Adel Infrastructure Study

Water System Sanitary Sewer System Adel, Iowa

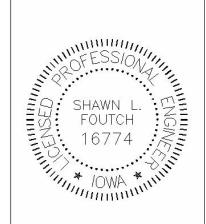
prepared for: City of Adel, Iowa

prepared by:



Kirkham Michael & Associates, Inc. Urbandale, Iowa KM Project 0611610

April 6, 2007



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CHAPTER 1	
Executive Summary	

CHAPTER 1 EXECUTIVE SUMMARY

This study of Adel's municipal infrastructure is being conducted to review the condition and capacity of existing water and sewer systems, identify improvements needed for continued reliable operation and compliance with applicable regulations, and to identify expansion requirements to meet forecasted growth. The study is based upon information collected from Adel staff, operating records, permit records, and field observations. Results from this study are intended to provide guidance to City leaders in order to prioritize, plan, and budget needed improvements to these systems.

Adel's population, currently estimated at about 4,000 people, has grown at around 1.5% per year for the recent past. Recent development trends in the city and in neighboring areas suggests that this growth rate may increase through the foreseeable future. Based on a review of these trends, Adel's population for the year 2030 (which is used as a design year for this analysis) will reach approximately 5,550 at a conservative estimate, higher if recent growth trends continue.

Based on these growth forecasts, the following findings are noted through the year 2030.

- Adel's existing well capacity of 1.29 million gallons per day (mgd) should be sufficient to provide the projected 2030 maximum daily flow of 1.11 mgd.
- Adel's water treatment capacity of 1.0 mgd is slightly undersized compared to the projected 2030 demand of 1.11 mgd
- Adel's water quality is generally good. Sodium content resulting from the softening process currently being utilized exceeds that recommended for persons on a sodium-restricted diet. This condition warrants consideration of a notification effort for Adel's water users.
- Adel's water treatment plant is 35 years old, has operational limitations, and exhibits signs of ongoing corrosion damage. Short-term recommendations for upgrades and repairs are estimated at \$425,000.
- Adel's water treatment plant is operated by one person, while two are recommended.
- Adel's water storage and distribution system requires upgrades to satisfactorily meet fire flows
 now, and to provide adequate service in the future. This includes construction of one additional
 storage facility, and upgrades to water mains in numerous locations. Costs to complete these
 improvements are preliminarily estimated at \$750,000 for additional storage, and \$1.1 million for

main improvements (not including surface restoration costs).

- In order to extend water service to the east of Raccoon River, additional main construction costs would be incurred. Alternatives for using Xenia Rural Water System to meet part of this demand are presented in Chapter 3 of the report. We recommend that the City of Adel consider option 1) as proposed by Xenia, which is to make a connection to their system for use in emergencies, and to supplement supply from Adel's systems if/when needed. Other alternatives for Xenia service could also be considered by Council as warranted, but require additional discussion about long-term priorities.
- Adel's lagoon-based wastewater treatment system is currently meeting effluent requirements, and provides sufficient capacity to meet forecasted demand for flow rate and biological oxygen demand.
- Regulatory changes anticipated within the next 10 years will require construction of a mechanical treatment plant.
- Wastewater collection system improvements include an estimated \$2.4 million in capital improvements for the following:
 - o Add backup power for the smaller existing north lift station
 - o Install Raccoon River crossing, lift station and trunkline along Highway 6 to service areas east of the river.

CHAPTER 2		
Project Introduction		

CHAPTER 2 PROJECT INTRODUCTION

This study is being conducted to review the condition and capacity of existing municipal infrastructure for the City of Adel, as well as to identify alternatives for expansion to meet forecasted growth. The study focuses on potable water supply, treatment, storage, and distribution facilities; and wastewater collection and treatment facilities. This study identifies deficiencies required for continued operation, as well as recommended improvements to prolong the life of facilities or to accommodate expansion of service areas. Cost estimates are provided to provide city leaders with guidance needed to prioritize and budget for needed improvements through a twenty-year planning period.

Adel is located in central Iowa approximately 15 miles west of Des Moines, and 5 miles north of Interstate 80. Adel has primary access to Iowa Highways 6 and 169, both of which pass through the city. Adel is located approximately 5 miles north of Interstate 80, with a direct connection via Highway 169. The study area for this project consists of the current incorporated limits for the city, as well as annexation areas that are currently being considered. **FIGURE 1-1** illustrates the current city limits and zoning that is in place now.

Adel is expected to grow significantly in coming years as a result of expansion and development in other adjacent western suburbs of Des Moines. Adel's city limits currently cover approximately 3.3 square miles, with approximately 1/3 of that area available for development. Outside the current city limits, an area of approximately 6 square miles has been identified as a possible area of expansion toward the east. Once annexed, this area would extend the easterly edge of Adel's city limits to County Road R-16. **FIGURE 1-2** shows existing city limits combined with the proposed annexation to the east. At the time of this study, the proposed annexation area was being considered as a possible location for a new regional airport. Whether or not that proposal advances, development within this area would be expected to occur in line with the demand for development space, once vital city services are available.

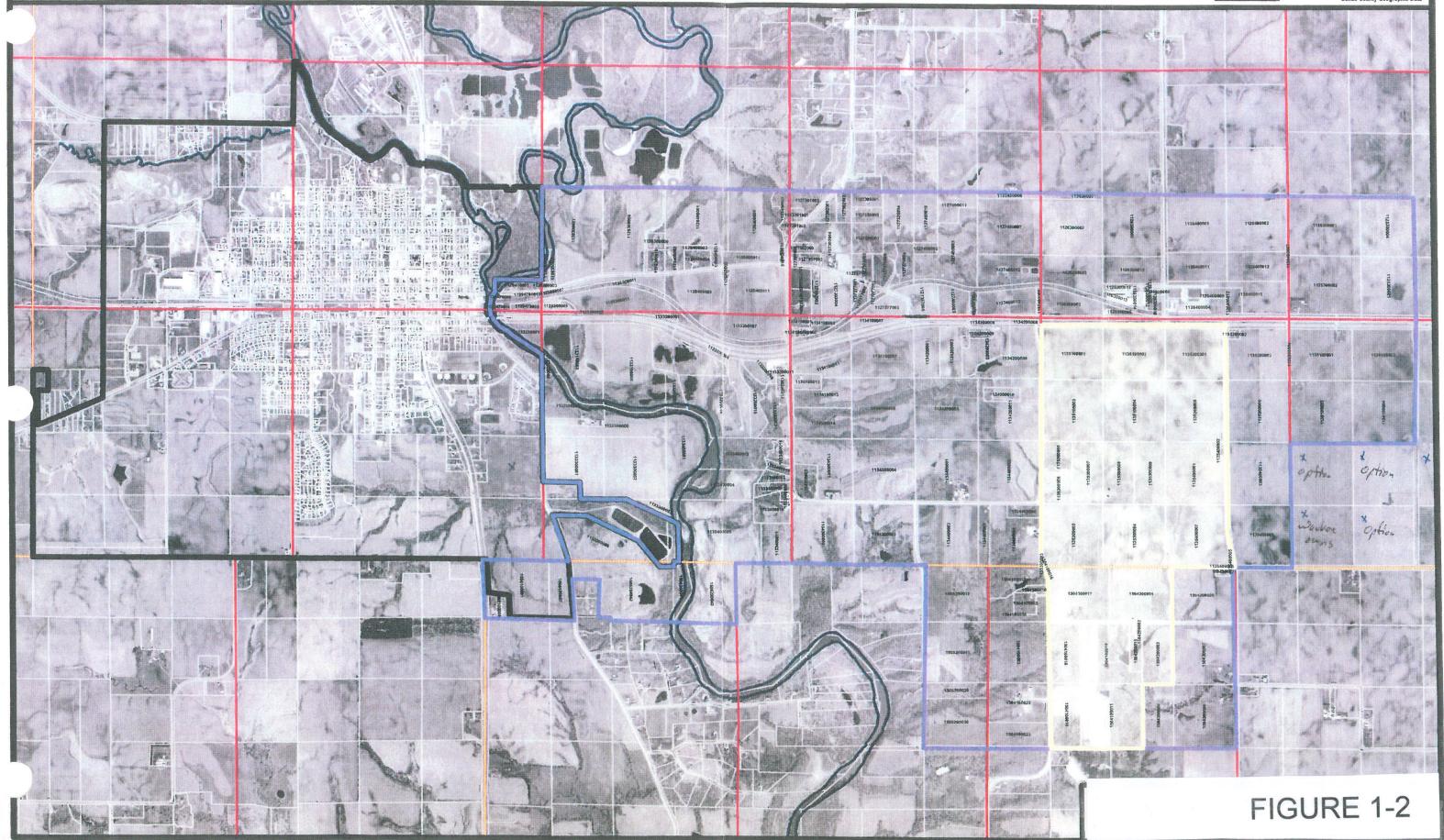
This study forecasts demand in relation to population increases based on historic growth, coupled with anticipated increases in growth as evidenced by adjacent communities. Existing available and proposed growth areas would accommodate population increases well beyond those expected in the planning period. These issues are discussed in greater detail later in this report.

ZONING BOUNDARIES RESIDENTIAL MULTI-FAMILY (RM) BUSINESS COMMERCIAL (BC) ARTERIAL COMMERCIAL (AC) RESIDENTIAL FAMILY (10RS) RESIDENTIAL FAMILY (8RS) HEAVY INDUSTRIAL (HI) LIGHT INDUSTRY (LI) CONSERVATION (CN) MOBILE HOME (MH) AGRICULTURE (AC) FIRE ZONE NAN FOSSEN LANE REVISIONS: 02/20/2006 FIGURE 1-1

CORPORATE LIMITS







I. PLANNING PERIOD

The planning period for this analysis and proposed improvements is 23 years, extending to the year 2030. For some parts of the analysis the planning period is extended another 30 years, to provide a perspective on the fully extended life of current infrastructure (for evaluation of potential operations with the Xenia Rural Water System), as well as to illustrate a longer-term perspective on population growth.

