aeration flow control. The current blowers are constant speed. **By installing aeration flow control, the number of blowers in operation can be reduced, saving operation and maintenance costs.**

Excessive air is currently sent to the aeration basins during times of low waste loading to the facility. The current oxygen level in the basins is 6 to 8 milligrams per liter (mg/L). The oxygen level should be around 2 mg/L. Excess oxygen in the basins means excess electrical and operational costs. The excessive air results from the inability to control the amount of air from the blower system. The blowers are either on or off, and the air flow rates are constant to the basins and are determined only by whether one or two blowers are operating. The existing aeration basins utilize coarse bubble aeration. **By retrofitting to a fine bubble system, oxygen transfer efficiency in the basins is improved.**

5.3.2 Existing Equipment

The aeration system for the aeration basins is equipped with three 60-horsepower blowers manufactured by Hoffman, model number 4207A, capable of delivering 1,100 standard cubic feet per minute (scfm) each. Photo 5-6 is a photo of the aeration basin blowers. Photo 5-7 is a photo of the aeration basin blower system control panel. Figure 5-3 shows the pump performance curve for the blowers.

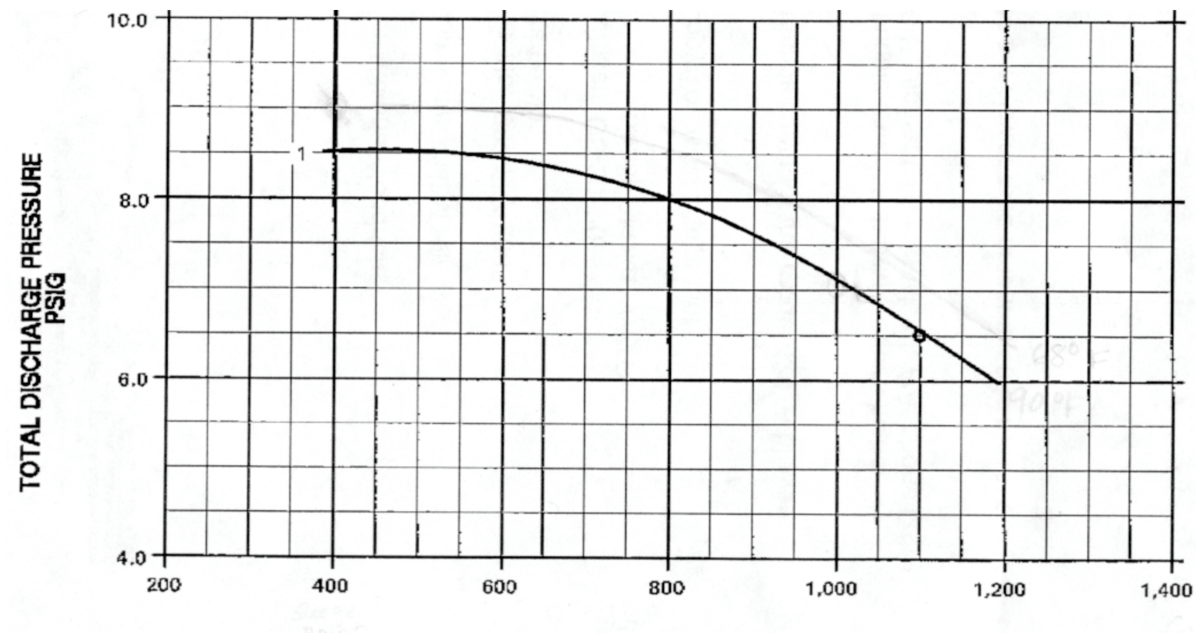
The coarse bubble diffuser system has a standard oxygen transfer rate of 224 pounds per hour. The system is manufactured by Sanitaire. Table 5-2 summarizes the aeration basin aeration system equipment information.

PHOTO 5-4
Aeration Basin

PHOTO 5-5
Aeration Basin Catwalk

PHOTO 5-6
Aeration Basin Blowers

PHOTO 5-7
Aeration Basin Blower System Control Panel



AIR FLOW
SCFM

FIGURE 5-3
Aeration Basin Blower Performance Curve

TABLE 5-2
City of Kenai WWTF Existing Aeration Equipment Summary

Equipment	WWTF Equipment No.	Manufacturer & Model No.	Type	Horsepower[a]	Air Flow (scfm)	Std. Oxygen Transfer Rate[b] (pounds per hour)
Aeration Basin Blowers	M103-1 M103-2 M103-2	Hoffman Co. mfg. no. GS-30520 & model no. 4207A	Constant Speed, Rotary	60	1,100	224
Aeration Basin Diffusers	–	Sanitaire	Coarse Bubble	–	–	–

[a] Power cost is 9.28¢/kilowatt-hour based on City of Kenai September 2001 electric bill.
[b] Standard conditions: Temperature = 20°C and Pressure = 14.7 psia
scfm = standard cubic feet per minute

Table 5-3 summarizes the existing aeration basin design criteria.

TABLE 5-3
City of Kenai WWTF Existing Aeration Basin Design Criteria

Parameter	Criteria
Number of Aeration Basin Cells and Size	Four, 75 feet by 18.5 feet
Total Aeration Basin Volume	520,000 gallons
Type of Flow through Basin	Complete mix
Aeration Equipment Type	Coarse bubble aeration
Number of Blowers and type	Three, centrifugal
Blowers Capacity	1,100 standard cubic feet per minute each at 6.5 pounds per square inch gauge
Blowers Size	60 horsepower each

5.3.3 Aeration Flow Control Improvements

The goal of the aeration flow control system is to maintain a dissolved oxygen (DO) level of 2 mg/L in the aeration basins. To achieve this goal, the control of air flow from the centrifugal blowers should be based on facility influent flow and DO levels in the aeration basins.

The City currently does not have the means to monitor or control air flow to the aeration basins automatically and thus uses more air than required during the diurnal low flows and load waste load periods that occur at night, when there is little influent to the WWTF. Using too much air during the night and other low-flow periods results in the City's using substantial wasted electrical power.

The aeration basin blowers have a minimum operation point called a "surge point" at 400 cubic feet per minute (cfm). Operating at air flows below the surge point is harmful to the blower. Diurnal low facility influent flow is approximately 0.2 mgd, at which point the air flow requirement in the aeration basins required for maintaining 2 mg/L is 100 cfm, which is below the surge point. Operating the blower above the air requirement increases the oxygen concentration above 2 mg/L. Currently air flow may be varied manually using the inlet flow control butterfly valve; however, the airflow typically can only be throttled a maximum of 50 percent without the chance of surge conditions occurring. Automatic control options for air flow would be to install adjustable frequency drives (AFDs) and flow monitoring to vary the blower speed to match dissolved air flow requirements. Both of these options (AFD or inlet throttle valve control) will not work when the air flow is less than 50 percent of the rated blower capacity. Thus, in order to reduce electrical costs and provide less air flow during low flow periods, the best solution is to replace one of the large blowers with a smaller blower with AFD and a flow monitoring system. The SCADA control system could be set up to pace air with the existing plant flow reading an existing analog DO monitor.

An additional method of reducing blower air requirements is to upgrade the diffused aeration system to fine bubble aeration in place of the coarse bubble aeration. The City is recommended to upgrade the aeration diffusers in conjunction with the smaller blower replacement project. Fine bubble aeration diffusers are much more efficient at diffusing oxygen into the aeration basin mixed liquor, providing more DO in the basins and making the blowers even more oversized for the operation. A smaller blower to replace the existing large lead blower is recommended. These system modifications will have a payback period of less than 10 years by reducing the operating power costs.

An example of the aeration flow control operation is as follows:

- The operator sets the lead blower (new, smaller blower such as M103-1). Blower M103-1 is controlled based on facility influent flow, which is fed into the logic control panel set up for the blowers.
- As flow increases, the lead blower speed is increased to full capacity. When the facility flow increases so that the corresponding AFD reaches full speed and/or the inlet valve of the lead blower is completely open, the lag blower (M 103-2) turns on, and the lead blower intake valve throttles to 50 percent demand, with the result that both blowers operate at 50 percent. The lead and lag blowers ramp up simultaneously as facility flow increases.
- The DO level in the aeration basins is used to trim the intake throttle valves so that the DO level stays at 2 mg/L. The DO level between the aeration basins is balanced by adjusting the air flow to the aeration basins using actuated butterfly valves.
- The operator sets the trim on a selected lead flow control valve (FCV 105-1). The trim on the lag valve (FCV 105-2) would modulate so that the air flow in FE 105-2 would match that of FE 105-1.

5.3.4 Aeration Basin Retrofit

5.3.4.1 Addressing SVI and Filaments

The sludge volume index (SVI) measures the settling characteristic of activated sludge. In recent years, the City's WWTF has been experiencing a high SVI. The SVI should be less than 100. Data over the past 4 years at the Kenai WWTF show that the SVI is approximately 400. This indicates a significant filamentous organism problem. Filamentous bacteria reduce the capacity of the secondary clarifiers to remove solids from the activated sludge process by hindering solids settlement in the secondary clarifier.

The SVI is related to the amount of RAS/WAS that is being transferred from the secondary clarifiers. A high SVI can indicate a low RAS/WAS concentration due to the inability of the sludge to compact in the clarifiers. The low concentration requires the RAS and WAS pumps to pump at greater flow rates to transfer the same mass of solids.

SVI in the 400 range typically indicates the presence of filamentous bacteria. The current environmental conditions in the aeration basins are conducive for filamentous bacteria to thrive and populate.

By converting the first third of the aeration basins into an anoxic/aerobic zone, the nonfilamentous bacteria become more predominant than the filamentous bacteria. The nonfilamentous bacteria have a better settling characteristic than the filamentous bacteria. The result is more efficient wasting of sludge, reduced operation time of the belt filter press, and more efficient use of the aerobic digester. In addition, the presence of an anoxic/aerobic zone will increase the secondary clarifier and digester capacity and available storage time.

5.3.4.2 Anoxic Zone

The settling characteristic of the activated sludge can be improved by incorporating an anoxic zone in the first third section of the basins. An anoxic zone can be created by installing a wall in the aeration basins separating the first third of the basin from the remainder. Flow passes from the anoxic zone to the aerated zone through openings in the bottom of the divider wall.

Due to the lack of free available oxygen in the anoxic zone, nitrification may occur. Nitrification reduces the alkalinity, which acts as a buffer in maintaining pH. **In order to preserve the desired microorganisms in the anoxic zone, a circulation pump should be installed in the aeration zone to pump flow back to the anoxic zone.** This will help maintain the alkalinity in the anoxic zone and maintain the desired nonfilamentous microorganisms.

The first third of the aeration basin has its own aeration header. Therefore, the header and coarse bubble diffusers in the proposed anoxic zone would remain intact but generally not used.

Unlike the aerobic zone, the anoxic zone will not be able to rely on diffusers for mixing. **In order to keep solids suspended, a mixer should be installed in the proposed anoxic zone.**

Figure 5-4 shows the proposed schematic of the aeration system. The first third of the basin is an anaerobic/anoxic zone and the remaining basin is plug flow aerobic zone.

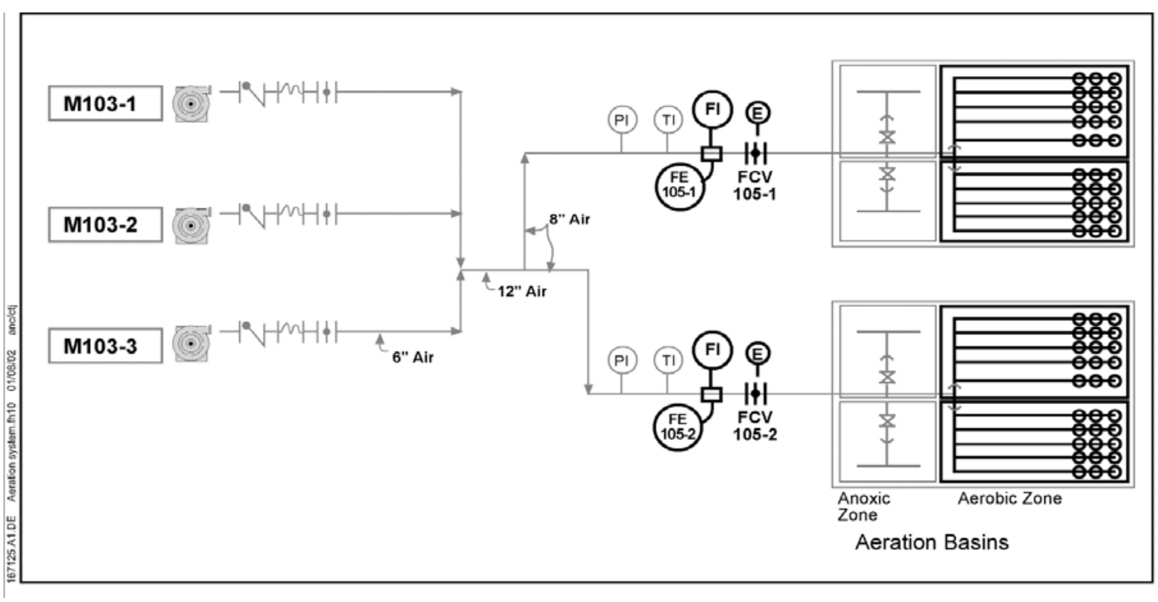


FIGURE 5-4
Schematic of Aeration System to Aeration Basin

5.3.4.3 Diffusers

The efficiency of the existing coarse bubble diffusers is approximately 6 percent. Fine bubble aeration typically has an efficiency around 20 percent. **To increase oxygen transfer efficiency in the aeration basins, the City should consider replacing the existing coarse bubble diffusers in the aeration basins with fine bubble diffusers.**

The advantages of having a fine bubble diffuser system are as follows:

- Aerobic digester blowers can be abandoned and the aeration requirement of aerobic digester can be met with aeration basin blowers using the existing aeration basin blower system.
- Energy cost savings can be made by running only one blower the majority of the time.
- Reduced air flow would be required because of more a more efficient diffuser.
- Only one blower would be needed except during peak diurnal facility flow.
- The need to operate all four aeration basins would be reduced. Only two aeration basins are necessary currently, three in the future. A fourth may be used for additional aerobic digestion.

5.3.5 Digester Aeration Improvements

The aerobic digester aeration system is currently equipped with two 125-horsepower blowers manufactured by Roots Dresser and capable of delivering 1,750 scfm each. The coarse bubble diffuser system has a standard oxygen transfer rate of 165 pounds per hour. The system is manufactured by Sanitaire. Table 5-4 lists the existing digester aeration design criteria. Photo 5-8 is a photo of the aerobic digester blowers.

TABLE 5-4
City of Kenai WWTF Existing Digester Aeration Design Criteria

Parameter	Criteria
Number of Digesters	1
Aeration Equipment Type	Coarse bubble aeration
Number of Blowers and Type	Two, positive displacement
Blowers Capacity	1,750 standard cubic feet per minute each
Blowers Size	125 horsepower each

PHOTO 5-8
Existing Aerobic Digester Blowers

The current aeration system for the aerobic digester is separate from that of the aeration basins. However, it is possible to have the aeration basin blowers serve both the aeration basins and the aerobic digester and save on horsepower.

Some treatment facilities blow off excess air to the atmosphere; however, excess air flow can also be routed to the digester. **An advantage to using the aeration basin blowers for both the aeration basins and the aerobic digester is that the two 125-horsepower blowers currently serving the aerobic digester can be utilized for emergency backup only.** To make these improvements, automatic, modulating butterfly valves, flow monitoring, and a flow control loop will be required to ensure air flows to the digester to maintain the 2.0 mg/L DO level minimum requirement. Also, digester coarse bubble diffusers should be raised so that the system head to the digester matches that to the aeration basins. **Two mixers should be added to completely mix the oxygen in the digester. A modulating airflow control butterfly valve between the blowers and the digester should be installed and trimmed based on DO level in the aerobic digester.** This system could be complicated by the fact that the digester level fluctuates 3 feet daily after removal of the supernatant operation is completed. By raising the height of the coarse bubble diffusers in the digester and adding mixers, excess air flow from the aeration basins can be efficiently utilized in the digester. In addition, the aeration basin blowers can accommodate the aeration requirements of both the aeration basins and the aerobic digester at peak 2021 facility influent flows.

5.4 Return Activated Sludge/Waste Activated Sludge Modifications

5.4.1 Summary of Return Activated Sludge/Waste Activated Sludge Process

The RAS/WAS is sludge from the underflow of the secondary clarifier. Typically, the RAS/WAS concentration is around 0.5 to 1.0 percent solids or 5,000 to 10,000 mg/L. The City's WWTF RAS/WAS concentration is much lower, approximately 0.2 percent, or 2,000 mg/L. The low concentration is indicative of a poorly settling sludge. A poorly settling sludge can be attributed to several factors occurring simultaneously, including filamentous bacteria due to lack of selector process control in the aeration basins, excessive aeration, too high of a solids retention time, and possibly an excessive wasting rate.

The following sections focus on modifying the methods used for wasting the sludge.

5.4.2 Return Activated Sludge Pumping Improvements

The RAS pumping rate is currently controlled by the need to maintain sufficient velocity in the RAS pipe to prevent settling of solids. The RAS pumping rate *should* be controlled by the need to maintain a set mixed liquor volatile suspended solids (MLVSS) concentration in the aeration basins. A typical return rate is 25 percent of facility influent flow.

Currently the RAS pipe plugs on the upstream side of the RAS screw pump inlet valve. **To prevent solids deposition behind the 8-inch valve, this valve should be replaced with an electrically actuated V-ball valve that modulates based on velocity.** The new 8-inch valve should modulate such that a velocity of 2 feet per second occurs through the valve opening. The RAS pumps are screw type. They are difficult to maintain due to the difficulty in accessing the motor and gearing. Photo 5-9 is a photo of the RAS pump motors. Photo 5-10 shows RAS screw conveyor-type pumps.

5.4.3 WAS Pumping Improvements

The two existing WAS pumps are progressing cavity-type pumps. The pumps require replacement of the rotor and stator annually at a total cost of $4,000. Photo 5-11 shows the WAS pumps.

The existing WAS pumps cycle on and off to send wasted sludge to the digester. The on/off cycling pattern is disruptive to maintaining a consistent solids concentration in the digester. A more efficient way to operate the digester is to waste continuously at a lower rate. **This can be achieved with a smaller pump, such as a centrifugal type slurry pump.**

In addition, the aerobic digester should operate at a 2.5 percent solids concentration. To achieve 2.5 percent solids with 40 percent volatile suspended solids destruction, 4.1 percent solids should be entering the digester. The WAS wasting rate should be controlled such that the WAS concentration is just under 1 percent. **In order to increase the solids concentration from 1 to 4.1 percent, a gravity belt thickener (GBT) should be installed upstream of the aerobic digester.** Solids concentration from a GBT is approximately 6 percent; therefore, the GBT will operate only a few hours during the day so that the average daily concentration entering the aerobic digester is around 4.1 percent.

PHOTO 5-9
RAS Pump Motors

PHOTO 5-10
RAS Pumps

PHOTO 5-11
Existing WAS Pumps

Influent flow to a 1-meter GBT is approximately 175 gpm. **The existing WAS pumps are not fast enough to meet the higher flow demanded by the GBT, and a new pump is necessary. In addition, a thickened WAS pump from the GBT to the aerobic digester is necessary.**

Figure 5-5 shows a schematic of the WAS flow to the aerobic digester and the RAS flow to the aeration basins. The different flow rates and system heads can be met using variable-speed, centrifugal-type slurry pumps. By installing three pumps, one pump can be used to feed RAS to the aeration basins and one can alternate feeding WAS to the GBT and the aerobic digester. The discontinuity in flow to the digester while flow is diverted to the GBT is insignificant over the next 5 to 10 years. The schematic shows that if any of the three pumps is out of service, the other two can provide backup. When flow to the GBT increases to the point such that a discontinuity in flow to the digester is disruptive to the digester operation, a fourth pump will be necessary. With a fourth pump to act as backup, one of the three existing pumps can be used to feed the GBT while the other two serve the digester and the aeration basins.

The advantage to installing the same pumps for RAS and WAS services is it simplifies pump maintenance, reduces the number of parts that need to be kept in stock, and reduces the number of backup pumps.

The advantage to upgrading the WAS system is that it increases the capacity of the existing aerobic digester, omitting the need for a second digester during the next 20 years.

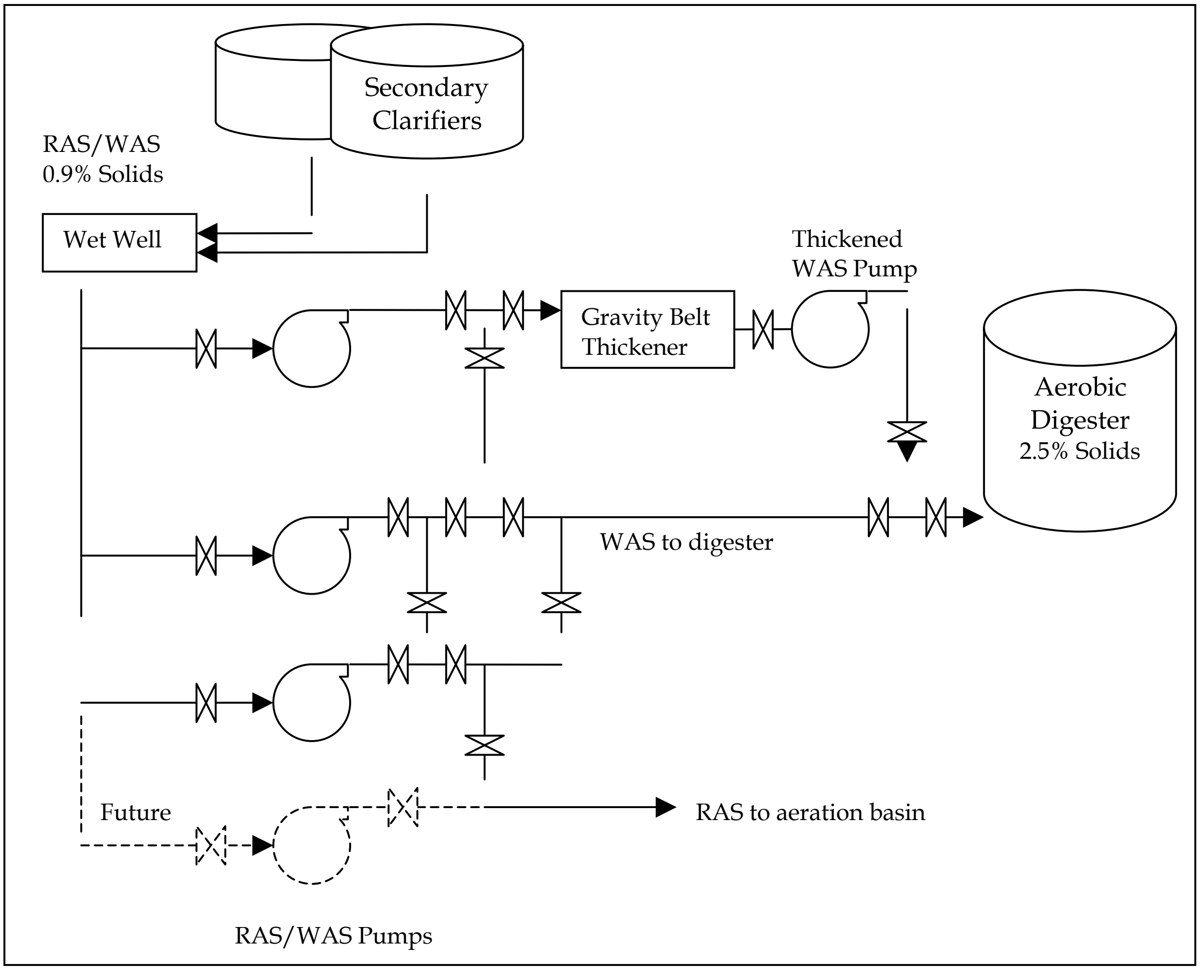


FIGURE 5-5
Schematic of Waste Activated Sludge to Aerobic Digester

5.5 Solids Handling and Digestion

5.5.1 Background

The existing solids handling system consists of an aerobic digester, a belt filter press, pumps, polymer system, and a truck loading area.

The current wasting to the digester is approximately 50,000 gallons per day. The detention time in the digester is about 8 days. The recommended detention time for activated sludge from a facility operating without primary settling is 12 to 18 days. The aerobic digester capacity (volume) is not sufficient to meet the current minimum time required to achieve the digestion goal of 40 percent destruction of volatile suspended solids.

5.5.2 Belt Filter Press Improvements

The 1-meter belt filter press (BFP) is approximately 20 years old. **The life span for BFPs is typically 20 years; therefore, the BFP will likely need replacing in the near future.** The

BFP has been maintained well by the staff, and belts have only required changing twice in the past 20 years. Typically, new BFP belts should last a minimum of 3,000 hours. Photo 5-12 shows the existing BFP. Photo 5-13 illustrates the dryness of the dewatered solids coming off the BFP. **It is recommended that the City consider replacing the BFP in the next 5 years** although the WWTF staff are happy with the current BFP and do not feel it needs immediate replacement.

PHOTO 5-12
City of Kenai WWTF Belt Filter Press

PHOTO 5-13
City of Kenai WWTF Belt Filter Press Dewatered Solids

5.5.3 Aerobic Digester Improvements

The digester has a capacity of 423,000 gallons (Photo 5-14). The solids concentration in the digester is approximately 8,500 mg/L, but varies ± 1,000 mg/L. A solids concentration of 25,000 mg/L is desirable. An aerobic digester can obtain 40 percent volatile suspended solids destruction when given adequate time to for digestion. **To accomplish this, the solids concentration entering the digester should be about 41,000 mg/L. To increase the WAS solids concentration from 9,000 to 41,000 mg/L, the flow needs to be thickened. Thickening can be achieved with a GBT.**

PHOTO 5-14
City of Kenai WWTF Aerobic Digester

The current average facility influent flow of 0.7 mgd represents approximately 25 percent of the peak design flow of 2.6 mgd for the WWTF. Based on the current average concentration of 3,000 mg/L to the aerobic digester, six aerobic digesters would be needed at peak design flow. However, by adding a GBT upstream of the digester and making changes to the aeration basin (Section 5.3), increased detention time can be gained.

By improving the sludge settling characteristic and increasing the solids concentration entering the digester to 41,000 mg/L, the flow rate to the digester can be reduced to 3,300 gallons per day at current average influent flow and 11,000 gallons per day at peak facility influent flow of 2.6 mgd. At peak design conditions, 38 days' detention can still be provided by one aerobic digester.

5.6 Summary of Wastewater Treatment Facility Improvements and Costs

5.6.1 Pretreatment Process Improvements and Costs

The following are improvements in the pretreatment process:

- Addition of a grit removal system
- Addition of a pipe to allow pumping of grease from the influent manhole directly to the digester if the grease ordinance fails to help reduce grease buildup in the influent manhole or if the contract grease hauler is no longer able to haul grease
- Installation of new fine screens and screening washer/compactor to prevent the downstream clogging of pipes and ragging of pumps

The benefits of these enhancements are detailed in Section 5.2 of this report.

The construction, O&M, and present-worth costs for improvements made to the pretreatment process are presented in Table 5-5. The present-worth costs are developed for a 20-year period at a 4 percent inflation rate.

TABLE 5-5
City of Kenai WWTF Cost Summary for Pretreatment Upgrades

Pretreatment Process	Capital Costs	Annual Operations and Maintenance Costs[a]	Present-Worth Costs for 20-Year Period
New Pump House	$329,000	$3,030	$395,000
Influent Manhole Modifications	$47,000	$840	$59,000
Grit Removal Cyclone	$89,000	$840	$101,000
Bar Screens	$633,000	$1,680	$657,000
Total for Upgraded System	**$1,098,000**	**$6,300**	**$1,212,000**

[a]Kilowatt-hour cost based on City of Kenai's September 2001 electrical bill

5.6.2 Aeration System Improvements and Cost

Several improvements can be made to the aeration system that will enhance performance of the aeration basins, secondary clarifier, and aerobic digester. These improvements are:

- Eliminate the need to run two blowers, thus reducing blower horsepower requirement with resultant energy cost savings.
- Convert the coarse bubble diffuser system to fine bubble in the last two-thirds of the aeration basins to significantly increase oxygen transfer efficiency and reduce electrical costs.

