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February 21, 2007

John Seifert
Public Works Superintendent
City of Rogers
22350 South Diamond Lake Road
Rogers, MN 55374-4773

RE: Comprehensive Water System Plan Update

Dear Mr. Seifert:

Progressive Consulting Engineers, Inc. is pleased to submit herewith the report on the Comprehensive Water System Plan Update. The report includes a reevaluation of future water needs, recommendations for water system improvements, and a capital improvement plan through 2030 for the City's water system. Future needs are based on development and annexation projections. Consideration has been given to the possibility that water treatment plants for iron and manganese removal will be necessary at some date in the future.

As a part of this study, the City's water distribution system computer model was updated and revised, and numerous computer simulations were run for a variety of water use conditions.

This report is the product of a cooperative effort between PCE and the City of Rogers staff. The City staff contributed much time and effort to the study, and we feel that an excellent working relationship developed and was maintained during the course of this project. We are especially appreciative of the cooperation and assistance we received from Scott Lange, Deb Schreiner, and you.

We will be available to discuss the report or any aspects of the study at your convenience.

Sincerely,

Naeem Qureshi

Naeem Qureshi, P.E.
NQ/bz

Attachments

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ABBREVIATIONS

The following abbreviations are used in the Comprehensive Water Plan Update:

AWWA	American Water Works Association
CEMP	Conservation and Emergency Management Plan
CIP	Capital Improvement Plan
EPA	Environmental Protection Agency
gpm	gallons per minute
gpd	gallons per day
gpcd	gallons per capita per day
HP	Horse Power
ISO	Insurance Services Office
KG	Kilogallon (1,000 gallons)
KGD	Kilogallon per Day
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MG	Million Gallons
MGD	Million Gallons per Day
MGY	Million Gallons per Year
MnDOH	Minnesota Department of Health
mg/L	milligrams per liter (equals parts per million)
ug/L	micrograms per liter (equals parts per billion)
NPDWR	National Primary Drinking Water Regulation
pCi/L	picocurie per liter
P_{AveDay}	Forecasted Average Day Pumpage into the distribution system
P_{MaxDay}	Forecasted Maximum Day Pumpage (Constant* P_{AveDay}) into the distribution system
P_{MaxHr}	Forecasted Maximum Hour Pumpage (Constant* P_{AveDay}) into the distribution system
psi	pounds per square inch
Q_{FPC}	Firm Production Capacity, which is the finished water that can be produced with the largest well out of service and the percent treatment desired
Q_{FWC}	Firm Well Capacity, which is the well capacity with the largest well out of service
Q_{EM}	Calculated 4-Hour Emergency Capacity with the largest well out of service
Q_{HSP}	High Service Pump Capacity
Q_{WTP}	Water Treatment Plant Capacity
SCADA	Supervisory Control and Data Acquisition
SMCL	Secondary Maximum Contaminant Level
tgpy	thousand gallons per year
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WTP	Water Treatment Plant

DEFINITIONS

The following definitions apply to the Comprehensive Water Plan Update:

Water Use Definitions:

Residential	Water used for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. Also called domestic water use.
Commercial	Water used by motels, hotels, restaurants, office buildings, commercial facilities, and institutions, both civilian and military. Although typically part of institutional use, included for this study are hospitals, nursing homes, schools, day care centers, and other facilities that use water for essential domestic requirements.
Industrial	Water used for thermoelectric power (electric utility generation) and other industrial uses such as steel, chemical and allied products, paper and allied products, mining, and petroleum refining.
Irrigation	Artificial application of water on lands to assist in the growing of crops and pastures or maintaining recreational lands such as parks and golf courses.
Unaccounted	Unaccounted-for water is the volume withdrawn minus the volume metered.
Institutional	Water used by the City that is metered but not billed, including the demand from City-owned buildings, sales from the private use of fire hydrants, and system maintenance including hydrant flushing, water tower cleaning, and well pre-lube water.

NOTE: Non-essential water uses defined by Minnesota Statutes 103G.291, include lawn sprinkling, vehicle washing, golf course and park irrigation, and other non-essential uses. Some of the categories listed above will also include non-essential uses of water because it is not possible for water suppliers to separate these uses for individual accounts.

1.0 EXECUTIVE SUMMARY

1.1 Introduction

The City of Rogers selected Progressive Consulting Engineers, Inc. (PCE) to prepare a Comprehensive Water System Plan Update. The purpose of the study is to address the needs of the City water supply in the areas of water storage, treatment, and distribution. Necessary system modifications are recommended in a Capital Improvement Plan (CIP). Well water quality parameters were evaluated and the City's water distribution system modeled in existing and future states with the WaterCAD computer program.

1.2 Population

The City estimates the population of Rogers to be 6,716 at the end of 2005 and projects an increase to 11,255 in 2015. This is an increase of about 68 percent over 10 years. These population projections are based on the planned development expected to occur within the current city limits and planned annexation area for 2010.

The City of Rogers also expects to annex significant areas of Hassan Township, which surrounds Rogers, by the year 2015. Expected annexation areas include over 1,000 acres southeast of current city limits, over 800 acres west of Willandale Road and south of Territorial Road, and over 1,100 acres north of current city limits. These areas are shown on the Appendix A map by S.E.H. entitled "Developable Land in Hassan Township". The north annexation area is already mostly developed with large lot residential, which has their own private water supply systems. This area is not expected to connect to the Rogers water system until 2015-2030 during reconstruction projects. The other annexation areas are projected to fully develop with new developments by 2015. The population in 2015 is expected by the City of Rogers to be close to the ultimate population inside the projected 2030 city boundary. Southwestern Hassan Township may develop in the future, but this area would not be included in the Rogers water system.

The total Rogers population including the annexed Hassan Township areas is projected as 26,964 in year 2015, including a projected 15,709 people from new development in Hassan annexation. This is an increase of about 300 percent over 10 years. Of this total population, the population served by the water distribution system, or serviced population, is projected as 23,787 in year 2015 and 27,396 in 2030.

1.3 Water Use

Design flows were estimated for the years 2006, 2015, and 2030 based on projected City development and historic and projected unit water use. Design flows are shown without and with the projected demands from the expected Hassan Township annexation areas. Based on the projected development and developable land map provided by S.E.H. and the demand projections for southeast Hassan provided by Schoell Madson, it is projected that Hassan Township will require a total of 1.927 million gallons per day (MGD) by 2015, and 2.331 MGD by 2030. This will require City to install wells and water mains to produce and distribute water to meet this additional demand.

Per capita residential use has averaged roughly 130 gpcd of water pumped. A Maximum Day/Average Day ratio of 3.3 is expected in the future. It has been assumed that the effects of conservation measures and legislation on water use practices will prevent any sustained exceedance of this average per capita residential water use and maximum day demand factor.

Projected City demands, or design flows (in million gallons pumped per day), are as follows:

Without Hassan	Ave Day (MGD)	Max Day (MGD)	Max Hour (MGD)
2006	1.442	4.760	9.520
2015	2.355	7.770	15.540
2030	2.461	8.123	16.246

With Hassan	Ave Day (MGD)	Max Day (MGD)	Max Hour (MGD)
2006	1.442	4.760	9.520
2015	4.282	14.130	28.261
2030	4.792	15.814	31.628

1.4 Existing System

The existing water system is shown on Insert A, and consists of six confined aquifer wells and two water towers. Wells 3, 4, 5 and 7 are located near County Road 81 and Rogers Memorial Drive, while Wells 6 and 8 are located by Rogers High School. Well 8 is under construction during spring 2007 and has a design capacity of 1,000 gpm. At present, the City wells have a combined capacity of 4,800 gallons per minute (gpm) or 6.912 million gallons per day (MGD) that will increase to 5,800 gpm (8.352 MGD) by spring 2007. The firm well capacity (capacity with the largest well out of service) after Well 8 is constructed will be 4,800 gpm (6.912 MGD). Wells 3, 4, 5, and 7 are run in rotation in the winter low-demand season, while Well 6 is locked out except when needed in summer due to high levels of iron and manganese. The City has two storage facilities: the 400,000-gallon East Tower and the 750,000-gallon West Tower. A high-pressure zone exists at the higher elevation in the southern part of the City. A booster station consisting of two 500-gpm capacity booster pumps and a 100-gpm capacity jockey pump serves the high-pressure zone. As of recently, the jockey pump is used only as a backup pump.

1.5 Safe Drinking Water Act (SDWA) Impact

The Minnesota Department of Health periodically tests City drinking water for various organic, inorganic, and microbiological contaminants that are regulated by the U.S. Environmental Protection Agency. Test results showed that the water supply meets all primary standards. Primary standards are those related to health. The results identified areas where more complete treatment of the water may be necessary to meet acceptable contaminant levels. The most significant problem identified in the City system is the relatively high concentrations of iron and manganese, which is not a human health concern but may cause nuisance problems in the distribution system if not adequately treated.

1.6 Water Treatment

Two methods of treatment to control iron and manganese in drinking water are (1) sequestering and (2) removal by filtration. In the sequestering process phosphate compounds are added to the water to prevent the iron and manganese from precipitating. Sequestering loses its effectiveness with high contaminant levels, time, and temperature. A more desirable solution is the removal process whereby the iron and manganese are oxidized, precipitated, and filtered out.

To reduce the levels of iron and manganese from the wells, water treatment by filtration is recommended for evaluation. If water treatment is approved, PCE recommends a south water treatment plant by the existing well field located near County Road 81 and Rogers Memorial Drive and a north water treatment plant by the existing well field located near Rogers High School. These two plants should be designed to treat the water from all existing and proposed wells.

1.7 Distribution System

Updated models using WaterCAD computer software were used to analyze the existing and projected distribution systems for conditions of peak customer demands and fire demands. The existing distribution system adequately meets the present needs in most parts of the city. Pressures are adequate throughout the system at all operating conditions. However, the existing distribution system is unable to meet fire flow demand requirements during Maximum Day conditions (or even Average Day conditions) in the residences on Ahlstrom Road (west from Main Street), commercial/ industrial areas east of the intersection of I-94 and TH 101 including the Union 76 station, and the majority of the high-pressure zone at the south edge of the city.

The high-pressure zone has inadequate fire protection for an extended period of time due to the combination of the following: only a single connection point connecting the zone through the booster station to the rest of the water system (the normal-pressure zone), an undersized main downstream of the booster station to serve the high-pressure zone, and the lack of supply wells or water storage in the high-pressure zone. Dead ends and undersized mains are causing the other insufficient areas throughout town to have inadequate fire protection for an extended period of time.

Recommended future watermain additions (see Insert B and the attached CIP) are given for the purpose of improving water circulation and supply in the water system, to maintain optimal water surface elevations in the towers, and to serve areas of future development with City water.

Rogers expects to annex large portions of Hassan Township and connect the areas to the Rogers water distribution system. Annexed land in the southeast, south, and west is planned to be connected to the water system as it develops up to year 2015. Existing development north of Rogers would be connected to the water system during reconstruction between 2015 and 2030.

1.8 Production

The City water source consists of five wells that draw water from the Franconia-Ironton-Galesville (or FIG) aquifer, with a total capacity of 4,800 gpm. One new FIG well of 1,000 gpm is under construction, which will increase the total capacity to 5,800 gpm in 2007. The well capacity must be able to supply the required water to the growing population during peak demand conditions.

Increased Rogers demands including annexed Hassan Township projected water demands would require six additional 1000-gpm wells before year 2015 and one more before 2030. In comparison, increased demands only within the current city limits and the current 2010 planned annexation areas would require one additional 1,000-gpm well before 2015.

Plans for the proposed wells are listed in the attached CIP. It will also be imperative to replace any wells taken out of service with new wells.

1.9 Storage

The existing storage includes the 400,000-gallon East Tower and the 750,000-gallon West Tower. A new 1 MG water tower is planned for 2008 in the high-pressure zone at the south edge of Rogers. This tower will increase the reliability and fire flow capacity of the high-pressure zone, which now relies only on the existing booster station to supply water. This tower will serve the expanding high-pressure zone in the higher elevation areas in the southern part of the City, but should also include the ability to provide water back to the normal-pressure zone during peak demand conditions.

In order to fulfill the growing demand of the City population including the demand of the annexed Hassan Township area, the City will approximately require an additional 2.5 MG of storage (after the 1 MG high-pressure tower) by year 2015 and another 0.6 MG of storage by 2030.

PCE recommends building the additional storage in the normal-pressure zone and building as few facilities as possible to minimize costs. City staff is interested in ground storage over elevated storage due to space and cost concerns. Therefore, PCE recommends the construction of a 2 MG ground storage reservoir in conjunction with each of the proposed water treatment plants.

1.10 Recommendations

The recommended capital improvements are shown on the Water Distribution System Maps – 2015 (Insert B) and 2030 (Insert C) and listed in detail in Table 8-1. Also listed in the CIP are the estimated costs of the capital improvements in terms of the value of dollars in year 2007. Recommended improvements include new wells, water storage facilities, treatment facilities, and new and reconstructed watermains to accommodate City growth and improve water system adequacy. Recommended improvements are estimated to cost $39.3 million between 2007 and 2015 and $3.6 million between 2016 and 2030.

1.0 INTRODUCTION

The City of Rogers selected Progressive Consulting Engineers, Inc. (PCE) to update the Comprehensive Water Plan. The report was to address the needs of the City in the areas of water supply, treatment, storage, and distribution.

The City of Rogers is located in northwestern Hennepin County on Highway I-94. The City estimates the population of Rogers to be 6,716 at the end of 2005 and projects an increase to 11,255 by 2015. This is an increase of about 68 percent over 10 years. These population projections are based on the planned development expected to occur within the current city limits and planned annexation area for 2010.

The City of Rogers also expects to annex significant areas of Hassan Township, which surrounds Rogers, by the year 2015. The total Rogers population including the annexed Hassan Township areas is projected as 26,964 by year 2015, including a projected 15,709 people from new developments in Hassan annexation. This is an increase of about 300 percent over 10 years.

The scope of the study for this report includes the following principal elements:

1. Inspect and evaluate existing facilities.

2. Analyze City planning data, population growth, development, and consumption trends to estimate present and future water requirements, including Average Day, Maximum Day, and Maximum Hour demands. Design years will be 2006, 2015, and 2030. The potential effects of existing and proposed water conservation measures will be evaluated.

3. Review the City's fire protection rating (ISO classification) and maximum fire flow requirements. Make recommendations for upgrading the City's ISO classification.

4. Evaluate treated water quality characteristics with respect to existing and proposed government regulations of the Minnesota Department of Health and the Federal Safe Drinking Water Act.

5. Analyze, with input from City staff, the impacts of the existing and proposed State and Federal regulations on the City's water supply and utilities budget.

6. Prepare an updated digital computer model of the existing water distribution system. Validate the computer model as necessary with field-testing. Use the computer model to evaluate the current and future adequacy of the water system and its transmission and distribution mains relative to required flows, water system pressures, and other operational considerations.

7. Make recommendations regarding type, size, and location of future production, treatment, storage, and transmission/distribution mains required to meet the design year population demands.

8. Prepare a Capital Improvement Plan through years 2015 and 2030 for the water system and include present day capital and operational/maintenance costs for each improvement.

This report is the product of the joint efforts of PCE, S.E.H., and the City of Rogers staff. The report should provide the City a good basis for future planning. Also, the recommended improvements should help to ensure that the community continues to have an adequate water supply that is safe, of good quality, and in compliance with all governmental regulations.

2.0 EXISTING WATER SUPPLY SYSTEM

2.1 General

The existing water system facilities and major water mains (mostly 6 to 12 inches in diameter) are indicated on the City water main map in Insert A. Information relating to the facilities is presented in Table 2-1. The following subsections discuss the source of water supply, distribution system layout, storage capacity, and water system controls. Water treatment is discussed in Section 5.0 and currently consists of chlorine, fluoride, and a corrosion inhibitor applied to all well water.

2.2 Source of Water Supply

The City of Rogers relies solely on groundwater. The City does not have an appropriation permit for using surface water and does not foresee requesting one. Existing wells are listed in Table 2-1. The City water source consists of five wells (Wells 3 through 7) that draw water from the Franconia-Ironton-Galesville (or FIG) aquifer, with a total capacity of 4,800 gpm. One new 1,000-gpm FIG well (Well 8) is under construction, which will increase the total capacity to 5,800 gpm in 2007.Wells 3, 4, 5 and 7 are located near County Road 81 and Rogers Memorial Drive, while Wells 6 and 8 are located by Rogers High School.

Wells 3, 4, 5, and 7 are run regularly using a first on/first off rotation. Well 6 is locked out under normal operating conditions because of high levels of iron and manganese. The well is only used after the other wells are unable to meet demands during summer peak conditions. The wells are controlled by a level indicator on the East Tower and turn on and off depending on the water tower level.

2.3 Distribution System

The City of Rogers water system operates on a dual water pressure system. All five wells and both water towers are located in the normal-pressure zone, which covers most of the city. Terrain within the normal-pressure zone varies in elevation between about 875 and 985 feet above sea level, a variation of 110 feet (equivalent to a difference of roughly 48 pounds per square inch (psi) of water pressure).

The high-pressure zone is connected to the normal-pressure zone by a booster station and two pressure reducing valves (PRVs). The booster station pumps water into the high-pressure zone located in the southern part of the city. The booster station consists of two 500-gpm capacity booster pumps and a 100-gpm capacity jockey pump. As of recently, the jockey pump is used only as a backup pump. The PRVs allow water to enter the high-pressure zone if the pressure ever drops below the normal-pressure zone in an emergency. The area presently served by the high-pressure zone varies in elevation between 950 feet and 1025 feet above sea level, a variation of 75 feet (or roughly 32 psi).

The majority of the water mains in the distribution system are 6 to 12 inches in diameter. Due to rural surroundings, there are no inter-system water connections with any other water systems. However, as expansion and annexation continue to occur in Rogers and neighboring cities, the distance to other systems continues to decrease. The Rogers system is now approximately 1 mile from the St. Michael system, 1 mile from Otsego, 5 miles from Maple Grove, and 1.5 miles from the new Dayton system. It may be possible at a future date to have an interconnection with another water system in case of emergencies. It is recommended that the City of Rogers should communicate with the surrounding communities so that the infrastructure can be properly sized for interconnections.

2.4 Storage Capacity

The two existing storage facilities in the City's distribution system are the East Tower and the West Tower as indicated in Table 2-1 and Insert A. The 400,000-gallon East Tower and the 750,000-gallon West Tower total 1.150 million gallons of storage capacity. Both elevated towers have an overflow elevation of 1,088 feet and are located in the normal-pressure zone.

2.5 Water Treatment

Water in the City of Rogers is pumped by the well pumps directly into the water system without filtration. All five wells inject chlorine gas for chlorination to inactivate bacteria and provide chlorine residual throughout the system, hydrofluosilic acid for fluoridation to prevent tooth decay, and the polyphosphate C-5 for sequestering the iron and manganese. Note that Well 4 feeds water to Well 3 and Well 7 feeds into Well 5, where the chemicals are added for both sources before entering the distribution system. Well 8, which is under construction, will feed water into well 6 where the same treatment chemicals will be added.

3.0 BASIS OF DESIGN

3.1 General

To ensure that a growing community such as Rogers continues to have an adequate supply of potable water in the future, the existing water system must be evaluated and there must be a comprehensive plan for the systematic improvement of the water system. Existing and projected water needs and water quality requirements for the City should be taken into account together with potential emergency situations such as fire demands.

Water needs (design flows) were calculated for the design year 2006, 2015, and 2030 based on historic water use trends and development data (existing and future) for residential, commercial/industrial, and institutional customers. Future design flows were calculated without and with the projected demands from the expected Hassan Township annexation areas. The design flows were then used to determine existing and future water production, storage, and transmission requirements. The development by 2015 is expected by the City of Rogers to be close to the ultimate population inside the projected 2030 city boundary.

In addition to the development of design flows for the water system, the City's current fire protection rating will be discussed in this section.

3.2 Land Use Planning

3.2.1 City Development

Population development data was provided by the City staff, including a current Zoning Map, an Annexation Phasing Map created by S.E.H., and the projected Hassan Township developable area map (see Appendix A). These maps project the area where residential development is expected to occur. This includes not only the undeveloped land within the City but also significant areas of Hassan Township surrounding the present city limits that are expected to be annexed and developed in the near future.

3.2.2 Population Development

Total Population

Historic and projected total population for the City of Rogers is presented in Table 3-1 and is graphically represented in Figure 3-1. Historic population estimates are based on 1990 and 2000 figures by the U.S. Census and 2001-2005 figures by the Metropolitan Council. The City estimates the population of Rogers to be 6,716 at the end of 2005 and projects an increase to 11,255 in 2015. This is an increase of about 68 percent over 10 years. Population projections are calculated using 2.7 people per unit times the number of units planned for development. These population projections are based on the planned development expected to occur within the current city limits and planned annexation area for 2010.

The City of Rogers also expects to annex significant areas of Hassan Township, which surrounds Rogers, by the year 2015. Expected annexation areas include over 1,000 acres southeast of current city limits, over 800 acres west of Willandale Road and south of Territorial Road, and over 1,100 acres north of current city limits. These areas are shown on the Appendix A map by S.E.H. entitled "Developable Land in Hassan Township". The north annexation area is already mostly developed with large residential lots, which have their own private water supply systems. This area is not expected to connect to the Rogers water system until 2015-2030 during reconstruction projects. The other annexation areas are projected to fully develop with new developments by 2015. The total population in 2015 is expected by the City of Rogers to be close to the ultimate population inside the projected 2030 city boundary. Southwestern Hassan Township may develop in the future, but this area would not be included in the Rogers water system.

The total Rogers population including the annexed Hassan Township areas is projected as 26,964 in year 2015, including a projected 15,709 people from new development in Hassan annexation. This is an increase of about 300 percent over 10 years. Of this total population, the total population served by the water distribution system, or serviced population, is projected as 23,787 in year 2015 and 27,396 in 2030.

Serviced Population

Estimated numbers of connected (serviced) population, and historic and projected population are given in Table 3-1. It is unknown how many households in Rogers are served by private wells, but the City staff estimates that the current and future serviced population is 99 percent of the total population. New construction inside the City limits is expected to immediately connect to the water system. It is expected that the serviced population will increase sharply over the next 10 years due to new subdivisions both in the present city boundaries and in parts of Hassan Township projected to be annexed and connected to the Rogers water system. The currently developed annexation area north of Rogers is expected to connect to the Rogers water system between 2015 and 2030 during reconstruction projects. The City may need to reevaluate this water plan and planned facilities if projected annexation areas and/or populations are much larger or smaller than anticipated.

3.2.3 Non-Residential Development

It is anticipated that the future non-residential growth will be roughly proportional to the population growth with regard to water demand. Areas where commercial and industrial growth is expected to occur within the current city limits are indicated on the Zoning Map in Appendix A. Also, specific commercial developments were shown on the projected "Sanitary Sewer Service Area" map by S.E.H. For this study, water demand projections for these properties were set equal to sewer demand figures. Institutional growth should generally occur throughout the City as population grows.

3.3 *Analysis of Water Demand*

3.3.1 Summary of Historic Water Use

Historic water use data is summarized in Table 3-2 and is shown graphically in Figure 3-2. Water use in Rogers has grown comparably to population since 1993. Figure 3-3 depicts variations in serviced population, residential usage, and annual pumpage.

3.3.2 Per Capita Water Use

The annual residential usage per capita has varied from year-to-year since residential consumption began to be tracked in 1999 as listed in Table 3-3 and shown graphically in Figure 3-3. The average value of 130 gallons per capita per day (gpcd) will be used to forecast water use. The "Water Supply Planning in the Twin Cities Metropolitan Area Technical Report" submitted to the state legislature by the Metropolitan Council in January 2007 indicated that the mean residential usage for the Twin Cities Metropolitan Area was 88 gpcd in 2004. Rogers has significantly higher per capita water use because many new and recent housing developments consume a lot of water for sod and turf establishment, typical lots are larger than average with a 15,000 square foot minimum, and the City of Rogers has a relatively large industrial base. Since the high rate of housing development is expected to continue, the average water use should remain higher than the regional average until rapid development has decreased for a few years. In light of this, a use of 130 gpcd is a reasonable assumption for projecting future water use, even with conservation efforts.

3.3.3 Water Demand by Customer Category

Water demands by customer category and corresponding percentages of total use in 2005 are summarized in Table 3-4. The City of Rogers categorizes customer use into following categories: residential, commercial/industrial, and institutional/other. The residential category includes multifamily housing. Commercial/industrial category includes schools, clinics, and churches because they are paying water customers. The institutional/other category consists of the demand from City-owned buildings, sales from the private use of fire hydrants, and system maintenance including hydrant flushing, water tower cleaning, and well pre-lube water. The water use contributed by large volume water customers is presented in Table 3-5.

3.3.4 Large Volume Customers

The largest volume water customers are listed in Table 3-5. For this study, a large volume customer is defined as a single customer using more than 4,000 gallons per day. The demands from these customers are individually entered into the water model.

3.3.5 Seasonal and Peak Water Demands

Peak water demands for the last ten years are summarized in Table 3-6. The data is from water pumpage records. From 1995 to 2005, the annual average pumped demand (Ave-Day) has increased from 0.239 MGD to 1.184 MGD, and the record peak demand (Max-Day) has increased from 0.711 MGD to 4.081 MGD. The Max-Day to Ave-Day Ratio over the last ten years, averaged about 3.3 times the normal daily demand on the peak summer day of each year. A Max-Day to Ave-Day Ratio of 3.3 will be used for modeling the current and future system.

Monthly water pumped by each well in 2005 is summarized in Table 3-7 and the total monthly variation is shown graphically in Figure 3-4. The largest variation is between February demand and July demand, an increase of 73.122 MG or 490 percent (88.044 – 14.922 = 73.122 MG). Much of this difference is attributable to non-essential summer uses such as lawn watering. The application of seasonal and peak water demand data is discussed in Sections 3.4.2 and 3.4.3.