A design period of approximately 20 years is normal for municipal infrastructure improvements. This reflects an assumed useful life of equipment and facilities, and acknowledges limitations in forecasting population, demand for services, regulatory environment and other related factors.

II. POPULATION

The City of Adel's population has generally increased over the last 35 years. The U.S. Census population history is depicted within **TABLE 1-1** for the decades of 1970 through 2000. Population forecasts through the year 2060 are based upon the Regional Economic Models Inc (REMI).

The REMI forecasts indicate that Adel will have a population of around 5,550 by 2030, at the end of the planning horizon for this study. For this analysis, growth rates throughout the study period average 1.6% per year.

Under an alternative scenario, if Adel's population growth rate remains constant at a current estimated 2.4%

TABLE 1-1 City of Adel Infrastructure Study Population Projections Annual **Growth Rate** Year **Population** 1970 2,419 1.6% 1980 2,846 3,304 1.5% 1990 2000 3,435 0.4% 4,018 3.2% 2005 2010 4,529 2.4% 5.040 1.1% 2020 2030 5,550 1.0% 2060 9,000 1.6% Average Annual Growth Rate 1.6%

per year (similar to other western suburbs in the Des Moines metropolitan area), the city's population would reach 7,020 by the year 2030. This accelerated growth scenario is illustrated in **TABLE 1-2**.

While the primary focus of this analysis is not population projections, forecasted population is an important determinant for future water and wastewater capacity requirements.

For the purposes of this analysis, the growth projections in **TABLE 1-1** are used to determine the planning horizon (2030) population. It is important to note that if a higher growth rate is sustained through that period, part but not all of the longer term (2060) growth will occur during that time period.

TABLE 1-2 City of Adel Infrastructure Study					
Accellerated Growth Projections					
		Annual			
Year	Population	Growth Rate			
1970	2,419				
1980	2,846	1.6%			
1990	3,304	1.5%			
2000	3,435	0.4%			
2005	4,018	3.2%			
2010	4,524	2.4%			
2020	5,735	2.4%			
2030	7,270	2.4%			
2060 14,808 2.4%					
Average Annual Growth Rate 2.0%					

Of Adel's approximately 3.3 square miles of incorporated area, approximately 2/3 is developed, supporting a population of approximately 4,000 people. Extending the same density of housing and mix of land uses (residential, retail, commercial, industrial, institutional, and open space) to the rest of the existing city limits indicates that when fully developed, they could be expected to support a maximum population of approximately 6,000 residents. Under the assumed growth scenario, this would essentially equal the forecasted population for 2030.

However, it is not reasonable to expect growth to occur to 100% density within the city limits without any significant growth in adjacent areas outside the city limits, unless there are significant obstacles to development outside. This is not the case, and would not be expected to be the case for Adel. A more appropriate growth plan would make desirable growth areas available as indicated by demand, then allowing secondary growth areas to "infill" as they become more attractive due to surrounding development. Based on this type of approach, areas to the east of the city along Highway 6 would be expected to be a priority growth area, followed by other areas that are easy to develop based on availability of streets and infrastructure, or areas that are higher-priority as a result of adjacent land uses, viewsheds, or other issues.

Using development densities discussed herein, the proposed annexation area shown in **FIGURE 1-2** would support the city's growth well beyond the 20-year planning horizon, while providing access to desirable development areas and allowing orderly coordination of growth with infrastructure development. It is important to note however, that while some growth would inevitably occur east of the Raccoon River in the proposed annexation area, it is equally likely that some amount of growth pressure will eventually develop around the other edges of the city. For the purposes of this initial study, the most important issues of concern are the magnitude of growth, acknowledgement that some of that will occur east of the river (requiring that services be extended across the river), and a rough estimation of where growth will occur. Implementation of this planning, as it occurs over the next 20 years, will require continual refinement of expected growth areas, to ensure that the infrastructure is extended and sized accordingly.

For the purposes of this study, the 2060 population of 9,000 residents is assumed to result in 5,000 residents west of the Raccoon River, and 4,000 residents east of the river. These estimates reflect the assumed patterns of development discussed above, and are accommodated by terrain and developable space within the planning area. In addition, the land uses summarized in **TABLE 1-3** are assumed for that growth east of the river.

TABLE 1-3			
City of Adel Infrastru	acture Study		
Assumed Land De	velopment		
East of Raccoo	•		
Land Use	Acres		
Parks & Green Space	153	5%	
Airport	22%		
Housing (Homes/Apts.)	533	17%	
Commercial	3%		
Schools/Churches/Hospitals 138 5			
Office Parks 132 49			
Misc. (Ponds/Lakes) 77 3			
Industrial	180	6%	
Floodplain/Acreage/Farmland	1,075	35%	
	3,060	100%	

Water Supply and Treatment	

CHAPTER 3

WATER SUPPLY AND TREATMENT

3.1 DESIGN CRITERIA & PROJECTED WATER REQUIREMENTS

A water treatment system should be designed to supply the required volume of water on the maximum day for the design year. The determination of this value, in a rapidly growing community, is dependent upon experience in other communities, past records and is not an exact science. Factors include the nature of the community, the extent of lawn watering, industrial and commercial needs, the percentage of unaccounted water, the cost of water and how it is charged. Most communities charge less for water, the more that is used. This tends to encourage water use. Some communities where water is scarcer, or being purchased, may establish rate structures that discourage water use by charging more per 1,000 gallons as use increases.

Values shown in **TABLE 3-1** illustrate typical residential water consumption (in gallons per capita per day). Values shown for Adel usage are based on meter readings at the water treatment plant in June of 2005. They do not include leaks or un-metered use in the system, which is estimated to average about 15,000 gallons per day. This represents only 3.75 gallons per capita, which is only about 4 percent of the total.

TABLE 3-1 Gallons per Capita per Day

	Range ⁽¹⁾	Average (1)	Adel
Yearly Average Consumption	100-130	110	95
Mean Winter Consumption	50-130	100	83
Mean Summer Consumption	130-260	170	123
Maximum Daily Use	160-520+	230	181 ⁽²⁾
Maximum Hour Use	200-1,300+	390	Not Available

⁽¹⁾ ref. *Hammers* (water resources textbook)

TABLE 3-2 summarizes water use forecasts, based on the projected 2030 population for Adel, of 5,550 residents.

TABLE 3-2 Forecasted Water Requirements for Year 2030

Yearly Average Consumption	5,550 x 110 <u>Gallon</u> = 610,500 GPD
	Cap./Day
Mean Winter Consumption	5,550 x 91 <u>Gallons</u> = 505,000 GPD
	Cap./Day
Mean Summer Consumption	5,550 x 135 <u>Gallon</u> = 749,250 GPD
	Cap./Day
Maximum Daily Use	5,550 x 200 <u>Gallon</u> = 1,110,000 GPD
·	Cap./Day

⁽²⁾ June 2005

The projected water requirements shown in **TABLE 3-2** do not include wet industries that may locate in the city or wish to use water from the city. They do include light industry and commercial establishments already being served by the city.

If a wet industry were to locate into the city at some point in the future, it is assumed that they may choose to establish their own water supply, in order to meet their specific water quality and capacity needs. If such an industry were to request water service from the city, a detailed investigation would be required to evaluate demands and re-assess capacity available from the city to meet those needs.

TABLE 3-3 summarizes water use forecasts, divided into areas east of the Raccoon River and areas west of the Raccoon River, as estimated for this analysis.

TABLE 3-3 Estimated Water Use

		Location	Location	Total Use
Year	Type Use	West of River	West of River East of River	
2030	Yearly Ave. Use	.526 MGD	.084 MGD	.61 MGD
		366 GPM	58 GPM	424 GPM
2030	Mean Winter Use	.44 MGD	.069 MGD	.51 MGD
		306GPM	48 GPM	354 GPM
2030	Mean Summer Use	.65 MGD	.103 MGD	.75 MGD
		452 GPM	72 GPM	524 GPM
2030	Maximum Daily Use	.96 MGD	.152 MGD	1.11 MGD
		667 GPM	106 GPM	773 GPM
2060	Yearly Ave. Use	.55 MGD	.44 MGD	.99 MGD
		382 GPM	306 GPM	688 GPM
2060	Mean Winter Use	.46 MGD	.36 MGD	.82 MGD
		320 GPM	250 GPM	570 GPM
2060	Mean Summer Use	.68 MGD	.54 MGD	1.22 MGD
		473 GPM	375 GPM	848 GPM
2060	Maximum Daily Use	1.0 MGD	.80 MGD	1.80 MGD
		695 GPM	555 GPM	1,251 GPM

3.1.1 Fire Flows

Newly annexed areas should be protected by fire flows from ground storage tanks, elevated tanks or from a reliable water source. In some cases a combination of all three can be used. A fire flow of at least 1,500 GPM should be provided for industries and commercial areas, and for schools, hospitals and churches. At least 3 hours at 1,500 GPM should be planned for during the peak or maximum daily use.

Some of the fire flow may be available from existing facilities depending upon how the future piping network is established and what costs may be encountered. Other alternatives may be available including new public storage tanks in the area, or separate private tanks serving individual properties. Insurance rates are developed around the degree of protection available and reliable fire flows are an important aspect of the overall ratings developed.

3.2 PRESENT WELL SUPPLY & TREATMENT CAPACITIES

3.2.1. Well Supply

The City of Adel owns and operates four wells. A fifth well has been abandoned and no longer is used. Well capacities are checked on a regular basis, the wells are acidized and the mechanical equipment inspected and repaired as needed. **TABLE 3-4** lists the approximate capacity of the wells, which depends on the discharge pressure at each well. Discharge pressure at the well depends upon how many wells are in operation and the condition of the discharge lines, which connect to the water treatment plant.