- Provide aeration flow control to maintain 2.0-mg/L oxygen concentration in the aeration basins.
- Allow for an aeration basin to be taken out of service for maintenance without impacting performance.
- Modify the aerobic digester aeration piping configuration and use air from aeration basin blowers, eliminating the need for the existing digester blowers and reducing the energy cost for operating the digester aeration system.

Upgrades to the aeration basin aeration system require:

- A new blower, one-half the capacity of the existing blower
- Two of the three aeration basins converted to fine bubble diffusers
- A mixer in the anoxic zone of three of the aeration basins
- Variable frequency driver motors on the aeration basin blowers
- Air flow control actuated butterfly valves on the 8-inch headers at the aeration basins
- Transmitting air flow indicator on the 8-inch headers at the aeration basins
- PLC programming changes to the blower controls, the actuated butterfly valve controls, DO indicator reading, and facility influent flow indicator reading

The advantages that can be achieved by incorporating these improvements are provided in Section 5.3 of this report.

Table 5-6 compares the cost of continuing to operate the coarse bubble aeration system and aerobic digester in their existing state versus upgrading them. While there are capital costs associated with upgrading the aeration system, the O&M costs decrease, and better facility operation is achieved.

5.6.3 Filament Control Improvements and Cost

The City's WWTF is currently experiencing very poor settling in the secondary clarifiers. This is impacting the downstream equipment and processes as well as significantly reducing the capacity of the existing two secondary clarifiers. Under existing conditions, a third secondary clarifier is required by the year 2020. This third secondary clarifier will be needed in order to take one secondary clarifier out for maintenance and still meet permit limits. An additional secondary clarifier can be avoided by implementing the following improvements:

- Retrofit the existing basins from complete mix to plug flow operations.
- Create an anoxic zone in the first one-third of the aeration basins by adding a divider wall in three aeration basins.
- Add an alkalinity recirculation pump in three aeration basins.

TABLE 5-6
City of Kenai WWTF Order-of-Magnitude Cost Comparison of Existing Versus Upgraded Aeration System

Aeration Process	Capital Costs	Annual Operations and Maintenance Costs[a]	Present-Worth Costs for 20-Year Period	Payback Period
Existing Coarse Bubble Aeration	$0	$74,000	$1,100,000	
Existing Aerobic Digester Blower System	$0	$78,000	$1,200,000	
Total for Existing System	**$0**	**$152,000**	**$2,300,000**	
Upgraded Fine Bubble Aeration	$300,000	$37,000	$900,000	
Upgraded Aerobic Digester Blower System	$200,000	$39,000	$800,000	
Total for Upgraded System	**$500,000**	**$76,000**	**$1,700,000**	**7 years**

[a] Kilowatt-hour cost based on City of Kenai's September 2001 electrical bill
An order-of-magnitude cost estimate is +50 to -30%.

A more detailed analysis of the improvements is provided in Section 5.3 of this report.

A cost comparison of constructing a third secondary clarifier versus modifying the aeration basins is provided in Table 5-7. The modifications made to the aeration basins cost less than the construction of a new secondary clarifier, allowing the City to use the existing structures at the WWTF.

TABLE 5-7
City of Kenai WWTF Order-of-Magnitude Cost Comparison of Constructing a Third Secondary Clarifier Versus Modifying the Aeration Basins

Process	Capital Costs	Annual O&M Costs	Present-Worth Costs for 20-Year Period	Payback Period
Construction of Third Secondary Clarifier	$1,600,000	$74,000	$2,700,000	
Aeration Basin Modifications for Filament Control	$1,700,000	$37,000	$2,200,000	N/A[a]

[a]This option allows the City of Kenai to use the WWTF's existing activated sludge system.

An order-of-magnitude cost estimate is +50 to -30%.

5.6.4 Return Activated Sludge/Waste Activated Sludge Process Improvements and Costs

The RAS/WAS comes from the underflow from the secondary clarifier. The RAS/WAS concentration is extremely low, approximately 0.2 percent, or 2,000 mg/L. A desirable RAS/WAS concentration is closer to 9,000 mg/L, almost five times higher. Operating the RAS/WAS at low concentrations requires the facility to waste a much greater volume of liquid to remove the necessary amount of solids than if the facility were operating at higher concentrations. Section 5.4 of this report discusses the modifications in greater detail.

Table 5-8 is a present-worth analysis over a 20-year period. The table compares the higher O&M costs for the existing RAS and WAS systems versus investing the necessary capital to upgrade the systems.

TABLE 5-8
City of Kenai WWTF Order-of-Magnitude Costs for RAS and WAS Upgrades

Summary of Present-Worth Costs	Capital Costs	Annual O&M Costs[a]	Present-Worth Costs for 20-Year Period	Payback Period
Existing RAS	$0	$10,000	$139,000	
Existing WAS	$0	$13,000	$183,000	
Total for Existing System	**$0**	**$23,000**	**$322,000**	
Upgraded RAS	$142,000	$5,000	$208,000	
Upgraded WAS	$22,000	$5,000	$89,000	
Total for Upgraded System	**$164,000**	**$10,000**	**$297,000**	**12 years**

[a] Kilowatt-hour cost based on September 2001 electrical bill for City of Kenai.

5.6.5 Aerobic Digester and Solids Handling System Improvements and Costs

Improvements to the aerobic digester system include adding a gravity belt thickener upstream of the digester and adding two mixers to the digester. The gravity belt thickener thickens the sludge entering the digester, which reduces the digestion volume required and aids the digestion process. The two mixers improve oxygen transfer efficiency inside the digester. The cost for modifying the aeration system is discussed in Section 5.5.2 of this report. The solids handling system can be improved by replacing the aging belt filter press. Section 5.5 of this report discusses the solids handling and digester upgrades in greater detail.

Table 5-9 provides the cost for upgrading the solids handling/digester system.

TABLE 5-9
City of Kenai WWTF Summary of Order-of-Magnitude Present-Worth Costs

Process	Capital Costs	Annual O&M Costs	Present-Worth Costs for 20-Year Period	Payback Period
Existing Aerobic Digester[a]	$3,833,000	$3,000	$3,882,000	
Existing Solids Handling System	$0	$4,000	$58,000	
Total for Existing System	**$3,833,000**	**$7,000**	**$3,940,000**	
Upgraded Aerobic Digester	$528,000	$3,000	$576,000	
Upgraded Solids Handling System	$510,000	$2,000	$539,000	
Total for Upgraded System	**$1,038,000**	**$5,000**	**$1,115,000**	N/A[b]

[a] Includes cost of building one additional aerobic digester.
[b] This option allows the City of Kenai to work with WWTF's existing digester system.

An order-of-magnitude cost estimate is +50 to -30%.

SECTION 6

Recommended Plan

6.1 Overview

Based upon the evaluation of the wastewater collection system described in Section 4 of this report and the evaluation of the WWTF in Section 5, a list of recommended capital improvements was developed. A prioritized list of recommended capital improvements is provided in Table 6-1.

6.2 Projects to Improve Wastewater Treatment Facility Operations

6.2.1 Approach to Wastewater Treatment Facility Improvements

The sewage collection system evaluation in Section 4 addressed each treatment process sequentially through the process train. This subsection reviews the proposed WWTF improvements developed in Section 5 and prioritizes them based on the following two goals:

- Minimizing O&M costs
- Increasing the efficiency of the existing WWTF

By increasing the efficiency of certain operations, the existing plant can operate for the next 20 years without adding additional aeration basins, clarifiers, or sludge digester tanks.

6.2.2 Activated Sludge System Improvements

6.2.2.1 Aeration Diffuser and Blower Improvements

The greatest opportunity for O&M cost savings is with the WWTF blower and aeration systems. The blowers currently provide three to four times the necessary oxygen concentration to the aeration basins, yet there is no way to efficiently control this with the existing equipment. The installation of one small blower with variable speed motors for the blowers, installation of an appropriate control system, and replacing the coarse bubble diffuser with fine bubble diffusers would lead to less power consumption and improved treatment.

A preliminary design report is recommended to detail how all recommended WWTP improvements can best be implemented. The next step would be developing bid-ready construction documents, along with acquisition of construction funds.

TABLE 6-1
Capital Improvements Summary for City of Kenai Wastewater Treatment and Collection

Phase	Description of Improvement	Capital Investment	Annual O&M Cost	Additional and/or Reduced O&M	Present-Worth Costs for 20-Year Period[a]
1	Activated Sludge System Improvements				
	Upgraded Fine Bubble Aeration	$300,000	$37,000		$900,000
	Upgraded Aerobic Digester Blower System	$200,000	$39,000		$800,000
	Subtotal	**$500,000**			
	Filament Control Improvements	$1,588,000	$400[b]		$1,800,000
	Subtotal	**$1,600,000**	**[c]**	**-$75,600**	
	RAS/WAS Process Improvements				
	Upgraded Waste Activated Sludge	$142,000	$4,700		$208,000
	Upgraded Return Activated Sludge	$22,000	$4,700		$89,000
	Subtotal	**$164,000**	**$9,400[d]**	**-$13,600**	**$297,000**
	Total Activated Sludge Improvements	**$2,300,000**	**$85,800**	**-$89,200**	**$3,800,000**
2	Suction/Jetter (Vactor) Truck	**$400,000**	**$3,500**	**0**	**$430,000[e]**
3	Pretreatment Process Improvements				
	New Pump House	$329,000	$3,030		$395,000
	Influent Manhole Modifications	$47,000	$840		$59,000
	Grit Removal Cyclone	$89,000	$840		$101,000
	Bar Screens	$633,000	$1,680		$657,000
	Total Pretreatment Process Improvements	**$1,098,000**	**$6,390**	**+$6,390**	**$1,212,000**
4	Aerobic Digester Solids Handling				
	Mechanical Upgrades for Aerobic Digester	$528,000	$3,400		$576,000
	Upgraded Solids Handling System	$510,000	$2,100		$539,000
	Recoating of Aerobic Digester	$350,000	N/A		$350,000
	Total Aerobic Digestion Solids Handling	**$1,400,000**	**$5,500[f]**	**0**	**$1,465,000**
Total for All Recommended Improvements		***$5,198,000***		***-$82,810***	***$6,907,000***

[a] Present value of Capital and O&M costs over a 20-year period at 4 percent interest.
[b] Approximately the same as present O&M costs in labor. The energy cost for operating the blowers are considered in Phase 3.
[c] This represents an annual O&M cost savings of approximately $76,000 over the present O&M costs for the aeration system or a 5-year payback period for the capital costs.
[d] This is an annual O&M cost savings of approximately $14,000 from the current WAS/RAS pumping system or a 12-year payback period for the capital costs.
[e] A 10-year period was used for the Present Value of the Vactor truck.
[f] Same as present O&M costs for conveying waste sludge to the aerobic digester.

O&M = operations and maintenance

6.2.2.2 Return Activated Sludge/Waste Activated Sludge Improvements

Taken together, the proposed improvements to the aeration system described above and the sludge pumping system described below can significantly improve the performance of the WWTF in terms of decreasing the costs of aeration and improving the settleability of the sludge.

The activated sludge treatment process works best when a steady low flow of sludge is returned to the aeration basin (RAS). The present pumps return too much sludge to the aeration basin because, as the operators have found, less flow will cause the pump influent lines to clog. This is not a desirable situation. It would be best if the RAS were able to deliver a lower flow, save pump energy, and improve the treatment efficiency.

The present WAS pumps are a progressive cavity type that requires frequent service. Changing to a simple centrifugal pump would save maintenance costs and improve treatment efficiency by allowing a steady low flow of waste sludge to be delivered to the aerobic digestion tank rather than larger intermittent flows.

6.2.2.2 Filament Control Improvement

As with most activated sludge WWTFs, the City's WWTF has the potential to develop problems with a floating sludge blanket. This is often caused by the predominance of filamentous organisms in the activated sludge. The aeration basins should be modified to a plug flow regime and providing an anoxic zone in the first third of each aeration basin. This will improve activated sludge settling by minimizing filamentous organisms in the activated sludge.

The benefit of this modification will be that the City would no longer need to operate both secondary clarifiers at all times. This will essentially make the second clarifier only a backup clarifier.

6.2.3 Aerobic Digester Solids Handling

Even with the improvements above and improved settleability of the activated sludge, obtaining a sufficiently high concentration of solids in the aerobic digestion tank may be difficult. A higher solids concentration means lower influent flow and a longer residence time within the digestion tank. Twelve to eighteen days is typically required for adequate digestion of sludge when there is no primary settling in the WWTF process. Presently, there is only 8 days digester residence time.

To increase the solids concentration entering the sludge digestion tank, a gravity belt thickener is recommended. This can be installed as shown in Figure 5-5. This will increase the capacity of the existing aerobic digestion tank to meet the projected waste loads for the next 20 years.

6.2.4 Pretreatment Process Improvements

Pumps and processes in the WWTF receive extra wear and are more prone to plugging if there is not adequate pretreatment. Pretreatment typically involves screening and grit removal. Currently, the WWTF does not use its two rotary screens, bypass screen, or screenings conveyor because they are quickly overloaded by the material entering the plant during peak flows. Washing and compacting the collected screenings to satisfy landfill requirements is required.

Grease is another problem for the WWTF. Grease accumulates in a 5-foot thick layer within the influent manhole. As shown in Figure 5-2 of this report, a modification is recommended to pump the grease from the influent manhole to the aerobic digester. The aerobic digester should be capable of degrading the grease.

6.3 General Operations and Maintenance Improvements

6.3.1 Equipment and Maintenance Improvements

The following are the most significant projects identified for the replacement of equipment:

- **Acquisition of a new suction/jetter truck**–Vactor (a subsidiary of Federal Signal Corporation) is a leading manufacturer, and these trucks are often referred to as Vactor trucks. This is a necessary piece of equipment for maintenance of the wastewater collection system and for the wastewater treatment system as well. The suction/jetter truck has the ability to flush sewer mains, vacuum clogged manholes, and clean debris from lift stations and sewage treatment equipment. It is a general-purpose piece of equipment that can be used by the City in a variety of ways. The existing Vactor truck is aged and in need of replacement (Section 4).
- **Recoating of the aerobic digestion tank at the WWTF**–The purpose of the 423,000-gallon aerobic digester is to hold waste sludge and, through aeration (aerobic digestion), inactivate any harmful microorganisms. There is no other tank for this purpose. Since the tank's construction in 1982, its interior has not been recoated. The tank interior was not inspected as a part of this study. Inspection, evaluation, and, if necessary, recoating of the aerobic digestion tank is recommended as a high-priority item because deferring this project could result in significantly higher costs in repairing or replacing this tank along with the severe disruption in the WWTF processes if this sludge tank were out of service for an extended time.

6.3.2 Fats, Oils, and Grease Program

The City has a problem with fats, oils, and grease in the sewage collection system as evidenced by the significant accumulation of grease in the influent manhole to the WWTF. The City is considering an ordinance to limit fats, oils, and grease from entering the sewage collection system, and substantial reductions in these substances may be realized if the ordinance is complied with. Appendix F contains a sample ordinance.

6.3.3 Pretreatment at Wildwood Prison

According to City maintenance staff, a significant quantity of debris enters the collection system from the Wildwood prison. Despite the installation of a grinder pump in lift station 13 (Mile 14, North Road), floatable material accumulates in the wet well, and shredded material continues downstream.

Although not specifically required by regulation, some form of pretreatment is typically installed for prison wastewater before it enters a community sewage system. Wildwood prison does not have a system for debris removal before discharging to the City's sewer along Wildwood Station Road.

A grinder station with solids removal may be a viable pretreatment option for the prison. A grinder station is primarily a grinder and not a pump. Typical manufacturers include JWC Environmental, makers of the "Muffin Monster" grinder. Certain models can be obtained that screen and convey solids out of the waste flow.

6.3.4 Work Order System

A work order system that tracks repairs and maintenance tasks is recommended. If such a system were managed electronically and interfaced with the City's KenaiView GIS system, it could become a powerful tool for coordinating work and planning maintenance. The key to this organization would be to log the location of each maintenance item (ID of the pipe, lift station, manhole, or cleanout) so that the GIS system could track the geographic location of repairs done in the system.

6.3.5 Inflow Protectors

Inflow protectors are plastic discs of minimal cost that can be inserted between a manhole frame and lid. They help prevent surface water from entering the sewer system through or along the manhole cover. These are recommended for the areas where inflow appears to be the greatest problem (Basin 12–Mission Street and Basin 3–Golf Course). Inflow protectors are inexpensive and could result in cost saving to the City in terms of pumping costs.

SECTION 7

Funding Strategies

7.1 Funding

The Kenai City Council recently increase the water and sewer rates by 10 and 12 percent effective June 15, 2003. This was the first increase since 1993 and provides funds for basic operation and maintenance costs. However, grants and/or loans should be pursued for all capital improvements.

Various grants and loans are available to cover costs associated with planning, design, and construction of wastewater projects from state and federal agencies. Support is also available for technical training and technical assistance. The following is an alphabetical listing of grants and loans, their description, and contacts for more information. The provided web sites are very informative and may answer many questions regarding the various programs.

7.1.1 Grants

Community Block Grant Program

This grant program is managed by the Department of Housing and Urban Development and by ADCED to provide financial assistance in areas that address health and safety needs. The grant offers financial resources to communities for public facility planning, design, and construction. Specific project activities may include water and sewer facilities construction, landfill construction, acquisition of property, relocation and demolition, and rehabilitation of structures. Municipal governments (except Anchorage) are eligible for this program. In addition, 51 percent of the persons who benefit from a funded project must be of low-to-moderate income. The Community Block Grant Program applications are distributed to eligible municipalities in September or October. Applications must be submitted around December or January (details in application) and awards are made the following spring.

Contact:

Jo Cooper, Block Grant Administrator
Department of Community and Regional Affairs
209 Forty Mile Avenue
Fairbanks, AK 99701-3301
Phone: (907) 452-4468 Fax: (907) 451-7251
E-mail: jo_cooper@dced.state.ak.us
http://wwwcomregaf.state.ak.mradcdbg.html
http://www.hud.gov/progdesc/cdbg-st.

Municipal Matching Grants: Water, Sewerage, and Solid Waste Grant Program

The Alaska Department of Environmental Conservation (ADEC) provides partial grants and engineering assistance to incorporated municipalities for planning, design, and construction projects in the area of water, sewer, and solid waste. ADEC mails a survey to eligible communities, which they must fill out to illustrate needed facility improvements. The Office of Management and Budget reviews the surveys and the Governor chooses suitable projects and requests funding from the State legislature.

Contact:

Jim Eversen, Program Manager
Department of Environmental Conservation
Division of Facility Construction and Operation
Municipal Grants and Loans Unit
410 Willoughby Avenue
Juneau, AK 99801
Phone: (907) 465-6594 Fax: (907) 465-5177
E-mail: Jim_Eversen@DEC.state.ak.us
http://www.state.ak.us/dec/dfco/mlp1.htm

Public Works and Development Facilities Program

The U.S. Department of Economic Development Administration funds this grant program to assist communities experiencing economic distress and whose economic growth is lagging behind the rest of the country. The program provides financial assistance to communities for water and wastewater treatment systems, access roads to industrial parks or sites, port improvements, and tourism projects with the goal of creating permanent jobs in the private sector. Grants from $200,000 to $2,000,000 are awarded to Tribal governments, cities, municipalities, boroughs, and public or private nonprofit organizations.

Contact:

Bernhard E. Richert, Jr.
Economic Development Representative
550 W. 7th Avenue Suite 1700
Anchorage, AK 99501
Phone: (907)271-2272 Fax:(907)271-2273/2274
E-mail: brichert@doc.gov
http://www.doc.gov/eda
http://www.eda.gov

U.S. Department of Agriculture Water and Waste Disposal Grants

U.S. Department of Agriculture (USDA) Rural Development manages this grant program to communities with a population of 10,000 or less, with priority given to populations less than 5,500, municipalities, boroughs, Alaska Native villages, and nonprofit corporations. The aim of the program is to bring the cost of water and waste disposal down to an affordable level for rural community users by providing assistance to construct, repair, modify, expand, or otherwise improve water supply, water distribution, waste collection, waste treatment, storm drainage, and solid waste disposal systems. Funding is also available for legal and engineering fees associated with the development of such systems.

Contact:

John LaVarnway
800 W. Evergreen, Suite 201
Palmer, AK 99645
Phone: (907) 761-7705 Fax: (907) 761-7783
E-mail: jlavarnw@rdmail.rural.usda.gov
http://www.usda.gov/rus/water/programs.htm#PROGRAMS

7.1.2 Loans

Alaska Clean Water Fund

The EPA and ADEC manage this low-interest loan program offered to municipalities. The loans are available for planning, design, and construction of wastewater treatment facilities, construction and rehabilitation of sewer collection systems, studying nonpoint source pollution, managing estuaries, protecting groundwater, and implementing control measures for combined sewers. Eligible communities can receive a questionnaire in February, which is due by mid-March.

Contact:

Jim Eversen, Program Manager
Department of Environmental Conservation
Division of Facility Construction and Operation
Municipal Grants and Loans Unit
410 Willoughby Avenue
Juneau, AK 99801
Phone: (907) 465-6594 Fax: (907) 465-5177
E-mail: Jim_Eversen@DEC.state.ak.us
http://www.state.ak.us/dec/dfco/mlp1.htm

Alaska Municipal Bond Bank Authority

The State of Alaska Department of Revenue provides loans to Alaskan municipalities for financing any capital projects.

Contact:

Deven Mitchell, Executive Director
Alaska Municipal Bond Bank Authority
P.O. Box 110405
Juneau, AK 99811-0405
Phone: (907) 465-2388 Fax: (907) 465-2902
E-mail: ambba@revenue.state.ak.us
http://www.revenue.state.ak.us/treasury/ambba/ambba.htm

U.S. Department of Agriculture Water and Waste Disposal Loans

USDA Rural Development provides this loan program to small communities that are unable to obtain loans at reasonable rates and terms from conventional lenders. The rural communities must have a population of 10,000 or less, with priority given to populations less than 5,500, municipalities, boroughs, Alaska Native villages, and nonprofit corporations. The loan offers assistance to construct, repair, modify, expand, or otherwise improve water supply, water distribution, waste collection, waste treatment, storm drainage, and solid waste disposal systems. Funding is also available for legal and engineering fees associated with the development of such systems.

Contact:

John LaVarnway
800 W. Evergreen, Suite 201
Palmer, AK 99645
Phone: (907) 761-7705 Fax: (907) 761-7783
E-mail: jlavarnw@rdmail.rural.usda.gov
http://www.usda.gov/rus/water/programs.htm#PROGRAMS

7.1.3 Training and Technical Assistance

The following is a list of programs that provide funding for training and technical assistance to communities.

Alaska Training/Technical Assistance Center

The EPA manages this training and technical assistance program with the aim to enhance the technical abilities of operators of small public water and wastewater systems. Training and technical assistance is free to the community. For those applying for continuing education units, a nominal processing fee is assessed based on the number of credits.

Contact:

Lee Michalsky, Program Director
Environmental Technology Program
University of Alaska Southeast/Sitka
1332 Seward Ave.
Sitka, AK 99835
Phone: toll free (888) 750-3823 or (907) 747-7755 Fax: (907) 747-7753
E-mail: lee.michalsky@uas.alaska.edu
http://www.water-alaska.org

Operator Training and Certification Program

The ADEC offers onsite technical assistance and training, correspondence courses, and classroom technical training to certify and advance community water and wastewater operators. The ADEC provides resources, including a library of training videos, textbooks, and reference materials. Through this program, the ADEC is also able to collect the concerns of operators and direct them to the Governor's Water/Wastewater Works Advisory Board.

Contact:

Ken Smith, Certification Officer
Department of Environmental Conservation
410 Willoughby Ave., Suite 303
Juneau, AK 99801-1795
Phone: (907) 465-5140 Fax: (907) 465-5177
E-mail: ksmith@envircon.state.ak.us
http://www.state.ak.us/dec/dfco/dec_dfco.htm#Operations

Wastewater Assistance Program

The ADEC Division of Facility Construction and Operation Assistance Unit and the EPA work together to provide training to operate and maintain wastewater facilities to extend the average facility life and protect public health. Program participants also receive onsite wastewater system evaluation, research on optimal equipment and necessary parts, and help with discharge permits and laboratory testing. Assistance is available for communities with a wastewater treatment plant larger that 5 million gallons per day (mgd) and a willing plant operator.

Contact:

Van Madding, 104 Assistance Provider
Department of Environmental Conservation
410 Willoughby Ave., Suite 303
Juneau, AK 99801-1795
Phone: (907) 465-5142 Fax: (907) 465-5177
E-mail: vmadding@envircon.state.ak.us
http://www.state.ak.us/dec/dfco/dec_dfco.htm#Operations

Appendix A
Technical Memorandum–
Inflow and Infiltration Study Approach

TECHNICAL MEMORANDUM **CH2MHILL**

City of Kenai - Wastewater Facility Master Plan - I&I Study

PREPARED FOR: Project File

PREPARED BY: Eric Lehan/ANC Kevin Schmidt/PDX Bill Nelson, Wm. J. Nelson & Associates, Kenai

DATE: December 3, 2001

PURPOSE

The purpose of this memorandum is to outline a plan for data collection and analysis for an inflow and infiltration (I&I) study for the City of Kenai.

BACKGROUND

The City of Kenai has a population of approximately 7,000. The sewage collection system consists of approximately 50 miles of sewer main and 16 duplex sewage lift stations. The soil is generally sandy. Most of the sewer pipe is asbestos-cement. The terrain is generally flat.

EXISTING DATA SOURCES

1. **Kenai WWTP** – have daily total flows in digital format dating back over 5 years. Strip charts of instantaneous flow from the main plant flowmeter are archived at the WWTP.

2. **Hourly rainfall/temperature records** – available though NOAA since about 1950 to present as measured at the Kenai airport. A subscription has been purchased to access this data via the NOAA web site.

3. **Sewer System Mapping** – City of Kenai's Water and Sewer Index and aerial photography may allow estimate of the population served and major facilities within the collection area for each lift station.

4. **Sewage Lift Station Records** – Some or all of the pertinent as-built records and pump design specifications may be available at the City of Kenai's Public Works office. This should include pump design data (pump curves), lift station drawings in plan and profile view, piping layouts, etc., if available.

5. **Pump run-time records** – April 2000 – May 2001 currently available for each lift station. Additional data collected monthly. Monthly data sheets list the run time for each pump at each lift station.

6. **Instantaneous pump status** – Sewage pump status is transmitted by radio to the City's SCADA panel at the main shop office. A screen display shows which sewage pumps are running at each lift station (Pump 1, Pump 2, or Both). A program feature has been added to record the pump hour meter at 5 minute intervals. The City staff have successfully downloaded the data for November 2001 and emailed the compressed file to Eric Lehan/ANC. Plans are to continue with this on a monthly basis.

APPROACH

Phase 1: **Present to 10/4/2001** - (CH2M HILL staff) Collect the available data per items #1 – #2 above. Compare plant influent over time to rainfall/freezeup events over the same time period. Evaluate for any readily discernable trends or issues for the collection system as a whole.

Deliverable: Baseline hydrograph (seasonal);

Phase 2: **Start 10/4/2001 complete 12/6/2001** - (Wm. J. Nelson & Associates) Compile a sewer system map per item #3 above to define the areas served by each lift station, the population served, and any major facilities served within each basin. Collect the available lift station records per item #4.