3.4 Design Flows

It should be noted that the design flows used in this report assume that the City of Rogers will continue to implement conservation measures addressed in Section 7 and in the Conservation and Emergency Management Plan (CEMP) to prevent any sustained increase in residential per capita water consumption. Odd/even water restrictions are effective during dry summer days. The City is in the process of implementing a proposed inclining block water rates structure.

3.4.1 Average Day Design Flows

Design flows for the City of Rogers are presented in Table 3-8 and Figure 3-4. Water sales have been projected through 2030 for different customer types, including estimated unaccounted-for water losses added to each category by percentage of total use. The total sales and unaccounted-for water losses were summed to get design flows in terms of water pumped. Also included separately in the design flows are projected demands from the expected Hassan Township annexation areas. Details of design flow projections are listed in Appendix B and are explained and referenced in Table 3-8 and the following paragraphs.

<u>Residential Sales</u>

Residential water demand projections within the current city limits and planned annexation area for 2010 are based on serviced population projections from Table 3-1 and the historic average residential per capita use of about 130 gpcd. It is also assumed that projected residential use is 61.6 percent of total use based on 2005 totals as shown in Table 3-4. The demand projections for the other categories are based on the residential demands.

Residential water demand projections in Hassan Township areas expected to be annexed by 2015 are based on the projected development and developable land map provided by S.E.H. and the demand projections for southeastern Hassan provided by Schoell Madson, Annexed developable land in Southeast Hassan, west of Willandale Road, and a strip south of Territorial Road is planned to be connected to the water system as it develops up to year 2015. Existing development north of Rogers would be connected to the water system during reconstruction between 2015 and 2030.

Residential demands in southeastern Hassan are calculated from the projected number of units provided by S.E.H., with the assumptions of 2.7 people per unit and 130 gpcd. However, Schoell

Madson provided direct water demands for certain sub-areas. Refer to the projected flow data tables in Appendix A. The Hassan demands in the west and south are assumed to develop at 2 units per acre, while the existing development in the north is assumed to be 1 unit per acre.

Commercial/Industrial Sales

Commercial/Industrial water demand projections within the current city limits and planned annexation area for 2010 are calculated as 31.7 percent of total use based on 2005 totals. However, this could change significantly if current businesses/industries relocate or expand, or new large users are added.

Commercial/Industrial water demand projections in Hassan Township areas expected to be annexed by 2015 are based on the projected development and developable land map provided by S.E.H. For this study, water demand projections for these properties were set equal to provided sanitary sewer demand figures.

Institutional/Other Sales

Institutional and "Other" water sales are categorized together for this study. The institutional/ other use water demand projections within the current city limits and planned annexation area for 2010 are calculated as 4.5 percent of total use based on 2005 totals.

Unaccounted-For Water

Unaccounted-for water demand is the difference between total pumped water and metered use. This number may fluctuate from year to year, but the projected unaccounted-for demand used in the report is 2.0 percent of total use. It was calculated as 2.2 percent of total use based on 2005 totals. According to the American Water Works Association, the acceptable quantity of unaccounted-for water is 10%. The low unaccounted-for water in Rogers is an indication of a well run utility. Unaccounted-for water is not presented separately in Table 3-8 or Appendix B, but they have been added to the other customer categories proportionally to their respective percentage of water use.

Total Average Day Demands

Average Day Demand (Ave-Day or P_{AveDay}) projections are calculated as the sum of residential, commercial/industrial, and institutional/other demands with the additional percentage for unaccounted-for water use already in each of the customer categories. Also added to the Average Day Demand are the total demand projections from annexed Hassan Township development.

3.4.2 Maximum Day Design Flows

Maximum Day Demand (Max-Day or P_{MaxDay}) projections are based on a Max-Day to Ave-Day ratio of 3.3 (i.e., $P_{MaxDay} = 3.3*P_{AveDay}$). The historic ratios are presented in Table 3-6 and range from about 2.5 to 3.8 with an average ratio of 3.32 between 1995 and 2005. The average and expected ratio of 3.3 is used for forecasting future water demands.

3.4.3 Maximum Hour Design Flows

Maximum Hour Design (Max-Hr or $P_{Max\text{-}Hr}$) projections are based on a Max-Hr to Max-Day ratio assumed to be 2.0 (i.e., $P_{MaxHr} = 2.0{*}P_{MaxDay}$). Although historic ratios were not available, in communities similar to Rogers the Max-Hr to Ave-Day ratio is often about twice the Max-Day to Ave-Day ratio.

3.4.4 Fire Demand Design Flows

Cities such as Rogers are given fire suppression classifications by the Insurance Services Office (ISO), based on the degree of fire protection they provide. The range of possible classifications is from 1 to 10, with 1 being the optimum classification and typical classifications ranging from 4 to 6. A city's overall fire suppression classification depends on the city's rating in three categories. These are the receiving and handling of fire alarms, the fire department, and the water supply. The water supply rating is based on the relationship between fire demands and available water storage, hydrant flow test results, and the distribution, adequacy, and condition of hydrants. The City classification applies to properties needing a fire flow of 3,500 gpm or less. Private and public protections at properties with larger fire flows are individually evaluated. A better ISO rating will likely lower insurance rates, increase property values, and attract new businesses and industries, thus raising city property tax revenues.

The City of Rogers currently has a rating of ISO level 3, which is one of the best in the state.

Evaluation of the existing water supply system and recommendations for future improvements will take into account ISO fire flow requirements together with American Waterworks Association (AWWA) and Ten States Standards recommendations relating to pressure, fire flow, and fire flow duration.

It should be noted that rather than design a water system to meet the large fire demands of a few individual customers, a city may designate maximum fire flows they will provide at given locations. Customers must then provide privately for fire flow requirements beyond these limits, such as with additional private storage or reducing their fire demand by means such as installation of sprinkler systems. Currently most new commercial/industrial buildings have sprinkler systems. They are required for any building over 12,000 s.f. or any hazard class building over 5,000 s.f. The fire department hopes to require all new buildings to have sprinklers in the near future. This would help the City maintain an ISO level 3 rating. The Rogers fire flow policy will supply at least 1,000 gpm for residential properties, 500 gpm for sprinklered commercial/industrial properties, and 2,000 gpm for non-sprinklered commercial/industrial properties.

4.0 WATER SUPPLY SYSTEM ADEQUACY

4.1 General

In this Section, the existing water supply system will be evaluated and future system improvements determined based on design flows and computer modeling. Potential water system improvements include production, treatment, storage, and distribution facilities.

Design flows, developed in Section 3.0, are used to determine the water system's existing and future facility needs. This takes into account the residential and non-residential development that is expected to occur in various portions of the City and annexations and also the anticipated effects of future conservation measures. The City's storage and production capacities may be technically adequate to meet its overall needs yet unable to actually meet those needs throughout the City because of poor facilities location, transmission main inadequacies, topography, and system operation limitations. Computer modeling is used to analyze factors other than design flows that determine system adequacy and needed improvements.

The existing water supply system is summarized in Section 2.0 and consists of a dual pressure zone. Information regarding key facilities is summarized in Table 2-1. The water system consists of five wells (Wells 3-7, with the sixth, Well 8, under construction in spring 2007), two elevated towers, and a distribution system consisting of water mains ranging from 6 to 16 inches in diameter (the majority are 8 to 12 inches). See Insert A for a map showing the existing water system.

The WaterCAD computer program was used to model the water supply system. This model was used, together with design flow data and design criteria, to determine the production, storage, and transmission facilities needs through the years 2015 and 2030. The model was then used to recommend locations for future facilities. Also discussed in this section are production-related issues such as source adequacy, alternate sources, and the potential for groundwater pollution.

With the changes recommended in this report, the water supply system should be adequate to meet the needs of the City of Rogers through the year 2030 with the projected water demands.

4.2 Production

The existing well supply's ability to meet present and future water needs is discussed in this subsection together with alternative water sources and the potential for contamination of the existing supply.

4.2.1 Existing Well Supply Source

The Rogers water supply source currently consists of five deep confined aquifer wells from the Franconia-Ironton-Galesville (FIG) formation, with the sixth FIG well under construction. Well capacities, etc. are discussed in Section 2.0 and well information is summarized in Table 2-1. According to the Minnesota Geological Survey (MGS) Bedrock Hydrogeology Map of Hennepin

County (Atlas C-4, Plate 6), Rogers is located over the Franconia-Ironton-Galesville Aquifer and the Mount Simon-Hinkley Aquifer. The MGS lists potential yields of 400 to 800 gpm from FIG wells and 1,000 to 1,500 gpm from Mount-Simon Hinkley wells in the Rogers area.

The Rogers FIG wells have yields equal to or greater than the high value indicated above. From Table 2-1, the well depths vary from 362 to 374 feet and the well pumping rates vary from 800 to 1,000 gpm. It appears that the current wells produce as well as can be expected from the FIG formation.

4.2.2 Historic Water Level Data

Draw down data for the wells from the time of construction is summarized in Table 2-1. The lowest allowable water level for a well is the top of the aquifer the well is pumping from. Well pumping levels have been consistent and no problems are anticipated.

4.2.3 Alternate Water Sources

The only procedures of augmenting the water supply would be the development of a Mount Simon-Hinkley well. This aquifer would require wells at least 50 feet deeper than the current FIG wells. In addition, the Department of Natural Resources would likely restrict the development of such a well unless deemed necessary due to a lack of other viable sources. The City should therefore continue to rely on FIG wells as its source of water for the foreseeable future.

4.2.4 Water Quality and Source Protection

Water quality is discussed in Section 5.0. The deep confined aquifer wells used for water supply vary from 362 to 374 feet in depth. The FIG formation wells, being relatively deep wells protected by overlying confining bedrock layers, are not very susceptible to contamination from surface sources. As stated in the Wellhead Protection report completed by the City in June 2001 and accepted by the Minnesota Department of Health, Wells 3-6 have all been rated as non-vulnerable to contamination. Wells 7 and 8, as well as any future wells, must be evaluated.

4.2.5 Location For Future Wells

As is discussed later in this section, 6 additional wells are needed to meet future design demands through the year 2015, with 1 more well needed through 2030 (for a total of 13 wells). Production requirements are based on the service population projections from Section 3.0. Locating the proposed wells near the existing wells appears desirable for several reasons: most of the land around the existing wells is currently vacant; the new well could be connected to the existing water transmission mains supplying the City; the grouping of wells together reduces the impact of the Wellhead Protection Plan by minimizing the City's wellhead protection areas; and also facilitates centralized water treatment in the future. It appears acceptable to locate proposed wells near existing wells as long as care is taken to protect the FIG aquifer from depletion and contamination from any surface pollution.

The City should plan to develop a FIG test well before actually constructing a permanent well site. If the site produces good capacities, future wells could be located near the test well.

4.2.6 Production and Treatment Requirements

Projected production, treatment, and storage needs, based on existing facilities, are tabulated in Table 4-1a (without Hassan projections included) and Table 4-1b (with Hassan projections included). Table 4-2a and Table 4-2b recommend future wells and storage facilities to fulfill the requirements described in Table 4-1a and Table 4-1b. Figure 4-1a (without Hassan projections included) and Figure 4-1b (with Hassan projections included) are schematics of the future peak water demands and the associated criteria used for planning improvements. The separate "a" and "b" tables and figures show the great impact of the expected Hassan Township annexation areas on the water system.

Well Production Criterion

The production criterion used in this report incorporates key concepts from the following two commonly used production criteria:

1. The Ten States "Recommended Standards For Water Works" states that the total groundwater production capacity should equal or exceed the design Maximum Day Demand and that the "Firm Well Capacity" should equal or exceed the design Average Day Demand. The Firm Well Capacity is well capacity with the largest well out of service.

2. A production criterion used in conjunction with storage requirements recommends that production should equal or exceed the Maximum Day Demand with demand beyond Maximum Day Demand being met by storage.

Evaluating production in terms of Firm Well Capacity (Q_{FWC}) is appropriate in order to properly plan for potential water emergencies. Linking production criteria to storage requirements proves very useful in assessing and planning for capital improvements. The criterion used will be as follows:

- **The Firm Well Capacity (Q_{FWC}) should equal or exceed the Maximum Day Demand (P_{MaxDay}).**

Wells Required

Additional wells proposed based on the well production criterion with annexed Hassan Township projections included are presented in Table 4-2b and depicted graphically in Figure 4-1b. The existing total well capacity is 4,800 gpm (6.912 MGD) and the Firm Well Capacity is 3,800 gpm (5.472 MGD). The expected Maximum Day Demand for 2007 is 3,926 gpm (5.654 MGD). Thus, the production capacity is insufficient to meet 2007 demands, not including under construction Well 8. Increased Rogers demands including annexed Hassan Township projected water demands would require 6 additional 1000-gpm wells (after Well 8) before year 2015 and 1 more before 2030 to meet firm well capacity requirements. In comparison, increased demands only within the current city limits and the current 2010 planned annexation areas would require 1 additional 1,000-gpm well before 2015. It will also be necessary for the City to immediately replace any non-productive well or abandoned well.

4.3 Storage

Two criteria have been considered for determining the water system storage needs. The first criterion is from the Ten States Standards, where it is stated that storage should be sufficient to meet fire flow requirements and the Average Daily consumption. This criterion is addressed using the WaterCAD Computer Model to verify the ability of the existing and proposed system to meet fire flow requirements.

The second criterion ties in with the production criterion being used in this plan and was eluded to in Section 4.2.6 and is depicted shown in Table 4-1a and Table 4-2b. It requires that the Emergency Flow Capacity (Q_{EM}) the City could provide, using the Firm Well Capacity (Q_{FWC}) and the flow associated with the portion of half the storage which could be delivered in a four-hour period, equal or exceed the Maximum Hour Demand (P_{MaxHr}). Thus the criterion is as follows:

- **The Emergency Flow Capacity (Q_{EM}), which is the flow that can be delivered for a period of 4 hours using the Firm Well Capacity (Q_{FWC}) and no more than ½ of the available storage, must equal or exceed the Maximum Hour Demand (P_{MaxHr}).**

Storage Requirements Governed by Local Fire Demand
The largest required ISO fire flow for the City is 3,500 gpm for an old building downtown. The duration for various fire flows are given in the AWWA Manual M31, "Distribution System Requirements for Fire Protection". The governing fire flow for Rogers is 3,500 gallons per minute (gpm) for 3 hours. WaterCAD modeling indicated that this could not be met during Maximum Day conditions in all areas without system pressures dropping below 20 pounds per square inch (psi). However, in a sprinklered building the fire flow needs are around 500 gpm and are met by the existing system. Available Fire Flow contour maps of the existing 2006 Rogers water model are included in Appendix C.

Industrial and school zones typically require the greatest fire flow coverage, usually in excess of 3,000 gpm for at least 3 hours. The existing system generally provides adequate fire flow coverage during base and peak conditions in commercial and industrial areas (Refer to Zoning Map in Appendix A). However, the existing distribution system is unable to meet fire flow demand requirements in certain localized areas. If a fire occurred at Rogers Elementary School at peak conditions, the existing water system is only capable of delivering about 2,500 gpm for 3 hours before pressure nears 20 psi. If a fire occurred at the Union 76 station off of I-94, one of the highest water users in the city, the existing water system is only capable of delivering about 900 gpm for 3 hours before pressure nears 20 psi. These limitations are not a result of insufficient storage, but the result of dead-ends with undersized water mains between the water towers and the location of the fire (See Section 4.4.3 for a further discussion).

Residential local fire demand is usually 1,500 gpm for at least 2 hours. The existing system generally provides adequate fire flow coverage during base and peak conditions in residential areas (Refer to Zoning Map in Appendix A), but with some notable exceptions. If a fire occurred anywhere in the high-pressure zone located at the south edge of the City during peak conditions, the existing water system is only capable of delivering from about 500 to 1,000 gpm for 2 hours before pressure nears 20 psi. Modeling also shows that during normal base demand conditions, the available fire flow is only about 1,000 to 1,500 in the majority of the high-pressure zone. These limitations result from a bottleneck into the high-pressure zone due the combination of the following: only a single connection point connecting the zone through the booster station to the rest of the water system (the normal-pressure zone), an undersized main downstream of the booster station to serve the high-pressure zone, and the lack of supply wells or water storage in the high-pressure zone (See Section 4.4.3 for a further discussion). Another insufficient area is on Ahlstrom Road located west from Main Street and just north of the high-pressure zone. The existing water system could only deliver around 1,000 gpm of available fire flow on this street during base or peak conditions. A dead-end and undersized main are causing the inadequate fire protection for an extended period of time.

Storage Required

The emergency flow capacity provided by the existing towers is not capable of handling design demands in 2007 based on the service population from Section 3.0. Three additional storage facilities are proposed by the year 2015 as presented in Table 4-2b: a 1.0 million gallon (MG) elevated water tower in the high pressure zone by year 2008, a 2.0 MG ground reservoir at the proposed South Water Treatment Plant location by 2010, and another 2.0 MG ground reservoir at the proposed North Water Treatment Plant location by 2015. In comparison, increased demands only within the current city limits and the current 2010 planned annexation areas would require a 1 MG high-pressure zone tower and a 0.75 ground reservoir by 2015.

As previously indicated, the City will not be able to meet large fire flow demands for an extended period of time in some areas with the existing system. The City could inform the water customers of the available fire coverage and recommend that anyone needing more than 2,000 gpm for 3 hours should install sprinkler systems or some other supplement for fire protection.

4.4 Distribution System

The existing and proposed distribution system for 2006, 2015, and 2030 are shown in Inserts A, B, and C, respectively. Distribution needs will be determined by computer modeling in relation to production and storage facilities, minimum pressure requirements, and peak demand conditions.

4.4.1 Distribution System Requirements

The adequacy of a water system depends not only on the location and capacity of its supply and storage facilities, but also on the size of water mains expected to distribute the water from these facilities to demand areas. The centralized well field mandates the need for large transmission mains extending to the perimeter of the water system as well as elevated storage away from the well field. Water main sizes are usually determined by fire demands since generally fire demands will result in much larger flows than other demands. As a city grows, the significance of Maximum Hour demands in the different portions of the city become more significant relative to local fire demands. In Rogers, fire demands remain the primary distribution design consideration.

The Ten States Standards states that a distribution system should be designed to maintain a minimum pressure of 20 pounds per square inch (psi) at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi. The American Water Works Association's "Distribution Requirements for Fire Protection" (M31) states that "worst case" conditions for a water system should be tested including Maximum Hour Demands, Maximum Day Demand, and the most stringent required fire flow.

The water distribution system was modeled with the WaterCAD computer program to evaluate the adequacy of the existing system with respect to the above criterion. Modeling was also used to design and locate future improvements.

4.4.2 WaterCAD Computer Model

PCE updated the Roger water system model with WaterCAD modeling software, which includes water mains (mostly 6 to 12 inches in diameter), storage facilities, booster pumps, wells, etc. "Nodes", primarily pipe junctions, are used in the model to establish elevations and to distribute demands in the model. We made necessary additions and adjustments to the piping system, booster pumps, and well controls to the model since the previous update. Water demands from the year 2006 were distributed and assigned to nodes based on water billing and pumping data, City street and zoning maps, new development data provided by S.E.H., and conversations with City personnel. Large demand customers were located individually in the model. Elevation data for nodes added to the model were estimated from United States Geological Survey (USGS) contour maps.

Friction affects the velocity that water moves through pipes. Water mains were assigned Hazen-Williams friction factors depending on age, size, and type of pipe. A high friction factor means that water experiences low friction through the pipe. New cement-lined pipes can have friction factors of 140 while old small pipes can easily have a friction factor of 85. The friction factor will generally decrease with pipe age because of corrosion or chemical deposition (scaling) inside the pipes, particularly with smaller pipes and pipes installed before cement lining became standard in 1962. The water quality in Rogers is not such that it should have had a notable adverse effect on the water mains over time. Pipes in the existing City water system model had friction factors ranging from 95 for aged pipes and 140 for recently constructed pipes. The somewhat low friction factors are conservative, which is desirable when evaluating distribution system performance.

The updated WaterCAD computer model was used to test the adequacy of the existing water system and to determine needed future improvements. Conditions tested included design year Peak Hour flows and various ISO fire demands during the design year Maximum Day conditions. Most simulations were single time-step "snapshots" of the distribution. An extended period (48-hour) water system simulation was also performed for existing Max-Day conditions to test the system's performance during conditions of changing demands. The simulation uses a typical daily water use pattern that ranges from 0.2 to 2.0 times the Max-Day demands.

4.4.3 Existing Distribution System

Existing facilities and water mains are indicated on the enclosed Water Distribution System Map-2006 (Insert A). The existing system was tested for demand conditions with both water towers filled to within five feet of the overflow elevation (to 1083 feet) and with the following assumed controls on the pumps (well controls only activated for 48-hour simulation):

- Wells 3, 7 – On if tower elevation below 1083 ft. Off if tower elevation above 1088 ft.
- Wells 4, 8 – On if tower elevation below 1082 ft. Off if tower elevation above 1087 ft.
- Well 5 – On if tower elevation below 1081 ft. Off if tower elevation above 1086 ft.
- Well 6 – On if tower elevation below 1079 ft. Off if tower elevation above 1084 ft.
- Booster Jockey – On constantly.
- Booster 1 – On if discharge pressure below 66 psi. Off if above 71.
- Booster 2 – On if discharge pressure below 60 psi. Off if above 66.

The water distribution system produces adequate system pressures under Ave-Day, Max-Day, and Max-Hour "snapshot" conditions. Ground level pressures at each junction are at least 35 psi, but typically between 50 and 80 psi. An extended period simulation revealed that the existing water system produces adequate system pressures (at least 20 psi) throughout a 48-hour period of Maximum Day conditions. The only problem area is the highest ground elevation portion of the high-pressure zone (neighborhood around Walnut Drive and Weber Way), which experiences pressures as low as 20 psi at various times in the simulation.

The system pressure performance is also adequate and remains basically unchanged when any one of the wells is turned off. However, the highest portion of the high-pressure zone is negatively affected by the lower well capacity and experiences inadequate pressures during a Max-Day 48-hour simulation. Pressures in this area are below 30 psi for half of the simulation and fall as low as 12 psi. This illustrates how the booster station and distribution mains into the high-pressure zone are inadequately serving this separate zone during peak conditions.

As previously mentioned in Section 4.3, the existing distribution system is unable to meet emergency fire flow demands in the following areas:

- The residences on Ahlstrom Road (west from Main Street).
- The commercial/ industrial areas east of the intersection of I-94 and TH 101 including the Union 76 station.
- The majority of the high-pressure zone at the south edge of the city.

The inadequacy results from limited water tower storage and a lack of sufficient water main capacity between the water towers and the location of fire simulations. The first two bulleted areas are served by dead-end mains that are undersized for handling the demands needed for fighting fires. These dead-end mains could be replaced with larger diameter pipe if possible, or hydrants on Main Street and Commerce Boulevard, respectively, would have to be used to provide adequate fire flows.

The high-pressure zone contains no wells or water towers and is connected by only a single 6-inch main inlet from the normal-pressure system to the booster station. Even if all booster pumps are running at capacity, the flow is limited by single 6-inch main that discharges water from the booster station to the rest of the zone. This problem will be overcome if additional water mains and a water tower in the high-pressure zone are added as outlined in the Capital Improvement Plan (CIP) and the Water Distribution System Map – 2015 (Insert B). These improvements will allow water to flow effectively to the location of fires in the high-pressure zone.

4.4.4 Future Distribution System

The proposed water plans are presented in the Water Distribution System Map – 2015 (Insert B) and 2030 (Insert C). Rogers expects to annex large portions of Hassan Township and connect the areas to the Rogers water distribution system. Annexed land in the southeast, south, and west is planned to be connected to the water system as it develops up to year 2015. Existing development north of Rogers would be connected to the water system during reconstruction between 2015 and 2030. The demands projected for 2030 are expected to be close to the ultimate development inside 2030 city boundaries. These maps show facilities improvements and water main improvements of 6-inch and larger diameter recommended through the years 2015 and 2030. The plan was developed to meet projected water demands (presented in Section 3.0) that were based on estimated residential and non-residential growth. Production and storage requirements have been calculated earlier in this section, and are tabulated in Table 4-1, Table 4-2, and depicted graphically in Figure 4-1. Each table and figure has an "a" and "b" version to show the difference caused by including or not including added development due to expected Hassan Township annexation to the Rogers distribution system.

Total annual water system demand, as design flows indicate in Table 3-8, is projected to increase by almost 200 percent between 2006 and 2015, and then increase by approximately 12 percent between 2015 and 2030. The increased demands were applied to nodes within areas of system expansion and new development in the future water system models. The future models incorporate existing and proposed future water mains, wells, and storage facilities.

The recommended improvements are listed in section 4.2, 4.3, and the CIP in Section 8.0.Along with watermain required for expanded service it is necessary to replace or augment some existing mains with larger mains for better service to existing customers. It is also necessary to loop some dead ends for improved fire flow protection and water quality. The City may need to reevaluate this water plan and planned system improvements if projected Hassan annexation areas and/or populations are much larger or smaller than anticipated.

The City has planned on connecting Hassan Township area to the water distribution system. The area is located surrounding the Rogers city limits, with high-elevation portions served by watermain connections to the high-pressure zone and the remainder served by connections to the normal-pressure zone. Due to the addition of expected Hassan Township annexed areas to the City of Rogers by year 2030, the water distribution system would need to produce and distribute

1.927 million gallons per day (or 1,338 gpm) more of water for average day water demands than it would need to produce otherwise. Hence the total of 6 additional 1,000-gpm capacities wells by the year 2015 and one more 1,000-gpm well by 2030 will be required to supply the peak demand conditions of the City along with the added Hassan Township areas.

4.4.5 Recommendations/Plans to Expand or Modify the System

Recommendations to expand and modify the system are made based on water system modeling results. Table 4-2b and Figure 4-1b show the plans for meeting future production and treatment requirements with expected Hassan Township annexation. The expected location of all proposed watermain, wells, and towers are shown on the enclosed Water Distribution System Maps –2015 (Insert B) and 2030 (Insert C). Existing watermain is indicated as blue pipe. Recommended watermain changes and expected watermain expansion as a result of annexation and future development from 2006-2015 is indicated as red pipe, and from 2016-2030 is indicated as green pipe. It is recommended that the City continue to locate all new wells near the current well field to allow for possible future centralized treatment plant.