TABLE 3-4
Nominal Well Capacities

Well No.	Capacity, GPM	Discharge Pressure
1	300	70
2	319	74
3	357	18
5	280	33
Capacity all Wells	1,256 GPM	

Supply capacity should normally be evaluated assuming that one well is out of service for maintenance or repair. So, if the largest well is out of service, this leaves the firm well capacity at (1,256 GPM – 357 GPM =) 899 GPM or 1.29 million gallons per day (MGD).

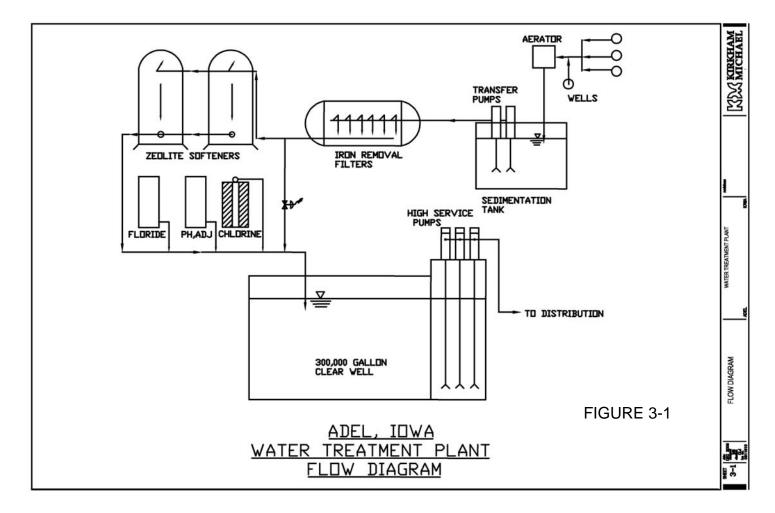
Based upon a review of the records for raw water and treated water pumped from Adel's facility, it is estimated that water use in the plant for backwash, cleaning and miscellaneous use averages 4.5% of the raw water pumped to the treatment plant. This is in line with normally accepted standards. Therefore, of the 899 gallons per minute delivered to the plant from the wells, 95.5% is available for distribution, or approximately 858 GPM. This is equivalent to 1.236 MGD.

The present demands on a peak day are estimated at 0.728 MGD. Therefore, adequate well supply is available at the present time. Based upon the projected maximum daily water requirements for the year 2030 shown in **TABLE 3-2**, 1.11 MGD will be needed, therefore the present well capacity is adequate to meet those needs.

This does not mean that the existing wells will remain in service without continued maintenance and possible replacement during the next 20 years. Allowance for such costs should be made based on historical records, adjusted for inflation.

3.2.2. Treatment Plant Operations

The treatment plant consists of induced draft aeration (2,200 cfm) for oxidation of iron and manganese, a reaction and settling basin, two transfer pumps that deliver the flow to a six cell iron removal filter and then to two zeolite softeners to reduce the hardness of the water. The treated water flows to a 300,000 gallon clearwell where it is stored until pumped to the distribution system by three (3) high service pumps.



Detailed information regarding the aerator, iron removal filter and the zeolite softening equipment is provided in the **APPENDIX**.

3.2.3 Treatment Plant Capacity

From the General Filter records available, the rated capacity of the 6-cell horizontal pressure iron removal filters is 700 GPM or 1.0 MGD. Comparison to the year 2030 maximum projected daily demand of 1.11 MGD indicates that the filters are slightly undersized (about 10%) for this design period. These calculations are based on a filtering rate of 2.59 gallons / minute / square foot which could be increased by 10% to 2.85 gallons / minute / square foot for short periods of time, providing the transfer pumps can

be increased from 700 GPM to 770 GPM. For the purpose of planning, it will be assumed this could be accomplished rather easily when the need arises.

It should also be realized that during peak or near peak water demands, it is an acceptable practice to discharge water with a slightly higher hardness level than normal. It is critical however, to reduce the iron in the water to required levels in order to prevent fouling the zeolite in the softening tanks.

In summary, the treatment units can be expected to operate at a peak capacity at or near the 2030 design requirement of 1.11 MGD. Unfortunately, these filtration and ion exchange units are 35 years old and considerable maintenance should be expected for continued use of the valves and piping systems. Replacement and/or repair of these components are discussed later in this chapter.

3.3 WATER QUALITY

Generally speaking the water quality is very good at Adel. The quality is monitored by the City operating personnel and checked routinely by the State Department of Natural Resources. A new operating permit has recently been issued and is included in the **APPENDIX**. This permit was effective on November 13, 2006 and expires February 2010.

Since the softening process is an ion exchange system, a review of the sodium content was made since this can be an issue for customers on a restricted or low salt diet. The maximum sodium concentration in drinking water for persons on a sodium-restricted diet, which is usually 2,000 mg of sodium per day, is 100 mg/l. For a severely restricted diet of 500 mg per day, the maximum concentration recommended by the American Heart Association is 20 mg/l.

Latest values for sodium-content in Adel's finished water supply are shown in **TABLE 3-5**, as provided by the plant personnel. On an average, the sodium levels are about 12 percent higher than is recommended for a restricted diet. It is recommended that the City contact the Iowa Department of Natural Resources and obtain guidance regarding notification of the medical profession and the public in the area.

TABLE 3-5 Sodium in Finished Water

Date	Value – mg/l
July 9, 2006	130
July 21, 2006	90
July 22, 2006	110
October 18, 2006	120

FIGURE 3-2 (sheet 1 of 2) 2004 WATER QUALITY REPORT **FOR** CITY OF ADEL

This report contains important information regarding the water quality in our water system. The source of our water is groundwater. Our groundwater is drawn from the alluvial aquifer(s).

our water quality test	MCLG	MCL	DETECTED	DATE SAMPLED	RANGE OF DETECTION	VIOLATION	SOURCE
Barium (ppm)	2	2	0.07	9/29/97		No	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits
Cadmium (ppb)	5	5	1.6	9/29/97		No	Corrosion of galvanized pipes; Erosion of natural deposits; Discharge from metal refineries; runoff from waste batteries and paints
Copper (ppm)	1.3	AL=1.3 One sample exceeded AL	0.55	6/20/02	ND – 1.48	No	Corrosion of household plumbing systems; Erosion of natural deposits
Fluoride (ppm)	4	4	1.57	6/23/03	0.93-1.57	No	Water additive which promotes strong teeth; Erosion of natural deposits; Discharge from fertilizer and aluminum factories
Lead (ppb)	0	AL=15 One sample exceeded AL	8	6/20/02	ND - 17	No	Corrosion of household plumbing systems; erosion of natural deposits
Nitrate [as N] (ppm)	10	10	0.55	8/13/03		No	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits
Sodium (ppm)	N/A	N/A	140	7/16/03		No	Erosion of natural deposits; Added to water during treatment process
Sulfate (ppm)	N/A	N/A	67	9/29/97		No	Erosion of natural deposits
1,2-Dichloroethane (ppb)	0	5	0.1	4/18/00		No	Discharge from industrial chemical factories

Note: Contaminants with dates indicate results from the most recent testing done in accordance with regulations.

DEFINITIONS

- Maximum Contaminant Level (MCL) The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
- Maximum Contaminant Level Goal (MCLG) The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
- ppb parts per billion.
- ppm -- parts per million.
- pCi/L picocuries per liter
- N/A Not applicable
- ND -- Not detected
- Treatment Technique (TT) A required process intended to reduce the level of a contaminant in drinking water.
- Action Level (AL) The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

FIGURE 3-2 (sheet 2 of 2)

GENERAL INFORMATION

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water posed a health risk. More information about contaminants or potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

ADDITIONAL HEALTH INFORMATION

Infants and young children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested and flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the Safe Drinking Water Hotline (800-426-4791)

OTHER INFORMATION

The City of Adel obtains its water from an alluvial aquifer. The alluvial aquifer was determined to be highly susceptible to contamination because the characteristics of the aquifer and overlying materials allow contaminants to move through the aquifer fairly quickly. The City wells will be most susceptible to activities such as hazardous waste generators, underground storage tanks, and leaking underground storage tanks. A detailed evaluation of your source water was completed by the Iowa Department of Natural Resources, and is available from the City of Adel at 515-993-4525.

CONTACT INFORMATION

For questions regarding this information, please contact Mary Sue Hibbs at Adel City Hall during the following hours: 9:00 a.m. – 4:00 p.m. Monday – Friday at (515)-993-4525.

Decisions regarding the water system are made at the City Council meetings held on 2nd Tuesday at 7:00 p.m. at Adel City Hall and are open to the public.

3.4 PLANT OPERATIONS

After reviewing the data and information available, touring the water plant and discussing the issues with the operating personnel, we believe the two major problems areas are:

- 1. The age of the existing plant and equipment.
- 2. The number of full time operating staff available to maintain the water supply and treatment facility.

The treatment plant is 35 years old, utilizes sodium chloride salt (NaCl) in the treatment process, and has several electronically controlled valves, motors and instruments that must be maintained and calibrated to keep the process operational.

Photographs in the **APPENDIX** illustrate the corrosion of much of the piping, tankage and valves that has taken place over the years. Some of the components have already been replaced, and more can be expected as time goes on. It is nearly impossible to predict when a component is apt to fail or will fail. A list of issues is shown in **TABLE 3-6**, with the assumption that the existing building will be used and that the capacity of the treatment plant will remain the same for the 20 year design period selected.

TABLE 3-6
Treatment Plant Issues

Priority No.	Item
1	Electrical corrosion and efficiency
2	Pipe and valves (rust, painting)
3	Steel Tanks (Internal Corrosion)
4	Control Functions
5	Building Code and Regulatory Issues
6	Policy Issues
	a. Connection to another water source
b. Hire another certified operator	
	c. Improve water distribution and fire fighting
	systems.