Deliverable: (1) Sewage system map with service areas defined for each lift station and an estimate of average normal dry weather flows in each area with supporting data. (2) Lift station data report.

Start 10/4/2001 complete 11/15/2001 - (CH2M HILL) Make preliminary evaluation of pump run time versus rainfall/breakup events. Note any discernable trends.

Phase 3: **Start 11/15/2001 complete 1/15/2001** - (CH2M HILL) Perform inspection and evaluation of individual lift stations. Make field estimates of pump discharge for individual lift stations. It is assumed that reasonable estimates of pump discharge can be obtained *without confined space entry.* Evaluate individual lift stations in terms of design discharge for the existing system versus field estimate of discharge.

Deliverable: Data report.

GOALS:

1) Estimate the volume of inflow and infiltration.

2) Identify the major sources of I&I and those which are practical to eliminate.

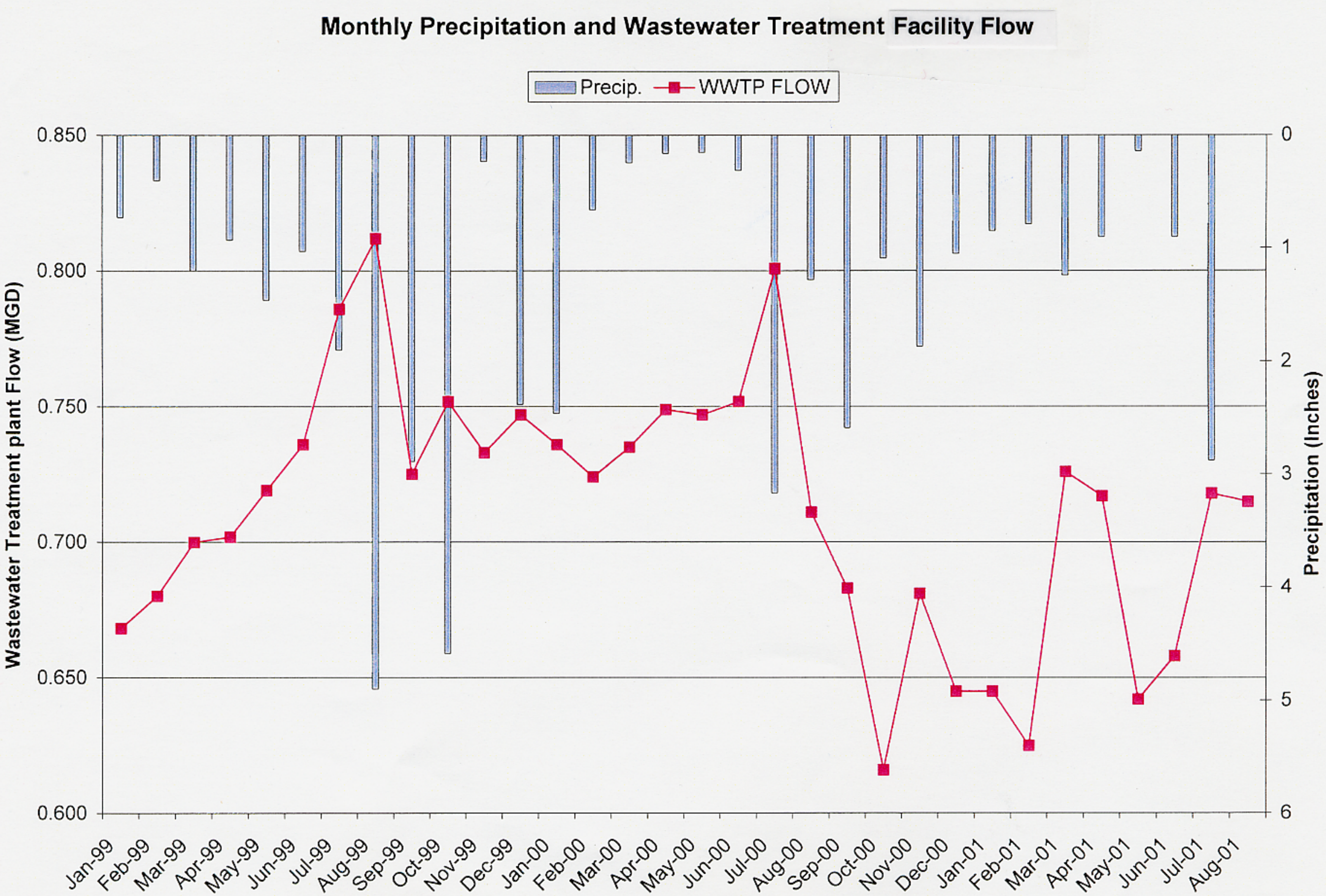
3) Estimate the costs to eliminate the I&I sources that are practical to eliminate.

4) Estimate the cost of pumping and treating the I&I that is practical to eliminate.

5) Compare the cost of eliminating the removable I&I sources with the cost of transporting and treating the removable I&I.

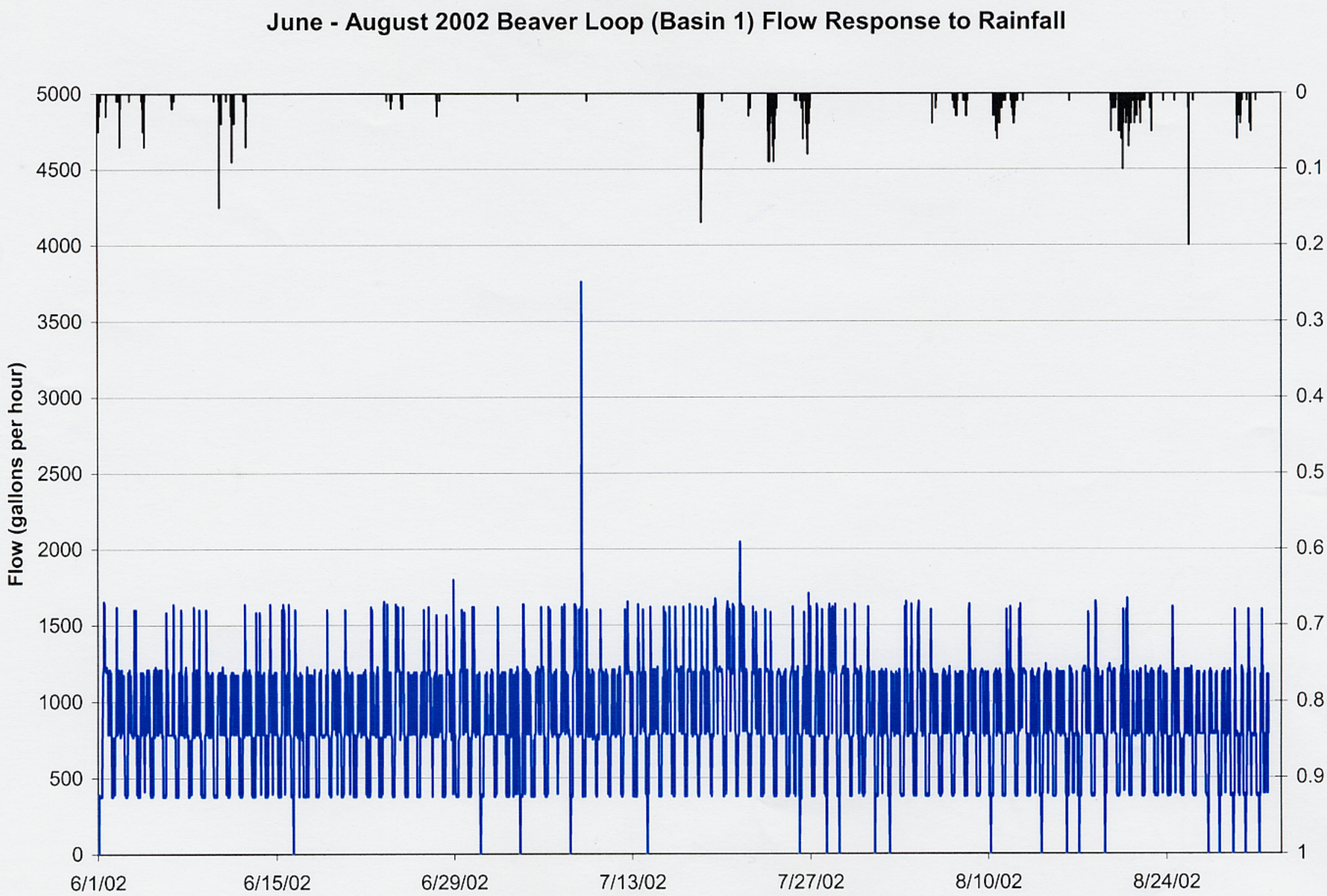
6) Make recommendations how to proceed (go/no-go or specific areas to investigate further).

Appendix B
Wastewater Treatment Facility–
Monthly Hydrographs

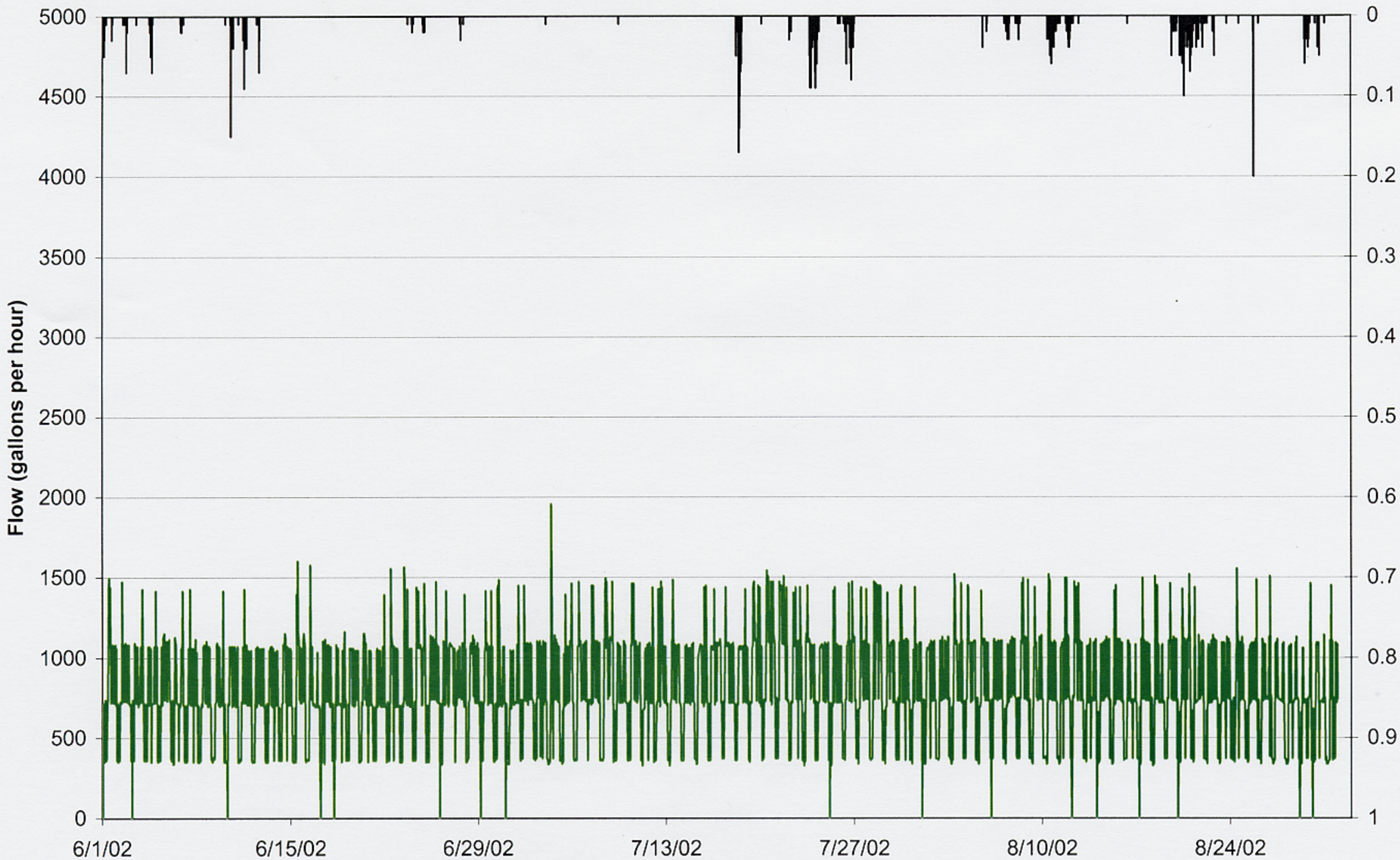


Monthly Precipitation and Wastewater Treatment Facility Flow
Precip.
WWTP FLOW
Wastewater Treatment plant Flow (MGD)
Precipitation (Inches)
0.850
0.800
0.750
0.700
0.650
0.600
0
1
2
3
4
5
6
Jan-99
Feb-99
Mar-99
Apr-99
May-99
Jun-99
Jul-99
Aug-99
Sep-99
Oct-99
Nov-99
Dec-99
Jan-00
Feb-00
Mar-00
Apr-00
May-00
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Jun-01
Jul-01
Aug-01

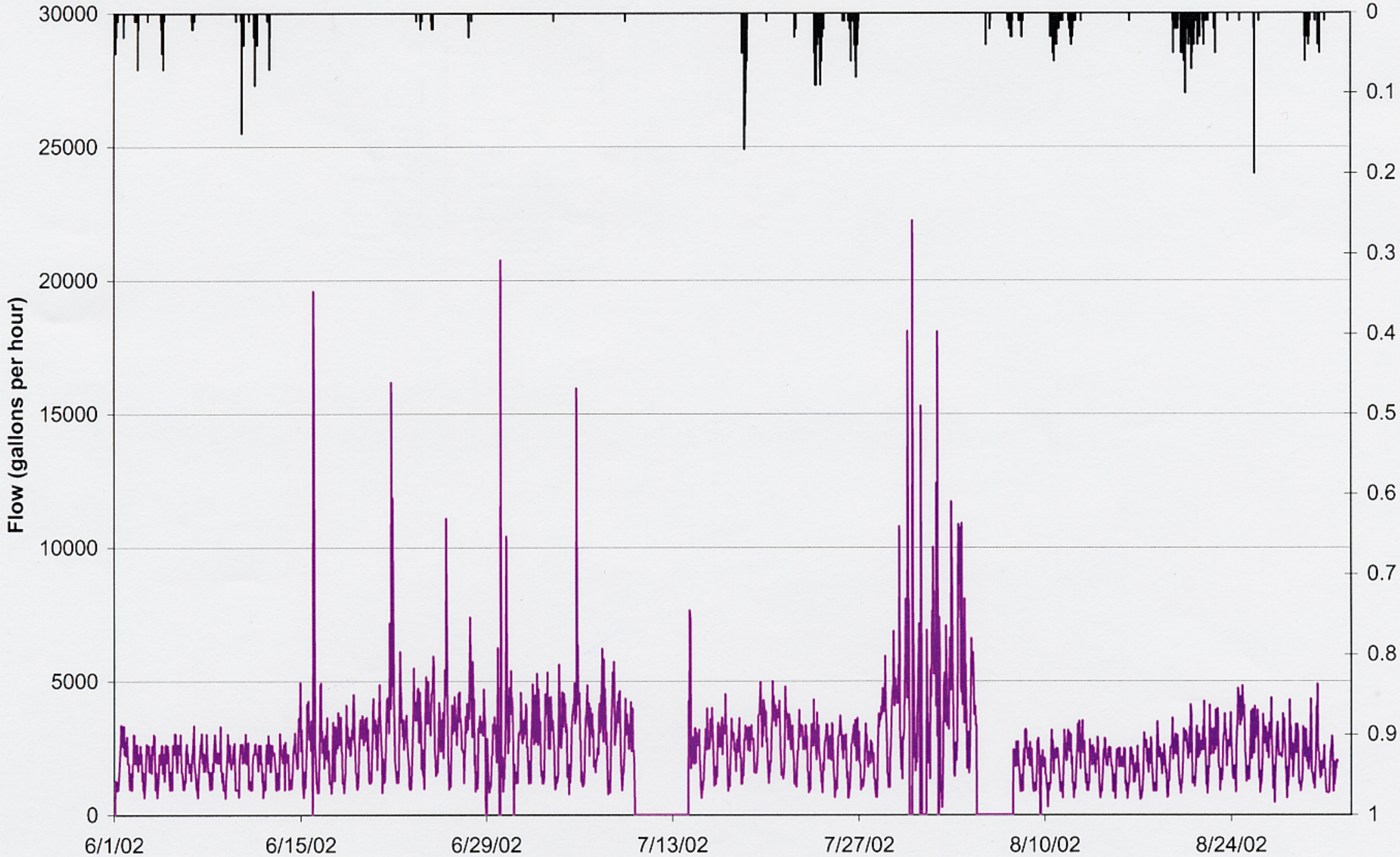
Appendix C
Sewage Lift Stations–June to August 2002 Flow Response to Rainfall

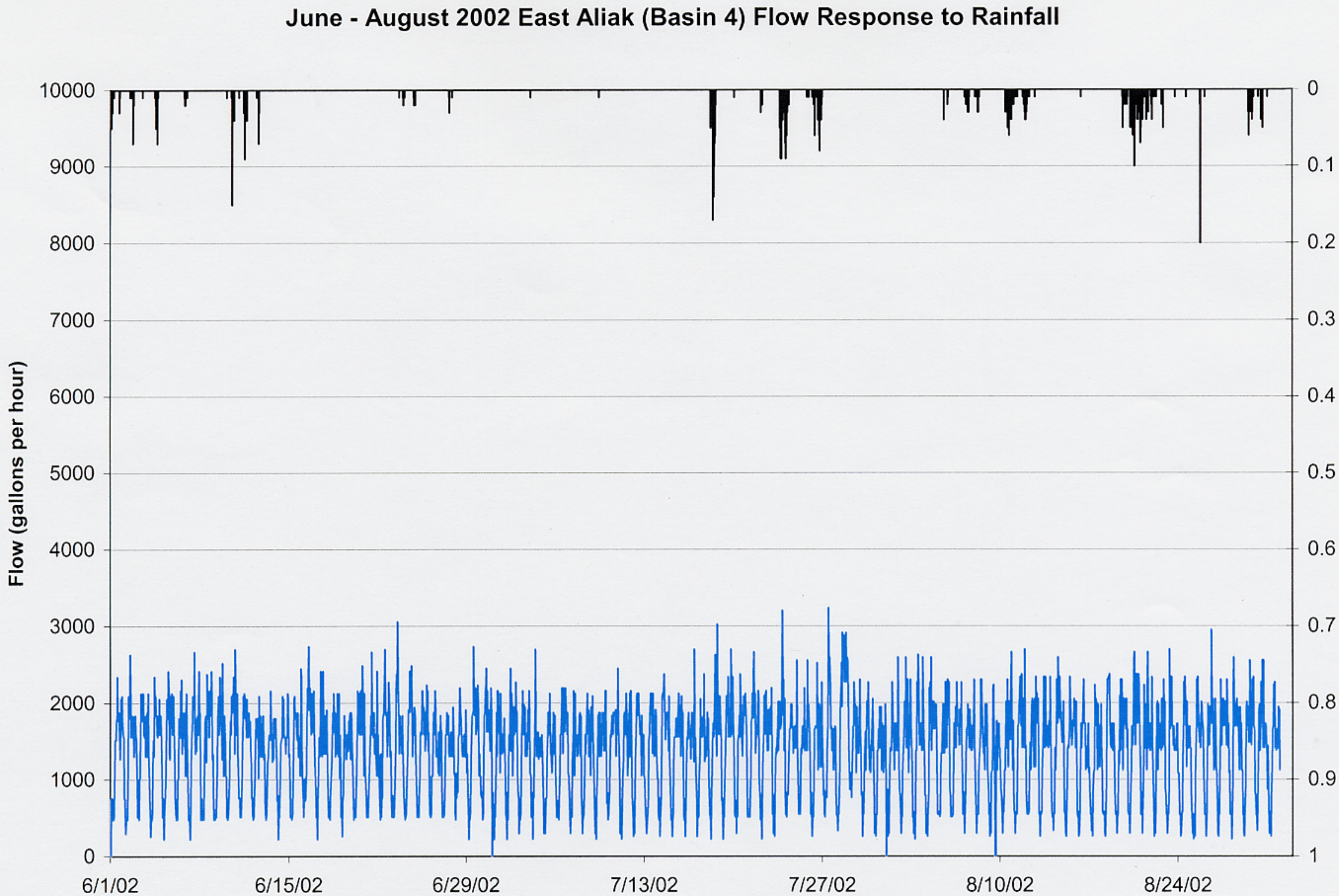

June - August 2002 Beaver Loop (Basin 1) Flow Response to Rainfall
Flow (gallons per hour)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/1/02
6/15/02
6/29/02
7/13/02
7/27/02
8/10/02
8/24/02