At present, a single 6-inch water main serves the high-pressure zone from the booster pumps. The head loss in this 6-inch water main is very high during peak hour and fire flow demand when all three booster pumps are at maximum capacity, and this pressure issue renders the booster station incapable of serving the high-pressure zone during peak conditions. The City should increase the fire flow capacity in the high-pressure zone by installing a 12-inch water main from the booster station to the high-pressure zone. It is also recommended to construct a proposed 1,000,000-gallon water tower in the high-pressure zone in order to satisfy the growing needs of community during peak hour and fire flow demand. This tower will serve the expanding high-pressure zone in the higher elevation areas in the southern part of the City, but should also include the ability to provide water back to the normal-pressure zone during peak demand or emergency conditions.

We also recommend the installation of a Supervisory Control and Data Acquisition (SCADA) system to remotely control and monitor the wells, towers, and the booster station. After the construction of a water tower in the high-pressure zone is completed, the booster pump operation should be controlled by the water level in the tower instead of downstream pressure.

The present average day demand of high-pressure zone is around 90 gpm and is expected to increase to around 390 gpm by the year 2015. Based on the design calculation for a 1,000,000-gallon tank, the demand of the high-pressure zone should be at least 325 gpm in order to prevent the tank from freezing during winter. The tank is expected to get constructed by year 2008. But till the demand of the high-pressure zone reaches 325 gpm, the tank may be susceptible to freezing during the winter. To prevent the tank from freezing, enough water turnover/circulation is needed, which can be made by taking following steps:

- PCE recommends installing a temperature sensitive valve/sensor. During winter, when the temperature goes below 20 degrees F, the temperature sensitive valve will open and will allow the water from the tower to drain to the surrounding normal-pressure zone till the level in the tower reaches a set elevation. The booster pumps will then help to bring fresh water into the tower to prevent water from freezing in the bowl.

As demands in the high-pressure zone increases over the years, the level to which the tank will drain water with opening of the temperature sensitive valve will progressively increase. Finally, when the average demand of 325 gpm is met, the temperature sensitive valve will be completely shut down.

- PCE also recommends installing a pressure-sustaining valve. During summer time, the maximum day demand for the City is high. If the pressure in the normal-pressure zone goes down below a certain set pressure (say 40psi) or water tower level, the pressure sustaining valve will open and will allow the water to flow from high-pressure to the normal-pressure area and hence helps in meeting the City demand.

In conjunction with the proposed 1.0 MG water tower in the high-pressure zone, PCE recommends the construction of another booster station to connect the normal-pressure zone to the high-pressure zone. This new booster station would allow the new tower to be filled faster and would provide greater reliability in case the existing booster station is taken offline due to emergency or maintenance. The preferred design location for this second booster station serving the high-pressure zone is at the edge of the proposed expanded high-pressure zone in southeast Hassan. This location would prevent stagnation of water in the proposed normal-pressure mains that would provide water to southeast Hassan.

The following recommended capital improvements and associated costs are tabulated in Table 8-1 and discussed in Section 8.0:

- SCADA system
- Seven new 1,000-gpm FIG wells (not including Well 8 under construction).
- One new 1.0 MG capacity elevated storage facility in the high-pressure zone.
- Additional booster station in the south of the high-pressure zone.
- Two new 2.0 MG capacity ground storage reservoirs at each proposed water treatment plant site.
- Install new watermain as indicated on Table 8-1 and Inserts B and C.

The above improvements should enable the City of Rogers to meet the water needs of its customers through the year 2030. New watermain will accommodate City growth and improve system transmission capabilities. The new production, storage, and additional watermain will increase available water during all operating conditions including emergency fire flow conditions.

5.0 WATER QUALITY

5.1 *Safe Drinking Water Act (SDWA)*

Congress first implemented the Safe Drinking Water Act (SDWA) in 1974, setting standards for water quality that all water utilities were required to meet. The United States Environmental Protection Agency (USEPA) must publish a maximum contaminant goal (MCLG) and promulgate National Primary Drinking Water Regulation (NPDWR) for contaminants that: 1) may have an adverse effect on human health; 2) are known or are likely to occur in public water systems at a frequency and concentration of significance to public health; and 3) whose regulation offers a meaningful opportunity to reduce health risk for people served by public water systems.

Continuing amendments to the SDWA generate a new series of water quality regulations that utilities will have to meet now and in the years to come as new regulations are implemented. The Minnesota Department of Health (MDH) tests for various contaminants in the Rogers water supply. The frequency of testing depends on the level of the contaminants.

Existing water quality data for the City of Rogers were analyzed to characterize the quality of the groundwater and to identify treatment requirements necessary to comply with current and proposed water quality regulations. A summary of the National Primary and Secondary Drinking Water Standards established by the SDWA regulations are presented in Appendix B. The levels recently measured in Rogers are presented in Tables 5-1 and 5-2. Because water quality in groundwater is generally fairly constant with time, these samples are considered to be an acceptable representation of the quality from each of the existing wells.

5.1.1 Review of NPDWRs

USEPA must review and revise National Primary Drinking Water Regulations (NPDWRs) as appropriate, every six years. Revisions to NPDWRs must maintain or provide for greater protection of human health. This will generally preclude promulgation of a revised standard for a contaminant that is less stringent than the standard already in place. Existing standards may only be made less stringent in the future if new scientific evidence demonstrates that the current level of health protection can be achieved by a less stringent standard.

5.2 *Primary Drinking Water Standards*

The Primary Drinking Water Standards were developed as a part of the original SDWA of 1974 to regulate contaminants that may affect human health. This includes organic and inorganic chemicals, microbiological contaminants, and turbidity. Maximum Contaminant Levels (MCLs) are enforceable standards that public water suppliers must meet to avoid any regulatory action. Maximum Contaminant Level Goals (MCLGs) are the levels below which the Environmental Protection Agency (EPA) has determined that a material poses no known or anticipated effects on human health. The EPA has not made MCLGs enforceable because these levels are often difficult to attain. Therefore, the EPA sets MCLs as close to MCLGs as is feasibly possible using the current best available technology (BAT) and the associated cost.

In addition to the contaminants listed in Table 5-1, monitoring is done for additional contaminants for which MCLs have not been established. If unacceptable levels are found of these "unregulated" contaminants—based on established state health standards and an assessment of the risks they pose—the response is the same as if an MCL has been exceeded: the public water system must take corrective actions, including notification of those served by the system.

Roger's water supply does not exceed any MCL currently established under the Primary Drinking Water Standards.

5.2.1 Fluoride

Fluoride was originally regulated under the 1974 SDWA due to its relation to dental health. These regulations were then revised as a part of the 1984 SDWA Amendments. The current MCL for *fluoride* is 4.0 mg/L and the SMCL is 2.0 mg/L.

The *fluoride* concentrations comply with the MCL and no potential problems are anticipated.

5.2.2 Volatile Organic Chemicals

The EPA has set standards for 53 organic chemicals that pose health risks in drinking water. These organic chemicals are a water quality concern primarily because of the toxic and carcinogenic effects they may have on humans. They are primarily found in groundwater that has been polluted by seepage from industrial and agricultural activities.

EPA Region 5, which includes Minnesota, has an exemption via a "use waiver" for one organic chemical, *dibromochloropropane (DBCP). DBCP* is a pesticide that commonly originates from runoff from soil fumigant formerly used on fields and orchards. The contaminant has been banned since 1979, so the MDH tests only as a check for the existence of *DBCP*. The testing method used in Rogers for *DBCP* has a detection limit of 2.0 ug/L, so results cannot be measured down to the MCL of 0.2 ug/L.

Contaminant levels for organic chemicals with available data comply with the MCLs. As long as the City monitors potential industrial and agricultural sources to prevent contamination, no potential problems are anticipated.

5.2.3 Coliform Rule

Coliforms are used as general indicator organisms to identify waters that may contain pathogenic microbiological species that can cause disease when ingested. Of greatest concern to the water consumer are those organisms that are transferred to the water through the feces of warm-blooded animals.

The *total coliform* test detects a wide range of indicator organisms, including some that are often present without any fecal contamination. The *Escherichia coliform*, or *fecal coliform*, tests are more specific and indicate only those organisms with fecal origin.

The Coliform Rule establishes compliance criteria based upon presence or absence of *total coliform*. For systems that analyze fewer than 40 samples per month, such as Rogers, no more than one sample per month can indicate the presence of *coliform* bacteria. For systems analyzing more samples per month, at least 95 percent of the monthly samples must be free from *coliform* bacteria.

The City has not had any problems complying with the Coliform Rule in the past. Because Rogers is supplied by groundwater, not under the influence of surface water, no problems are anticipated with Total Coliform Rule compliance.

5.2.4 Lead and Copper Rule

The Lead and Copper Rule (LCR) regulates *lead* and *copper* through the establishment of treatment technique requirements. Treatment is required when *lead* or *copper* concentrations exceed certain "action levels" at consumer taps. To be in compliance with the Lead and Copper Rule, 90 percent of the consumer tap samples must be less than the 15 ug/L *lead* and 1.3 mg/L *copper* action levels. If 90 percent of the *lead* and *copper* concentrations are below the action levels, the existing treatment process is considered optimal for corrosion control and the public water supply may apply for reduced monitoring.

The *lead* and *copper* concentrations listed in the latest Rogers Water System Annual Drinking Water Report (in Appendix D) comply with the MCL and no potential problems are anticipated.

5.2.5 Arsenic

Arsenic is a naturally occurring element that is mainly transported by water. Long-term exposure has been shown to lead to cancer. *Arsenic* concentrations are usually higher in groundwater. As of October 31, 2001, the standard for *arsenic* has been reduced from 50 ppb to 10 ppb. The date at which utilities must comply with the 0.010 mg/L MCL is January 2006.

The *arsenic* concentrations comply with the MCL and no potential problems are anticipated.

5.2.6 Radionuclides

Radon is a naturally occurring gas that forms when *uranium* breaks down. Long-term exposure to radon increases the risk of cancer in humans. At present there are no regulations in place but the EPA is proposing a standard that will be put into place in the near future. The proposed regulation requires the *radon* concentration in water to be less than 300 pCi/L (picocuries per liter) without multimedia mitigation (MMM), or 4,000 pCi/L provided that the state puts a MMM program in place. These MMM programs look at limiting *radon* exposure from other methods through educating the public about the risk of *radon* in indoor air as well as providing assistance to building designers to employ *radon* resistant building methods. Exposure to *radon* in drinking water is not thought to be as dangerous as inhalation. If the state does decide to initiate a MMM program, the City should have no problem meeting the 4,000 pCi/L limit. In speaking with the Minnesota Department of Health, they said it was "very likely" that a MMM program would be put into place if the proposed regulations become law.

Radium is naturally present in some sources of drinking water. Long-term exposure will increase the risk of cancer in certain people. The EPA has set the MCL for combined *radium 226/228* at 5 pCi/L. Standards for other *radionuclides* are as follows: the MCL for *beta particles and photo emitters* is 4 millirems per year, the MCL for *gross alpha particles* is 15 pCi/L, and the MCL for *uranium* is 45 pCi/L.

The measured *radionuclide* concentrations are presented in Table 5-1. *Radium 226/228* and *gross alpha particles* levels comply with the MCLs and are not expected to pose any compliance problems. The *radon* levels measured in various locations ranged from 305 to 501 pCi/L, above the proposed standard of 300 pCi/L. However, it is likely that the state would implement a MMM program that would increase the MCL to 4,000 pCi/L, which would be well above current measured levels. In addition, radon is readily removed during aeration in the iron and manganese removal process in a water treatment plant.

5.2.7 Disinfection Byproducts

These contaminants are byproducts of the disinfection process, including *trihalomethanes* (*THMs*), which have been associated with a variety of cancers. *THMs* are regulated as *Total Trihalomethanes* (*TTHMs*), which is the combined concentration of four specific compounds: *bromodichloromethane, chloroform, bromoform,* , and *chlorodibromomethane*. These compounds may be regulated individually in the future.

Disinfection byproducts currently included under the Primary Drinking Water Standards and the corresponding standards are as follows: the MCL for *total trihalomethanes* (*TTHMs*) is 0.080 mg/L, the MCL for *haloacetic acids* (*HAA5*) is 0.060 mg/L, the MCL for *bromate* is 0.010 mg/L, and the MCL for *chlorite* is 1.0 mg/L.

Recent results for disinfection byproducts are not available, but *THMs* are mainly a concern for systems under the influence of surface water. Since the Rogers water supply consists solely of ground water, no problems with compliance are anticipated.

5.2.8 Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) sets standards for disinfection requirements and finished water turbidity levels for public water supplies utilizing surface water or groundwater under the influence of a surface water. The groundwater supply for Rogers is not under the influence of surface water so this rule is not applicable.

5.2.9 Groundwater Rule

The Groundwater Rule was promulgated by the EPA in order to protect the public from groundwater contamination. It consists of multiple methods to identify possible problems and correct them. All of the regulations are basically to ensure that viruses in the drinking water are removed or inactivated to the level of 4 log (99.99%).

The Groundwater Rule will require that adequate disinfection residuals be maintained in the distribution system. However, the City already chlorinates water from all of the wells, so there should be no problems with compliance.

For up-to-date information regarding the EPA Groundwater Rule, contact the EPA Safe Drinking Water Hotline at (800) 426-4791.

5.3 Secondary Drinking Water Standards

Secondary Drinking Water Standards were also developed as a part of the 1974 SDWA. Secondary Maximum Contaminant Levels (SMCLs) are unenforceable drinking water standards set by the Federal government as guidelines for the states. The chemicals that they regulate do not have health risks, but rather impact the aesthetic quality of the water. In excess of the SMCL, they may cause stains on plumbing fixtures and on laundered clothing. They also promote microorganism growth within the distribution system and reduce the disinfectant level in the water. In addition, *iron* and *manganese* sometimes produce a disagreeable taste and odor in water.

Iron and *manganese* levels exceed the SMCLs. The only two other secondary contaminants that have been tested recently, *fluoride* and *sulfate*, comply with the standards and no potential problems are anticipated.

5.3.1 Iron and Manganese

The measured concentrations for both *iron* and *manganese* for each well are presented in Table 5-3. The SMCL is 0.05 mg/L for *manganese* and 0.30 mg/L for *iron*. The dissolved *manganese* and *iron* concentrations exceeded the SMCL at all wells based on recent testing. More frequent and accurate testing at the wells by both the City and an independent testing laboratory is recommended to verify the results in preparation for future iron and manganese removal plants.

Neither contaminant poses a health concern at measured levels, but both contaminants may cause staining of clothing and plumbing fixtures, clogging of pipelines with insoluble *iron* and *manganese* compounds, and growth of *iron bacteria* (*Gallionella* and *Crenothrix*) that can create taste and odor problems.

5.4 Summary

The Rogers water system complies with EPA enforceable primary drinking water standards for all contaminants with available data.

The Rogers water system complies with EPA unenforceable secondary drinking water standards for all contaminants with available data except *iron* and *manganese*. Concentrations exceed the standard of each contaminant at all wells.

The water system currently does not employ *iron* and *manganese* removal. Elevated levels of *manganese*, and to a lesser extent *iron*, can cause aesthetic water quality problems and staining of laundry and fixtures if not properly treated. Rogers should look into options for removing *iron* and *manganese* as discussed in Section 6.0. However, the decision to implement iron and manganese removal is a local decision that depends on City tolerance of water quality complaints.

6.0 WATER TREATMENT ALTERNATIVES

This section discusses the alternative treatment processes for addressing iron and manganese (Subsection 6.1), describes existing treatment processes (Subsection 6.2), evaluates existing treatment processes (Subsection 6.3), and makes process recommendations for future facilities (Subsection 6.4).

6.1 Alternative Treatment Processes

Two basic types of processes are typically used for treatment of iron and manganese: sequestration and removal. In America, removal has historically been accomplished by aeration followed by filtration or chemical oxidation followed by filtration. These removal processes will be referred to as conventional removal throughout this document. These characteristic processes for iron and manganese removal are presented in Figure 6-1. Another process for iron and manganese removal is biological removal, which relies on aeration followed by filtration through a biologically active filter. Biological removal is widely practiced in Europe and interest in the process in the United States Drinking Water Industry is growing. These processes (sequestration, conventional removal, and biological removal) are discussed in more detail as follows:

6.1.1 Sequestration

It should be noted that sequestration is not a removal technique because the iron and manganese are still in solution when the water reaches the customer. However, in some cases, sequestration does have the ability to alleviate the aesthetic problems associated with these contaminants.

Sequestration is typically accomplished by adding *polyphosphates* to the water. The effectiveness of these sequestering agents is generally dependent upon the relative iron and manganese concentrations (individual and collective), the residence time in the distribution system, and the water temperature.

6.1.2 Conventional Removal

Iron and manganese can be removed from water by oxidation to insoluble particles, followed by filtration to remove these particles. Some form of waste disposal is then required for the backwash water used to remove the solids that accumulate in the filters. Several options are available for each of the three steps involved in removal such as oxidation, filtration, and waste disposal.

6.1.2.1 Oxidation

Two different processes are typically used for the oxidation of iron and manganese – oxidation by aeration and oxidation by the application of chemicals.

Aeration

Oxidation by aeration is accomplished by bringing the water into contact with oxygen to form insoluble iron and manganese compounds, which are then removed during filtration. Aeration can be accomplished by injecting air into the water stream (referred to as pressure aeration) or by passing the water over a series of trays to increase the surface area of the water in contact with oxygen in the atmosphere. Other methods of aeration include natural draft, induced draft, and forced draft aeration. Because pressure aeration is accomplished in the pipelines entering the filters, air binding of the filters may be a problem. Therefore, pressure aeration is not recommended in conjunction with filtration.

Following aeration, the water is generally conveyed to a detention basin after the aeration process to allow the oxidation reactions to be completed. Recommended detention times are approximately 20 to 30 minutes for iron oxidation. However, much longer times are required for oxidation of manganese. Testing can be conducted to determine the appropriate detention for a given water supply. Oxidation of iron and manganese is highly pH dependent. For a pH of 7.2, iron oxidation by oxygen (oxygenation) will be 90 percent complete within 8 minutes for a water temperature of 60 degrees F. At lower temperatures the rate of reaction would be slower. The rate of iron oxidation will increase about 100 fold for every 1.0 pH unit increase. Oxygenation of manganese is extremely slow for pH values below 9.5 and is typically considered impractical for manganese removal.

Chemical Oxidation

Another method of iron and manganese oxidation is by the application of chemicals. Chlorine is a very effective oxidant and is commonly used to oxidize iron. Iron oxidation by chlorine is almost immediate for most drinking water (i.e., pH > 6). Manganese oxidation by chlorine is very slow (2-4 hours) for pH values below 9.5. Manganese oxidation by *potassium permanganate* is relatively rapid (4 minutes for a pH of 6.0; 1.5 minutes for a pH of 7.0; immediate for a pH of 7.5 or higher). It should be noted that the cost of *potassium permanganate* can approach 4 times that of chlorine. Thus, to limit *potassium permanganate* use and thereby limit chemical costs, *chlorine gas* is fed before *potassium permanganate*. This allows chlorine to oxidize the majority of the iron prior to the introduction of *potassium permanganate*, which will complete the iron oxidation and oxidize the manganese.

6.1.2.2 Filtration

Filtration is used to remove the insoluble compounds formed during the oxidation process. Filtration can be accomplished with different types of media and by different processes.

Media

Three types of media are generally used in the filtration process. The first type of media is a conventional dual media and consists of a layer of anthracite over a layer of sand. The anthracite removes larger particles before they reach the sand, thus extending filter runs. A bed of gravel supports the media over the underdrain system.

The second type of media is manganese greensand that consists of a layer of a manganese oxide-coated sand. Similar to conventional media, a layer of anthracite is generally provided over the greensand to extend filter runs. A bed of gravel supports the media over the underdrain system.

The third type of media is proprietary media furnished by a single supplier. Several of these proprietary medias for the removal of iron and manganese are currently available. These processes can be called "black box" treatment processes since the actual process is unknown to the operator and the manufacturer must handle malfunctions and repairs. Also, because of their proprietary nature, equipment and media repair or replacement rely upon a single supplier. If this manufacturer would discontinue this process or go out of business, it may be impossible to obtain the necessary replacement items or repairs.

A problem encountered with conventional dual media when used for iron and manganese removal is that excess *potassium permanganate* applied to ensure complete oxidation can pass through the filter and appear as a pink color in the effluent. This occurrence may generate complaints from customers although there are no health or operational problems. The manganese oxide coating on the manganese greensand acts as a buffer to prevent color in the effluent by reducing any excess *potassium permanganate* in the water.

Process

Two processes for filtration can be utilized to remove the insoluble iron and manganese precipitates- gravity filtration and pressure filtration. Both processes are commonly used in the metropolitan area.

Gravity filtration generally consists of reinforced filter boxes open to the atmosphere and employs gravity to draw the water through the media. Filter loading rates are typically less than four gallons per minute per square foot of filter surface area. These types of filters generally require a pipe gallery for accessing the filter control valves.

Pressure filters are self-contained vessels that operate under the pressure of the water supply pumps. These units are generally constructed of steel and are pre-assembled with control valving attached. Filter loading rates are also typically less than four gallons per minute per square foot.

Additional Notes

It should also be noted that although oxidized manganese is insoluble in water, the floc particles formed are very small, do not settle well, and have a tendency to pass through filters. Chemical oxidation processes have an added benefit over oxygenation in that they also help establish a coating of manganese dioxide and ferric oxides on the filter media that in turn enhances the removal of the oxidized manganese through adsorption and autocatalytic processes. On the other hand, oxidation by aeration has an added benefit over chemical oxidation in that the concentration of many dissolved gases, including radon, are substantially reduced during the aeration process. Chemical oxidation has little or no effect on the levels of dissolved gases.

6.1.3 Biological Removal

Biological removal relies on aeration followed by filtration through biologically active filters. The aeration plus filtration process train, commonly used in France, led to the discovery of biological phenomena that occurred simultaneously with or instead of physical-chemical processes. It was noted that the observed biological activity produced a substantial improvement in treatment efficiency. Biological processes now offer the best alternative to conventional removal plants. The primary advantages associated with such processes are a high filtration rate, high retention capacity, elimination of need for chemical oxidation, flexibility of operation, reduced capital and operating costs, and good sludge treatability. One potential limitation is that some waters will require two-filtration stages- one for iron and a second one for manganese. An additional concern is time required for start-up and re-starting facilities. Initial start-up is enhanced by seeding a new filter with sludge from the wash water of an established biological filter that is treating similar water. A new filter can be achieving residual iron levels of 0.1 mg/L within 10 hours of start-up and residuals less than 0.03 after 1 day of operation. Manganese removal improves at a slower rate, but a new filter can be achieving excellent manganese removal within 35 days of start-up. If a plant that is operating well is shut down for two months, it can be achieving excellent iron and manganese removals with 5 days.

6.2 Existing Treatment Process

Rogers does not provide filtration for any source water. For water drawn from each well, Rogers chlorinates with *chlorine gas*, fluoridates with *hydrofluosilicic acid*, and adds the polyphosphate *C-5* as a corrosion inhibitor. Chlorination is performed to provide a residual disinfectant throughout the water system and fluoridation is performed to prevent dental decay.

6.3 Evaluation of the Existing Treatment Process

The City receives approximately 10 to 20 water quality complaints per year, mostly associated with odor complaints. Brown water complaints often follow hydrant flushing in the area. The brown water is caused by high levels of iron and manganese pumped from all wells directly into the system without filtration. However, the decision to implement iron and manganese removal is a local decision that depends on City tolerance of water quality complaints.

6.4 Recommendations for Future Facilities

Sequestering iron and manganese is cheaper and easier to implement than filtration. The Ten States Standards and Minnesota Department of Health does not recommend using *polyphosphates* for sequestering iron and manganese if the combined levels are in excess of 1.0 mg/L, such as at Well 6. Also, sequestering is a short-term solution that does not remove the contaminants and the process loses effectiveness in the system over time.

It is recommended that an independent testing laboratory verify the iron and manganese levels. Combined iron/manganese levels range from about 0.4 to 1.5 mg/L at the wells. Assuming these levels are accurate, future iron and manganese treatment is recommended. The recommended option for the provision of aesthetically pleasing water at user taps is to design **Conventional Removal Facilities** for the reduction of iron and manganese levels via filtration.

6.4.1 Conventional Removal Facilities

Conventional removal facilities would rely on the chemical oxidation of iron and manganese followed by filtration. Most cities treat 80 percent of the source water and use outlying wells to augment the flow during peak demands. For example, analysis at the City of Lakeville plant showed that the outlying wells were needed for only 14 days during the year. Normally during peak days the water in the mains has very low resident time and therefore the chances of precipitation of iron and manganese are low.

We recommend the construction of a filtration plant to treat water from Wells 3, 4, 5, and 7, and that Wells 6 and 8 be used only to augment flow during peak demands. As demands increase in the future, we recommend a second filtration plant to treat water from Wells 6, 8, and any future wells constructed nearby.

7.0 WATER CONSERVATION

Section Pending

8.0 CAPITAL IMPROVEMENT PLAN (CIP)

Plans for expanding and modifying the existing system are discussed in Section 4.4.5.

Table 8-1 identifies major improvements that the City of Rogers water supply system will need to provide through 2015 and through 2030 and tabulates the associated estimated costs. The improvements that have been identified consist of several types of work. These include new well construction, storage facilities, and new trunk watermain construction.

To remove iron and manganese from the water and eliminate brown water complaints, we recommend the construction of centralized filtration plants. The first plant, the South Water Treatment Plant, should be designed to treat the capacity of existing Wells 3, 4, 5, 7, and three proposed 1,000-gpm wells. The North Water Treatment Plant should be designed to treat the capacity of existing Well 6, the under construction Well 8, plus capacity to treat another four proposed 1,000-gpm wells.