^{*}Two years ago, the iron filter media was replaced and the filter tanks were noted in "good condition". Five years ago some corrosion was noted in the Zeolite softeners when the Zeolite was replaced. Continued monitoring is recommended.

Most of the priorities listed above are inter related and have to do with the environment within the water plant and high service pump station. In view of the corrosion issues, we recommend that the following corrective items be initiated.

1. A dehumidification system be installed in the building that would provide dry air and prevent rusting. A proper coating system for tanks of all metal components following a detailed inspection of metal thickness and integrity should be done. Prior to coating, the metal should be sand blasted and primed. In some cases, patching by welding may be required.

Dehumidification - \$31,750 Sand Blast and Painting – Upstairs Pipe and Tanks - \$16,450

2. Pipe and valves may be more economical to replace than to coat. Pressure PVC, Polyethylene, or similar pipe should be used to replace connecting process piping. This should be considered in the Pipe Gallery.

Valves and Pipe Cost estimate - \$49,000.

- 3. Electrical switch gear, control panels, and conduit and wiring in the pipe gallery and in the bulk water building are likely in need of replacement. Cost Range \$150,000 to \$250,000.
- 4. Automatic feeding of chemicals for pH control should be considered.
- 5. Recommendations contained in the Municipal Water Works Sanitary Survey should be implemented. This document is contained in the **APPENDIX**, and includes the following items:

a.	Ventilation system in chlorine gas room	\$ 4,000
b.	Separate caustic soda and hydrofoorocilic acid	\$ 1,000
c.	Install chlorine gas detector	\$ 1,200
d.	Change pressurized chlorine system to vacuum syste	
e.	Replace backwash filter valve	\$ 7,000
	Total	\$16,200

- (1) City staff are completing this work at the rate of one filter per year, with four remaining as of the date of this report.
- 6. Policy issues having a major impact on cost and the overall operation include adding another water source and hiring a second full-time operator. It is our understanding that the city is considering adding a second full-time employee to the water department, which is encouraged.

TABLE 3-7
Costs for Plant Improvements

1	Provide dehumidification equipment for water treatment plant.	\$31,750
2	Sandblast and paint upper level tanks and pipe	\$16,450
3	Replace lower level pipe and worn valves	\$49,000
4	Electrical items	\$200,000
5	Recommendations contained in Municipal Water Works Sanitary Survey	\$16,200
	Sub-Total	\$313,400
	Contingencies	\$62,700
	Engineering, Overheads and Inspection	\$55,500
	Opinion of Total Costs	\$431,600

In addition to the proposed personnel cost increase, we recommend \$10,000 a year be set aside for miscellaneous repair and replacement of plant components including valves, controls, chemical feed pumps and miscellaneous items. Also, an allowance of from \$10,000 to \$15,000 should be reserved for replacement of well transfer and high service pump components.

3.5 XENIA RURAL WATER DISTRICT SUPPLY AND OPERATIONS

The Xenia Rural Water District currently provides potable water to incorporated and unincorporated areas near Adel, and is in the process of evaluating system improvements in this area that could potentially serve Adel. The City should consider possible alternatives for coordinating with Xenia to meet part or all of their future water supply needs, for the following reasons.

- 1. Stress on the city's plant will grow as population and water demand increase.
- 2. The existing water plant components are reaching their life expectancy. Repair or replacement of items discussed herein may require brief periods of plant shutdown or reduced flow. In that event, it would be beneficial if an alternate supply could be made available.
- 3. If wet industry locates and connects to the water system in the jurisdiction of Adel, the City's capacity may be exceeded very rapidly and at an early date.
- 4. It may be desirable for Xenia to consider Adel as a backup supply to their system during certain periods.

Options that could be considered for coordinating with Xenia's system include:

- 1) Construct improvements to connect to Xenia's system, but do not contract for guaranteed capacity. In this option, the city incurs minimal costs to connect to Xenia's system, making it available for emergency or supplementary supply. Since the city would not be participating in capital upgrades for Xenia to increase their capacity in this option, supply volume would not be guaranteed, and water that is provided would be charged at a retail per-unit rate.
- 2) Construct improvements to connect to Xenia's system, and contract for guaranteed minimum capacity from their system. Annual payments would then be made to Xenia to cover capital costs for upgrading their system. Actual water used would be charged at a wholesale rate. **TABLE 3-8** summarizes alternatives for this option.
- 3) Contract with Xenia water to operate all of Adel's water supply system through a franchise agreement. In this option, Xenia would be granted the exclusive rights to operate Adel's system and provide water to Adel residents for a 40-year period. Xenia would be responsible for all operation and maintenance, with costs passed along to users through water rates. Adel's City Council would retain the right to review and comment on improvements and rate increases prior to implementation. Upon completion of the 40-

year franchise agreement, it could be renewed, or water supply facilities could revert to City ownership and operations upon payment to Xenia for outstanding debt incurred for the system

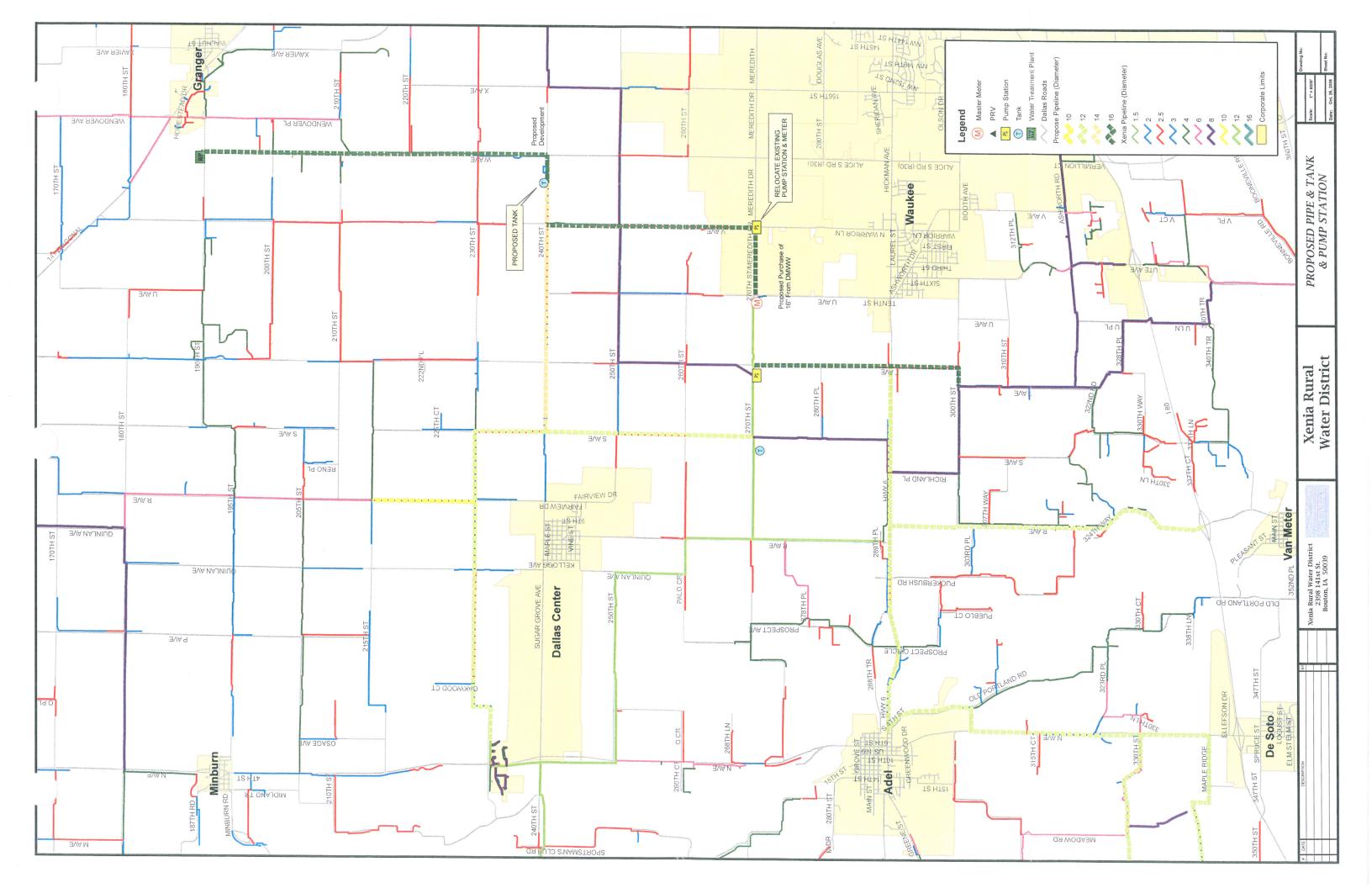
TABLE 3-8 Xenia Rural Water System

Options for Wholesale Service to the City of Adel from the New Water Treatment Plant north of Van Meter January 22, 2007.

					Standby
	Option 1	Option 2	Option 3	Option 4	Only
Guaranteed Max Contract Volume, gal/day	180,000	450,000	899,000	1,799,000	-
% of 2007 Peak Daily Demand	23%	59%	117%	234%	0%
% of 2030 forecasted Peak Daily Demand	16%	41%	81%	162%	0%
% of 2060 forecasted Peak Daily Demand	10%	25%	50%	100%	0%
Debt Service Cost per month	\$2,960	\$7,187	\$14,220	\$28,312	\$141
Water Rate per 1,000 gallons	\$1.06	\$1.06	\$1.06	\$1.06	\$1.78

FIGURE 3-3 illustrates Xenia Rural Water District system plans for the Adel area, as of late 2006.

Additional details for Xenia water alternatives are provided in their summary proposal, included in the **APPENDIX**.