June - August 2002 Aleene Street (Basin 2) Flow Response to Rainfall

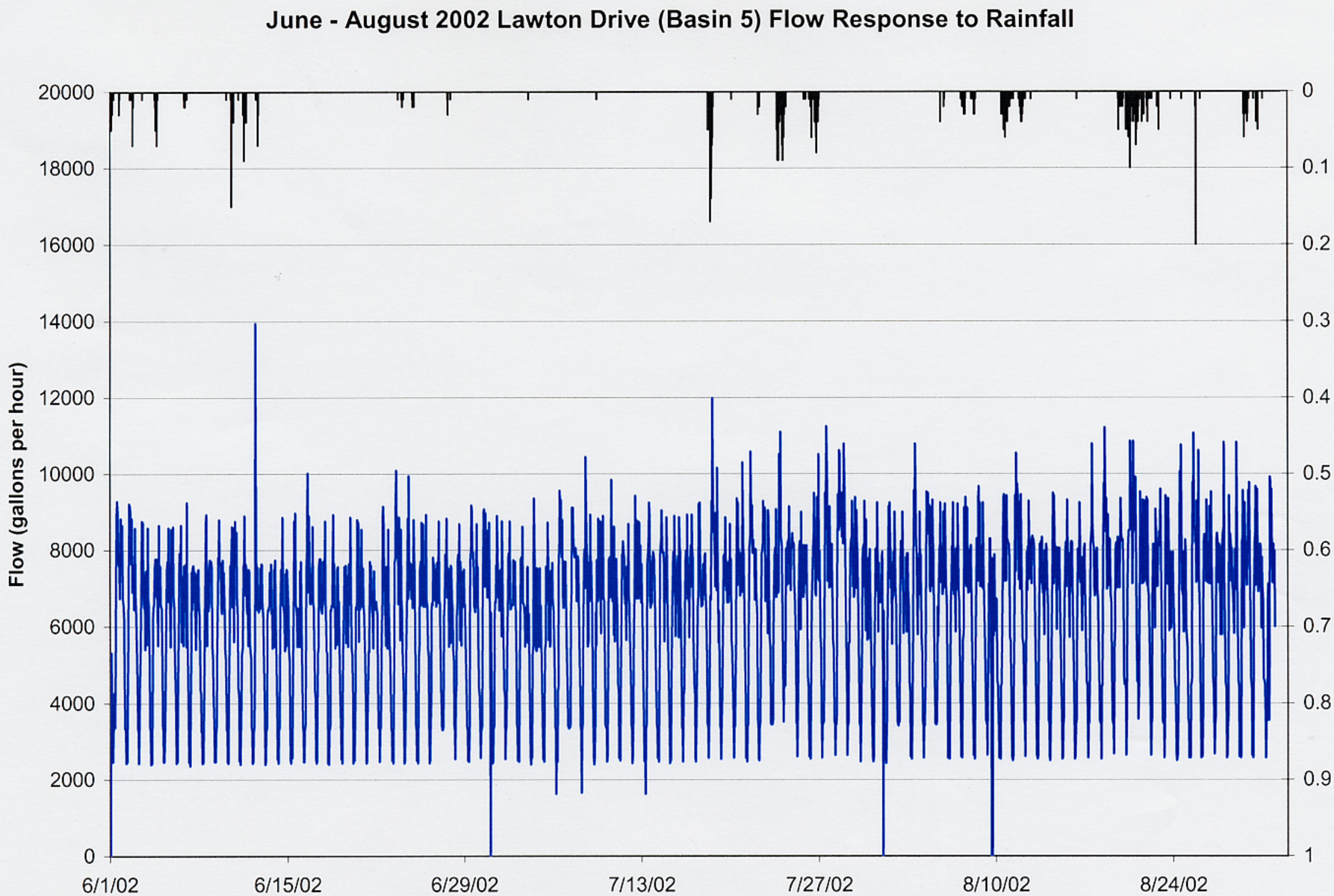


June - August 2002 Golf Course (Basin 3) Flow Response to Rainfall

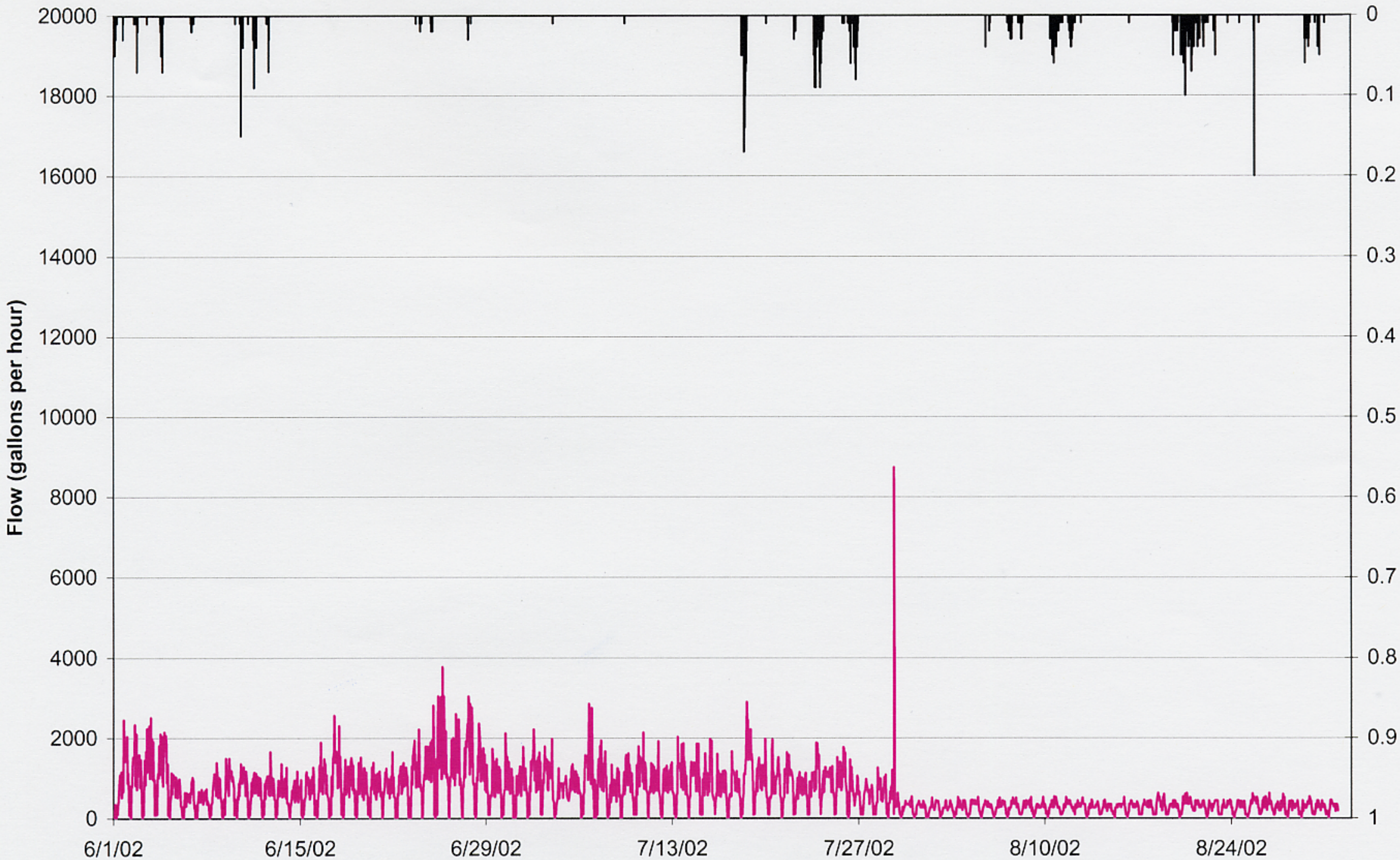




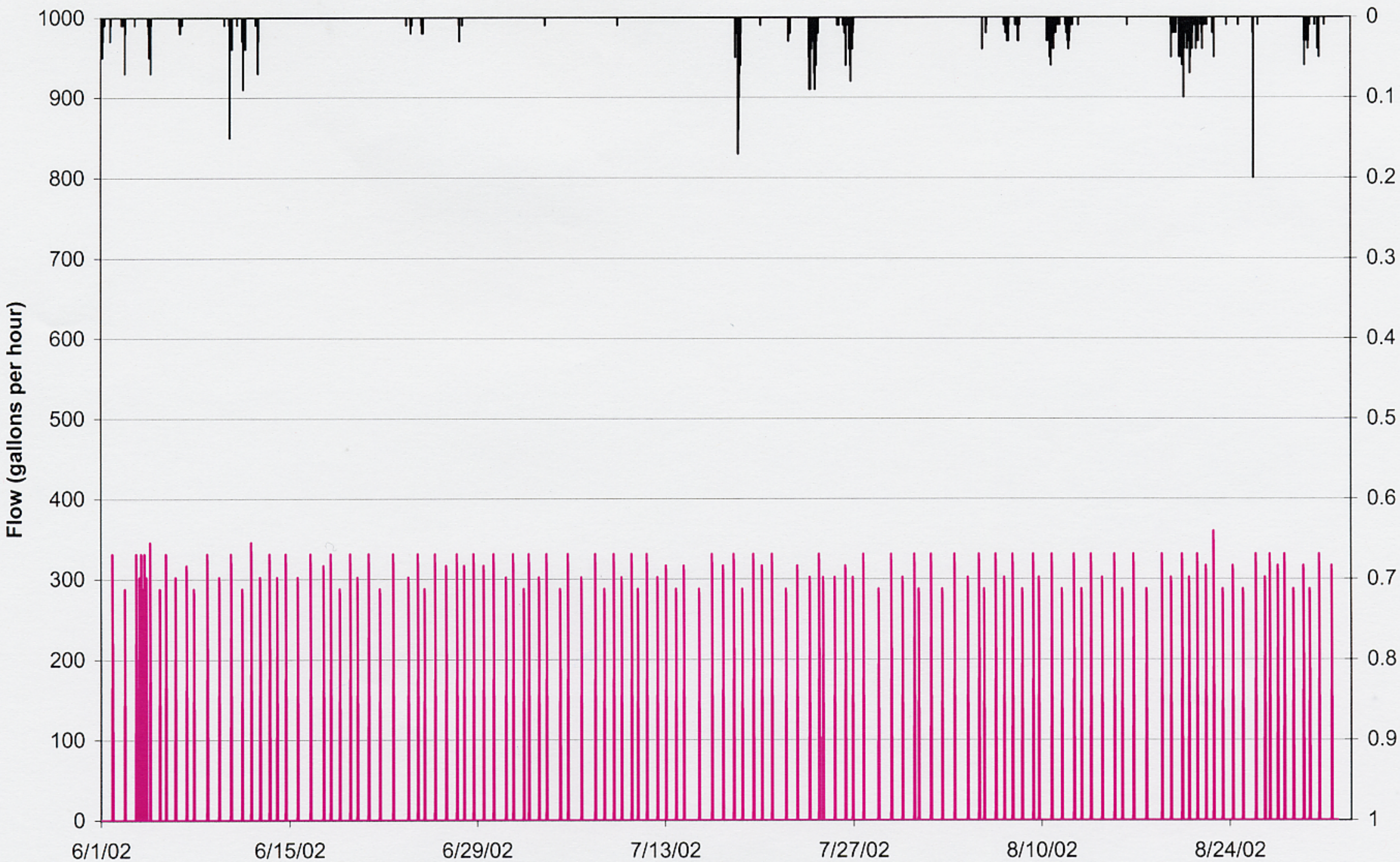
June - August 2002 East Aliak (Basin 4) Flow Response to Rainfall
Flow (gallons per hour)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/1/02
6/15/02
6/29/02
7/13/02
7/27/02
8/10/02
8/24/02

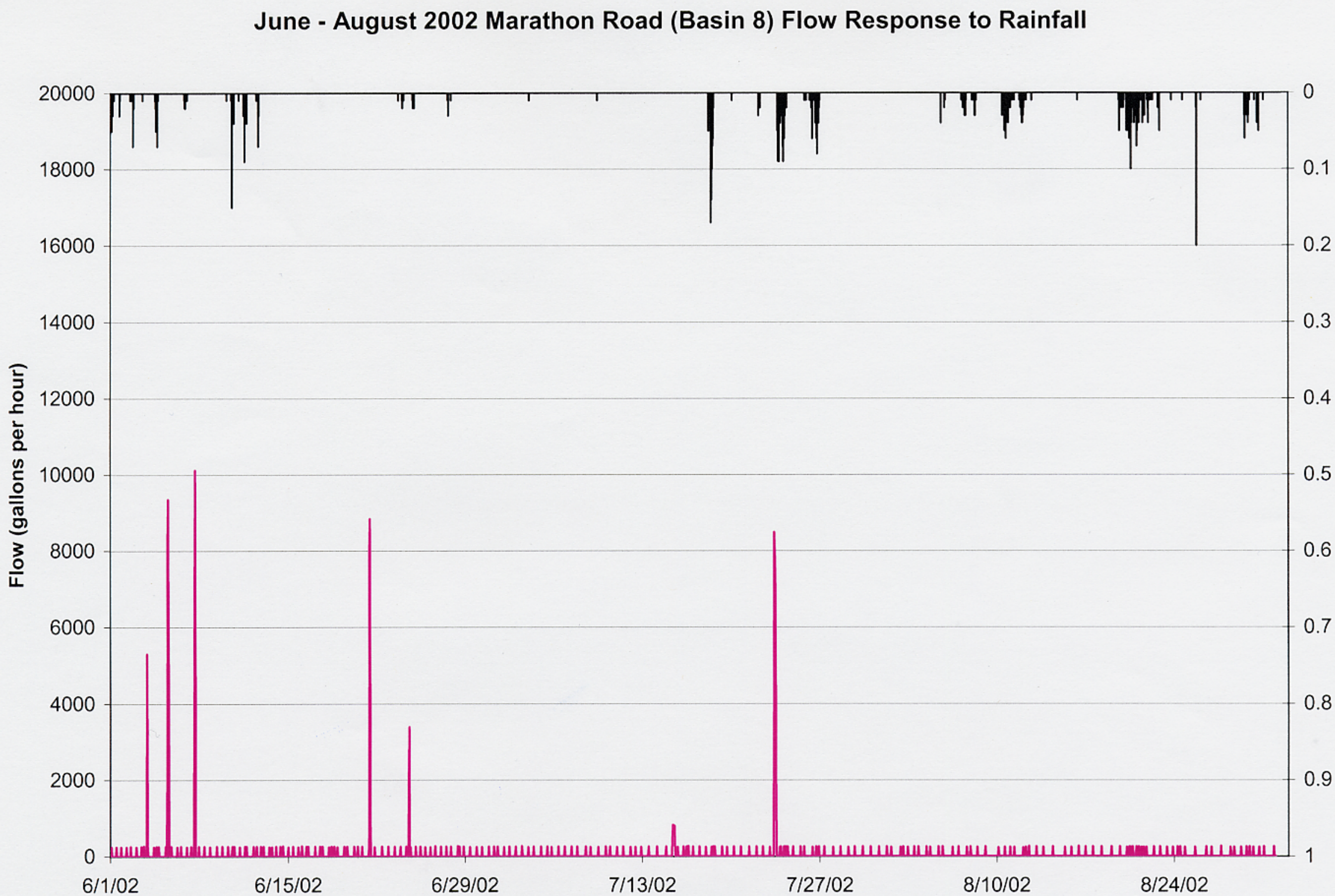

June - August 2002 Lawton Drive (Basin 5) Flow Response to Rainfall
Flow (gallons per hour)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/1/02
6/15/02
6/29/02
7/13/02
7/27/02
8/10/02
8/24/02

June - August 2002 Walker Lane (Basin 6) Flow Response to Rainfall

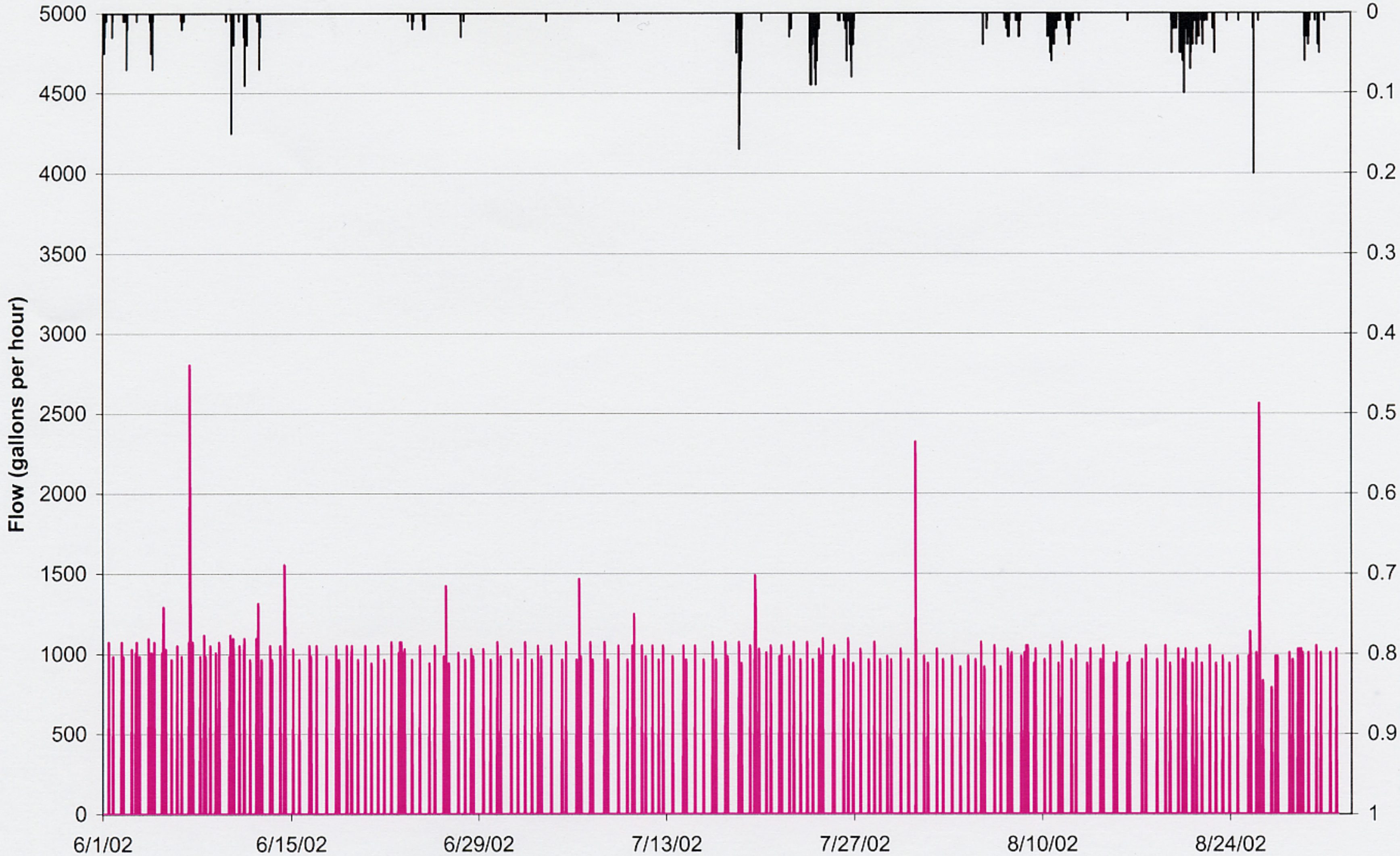


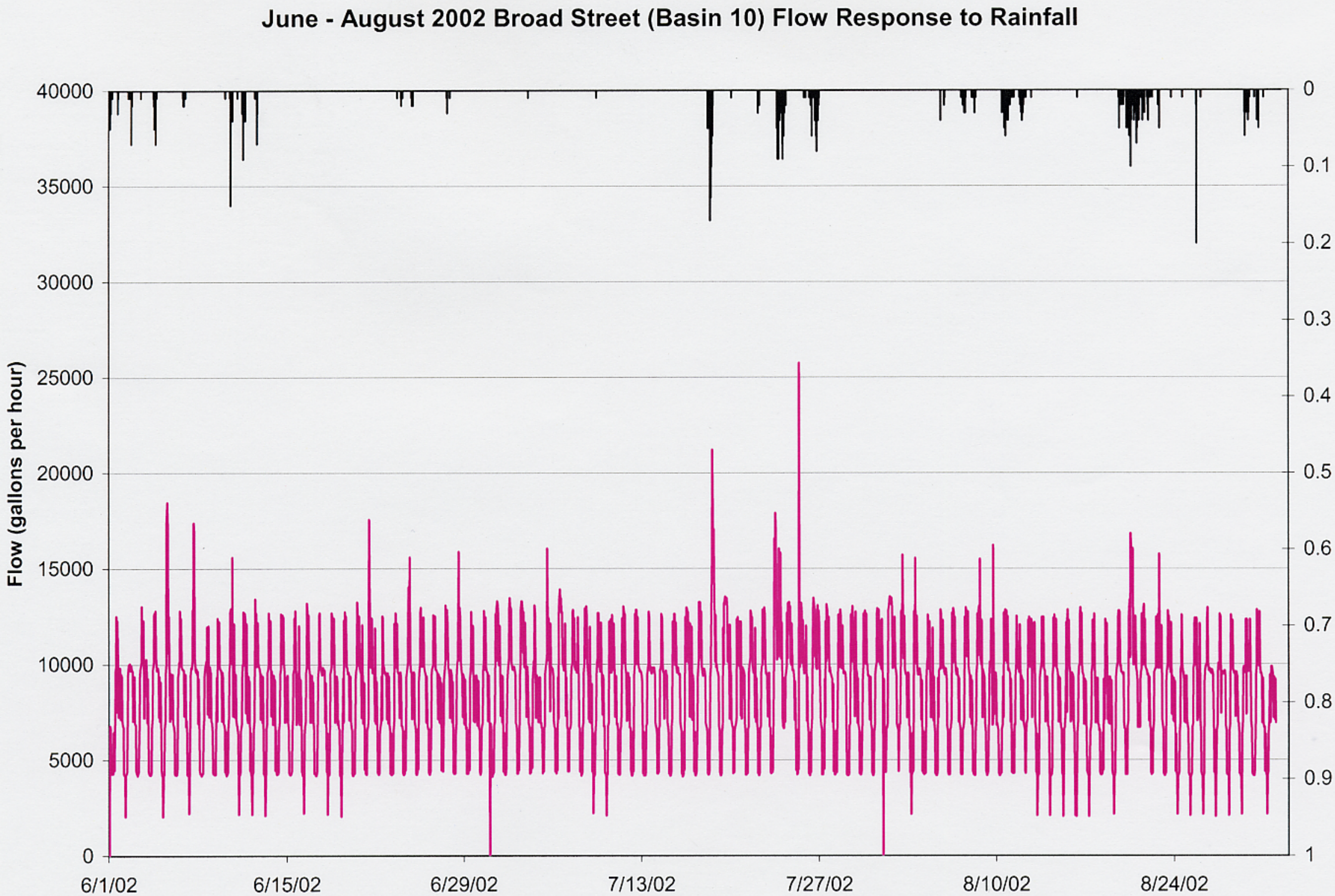
June - August 2002 Granite Point (Basin 7) Flow Response to Rainfall

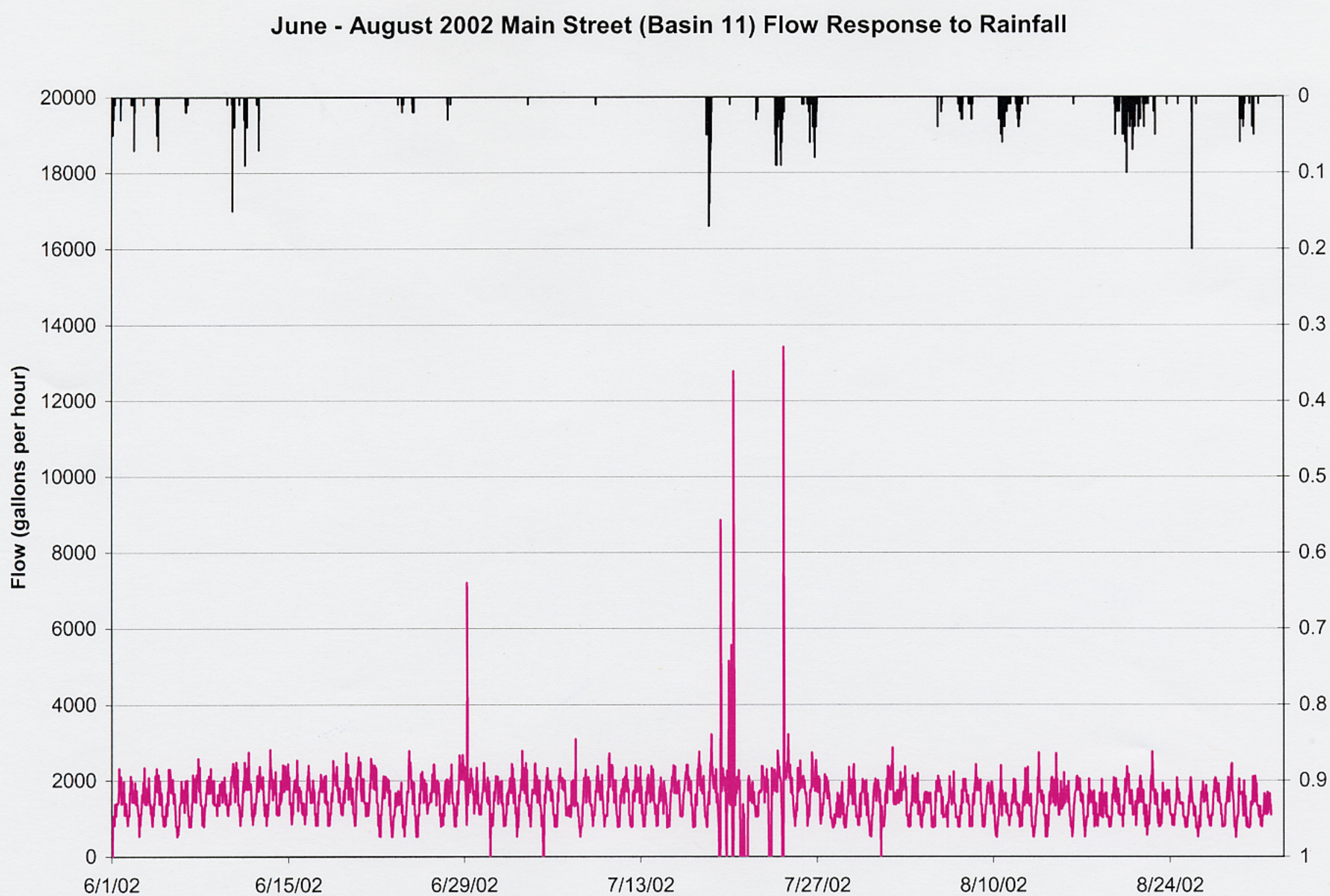



June - August 2002 Marathon Road (Basin 8) Flow Response to Rainfall
Flow (gallons per hour)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/1/02
6/15/02
6/29/02
7/13/02
7/27/02
8/10/02
8/24/02

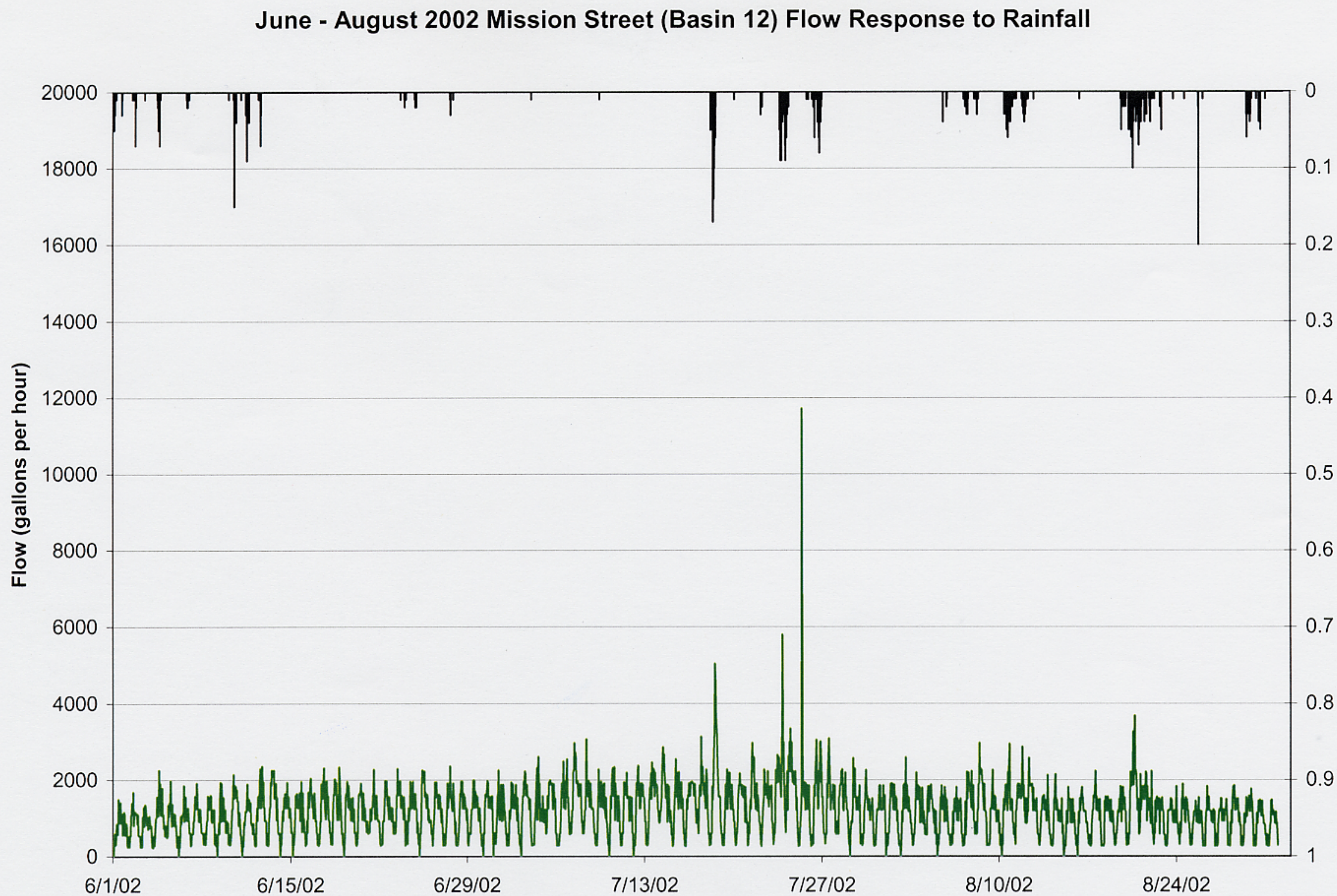
June - August 2002 Control Tower (Basin 9) Flow Response to Rainfall




June - August 2002 Broad Street (Basin 10) Flow Response to Rainfall
Flow (gallons per hour)
40000
35000
30000
25000
20000
15000
10000
5000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/1/02
6/15/02
6/29/02
7/13/02
7/27/02
8/10/02
8/24/02

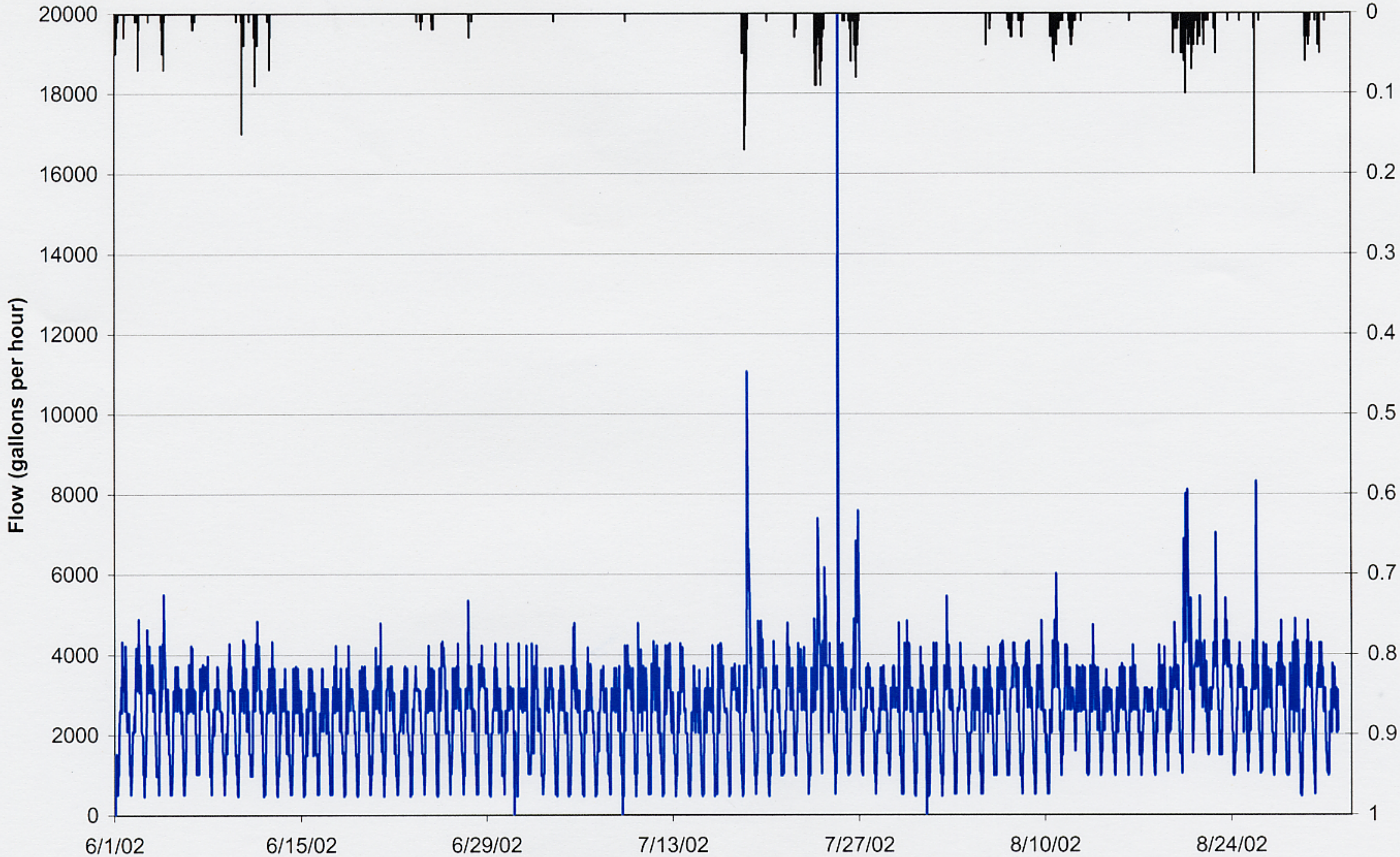


June - August 2002 Main Street (Basin 11) Flow Response to Rainfall
Flow (gallons per hour)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/1/02
6/15/02
6/29/02
7/13/02
7/27/02
8/10/02
8/24/02