In order to improve security, we also recommend the installation of a Supervisory Control and Data Acquisition (SCADA) system to remotely control and monitor the wells, towers, booster station, and proposed treatment plants.

The following production and storage capital improvements are recommended:

- SCADA system
- Seven new 1,000-gpm FIG wells (not including Well 8 under construction).
- One new 1.0 MG capacity elevated storage facility in the high-pressure zone.
- Additional booster station in the south of the high-pressure zone.
- Two new 2.0 MG capacity ground storage reservoirs at each proposed water treatment plant site.
- Install new watermains as indicated on Table 8-1 and Inserts B and C.

Proposed watermain improvement priorities for system adequacy over the next few years includes but is not limited to the following as shown on the Water Distribution System Map – 2015 (Insert B):

- New 12-inch main along the west side of Main Street connecting the booster station to Elm Pkwy in the high-pressure zone.
- New 16-inch and 12-inch mains in high-pressure zone from proposed Water Tower 3 to existing piping system.
- New 16-inch main on Industrial Blvd from Fletcher Lane southeast to the proposed Hassan annexation area.
- New 30-inch main on Industrial Blvd between Memorial Drive and Fletcher Lane to distribute water from the proposed South Water Treatment Plant.

Recommended improvements are estimated to cost $39.3 million between 2007 and 2015 and $3.6 million between 2016 and 2030.

Costs in Table 8-1 include 15 percent engineering, 10 percent contingencies, and 5 percent for administrative and legal costs. All costs are based in terms of the value of dollars in year 2007. It should be noted that land acquisition and restoration costs are not included in the CIP. No costs have been included for easements or unusual subsurface conditions.

Trunk watermain needs were developed in consultation with City staff to accommodate ongoing development in the City. Cost estimates for trunk mains were based on average costs in the Minneapolis/St. Paul metropolitan area. The costs do not include restoration; so we assume water main construction in roadways will be performed in conjunction with roadway construction.

Financing of CIP water main construction should be by existing Water Fund cash reserves. Well and storage construction should be financed as far as is possible by existing Water Fund cash reserves. Additional funding may be obtained via borrowing of revenue bonds to be paid back by water rates.

Because of the duration of the CIP and the effect that City growth will have on the CIP, we would recommend updating the report in five years to reflect the improvements that were made and those still pending. It should also be noted that this CIP is not a feasibility study. It is a planning document. A feasibility study should be performed on each project as future City growth determines their need.

TABLES

Table 2-1
Existing Water Facilities and Source of Supply
Rogers, Minnesota

SERVICE AREAS: Pressure Zone	Normal Elevation Zone					
SUPPLY:						
Well No.	3	4	5	6	7	8 *
Capacity (gpm)	800	1000	1000	1000	1000	1000
Capacity (MGD)	1.152	1.44	1.44	1.44	1.44	1.44
Year Installed	1983	1995	1999	2002	2006	2007
Uniqueness Number	161431	541548	625354	664853	307594	
Casing Diameter (inches)	20 / 12	20 / 14	18	24 / 18	24 / 18	24 / 18
Casing Depth (feet)	147 / 319	151 / 231	222	258 / 299	152 / 200	265 / 310
Well Depth (feet)	370	367	364	374	362	360
Formation	FIG	FIG	FIG	FIG	FIG	FIG
Static Level (feet)	90	85	85	34.7	97.1	
Drawdown (feet)	115	118	107	187	176	
Pump Type	VT	VT	VT	VT	Sub	Sub
Motor HP	75	50	100	150	125	125
TREATMENT:	H2SiF6 Cl2 C-5	(Feeds into Well 3)	H2SiF6 Cl2 C-5	H2SiF6 Cl2 C-5	(Feeds into Well 5)	H2SiF6 Cl2 C-5 (Feeds into Well 6)

STORAGE:			
Name	East Tower	WestTower	
Location	George Weber Dr.	Orchid Ave	
Type	Single Pedisphere	Fluted Column	
Volume (gallons)	400,000	750000	
Year Constructed	1993	2001	
Overflow Elevation (feet)	1,088	1088	
Bowl Bottom Elev. (feet)	1,063	1046	

KEY TO SYMBOLS:

Geological Formation:
FIG - Franconia-Ironton-Galesville

Pump Type:
VT - Vertical Turbine
Sub - Submersible

Treatment:

H2SiF6 - Hydrofluosilicic Acid (for fluoridation)
Cl2 - Chlorine Gas (for disinfection)
C-5 - Polyphosphate (corrosion inhibitor)

* Well No. 8 under construction in 2007. Data subject to change.

Table 3-1
Population and Serviced Population Data
Rogers, Minnesota

	Current City of Rogers					Annexed Hassan Township			Total Future Rogers
Year	Total City Population *	New Res. Units *	New Population *	Population Served ***	Percent Served	Total Annexed Population**	Population Served ***	Percent Served	Population Served ***
1995	1,162	--	--	1,075	92.5%		0	0.0%	1,075
1996	1,322	--	--	1,235	93.4%		0	0.0%	1,235
1997	1,605	--	--	1,522	94.8%		0	0.0%	1,522
1998	2,029	--	--	1,946	95.9%		0	0.0%	1,946
1999	2,663	--	--	2,588	97.2%		0	0.0%	2,588
2000	3,588	--	--	3,513	97.9%		0	0.0%	3,513
2001	4,370	--	--	4,295	98.3%		0	0.0%	4,295
2002	5,010	--	--	4,935	98.5%		0	0.0%	4,935
2003	5,580	--	--	5,505	98.7%		0	0.0%	5,505
2004	5,760	--	--	5,685	98.7%		0	0.0%	5,685
2005	6,716	77	--	6,641	98.9%		0	0.0%	6,641
2006	6,924	100	208	6,849	98.9%	4,653	0	0.0%	6,849
2007	7,194	188	270	7,119	99.0%	6,398	1,401	21.9%	8,520
2008	7,702	188	508	7,627	99.0%	8,144	2,802	34.4%	10,428
2009	8,209	188	508	8,134	99.1%	9,889	4,202	42.5%	12,336
2010	8,717	188	508	8,642	99.1%	11,635	5,603	48.2%	14,245
2011	9,224	188	508	9,149	99.2%	13,380	7,004	52.3%	16,153
2012	9,732	188	508	9,657	99.2%	15,126	8,405	55.6%	18,062
2013	10,240	188	508	10,165	99.3%	16,871	9,805	58.1%	19,970
2014	10,747	188	508	10,672	99.3%	18,617	11,206	60.2%	21,878
2015	11,255	188	508	11,180	99.3%	15,709	12,607	80.3%	23,787
2016	11,762	0	508	11,687	99.4%	15,709	12,814	81.6%	24,501
2017	11,762	0	0	11,687	99.4%	15,709	13,021	82.9%	24,708
2018	11,762	0	0	11,687	99.4%	15,709	13,227	84.2%	24,915
2019	11,762	0	0	11,687	99.4%	15,709	13,434	85.5%	25,122
2020	11,762	0	0	11,687	99.4%	15,709	13,641	86.8%	25,328
2021	11,762	0	0	11,687	99.4%	15,709	13,848	88.2%	25,535
2022	11,762	0	0	11,687	99.4%	15,709	14,055	89.5%	25,742
2023	11,762	0	0	11,687	99.4%	15,709	14,261	90.8%	25,949
2024	11,762	0	0	11,687	99.4%	15,709	14,468	92.1%	26,156
2025	11,762	0	0	11,687	99.4%	15,709	14,675	93.4%	26,362
2026	11,762	0	0	11,687	99.4%	15,709	14,882	94.7%	26,569
2027	11,762	0	0	11,687	99.4%	15,709	15,089	96.1%	26,776
2028	11,762	0	0	11,687	99.4%	15,709	15,295	97.4%	26,983
2029	11,762	0	0	11,687	99.4%	15,709	15,502	98.7%	27,190
2030	11,762	0	0	11,687	99.4%	15,709	15,709	100.0%	27,396
Total New (2006-2015):		1,792	4,539			15,709	12,607		16,938
Total New (2016-2030):		0	508			0	2,895		2,895

* 2000 population from U.S. Census data.
2001-2005 population from Metropolitan Council estimates.
Projected population from new units added to the year after development.
See Section 3.2.2 for explanation of projected new units.

** Total Hassan Township population is estimated based on the number of units data provided by SEH.

*** Number of people served by City water, with the remainder using private wells.

Table 3-2
Summary of Historic Water Use
Rogers, Minnesota

Year	Annual Pumped Water (thousand gallons)	Serviced Population *	Total Service Connections
1995	87,227	1,075	--
1996	91,759	1,235	--
1997	108,185	1,522	523
1998	159,396	1,946	858
1999	176,958	2,588	1,158
2000	263,920	3,513	1,439
2001	302,482	4,295	1,807
2002	317,824	4,935	2,159
2003	441,863	5,505	2,321
2004	422,115	5,685	2,931
2005	432,102	6,641	2,658

* See Table 3-1.

Table 3-3
Per Capita Water Use
Rogers, Minnesota

Year	Estimated Serviced Population *	Annual Pumped Water (thousand gallons)	Pumped Water per Capita per Day (gpcd)	Annual Residential Consumption (thousand gallons)	Residential Usage per Capita per Day (gpcd)
1995	1,075	87,227	222.3	--	--
1996	1,235	91,759	203.6	--	--
1997	1,522	108,185	194.7	--	--
1998	1,946	159,396	224.4	--	--
1999	2,588	176,958	187.3	105,138	111.3
2000	3,513	263,920	205.8	176,460	137.6
2001	4,295	302,482	192.9	202,503	129.2
2002	4,935	317,824	176.4	219,178	121.7
2003	5,505	441,863	219.9	322,030	160.3
2004	5,685	422,115	203.4	295,676	142.5
2005	6,641	432,102	178.3	266,120	109.8

* See Table 3-1. **Average: 130.3**

Table 3-4
2005 Water Demand by Customer Category
Rogers, Minnesota

Category	Number of Service Connections	2005 Use, from water sales and pumpage total (thousand gallons)	% of Total 2005 Annual Use
Residential	2,300	266,120.0	61.6%
Commercial/Industrial	354	136,760.0	31.7%
Institutional/Other	4	19,629.0	4.5%
Unaccounted *		9,591.0	2.2%
Total Connections	2,658		
Total Pumped		432,100.0	100.0%

* 1.0% unaccounted is used for designing future demands.

Table 3-5
Large Volume Customers
Rogers, Minnesota

Name	2005 Usage (thousand gallons)	Daily Usage (gallons/day)	Approximate % of Total Use **
LLC, Rogers Preserve	7,208	19,748	1.7%
Alcoa-KAMA	6,650	18,219	1.6%
Rogers Public Schools	4,749	13,011	1.1%
Twin City West/Union 76	3,958	10,844	0.9%
Cabelas	3,438	9,419	0.8%
The Wellstead	3,432	9,403	0.8%
Profile Powder Coating	3,373	9,241	0.8%
Reinhart Foodservice	3,178	8,707	0.8%
Imperial Custom Molding	3,081	8,441	0.7%
Graco	2,817	7,718	0.7%
Super 8 Motel	2,543	6,967	0.6%
Flame Metals	2,533	6,940	0.6%
Veit	2,097	5,745	0.5%
Americ Inn	1,912	5,238	0.5%
Touch em All	1,695	4,644	0.4%
Super Target	1,498	4,104	0.4%

** Percent of total use is based on 2005 use of 422,509,000 gallons.
(total not including unaccounted-for water).

Table 3-6
Peak Water Demands
Rogers, Minnesota

Year	Water Pumped Demand (Annual / Peak)	Average Pumped Demand (1,000 gal / day)	Maximum Day Pumped Demand (1,000 gal / day)	Max-Day to Ave-Day Ratio *
1995	Annual	239		
	Record Peak Demand (July 24)		711	2.975
1996	Annual	251		
	Record Peak Demand (Aug 30)		706	2.808
1997	Annual	296		
	Record Peak Demand		1,062	3.583
1998	Annual	437		
	Record Peak Demand (Sept 18)		1,556	3.563
1999	Annual	485		
	Record Peak Demand (July 12)		1,842	3.799
2000	Annual	723		
	Record Peak Demand (Aug 11)		1,867	2.582
2001	Annual	829		
	Record Peak Demand (July 15)		3,123	3.768
2002	Annual	871		
	Record Peak Demand (July 4)		3,114	3.576
2003	Annual	1,211		
	Record Peak Demand (Aug 14)		3,636	3.004
2004	Annual	1,156		
	Record Peak Demand (Aug 4)		3,932	3.400
2005	Annual	1,184		
	Record Peak Demand (Aug 16)		4,081	3.447

Average Ratio: 3.319

Table 3-7
2005 Monthly Water Pumped Demand
Rogers, Minnesota

2005 Month	Water Pumped Demand (1,000 gallons)					
	Well 3	Well 4	Well 5	Well 6	Well 7 *	Total
January	7,439	2,699	6,251	0	0	16,389
February	7,126	2,652	5,144	0	0	14,922
March	4,210	1,433	11,949	0	0	17,592
April	11,508	991	11,202	269	0	23,970
May	0	15,109	25,284	1,713	0	42,106
June	23,561	7,505	10,408	3,356	0	44,830
July	30,757	15,813	23,293	18,181	0	88,044
August	24,302	8,883	29,286	10,249	0	72,720
September	17,522	7,269	15,042	1,864	0	41,697
October	14,771	905	15,117	249	0	31,042
November	5,985	1,335	11,616	16	0	18,952
December	6,607	1,497	11,728	6	0	19,838
Annual	153,788	66,091	176,320	35,903	0	432,102

* Well 7 was not constructed until 2006.

Table 3-8
Projection of Water Demands
Rogers, Minnesota

Year	Demand Flows (thousand gallons/day)						
	City of Rogers			Annexed			
	Residential (1)	Commercial/ Industrial (1)	Institutional/ Other (1)	Hassan Township	Ave-Day	Max-Day (2)	Max-Hr (2)
1995	150	77	11		239	711	--
1996	158	81	12		251	706	--
1997	187	96	14		296	1,062	--
1998	275	141	20		437	1,556	--
1999	305	157	23		485	1,842	--
2000	455	234	34		723	1,867	--
2001	522	268	39		829	3,123	--
2002	548	282	41		871	3,114	--
2003	762	392	56		1,211	3,636	--
2004	728	374	54		1,156	3,932	--
2005	745	383	55		1,184	4,081	--
2006	908	467	67	0	1,442	4,760	9,520
2007	944	485	70	214	1,713	5,654	11,309
2008	1,011	520	75	428	2,035	6,714	13,428
2009	1,079	555	80	642	2,356	7,773	15,547
2010	1,146	589	85	857	2,677	8,833	17,666
2011	1,213	624	90	1,071	2,998	9,892	19,785
2012	1,281	658	95	1,285	3,319	10,952	21,904
2013	1,348	693	100	1,499	3,640	12,011	24,023
2014	1,415	728	105	1,713	3,961	13,071	26,142
2015	1,483	762	110	1,927	4,282	14,130	28,261
2016	1,550	797	115	1,954	4,416	14,572	29,144
2017	1,550	797	115	1,981	4,443	14,661	29,321
2018	1,550	797	115	2,008	4,470	14,749	29,499
2019	1,550	797	115	2,035	4,496	14,838	29,676
2020	1,550	797	115	2,062	4,523	14,927	29,854
2021	1,550	797	115	2,089	4,550	15,016	30,031
2022	1,550	797	115	2,116	4,577	15,104	30,208
2023	1,550	797	115	2,142	4,604	15,193	30,386
2024	1,550	797	115	2,169	4,631	15,282	30,563
2025	1,550	797	115	2,196	4,658	15,370	30,741
2026	1,550	797	115	2,223	4,685	15,459	30,918
2027	1,550	797	115	2,250	4,711	15,548	31,095
2028	1,550	797	115	2,277	4,738	15,636	31,273
2029	1,550	797	115	2,304	4,765	15,725	31,450
2030	1,550	797	115	2,331	4,792	15,814	31,628

Total New (2006-2015):	1,927	2,840
Total New (2016-2030):	376	376

Notes:

(1) Categorized water demand projections are based on the Population Served projections from Table 3-1. Water demand projections include unaccounted-for water by allocating all pumped water to each customer category respective of their demand percentages from Table 3-4.

(2) Max-Day and Max-Hr water demand projections are based on Max-Day/Ave-Day ratios observed from 1995-2005 (see Table 3-6). Max-Day was calculated as 3.3 x (Ave-Day) and Max-Hr was calculated as 2.0 x (Max-Day).

See Design Flow Calculations in Appendix B.

Table 4-1a
Summary of Forecasted Water System Adequacy
(Without Hassan Projections)
Rogers, Minnesota

Year	Projected Pumping Demands (thousand gallons/day)			Existing Flow Capacities - 2006 (thousand gallons/day)		Additional Well Capacity Needed (gpm)	Additional Storage Needed ** (thousand gallons)
	P_{AveDay}	P_{MaxDay}	P_{MaxHr}	Q_{FWC}	Q_{EM} *		
2006	1,442	4,760	9,520	5,472	8,922		199
2007	1,499	4,948	9,895	5,472	8,922		324
2008	1,606	5,300	10,601	5,472	8,922		560
2009	1,713	5,653	11,307	5,472	8,922	126	734
2010	1,820	6,006	12,012	5,472	8,922	371	852
2011	1,927	6,359	12,718	5,472	8,922	616	970
2012	2,034	6,712	13,423	5,472	8,922	861	1,087
2013	2,141	7,064	14,129	5,472	8,922	1,106	1,205
2014	2,248	7,417	14,834	5,472	8,922	1,351	1,322
2015	2,355	7,770	15,540	5,472	8,922	1,596	1,440
2016	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2017	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2018	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2019	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2020	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2021	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2022	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2023	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2024	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2025	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2026	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2027	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2028	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2029	2,461	8,123	16,246	5,472	8,922	1,841	1,558
2030	2,461	8,123	16,246	5,472	8,922	1,841	1,558

The shaded cells are where it appears that the water system will not meet the corresponding criteria.

Notes:
This table is only intended to communicate the adequacy of the existing system to meet projected pumping demands.

See Abbreviations (page iv) and Section 4.2 for flow definitions
(such as Q_{EM} = Emergency Flow and Q_{FWC} = Firm Well Capacity).

* Assumes that 1/2 of the storage volume could be made available over the duration of a 4-hour emergency.

** Assumes that the Well Capacity is first increased to meet the Max-Day demands.

Table 4-1b
Summary of Forecasted Water System Adequacy
(With Hassan Projections)
Rogers, Minnesota

Year	Projected Pumping Demands (thousand gallons/day)			Existing Flow Capacities - 2006 (thousand gallons/day)		Additional Well Capacity Needed (gpm)	Additional Storage Needed ** (thousand gallons)
	P_{AveDay}	P_{MaxDay}	P_{MaxHr}	Q_{FWC}	Q_{EM} *		
2006	1,442	4,760	9,520	5,472	8,922		199
2007	1,713	5,654	11,309	5,472	8,922	127	735
2008	2,035	6,714	13,428	5,472	8,922	862	1,088
2009	2,356	7,773	15,547	5,472	8,922	1,598	1,441
2010	2,677	8,833	17,666	5,472	8,922	2,334	1,794
2011	2,998	9,892	19,785	5,472	8,922	3,070	2,147
2012	3,319	10,952	21,904	5,472	8,922	3,806	2,501
2013	3,640	12,011	24,023	5,472	8,922	4,541	2,854
2014	3,961	13,071	26,142	5,472	8,922	5,277	3,207
2015	4,282	14,130	28,261	5,472	8,922	6,013	3,560
2016	4,416	14,572	29,144	5,472	8,922	6,319	3,707
2017	4,443	14,661	29,321	5,472	8,922	6,381	3,737
2018	4,470	14,749	29,499	5,472	8,922	6,443	3,766
2019	4,496	14,838	29,676	5,472	8,922	6,504	3,796
2020	4,523	14,927	29,854	5,472	8,922	6,566	3,826
2021	4,550	15,016	30,031	5,472	8,922	6,627	3,855
2022	4,577	15,104	30,208	5,472	8,922	6,689	3,885
2023	4,604	15,193	30,386	5,472	8,922	6,751	3,914
2024	4,631	15,282	30,563	5,472	8,922	6,812	3,944
2025	4,658	15,370	30,741	5,472	8,922	6,874	3,973
2026	4,685	15,459	30,918	5,472	8,922	6,935	4,003
2027	4,711	15,548	31,095	5,472	8,922	6,997	4,033
2028	4,738	15,636	31,273	5,472	8,922	7,059	4,062
2029	4,765	15,725	31,450	5,472	8,922	7,120	4,092
2030	4,792	15,814	31,628	5,472	8,922	7,182	4,121

The shaded cells are where it appears that the water system will not meet the corresponding criteria.

Notes:
This table is only intended to communicate the adequacy of the existing system to meet projected pumping demands.

See Abbreviations (page iv) and Section 4.2 for flow definitions
(such as Q_{EM} = Emergency Flow and Q_{FWC} = Firm Well Capacity).

* Assumes that 1/2 of the storage volume could be made available over the duration of a 4-hour emergency.

** Assumes that the Well Capacity is first increased to meet the Max-Day demands.

Table 4-2a
Emergency Flow (Q_{EM}) and Firm Well Capacity (Q_{FWC}) Requirements
(Without Hassan Projections)
Rogers, Minnesota

Year	Flows (thousand gallons/day)				Well Capacity Added	Storage Capacity Added
	P_{MaxDay}	P_{MaxHr}	Q_{FWC}	Q_{EM}	(gpm)	(gallons)
2006	4,760	9,520	5,472	8,922	0	0
2007	4,948	9,895	6,912	10,362	1,000	0
2008	5,300	10,601	6,912	13,362	0	1,000,000
2009	5,653	11,307	6,912	13,362	0	0
2010	6,006	12,012	6,912	15,612	0	750,000
2011	6,359	12,718	6,912	15,612	0	0
2012	6,712	13,423	8,352	17,052	1,000	0
2013	7,064	14,129	8,352	17,052	0	0
2014	7,417	14,834	8,352	17,052	0	0
2015	7,770	15,540	8,352	17,052	0	0
2016	8,123	16,246	8,352	17,052	0	0
2017	8,123	16,246	8,352	17,052	0	0
2018	8,123	16,246	8,352	17,052	0	0
2019	8,123	16,246	8,352	17,052	0	0
2020	8,123	16,246	8,352	17,052	0	0
2021	8,123	16,246	8,352	17,052	0	0
2022	8,123	16,246	8,352	17,052	0	0
2023	8,123	16,246	8,352	17,052	0	0
2024	8,123	16,246	8,352	17,052	0	0
2025	8,123	16,246	8,352	17,052	0	0
2026	8,123	16,246	8,352	17,052	0	0
2027	8,123	16,246	8,352	17,052	0	0
2028	8,123	16,246	8,352	17,052	0	0
2029	8,123	16,246	8,352	17,052	0	0
2030	8,123	16,246	8,352	17,052	0	0

Notes:
See Abbreviations (page iv) and Section 4.2 for flow definitions.

Reference Table 4-1a and Appendix B worksheet.

See Figure 4-1a for graphical representation.

Table 4-2b
Emergency Flow (Q_{EM}) and Firm Well Capacity (Q_{FWC}) Requirements
(With Hassan Projections)
Rogers, Minnesota

Year	Flows (thousand gallons/day)				Well Capacity Added	Storage Capacity Added
	P_{MaxDay}	P_{MaxHr}	Q_{FWC}	Q_{EM}	(gpm)	(gallons)
2006	4,760	9,520	5,472	8,922	0	0
2007	5,654	11,309	6,912	10,362	1,000	0
2008	6,714	13,428	6,912	13,362	0	1,000,000
2009	7,773	15,547	8,352	14,802	1,000	0
2010	8,833	17,666	9,792	22,242	1,000	2,000,000
2011	9,892	19,785	11,232	23,682	1,000	0
2012	10,952	21,904	11,232	23,682	0	0
2013	12,011	24,023	12,672	25,122	1,000	0
2014	13,071	26,142	14,112	26,562	1,000	0
2015	14,130	28,261	15,552	34,002	1,000	2,000,000
2016	14,572	29,144	15,552	34,002	0	0
2017	14,661	29,321	15,552	34,002	0	0
2018	14,749	29,499	15,552	34,002	0	0
2019	14,838	29,676	15,552	34,002	0	0
2020	14,927	29,854	15,552	34,002	0	0
2021	15,016	30,031	15,552	34,002	0	0
2022	15,104	30,208	15,552	34,002	0	0
2023	15,193	30,386	15,552	34,002	0	0
2024	15,282	30,563	15,552	34,002	0	0
2025	15,370	30,741	15,552	34,002	0	0
2026	15,459	30,918	15,552	34,002	0	0
2027	15,548	31,095	16,992	35,442	1,000	0
2028	15,636	31,273	16,992	35,442	0	0
2029	15,725	31,450	16,992	35,442	0	0
2030	15,814	31,628	16,992	35,442	0	0

Notes:
See Abbreviations (page iv) and Section 4.2 for flow definitions.

Reference Table 4-1b and Appendix B worksheet.

See Figure 4-1b for graphical representation.

Table 4-3
Demand Requirements Versus Serviced Population
Rogers, Minnesota

Serviced Population	Flows (thousand gallons/day)				Well Capacity Added	Storage Capacity Added
(thousands)	P_{MaxDay}	P_{MaxHr}	Q_{FWC}	Q_{EM}	(gpm)	(gallons)
7	4,865	9,730	5,472	8,922	0	0
8	5,560	11,120	6,912	13,362	1,000	1,000,000
9	6,034	12,069	6,912	13,362	0	0
10	6,516	13,031	6,912	13,362	0	0
11	7,042	14,083	8,352	14,802	1,000	0
12	7,540	15,081	8,352	20,802	0	2,000,000
13	8,132	16,263	8,352	20,802	0	0
14	8,728	17,457	9,792	22,242	1,000	0
15	9,161	18,323	9,792	22,242	0	0
16	9,730	19,460	9,792	22,242	0	0
17	10,481	20,962	11,232	23,682	1,000	0
18	10,869	21,739	11,232	23,682	0	0
19	11,444	22,889	12,672	25,122	1,000	0
20	12,223	24,445	12,672	25,122	0	0
21	12,803	25,606	14,112	26,562	1,000	0
22	13,379	26,758	14,112	32,562	0	2,000,000
23	13,702	27,403	14,112	32,562	0	0
24	14,518	29,036	15,552	34,002	1,000	0
25	14,801	29,602	15,552	34,002	0	0
26	15,343	30,685	15,552	34,002	0	0
27	15,517	31,035	15,552	34,002	0	0
28	16,026	32,052	16,992	35,442	1,000	0

Notes:
See Abbreviations (page iv) and Section 4.2 for flow definitions.