CHAPTER 4	
Water Distribution System	

CHAPTER 4

WATER DISTRIBUTION SYSTEM

4.1 WATER REQUIREMENTS

4.1.1 Water Demands

The rate of water use varies over a wide range during different periods of the year and during different hours of the day. Several characteristic demands are recognized as being critical in the design and operation of a water system. In this report, demand rates are expressed in gallons per day (gpd) or million gallons per day (mgd), which, in the case of daily use, indicates the total amount of water pumped in a 24-hour period.

The average daily use is equal to the total annual pumpage divided by the number of days in the year. The principal significance of the average daily use is in estimating maximum daily use or maximum hourly demands. The average daily use is also utilized for storage facility sizing and in estimating revenues and operating costs, such as for power or chemicals since these items are determined primarily by the total annual use and not by daily or hourly rates.

Maximum daily use is the maximum quantity pumped in any day during the year. The maximum daily use is the critical factor in the design of certain elements of the water system. The principal items affected by the maximum daily use are: water treatment plant capacity (including high service pumps) and well (water source) capacity.

4.1.2 Future Requirements

The current per capita water demands are utilized concurrently with the projected population in the design year 2030 to determine the future average day and maximum day water demands. Per capita water demands may actually decrease through the future years, due to on-going development and use of water saving plumbing fixtures and appliances as well as continuing pressure for water conservation. These decreases are difficult to accurately predict at this time, and therefore, it is prudent to use the current per capita demands for design of water system improvements. These future water demands are shown in **TABLE 4-1**, as follows:

TABLE 4-1 Population and Water Demand City of Adel, Iowa

Year	Population	A.D.D. (gpd)	M.D.D. (gpd)
2005	4018	441,980	803,600
2010	4529	498,190	905,800
2020	5,040	554,400	1,008,000
2030	5,550	610,500	1,110,000

A.D.D.- Average Day Demand (gallons per day) – 110 gpcpd

M.D.D. - Maximum Day Demand (gallons per day) – 200 gpcpd

These projected future water demands are used as the basis of the sizing and design of the proposed improvements. The per capita average day demand was projected at 110 gallons/day and the maximum day demand was projected at 200 gallons/day.

4.2 DESIGN STANDARDS

All design criteria, materials and equipment discussed in this report and included in the final project design shall meet the requirements of State and Federal laws and regulations, including:

- A. Iowa Statewide Urban Standard Specifications for Public Improvements, current adopted edition.
- B. Great Lakes Upper Mississippi River Board of State Health and Environmental Managers
 (Ten State Standards) Recommended Standards for Water Works

4.3 EXISTING FACILITIES

Adel's existing water distribution system is shown on **FIGURE 4-1**.

4.3.1 Water Mains

Public water mains within the city range from 4 inch to 14 inches in diameter, including approximately 117,300 lineal feet of mains. The approximate inventory of main sizes in feet, are as shown in **TABLE 4-2**.

TABLE 4-2
Adel Water Distribution System
Existing Main Diameters

4-inch =	37,500 LF
6-inch =	32,000 LF
8-inch =	19,700 LF
10-inch =	20,500 LF
12-inch =	7,400 LF
14-inch =	200 LF
Total =	117,300 LF

The fire hydrants and distribution valves are maintained by city water staff. There are approximately 202 hydrants in the system. The hydrants are generally operated and flushed a minimum of once per year. There is not a reported valve operation program in place.

The existing distribution system generally serves the basic domestic water service needs of most of the users. However, there are areas of the City that cannot provide the recommended Needed Fire Flow (NFF).

Generally, minimum recommended fire flow requirements for residential areas are 1,000 gpm to 1,500 gpm at 20-psi residual pressure. Higher value or risk buildings normally require a larger fire flow. Downtown buildings, schools, hospitals, large churches and industrial or commercial buildings may require 3,000 - 3,500 gpm or more at 20-psi residual pressure.

The Insurance Services Office periodically conducts a review and classification of a community's fire suppression system, which includes evaluations of the water system, fire department and fire communications. This was last conducted in Adel in 2005 and resulted in an overall classification of 6 (on a scale of 1-10 with one being the best rating). Overall, an ISO Classification of 6 is good. The Insurance Service Offices 2005 Hydrant Flow Data Summary and ISO report is included in the **APPENDIX**.





ITIES DISTRIBUTION ID PROPOSED

FIGURE **4-1**

4.3.2 Water Storage

Adel's system includes an existing elevated water storage tanks on 15th Street at Meadow Road, and on 15th Street at Prairie Street. The two elevated tanks have overflow elevations of 1,145 USGS datum and 1,045 USGS datum respectively, configured as follows:

Location		<u>Size/Type</u>
15 th Street at Meadow Road (high zon	ie)	200,000 gallons Elevated Storage
15 th Street at Prairie Street (low zone)		250,000 gallons Elevated Storage
	Total	450,000 Gallons





ITIES DISTRIBUTION ID PROPOSED

FIGURE **4-1**

4.4 DESIGN CRITERIA

4.4.1 Water Mains

The water mains should be sized to provide domestic demands and the needed fire flow to each respective location. Generally, a minimum main size of 6-inch diameter is required to provide minimal residential fire flow and is the recommended minimum diameter by Ten State Standards. If undersized water mains are utilized, excessive velocities and head losses will result at fire flow demand conditions. Therefore, it is generally recommended that a minimum diameter of 6 inch, or larger diameter as suited to the design fire flow needed, be utilized for all water main replacements or extensions to new service areas. Also, mains should be connected in loops whenever possible to provide circulation, increased fire flow protection and enhance water quality.

The water main distribution system in Adel generally provides adequate domestic flow to residents and commercial properties and provides sufficient fire flow to some areas of the City. There are however, some areas where the available fire flow (AFF) does not meet the needed flow (NFF) requirement. Some water main improvements are therefore recommended to improve available fire flow to those areas not meeting the design needed fire flow.

4.4.2 Water Storage

Effective storage should be provided in an amount equal to the average day demand or as required to provide fire protection in systems that provide fire flow. The total existing elevated storage volume is 450,000 gallons, which slightly exceeds the 2005 average day demand of 441,980 gallons per day. However, this will be insufficient for the 2030 design year demand of 610,500 gallons per day. For this reason and also to improve the available fire flows (AFF) in some specific areas, additional elevated storage is recommended within the planning period.

The addition of a 200,000 gallon elevated storage tank would provide the City with over 650,000 gallons of elevated storage. Additional elevated storage would improve system reliability and could also improve pressures in targeted specific areas if located properly. This additional storage would also provide more fire flow capacity for longer duration in the low pressure zone where the new tank would located.

4.5 WATER SYSTEM ANALYSIS

The existing water system was computer modeled using the Bentley Systems WaterGems Computer Software Program. The program was first calibrated to ensure the computer model performed within generally acceptable tolerances of actual field measured conditions. The calibration was completed and the computer results matched the field pressures with reasonably good correlation. Some variations between the flows available in Insurance Services Office (ISO) field tests and the computer model were observed. The ISO available flow only represents the amount of flow available at the specific time of the test under the physical conditions during the test. The flow test locations are shown in **TABLE 4-3**, and depicted graphically on **FIGURE 4-1**.

TABLE 4-3 ISO Hydrant Flow Tests Existing Water System

Model Junction	Map Reference	Location	Hydrant Flow (GPM)	Residual Field Pressure (psi)	Residual Pressure Model (psi)
15	2	1900 Block of Greene Street	750	38	33
18	3	Brickyard Rd. and Visions Parkway	750	30	41
28	5	North 6 th and Rapids St	490	60	67
104	10	South Kinnick Dr and Greenwood Hills Dr	970	52	10
120	12	South 14 th and Ann Ave	870	55	43
132	13	South 14 th and Greene St	520	44	33
141	16	North 11 th and Court St	1250	48	50
186	20	Kinnick Dr and Main St	970	44	15
48	6	N. 10 th St. & Kinnick Feller Park	970	50	49
141	16	N. 11 th and Court Street	1050	53	52
158	21	6 th & Aspen St. School	950	54	58
132	13	FH Norht of 14 th & Bike Trail	930	44	39

All flowrates in gallons per minute

Refer to Figure 4-1 to locate map references

TABLE 4-4
Needed and Available Fire Flows
Existing Water System

Model Junction	Map Reference	Location	Needed Fire Flow (NFF)	Avail. Flow per Model
2	1	Sunset Circle and North 15 th St	1000	1330
15	2	1900 Block of Greene St	3000	1660
18	3	Brickyard Rd and Visions Parkway	4500	1290
27	4	N. 12 th St and Court St	1000	1400
28	5	North 6 th St and Rapids St	3500	2780
48	6	North 10 th St and Kinnick Feller Park	1000	1800
53	7	19 th St and Rapids St	1000	505
74	8	Horse n Buggy Dr at 19 th St	1000	440
84	9	Bryan St and S. 8 th Street	1000	1525
104	10	800 Block of Nile Kinnick Dr South	3000	745
111	11	FH North of 14 th & Bike Trail	2500	2300
118	12	West End of Beverly Circle	1000	1025
120	13	South 14 th St and Ann Ave	1000	1900
132	14	South 14 th St and Greene St	2500	585
135	15	West Court at 17 th St	1000	500
140	16	North 12 th Street Circle	1000	395
141	17	North 11 th and Court St	2500	3800
158	18	6 th and Aspen St, School	3000	2100
159	19	1800 Block of Greene St	3000	1660
178	20	1100 Block of S. 12 th St. & Evansview Dr.	1000	1650
182	21	South 10 th at Greenwood Hills Dr	1000	745
186	22	100 Block of Nile Kinnick Dr. South	2000	910

All flowrates in gallons per minute

Refer to Figure 4-1 to locate map references

The computer analysis of the distribution system showed areas of the system where the AFF does not meet the NFF and water main improvements are needed. The improvement of available fire flows generally requires larger diameter water mains at strategic locations. The recommended storage

improvements will also improve AFF, especially to the western part of the City within the low zone. The available fire flows after each of the improvement phases are shown in **TABLES 4-5, 4-6**, and **4-7**.