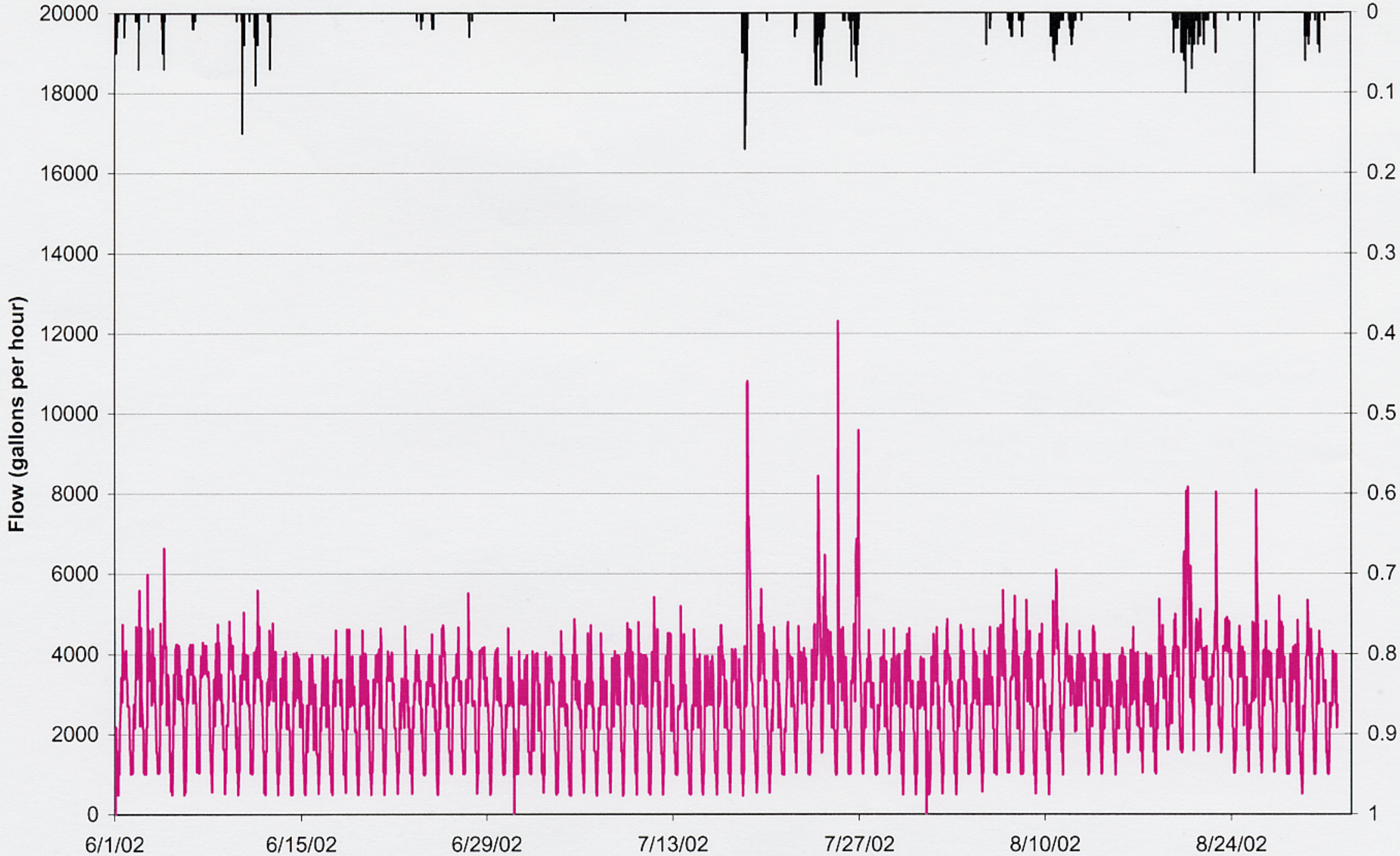


June - August 2002 Mission Street (Basin 12) Flow Response to Rainfall
Flow (gallons per hour)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/1/02
6/15/02
6/29/02
7/13/02
7/27/02
8/10/02
8/24/02

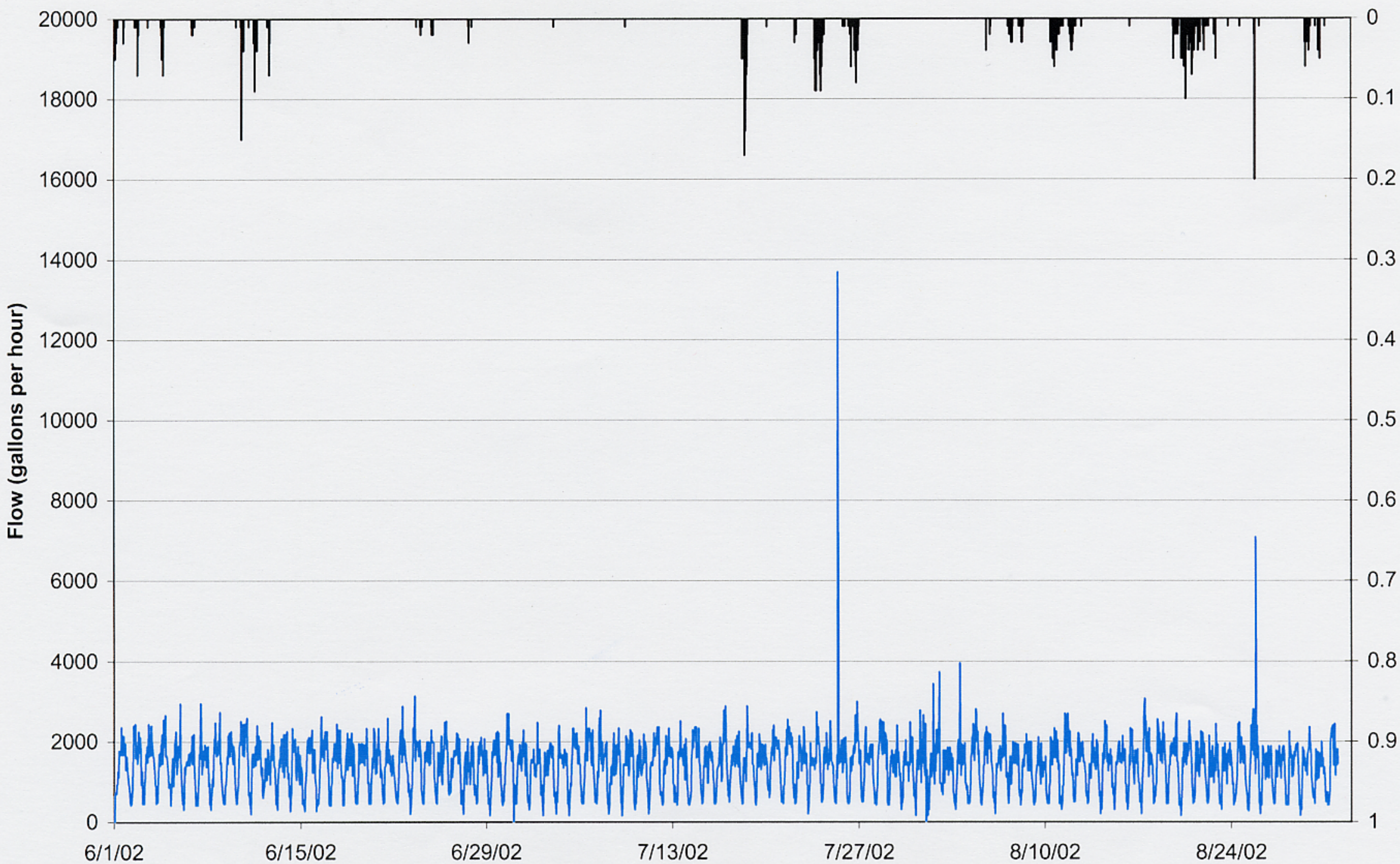
June - August 2002 Mile 14 North Road (Basin 13) Flow Response to Rainfall



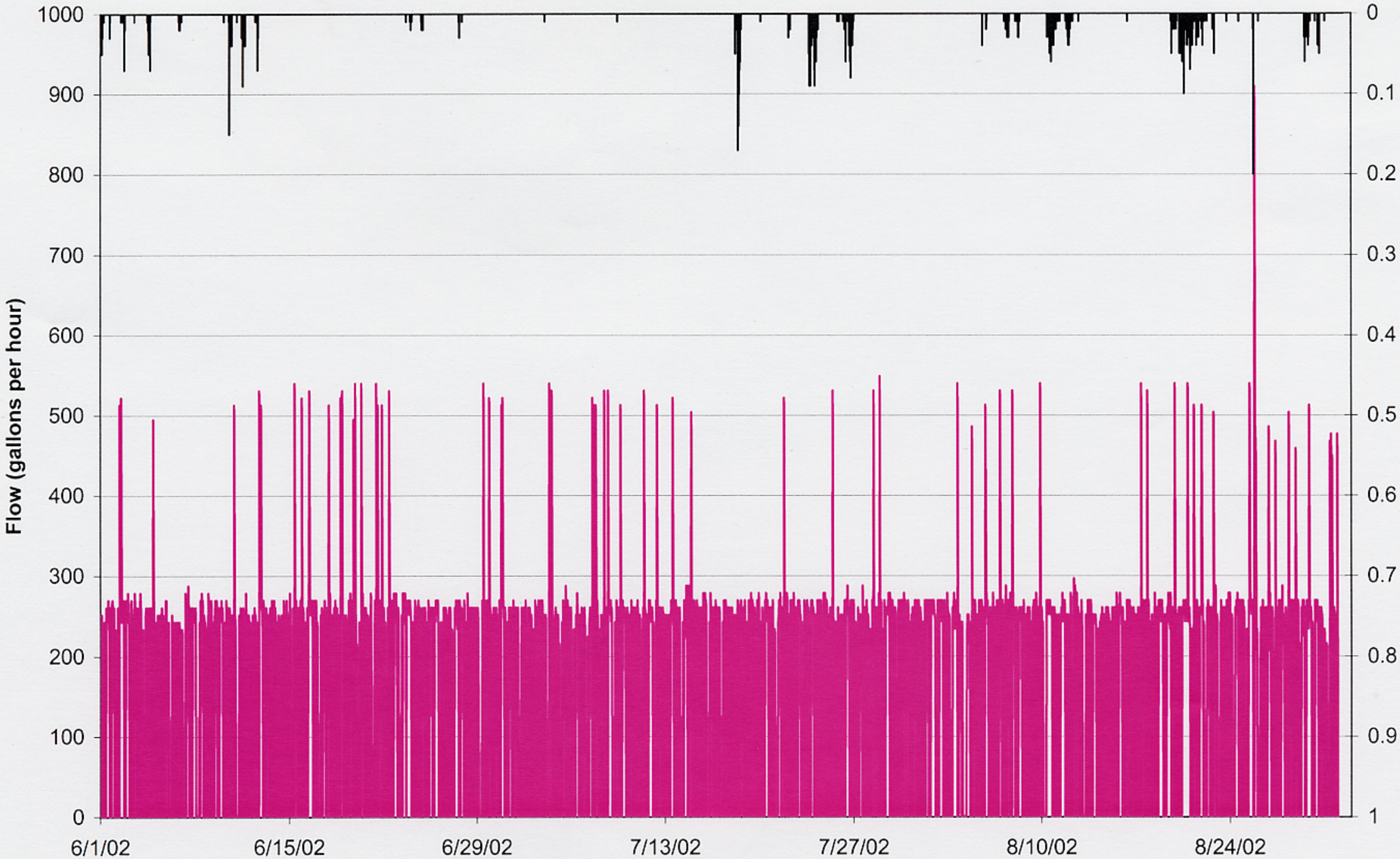
June - August 2002 Mile 13 North Road (Basin 14) Flow Response to Rainfall



June - August 2002 Redoubt Street (Basin 15) Flow Response to Rainfall



June - August 2002 Inlet Woods (Basin 16) Flow Response to Rainfall



Appendix D
Sewage Lift Station Data

CITY OF KENAI WASTEWATER FACILITY MASTER PLAN
LIFT STATION DATA COLLECTION SUMMARY

	BEAVER CR	ALEENE ST	GOLF	EAST ALIAK	LAWTON DR	WALKER LN	GRANITE PT	MARATHON RD
DIA OF MANHOLE (FT)	8	8	6	6	6	6	6	6
ELEV OF PUMP #1 ON (FT)	3.8	3.8	3.5	3.3	5.5	3.3	3.3	3.3
ELEV OF PUMP #2 ON (FT)	4.6	4.6	4.4	4.4	6.5	4.4	4.4	4.4
ELEV OF PUMP OFF (FT)	2.3	2.3	2.5	2.3	2.3	2.3	2	2
VOLUME #1 PER CYCLE (FT^3)	75.4	75.4	28.3	28.3	90.5	28.3	36.8	36.8
VOLUME #2 PER CYCLE (FT^3)	115.6	115.6	53.7	59.4	118.8	59.4	67.9	67.9
VOLUME #1 PER CYCLE (GAL)	564.0	564.0	211.5	211.5	676.8	211.5	274.9	274.9
VOLUME #2 PER CYCLE (GAL)	864.8	864.8	401.8	444.1	888.3	444.1	507.6	507.6
DEPTH OF LIFT STATION (FT)	24.67	23.17	27.17	21.33	23.6	21.5	19	19.75
OUTLET PIPE, DIST FROM TOP (FT)	13.92	13	9.42	5	8.3	6	5.25	7.83
STATIC HEAD, SH (FT)	8.5	7.9	15.3	14.0	13.0	13.2	11.8	9.9
FLOW TYPE	PRESSURE	PRESSURE	GRAVITY	GRAVITY	GRAVITY	GRAVITY	GRAVITY	GRAVITY
IF PRESSURE, ADDITIONAL SH (FT)	27.9	35.2	-	-	-	-	-	-
DIST TO NEXT MANHOLE (FT)	800	5603	100	330	250	290	30	320
OUTLET PIPE DIA (IN) & TYPE	6 HDPE	6 HDPE	8 DIP	12 ACP	16 ACP	10 ACP	8 ACP	8 DIP
MANNING'S ROUGHNESS COEF, n	0.0135	0.0135	0.0135	0.12	0.012	0.012	0.012	0.0135
INLET PIPE DIA (IN) & TYPE	12 DIP	12 DIP	8 DIP	12 ACP	16 ACP	8 ACP	8 DIP	8 DIP
PUMP #1								
BRAND	ABS	ABS	FLYGT	ABS	FLYGT	FLYGT	ABS	FLYGT
MODEL	AFP-N-7-EX	AFP-10-EX	3085.091	AF-30-4	3102.090	3101.180	AF-13-4W	3085.091
RPM	1150	1750	1700	1750	1700	1700	1750	1700
IMPELLER	270/1	230/1	434	CB31	437	435	CB24	438
PHASE	3	3	3	3	3	3	1	3
DISCHARGE DIA (IN)	ASSUMED 4	ASSUMED 4	4	4	4	4	4	4
HORSE POWER	7.5	10	3.2	4	5	5	1.75	2.2
VOLTS	208	208	230	208	?	230/460	230	230
AMPS	22.8	31	10.4	13.6	13	13.4/6.4	10.1	6.4
HEAD LOSS IN VERTICAL PIPE (FT)	0.7	0.5	1.3	3.5	1.3	4.0	0.8	0.4
F PRESSURE, LOSS IN HORZ PIPE (FT)	5.2	25.4	-	-	-	-	-	-
TOTAL HEAD (FT)	**42.3**	**69.0**	**16.6**	**17.5**	**14.3**	**17.2**	**12.6**	**10.3**
DISCHARGE RATE, Q (GPM)	**310**	**255**	**310**	**560**	**460**	**625**	**270**	**215**
LOCATION ON PUMP CURVE	**GOOD-H**	**FAIR-H**	**GOOD-L**	**GOOD-L**	**GOOD-L**	**FAIR-L**	**GREAT-H**	**GOOD-L**
PUMP #2								
BRAND	ABS	ABS	FLYGT	ABS	FLYGT	FLYGT	ABS	FLYGT
MODEL	AFP-N-7-EX	AFP-10-EX	3085.091	AF-30-4	3101.180	3101.180	AF-13-4W	3085.091
RPM	1150	1750	1700	1750	1700	1700	1750	1700
IMPELLER	270/1	230/1	434	CB31	435	435	CB24	438
PHASE	3	3	3	3	3	3	1	3
DISCHARGE DIA (IN)	4	4	4	4	ASSUMED 4	4	4	4
HORSE POWER	7.5	10	3.2	4	5	5	1.75	2.2
VOLTS	208	208	230	208	?	230	230	230
AMPS	22.8	31	10.4	13.6	13.4/6.7	13.4	10.1	6.4
HEAD LOSS IN VERTICAL PIPE (FT)	0.7	0.5	1.3	3.5	4.0	4.0	0.8	0.4
F PRESSURE, LOSS IN HORZ PIPE (FT)	5.2	25.4	-	-	-	-	-	-
TOTAL HEAD (FT)	**42.3**	**69.0**	**16.6**	**17.5**	**17.0**	**17.2**	**12.6**	**10.3**
DISCHARGE RATE, Q (GPM)	**310**	**255**	**310**	**560**	**625**	**625**	**270**	**215**
LOCATION ON PUMP CURVE	**GOOD-H**	**FAIR-H**	**GOOD-L**	**GOOD-L**	**FAIR-L**	**FAIR-L**	**GREAT-H**	**GOOD-L**

CITY OF KENAI WASTEWATER FACILITY MASTER PLAN
LIFT STATION DATA COLLECTION SUMMARY

	CONTROL TOWER	BROAD ST	MAIN ST	MISSION ST	MILE 14	MILE 13	REDOUBT ST	INLET WOODS
DIA OF MANHOLE (FT)	6	6.7 / 10.7	22	6.0	6	6	6	6
ELEV OF PUMP #1 ON (FT)	3.8	7	3.8	3.3	7	4.4	2.4	1.4
ELEV OF PUMP #2 ON (FT)	4.6	7.5	4.6	4.4	8	5	3.8	2.1
ELEV OF PUMP OFF (FT)	2.3	3	2.3	2.3	2.3	2.3	1.8	0.5
VOLUME #1 PER CYCLE (FT^3)	42.4	285.0	570.2	28.3	132.9	59.4	17.0	25.4
VOLUME #2 PER CYCLE (FT^3)	65.0	320.0	874.3	59.4	161.2	76.3	56.5	45.2
VOLUME #1 PER CYCLE (GAL)	317.2	2131.8	4265.1	211.5	994.0	444.1	126.9	190.3
VOLUME #2 PER CYCLE (GAL)	486.4	2393.6	6539.8	444.1	1205.5	571.0	423.0	338.4
DEPTH OF LIFT STATION (FT)	21.17	27.5	22	24.4	25.3	26.75	25.7	20.75
OUTLET PIPE, DIST FROM TOP (FT)	8	18.25	10.6	10.5	15	7.75	4.7	5.67
STATIC HEAD (FT)	10.9	6.3	9.1	11.6	8.0	16.7	19.2	14.6
FLOW TYPE	GRAVITY	PRESSURE	PRESSURE	PRESSURE	GRAVITY	GRAVITY	GRAVITY	GRAVITY
IF PRESSURE, ADDITIONAL SH (FT)	-	7.0	-0.3	2.2	-	-	-	-
DIST TO NEXT MANHOLE (FT)	400	1900	200	280.0	15	400	360	150
OUTLET PIPE DIA (IN) & TYPE	8 DIP	12 DIP	6 HDPE	6 DIP	12 DIP	16 DIP	12 ACP	10 DIP
MANNING'S ROUGHNESS COEF, n	0.0135	0.0135	0.010	0.0135	0.0135	0.0135	0.0135	0.0135
INLET PIPE DIA (IN) & TYPE	8 DIP	16 DIP	10 ACP	10 ACP	12 DIP	16 DIP	12 ACP	10 DIP
PUMP #1								
BRAND	ABS	FLYGT	FLYGT	ABS	FLYGT	ABS	FLYGT	FLYGT
MODEL	AFP-1040-M-18/4W	3152.09	CP3085.092	AF-22-4	3127.09	AF-30-4	3101	3085.181
RPM	1780	1150	1705	1750	1735	1750	1700	1700
IMPELLER	3.5"	612	436	CB21	492	CB32	434	438
PHASE	1	3	1	3	3	3	3	1
DISCHARGE DIA (IN)	4	8 or 10	4	4	ASSUMED 4	4TN	ASSUMED 4	3
HORSE POWER	2.4	14	2.4	2.6	10	4	5	2.4
VOLTS	230	230	230	230	230	230	230/460	230
AMPS	12.1	38.4	10	7.8	13	12.3	13.4	10
HEAD LOSS IN VERTICAL PIPE (FT)	0.7	0.1	0.6	1.2	4.3	3.0	1.5	1.3
IF PRESSURE, LOSS IN HORZ PIPE (FT)	-	9.6	7.4	4.1	-	-	-	-
TOTAL HEAD (FT)	**11.6**	**23.0**	**16.8**	**19.1**	**12.3**	**19.7**	**20.7**	**15.9**
DISCHARGE RATE, Q (GPM)	**265**	**1250**	**260**	**350**	**850**	**470**	**300**	**150**
LOCATION ON PUMP CURVE	**GREAT-L**	**GOOD-H**	**IDEAL**	**IDEAL**	**FAIR-L**	**GREAT-L**	**IDEAL**	**GREAT-H**
PUMP #2								
BRAND	ABS	FLYGT	FLYGT	ABS	FLYGT	ABS	FLYGT	FLYGT
MODEL	AFP-1040-M-18/4W	3152.090	CP3085.092	AF-22-4	3127.09	AF-30-4	3101	3085.181
RPM	1780	1150	1705	1750	1735	1750	1700	1700
IMPELLER	3.5"	612	436	CB21	492	CB32	435	438
PHASE	1	3	1	3	3	3	3	1
DISCHARGE DIA (IN)	4	8 or 10	4	4	ASSUMED 4	4	ASSUMED 4	3
HORSE POWER	2.4	14	2.4	2.6	10	4	5	2.4
VOLTS	230	230	230	230	230	230	230/460	230
AMPS	12.1	38.4	10	7.8	13	12.3	13.4	10
HEAD LOSS IN VERTICAL PIPE (FT)	0.7	0.1	0.6	1.2	4.3	3.0	4.2	1.3
IF PRESSURE, LOSS IN HORZ PIPE (FT)	-	9.6	7.4	4.1	-	-	-	-
TOTAL HEAD (FT)	**11.6**	**23.0**	**16.8**	**19.1**	**12.3**	**19.7**	**23.4**	**15.9**
DISCHARGE RATE, Q (GPM)	**265**	**1250**	**260**	**350**	**850**	**470**	**525**	**150**
LOCATION ON PUMP CURVE	**GREAT-L**	**GOOD-H**	**IDEAL**	**IDEAL**	**FAIR-L**	**GREAT-L**	**GREAT-L**	**GREAT-H**

Appendix E
Technical Memorandum–
Wastewater Treatment Facility Site Visit Report

Kenai Wastewater Treatment Facility Site Visit Report

TO: Eric Lehan/CH2M HILL

COPIES: File
Mike Guthrie/CH2M HILL

FROM: Jim Wodrich/CH2M HILL

DATE: November 26, 2001

Jim Wodrich/CH2M HILL and Mike Guthrie/CH2M HILL arrived at Kenai Wastewater Treatment Facility (WWTF) at 10:00am Saturday October 27, 2001. We met with Mr. Fred Macvie/City of Kenai Operations.

PURPOSE OF THE WASTEWATER TREATMENT PLANT TOUR

The primary purpose of this trip was to introduce Fred Macvie/City of Kenai to Mike Guthrie, a senior wastewater treatment specialist with CH2M HILL, and walk through the plant to learn more about how the plant operates and to develop an inventory of the current operating conditions.

TRIP SUMMARY

The plant was last upgraded substantially in 1980 to 1982. Additional improvements to the disinfection system have been made since that time. However, most of the original equipment from the early 1980's is still operating at the Kenai WWTF. A list of the equipment along with it's condition and replacement value is attached to this trip report.

Pretreatment Process Operations

The pretreatment process operations include the following :

- Influent Manhole
- Rotary Screens
- One screenings belt conveyor for truck haul operations
- Bypass Bar Screens

Influent Manhole

The influent manhole collects the wastewater from the City collection system's three primary pipelines. The inlet manhole is approximately 22 feet high and extends approximately 8 feet above grade. The inlet manhole collects grease at the top of the water surface. The grease must be removed using a vacuum truck and hauled to the landfill. Currently, the landfill is not accepting the grease from this manhole. This poses a disposal problem for the City operations crew.

The facilities plan shall address a proposed solution to addressing the grease problem, preferably by eliminating the need to dispose of the grease off-site while at the same time reducing the maintenance required to remove the grease by vacuum truck . One method of removal proposed during the site visit would be to pump the grease to the aerobic digester on a timed or level control basis. The pump discharge pipe could be run to the existing pipeline that runs from the heat exchanger to the digester. This pipeline is currently not being used as the temperatures in the digester do not warrant the use of the heat exchanger. The grease would be digested well in the digester and this could eliminate the need to haul the grease off site

Influent Manhole


Grease Buildup in Influent Manhole

Screening

Currently, the plant does not use the existing two rotary screens, the bypass screen or the screenings conveyor. The reason for this is that the screens would plug on occasions that an excessive amount of rags and debris get washed into the collection system. A large amount of rags and grit is experienced at the WWTF when the collection system pipeline from the prison is washed clean by a large rainstorm or snowmelt event, according to Fred Macvie. Fred feels the pipeline is too flat and does not have a pumps station in the line to keep it cleaned out. Thus, the rags and grit buildup until enough wastewater enters the line and increases the velocity in the line enough to wash out the deposits.


Influent Screening Area

Another problem with the existing screening problem is that the screenings are being conveyed to the truck with excess water and were not acceptable for hauling to the landfill. There is currently no method for compacting the screenings prior to disposal.

Screening upstream of the aeration and digestion processes is very important for reducing fouling problems due to rags and large debris that collects in the digester. This debris can plug pipelines, foul pump suction intakes and cause unnecessary maintenance.

Two solutions to consider in the facilities plan to address these problems are:

1. New, larger capacity screens and a screenings washer/compactor would reduce the problems that staff is currently experiencing. The washer/compactor washes the fecal matter from the screenings and squeezes the water out of the screenings prior to disposal in a landfill.
2. Address the problem of the collection system pipeline from the prison in the collection system improvements portion of this facility plan.

Rags and Scum Buildup in the Secondary Clarifier Centerwell due to Lack of Screening and Grinder Not Working Adequately

Grit Handling

There is no grit removal system at the Kenai WWTF at this time. Grit thus accumulates in the quiescent areas of the plant downstream such as the aeration basins and the aerobic digester. The staff takes a basin out of service for grit removal on a regular basis. The grit is removed by shovel and hose. The remaining grit then settles in the aerobic digester.

Grit removal should be considered for the treatment plant to reduce future problems with grit deposition.

Activated Sludge Process Operations

The activated sludge process operations include the following :

- An aeration basin flow splitter box
- Four, complete mix, aeration basins with coarse bubble aeration
- Three centrifugal blowers for aeration
- Two, fifty foot diameter, secondary clarifiers
- Two screw type return activated sludge pumps
- Two progressing cavity, waste activated sludge and scum pumps

Aeration Basins

The current national pollutant discharge elimination system (NPDES) permit was recently reissued to the City of Kenai. There is currently no nitrogen limitation in the national pollutant discharge elimination system (NPDES) permit. Thus, the aeration basins are required to reduce the carbonaceous biological oxygen demand (BOD) at this time. Currently, the City is operating all four of the 130,000 gallon aeration basins. The aeration is supplied by three, 60 hp centrifugal blowers to a coarse bubble aeration system in a complete mix-type aeration design.