See Figure 4-2 for graphical representation.

This table and Figure 4-2 show the hypothetical demand requirements and corresponding supply and storage improvements based on the total serviced popluation of the water system.
See table in Appendix B for calculations of flow per population.

Table 5-1
Primary Drinking Water Quality Data
Rogers, Minnesota

MICROORGANISMS

contaminant	unit	MCL	measure	date	location
Cryptosporidium		TT			
Giardia lamblia		TT			
Heterotrophic plate count (HPC)		TT			
Legionella		TT			
Total Coliforms	positive/samples	1 per month	absent	Jul-03	various
Turbidity	NTU	TT	< 1	Nov-03	Well 6
Viruses (enteric)		TT			

DISINFECTION BYPRODUCTS

contaminant	unit	MCL	measure	date	location
Bromate	ug/L	10			
Chlorite	ug/L	1000			
Haloacetic acids (HAA5)	ug/L	60			
Total Trihalomethanes (TTHMs)	ug/L	80			

DISINFECTANTS

contaminant	unit	MCL	measure	date	location
Chloramines (as Cl2)	mg/L	MRDL=4.0			
Chlorine (as Cl2)	mg/L	MRDL=4.0			
Chlorine dioxide (as ClO2)	mg/L	MRDL=0.8			

INORGANIC CHEMICALS

contaminant	unit	MCL	measure	date	location
Antimony	ug/L	6	< 0.60	Jul-02	Well 6
Arsenic	ug/L	10	< 1	Nov-03	Well 6
Asbestos (fiber >10 micrometers)	mill. fibers/L	7			
Barium	ug/L	2000	123	Jul-02	Well 6
Beryllium	ug/L	4	< 0.40	Jul-02	Well 6
Cadmium	ug/L	5	< 0.50	Jul-02	Well 6
Chromium (total)	ug/L	100	< 10.0	Jul-02	Well 6
Copper (Action Level)	mg/L	TT; 1.3	90% < 0.71	1998	distribution
Cyanide (as free cyanide)	mg/L	0.2	< 0.10	Jul-02	Well 6
Fluoride	mg/L	4.0	1.1	Feb-03	distribution
Lead (Action Level)	mg/L	TT; 0.015	90% < 1.8	1998	distribution
Mercury (inorganic)	ug/L	2	< 0.01	Jul-02	Well 6
Nitrate (measured as Nitrogen)	mg/L as N	10	< 0.05	May-03	Well 5
Nitrite (measured as Nitrogen)	mg/L as N	1	< 0.05	May-03	Well 5
Selenium	ug/L	50	< 5.00	Jul-02	Well 6
Thallium	ug/L	2	< 1.00	Jul-02	Well 6

Table 5-1
Primary Drinking Water Quality Data
Rogers, Minnesota

ORGANIC CHEMICALS

contaminant	unit	MCL	measure	date	location
Acrylamide		TT			
Alachlor	ug/L	2	< 0.2	Jan-03	Well 6
Atrazine	ug/L	3	< 0.3	Oct-02	Well 6
Benzene	ug/L	5	< 0.2	Jul-03	Well 6
Benzo(a)pyrene (PAHs)	ug/L	0.2	< 0.2	Jan-03	Well 6
Carbofuran	ug/L	40	< 2.0	Oct-02	Well 6
Carbon tetrachloride	ug/L	5	< 0.2	Jul-03	Well 6
Chlordane	ug/L	2			
Chlorobenzene	ug/L	100	< 0.2	Jul-03	Well 6
2,4-D	ug/L	70	< 0.5	Oct-02	Well 6
Dalapon	ug/L	200	< 0.5	Oct-02	Well 6
1,2-Dibromo-3-chloropropane (DBCP)	ug/L	0.2	< **2.0 ** **	Jul-03	Well 6
o-Dichlorobenzene	ug/L	600			
p-Dichlorobenzene	ug/L	75			
1,2-Dichloroethane	ug/L	5	< 0.2	Jul-03	Well 6
1,1-Dichloroethylene	ug/L	7			
cis-1,2-Dichloroethylene	ug/L	70			
trans-1,2-Dichloroethylene	ug/L	100			
Dichloromethane	ug/L	5			
1,2-Dichloropropane	ug/L	5	< 0.2	Jul-03	Well 6
Di(2-ethylhexyl) adipate	ug/L	400	< 5.0	Jan-03	Well 6
Di(2-ethylhexyl) phthalate	ug/L	6	< 4.0	Jan-03	Well 6
Dinoseb	ug/L	7	< 0.5	Oct-02	Well 6
Dioxin (2,3,7,8-TCDD)	ug/L	0.00003			
Diquat	ug/L	20			
Endothall	ug/L	100			
Endrin	ug/L	2	< 0.2	Jan-03	Well 6
Epichlorohydrin		TT			
Ethylbenzene	ug/L	700	< 0.2	Jul-03	Well 6
Ethylene dibromide	ug/L	0.05			
Glyphosate	ug/L	700	< 10	Oct-02	Well 6
Heptachlor	ug/L	0.4	< 0.4	Jan-03	Well 6
Heptachlor epoxide	ug/L	0.2	< 0.2	Jan-03	Well 6
Hexachlorobenzene	ug/L	1	< 0.1	Jan-03	Well 6
Hexachlorocyclopentadiene	ug/L	50	< 0.5	Jan-03	Well 6
Lindane	ug/L	0.2	< 0.2	Jan-03	Well 6
Methoxychlor	ug/L	40	< 0.5	Jan-03	Well 6
Oxamyl (Vydate)	ug/L	200	< 1.0	Oct-02	Well 6
Polychlorinated biphenyls (PCBs)	ug/L	0.5			
Pentachlorophenol (PCP)	ug/L	1	< 0.5	Oct-02	Well 6
Picloram	ug/L	500	< 0.5	Oct-02	Well 6
Simazine	ug/L	4	< 0.4	Jan-03	Well 6
Styrene	ug/L	100	< 0.5	Jul-03	Well 6

** DBCP exempt in Minnesota, tested with 2.0 µg/L detection limit. (See Section 5.2.2 for details)

Table 5-1
Primary Drinking Water Quality Data
Rogers, Minnesota

ORGANIC CHEMICALS cont.

contaminant	unit	MCL	measure	date	location
Tetrachloroethylene	ug/L	5			
Toluene	ug/L	1000	< 0.2	Jul-03	Well 6
Toxaphene	ug/L	3	< 3.0	Jan-03	Well 6
2,4,5-TP (Silvex)	ug/L	50	< 0.5	Oct-02	Well 6
1,2,4-Trichlorobenzene	ug/L	70	< 0.5	Jul-03	Well 6
1,1,1-Trichloroethane	ug/L	200	< 0.2	Jul-03	Well 6
1,1,2-Trichloroethane	ug/L	5	< 0.2	Jul-03	Well 6
Trichloroethylene	ug/L	5			
Vinyl chloride	ug/L	2	< 0.5	Apr-03	Well 5
Xylenes (total)	ug/L	10000			

RADIONUCLIDES

contaminant	unit	MCL	measure	date	location
Alpha particles	pCi/L	15	4.1 - 6.3	1999-02	various
Beta particles and photon emitters	mrem/yr	4			
Radium 226/228 (combined)	pCi/L	5	1.00 - 4.0	2001-02	various
Uranium	pCi/L	45			
Radon (not yet enforced)	pCi/L	--	305 - 501	1999-02	various

N/A = Data not available
TT = Treatment Techique
Measurements in BOLD exceed the MCL

Notes:
Primary Drinking Water Regulations from USEPA (see Appendix C).
Measured data from Minnesota Department of Health.

Table 5-2
Secondary Drinking Water Quality Data
Rogers, Minnesota

contaminant	unit	SMCL	measure	date	location
Aluminum	mg/L	0.05 - 0.2			
Chloride	mg/L	250			
Color	color units	15			
Copper	mg/L	1.0	0.084	Sep-06	Well 7
Corrosivity		noncorrosive			
Fluoride	mg/L	2.0	1.1	Nov-03	distribution
Foaming agents	mg/L	0.5			
Iron *	mg/L	0.3	**0.34 - 1.098**		various
Manganese *	mg/L	0.05	**0.084 - 0.439**		various
Odor	threshold odor number	3			
pH	mg/L	6.5 - 8.5			
Silver	mg/L	0.10			
Sulfate	mg/L	250	15	Jul-02	Well 6
Total Dissolved Solids	mg/L	500			
Zinc	mg/L	5			

N/A = Data not available
Measurements in BOLD exceed the SMCL
* See Table 5-3 for levels from each well

Notes:
Secondary Drinking Water Regulations from USEPA (see Appendix C).
Measured data from Minnesota Department of Health and Pace Analytical.

Table 5-3
Iron and Manganese Concentration
Rogers, Minnesota

contaminant	unit	SMCL	Well 3	Well 4	Well 5	Well 6	Well 7
Iron (Fe)	mg/L	0.3	**0.34**	**0.430**	**0.407**	**1.098**	**0.847**
Manganese (Mn)	mg/L	0.05	**0.105**	**0.084**	**0.280**	**0.412**	**0.439**

N/A = Data not available
Measurements in BOLD exceed the SMCL

Notes:
Measured data for Wells 3-6 is a 2003 average from the City of Rogers.
Measured data for Well 7 is from 2006 Pace Analytical testing.

Table 8-1
Capital Improvement Plan
Rogers, Minnesota

THROUGH 2015		
Year	**Improvement**	**Probable Cost ***
2007	New 1,000-gpm Well 8 [4]	$750,000
2007	New SCADA System	$100,000
2008	New 1.0-MG Water Tower 3	$2,000,000
2009	New 1,000-gpm Well 9	$750,000
2010	New 1,000-gpm Well 10	$750,000
2010	New 10.0-MGD South Water Treatment Plant [1]	$8,500,000
2010	New 2.0-MG Ground Reservoir at South Plant	$1,200,000
2011	New 1,000-gpm Well 11	$750,000
2013	New 1,000-gpm Well 12	$750,000
2014	New 1,000-gpm Well 13	$750,000
2015	New 1,000-gpm Well 14	$750,000
2015	New 10.0-MGD North Water Treatment Plant [1]	$8,500,000
2015	New 2.0-MG Ground Reservoir at North Plant	$1,200,000
2007-2015	Watermain [2] :	
	6" watermain (9,428' @ $25.00/lf)	$235,700
	8" watermain (149,298' @ $30.00/lf)	$4,478,940
	10" watermain (35,307' @ $35.00/lf)	$1,235,745
	12" watermain (134,453' @ $40.00/lf)	$5,378,120
	16" watermain (14,487' @ $48.00/lf)	$695,376
	18" watermain (2,627' @ $55.00/lf)	$144,485
	30" watermain (5,841' @ $70.00/lf)	$408,870
	Total Watermain	$12,577,236
TOTAL 2007-2015		**$39,327,236**

THROUGH 2030		
Year	**Improvement**	**Probable Cost ***
2024	New 1,000-gpm Well 15	$750,000
2016-2030	Watermain [3] :	
	6" watermain (941' @ $25.00/lf)	$23,525
	8" watermain (50,829' @ $30.00/lf)	$1,524,870
	10" watermain (1,052' @ $35.00/lf)	$36,820
	12" watermain (30,092' @ $40.00/lf)	$1,203,680
	16" watermain (851' @ $48.00/lf)	$40,848
	Total Watermain	$2,829,743
TOTAL 2016-2030		**$3,579,743**
TOTAL 2007-2030		**$42,906,979**

* Estimated costs are in 2007 dollars. Add 4%/year inflation for future years. It is assumed that watermain installation in roadways will be done in conjunction with roadway construction.

Notes:
(1) Treatment Plants are centralized iron and manganese filtration removal plants
(2) Watermain includes all proposed (red) mains on Water Distribution Map - 2015 (Insert B)
(3) Watermain includes all proposed (green) mains on Water Distribution Map - 2030 (Insert C)
(4) Well 8 under construction in spring 2007

FIGURES

Figure 3-1
Historic and Projected Serviced Population
City of Rogers, Minnesota

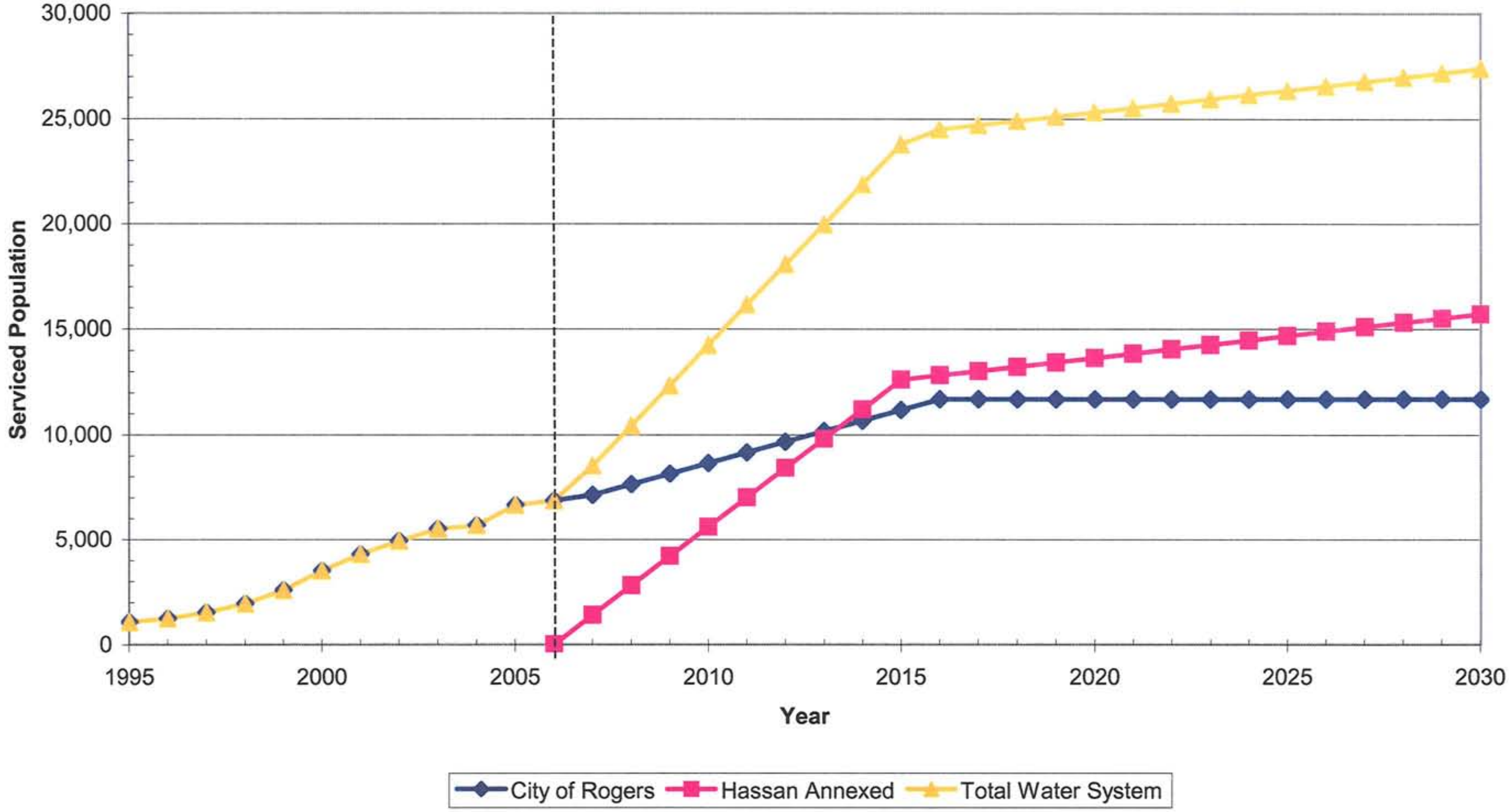


Figure 3-2
Historic and Projected Water Demands
City of Rogers, Minnesota

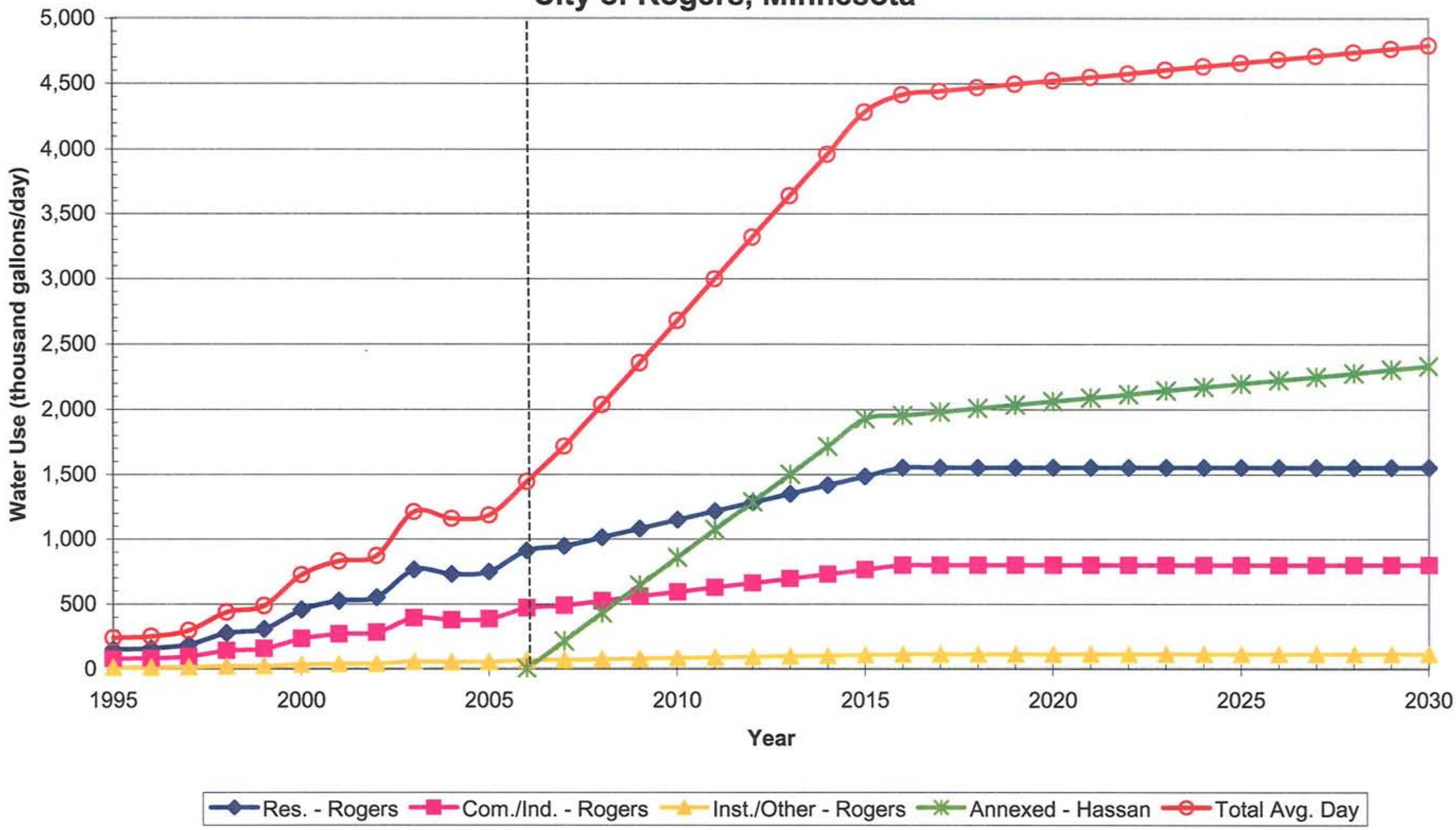


Figure 3-3
Variation of Pumpage, Serviced Population, and Residential Usage
City of Rogers, Minnesota

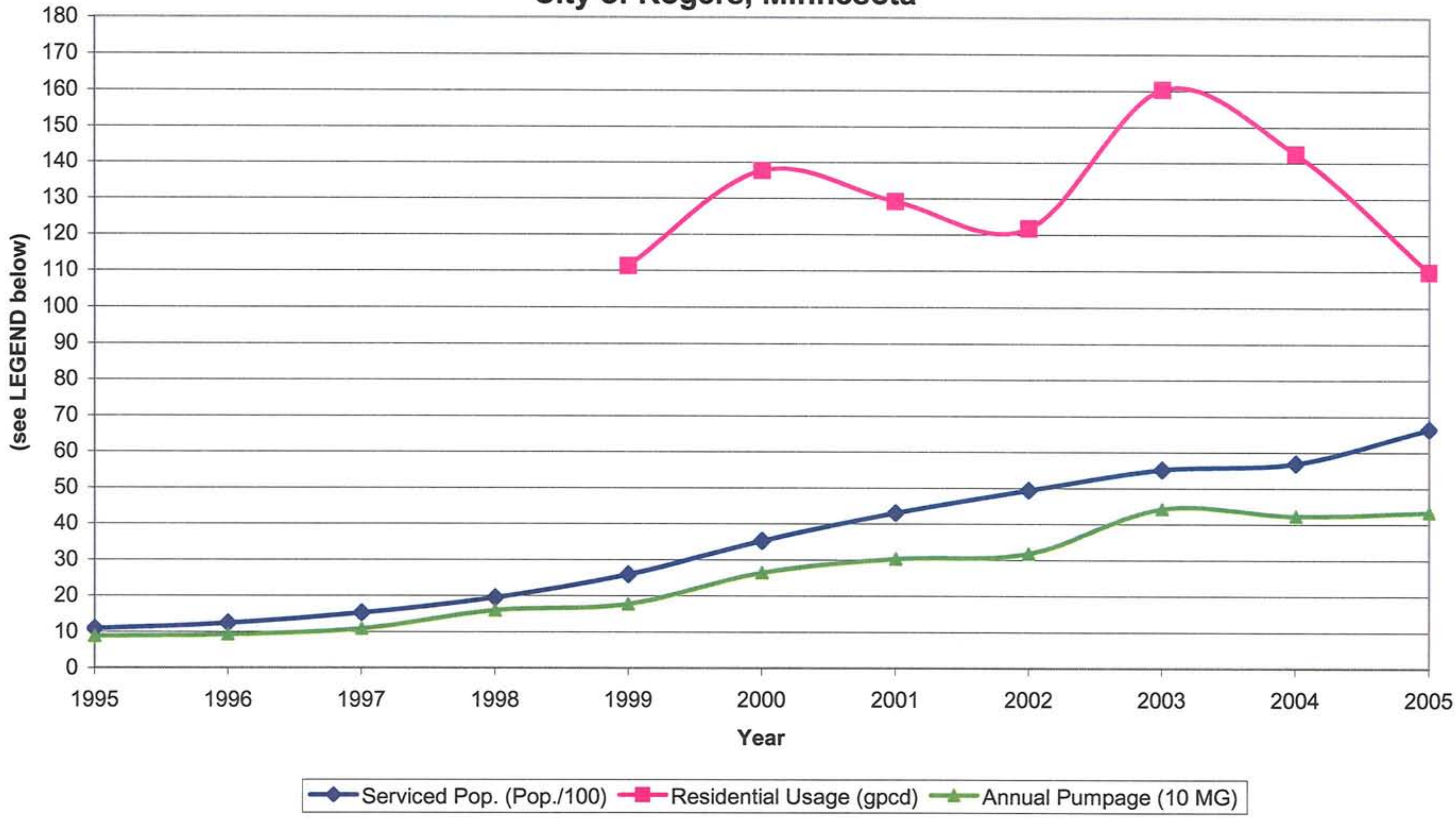


Figure 3-4
2005 Monthly Water Pumping
City of Rogers, Minnesota

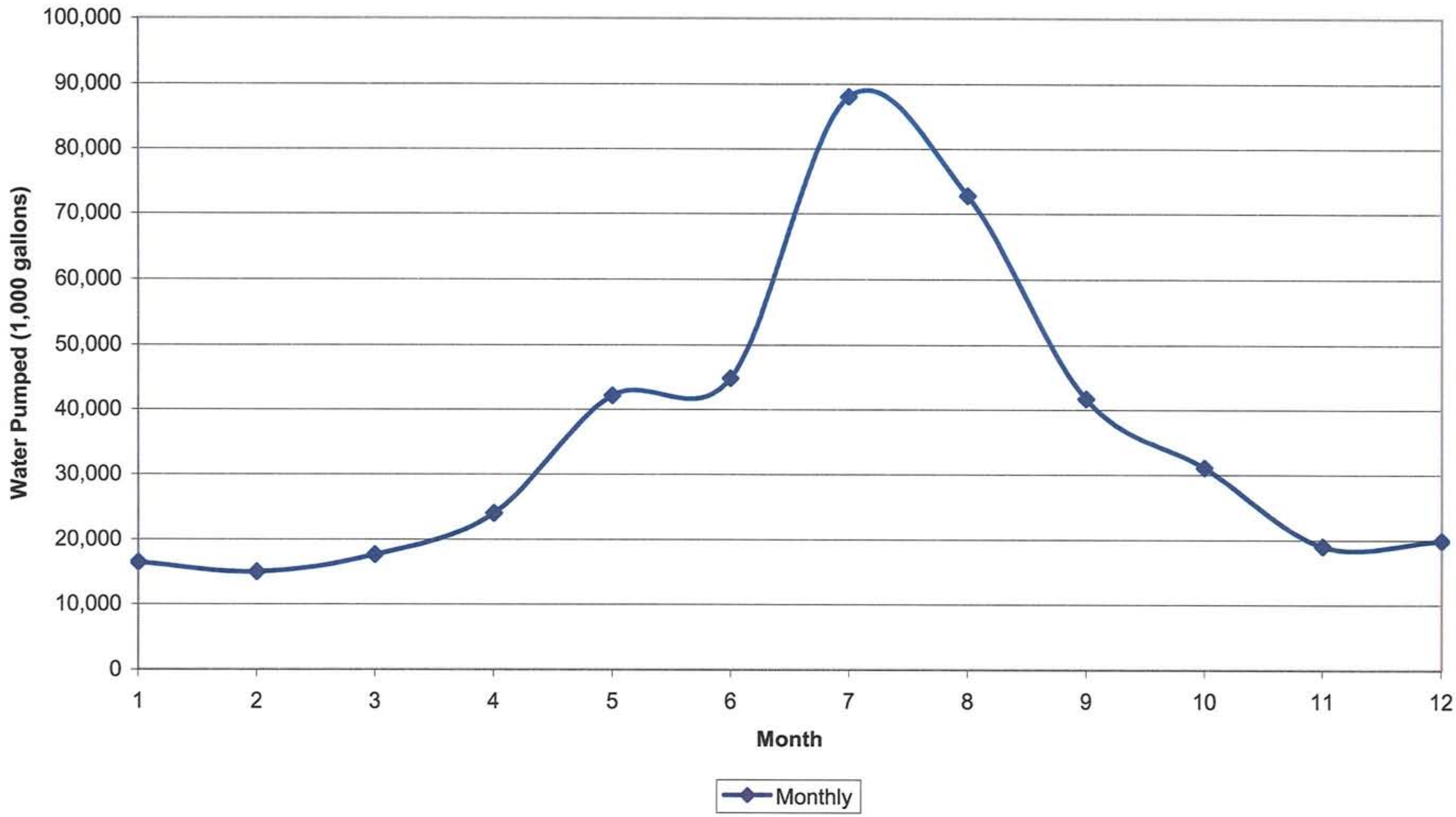


Figure 3-5
Historic and Projected Peak Water Conditions
City of Rogers, Minnesota