TABLE 4-5
Available Flowrate
With Phase I Recommended Improvements

Map Reference	Location	NFF	AFF
1	Sunset Circle and North 15 th St	1000	1360
2	1900 Block of Greene St	3000	1660
3	Brickyard Rd and Visions Parkway	4500	1290
4	N. 12 th St and Court St.	1000	1500
5	North 6 th St and Rapids St	3500	3470
6	North 10 th St and Kinnick Feller Park	1000	2970
7	19 th St and Rapids St	1000	1690
8	Horse n Buggy Dr at 19 th St	1000	1690
9	Bryan St & South 8 th Street	1000	1550
10	800 Block of Nile Kinnick Dr. South	3000	1600
11	FH North of 14 th & Bike Trail	2500	2500
12	West End of Beverly Circle	1000	1025
13	South 14 th St and Ann Ave	1000	1900
14	South 14 th St and Greene St	2500	585
15	West Court at 17 th St	1000	1045
16	North 12 th Street Circle	1000	1550
17	North 11 th and Court St	2500	4000
18	6 th and Aspen St, School	3000	2250
19	1800 Block of Greene St 12" Dead End Main	3000	2660
20	1100 Block of S. 12 th Street & Evansview Dr.	1000	1650
21	South 10 th at Greenwood Hills Dr	1000	1600
22	100 Block of Nile Kinnick Dr. South	2000	3000

Flowrates in gallons per minute

Fire flows simulated with the Phase I recommended water main improvements.

TABLE 4-6
Available Flowrate
With Phase II Recommended Improvements

Map Reference	Location	NFF	AFF
1	20 th St and North 15 th St	1000	1375
2	1900 Block of Greene St	3000	1660
3	Brickyard Rd and Visions Parkway	4500	1290
4	12 th St and Rapids St	1000	1510
5	North 6 th St and Rapids St	3500	3500
6	North End of 10 th St	1000	3000
7	19 th St and Rapids St	1000	2050
8	Horse n Buggy Dr at 19 th St	1000	1825
9	Bryan St at Highway 169	1000	1550
10	South Kinnick Dr at Greenwood Hills Dr	3000	3150
11	FH North of 14 th & Bike Trail	2500	2500
12	West End of Beverly Circle	1000	1425
13	South 14 th St and Ann Ave	1000	3625
14	South 14 th St and Greene St	2500	585
15	West Court at 17 th St	1000	1625
16	North End of 12 th Circle	1000	1775
17	North 11 th and Court St	2500	4000
18	6 th and Aspen St, School	3000	2265
19	1900 Block of Greene St 12" Main	3000	1660
20	12 th and Penoach St	1000	2640
21	South 10 th at Greenwood Hills Dr	1000	3100
22	Kinnick Dr and Main St	2000	3000

Flowrates in gallons per minute

Fire flows simulated with the Phase I and II recommended water main improvements

TABLE 4-7
Available Flowrate With Phase III Recommended Improvements

Map Reference	Location	NFF	AFF
1	Sunset Circle and North 15 th St	1000	1380
2	1900 Block of Greene St	3000	4200
3	Brickyard Rd and Visions Parkway	4500	7000
4	N. 12 th St and Court St	1000	1510
5	North 6 th St and Rapids St	3500	3600
6	North 10 th St and Kinnick Feller Park	1000	3000
7	19 th St and Rapids St	1000	2075
8	Horse n Buggy Dr at 19 th St	1000	2250
9	Bryan St and S. 8 th St.	1000	1550
10	800 Block of Nile Kinnick Dr. South	3000	4375
11	FH North of 14 th & Bike Trail	2500	2550
12	West End of Beverly Circle	1000	1450
13	South 14 th St and Ann Ave	1000	3880
14	South 14 th St and Greene St	2500	590
15	West Court at 17 th St	1000	1625
16	North 12 th Street Circle	1000	1775
17	North 11 th and Court St	2500	4000
18	6 th and Aspen St, School	3000	2300
19	1800 Block of Greene St	3000	4225
20	100 Block of S 12 th St & Evansview Rd	1000	3025
21	South 10 th at Greenwood Hills Dr	1000	4240
22	100 Block of Nike Kinnick Dr. South	2000	3000
23	S 10 th St. at Meadow Rd.	1500	4500
24	Meadow Road at Van Fossen Ln	1500	4200
25	Van Fossen Lane at Ann Ave	1500	4250
26	S. 19 th St at Ann Ave	1500	4500
27	S. 19 th St at Penoach St.	1500	4000
28	S. 10 th St. at Ann Ave.	1500	3100

Flowrates in gallons per minute. Fire flows simulated with the recommended water main improvements and with the new storage tank (Phases I, II, and III).

4.6 RECOMMENDED IMPROVEMENTS AND ESTIMATES OF PROBABLE COST

4.6.1 Water Main Improvements

In order to provide better operating pressures and provide the recommended fireflows to the critical areas as identified in Tables 4-4 through 4-8, some water main improvements are recommended. The recommended water main improvements for each of the three alternatives are shown in **TABLES 4-8** through **4-10** and are depicted graphically on **FIGURE 4-1**. It should be noted and emphasized that the specific location of the proposed water distribution mains may be adjusted based upon design considerations and City input and experience.

Table 4-8 Recommended Phase I Water Main Improvements

No.	Description	Size (inches)	Length (ft.)
PHASE	İ		
1	Grove St 6 th St to 17 th St	8	3,950
2	6 th St Rapids St to Grove St	8	400
3	17 th St Rapids St to Grove St	8	400
4	Rapids St 17 th St to 19 th St	8	800
5	8 th St Rapids St to Alley South of Court St	10	550
6	Bike Trail 14 th St to 19 th St	12	1,500
7*	18 th St., Greene St to Prairie St.	6	850
8*	Greene St 18 th St to 14 th St.	6	1250
9*	Prairie St., 18 th St. to Elevated Tank	6	850
10	19 th St Horse n Buggy Dr to Hyvue St	6	400
11	Greenwood Hills Dr So 10 th St to Nile Kinnick Dr	10	1,000
12	So 10 th St Penoach St to Greenwood Hills Dr	8	500
13	Penoach St So 10 th St to 12 th St	8	750
14	12 th St Grove St to the North	8	750
15	12 th Street Circle	6	400
16	11 th Street Circle	6	450
17	9 th St Grove St to North End	6	550
18	8 th St Grove St to North End	6	550

^{*} Include replacement of AC pipins.

TABLE 4-9 Recommended Phase II Water Main Improvements

No.	Description	Size (inches)	Length (ft.)
PHASE	II		
1	North of Locust St 12 th St to 15 th St	6	900
2	19 th St Grove St to Rapids St	6	700
3	18 th St Rapids St to West end of 17 th St	6	500
4	14 th St Beverly Dr to Meadow Rd	8	1,100
5	So. 10 th St Penoach St to Meadow Rd	8	2,650
6	Meadow Rd 15 th St to So 10 th St	10	2,150

TABLE 4-10 Recommended Phase III Water Improvements

No.	Description	Size (inches)	Length (ft.)
PHASE	III		
1	200,000 Gallon Elevated Tank	NA	NA
2	12" Connecting Water Main	12	200
3	Nile Kinnick Dr. – Greenwood Hills to Meadow Rd	10	3400
4	Meadow Rd S. 10 th to Nike Kinnick	10	1800
5	Meadow Rd S/ 15 th to Visions Parkway	10	3000
6	Visions Parkway – Meadow Rd to Highway 6	10	4200
7	Penoach St. – 16 th St. to 19 th St.	8	950
8	19 th St – Meadow Road to Penoach St	8	2650
9	Highway 6 – 6 th St. to East of N. Raccoon River	8	1700
10	Highway 6 – 6 th St to East of N. Raccoon River	12	1200

TABLE 4-11
Estimates of Probable Costs – Recommended Water Mains
PHASE I

No.	Description	Diameter (in.)	Length (ft.)	Unit Cost	Cost
1	Grove St 6 th St to 17 th St	8	3,950	\$35	\$138,250
2	6 th St Rapids St to Grove St	8	400	\$35	\$14,000
3	3 17 th St Rapids St to Grove St		400	\$35	\$14,000
4	Rapids St 17 th St to 19 th St	8	800	\$35	\$28,000
5	8 th St Rapids St to Alley South of Court St	10	550	\$42	\$23,100
6	Bike Trail 14 th St to 19 th St	12	1,500	\$49	\$73,500
7	18 th St Greene St to Prairie St.	6	850	\$28	\$23,800
8	8 th St Rapids St to 14 th St.	6	1250	\$28	\$35,000
9	Prairie St – 18 th St. to Elevated Tank	6	850	\$28	\$23,800
10	19 th St Horse n Buggy Dr to Hyvue St	6	400	\$28	\$11,200
11	Greenwood Hills Dr So 10 th St to Nile Kinnick Dr	10	1,000	\$42	\$42,000
12	So 10 th St Penoach St to Greenwood Hills Dr	8	500	\$35	\$17,500
13	Penoach St So 10 th St to 12 th St	8	750	\$35	\$26,250
14	12 th St Grove St to the North	8	750	\$35	\$26,250
15	12 th Street Circle	6	400	\$28	\$11,200
16	11 th Street Circle	6	450	\$28	\$12,600
17	9 th St Grove St to North End	6	550	\$28	\$15,400
18	8 th St Grove St to North End	6	550	\$28	\$15,400
			S	Subtotal	\$551,250
Contingencies (15%)					\$82,375
Engineering (15%)					\$82,375
Other Costs (5%)					\$27,500
		Pro	bable Proje	ct Cost	\$743,500