Several areas of concern were noted during the site visit that should be addressed in the facility plan. These areas of concern are noted as follows:

1. The sludge volume index (SVI) is an index that provides a method of determining the relative settling characteristics of activated sludge. A high SVI (>100) could cause poor settling in the secondary clarifiers and cause the plant to be out of compliance with total suspended solids levels in the effluent, especially if the plant needs to take down one clarifier for cleaning or repair. The City's SVI has been approximately 400 for most of the last 4 years of data. SVI should be less than 100. Methods to correct this problem include adding a wall, mixer and creating an anoxic zone at the front of each aeration basin, also known as selector technology. Solutions to this problem and present worth cost analysis should be explored in this facility plan. The objective of any solution should be to reduce the SVI such that the City need only operate one secondary clarifier at this time and have the second clarifier as a backup and for future solids loading increases due to population growth.
2. Lack of blower/aeration control allowing the dissolved oxygen (D.O.) in the basins to be unnecessarily excessive in the range of 6 to 8 mg/L. A well operating aeration basin should have D.O. levels around 2 mg/L. Operating the basins with a dissolved oxygen level over 2 mg/L is wasting money in electricity costs by operating more blowers than required. CH2M HILL has assisted cities around the country with similar problems. A solution and present worth cost analysis should be done to see what the return rate is on modifying the blower system aeration supply control functions.
3. Consideration should be given to using fine bubble aeration in lieu of the existing course bubble aeration system in the aeration basins. The facility plan will provide a present worth analysis for tradeoffs between electricity costs versus the capital costs for installing fine bubble aeration.
4. Based upon initial calculations and current year 2001 wasteloads, the City should only have to operate two of the four aeration basins and one secondary clarifier. This assumes the SVI problems are addressed and the more efficient fine bubble aeration system and blower aeration control are provided in the future.
5. Grit accumulations in the aeration basins has been a reoccurring problem. The floors are also flat and do not provide for a good method to collect the grit at one end and remove it. The facility plan should consider a grit handling system upstream of the aeration basins.

Secondary Clarification, Return Activated Sludge (RAS) and Waste Activated Sludge (WAS) Pumping

The City operates two secondary clarifiers with poor settling sludge. During the site visit we looked at the sludge judge and there was no discernable sludge blanket at the bottom of the clarifier. This is also an indication of a poor settling sludge with SVI problems. This could be caused by filamentous bacteria. The problems were addressed in the aeration basin discussions earlier in this memorandum.

Additional impacts of poor settling sludge occur as the sludge is drawn off at the bottom of the clarifier for use as return activated sludge (RAS) and waste activate sludge (WAS). The RAS and WAS concentration are the same as they are taken from the same waste stream. In a well operating plant, the WAS and RAS solids concentration should be 0.75% to 1.0% (7,500 to 10,000 mg/L). At the Kenai WWTF, the WAS and RAS solids concentrations are 0.02% or 2,000 mg/L. This impacts the amount of pumping required to waste the pounds of solids required to operate the plant as well as reduces the capacity of the digester and dewatering processes downstream of the clarifiers. Thus, addressing the SVI (poor settling sludge) problem helps the efficiency of the plant in many other process operations and thus adds capacity to the plant, allowing more capacity to operate in the future.

RAS Screw Pumps

The following areas of concern should be addressed and costs for fixing the problems should be determined in the facility plan:

1. Correct the SVI problem and thus increase the WAS and RAS concentration.
2. The existing RAS pumping rate is controlled by the need to keep a high enough velocity in the large pipeline to reduce settling of solids in the pipe and plugging problems. This problem could be corrected by adding a flow control valve and flow meter to monitor the flow and keep the velocity high enough to reduce the possibility of sludge settling in the pipe. Thus, this would allow the operator to control RAS flow rates based on process kinetics, not concerns over plugging lines.
3. The two WAS pumps are progressing cavity pumps which are requiring stator/rotor replacement approximately every year at a cost of approximately $2000 each. The

wasting is done on a cycled basis, an inefficient way to operate the wasting from a treatment plant. It is better to waste continuously at a lower rate to keep the solids in the system from fluctuating excessively. A present worth cost analysis should be completed in the facility plan to consider the use of centrifugal, recessed impeller type pumps and adjustable frequency drive control to reduce the maintenance costs over the next 20 years of design life.

4. The screw pumps have been a maintenance headache for the City. There is no easy way to remove the motor and gearing. This plan will consider the present worth costs for replacing the screw pumps with easier to maintain and operate, centrifugal pumping system.

WAS Pumps

Digestion and Solids Handling

The digestion and solids handling process operations include the following :

- One fifty foot diameter aerobic digester
- Two rotary blowers for aeration of the aerobic digester
- One boiler for the aerobic digestion heat supply
- Two, progressing cavity, digested sludge/belt filter press feed pumps
- A one meter belt filter press
- One dewatered sludge belt conveyor for truck haul operations
- One dry polymer feed system including two tanks and two progressing cavity feed/transfer pumps
- Septage Handling dump station including two tanks and pumps

Aerobic Digester

There is currently one fifty foot diameter aerobic digester. The City does not regularly take the digester out of service for cleaning. Currently there is not a second, redundant digester to use during any cleaning or maintenance. The digester has a heat exchanger for heating sludge but it is not in use as the City has not had problems with keeping the required temperature range in the digester. Temperatures in the digester range between approximately 18 degrees C and 26 degrees C. Sludge (WAS) influent to the digester is very low in concentration. Thicker influent solids make the digestion process efficient and increases the solids retention time available for digestion. Optimum solids influent concentration would be between 2% and 3% solids (20,000 to 30,000 mg/L). Currently the solids concentration going to the belt filter press operation is 10,000 mg/L. This low solids concentration going to the belt filter press impacts the operation of the unit by increasing the required run time to dewater the mass of sludge that needs to be processed each week.

Aerobic Digester

The City is currently decanting about 0.75 mgd back to the activated sludge process.

Several enhancements to the present solids handling-digestion processes that would aid today's operations as well as provide additional capacity for the future are as follows:

1. Increase the influent solids concentration to the digester by prethickening. This would increase the solids retention time in the process and thus provide additional capacity currently being used by excess water in the WAS.
2. Pump the excess grease into the digester from the influent manhole as discussed previously.
3. Fred indicated that there is a substantial grit and ragging problem in the digester and at times this plugs the pipeline and pumping system. See previous discussion on options for grit and screenings removal.
4. One way to reduce operation, power and maintenance costs for the digestion system would be to eliminate the need for the existing digester blowers and instead use the centrifugal blowers used for the aeration basin air supply. The current required blower air volume is far in excess of the aeration basin needs and this excess air could be used for the aerobic digester by adding flow control valves and flow monitoring. This would cut power consumption and allow the City to use some of its excess aeration capacity.

Belt Filter Press Dewatering

The City's belt filter press is in need of replacement. It has been operating since the 1980's. It is operated for 3 to 4 hours every other day. Changes to the digestion process described above would decrease the amount of runtime required to process the mass of sludge every week. Thicker sludge fed to the belt filter press increases the solids throughput (pounds of sludge/hour) and thus reduces the amount of time required to run the belt filter press.

Fred has been reasonably happy with the current belt filter press. The City has made modifications to the existing belt conveyor to reduce spillage and cleanup requirements. The costs for replacing and installing a new belt filter press will be addressed in the facility plan.

Belt Filter Press

Disinfection and Effluent flow monitoring

A gas chlorine disinfection system and scrubber was installed in the 1980's. The disinfection process was changed in the 1990's to eliminate gaseous chlorine and the need for a gas scrubber by the addition of a liquid sodium hypochlorite system and sodium bisulfite dechlorinination system.

The disinfection process operations and effluent flow monitoring includes the following :

- A sodium hypochlorite solution chlorination system
- A sodium bisulfite dechlorination system
- Oxidation reduction potential (ORP) chlorination control system
- A chlorine contact tank
- Effluent Parshall flume and level/flow meter

Chlorination/Dechlorination System

The City operations staff has very little problem with the current chlorination and dechlorination system. We spent very little time discussing this system due to the City's satisfaction with the system. The facility plan should consider the sizing of the existing equipment to meet the future twenty year planning period.

The City currently uses 20 gallons per day of sodium hypochlorite and 5 gallons per day of sodium bisulfite.

It was suggested that the effluent water could be used for nonpotable plant water uses such as the belt filter press washwater and the clarifier sprays. This would reduce the amount of potable city water the plant currently uses for these purposes.

Support Systems

The support systems include the following :

- Boiler System
- HVAC system
- 25 kilowatt-480 V Emergency engine generator and 50 amp transfer switch
- Instrumentation and controls system
- Septage Receiving Station

Boiler System

The boiler system has been upgraded since they were initially installed in the 1980's. See the attached equipment summary for the information of this system.

HVAC System

The City has not had many difficulties with the HVAC system. However, if changes are made in the Control Building, the HVAC system would no longer be grandfathered and adequate ventilation rates and classification requirements will need to be made to met the current electrical codes. These requirements will be discussed in further detail the facility planning portion of this work.

Instrumentation and Control System

The City is currently using Wonderware software and an Allen Bradley programmable logic controller (PLC) for some of the control and monitoring at the plant. Improvements to the system shall be discussed in the facility plan to provide the City with options for future improvements. The plan should address items that would reduce the daily operator attention requirements and assist the City with better data acquisition capacity.

Septage Receiving Station

The City has a Septage receiving tank and pumps to allow dumping Septage at the plant. However, the City does not currently use this Septage handling system.

Septage Receiving Area

Appendix A

Design Criteria and Equipment Inventory

Existing Wastewater Treatment Facility Design Criteria (Developed 1979)

Design Year	1990
Population	
Initial 8,400	
Design	13,500
Flow, MGD	
Average (Design)	1.3
Peak	2.6
Biochemical Oxygen Demand (BOD5)	
Strength, mg/l	
At Design Flow	193
Loading, Lb./day	
At Design Flow	2,097
Suspended Solids (SS)	
Strength, mg/l	
At Design Flow	182
Loading, Lb./day	
At design Flow	1,980
Rotary Screens	
Number of Units	2
Screen Opening, In.	.030
Capacity/Screen, gpm	1,850
BOD Reduction, %	10
SS Reduction, %	10
Estimated Screenings, cu.yd./day	2.4
Aeration Basins	
Number of Basins	4
Total Volume, gal	520,000
MLSS, mg/l	3,200
F:M Ratio, lb. BOD/lb. MLSS	.15
Sludge Age, Days	8.8
Oxygen Required, LB/hr.	71

Wastewater Temperature, °C	8
Basin Loading, lb. BOD/1,000 cu. ft.	30.2
Aeration System	
Number of Blowers	3
Capacity of Each Blower, scfm	1,100
Horse Power, Each Blower	60
Diffusers: Non-Clog Leaf Spring	
Standard Oxygen Transfer Rate, LB./hr.	224

Secondary Clarifiers

Number of Clarifiers	2
Diameter, ft.	50
Depth, ft.	12
Solids Loading, lb/ft2/day	
Average	15.4
Peak	24.7
Hydraulic Loading, gal/ft2/day	
Average	331
Peak	662
Expected Underflow SS Concentration, mg/l	7,500
Return Sludge Rate % of Design Flow	0-150

Return Activated Sludge Pumps

Number of Units	2
Capacity of Each Pump	
Interim, gpm	315-675
Ultimate, gpm	675-980
Pump Lift, ft.	12

Waste Activated Sludge And Secondary Scum Pumps

Number of Pumps	2
Capacity of Each Pump, gpm	125
Total Head	40

Chlorination System

Effluent chlorination was not required.
Return activated sludge is now chlorinated as necessary to control filamentous bacteria.

Chlorine Dosage, mg/l	10
Chlorine/day, LB./day	150

Septage Transfer Pumps

Number of Units	2
Capacity of Each Pump, gpm	50
Total Head	27

Maximum Quantity of Septage/day (gal)	2,000

Aerobic Digester

Number of Tanks	1
Digester Volume, cu. ft.	56,540
Hydraulic Retention time, days	12.1
VSS Loading, LB./day	1,825
Minimum VSS Reduction, %	40
Suspended Solids Concentration, mg/l	15,000
Minimum Temperature, °C	16
Aeration	
Diffusers: Non-Clog Leaf Spring	
w/Standard Oxygen Transfer Rate, LB./hr.	165
Blowers:	
Number of Units	2
Capacity, Each scfm	1,750
Horse Power, each	125

Sludge Recirculation Pumps

Number of Units	2
Capacity, Each, gpm	200
Total Head, ft.	40

Heat Exchanger Circulation Pump

Number of Units	1
Capacity, gpm	200
Total Head	38

Boiler Circulation Pump

Number of Units	1
Capacity, gpm	90
Total Head, ft.	55

Digested Sludge Pumps

Number of Units	2
Capacity, gpm	
Rated Capacity	60 at 25 ft.
Lowest Capacity	30 at 10 ft.

Polymer Feed System

Mix Tanks:	
Number of Tanks	2
Total Capacity, gal	500
Polymer Feed Pumps	
Number of Pumps	2

Capacity	
Rated Capacity, gpm	2 at 2 psi differential pressure
Lowest Capacity	.2 at 2 psi differential pressure

Sludge Dewatering System (Belt Press)

Number of Units	1
Capacity, lbs. hr.	450
Solids Concentration, % solids	
Influent	1.5
Effluent	10
Solids Production, cu.yd./day	15.3

Appendix B

Equipment and Manufacturer's information

Equipment No.	Equipment/Model No.	Equipment Item	Manufacturer
		Aeration Equipment	Sanitaire
S101 S203	S-500	Automatic Composite Samplers	Manning Environmental Corp.
M106-1 M107-1 M406-1 M106-2 M107-1 M406-2		Belt Conveyor Belt Thumper Belt Thumper Belt Thumper Belt Thumper	The Bucket Elevator Co.
M103-1 M103-2 M103-3 M103-1 M103-2 M103-3	Hoffman Co. No. GS-30520 Serial No. 0880030 0880031 0880032	Aeration Basin Blowers	Hoffman Air Filtration Systems
M453	M155K	Aerobic Digester Boiler	Kewanee Boiler Corporation
M403-1 M403-2		Aerobic Digester Blowers	Roots Dresser
M200-1 M200-2	S-90 50' Dia. 12' SWD	Secondary Clarifier Mechanism	Door Oliver, Inc.
	485	Gas Chlorinator	Capitol Control Co.
	Broad Range 30.0 DDA-15R	Diesel Engine Generator Set	Onan Corporation
M452	No. 108 Serial No. 81451-3	Sludge Heat Exchanger	Door Oliver, Inc.
M410-1	 Series 55-10 439	Polymer Equipment Polymer Flow Meter Polymer Scale	Mixing Equipment Co., Inc. Wallace & Tiernan Detecto Scales, Inc.
M405	9.3 Ecopress	Sludge Belt Filter Press and Control Panel	Euramca, Inc.
M100-1 M100-2	CS-376	Rotary Screens	Baker Filteration Co.

Equipment No.	Equipment/Model No.	Equipment Item	Manufacturer
P453	B&G Series 4x4x7	Heat Circulation Pump	Bell & Gosset
P456	B&G Series 2x2x9-1/2	Boiler Circulation Pump	Bell & Gossett
P300-1 P300-2	1PC8-45 CDGU, 8”	Waste Activated Sludge/Secondary Scum Pumps	Peabody Barnes
P402-1	1PC6-20 CDGU, 6”	Digested Sludge Pumps	Peabody Barnes
P408-1	IPC5 SSSQ, 1”	Polymer Pumps	Peabody Barnes (as above)
P102-1 P102-2	Vaughan Model 150	Septage Transfer Pumps	Vaughan Co., Inc.
P301-1 P302-2	36” Dia.	Activated Sludge Screw Pumps	Neptune/CPC
P450	Wemco Torque-Flow Pump Model E	Sludge Circulation Pump	Envirotech Corporation
	446	Sewage Trash Pump	Marlow Pumps
	Kenworth W900 R-E-J 24-22	Truck Trailer	Kenworth Truck Company
	38090	Snow Thrower	The Toro Company
	1A1212B	Gantry Crane	Spanco, Inc.
ASU-1 ASU-2 ASU-3	PCCA-141 Pent House Climate Changer	Air Supply Units	The Trane Company
ASU-4	CFA-12 Wf Platform	Air Supply Unit	Rupp Industries, Inc.
UH-1	B-50P	Unit Heater	Sterling
EF-1	Model No. 6	Exhaust Fan	The Trane Company
DF-1	GDAB03900B	Duct Furnace	The Trane Company

Appendix C

Photo Log

Photo #	Description
1	RAS Screw Pumps
2	Control Building
3	Top of Digester
4	Influent Manhole
5	Influent Manhole and Emergency Generator
6	Controls Building
7	Septage Receiving Area
8	Aerobic Digester
9	Screw Pumps OR – Looking at 10 Year Replacement
10	Replace One Mayno With Septage Pump – Uemco
11	WAS Pump
12	RAS / WAS Wet Well
13	Screw Pump Motors
14	Aeration Basin & Secondary Clarifier (Background)
15	RAS Screw Pumps
16	WAS / RAS Wet Well
17	WAS Pumps
18	RAS Screw Pumps
19	RAS Screw Pumps
20	WAS Pumps
21	WAS / RAS Control Panel
22	ORP Control Strantror 9000
23	Chlorination Points
24	Old Scrubber Area
25	Chlorine Feed Pumps
26	Sodium Hypochlorite Storage

Photo #	Description
27	Sodium Hypochlorite Storage
28	Sodium Hypochlorite Feed Pumps
29	Disinfection
30	Aerobic Digestor Heat Exchanger
31	Blower
32	Aeration Basin Blowers
33	Aeration Basin Blowers
34	Aerobic Digester Blowers
35	Aeration Basin Blowers
36	Boiler System
37	Screenings Area
38	Digested Sludge Pumps
39	Secondary Clarifier Centerwell – Rags
40	Belt Filter Press
41	Belt Filter Press
42	Dewatered Solids Conveyor
43	Water Air Gap
44	Belt Filter Press Control Panel
45	Scum Collection (Add Wier Box & Pump to Remove Scum Daily)
46	Belt Press is Old and Should be Replaced in the Next 5 Years
47	Sec Clar – Use to Convey the Need for Good Screens And That The Current Grinder Does Not Do A Good Job.
48	Aeration Basins and Control Building
49	WAS / RAS Pumping Building
50	Aeration Basins
51	Influent Manhole & Emergency Generator
52	Chlorination & Contact Chamber

Appendix F
Sample Ordinance for Industrial Discharge, Fats, Oils, and Grease

Excerpt from the newly revised Anchorage Municipal Code 26.50 (November 2000).

= Indicates a lower level of urgency in response, unless worker safety or health is jeopardized.

= indicates a high level of urgency in response.

26.50.050 Prohibited acts.

A. It shall be unlawful for any user to:

1. Introduce or cause to be introduced into the municipal sewerage system any pollutant or wastewater which causes pass through or interference. This general prohibition and the specific prohibitions below apply to all users whether or not they are subject to categorical pretreatment standards or any other national, state, or local pretreatment standards or requirements.

2. Discharge or cause to be discharged any of the following described pollutants, substances, or wastewater into the municipal sewerage system:

   a. Any stormwater, surface water, surface runoff, groundwater, roof runoff, subsurface drainage, cooling water or other unpolluted water.

   b. Any water or wastewater which contains petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through or which in the opinion of the Utility are in amounts greater than that which would be normally construed as incidental in normal discharges.

   c. Any solid or viscous substance, or liquid that can become viscous when cooled, in amounts capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewerage system such as, but not limited to, fat, grease, uncomminuted garbage, animal guts or tissues, hair, hide, fleshings or entrails.

   d. Any wastewater which creates a fire or explosive hazard, including, but not limited to, wastewaters with a closed-cup flashpoint of less than 140°F (60°C) using the test methods specified in 40 CFR 261.21. At no time shall two (2) successive readings on an explosion meter, at the point of discharge into the system (or at any point in the system), be more than five (5%) per cent nor any single reading over ten (10%) per cent of the lower explosive limit (LEL) of the meter.

   e. Any wastewater having a pH lower than 5.0 or higher than 12.5 at any time, or having any corrosive property capable of causing damage or hazard to structures, equipment and personnel of the sewerage works.

f. Any wastewater which results in the presence of toxic gases, vapors, or fumes in a quantity that, in the opinion of the Utility, may cause acute worker health and safety problems.

g. Any wastewater containing radioactive substances except in compliance with applicable state or federal regulations.

h. Any noxious or malodorous liquids, gases or solids which either singly or by interaction with other wastes are sufficient to create a public nuisance, or hazard to life or health, or that are sufficient to prevent entry into the municipal sewerage system for its maintenance and repair.

i. Any substance that will cause the Utility to violate its NPDES permit.

j. Any substance that may cause the municipal sewerage system's treatment residues, sludges, incinerator ash or scums to be unsuitable for reclamation and reuse or to interfere with the reclamation process.

k. Any wastewater that causes the temperature at the treatment works influent to exceed 40 degrees Celsius (104 degrees Fahrenheit).

l. Any pollutants, including oxygen demanding pollutants, released at a flow rate or concentration that, either singly or by interaction with other pollutants, will interfere with operation of the municipal sewerage system.

m. Any wastewater containing medical wastes from industrial users including but not limited to hospitals, clinics, offices of medical doctors, convalescent homes, medical laboratories or other medical facilities.

3. *Prohibited connection of sanitary sewer with storm sewer system.* Interconnect or cause to be interconnected directly or indirectly any part of a sanitary sewer system with any part of a storm sewer system.

4. *Prohibited discharge at unapproved location.* Discharge or cause to be discharged into a sanitary sewer any waters or wastes whatsoever other than through an approved, permanent sewer extension, or at a sewage dump station or other location that has been specifically so designated by the Utility.

B. *Vandalism.* No person or entity shall willfully or negligently break, damage, destroy, uncover, deface, tamper with, or prevent access to any structure, appurtenance or equipment, or other part of the municipal sewerage system.

C. Any person or entity found in violation of this section shall be subject to the sanctions set out in this chapter.

(AO No. 81-207; AO No. 86-118, 9-4-86)

Appendix G
Inflow and Infiltration Analysis

Kenai Infiltration and Inflow Analysis

PREPARED FOR: Eric Lehan/CH2M HILL

PREPARED BY: Joe Plaskett

DATE: September 18, 2002

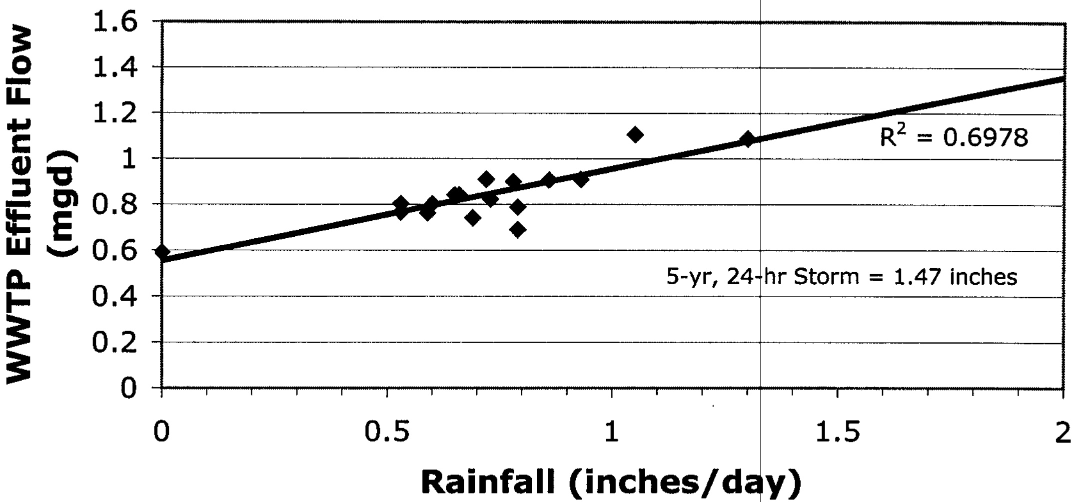
Examination of measured wastewater flows within the Kenai wastewater collection system shows that infiltration and inflow is not currently a significant problem.

Daily wastewater treatment plant effluent flow was correlated with daily rainfall at the Kenai airport for several significant rainfall events occurring during the available flow record: January 1996 to July 2002. Only 100 percent rainfall events were used in the flow and rainfall correlation, meaning there was no snow on the ground, and temperatures were above freezing. In addition, only rainfall events exceeding 0.5 inches in 24 hours were included in the flow and rainfall correlation. The data show that there is a reasonably good correlation between rainfall and treatment plant flow. This means that there is some response (increase in flow) at the treatment plant to significant rainfall events.

There was not enough data available during the available period of record to analyze the relationship between snowmelt and flow at the wastewater treatment plant.

The flow and rainfall correlation was also used to estimate the expected flow at the treatment plant resulting from a 5-year, 24-hour rainfall event. Figure 1 shows the results of the analysis. The 5-year, 24-hour rainfall was computed by Western Regional Climate Data Center staff to be 1.47 inches. The flow at the treatment plant resulting from this rainfall event is predicted to be about 1.14 mgd.

Figure 1: Daily Effluent Flow vs Daily Rainfall



The ratio of peak flow to average base flow at the treatment plant (indicator of rainfall dependent inflow) for the 5-year, 24-hour rainfall event is 1.9, indicating that overall the Kenai wastewater collection system does not have a significant inflow problem.

Data from the City of Kenai's 16 lift stations was also analyzed to see if any of the City's collection system subbasins exhibited I/I problems. Average base sanitary flow (ABF) was calculated at the wastewater treatment plant and the 16 lift stations based on flow measurements taken during November and January of 2001 and 2002. This period was chosen so that only sanitary flows were measured, since temperatures at this time of year preclude I/I, and groundwater infiltration is minimal.

Hourly flow data for the 16 lift stations were available for the period of October 16, 2001 to August 31, 2002. As with the treatment plant flow data, only 100 percent rainfall events were included in the I/I analysis. Therefore, flow and rainfall data for the period between June 1, 2002 and August 31, 2002 was examined.

First, the flow and rainfall data were plotted to verify that the flow values were reasonable and consistent. The plots also qualitatively show the pump station response to each rainfall event. These figures have been included as attachments. The plot of the Walker Lane lift station flows showed a problem with the data, and it was therefore excluded from the analysis. Also, there appeared to be flow data anomalies at the Main Street and Redoubt Street lift stations, however the data irregularities were of short duration, and may or may not be real.

In order to examine the rainfall dependent infiltration and inflow (RDII), four significant rainfall events were chosen for analysis. The depth and duration of these rainfall events are as follows:

Storm 1: July 18, 2002 to July 22, 2002 - 0.70 inches

Storm 2: July 24, 2002 to July 31, 2002 - 1.17 inches

Storm 3: August 10, 2002 to August 14, 2002 - 0.68 inches

Storm 4: August 19, 2002 to August 25, 2002 - 1.34 inches

As can be seen in the attached figures, the storms chosen varied in volume and intensity so that the analysis of flow response at the lift station would include a range of rainfall inputs. For example, storm 1 is more intense (depth/duration), with a much lower volume than storm 4, which has a relatively large rainfall volume, but has a much lower rainfall intensity.

RDII volume for each subbasin was calculated by subtracting the ABF from the flow at each lift station. Local flow values were obtained by subtracting flows from upstream lift stations. This flow subtraction does not always give accurate results for the local RDII volume. For example, subtraction of the upstream flow volume from the total flow volume at the Lawton Drive lift station resulted in negative RDII flow volumes for all four storms. In such cases, the best course of action is to look at the total upstream RDII volume, as well as the flow and rainfall plot to see if RDII is significant.