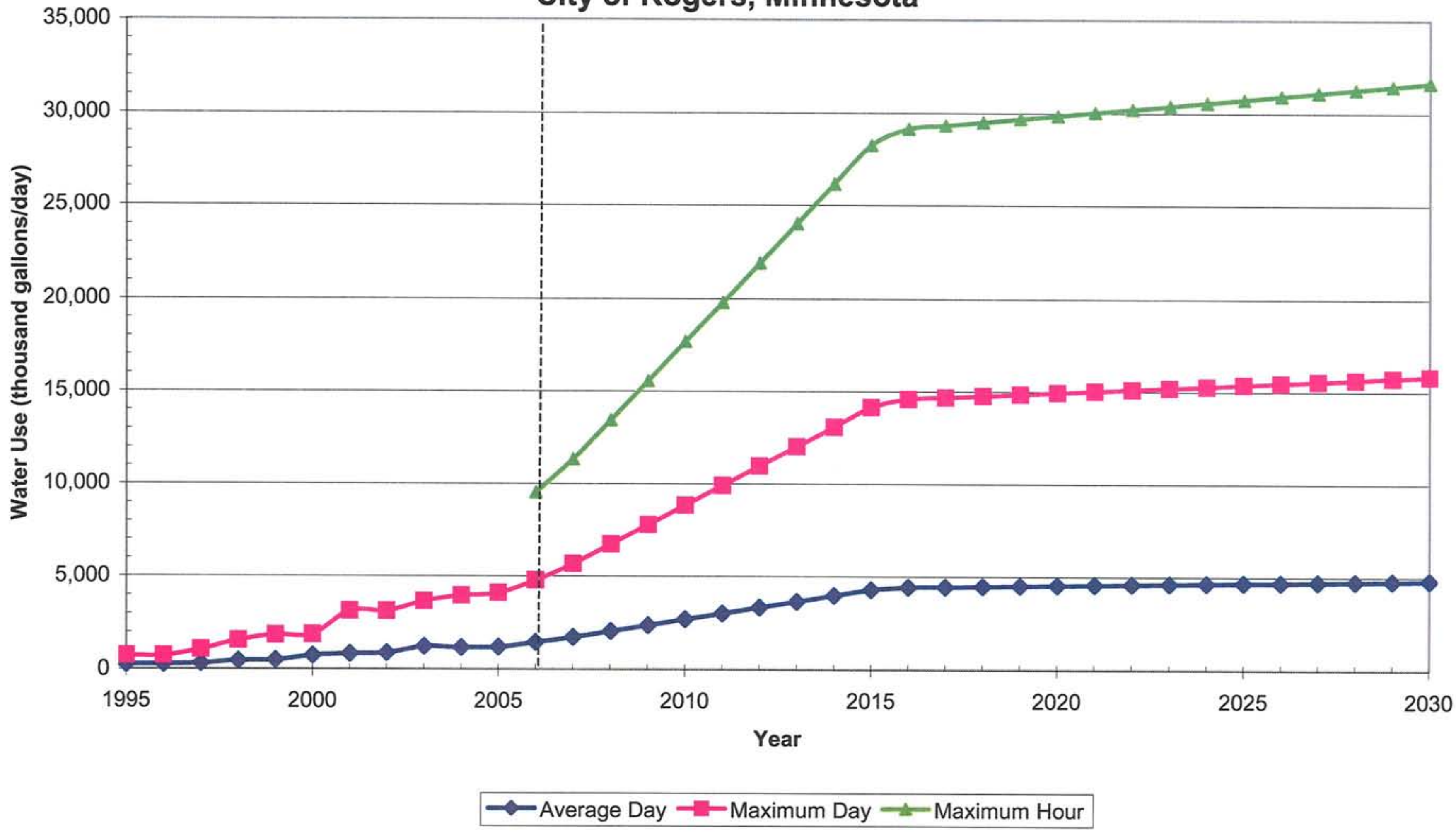


Figure 4-1a
Storage and Pumping Requirements (Without Hassan Projections)
City of Rogers, Minnesota

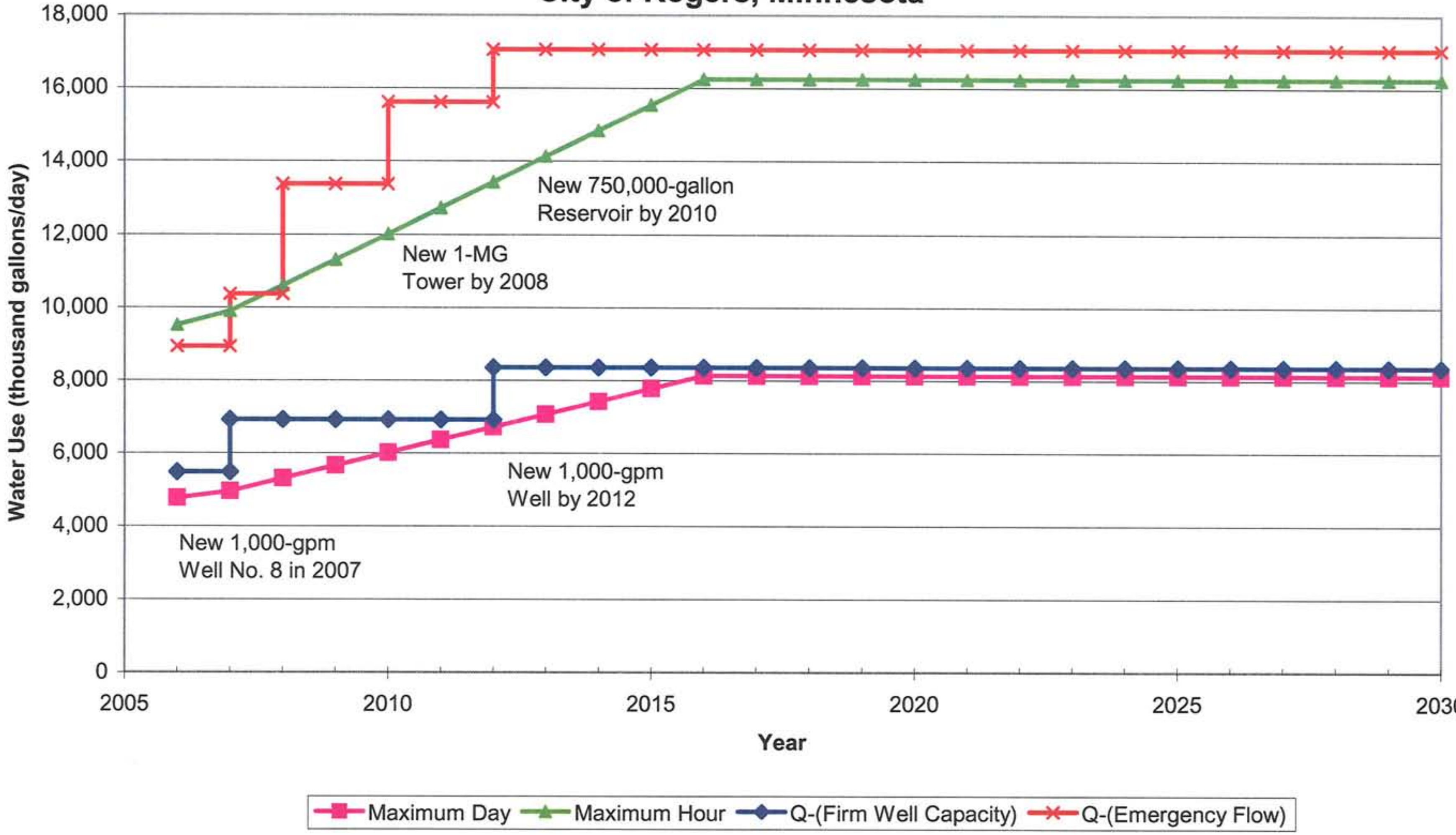


Figure 4-1b
Storage and Pumping Requirements (With Hassan Projections)
City of Rogers, Minnesota

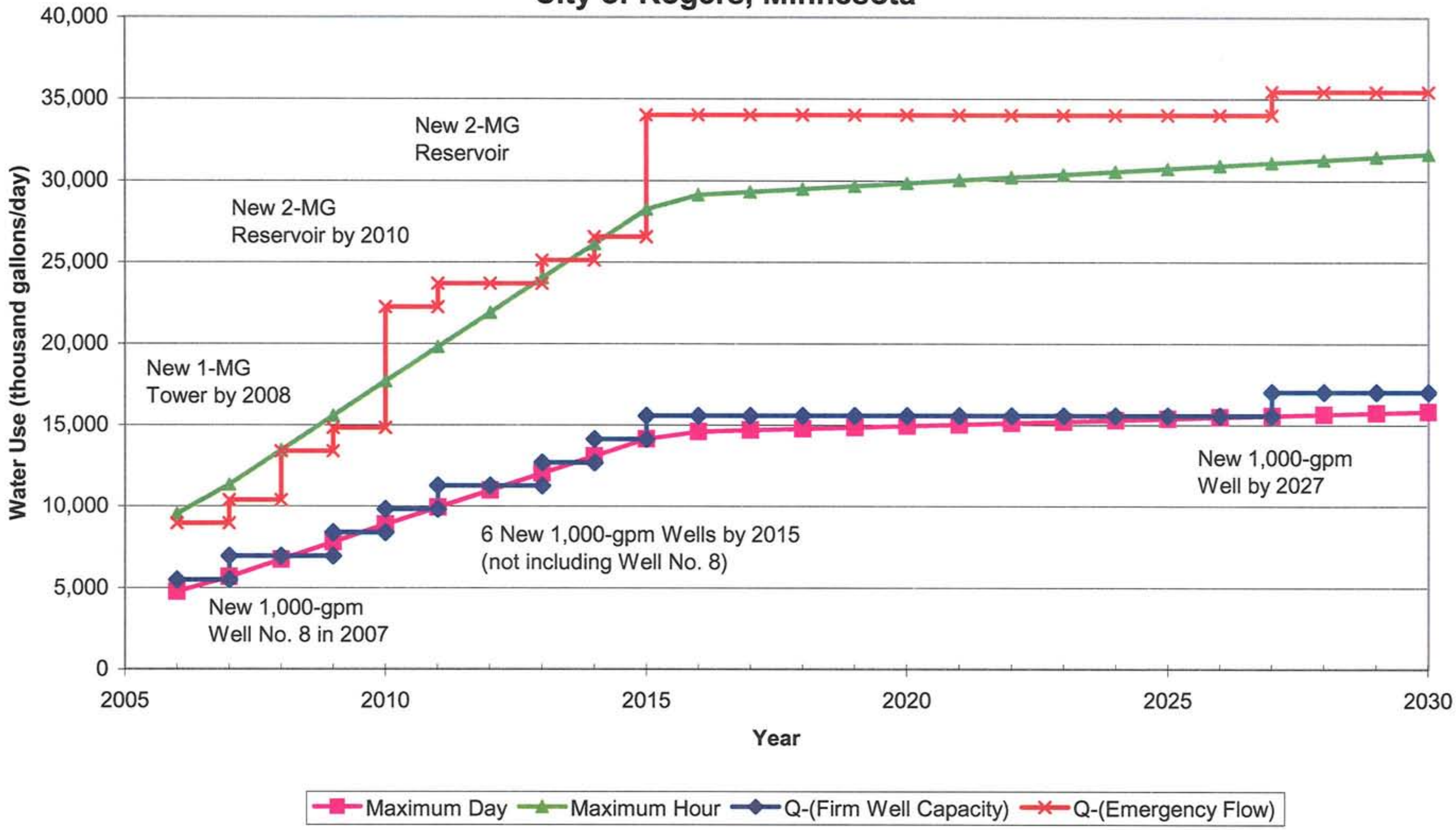


Figure 4-2
Demand Requirements Versus Serviced Population
City of Rogers, Minnesota

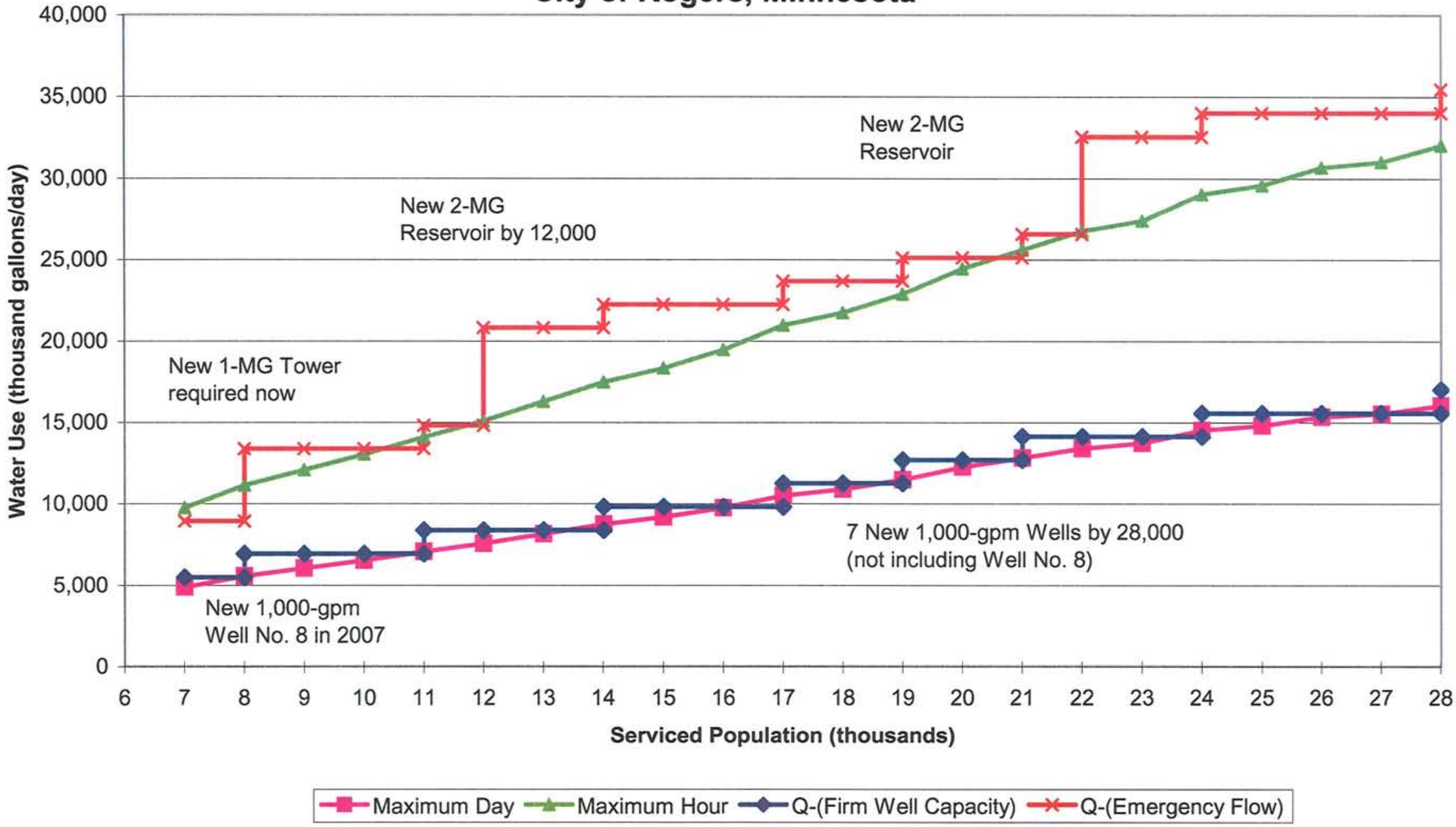
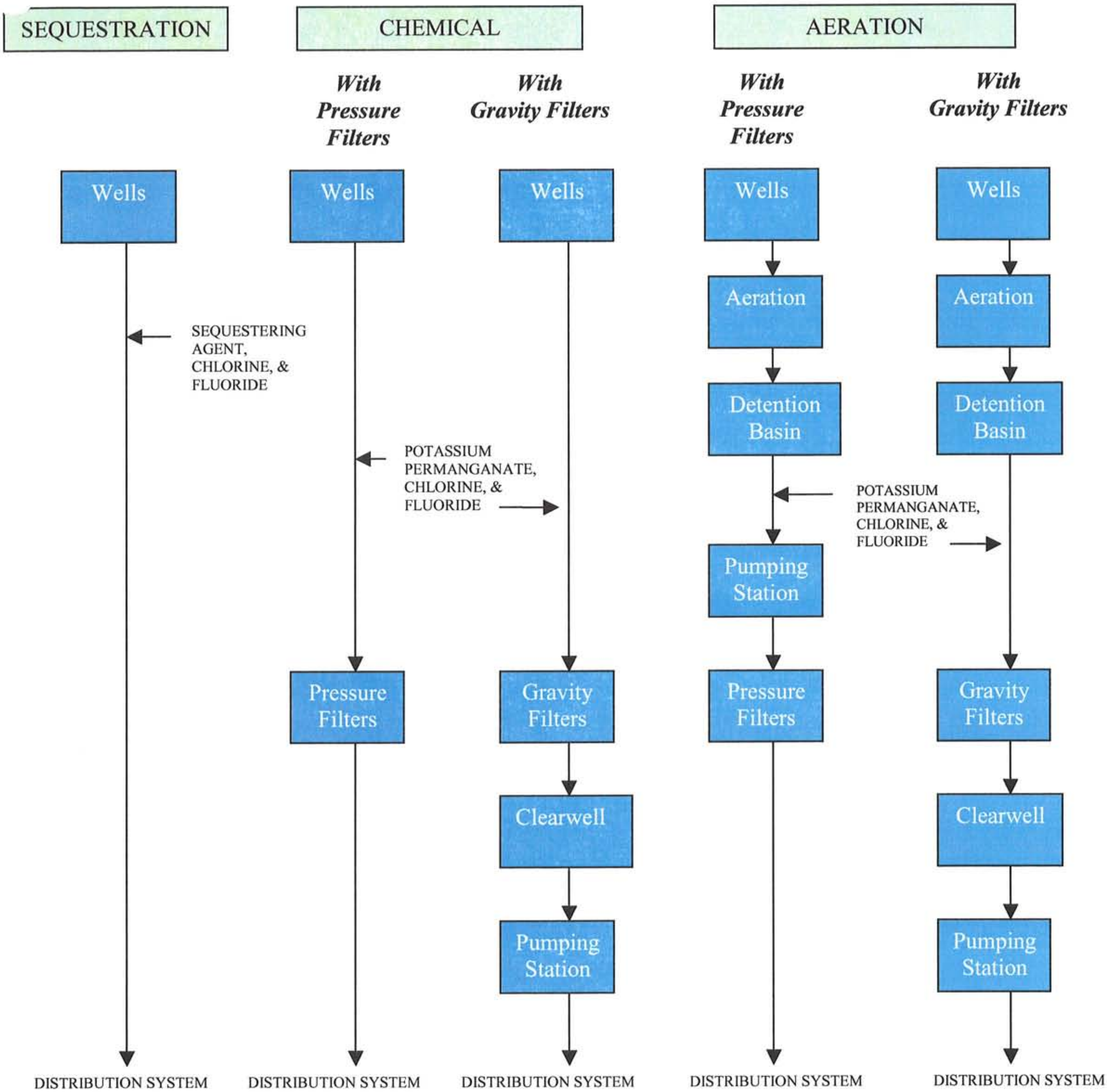


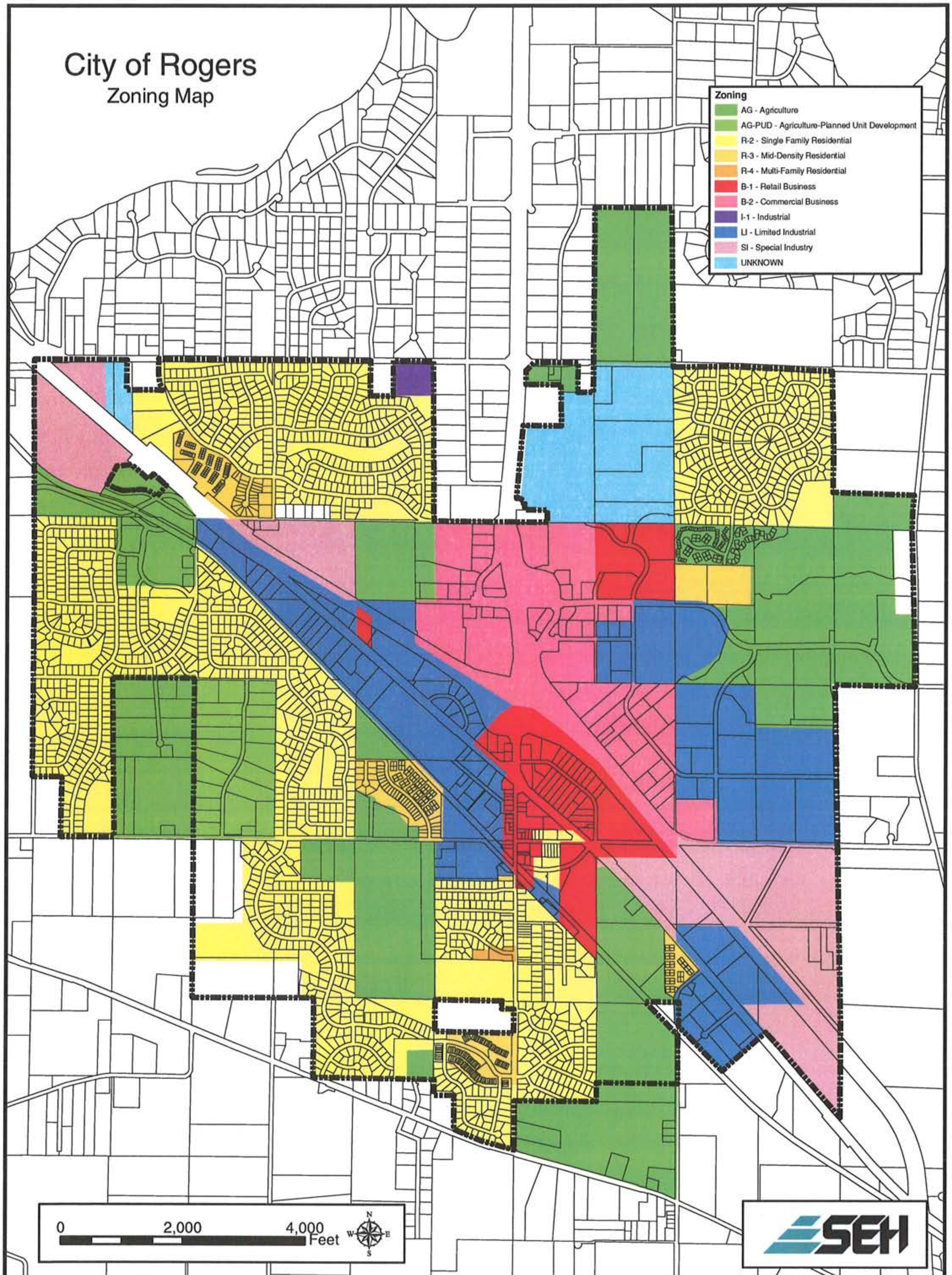
Figure 6-1
Iron and Manganese Treatment Alternatives
City of Rogers, Minnesota