TABLE 4-12
Estimates of Probable Costs – Recommended Water Mains
PHASE II

No.	Description	Diameter (in.)	Length (ft.)	Unit Cost	Cost
1	North of Locust St 12 th St to 15 th St	6	900	\$28	\$25,200
2	19 th St Grove St to Rapids St	6	700	\$28	\$19,600
3	18 th St Rapids St to West end of 17 th St	6	500	\$28	\$14,000
4	14 th St Beverly Dr to Meadow Rd	8	1,100	\$35	\$38,500
5	So. 10 th St Penoach St to Meadow Rd	8	2,650	\$35	\$92,750
6	Meadow Rd 15 th St to So 10 th St	10	2,150	\$42	\$90,300
			S	Subtotal	\$280,350
		Co	ntingencies	s (15%)	\$42,075
Engineering (15%)					\$42,075
Other Costs (5%)					\$14,000
		Pro	bable Proje	ct Cost	\$378,500

TABLE 4-13
Estimates of Probable Costs – Recommended Water Mains
PHASE III

No.	1Description	Diameter (in.)	Length (ft.)	Unit Cost	Cost
1	200,000 Gallon Elevated Tank	NA	NA	LS	\$550,000
2	12" Connecting Water Main	12	200	\$49	\$9,800
3	Nile Kinnick Drive – Greenwood Hills to Meadow Rd	10	3,400	\$42	\$142,800
4	Meadow Rd. – S. 10 th to Nile Kinnick Dr.	10	1,800	\$42	\$75,600
5	Meadow Rd. – S. 15 th to Visions Parkway	10	3,000	\$42	\$126,000
6	Visions Parkway – Meadow Rd to Highway 6	10	4,200	\$42	\$176,400
7	Penoach St. – 16 th St to 19 th St.	8	950	\$35	\$33,250
8	19 th . St – Meadow Rd. to Penoach St.	8	2,650	\$35	\$92,750
9	Highway 6 – HyVee to 19 th & Penoach St.	8	1,700	\$35	\$59,500
			S	Subtotal	\$1,386,100
Contingencies (15%)					
Engineering (15%)					\$207,450
Other Costs (5%)					\$69,000
		Pro	bable Proje	ct Cost	\$1,870,000

4.7 PRIORITIES / PHASING OF RECOMMENDED IMPROVEMENTS

In order to formulate an orderly implementation of the recommended improvements, balance financial resources and to accomplish the more urgent system needs first, the total planning period recommendations have been prioritized. The first phase of the water main improvement includes the water mains to improve the AFF to those locations with the most significant shortfall and as practical for an orderly phasing of the projects.

The second phase of water main improvements includes the recommended water mains for additional AFF to the remaining areas not addressed in Phase I and to loop dead end mains where practical.

The last phase of improvements includes the recommended 200,000 gallon elevated storage tank which will provide sufficient storage volume for the design year and will also provide much improved fire flow to the areas in the western part of the City especially along Highway 6.

Also included are proposed water mains to serve future growth areas in the southern part of the City. Exact alignments of these mains may change as development occurs. Some of the improvements shown in Phase III may be moved up to earlier phases as development dictates.

A 12-inch diameter main with river crossing is also included to serve areas to the east. This would only be necessary if these areas are not served by Xenia facilities.

CHAPTER 5	
Wastawater Collection and Treatment	

CHAPTER 5 WASTEWATER COLLECTION AND TREATMENT

5.1 EFFLUENT LIMITATIONS

5.1.1 Current Discharge Permit Requirements

The Adel wastewater treatment facility operates under Iowa NPDES Permit No. 2503001. **TABLE 5-1** presents the current effluent requirements. The current permit expires on 01-05-2006. The City is required to file for renewal of the permit by 07-09-2007.

TABLE 5-1
City of Adel Wastewater Treatment
Current Effluent Limits

			EFFI	LUENT LIMITS		
		CONCENTRAT	ION (MG/L)		MASS (LBS)	
PARAMETER	SEASON	7 Day Ave	30 Day Ave	7 day Ave	30 day Ave	Daily Max
CBOD		40	25	414	259	
TSS		120	80	1250	827	
AMMONIA AS N	JAN				25.1	65
(LBS/CFS STREAM FLOW)	FEB				28.6	73.8
	MAR				12.4	50.5
	APR				8.6	34.2
	MAY				7.2	33.9
	JUN				4.6	33.9
	JUL				5.8	36.5
	AUG				5.3	30.1
	SEP				12.4	41.3
	ОСТ				15.7	41.3
	NOV				18.6	33.7
	DEC				4.1	41.5
PH		6.0 - 9.0	Min-Max			
COLIFORM, FECAL	SUMMER	200,000 #/100 ML	Daily Max			

5.1.2 Future Discharge Permit Requirements

The future permit requirements are unknown at this time. It is anticipated that nutrient removal requirements, if needed, would be added to the NPDES permit within the next 10 years.



5.2 CURRENT CONDITIONS

5.2.1 Existing Wastewater Flows and Waste Loads

TABLE 5-2 summarizes 2004 average wastewater flows, carbonaceous biological oxygen demand (CBOD) loadings, and total suspended solids (TSS) loadings to the Adel wastewater treatment facility, expressed in mg/l.

TABLE 5-2
City of Adel Wastewater Treatment
Year 2004 Wastewater Flows and Waste Loads in mg/l

MONTHS	INFLUENT FLOW	CBOD(N	IG/L)	EFFLUENT FLOW	TSS (MC	G/L)
	(MGD)	INFLUENT	EFFLUENT	(MGD)	INFLUENT	EFFLUENT
JANUARY	0.378	144	9.6	0.402	156	14.5
FEBRUARY	0.431	133	8.4	0.378	163	10.6
MARCH	0.719	89	4.6	0.728	46	13.3
APRIL	0.61	71	6.9	0.589	125	15.5
MAY	0.638	55	9	0.717	117	27.8
JUNE	0.855	35	5.4	0.854	70	10.7
JULY	0.645	50	4	0.558	104	9.6
AUGUST	0.668	56	4.1	0.562	68	42.5
SEPTEMBER	0.459	93	4.1	0.37	89	12.2
OCTOBER	0.386	89	4.6	0.342	46	13.3
NOVEMBER	0.428	61	4.3	0.538	39	12.8
DECEMBER	0.423	81	7.3	0.507	75	14.7
AVERAGE	0.553	80	6.0	0.545	92	16.5

Avg Dry Weather (ADW)	0.396
Avg Wet Weather (AWW)	0.855
Max Wet Weather (MWW)	2.64

1.197

TABLE 5-3 summarizes 2004 average wastewater flows, carbonaceous biological oxygen demand (CBOD) loadings, and total suspended solids (TSS) loadings to the Adel wastewater treatment facility, expressed in pounds per day.

TABLE 5-3
City of Adel Wastewater Treatment
Year 2004 Wastewater Flows and Waste Loads in lbs/day

	INFLUENT FLOW	CBOD(LB/D)		EFFLUENT FLOW	TSS (LB	/D)
	(MGD)	INFLUENT	EFFLUENT	(MGD)	INFLUENT	EFFLUENT
JANUARY	0.378	454	32	0.402	492	49
FEBRUARY	0.431	478	26	0.378	586	33
MARCH	0.719	534	28	0.728	276	81
APRIL	0.61	361	34	0.589	636	76
MAY	0.638	293	54	0.717	623	166
JUNE	0.855	250	38	0.854	499	76
JULY	0.645	269	19	0.558	559	45
AUGUST	0.668	312	19	0.562	379	199
SEPTEMBER	0.459	356	13	0.37	341	38
OCTOBER	0.386	286	13	0.342	148	38
NOVEMBER	0.428	218	19	0.538	139	57
DECEMBER	0.423	285	31	0.507	265	62
AVERAGE	0.553	341	27	0.545	412	77

TABLE 5-4 summarizes 2005 average wastewater flows, carbonaceous biological oxygen demand (CBOD) loadings, and total suspended solids (TSS) loadings to the Adel wastewater treatment facility, expressed in mg/l.

TABLE 5-4
City of Adel Wastewater Treatment
Year 2005 Wastewater Flows and Waste Loads in mg/l

	INFLUENT FLOW	CBOD(MG/L)		EFFLUENT FLOW	TSS (MC	G/L)
	(MGD)	INFLUENT	EFFLUENT	(MGD)	INFLUENT	EFFLUENT
JANUARY	0.417	120	9.6	0.424	139	15
FEBRUARY	0.556	114	16.8	0.782	170	21.5
MARCH	0.502	121	11.8	0.523	209	25.5
APRIL	0.547	103	6.5	0.553	169	12
MAY	0.729	76	10.6	0.668	83	25.2
JUNE	0.537	82	6	0.531	115	13.8
JULY	0.498	41	6	0.399	99	16.4
AUGUST	0.469	125	4.1	0.426	196	8.7
SEPTEMBER	0.409	114	4.3	0.328	155	10.8
OCTOBER	0.377	203	6.5	0.273	432	16.2
NOVEMBER	0.387	120	4.4	0.304	195	17.1
DECEMBER	0.401	151	8.6	0.375	196	15.4
AVERAGE	0.486	114	7.9	0.466	180	16.5

Avg Dry Weather (ADW)	0.388
Avg Wet Weather (AWW)	0.729
Max Wet Weather (MWW)	1.835

1.044

TABLE 5-5 summarizes 2005 average wastewater flows, carbonaceous biological oxygen demand (CBOD) loadings, and total suspended solids (TSS) loadings to the Adel wastewater treatment facility, expressed in pounds per day.