Several measures of RDII have been calculated to attempt to characterize RDII (Is it the result of inflow or infiltration?) and rank the subbasins according to their level of RDII.

Table 1 summarizes the analysis of RDII at the 16 lift stations. The primary RDII measures are the peak flow to average base flow ratio, rainfall return, RDII per acre, and RDII per inch diameter mile (IDM) of pipe. A high peak flow to average base flow ratio is an indicator of inflow. A low peak flow to average base flow ratio along with a high rainfall return would indicate infiltration. RDII per acre can be misleading, since a large undeveloped subbasin would tend to produce a low number. More appropriately, the RDII per developed acre should be used, but that information was not available for this analysis. The RDII per inch diameter mile of pipe attempts to factor in the subbasin's level of development. In a relatively large undeveloped basin the rainfall return and RDII per acre may be very small, but the RDII per IDM could still be quite high.

None of the subbasins examined have alarmingly high levels of RDII. Category 1 subbasins show a definite flow response to rainfall, relatively high rainfall return and RDII per IDM for at least one of the chosen storms. No action is needed at this time, but these subbasins should be monitored to observe whether and/or when RDII increases to problem levels. Typically, inflow is not considered a problem until the peak flow to average base flow ratio is 5.0 or greater. Rainfall return above 10% is considered high in a separated sewer system. For a substantially developed subbasin, an RDII per acre value of 8,000 or higher might be considered high.

Category 2 basins also show increased flow as a result of rainfall, but this flow response is quite weak compared to Category 1 basins.

Category 3 basins pump intermittently, and due to the intermittent pump operation the flow and volume calculations (ABF and RDII) appeared to be inaccurate. Also, it is possible that the lift stations were operated differently during the period when the ABF was calculated resulting in negative RDII volumes for the chosen storms. Visual inspection of the flow and rainfall plots show that these subbasins do not exhibit consistent increases in flow peaks or volumes due to rainfall events, and the pump stations were operating well within their capacity. Therefore it was concluded that RDII is not a problem for these subbasins.

It was not possible to analyze the Aileene Street lift station for I/I, since it only gets flow via the force main from the Beaver Creek lift station. This subbasin was included in its own category, Category 4, for completeness.

Category 5 includes subbasins in which local flows are the result of subtractions. As a result of subtration of the upstream flow the ABF for Mile 13 North Road was probably not accurate (low), and as a result caused all other calculations using ABF to be inaccurate. Most importantly, the low ABF results in an exageratedly high calculated value of RDII. Since flow data were not available for July and August at the treatment plant, no RDII calculations could be made for the gravity flow zone.

Category 6 shows the calculated RDII values for the Walker Lane lift station. As mentioned previously, it is suspected that these data contain flow measurement errors for a portion of the June to September period. The plot of flow and rainfall shows a marked difference between flows before and after July 29, 2002. It was not apparent which portion contained the bad data.

TABLE 1
Summary of Inflow and Infiltration Evaluation

Category	Basin Number
1: Inflow Response[a]	
Mission Street	12
Mile 14 North Road	13
Golf Course	3
2: Inflow and Infiltration Not Significant	
Beaver Creek	1
East Aliak	4
Lawton Drive	5
Broad Street	10
Main Street	11
Redoubt Street	15
Inlet Woods	16
3: Intermittent Pumping - Inflow and Infiltration Not Significant	
Granite Point	7
Marathon Road	8
Control Tower	9
4: Transfer Stations	
Mile 13 North Road	14
Aleene Street	2
5: Indeterminate Basin	
Gravity Flow Zone	17
6: Flow Measurement Problems	
Walker Lane	6

[a] Ratio of Peak Flow to ABF > 4.0, Rainfall Return > 2.8 %

Appendix H
City Council Resolution and Wastewater Management–Financial Plan

SUBSTITUTE
Suggested by: Administration

City of Kenai

RESOLUTION NO. 2003-16

A RESOLUTION OF THE COUNCIL OF THE CITY OF KENAI, ALASKA INCREASING THE WATER AND SEWER RATES.

WHEREAS, the City of Kenai commissioned a study of water and sewer rates; and,

WHEREAS, CH2M Hill performed the study and recommends water rates be increased 30% and sewer rates be increased 35% effective for fiscal year 2004; and,

WHEREAS, it is in the best interest of the City of Kenai to phase in this increase over more than one year; and,

WHEREAS, the water and sewer rates have not been increased since 1993; and,

WHEREAS, the water and sewer system is self-supporting and in order to have sufficient funds for capital improvements and operations it is in the best interest of the City to increase rates effective June 15, 2003; and,

WHEREAS, an increase of 10% for water and 12% for sewer would provide adequate resources for the Water and Sewer Fund for FY 2004.

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF KENAI, ALASKA, that the rates identified in the Public Utility Regulations and Rates in Schedules A, B, C and E be increased 10% for water and 12% for sewer effective June 15, 2003.

PASSED BY THE COUNCIL OF THE CITY OF KENAI, ALASKA, this 2nd day of April, 2003.

JOHN J. WILLIAMS, MAYOR

ATTEST:

Sheryl Padilla, Acting City Clerk

Approved by Finance: ______
(3/26/03) hl

CITY OF KENAI

"Oil Capital of Alaska"

210 FIDALGO AVE., SUITE 200 KENAI, ALASKA 99611-7794
TELEPHONE: 907-283-7535
FAX: 907-283-3014

MEMORANDUM

TO: City Council
THROUGH: Linda Snow, City Manager
FROM: Lawrence A. Semmens, Finance Director
DATE: March 26, 2003
SUBJECT: Water and Sewer Rates

This memo is to supplement the March 12, 2003 memo from Linda Snow included in the packet.

The following are the primary reasons that an increase in water and sewer rates is necessary at this time:

1. Recent capital improvement expenditures in the amount of $1,200,000 have depleted the fund balance to below acceptable levels. The City has relied on matching grants to finance capital improvements; however, it is uncertain if grants will be available for future improvements. Unfortunately, even if grants are available, the Water and Sewer Fund does not have cash to match the grants. This puts the ability of the water and sewer system to meet future service demands at risk.

   In their report CH2M Hill recommends that the City raise rates 30% to 35% if we use debt to finance a portion of future capital costs. If debt is not used they recommend that the water and sewer rates need to be increased 90% & 100% respectively! Copies of their reports are in your packet.

2. The Water and Sewer Fund is self supporting – services are paid for from user fees. Costs are increasing, and have increased substantially since the last rate increase effective FY 1994. That year the operating cost was $938,350. In FY 2002 the operating cost was $1,220,000, which is a 30% increase. Service fee revenues have increased 10%. Water production has increased 40%! Population growth over the same period is 2%. We have added 4 miles of sewer lines, an increase of 5%, to a total of 78 miles and we added Wellhouse 3. All without increasing rates.

It is very interesting that water production is up 40% while service fee revenue is only up 10%. Why? Because there is no correlation between water production and revenue when most of the customers are on a flat rate. Our customers are using 40% more service, but only paying an additional 10%.

3. Operating costs are going to continue to increase (unless services are reduced). General inflation over this period is 21%. While our cost per gallon produced (a measure of efficiency) has dropped by over 20% in the same time frame, new regulations are expected to increase operating costs due to higher water quality standards and security requirements.

4. The fund has had two revenue sources that are drying up. In FY 2001 the fund started receiving interest earnings. In that year the amount was $107,000 and last year it was $63,000. Since fund balance has dropped from over $1 million to less than $150,000 at the end of FY 2003, interest earnings will be insignificant especially at current rates. Second, the fund has been receiving special assessment payments from the Thompson Park Project. Almost all of these assessments will be paid off in 2005. These revenues will have to be replaced.

For all of the forgoing reasons it is my strong recommendation that water and sewer rates be increased. The financial health of the system depends on it. It is understandable that the Council does not want to raise rates 30% and 35%, particularly this year. Given that, it is my recommendation that you take the alternative mentioned in City Manager Snow's memo to increase rates in two steps of $7 in FY 2004 and 2005. For residential customers this will be $84 per year. For other customers this would be about a 16% increase each year. The total estimated revenue increase will be $215,500 which would provide some growth in fund balance. This is a reasonable and justifiable approach.

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FAX: 907-283-3014

MEMORANDUM

TO:	Mayor Williams & City Council Members
FROM:	Linda L. Snow, City Manager LLS
DATE:	March 12, 2003
RE:	Water and Sewer Rate Increases

As you know, the City's water and sewer utilities face a number of challenges, including the capital improvements needed to replace aging infrastructure and the imperative to comply with Federal and State regulatory measures. CH2M Hill was selected by the City to prepare water and sewer rate reviews and financing plans to help address these challenges. The Administration has reviewed and concurs with the final reports and rate recommendations presented by CH2M Hill in the *City of Kenai Water Rate Study and Finance Plan* and the *City of Kenai Wastewater Facility Master Plan.* Specifically, CH2M Hill recommends a 30% water rate increase and a 35% sewer rate increase as illustrated in the first chart on the attached schedule prepared by Keith Kornelis.

The City has not increased water and sewer rates since 1993. CH2M Hill reports the majority of Alaska communities surveyed have increased rates at least once since that time. Revenues have traditionally been adequate to support operations and maintenance costs of the water, sewer, and sewer treatment plant departments, but are insufficient to fund capital expenditures. The results of no rate adjustments for the last ten years are that the City has not established replacement reserves, cannot absorb increased operations and maintenance costs, and has no development fees available to finance a portion of the requirements for capital improvement programs.

According to CH2M Hill, if the current single-family monthly water rate of $10.35 had risen with general inflation (21% during the nine-year period, U.S. Bureau of Labor Statistics Anchorage Price Index), the rate would currently average about $12.50 per month. This rate would have contributed to increased revenue for water system replacements and CIP costs. The consultant's experience has shown that more modest, but frequent rate increases generate more sufficient revenues and result in overall lower rates than less frequent but major rate increases.

As an alternative, Council may wish to consider phasing in the recommended increase over two years, rather than doing it all in one year. As illustrated in the second chart on the attachment, this would result in a combined water and sewer increase of only $7.00 in FY 04 and $7.00 in FY05. Resolution No. 2003-16 increases all of the water rates by 30% and sewer rates by 35%. However, if Council wishes to pursue the option to phase in the recommended increase, then those may substitute the percentage rates in the Resolution identified in the second chart as "Option to Increase the Water and Sewer Total Monthly Bill by $7.00 for the Next 2 Years."

CITY OF KENAI							
RECOMMENDED BY CH2MHILL WATER AND SEWER RATE STUDY							
DATED MARCH 2003							
FLAT RESIDENTIAL RATE							
Year	**% Water**	**% Sewer**	**Water**	**Sewer**	**Sub Total**	**Sales Tax**	**Total**
FY	**Increase**	**Increase**	**$**	**$**	**$**	**$**	**$**
2002/03	0	0%	10.35	28.70	39.05	1.95	41.00
2003/04	30%	35%	13.46	38.75	52.21	2.61	54.82
2004/05	4%	4%	13.99	40.29	54.28	2.71	56.99
2005/06	4%	4%	14.55	41.91	56.46	2.82	59.28
2006/07	4%	4%	15.14	43.58	58.72	2.94	61.66
2007/08	0%	0%	15.14	43.58	58.72	2.94	61.66
Option to Increase the Water and Sewer Total Monthly Bill by $7.00 for Next 2 Years							
2002/03	0.0%	0.0%	10.35	28.70	39.05	1.95	41.00
2003/04	15.0%	17.8%	11.90	33.81	45.71	2.29	48.00
2004/05	13.0%	15.1%	13.45	38.93	52.38	2.62	55.00
2005/06	8.2%	7.7%	14.55	41.91	56.46	2.82	59.28
2006/07	4.1%	4.0%	15.14	43.58	58.72	2.94	61.66
2007/08	0.0%	0.0%	15.14	43.58	58.72	2.94	61.66
Option to Increase the Water and Sewer Total Monthly Bill by 10 % for 2003/04							
2002/03	0.0%	0.0%	10.35	28.70	39.05	1.95	41.00
2003/04	10%	10%	11.38	31.57	42.95	2.15	45.10

City Of Kenai
Fiscal Year 2004 Operating Budget

Budget Projection
Fund 10: Water and Sewer Fund

	Actual FY 2001	Actual FY 2002	Original Budget FY 2003	Amended Budget FY 2003	Projection FY 2003	Administration Recommended FY 2004
Revenues						
Usage Fees						
Hook-up	$ 5,320	$ 3,800	$ 5,000	$ 5,000	$ 3,200	$ 3,500
Residential Water	228,904	232,953	233,000	233,000	235,000	270,250
Commercial Water	106,377	111,969	115,000	115,000	110,000	126,500
Residential Sewer	627,374	644,331	640,000	640,000	645,000	759,810
Commercial Sewer	276,599	289,964	280,000	280,000	280,000	323,950
Total Usage Fees	1,244,574	1,283,017	1,273,000	1,273,000	1,273,200	1,484,010
Miscellaneous Revenues						
Penalty and interest	17,552	18,234	18,000	18,000	18,000	18,000
Spec. Asmnt. Principal	41,617	40,414	40,000	40,000	32,000	30,000
Sale of Assets			-	-	-	-
Interest earnings	106,919	63,409	58,000	58,000	40,000	28,000
Other	3,011	2,013	2,500	2,500	2,500	2,500
Total Miscellaneous Revenues	169,099	124,070	118,500	118,500	92,500	78,500
Total Revenues	1,413,673	1,407,087	1,391,500	1,391,500	1,365,700	1,562,510
Expenditures						
Water Department	453,486	405,426	467,347	496,831	1,446,831	482,569
Sewer Department	450,903	230,627	290,726	307,423	307,423	274,473
Sewer Treatment Plant Dept.	745,810	584,104	673,836	725,522	725,522	644,445
Total Expenditures	1,650,199	1,220,157	1,431,909	1,529,776	2,479,776	1,401,487
Contribution To/(From) Fund Balance	(236,526)	186,930	(40,409)	(138,276)	(1,114,076)	161,023
Projected lapse (3%)			85,915	91,787	84,089	42,045
Adjusted (Deficit)/Surplus			45,506	(46,489)	(1,029,987)	203,068
Beginning Fund Balance	1,132,042	895,516	855,984	1,176,950	1,176,950	146,963
Residual Equity Transfers	-	94,504	-	-	-	-
Ending Fund Balance	$ 895,516	$ 1,176,950	$ 901,490	$ 1,130,461	$ 146,963	$ 350,031

Rate Increase water 15%
Sewer 17.8%

City Of Kenai
Fiscal Year 2004 Operating Budget

Budget Projection
Fund 10: Water and Sewer Fund

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Total Usage Fees	1,244,574	1,283,017	1,273,000	1,273,000	1,273,200	1,395,000
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Expenditures						
Water Department	453,486	405,426	467,347	496,831	1,446,831	482,569
Sewer Department	450,903	230,627	290,726	307,423	307,423	274,473
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Projected lapse (3%)			85,915	91,787	84,089	42,045
Adjusted (Deficit)/Surplus			45,506	(46,489)	(1,029,987)	114,058
Beginning Fund Balance	1,132,042	895,516	855,984	1,176,950	1,176,950	146,963
Residual Equity Transfers	-	94,504	-	-	-	-
Ending Fund Balance	$ 895,516	$ 1,176,950	$ 901,490	$ 1,130,461	$ 146,963	$ 261,021

Rate Increase
Water 10%
Sewer 10%

City Of Kenai
Fiscal Year 2004 Operating Budget

Budget Projection
Fund 10: Water and Sewer Fund

	Actual FY 2001	Actual FY 2002	Original Budget FY 2003	Amended Budget FY 2003	Projection FY 2003	Administration Recommended FY 2004
Revenues						
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Miscellaneous Revenues						
Penalty and interest	17,552	18,234	18,000	18,000	18,000	18,000
Spec. Asmnt. Principal	41,617	40,414	40,000	40,000	32,000	30,000
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Total Revenues	1,413,673	1,407,087	1,391,500	1,391,500	1,365,700	1,347,000
Expenditures						
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Projected lapse (3%)			85,915	91,787	84,089	42,045
Adjusted (Deficit)/Surplus			45,506	(46,489)	(1,029,987)	(12,442)
Beginning Fund Balance	1,132,042	895,516	855,984	1,176,950	1,176,950	146,963
Residual Equity Transfers	-	94,504	-	-	-	-
Ending Fund Balance	$ 895,516	$ 1,176,950	$ 901,490	$ 1,130,461	$ 146,963	$ 134,521

Current Rates

City of Kenai
Wastewater Facility Master Plan

Wastewater Management – Financial Plan

Prepared for

City of Kenai
Kenai, Alaska

March 2003

CH2MHILL

CH2M HILL
301 West Northern Lights Boulevard
Suite 601
Anchorage, AK 99503

Contents

Wastewater Management - Financial Plan

Summary

The City of Kenai provides residential and commercial customers with sewer and potable water among other services. The City's utilities face a number of challenges, including capital improvements needed to replace aging infrastructure. The City selected CH2M HILL to prepare a sewer rate review and financing plan to help address these challenges. CH2M HILL is also currently performing a similar review for the water system. The City provided financial reports to CH2M HILL in January and February 2003 to support this effort. This report comprises the sewer rate financial review and recommendations. A parallel report recommends water revenue changes.

The City has not increased sewer rates since 1993, while the majority of Alaska communities surveyed have increased rates at least once since that time. Currently, most residential customers are billed monthly and pay flat rates per month. See Table 1 for the trend in general Alaska inflation since 1993.

The City currently funds the water and sewer enterprise fund from two sources: current and new customers. To date, costs of new connections have been paid by all sewer system customers. New connections pay a connection fee of $100. The City is in the process of addressing its long term funding needs through rate increases and long term financing sources to reduce the need for significant customer rate increases resulting from large capital expenditures.

The City of Kenai's sewer and water systems operate as a consolidated enterprise unit but are separately accounted. The City of Kenai provided financial statements and annual budgets for the sewer and water systems to CH2M HILL. The sewer system includes the Sewer Department (sewage collection system) and the Sewer Treatment Plant Department. Sewer system revenues and costs are shown as separate categories from Water revenues and costs. In the past several years, total sewer related revenues have exceeded combined Sewer Department and Sewer Treatment Plant Department operating expenses to provide an operating surplus.

A rate increases is necessary in FY2003/04 to allow the sewer system to continue to fund sewer operations while making a contribution to funding planned capital improvements. Subsequent moderate increases are also projected through the end of the study period (FY2007/08). The City may chose to smooth these future rate increases over multiple years, or implement a single larger rate increase, depending on the City's objectives.

The report makes additional recommendations, including the following:

- The budget documents provided indicate that the City has typically reserved about $40,000 each year for contingencies for the combined Sewer Department and Sewer Treatment Plant Departments. Typical practice for water and sewer utilities is to maintain about 30-45 days of operating expenses as a reserve for contingencies. In the City's case, this would be about $70,000 annually.
- The City faces the very common situation of not having significant available financial reserves to meet needed capital improvements. Rather than use a cash "pay as you go" approach, which inevitably creates large "rate shocks" and instability to customer bills, some long term financing method would significantly dampen and reduce annual revenue requirements. The difference between revenue requirements of cash outlays and financed expenditures is significant. While grant-financed capital expenditures would be the best method to reduce future customer rate increases, even conventional municipal revenue bonds would create a significant savings to customer bills compared to using customer rate increases to finance capital outlays at one time, which would probably be infeasible.
- This report recommends that the City's rate structure should be reviewed at least every 5 years.

Introduction

The City of Kenai serves almost 1,600 sewer connections including nearly 1,341 residential units, 44 duplex units, 82 multi-unit residences, 105 commercial flat rate customers, and 140 metered rate commercial customers. The majority of the City's customers are residential connections (over 1,500). Commercial accounts include all nonresidential sewer users.

The City selected CH2M HILL to review its sewer and water rates and financing plans analyze the City's rate structures and recommend rates to fund capital improvements and replacements associated with its current sewer and water services. This report summarizes our findings and recommendations for the sewer enterprise.

The City of Kenai has not increased sewer rates in almost ten years (since 1993). Based on the financial and budget information provided by the City, sewer revenues have traditionally been adequate to support maintenance and operating costs of the combined Sewer Department and Sewer Treatment Plant Department, but revenues have been insufficient to fund sewer system capital expenditures. One result of no rate adjustments for the last ten years is that the City does not appear to have established replacement reserves. Additionally, the City continues to experience increased operating costs, especially those relating to salaries and benefits.

TABLE 1
Alaska (Anchorage) CPI Since 1993 Compared to No Sewer Rate Increases in Kenai
City of Kenai Sewer Rate Study and Financing Plan

Year	Monthly Residential Rate ($)	Anchorage CPI\1	CPI Annual Change	Cumulative CPI Change
1993	28.70	132.2	3.1%	3.1%
1994	28.70	135.0	2.1%	5.3%
1995	28.70	138.9	2.9%	8.3%
1996	28.70	142.7	2.7%	11.3%
1997	28.70	144.8	1.5%	12.9%
1998	28.70	146.9	1.5%	14.6%
1999	28.70	148.4	1.0%	15.8%
2000	28.70	150.9	1.7%	17.7%
2001	28.70	155.2	2.8%	21.1%
2002	28.70			
Increase	0.0%			21.1%

\1 U.S. Bureau of Labor Statistics Consumer Price Index for Anchorage MSA

The City does not have a development fee for sewer facilities. Development fees are not a part of this study. However, development fees can be used to finance a portion of the revenue requirements for capital improvement programs. All sewer customers, existing and new, pay for the capital costs of the sewer system.

Current Rates and Fees

Since the last sewer rate increase in 1993, there has been an escalation of general prices in Alaska of about 21.1 percent during this nine-year period, according to the U.S. Bureau of Labor Statistics Anchorage Price Index (CPI). (See Table 1) If the current single-family monthly sewer rate of $28.70 had risen with general inflation, the rate would currently average almost $35 per month. This rate would have generated revenue for increased system replacements and CIP costs.

Table 2 summarizes current residential sewer customer data. Customer growth has averaged a little over 1.05 per year for the past several years. This report assumes that rate of customer growth will continue at this modest rate over the next several years.

TABLE 2
Current Users – Monthly Billing
City of Kenai Sewer Rate Study and Financing Plan

Total Flat Rate and Metered Sewer Accounts	2000	2001	2002	Average Growth
Sewer – Residential	1,456	1,475	1,485	1.0%
Sewer – Commercial	202	205	208	1.5%
Water – Residential	1,466	1,485	1,494	1.0%
Water – Commercial	208	212	214	1.4%

	2002	
Flat Rate Water and Sewer Accounts	Water	Sewer
Single Family Residence	1,351	1,341
Duplex Residences	44	44
Multi-Unit Residences	81	82
Commercial Flat Rates	108	105
Total Number of Flat Rate Accounts	**1,584**	**1,572**

TABLE 2
Current Users – Monthly Billing
City of Kenai Sewer Rate Study and Financing Plan

Metered Water and Sewer Accounts	2000	2001	2002	Avg. Growth
5/8"	1	1	2	41.4%
3/4"	11	11	11	0.0%
1"	45	46	46	1.1%
1-1/4"	6	6	6	0.0%
1-1/2"	28	29	29	1.8%
2"	31	31	31	0.0%
3"	12	12	12	0.0%
4"	1	1	1	0.0%
6"	1	1	1	0.0%
Total Metered Accounts	**136**	**138**	**139**	**1.1%**

For residential service, nine flat rate categories are currently in effect as shown in Schedule A of the Kenai Current Rates table.

Given the absence of water meters, which is the prevalent practice in Alaskan communities, the City's current residential rate structure reflects a reasonable approach to achieve an equitable residential sewer rate structure. This report recommends no material change to the residential rate classifications or structure.

Many nonresidential customers are also unmetered. Most of these customers are commercial establishments and are generally minimal water users and wastewater dischargers. For customers with meters, Kenai charges both a flat rate based on customer type and a usage charge based on metered water consumption. There are 35 nonresidential non-metered sewer classifications that are each charged a different flat rate. (See Appendix A of Current Rates.)

Table 3 compares the City of Kenai's sewer rates to those of other Alaska cities. Kenai's current average residential monthly sewer bill is about 89 percent of the state average monthly sewer bill for assumed usage of 7,500 gallons and 79% of the average sewer bill assuming 15,000 gallons of sewer flow. The City of Kenai's current average bills are lower than most of the cities surveyed.

TABLE 3
Residential Sewer Monthly Rate Comparison[1]
City of Kenai Sewer Rate Study

Community	Population	Wastewater Accounts	Effective Date of WW Rates	Residential Rate Structure	Average Monthly Bill –7.5K Gallons	Average Monthly Bill –15K Gallons
Anchorage	261,446	54,000	2000	Flat	$21.33	$21.33
Craig	2,355	365	1998	Water Usage	21.35	28.35
Dillingham	2,400		2000	Flat	37.54	37.54
Haines[2]	1,808	474	1998	Flat	38.75	38.75
Haines[2]	1,808	50	2000	Water Usage	89.77	89.77
Homer	4,205	1,102	2001	Water Usage	49.90	85.15
Juneau	31,262	7,594	2000	Flat	37.28	37.28
Kenai	**7,039**	**1,684**	**1993**	**Flat**	**28.70**	**28.70**
Ketchikan	8,295	2,758	1999	Flat	32.35	32.35
King Cove	671		1998	Flat	13.50	13.50
Klawock	750	357	2000	Flat	37.70	37.70
Kodiak	6,869	2,340	1996	Flat	32.20	32.20
Petersburg	3,398	1,135	1995	Water Usage	32.93	38.03
Seward	3,085	824	1993	Flat	34.00	34.00
Sitka	8,788	3,575	1992	Flat	24.00	24.00
Skagway	820	375	1991	Flat	10.75	10.75
Valdez	4,271	774	1999	Flat	7.75	7.75
Wasilla	5,568	482	1999	Water Usage	33.38	66.75
Wrangell	2,569	835	2000	Flat	28.12	28.12
Average					32.17	36.42

[1] Source: Alaska Water/Wastewater Rate Survey - 2001, Black and Veatch

[2] 80% of the City of Haines is served by Haines Utilities and 20% is served by Crystal Cathedrals Water System, Inc.

Sewer Enterprise Finances

Table 4 shows a history of combined sewer and water operating revenues and expenses, data which was provided by the City. It also shows the estimate of net operating revenues for the combined Sewer Department and Sewer Treatment Plant Department both before and after Capital Outlays. Sewer revenues are almost entirely from sewer service charges. We have assumed that the total sewer and water system Miscellaneous Revenues, such as Interest Earnings and Penalty fees, are attributed to the sewer and water systems according to the systems by the proportions of sewer and water revenues.

TABLE 4

History of Sewer and Water Operating Revenues and Expenses in 2000- 2003
City of Kenai Sewer Rate Study

Revenues	Actual 2000	Actual 2001	Actual 2002	Projected 2003
Usage Fees				
Hook-up	3,720	5,320	3,800	3,200
Residential Water	227,395	228,904	232,953	235,000
Commercial Water	101,653	106,377	111,969	110,000
Residential Sewer	628,482	627,374	644,331	645,000
Commercial Sewer	270,498	276,599	289,964	280,000
Total Usage Fees	**1,231,748**	**1,244,574**	**1,283,017**	**1,273,200**
Miscellaneous Revenues				
Penalty and interest	18,253	17,552	18,234	18,000
Spec. Asmnt. Principal	45,397	41,617	40,414	32,000
Sale of Assets			0	0
Interest earnings		106,919	63,409	40,000
Other	3,255	3,011	2,013	2,500
Total Miscellaneous Revenues	**66,905**	**169,099**	**124,070**	**92,500**
Total Sewer, Water and Misc. Revenues	**1,298,653**	**1,413,673**	**1,407,087**	**1,365,700**
Expenditures, Including Capital Outlays				
Water Department	(528,471)	(453,486)	(405,426)	(1,446,831)
Sewer Department	(214,187)	(450,903)	(230,627)	(307,423)
Sewer Treatment Plant Dept.	(579,757)	(745,811)	(584,105)	(725,522)
Total Expenditures	**(1,322,415)**	**(1,650,200)**	**(1,220,158)**	**(2,479,776)**
Combined Water/Sewer Contrib To/(From) Fund Balance	**(23,762)**	**(236,527)**	**186,929**	**(1,114,076)**

Table 5 presents a summary of combined sewer and sewer treatment plant operating results. Through 1999/00, net sewer revenues were sufficient to fund Sewer Department and Sewer Treatment Plant operations and capital expenditures of $191,300, which include Transfers Out of these two Departments' accounts, to leave positive net revenue for the sewer system of about $153,900.