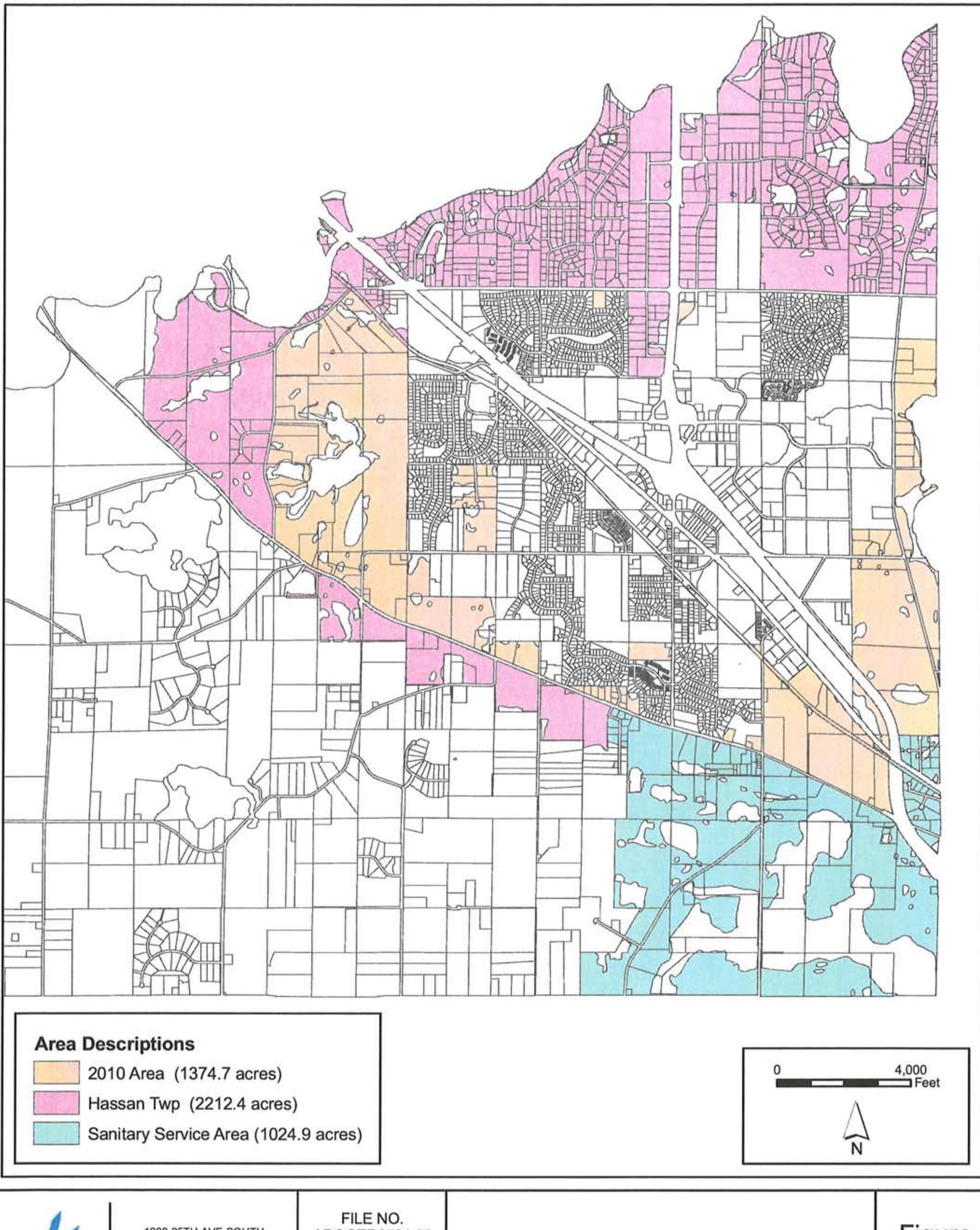


TREATMENT ALTERNATIVES

APPENDIX A

City Maps and Projected Development Data


City of Rogers
Zoning Map
Zoning
AG - Agriculture
AG-PUD - Agriculture-Planned Unit Development
R-2 - Single Family Residential
R-3 - Mid-Density Residential
R-4 - Multi-Family Residential
B-1 - Retail Business
B-2 - Commercial Business
I-1 - Industrial
LI - Limited Industrial
SI - Special Industry
UNKNOWN
0
2,000
4,000
Feet
N
S
E
W
SEH



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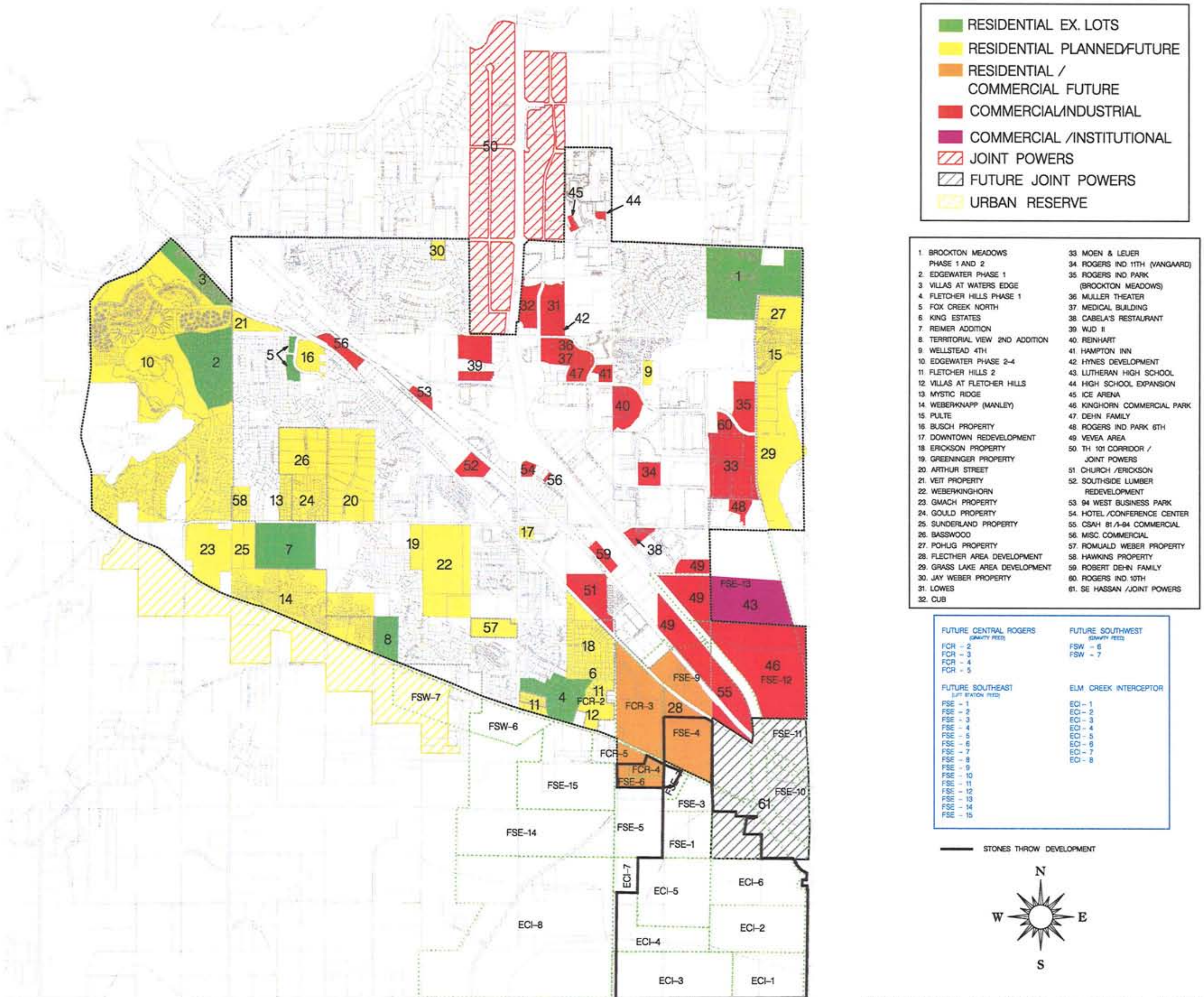
AROGER0701.00

DATE:
09/13/06

Developable Land in Hassan Township
Rogers, Minnesota

Figure
1



SANITARY SEWER SERVICE AREA
ROGERS, MINNESOTA

SEH

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SEH

Sanitary Sewer Flow Generation
Rogers, MN
A-ROGER 0623

08/22/06

EXHIBIT B
PROJECTED FLOWS

Existing Lots

	Development Name	Lots Available Single Family	Lots Available Multi-Family	Single Family (274 gpd/HH)	Multi-Family (220/HH)	Subtotal	Year	Buildout
1	Brockton Meadows 1st and 2nd	118	64	32,332	14,080	46,412	2006-2009	4
2	Edgewater (phase 1)	165	48	45,210	10,560	55,770	2006-2009	4
3	Villas @ Watersedge	0	76	0	16,720	16,720	2006-2009	4
4	Fletcher Hills (phase 1)	76	0	20,824	0	20,824	2006-2009	4
5	Fox Creek North	16	0	4,384	0	4,384	2007	1
6	King Estates	18	0	4,932	0	4,932	2006-2007	2
7	Reimer Addition	79	46	21,646	10,120	31,766	2006-2009	4
8	Territorial View 2nd Addition	25	0	6,850	0	6,850	2007-2009	3
	Total	**497**	**234**	**136,178**	**51,480**	187,658		

Planned Developments

	Development Name	Lots Available Single Family	Lots Available Multi-Family	Single Family (274 gpd/HH)	Multi-Family (220/HH)	Subtotal	Year	Buildout
10	Edgewater (phase 2-4)	404	552	110,696	121,440	232,136	2008-1012	5
11	Fletcher Hills (phase 2)	25	0	6,850	0	6,850	2007-2009	3
12	Villas @ Fletcher Hills	0	34	0	7,480	7,480	2007-2009	3
13	Mystic Ridge	23	0	6,302	0	6,302	2007-2009	3
14	Weber/Knapp (Manley)	212	0	58,088	0	58,088	2009-2012	4
15	Pulte	70	0	19,180	0	19,180	2008-2012	4
	Total	**734**	**586**	**201,116**	**128,920**	330,036		

Future Residential Areas - Served

	Development Name	Planned Single Family	Planned Multi-Family	Single Family (274 gpd/HH)	Multi-Family (220/HH)	Subtotal	Year	Buildout
9	Wellstead 4th	0	40	0	8,800	8,800	2008-2010	3
16	Busch Property	0	40	0	8,800	8,800	2010-2011	2
17	Downtown Redevelopment	0	55	0	12,100	12,100	2012-2013	2
18	Erickson Property	77	60	21,098	13,200	34,298	2012-2013	2
19	Greeninger Property	11	0	3,014	0	3,014	2010	1
20	Arthur Street	20	0	5,480	0	5,480	2015	1
21	Veit Property	0	30	0	6,600	6,600	2016	1
22	Weber/Kinghorn	133	0	36,442	0	36,442	2012-2013	2
23	Gmach Property	86	0	23,564	0	23,564	2010-2011	2
24	Gould Property	58	0	15,892	0	15,892	2010-2011	2
25	Sunderland Property	40	0	10,960	0	10,960	2010-2011	2
26	Basswood	12	0	3,288	0	3,288	2015	1
27	Pohlig Property	37	0	10,138	0	10,138	2016	1
28	Fletcher Area Development	0	10.6	0	2,332	2,332	2010-2011	2
29	Grass Lake Area Development	105	50	28,770	11,000	39,770	2012-2013	2
30	Weber	0	15	0	3,300	3,300	2015	1
FSE-4	In Annexation Area		261	0	57,420	57,420	2012-2013	2
FSE-6	In Annexation Area	36		9,864	0	9,864	2016	1
FCR-4	In Annexation Area	32	4	8,768	880	9,648	2017	1
FCR-5	Half in Annexation Area	24	6	6,576	1,320	7,896	2018	1
	Total	**671**	**571.6**	**183,854**	**125,752**	309,606		

Future Institutional Areas

	Development Name	Planned Single Family	Planned Multi-Family	Subtotal	Year	Buildout
43	Lutheran High School	500	20gal/student	10,000	2012-2013	2

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EXHIBIT B
PROJECTED FLOWS

	Commercial Developments						
	Development Name	Acreage	Square Feet Bld	SAC WH (7,000sf) Office (2,400sf)	Flows	Year	Buildout
31	Lowes	15.9	155,836	33	9,023	2006	1
32	Cub	12.9	126,433	27	7,320	2006	1
33	Moen & Leur	53	519,453	110	30,076	2008	1
34	Roger Industrial (Vangaard)	2.2	21,562	5	1,248	2007	1
35	Roger Industrial Park (Brockton Meadows	17.1	167,597	35	9,704	2009	1
36	Muller Theater	12	117,612	25	6,810	2006	1
37	Medical Building	3	29,403	6	1,702	2008	1
38	Cabelas Restaurant	1.6	15,682	3	908	2006	1
39	WJD II	20	196,020	41	11,349	2008	1
40	Reinhart	18.7	183,279	39	10,612	2006	1
41	Hampton Inn	4.7	46,065	10	2,667	2006	1
42	Hynes Development	5.4	52,925	11	3,064	2008	1
44	High School Expansion	500 students	20gal/student		10,000	2008	1
45	Ice Arena	1.6	600 seats		4,000	2007	1
46	Kinghorn Industrial/Commercial Park	2.8	27,443	6	1,589	2009	1
47	Dehn Family	6.5	63,707	13	3,689	2008	1
48	Rogers Ind. Park 6th	6	58,806	12	3,405	2009	1
49	Vevea Area	32.7	320,493	68	18,556	2009	1
50	Th 101 Corridor	300	600gal/acre		180,000	2014-2020	7
51	Church/Erickson	24.3	238,164	50	13,789	2015	1
52	Southside Lumber Redevelopment	9.4	92,129	19	5,334	2015	1
53	94 West Business Park	4.3	42,144	9	2,440	2015	1
54	Hotel/Conference Center	3.3	32,343	7	1,873	2015	1
	CSAH 81/I-94 Commercial						
FSE-9	In Annexation Area	100	980,002	207	56,741	2012-2015	4
FSE-12	In Annexation Area	33	326,667	69	18,914	2012-2013	2
FCR-3	In Annexation Area	68	668,722	141	38,718	2012-2013	2
	Total	**459**			**453,531**		

HASSAN TOWNSHIP

				Township Method			City Method		
		Planned Units							
	Residential	Single Family	Multi-Family	Single Family (274 gpd/HH)	Multi-Family (274/HH)	**Subtotal**	Single Family (274 gpd/HH)	Multi-Family (220/HH)	Subtotal
ECI-1			318	0	87,132	60,992	0	69960	87,132
ECI-3		188		51,512	0	51,512	51512	0	51,512
ECI-4			0	0	0	0	0	0	0
ECI-5			264	0	72,336	72,336	0	58080	72,336
ECI-7		15	4	4,110	1,096	5,027	4110	880	5,206
ECI-8		541	135	148,234	36,990	177,749	148234	29700	185,224
							0	0	
FSE-1		103	0	28,222	0	28,222	28222	0	28,222
FSE-2			183	0	50,142	50,142	0	40260	50,142
FSE-3		43		11,782	0	11,782	11782	0	11,782
FSE-5		85	21	23,290	5,754	29,091	23290	4620	29,044
FSE-7		25	6	6,850	1,644	8,598	6850	1320	8,494
FSE-8		38	9	10,412	2,466	12,453	10412	1980	12,878
FSE-14		284	71	77,816	19,454	97,128	77816	15620	97,270
FSE-15		209	52	57,266	14,248	71,752	57266	11440	71,514
							0	0	
FSW-6		89	22	24,386	6,028	29,142	24386	4840	30,414
FSW-7		91	23	24,934	6,302	29,821	24934	5060	31,236
	Total					**735,747**			**772,406**

		Township Method			City Method			
	Commercial	Acreage	Square Feet Bld	Subtotal	Acreage	Square Feet Bld	SAC WH (7,000sf)	Flow
ECI-2		43.57	531,415	43,576	78.31	767516	162	44,438
ECI-6		52.43	639,478	52,437	73.91	724392	153	41,941
FCR-5		8.29	101,111	4,704	8.29	81250	17	4,704
FSE-8		7.82	95,379	7,757	13.67	133980	28	7,757
FSE-10		32.70	398,835	32,704	40.22	394196	83	22,823
FSE-11		22.17	270,403	22,173	30.56	299519	63	17,342
FSE-13		60.39	736,565	60,398	149	1460349	309	84,552
	Total			**223,750**				**223,559**

	Township	**Rogers**
Total Served Flow	1,280,831	1,280,831
Misc. Commercial	100,000	100,000
Total Unserved Flow	10,000	10,000
Hassan Township	959,496	995,965
Total	2,350,327	2,386,796

Sanitary Sewer Flow Generation
Rogers, MN
A-ROGER 0623

08/22/06

EXHIBIT B
PROJECTED FLOWS

Estimated buildout rate for development projects per year.(non-sewered not included)

Year	Flow
2006	82,678
2007	64,132
2008	166,069
2009	153,965
2010	102,466
2011	96,518
2012	193,965
2013	133,016
2014	39,900
2015	75,404
2016	52,316
2017	35,362
2018	33,610
2019	25,714
2020	25,714
	1,280,831

SAC determination
85% Impervious - 30% Building - 75/25
75 - Warehouse 1 SAC/7,000 SF
25 - Office 1 SAC/2,000SF

Notes:
Metro flow numbers for Hassan Township are based on "StonesThrowConceptSewerFlows-JcJ_Rev3_8-9-06.xls" From Metro LS &CE

Rogers flow numbers for Hassan Township are based on the "StonesThrowConceptSewerFlows-JcJ_Rev3_8-9-06.xls" for the following:
Residential flow numbers from concept layouts of Stone Throw development projected units times 274 gallons
Commercial flow numbers calculated from total land per area times the met council calculation.

Stones Throw Water Needs
9/1/2006

Sewer Service Area	San Flow (gpd)	Water Flow (gpd)	Start Construction	Final Absorption
FSE-1	36,252	43,502	2007	2009
FSE-2	50,304	60,365	2008	2011
FSE-3	16,986	20,383	2007	2008
FSE-4	71,040	85,248	2007	2010
FSE-6	9,120	10,944	2007	2008
FCR-4	7,980	9,576	2007	2008
ECI-1	61,065	73,278	2010	2012
ECI-2	43,570	52,284	2010	2013
ECI-3	52,640	63,168	2009	2013
ECI-4	0	0	2008	2008
ECI-5	48,280	57,936	2008	2012
ECI-6	52,430	62,916	2010	2013

* All flows are average daily flows per Township report

Anticipated Absorption Table							
2007	2008	2009	2010	2011	2012	2013	
21,751	10,876	10,876					
	30,182	10,061	10,061	10,061			
10,192	10,192						
42,624	14,208	14,208	14,208				
5,472	5,472						
4,788	4,788						
			36,639	18,320	18,320		
			26,142	8,714	8,714	8,714	
			31,584	10,528	10,528	10,528	
	0						
		28,968	9,656	9,656	9,656		
			31,458	10,486	10,486	10,486	
84,827	75,718	64,112	159,748	67,764	57,704	29,728	Inc.
84,827	160,544	224,657	384,405	452,169	509,872	539,600	Cum.
254,480	481,633	673,970	1,153,214	1,356,507	1,529,617	1,618,801	Peak(3.0)

* Anticipated absorption is 50% in the first year and remainder is equally divided over remaining years.

Total by Construction Start Date

Year	Inc.	Cum.
2007	169,654	169,654
2008	118,301	287,954
2009	63,168	351,122
2010	188,478	539,600

Total by Final Absorption Date

Year	Inc.	Cum.
2008	40,903	40,903
2009	43,502	84,406
2010	85,248	169,654
2011	60,365	230,018
2012	131,214	361,232
2013	178,368	539,600

APPENDIX B

Population and Design Flow Projection Calculations

APPENDIX B
Facility Requirements Worksheet

2006 FACILITIES:

Well No.	Capacity (gpm)
3	800
4	1,000
5	1,000
6	1,000
7	1,000
Total	4,800

Largest Well Capacity = 1,000 gpm

Firm Well Capacity = Total - Largest = **3,800 gpm = 5,472,000 gal/day**

Tower	Gallons	Added Emergency Capacity from Elevated Storage ** (gpm)
East	400,000	833
Central	750,000	1,563
Total	1,150,000	2,396

** Assumes that 1/2 of the storage volume could be made available over the duration of a 4-hour emergency.

Thus, **Total Emerg Contribution** = Tower Contribution = Total

= 2,396 = **2,396 gpm**

3,450,000 gal/day

Emergency Capacity = Firm Well Capacity + Added Emergency Capacity

Emergency Capacity = 3,800 + **2,396** = **6,196 gpm**

= **8,922,000 gal/day**

WITH HASSAN PROJECTIONS (B tables)

Year	Added Well Capacity (gpm)	Added Storage (gal)	Total Well Capacity (gpm)	Largest Well (gpm)	Added Emerg Cap (gpm)	Firm Well Capacity (gal/day)	Emerg Capacity (gal/day)
2005	0	0	4,800	1,000	2,396	5,472,000	8,922,000
2006			4,800	1,000	2,396	5,472,000	8,922,000
2007	1,000		5,800	1,000	2,396	6,912,000	10,362,000
2008		1,000,000	5,800	1,000	4,479	6,912,000	13,362,000
2009	1,000		6,800	1,000	4,479	8,352,000	14,802,000
2010	1,000	2,000,000	7,800	1,000	8,646	9,792,000	22,242,000
2011	1,000		8,800	1,000	8,646	11,232,000	23,682,000
2012			8,800	1,000	8,646	11,232,000	23,682,000
2013	1,000		9,800	1,000	8,646	12,672,000	25,122,000
2014	1,000		10,800	1,000	8,646	14,112,000	26,562,000
2015	1,000	2,000,000	11,800	1,000	12,813	15,552,000	34,002,000
2016			11,800	1,000	12,813	15,552,000	34,002,000
2017			11,800	1,000	12,813	15,552,000	34,002,000
2018			11,800	1,000	12,813	15,552,000	34,002,000
2019			11,800	1,000	12,813	15,552,000	34,002,000
2020			11,800	1,000	12,813	15,552,000	34,002,000
2021			11,800	1,000	12,813	15,552,000	34,002,000
2022			11,800	1,000	12,813	15,552,000	34,002,000
2023			11,800	1,000	12,813	15,552,000	34,002,000
2024			11,800	1,000	12,813	15,552,000	34,002,000
2025			11,800	1,000	12,813	15,552,000	34,002,000
2026			11,800	1,000	12,813	15,552,000	34,002,000
2027	1,000		12,800	1,000	12,813	16,992,000	35,442,000

2028			12,800	1,000	12,813	16,992,000	35,442,000
2029			12,800	1,000	12,813	16,992,000	35,442,000
2030			12,800	1,000	12,813	16,992,000	35,442,000

WITHOUT HASSAN PROJECTIONS (A tables)

Year	Added Well Capacity (gpm)	Added Storage (gal)	Total Well Capacity (gpm)	Largest Well (gpm)	Added Emerg Cap (gpm)	Firm Well Capacity (gal/day)	Emerg Capacity (gal/day)
2005	0	0	4,800	1,000	2,396	5,472,000	8,922,000
2006			4,800	1,000	2,396	5,472,000	8,922,000
2007	1,000		5,800	1,000	2,396	6,912,000	10,362,000
2008		1,000,000	5,800	1,000	4,479	6,912,000	13,362,000
2009			5,800	1,000	4,479	6,912,000	13,362,000
2010		750,000	5,800	1,000	6,042	6,912,000	15,612,000
2011			5,800	1,000	6,042	6,912,000	15,612,000
2012	1,000		6,800	1,000	6,042	8,352,000	17,052,000
2013			6,800	1,000	6,042	8,352,000	17,052,000
2014			6,800	1,000	6,042	8,352,000	17,052,000
2015			6,800	1,000	6,042	8,352,000	17,052,000
2016			6,800	1,000	6,042	8,352,000	17,052,000
2017			6,800	1,000	6,042	8,352,000	17,052,000
2018			6,800	1,000	6,042	8,352,000	17,052,000
2019			6,800	1,000	6,042	8,352,000	17,052,000
2020			6,800	1,000	6,042	8,352,000	17,052,000
2021			6,800	1,000	6,042	8,352,000	17,052,000
2022			6,800	1,000	6,042	8,352,000	17,052,000
2023			6,800	1,000	6,042	8,352,000	17,052,000
2024			6,800	1,000	6,042	8,352,000	17,052,000
2025			6,800	1,000	6,042	8,352,000	17,052,000
2026			6,800	1,000	6,042	8,352,000	17,052,000
2027			6,800	1,000	6,042	8,352,000	17,052,000
2028			6,800	1,000	6,042	8,352,000	17,052,000
2029			6,800	1,000	6,042	8,352,000	17,052,000
2030			6,800	1,000	6,042	8,352,000	17,052,000

DEMAND VS. POPULATION PROJECTIONS (Table 4-3)

Serviced Pop	Added Well Capacity (gpm)	Added Storage (gal)	Total Well Capacity (gpm)	Largest Well (gpm)	Added Emerg Cap (gpm)	Firm Well Capacity (gal/day)	Emerg Capacity (gal/day)
6,000+	0	0	4,800	1,000	2,396	5,472,000	8,922,000
7,000			4,800	1,000	2,396	5,472,000	8,922,000
8,000	1,000	1,000,000	5,800	1,000	4,479	6,912,000	13,362,000
9,000			5,800	1,000	4,479	6,912,000	13,362,000
10,000			5,800	1,000	4,479	6,912,000	13,362,000
11,000	1,000		6,800	1,000	4,479	8,352,000	14,802,000
12,000		2,000,000	6,800	1,000	8,646	8,352,000	20,802,000
13,000			6,800	1,000	8,646	8,352,000	20,802,000
14,000	1,000		7,800	1,000	8,646	9,792,000	22,242,000
15,000			7,800	1,000	8,646	9,792,000	22,242,000
16,000			7,800	1,000	8,646	9,792,000	22,242,000
17,000	1,000		8,800	1,000	8,646	11,232,000	23,682,000
18,000			8,800	1,000	8,646	11,232,000	23,682,000
19,000	1,000		9,800	1,000	8,646	12,672,000	25,122,000
20,000			9,800	1,000	8,646	12,672,000	25,122,000
21,000	1,000		10,800	1,000	8,646	14,112,000	26,562,000
22,000		2,000,000	10,800	1,000	12,813	14,112,000	32,562,000
23,000			10,800	1,000	12,813	14,112,000	32,562,000
24,000	1,000		11,800	1,000	12,813	15,552,000	34,002,000
25,000			11,800	1,000	12,813	15,552,000	34,002,000
26,000			11,800	1,000	12,813	15,552,000	34,002,000
27,000			11,800	1,000	12,813	15,552,000	34,002,000
28,000	1,000		12,800	1,000	12,813	16,992,000	35,442,000