TABLE 5-5
City of Adel Wastewater Treatment
Year 2005 Wastewater Flows and Waste Loads in lbs/day

	INFLUENT FLOW	CBOD(LB/D)		EFFLUENT FLOW	TSS (LB	/D)
	(MGD)	INFLUENT	EFFLUENT	(MGD)	INFLUENT	EFFLUENT
JANUARY	0.417	417	34	0.424	492	53
FEBRUARY	0.556	529	110	0.782	1109	140
MARCH	0.502	507	51	0.523	912	111
APRIIL	0.547	470	30	0.553	779	55
MAY	0.729	462	59	0.668	462	140
JUNE	0.537	367	27	0.531	509	61
JULY	0.498	706	20	0.399	329	55
AUGUST	0.469	489	4.2	0.426	696	31
SEPTEMBER	0.409	389	15	0.328	424	30
OCTOBER	0.377	638	15	0.273	984	82
NOVEMBER	0.387	387	11	0.304	494	187
DECEMBER	0.401	505	27	0.375	613	48
AVERAGE	0.486	489	34	0.466	650	83

TABLE 5-6 summarizes 2006 average wastewater flows, carbonaceous biological oxygen demand (CBOD) loadings, and total suspended solids (TSS) loadings to the Adel wastewater treatment facility, expressed in mg/l.

TABLE 5-6
City of Adel Wastewater Treatment
Year 2006 Wastewater Flows and Waste Loads in mg/l

	INFLUENT FLOW	INFLUENT FLOW CBOD(MG/L)		EFFLUENT FLOW	TSS (MG/L)		
	(MGD)	INFLUENT	EFFLUENT	(MGD)	INFLUENT	EFFLUENT	
JANUARY	0.406	141	12.6	0.369	278	20.4	
FEBRUARY	0.383	150	16.1	0.402	256	24.9	
MARCH	0.415	135	13.4	0.386	163	17.8	
APRIL	0.624	72	5.6	0.61	136	8.1	
MAY	0.598	78	7.6	0.565	108	22.2	
JUNE	0.354	109	4.8	0.344	159	12	
JULY	0.353	88	6.4	0.365	135	19	
AUGUST	0.41	101	5.3	0.368	119	11	
SEPTEMBER	0.422	85	5.3	0.484	113	13.6	
OCTOBER	0.354	88	4	0.369	130	10.8	
NOVEMBER	0.433	88	6.1	0.345	150	8.3	
DECEMBER							
AVERAGE	0.432	103	7.9	0.419	159	15.3	

Avg Dry Weather (ADW)	0.354
Avg Wet Weather (AWW)	0.624
Max Wet Weather (MWW)	1.624

1.084

TABLE 5-7 summarizes 2006 average wastewater flows, carbonaceous biological oxygen demand (CBOD) loadings, and total suspended solids (TSS) loadings to the Adel wastewater treatment facility, expressed in pounds per day.

TABLE 5-7
City of Adel Wastewater Treatment
Year 2006 Wastewater Flows and Waste Loads in lbs/day

	INFLUENT FLOW	CBOD(LB/D)		EFFLUENT FLOW	TSS (LB	/D)
	(MGD)	INFLUENT	EFFLUENT	(MGD)	INFLUENT	EFFLUENT
JANUARY	0.406	477	39	0.369	941	63
FEBRUARY	0.383	479	51	0.402	818	80
MARCH	0.415	467	46	0.386	564	62
APRIL	0.624	375	29	0.61	708	42
MAY	0.598	389	38	0.565	539	111
JUNE	0.354	322	14	0.344	469	35
JULY	0.353	259	19	0.365	397	56
AUGUST	0.41	345	18	0.368	407	38
SEPTEMBER	0.422	299	19	0.484	398	48
OCTOBER	0.354	260	12	0.369	384	32
NOVEMBER	0.433	318	22	0.345	542	30
DECEMBER						
AVERAGE	0.432	363	28	0.419	561	54

5.2.2 Existing Wastewater Collection System

The existing wastewater collection system is shown in **FIGURE 5-1**. Existing sewers range in diameter from 8" to 24". The collection system has two lift stations; a small likft station on the northwest side of town and the main lift station near the wastewater treatment facilities. The small lift station has no backup power.

The majority of the collection system flows by gravity to the main lift station. The existing main lift station was modified in 1991 by the addition of four submersible pumps, a grit removal facility, shredder, and backup power generation.

5.2.3 Existing Wastewater Treatment System

The existing wastewater system consists of a 2-cell aerated lagoon system with a quiescent 3rd cell. Two blowers supply air to cells 1 and 2. Cell 1 has 36 diffusers and Cell 2 has 19 diffusers. The total surface area of the lagoons is 9.53 acres. The existing treatment system was designed to treat an average dry weather flow of 0.520 million gallons per day (MGD) and organic loading of 805 pounds of biological oxygen demand (BOD) per day.

Effluent from the lagoons is disinfected with chlorine and de-chlorinated with sulfur dioxide. Final effluent is discharged to the North Raccoon River through a diffuser having twelve 4-inch nozzles. Five additional capped nozzles are available for future use. The diffuser system was designed for a peak flow of 6.56 MGD.

The existing wastewater treatment system consistently met the permitted effluent limits during the years 2004 through 2006, as shown in **TABLES 5-2** through **5-7**. Final effluent also met the effluent ammonia loading limits shown in **TABLE 5-1**. During the most recent years of operation, the highest effluent ammonia loading was 1.11 pounds per cubic feet per second of stream flow.

5.2.4 Ortonville Lagoons

Businesses at the Ortonville Business park currently discharge to existing lagoons located north of Highway 6, west of the business park. These lagoons are operated independently, located outside the Adel City limits.

It is expected that once Adel extends sewer service to expected areas of annexation, the Ortonville Business Park users will be connected into Adel's system, and the existing lagoons can be abandoned and reclaimed. However, prior to this connection, we recommend a detailed review of effluent from these businesses, to determine if any form of pre-treatment is required prior to discharging into Adel's system. The lagoons might be retained for this purpose, depending on the extent and type of treatment required. In addition, we recommend that prior to annexing the lagoons, the City should conduct a detailed phase 1 and 2 environmental analysis of the lagoons, and require cleanup, if required.

5.3 FUTURE CONDITIONS – WASTEWATER TREATMENT DEMAND

Wastewater flows and waste loads are forecasted for the years 2010, 2020 and 2030 based upon the population projections developed for this project. These are summarized in **TABLE 5-8**.

TABLE 5-8
City of Adel Wastewater Treatment
Future Flows and Waste Loads

		YEAR				
	UNITS	2010	2020	2030		
POPULATION		4380	4970	5550		
CBOD	LB/D	444	562	678		
TSS	LB/D	592	721	849		
ADW	MGD	0.402	0.461	0.519		
AWW	MGD	0.776	0.890	1.002		
MWW	MGD	2.126	2.438	2.745		

5.4 WASTEWATER TREATMENT ALTERNATIVES

5.4.1 Optimum Operation of the Existing Facilities

TABLE 5-9 compares the year 2030 design values to existing system capacity. The estimated influent maximum wet weather (MWW) flow for the year 2030 is 2.745 MDG. Since Adel has a lagoon system, the effluent MWW flow could be kept below 2.084 MGD. During the years 2004-2006, the highest daily flow was 1.197 MGD. Based on **TABLE 5-8**, optimum operation of the existing facilities is possible for the year 2030 design conditions.

TABLE 5-9
City of Adel Wastewater Treatment
Wastewater Treatment Plant Capacity Analysis

	UNITS	DESIGN	YEAR 2030
CBOD	LB/D	805	678
Avg Dry Weather (ADW)	MGD	0.520	0.519
Avg Wet Weather (AWW)	MGD	1.240	1.002
Max Wet Weather (MWW)	MGD	2.084	2.745

5.4.2 Alternative Wastewater Treatment Systems

The existing treatment plant can treat the flows and waste loads under the design year conditions given the current effluent requirements. If the effluent limitations were to be changed to include nutrient removal requirements, a new mechanical treatment plant would be needed.

The current NPDES permit expires on January 5, 2008. It is not likely that the new permit would have different effluent limitations than the current requirements. IDNR is going through stream studies to determine which streams would need better protection against some of the organics (and/or inorganics) discharged from the wastewater treatment plants. It is not known at this time if Adel would need to treat their wastewater to remove nitrogen and phosphorus. If IDNR sets new effluent limits for Adel, the 2013 permit would show the new limits and the compliance schedule. The schedule would probably require that the new mechanical treatment plant be operational by the year 2017. The logical choice for any new plant would be close to the existing lagoons. The conceptual cost of a new mechanical plant, based on current estimates for Adel's wastewater flow and assumed treatment requirements, is estimated at \$8 million (in 2007 dollars).

5.5 WASTEWATER COLLECTION SYSTEM IMPROVEMENTS

Adel's wastewater collection system provides adequate capacity for existing users and infill development within areas already served. The only improvement identified for the existing system is addition of backup power for the existing lift station at 18th and Grove Streets.

Anticipated growth of the city will require extension of trunk lines to serve those areas. Additional sewer mains to be constructed within growth areas would then be constructed as part of each individual site improvements project.

Extension of service to expected development areas along the southerly edge of the city will require a new trunk line connection from Highway 169 to the existing outfall line leading to the sewage lagoons. The trunk line can connect to an existing manhole on the gravity-flow portion of the trunk line. This improvement is shown on **FIGURE 5-2.**

Extension of service to expected development areas east of the North Raccoon River requires construction of a forcemain river crossing, pump station on the east bank, and extension of a trunk line along Highway 6. These improvements, which can be stage constructed to some extent as development demands, are shown on **FIGURE 5-2.**

5.6 RECOMMENDED IMPROVEMENTS

Based on our evaluation of the wastewater treatment facilities and future needs, we offer the following recommendations and upgrades for Adel's system.

1. Provide backup power for the existing small lift station	\$	75,000
2. Construct trunk line along Highway 6	\$	720,000
3. Construct a new lift station for the Raccoon River Crossing	\$1	,400,000
4. Install Raccoon River crossing and forcemain to the lagoons	\$	200,000
(Note 2 alternative alignments to be evaluated prior to implementation)		
5. Install 12" sewer main from Highway 169 to existing lagoons	\$	70,000