During 2000/01 sewer revenues continued to provide an estimated combined sewer system operating reserve of almost $399,000 but this was insufficient to meet Capital Outlays and

Transfers of $569,000, which left a net combined sewer system loss of almost $(170,000). In 2001/02, sewer revenues were sufficient to cover operating expenses and capital outlays. The available information indicated that these sewer outlays were made on a cash or "pay as you go" basis. The information provided does not indicate any debt owed by the sewer (or water) system.

TABLE 5

Historical operating Results for Combined Sewer and Treatment Plant
City of Kenai Sewer Rate Study

	FY 1999/00	FY 2000/01	FY 2001/02	FY 2002/03
Total Sewer Revenues	898,980	903,973	934,295	925,000
Sewer Operating Expenses	(146,355)	(154,496)	(137,936)	(214,205)
Treatment Plant Expenses	(456,276)	(473,411)	(477,805)	(576,243)
Sewer Operating Income	296,349	276,066	318,554	134,553
"Other" Revenues Apportioned to Sewer	48,830	122,822	90,348	67,203
Est. Total Sewer Operating Income	**345,179**	**398,888**	**408,902**	**201,755**
Total Sewer Capital Outlays	**(191,313)**	**(568,807)**	**(198,991)**	**(179,900)**
Estimated Total Sewer Income	**153,866**	**(169,919)**	**209,911**	**21,855**

Operation and maintenance costs include all costs associated with operating and maintaining the systems, including personnel, materials and services costs, and administrative transfers. O&M costs do not include capital outlays, which for the purposes of this analysis are included in the CIPs. Expenses associated with issuing debt anticipated during the study period are included in O&M costs.

O&M costs are projected for the five-year study period based on the FY2002/03 estimates and an assumed annual escalation rate of five percent. Beyond the base budget estimates, a number of O&M adjustments are also included to account for changes to O&M due to the implementation of the CIP.

Operation and maintenance costs for the combined sewer system/treatment plant, including personnel, materials and services costs, and administrative transfers are displayed in Table 6.

Total estimated costs for FY 2002/03 are approximately $790,000 including salaries of approximately $228,000. Utility costs at the wastewater treatment plant are expected to be approximately $189,000 while repair and maintenance expenses are nearly $89,000. Repair and maintenance costs were adjusted from the 2002/03 budget to more accurately reflect actual historical results over the past three years. The midpoint between the historical average and the 2002/03 budget was used to project future repair and maintenance expenses.

Operating expenditures are projected to increase to approximately $991,000 during the five-year study period; representing an average annual increase of 2.6 percent. The historical average annual increase in operating expenses from 1999/00 through 2001/02 was approximately 1 percent.

TABLE 6

Kenai Water Rate Study
Combined Sewer System/Treatment Plant O&M Expenses

	Budgeted	Proj. Actual	Projected				
	FY 01-02	**FY 02-03**	**FY 03-04**	**FY 04-05**	**FY 05-06**	**FY 06-07**	**FY 07-08**
Sewer Department							
Salaries and Benefits							
Salaries	220,833	228,404	239,800	251,800	264,400	277,600	291,400
Overtime	6,445	10,000	10,500	11,000	11,500	12,100	12,700
Holiday Pay	8,515	8,574	9,000	9,500	10,000	10,500	11,000
Leave	10,823	12,908	13,600	14,300	15,100	15,900	16,700
Medicare	3,139	3,280	3,500	3,600	3,700	3,800	3,900
PERS	6,201	6,496	6,800	7,100	7,400	7,700	8,100
Unemployment Insurance	272	1,299	1,400	1,400	1,400	1,400	1,400
Workers Compensation	2,903	4,881	5,100	5,300	5,500	5,700	6,000
Health & Life Insurance	34,279	41,638	43,700	45,900	48,200	50,600	53,100
Supplemental Retirement	5,463	6,750	7,100	7,400	7,700	8,100	8,500
Subtotal	**298,873**	**324,230**	**340,500**	**357,300**	**374,900**	**393,400**	**412,800**
Maintenance and Operations							
Office Supplies	319	1,900	2,000	2,100	2,200	2,300	2,400
Operating & Repair Supplies	66,971	77,816	81,700	85,800	90,100	94,600	99,300
Small Tools/Minor Equipment	21,970	18,250	19,200	20,100	21,100	22,100	23,200
Computer Software	2,250	5,375	5,700	6,000	6,300	6,600	6,900
Professional Services	8,832	19,830	20,800	21,800	22,900	24,000	25,200
Communications	4,409	6,500	6,900	7,300	7,700	8,100	8,500
Travel & Transportation	3,935	8,500	9,000	9,500	10,000	10,500	11,000
Advertising	481	0	0	0	0	0	0
Printing & Binding	310	300	300	300	300	300	300
Insurance	9,500	16,400	17,200	18,000	18,900	19,900	20,900
Utilities	175,169	189,000	198,500	119,400	123,400	166,600	181,300
Repair & Maintenance	18,221	88,660	93,100	97,700	102,600	107,800	113,200
Rentals	89	500	500	500	500	500	500
Books	56	1,059	1,100	1,100	1,100	1,100	1,100
Dues & Publications	218	573	600	600	600	600	600
Contingency	0	24,800	66,425	62,292	65,217	71,533	75,600
Miscellaneous	4,138	6,755	7,000	7,300	7,600	7,900	8,300
Subtotal	**316,868**	**466,218**	**530,025**	**459,792**	**480,517**	**544,433**	**578,300**
Total Sewer Department	**615,741**	**790,448**	**870,525**	**817,092**	**855,417**	**937,833**	**991,100**

Capital Improvement Program

Table 7 summarizes the currently estimated sewer CIP program.. It is anticipated that the sewer department will purchase a new vacuum/jetter (Vactor) truck for routine maintenance at an estimated cost of $400,000 in 2004. A number of capital projects have been identified for the sewer treatment plant, including improvements to the pretreatment process, aeration equipment, basin modifications, sludge processes, and sludge digestion systems.

The CIP has identified combined Sewer Department and Sewer Treatment Department CIP expenditures of $967,400 in FY 2004, $743,000 in FY 2005, $1.2 million in FY 2006, $1.8 million in FY 2007, and $1.3 million in FY 2008.

Replacement costs are those to replace system components that are worn out from use or are obsolete. Revenues to fund projects allocated to new development are also currently generated from user rates and charges. The City does not currently have a sewer development fee. Current sewer rates do not generate sufficient funds for planned capital projects and replacements.

TABLE 7

Wastewater Rate Study
Capital Improvement Plan ($2003)

Sewer Department Outlays	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**FY 2008**
Land						
Buildings						
Improvements						
Machinery and Equipment		$25,000	$25,000	$25,000	$25,000	$25,000
Vactor Truck		$400,000				
Transfers Out	$73,500	$73,500	$73,500	$73,500	$73,500	$73,500
Subtotal	$73,500	$498,500	$98,500	$98,500	$98,500	$98,500
Sewer Treatment Plant Outlays						
Land						
Buildings						
Improvements						
New Pump House						$329,000
Influent Manhole Modifications						$47,000
Grit Removal						$89,000
Bar Screens						$633,000
Upgraded Fine Bubble Aeration			$291,000			
Upgraded Aerobic Digester Blower System			$71,000			
Aeration Bain Modifications for Filament Control					$1,588,000	
Upgraded RAS			$22,000			
Upgraded WAS			$142,000			
Recoating of Aerobic Digester		$350,000				
Upgraded Aerobic Digester				$528,000		
Upgraded Solids Handling System				$510,000		
Machinery and Equipment		$15,000	$15,000	$15,000	$15,000	$15,000
Sludge Digestion Tank Relining						
Sewage Lift Station-Bridge Rd.						
Transfers Out	$103,900	$103,900	$103,900	$103,900	$103,900	$103,900
Subtotal	$103,900	$118,900	$644,900	$1,506,900	$1,706,900	$1,216,900
Total Capital Outlays	$177,400	$967,400	$743,400	$1,255,400	$1,805,400	$1,315,400

Replacement Funding

Public agencies often have difficulty in funding replacement of existing assets. With thoughtful planning, the appropriate level of replacements can be estimated and a funding plan can be developed. According to new Government Accounting Standards Board regulations, notably the GASB 34 announcement, the City must adopt either an explicit depreciation plan for its assets or an asset management plan by June 30, 2003. Exceptions to the depreciation requirement can be made for enterprise funds, however. Asset accounting, including depreciation or documented asset maintenance programs will become expected under the new GASB rules. The City might consider funding replacement costs through either depreciation charges as part of operating expenses for the sewer system or as part of a scheduled asset maintenance program. These steps would help to protect the City's investment in existing assets. These approaches have proven to be cost effective asset management strategies.

Financing Alternatives

The most desirable methods of financing system improvements is to obtain grants from federal or state agencies. These funding sources help to minimize capital costs to the local community residents. Although there can be some indirect costs associated with assistance such as record keeping and administration, the benefits of these financial sources clearly outweigh the costs. The limited availability of such funding is its major drawback. There are a number of different programs that the City may want to pursue in establishing an overall funding plan. These are listed below.

Revenue Bonds

Revenue bonds are issued through the conventional bond market and are secured by the revenues of the wastewater system. Typically, bonds have a 20-year term and an interest rate of around 5 or 6 percent. The wastewater system would also have to establish a reserve fund equal to one annual debt service payment and pay a 2 percent bond issuance fee. The advantage of revenue bonds is that the utility can avoid large, one-time rate increases that would be necessary if the financing of the capital projects was expected to come from rate revenue only.

Clean Water State Revolving Loan Funds

In the 1970's and 1980's, federal grants were available for certain major utility system improvements, particularly wastewater treatment facilities, through the Environmental Protection Agency (EPA) Construction Grants Program. However, in the early 1990's, this program was replaced with State Water Pollution Control Revolving Funds (SRFs). Under the SRF program, states were given federal grants to fund loans to communities for water pollution control projects. Communities that receive SRF loans, then repay them to the state to create "revolving" sources of assistance for other communities. In most states, the demands for SRF funds far exceed the available pool of funds.

In Alaska, the Clean Water SRF program is administered by the Department of Environmental Conservation (DEC). In addition to sewage treatment facilities, eligible projects include infiltration and inflow projects that are part of a long-term planning process, non-point source projects, and estuary management projects.

In allocating SRF funds, the DEC considers the following eligibility criteria:

- **Receiving water body sensitivity** – Those projects that will enhance water quality in sensitive waterways are given highest priority.
- **Enforcement activities and water quality violations** – Those projects that are required to address Environmental Quality Commission (EQC) orders, or to carryout mutual agreements and orders, are given the highest priorities.
- **Affordability** – Priority is given to projects where the resulting user fees would be less than 1.75 percent of median household income in the community.

In order to secure SRF funding, it is necessary for the community to demonstrate that it has a stable, reliable source for repaying the loans. Therefore, this funding source would need to be used in conjunction with some other method, such as user charges or taxes. The loans carry a fee of 0.5% of the funding amount to help offset future operational costs. Interest rates are based on the amortization period and are either flat or based on the Municipal Bond Index, whichever is higher. For 2001, flat interest rates ranged from 1 percent to 2.5 percent.

Village Safe Water

The Village Safe Water program provides grants and engineering assistance to small communities for sewer projects. The program is operated by the DEC and the Division of Facility Construction and Operation. The program helps communities secure federal grant funds and state matching funds. The City would have to apply for funds for FY 2005 as the deadline for FY 2004 funding has passed.

Community Grants

A community grants program is administered by the Department of Community and Economic Development (DCED). The program consists of the following grants:

- **Legislative grants:** the state legislature awards grants to communities for a variety of infrastructure projects. Water and sewer projects are eligible.
- **Capital Project Matching Grants:** provides grants for capital projects to unincorporated communities outside the organized borough. In order to be eligible, the community must have been eligible for the State Revenue Sharing Program (SRS) the previous year. According to the DCED, Kenai received SRS funds in 2002. An account is set-up for each community so that a community may accumulate grants for up to a five-year period to fund larger capital projects.

Community Development Block Grant

Limited federal grant and loan funds are still available through the Community Development Block Grant (CDBG) program administered by the Department of Community and Economic Development (DCED). The grants are issued after a competitive application process. Eligibility for the program is limited to projects that benefit low- and moderate- income persons. Any community other than Anchorage is eligible. A maximum of $500,000 per community may be awarded for a single-purpose project.

Cash Flow Projections

The following general assumptions were used in developing the financial plan:

- Customer growth will occur at a modest average rate of 1.0 percent annually based on engineering estimates and historical trends.
- O&M costs will escalate at annual rates of 5.0 percent, based on projected inflation and system growth. An assumed reversion, or "lapse", of 6.0% of O&M expenses occurs each year, based on historical budget to actual trends.
- Revenues from existing rates were projected to increase by 1 percent annually to account for anticipated customer growth.
- The interest rate on investments is assumed to average 2.0 percent.
- In order to account for fluctuations in O&M expenses, budgeted contingencies were increased to equal 30-days of operating expenses. Budgeted contingency expenses are assumed to be unspent and are carried forward as a part of ending balances.
- O&M expenses were increased or decreased based on the improvements recommended in Section 5 of the City of Kenai's Wastewater Facility Master Plan (November 2002, 65% draft). Aeration equipment improvements and improvements to the aeration basin are expected to decrease the O&M costs from the City's current operation practice. The other wastewater improvements are to replace or upgrade aging equipment without necessarily decreasing the net O&M costs. Capital costs will increase at an annual rate of 3 percent to account for inflation.
- Debt service payments are based on the city receiving an SRF loan: 20-year term, 2.5 percent interest, 0.5 percent administration cost, and a reserve requirement equal to one annual debt service payment.
- Debt service coverage will equal or exceed 1.10 times annual debt service. This requirement states that revenues must be sufficient to meet operating expenses plus a factor set at 1.10 times annual debt service on all revenue bonds.

Summary of Required Rate Increases

Tables 8A and 8B show a summary of sewer revenue increases needed if the combined sewer system were to meet operating and capital expenditures using a financing mechanism, such as an SRF loan, to finance these outlays. Total operating expenses are expected to continue to grow at modest rates of about 5.0% per year. However, without an outside financing structure, net revenues at current rates would be deficient each year through 2008.

Suggested rate increases assuming the City receives SRF financing are shown in Table 7B. The large initial rate increase is largely caused by the drawing down of reserves in FY 2002/03 to help pay for a water system capital project. A reduction in debt service though a higher proportion of cash financing of equipment would also reduce required revenues. The ending balance in the combined sewer/treatment plant fund will be approximately $167,000 at the end of the analysis.

Based on the assumptions outlined above, Table 8B indicates that increases in total revenues over the next 5 years, combined with the term financing of the recommended capital improvements as shown in Table 7, will keep the combined sewer system financially sound. The alternative "pay as you go" cash financing approach to financing capital improvements is probably not feasible in terms of generated cash flow or the significant rate increases that would be required to raise the required level of resources to implement cash financing.

TABLE 8A

City of Kenai, Sewer Rate Analysis
Sources and Uses of Funds

Fund / Description	Actual FY 2001-02	Projected FY 2002-03	Projected FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08
Sources of Funds							
Beginning Balance -- July 1 (a)	$401,422	$0	$95,794	$1,712,440	$1,449,875	$574,749	$1,400,541
Service Charges	$934,295	$925,000	$1,260,900	$1,323,972	$1,390,072	$1,460,861	$1,476,047
Hookup Fees	$3,800	$3,200	$3,500	$3,500	$3,500	$3,500	$3,500
Interest Income	$46,175	$29,061	$19,406	$31,275	$20,011	$21,265	$15,494
Miscellaneous	$44,173	$38,142	$38,905	$39,683	$477	$486	$496
Loan repayments	$0	$0	$0	$0	$0	$0	$0
Proceeds long-term debt	$0	$0	$2,387,405	$0	$0	$2,738,750	$0
Grants/Contributions	$0	$0	$0	$0	$0	$0	$0
Intergov Revenues	$47,252	$0	$0	$0	$0	$0	$0
Total Sources of Funds	$1,477,117	$995,403	$3,805,910	$3,110,871	$2,863,935	$4,799,611	$2,896,078
Uses of Funds							
Personal Services	$298,873	$324,230	$340,500	$357,300	$374,900	$393,400	$412,800
Materials and Services	$316,868	$441,418	$463,600	$397,500	$415,300	$472,900	$502,700
Debt Service	$0	$0	$153,200	$153,100	$153,200	$328,800	$328,900
Transfers	$163,000	$179,900	$179,900	$179,900	$179,900	$179,900	$179,900
Capital Improvements	$35,991	$0	$838,111	$618,483	$1,213,298	$1,887,298	$1,358,832
Expense Lapse @ 6.0%	-	(45,939)	(48,246)	(45,288)	(47,412)	(51,978)	(54,930)
SRF Admin Fee	$0	$0	$11,105	$0	$0	$12,750	$0
SRF Reserves	$0	$0	$155,300	$0	$0	$176,000	$0
Ending Fund Balance -- June 30							
Operating Fund Balance	$662,385	$70,994	$1,646,015	$1,387,584	$509,532	$1,329,008	$92,276
Contingency	$0	$24,800	$66,425	$62,292	$65,217	$71,533	$75,600
Total Uses of Funds	$1,477,117	$995,403	$3,805,910	$3,110,871	$2,863,935	$4,799,611	$2,896,078

TABLE 8B

City of Kenai, Sewer Rate Analysis
Projected Operating Results

				Projected					
Item			FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08
Beginning Balance			$401,422	$0	$95,794	$1,712,440	$1,449,875	$574,749	$1,400,541
Sewer Sales Revenue (existing rates)			$934,295	$925,000	$934,000	$943,000	$952,000	$962,000	$972,000
Additional Revenue from Rate Increase									
Year	*Percent*	*% of Initial FY Effec.*							
FY 2002-03	0.00%	0%		-	-	-	-	-	-
FY 2003-04	35.00%	100%			326,900	330,050	333,200	336,700	340,200
FY 2004-05	4.00%	100%				50,922	51,408	51,948	52,488
FY 2005-06	4.00%	100%					53,464	54,026	54,588
FY 2006-07	4.00%	100%						56,187	56,771
FY 2007-08	0.00%	100%							-
Subtotal Additional Revenue			$0	$0	$326,900	$380,972	$438,072	$498,861	$504,047
Total Sales Revenue			$934,295	$925,000	$1,260,900	$1,323,972	$1,390,072	$1,460,861	$1,476,047
			3.4%	-1.0%	36.3%	5.0%	5.0%	5.1%	1.0%
Other Revenue									
Interest Income			46,175	29,061	$19,406	$31,275	$20,011	$21,265	$15,494
Miscellaneous			44,173	38,142	$38,905	$39,683	$477	$486	$496
Subtotal Other Revenue			90,348	67,203	58,311	70,958	20,488	21,751	15,990
Total Resources			**$1,024,643**	**$992,203**	**$1,319,211**	**$1,394,930**	**$1,410,560**	**$1,482,612**	**$1,492,037**
Revenue Requirements									
Operation & Maintenance			$615,741	$765,648	$804,100	$754,800	$790,200	$866,300	$915,500
Net Revenue Avail. For Debt Service			$408,902	$226,555	$515,111	$640,130	$620,360	$616,312	$576,537
Debt Service									
Senior Lien			$0	$0	$153,200	$153,100	$153,200	$328,800	$328,900
Subordinate			0	0	0	0	0	0	0
Debt Service			$0	$0	$153,200	$153,100	$153,200	$328,800	$328,900
Senior Lien Debt Service Coverage			-	-	3.36	4.18	4.05	1.87	1.75
Subordinate Debt Coverage			-	na	na	na	na	na	na
Other Sources of Funds									
Hookup fees			3,800	3,200	3,500	3,500	3,500	3,500	3,500
Debt Proceeds			0	0	2,387,405	0	0	2,738,750	0
Grants/Contributions			0	0	0	0	0	0	0
Intergovernmental Revenues			-	-	-	-	-	-	-
Loan Repayments			-	-	-	-	-	-	-
Transfers From Other Funds			0	0	0	0	0	0	0
Total Other Sources of Funds			3,800	3,200	2,390,905	3,500	3,500	2,742,250	3,500
Other Expenditures									
Capital Expenditures			35,991	-	838,111	618,483	1,213,298	1,887,298	1,358,832
SRF Admin Fee			-	-	11,105	-	-	12,750	-
Reserve			-	-	155,300	-	-	176,000	-
Expense Lapse @ 6.0%			-	(45,939)	(48,246)	(45,288)	(47,412)	(51,978)	(54,930)
Capital-Related Transfers			163,000	179,900	179,900	179,900	179,900	179,900	179,900
Total Other Expenditures			198,991	133,961	1,136,170	753,095	1,345,786	2,203,970	1,483,802
Total Sources of Funds									
Beginning Balance			401,422	-	95,794	1,712,440	1,449,875	574,749	1,400,541
Total Sales Revenue			934,295	925,000	1,260,900	1,323,972	1,390,072	1,460,861	1,476,047
Other Revenue			90,348	67,203	58,311	70,958	20,488	21,751	15,990
Other Sources of Funds			3,800	3,200	2,390,905	3,500	3,500	2,742,250	3,500
Total Sources of Funds			**1,429,865**	**995,403**	**3,805,910**	**3,110,871**	**2,863,935**	**4,799,611**	**2,896,078**
Total Requirements									
Operation & Maintenance			615,741	765,648	804,100	754,800	790,200	866,300	915,500
Debt Service			-	-	153,200	153,100	153,200	328,800	328,900
Other Expenditures			198,991	133,961	1,136,170	753,095	1,345,786	2,203,970	1,483,802
Total Requirements			**814,732**	**899,609**	**2,093,470**	**1,660,995**	**2,289,186**	**3,399,070**	**2,728,202**
Ending Operating Balance			**615,133**	**95,794**	**1,712,440**	**1,449,876**	**574,749**	**1,400,541**	**167,876**
Unreserved			615,133	70,994	1,646,015	1,387,584	509,533	1,329,008	92,276
Contingency			-	24,800	66,425	62,292	65,217	71,533	75,600

Sewer Rates

This report does not recommend significant changes to the existing structure of the City's current sewer rates. Proposed rate increases will be proportional increases across all existing rate classes. This analysis will not require the city to invest in additional metering equipment or billing software that would likely be required if the City were to extensively modify its existing structure.

It is recommended that the City's financial plan be reviewed regularly in the future to avoid significant rate increases.

The projected rate increases calculated in this analysis will be proportional increases across all customer classes. The annual rate increases and the projected residential rate are presented in Table 9.

TABLE 9

Projected Residential Rate Increases
City of Kenai Sewer Rate Study

Year	% Increase	Projected Flat Residential Rate
FY 2002/03	0.00%	$28.70
FY 2003/04	35.00%	$38.75
FY 2004/05	4.00%	$40.29
FY 2005/06	4.00%	$41.91
FY 2006/07	4.00%	$43.58
FY 2007/08	0.00%	$43.58

Consolidated Sewer and Water Financial Projections

The City of Kenai's Water and Sewer Departments are consolidated into one Water and Sewer Fund. Decisions relating to the Sewer and Water Departments take into consideration the impact to the combined Water and Sewer Fund. The accompanying Water Rate Report indicates the possible revenue requirement changes from suggested CIP plans. Table 10 shows the estimated, combined Water and Sewer Funds after revenue changes resulting from the recommended CIP plans. It is important to reemphasize that the scenario shown here indicates a growing level of ending balance cash each year. Rate increases for both the water and sewer systems can be mitigated by using cash resources to reduce bond and annual debt service requirements.

TABLE 10

Combined Sewer and Water Fund Summary

City of Kenai Sewer Rate Analysis

Fund / Description	Actual FY 01-02	Projected Actual FY 02-03	Projected FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08
Sources of Funds							
Beginning Balance -- July 1 (a)	$900,835	$1,182,268	$136,511	$1,776,896	$1,512,894	$642,962	$1,481,341
Service Charges - Sewer	934,295	925,000	1,260,900	1,323,972	1,390,072	1,460,861	1,476,047
Service Charges - Water	344,922	345,000	452,400	474,552	499,158	524,974	530,823
Hookup Fees	3,800	3,200	3,500	3,500	3,500	3,500	3,500
Interest Income	63,409	41,064	20,342	32,739	21,205	22,635	16,979
Miscellaneous	60,661	52,500	53,550	54,621	15,713	16,028	16,348
Loan repayments	0	0	0	0	0	0	0
Proceeds long-term debt	0	0	2,387,405	483,250	0	2,738,750	0
Grants/Contributions	0	0	0	0	0	0	0
Intergovernmental Revenues	94,504	0	0	0	0	0	0
Total Sources of Funds	$2,402,426	$2,549,032	$4,314,608	$4,149,530	$3,442,543	$5,409,710	$3,525,038
Uses of Funds							
Personal Services	$615,741	$765,648	$804,100	$754,800	$790,200	$866,300	$915,500
Materials and Services	270,135	347,460	364,833	383,074	402,228	422,340	443,457
Debt Service	0	0	153,200	184,100	184,200	359,800	359,900
Transfers	262,300	256,200	256,200	256,200	256,200	256,200	256,200
Capital Improvements (Sewer)	35,991	0	838,111	618,483	1,213,298	1,887,298	1,358,832
Capital Improvements (Water)	35,991	1,110,000	25,000	475,000	25,000	25,000	25,000
Expense Lapse @ 6.0%	0	(66,786)	(70,136)	(68,272)	(71,546)	(77,318)	(81,537)
SRF Admin Fee	0	0	11,105	2,250	0	12,750	0
SRF Reserves	0	0	155,300	31,000	0	176,000	0
Ending Fund Balance -- June 30							
Operating Fund Balance	1,182,268	91,711	1,680,233	1,418,853	544,408	1,374,803	135,333
Contingency	0	44,800	96,663	94,041	98,554	106,537	112,354
Total Uses of Funds	$2,402,426	$2,549,032	$4,314,608	$4,149,530	$3,442,543	$5,409,710	$3,525,038

Alternative Funding Scenario

As with any forecast, the wastewater system forecast prepared for the City relies on a number of different assumptions related to costs and revenues. An additional strategy is presented below to illustrate the potential impact on rates.

- **Pay for capital projects through rate increases only - the City issues no long-term debt**

Under this scenario, the City would continue to be debt free and would pay for capital projects on a pay-as-you-go basis. As opposed to debt financing, which allows the City to level the required rate increases, this financing option will result in larger and more sporadic changes to customer rates. The affordability of the City's rates will also become an issue as customers experience large increases in their sewer rates. Finally, equity becomes an issue as existing rate payers are paying for capital projects that will benefit users for future years. Table 11 presents the required rate increases to pay for capital expenditures through customer rates as the primary source of funds.

TABLE 11

Projected Residential Rate Increases
City of Kenai Sewer Rate Study

Year	% Increase	Projected Residential Rate
FY 2002/03	0.00%	$28.70
FY 2003/04	100.00%	$57.40
FY 2004/05	0.00%	$57.40
FY 2005/06	20.00%	$68.88
FY 2006/07	0.00%	$68.88
FY 2007/08	0.00%	$68.88

Appendix I
Upgrades to KenaiView GIS Incidental to This Project

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