APPENDIX B
Design Flows Calculations for Table 3-8

Year	Pop Served	Res. GPD	Res. GPCD		Res.	Com/Ind.	Inst.	Unac.	Ave. Day	
					61.6%	31.7%	4.5%	2.2%	100.0%	actual 2005
										w/o unac.
					63.0%	32.4%	4.7%	0.0%	100.0%	(Table 3-8)
										design
					61.7%	31.7%	4.6%	2.000%	100.0%	(2% unac.)
					266,120	136,760	19,629	8,622	431,131	calc (1k gal)
					271,499	139,552	20,079	0	431,131	w/o unac.
					63.0%	32.4%	4.7%	0.0%	100.0%	w/o unac.
1995	1,075	--	--							
1996	1,235	--	--							
1997	1,522	--	--							
1998	1,946	--	--	exact res. %					check	
1999	2,588	288,049	111.3	0.6173					1,181	calc 2005 (1k gal)
2000	3,513	483,452	137.6						1,184	actual 2005
2001	4,295	554,803	129.2							
2002	4,935	600,488	121.7							
2003	5,505	882,274	160.3							
2004	5,685	810,071	142.5	check	GPD	GPD	GPD		GPD	
2005	6,641	729,096	109.8	1,181,181	743,834	382,336	55,011		1,181,181	calc (don't use)
2006	6,849	890,357	130.0	1,442,434	908,355	466,900	67,179		1,442,434	
2007	7,119	925,457	130.0	1,499,298	944,165	485,307	69,827		1,499,298	
2008	7,627	991,445	130.0	1,606,203	1,011,487	519,911	74,806		1,606,203	
2009	8,134	1,057,433	130.0	1,713,108	1,078,809	554,514	79,785		1,713,108	
2010	8,642	1,123,421	130.0	1,820,012	1,146,130	589,118	84,763		1,820,012	
2011	9,149	1,189,409	130.0	1,926,917	1,213,452	623,722	89,742		1,926,917	
2012	9,657	1,255,397	130.0	2,033,822	1,280,774	658,326	94,721		2,033,822	
2013	10,165	1,321,385	130.0	2,140,726	1,348,096	692,930	99,700		2,140,726	
2014	10,672	1,387,373	130.0	2,247,631	1,415,418	727,534	104,679		2,247,631	
2015	11,180	1,453,361	130.0	2,354,536	1,482,740	762,138	109,658		2,354,536	
2016	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2017	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2018	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2019	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2020	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2021	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2022	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2023	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2024	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2025	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2026	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2027	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2028	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2029	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	
2030	11,687	1,519,349	130.0	2,461,440	1,550,062	796,742	114,637		2,461,440	

APPENDIX B
Calculations for Figure 3-3

Year	Estimated Serviced Population *	(Pop./100)	Annual Pumped Water (thousand gallons)	(10 MG)	Residential Usage per Capita per Day (gpcd)	(gpcd)
1995	1075	**10.75**	87227.0	**8.7227**	--	
1996	1235	**12.35**	91759.0	**9.1759**	--	
1997	1522	**15.22**	108185.0	**10.8185**	--	
1998	1946	**19.46**	159396.0	**15.9396**	--	
1999	2588	**25.88**	176958.0	**17.6958**	111.3	**111.3**
2000	3513	**35.13**	263920.0	**26.392**	137.6	**137.6**
2001	4295	**42.95**	302482.0	**30.2482**	129.2	**129.2**
2002	4935	**49.35**	317824.0	**31.7824**	121.7	**121.7**
2003	5505	**55.05**	441863.0	**44.1863**	160.3	**160.3**
2004	5685	**56.85**	422115.0	**42.2115**	142.5	**142.5**
2005	6641	**66.41**	432102.0	**43.2102**	109.8	**109.8**

APPENDIX B
Demand per Population Calculations for Table 4-3 and Figure 4-2

Projection Info from Tables 3-1 and 3-8

Year	Avg Day Demand Projections (thousand gal/day)					Serviced Population Projections		
	Rogers	%	Hassan	%	Total	Rogers	%	Total
2006	1,442	1	0	0	1,442	6,849	1	6,849
2007	1,499	0.8750138	214	0.1249862	1,713	7,119	0.835583	8,520
2008	1,606	0.7894752	428	0.2105248	2,035	7,627	0.731344	10,428
2009	1,713	0.7272542	642	0.2727458	2,356	8,134	0.659356	12,336
2010	1,820	0.6799601	857	0.3200399	2,677	8,642	0.606656	14,245
2011	1,927	0.6427965	1,071	0.3572035	2,998	9,149	0.566408	16,153
2012	2,034	0.6128235	1,285	0.3871765	3,319	9,657	0.534666	18,062
2013	2,141	0.5881383	1,499	0.4118617	3,640	10,165	0.50899	19,970
2014	2,248	0.5674549	1,713	0.4325451	3,961	10,672	0.487793	21,878
2015	2,355	0.5498732	1,927	0.4501268	4,282	11,180	0.469998	23,787
2016	2,461	0.5574233	1,954	0.4425767	4,416	11,687	0.477011	24,501
2017	2,461	0.5540505	1,981	0.4459495	4,443	11,687	0.473019	24,708
2018	2,461	0.5507183	2,008	0.4492817	4,470	11,687	0.469093	24,915
2019	2,461	0.5474259	2,035	0.4525741	4,496	11,687	0.465231	25,122
2020	2,461	0.5441727	2,062	0.4558273	4,523	11,687	0.461432	25,328
2021	2,461	0.5409579	2,089	0.4590421	4,550	11,687	0.457695	25,535
2022	2,461	0.5377808	2,116	0.4622192	4,577	11,687	0.454019	25,742
2023	2,461	0.5346409	2,142	0.4653591	4,604	11,687	0.4504	25,949
2024	2,461	0.5315374	2,169	0.4684626	4,631	11,687	0.446839	26,156
2025	2,461	0.5284697	2,196	0.4715303	4,658	11,687	0.443334	26,362
2026	2,461	0.5254372	2,223	0.4745628	4,685	11,687	0.439883	26,569
2027	2,461	0.5224394	2,250	0.4775606	4,711	11,687	0.436486	26,776
2028	2,461	0.5194755	2,277	0.4805245	4,738	11,687	0.43314	26,983
2029	2,461	0.5165451	2,304	0.4834549	4,765	11,687	0.429846	27,190
2030	2,461	0.5136476	2,331	0.4863524	4,792	11,687	0.426601	27,396

Calculation for Approximate Demand per Pop in Current City of Rogers Limits

Total Pop	Approx %	Approx Pop	Res. GPD	Res. GPCD	Res %	GPD
7,000	1	7000	910,000	130.0	0.61726	1,474,257
8,000	0.9	7200	936,000	130.0	0.61726	1,516,379
9,000	0.82	7380	959,400	130.0	0.61726	1,554,288
10,000	0.75	7500	975,000	130.0	0.61726	1,579,561
11,000	0.7	7700	1,001,000	130.0	0.61726	1,621,683
12,000	0.66	7920	1,029,600	130.0	0.61726	1,668,016
13,000	0.63	8190	1,064,700	130.0	0.61726	1,724,881
14,000	0.61	8540	1,110,200	130.0	0.61726	1,798,593
15,000	0.58	8700	1,131,000	130.0	0.61726	1,832,291
16,000	0.56	8960	1,164,800	130.0	0.61726	1,887,049
17,000	0.55	9350	1,215,500	130.0	0.61726	1,969,186
18,000	0.53	9540	1,240,200	130.0	0.61726	2,009,202
19,000	0.52	9880	1,284,400	130.0	0.61726	2,080,808

20,000	0.51	10200	1,326,000	130.0	0.61726	2,148,203
21,000	0.5	10500	1,365,000	130.0	0.61726	2,211,385
22,000	0.49	10780	1,401,400	130.0	0.61726	2,270,356
23,000	0.48	11040	1,435,200	130.0	0.61726	2,325,114
24,000	0.47	11280	1,466,400	130.0	0.61726	2,375,660
25,000	0.46	11500	1,495,000	130.0	0.61726	2,421,994
26,000	0.45	11700	1,521,000	130.0	0.61726	2,464,115
27,000	0.43	11610	1,509,300	130.0	0.61726	2,445,160
28,000	0.42	11760	1,528,800	130.0	0.61726	2,476,752

Calculation for Approximate Total Demand per Population

Pop	Approx. Demand %			GPD		GPD
	Rogers	Hassan	Total	Rogers	Hassan	Total
7,000	1	0	1	1,474,257	0	1,474,257
8,000	0.9	0.1	1	1,516,379	168,487	1,684,865
9,000	0.85	0.15	1	1,554,288	274,286	1,828,574
10,000	0.8	0.2	1	1,579,561	394,890	1,974,451
11,000	0.76	0.24	1	1,621,683	512,110	2,133,793
12,000	0.73	0.27	1	1,668,016	616,938	2,284,954
13,000	0.7	0.3	1	1,724,881	739,235	2,464,115
14,000	0.68	0.32	1	1,798,593	846,397	2,644,990
15,000	0.66	0.34	1	1,832,291	943,907	2,776,198
16,000	0.64	0.36	1	1,887,049	1,061,465	2,948,514
17,000	0.62	0.38	1	1,969,186	1,206,920	3,176,106
18,000	0.61	0.39	1	2,009,202	1,284,571	3,293,773
19,000	0.6	0.4	1	2,080,808	1,387,206	3,468,014
20,000	0.58	0.42	1	2,148,203	1,555,595	3,703,798
21,000	0.57	0.43	1	2,211,385	1,668,238	3,879,623
22,000	0.56	0.44	1	2,270,356	1,783,851	4,054,207
23,000	0.56	0.44	1	2,325,114	1,826,875	4,151,989
24,000	0.54	0.46	1	2,375,660	2,023,710	4,399,370
25,000	0.54	0.46	1	2,421,994	2,063,180	4,485,173
26,000	0.53	0.47	1	2,464,115	2,185,159	4,649,274
27,000	0.52	0.48	1	2,445,160	2,257,071	4,702,232
28,000	0.51	0.49	1	2,476,752	2,379,624	4,856,376

ROGERS MODEL 2006 DEMANDS WORKSHEET

(USING 2005 POPULATION)

See Table 3-8:	Total Demand		Avg-Day	(From table 3-6) (3.3X) Max-Day	(Assumed) (2.0X) Max-Hr		(From Table 3-5) % Annual Use
Total Residential Demand:	745,479	**gal/day**	541.82	1788.02	3576.03	**gpm****	61.6%
Total Com./Ind. Demand:	383,196	**gal/day**	278.53	919.13	1838.27	**gpm****	31.7%
Total Institutional Demand:	55,166	**gal/day**	0.00	0.00	0.00	**gpm**	4.5%

** (including unaccounted-for and institutional demand by percentage)

RESIDENTIAL

Area Name	No. of Units (Single Family+Multi-Family)	Demand (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)
Brockton Meadows 1st and 2nd	182	44.36	19	2.33	7.71	15.41
Edgewater (phase 1)	213	51.92	15	3.46	11.42	22.84
Villas @ Watersedge	76	18.53	4	4.63	15.28	30.57
Fletcher Hills (phase 1)	76	18.53	12	1.54	5.09	10.19
Fox Creek North	16	3.90	2	1.95	6.44	12.87
Reimer Addition	125	30.47	14	2.18	7.18	14.36
Territorial View 2nd Addition	25	6.09	5	1.22	4.02	8.04
Total new Residential		173.79	71			
Normal		368.03	285	1.29	4.26	8.52
Total Res.		541.82				

COMMERCIAL/INDUSTRIAL

Area Name	Demand (gpy)	Demand (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)	
normal		175.48	128	1.37	4.52	9.05	6 zero node
LARGE CUSTOMERS: separate nodes, demands subtracted from category totals							
LLC, Rogers Preserve	7,208,000	13.71	1	13.71	45.26	90.51	
Alcoa-KAMA	6,650,000	12.65	1	12.65	41.75	83.50	
Rogers Public Schools:							
Elementary School	2,453,000	4.67	1	4.67	15.40	30.80	
Junior High School	1,080,000	2.05	1	2.05	6.78	13.56	
High School	800,000	1.52	9	0.17	0.56	1.12	
Hassan Elementary School	416,000	0.79	2	0.40	1.31	2.61	
Twin City West/Union 76	3,958,000	7.53	1	7.53	24.85	49.70	
Cabelas	3,438,000	6.54	1	6.54	21.59	43.17	
The Wellstead	3,432,000	6.53	1	6.53	21.55	43.10	
Profile Powder Coating	3,373,000	6.42	1	6.42	21.18	42.36	
Reinhart Foodservice	3,178,000	6.05	1	6.05	19.95	39.91	
Imperial Custom Molding	3,081,000	5.86	1	5.86	19.34	38.69	
Graco	2,817,000	5.36	1	5.36	17.69	35.37	
Super 8 Motel	2,543,000	4.84	1	4.84	15.97	31.93	
Flame Metals	2,533,000	4.82	1	4.82	15.90	31.81	
Veit	2,097,000	3.99	1	3.99	13.17	26.33	
Touch em All	1,695,000	3.22	1	3.22	10.64	21.28	
Americ Inn	1,912,000	3.64	3	1.21	4.00	8.00	
Super Target	1,498,000	2.85	7	0.41	1.34	2.69	
large customer total (subtracted from total for "normal")		103.05	36				
Total Com./Ind.		278.53	164				

TOTAL DEMAND		Avg-Day	Max-Day	Max-Hr
From Table 3-8		820.35	2,707.15	5,414.30
gpm		820.35	2,707.15	5,414.30
MGD		1.181	3.898	7.797

No. of Nodes in Model	526	
No. of Nodes in Table	526	
Extra Nodes in Model	0	
Total Demand in Model	819.77	gpm
Total Demand in Table	820.35	gpm
Extra Demand in Model	-0.58	gpm

ROGERS MODEL 2015 DEMANDS WORKSHEET

(USING 2015 PROJECTED POPULATION)

	Total Demand		(From table 3-6) Avg-Day	(Assumed) (3.3X) Max-Day	(2.0X) Max-Hr		% Annual Use
From 2006 Worksheet:							61.6%
Total Residential Demand:	745,479	gal/day	541.82	1788.02	3576.03	gpm**	31.7%
Total Com./Ind. Demand:	383,196	gal/day	278.53	919.13	1838.27	gpm**	4.5%
Total Institutional Demand:	55,166	gal/day	0.00	0.00	0.00	gpm	
2015 Total (See Table 3-8):							
Total Residential Demand:	1,482,740	gal/day	1077.64	3556.23	7112.46	gpm**	
Total Com./Ind. Demand:	762,138	gal/day	553.95	1828.02	3656.04	gpm**	
Total Institutional Demand:	109,658	gal/day	0.00	0.00	0.00	gpm	
Total Annexed Hassan Township Demand:	1,927,426	gal/day	1338.49	4417.017	8834.034	gpm	
New Model Demands:							
Total Residential Demand:	737,261	gal/day	537.21	1772.81	3545.62	gpm**	
Total Com./Ind. Demand:	378,942	gal/day	275.77	910.03	1820.07	gpm**	
Total Institutional Demand:	54,492	gal/day	0.00	0.00	0.00	gpm	
Total Annexed Hassan Township Demand:	1,927,426	gal/day	1338.49	4417.02	8834.03	gpm	

** (including unaccounted-for and institutional demand by percentage)

RESIDENTIAL

Area No.	Area Name	TOTAL New Units	BY 2015 New Units	Demand * (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)
(From Zoning Map)								
Total New Res.				**537.21**				
6	King Estate	18	18	4.39	1	4.39	14.48	28.96
9	Wellstead IV	40	40	9.75	1	9.75	32.18	64.35
10	Edgewater (phase 2-4)	956	956	233.03	50	4.66	15.38	30.76
11	Fletcher Hills II	25	25	6.09	2	3.05	10.05	20.11
12	Villas @ Fletcher Hills	34	34	8.29	1	8.29	27.35	54.70
13	Mystic Ridge	23	23	5.61	2	2.80	9.25	18.50
14	Weber/Knapp (Manley)	212	212	51.68	15	3.45	11.37	22.74
15	Pulte	70	70	17.06	6	2.84	9.38	18.77
16	Busch Prop.	40	40	9.75	2	4.88	16.09	32.18
17	Downtown Redevel.	55	55	13.41	1	13.41	44.24	88.48
18	Erickson / King	137	137	33.39	6	5.57	18.37	36.73
19	Greeninger Property	11	11	2.68	2	1.34	4.42	8.85
20	Arthur Street	20	20	4.88	2	2.44	8.04	16.09
21	Veit Prop.	30	30	7.31	1	7.31	24.13	48.26
22	Weber / Kinghorn	133	133	32.42	5	6.48	21.40	42.79
23	Gmach Prop.	86	86	20.96	1	20.96	69.18	138.35
24	Gould Prop.	58	58	14.14	4	3.53	11.66	23.33
25	Sunderland Prop.	40	40	9.75	1	9.75	32.18	64.35
26	Basswood	12	12	2.93	1	2.93	9.65	19.31
27	Pohlig Property	37	37	9.02	3	3.01	9.92	19.84
28	Fletcher Area Development	10.6	10.6	2.58	1	2.58	8.53	17.05
29	Grass Lake Area	155	155	37.78	7	5.40	17.81	35.62
30	Weber Prop.	15	15	3.66	2	1.83	6.03	12.07
	Total New Development	839.6	839.6	540.54	117			
	Remainder			-3.33				
	Existing Residential Demand		See 2006	173.79	71			
	Normal (new+existing)			363.31	287	1.27	4.18	8.35

COMMERCIAL/INDUSTRIAL

Area No.	Area Name	Demand (gpd)	Demand (gpm)	Demand * (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)
(From Zoning Map)								
Total New Com./Ind.				**275.77**				
INDIVIDUAL CUSTOMERS: separate nodes, demands subtracted from category totals								
31	Lowes	9,023	6.27	6.27	2	3.13	10.34	20.68
32	Cub	7,320	5.08	5.08	1	5.08	16.78	33.55
33	Moen & Leur	30,076	20.89	20.89	4	5.22	17.23	34.46
35	Roger Industrial Park (Brockton Mea	9,704	6.74	6.74	1	6.74	22.24	44.48
36	Muller Theater	6,810	4.73	4.73	1	4.73	15.61	31.21
39	WJD II	11,349	7.88	7.88	2	3.94	13.00	26.01
40	Reinhart	10,612	7.37	7.37	1	7.37	24.32	48.64
44	High School Expansion	10,000	6.94	6.94	1	6.94	22.92	45.83
45	Ice Arena	4,000	2.78	2.78	1	2.78	9.17	18.33
49	Vevea Area	18,556	12.89	12.89	6	2.15	7.09	14.17

50 TH 101 Corridor ***	180,000	125.00	62.50	6	10.42	34.38	68.75
51 Church/Erickson	13,789	9.58	9.58	7	1.37	4.51	9.03
52 Southside Lumber Redevelopment	5,334	3.70	3.70	1	3.70	12.22	24.45
Individual New Customer Total			157.34	34			
Other large customers (Existing Demand)		see 2006	103.05	36			
Individual customer total			260.39				
Normal (new+existing)			293.56	137	2.14	7.07	14.14

HASSAN TOWNSHIP

Area No.	Area Name	Total New Units	New Units by 2015/Demand Flow	Demand * (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)
(From Zoning Map)								
Total Hassan Township area				**1338.49**				
Residential Hassan Area								
	ECI-1	318		50.89	2	25.44	83.96	167.93
	ECI-3	188	63,168	43.87	4	10.97	36.19	72.38
	ECI-4	0		0.00	1	0.00	0.00	0.00
	ECI-5	264		40.23	2	20.12	66.39	132.77
	ECI-7	19	19	4.63	2	2.32	7.64	15.28
	ECI-8	676	676	164.78	6	27.46	90.63	181.25
	FCR-4	36		6.65	2	3.33	10.97	21.95
	FCR-5 (Residential)	30	30	7.31	2	3.66	12.07	24.13
	FSE-1	103		30.21	1	30.21	99.69	199.38
	FSE-2	183		41.92	1	41.92	138.34	276.67
	FSE-3	43		14.15	2	7.08	23.36	46.71
	FSE-4	261		59.20	5	11.84	39.07	78.14
	FSE-5	106	106	25.84	2	12.92	42.63	85.26
	FSE-6	36		7.60	2	3.80	12.54	25.08
	FSE-7	31	31	7.56	1	7.56	24.94	49.87
	FSE-8 (Residential)	47	47	11.46	1	11.46	37.81	75.61
	FSE-14	355	355	86.53	7	12.36	40.79	81.59
	FSE-15	261	261	63.62	12	5.30	17.50	34.99
	FSW-6	111	111	27.06	5	5.41	17.86	35.71
	FSW-7	114	114	27.79	4	6.95	22.92	45.85
		Units/acre	Total Acre (on map)					
	Pink Area 4 (Jimmy Dean prop.)	1.5	80	29.25	2	14.63	48.26	106.18
	Pink Area 3 (north of I-94)	1	0	0.00				
	Pink area 2 (west of Willandale Roac	2	453.542	221.10	13	17.01	56.13	123.48
	Pink area 1 (south of Territorial Roac	2	230.09	112.17	17	6.60	21.77	47.90
Comercial Hassan Area								
	ECI-2			36.31	4	9.08	29.95	59.91
	ECI-6			43.69	4	10.92	36.05	72.09
	FCR-3		38,718	26.89	8	3.36	11.09	22.18
	FCR-5 (Commercial)			3.27	1	3.27	10.78	21.56
	FSE-8 (Commercial)		7,757	5.39	1	5.39	17.78	35.55
	FSE-9		56,741	39.40	3	13.13	43.34	86.69
	FSE-12		18,914	13.13	4	3.28	10.84	21.67
	FSE-10			15.85	7	2.26	7.47	14.94
	FSE-11			12.04	7	1.72	5.68	11.35
	FSE-13			58.72	3	19.57	64.59	129.18
Hassan Township Total (Residential+Commercial)				1338.49	138			
				0.00				

TOTAL DEMAND	Avg-Day	Max-Day	Max-Hr
From Table 3-8	2970.08	9,801.27	19,602.53
gpm	2,970.08	9,801.28	19,602.55
MGD	4.277	14.114	28.228

* gpm = units x (2.7 persons/unit) x (130 GPCD) x (1/1440 day/min)
*** For TH 101 Corridor, it is assumed that only 50% of the demand will be generated by year 2015.

No. of Nodes in Model	842	
No. of Nodes in Table	820	
Zero Nodes in Model	18	
Extra Nodes in Model	4	
Total Demand in Model	3,053.11	gpm
Total Demand in Table	2,970.08	gpm
Extra Demand in Model	83.03	gpm

ROGERS MODEL 2030 DEMANDS WORKSHEET

(USING 2030 PROJECTED POPULATION)

	Total Demand		(From table 3-6) Avg-Day	(Assumed) (3.3X) Max-Day	(2.0X) Max-Hr		% Annual Use
From 2015 Worksheet:							61.6%
Total Residential Demand:	1,482,740	gal/day	541.82	1788.02	3576.03	gpm**	31.7%
Total Com./Ind. Demand:	762,138	gal/day	278.53	919.13	1838.27	gpm**	4.5%
Total Institutional Demand:	109,658	gal/day	0.00	0.00	0.00	gpm	
Total Annexed Hassan Township Demand:	1,927,426	gal/day	1338.49	4417.017	8834.034	gpm	
2030 Total (See Table 3-8):							
Total Residential Demand:	1,550,062	gal/day	1126.57	3717.69	7435.39	gpm**	
Total Com./Ind. Demand:	796,742	gal/day	579.10	1911.02	3822.04	gpm**	
Total Institutional Demand:	114,637	gal/day	0.00	0.00	0.00	gpm	
Total Annexed Hassan Township Demand:	2,330,640	gal/day	1618.50	5341.05	10682.10	gpm	
New Model Demands:							
Total Residential Demand:	67,322	gal/day	49.06	161.89	323.77	gpm**	
Total Com./Ind. Demand:	34,604	gal/day	25.18	83.10	166.21	gpm**	
Total Institutional Demand:	4,979	gal/day	0.00	0.00	0.00	gpm	
Total Annexed Hassan Township Demand:	403,214	gal/day	280.01	924.03	1848.07	gpm	

** (including unaccounted-for and institutional demand by percentage)

RESIDENTIAL

Area No.	Area Name	TOTAL New Units	BY 2030 New Units	Demand * (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)
(From Zoning Map)								
Total New Res.				**49.06**				
	NO CHANGES							
	Total New Development	0	0	0.00	0			
	Remainder (NOT INCLUDED IN MODEL)			49.06				

COMMERCIAL/INDUSTRIAL

Area No.	Area Name	Demand (gpd)	Demand (gpm)	Demand * (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)
(From Zoning Map)								
Total New Com./Ind.				**25.18**				
INDIVIDUAL CUSTOMERS: separate nodes, demands subtracted from category totals								
50	TH 101 Corridor ***	180,000	125.00	125.00	6	20.83	68.75	137.50
	Total New Development	0	0	62.50	0			
	Remainder			-37.32				

HASSAN TOWNSHIP

Area No.	Area Name	Total New Units	New Units by 2015/Dem and Flow (gpd)	Demand * (gpm)	Nodes in Area	Avg-Day Demand per Node (gpm)	Max-Day Demand per Node (gpm)	Max-Hr Demand per Node (gpm)
(From Zoning Map)								
Total New Hassan Township				**280.01**				
		Units/acre	Total Acre (on map)					
	Pink Area 3 (north of I-94)	1	1148.77	280.01	79	3.54	11.70	25.73
Hassan Township Total (Residential+Commercial)				280.01	79			
				0.00				

TOTAL DEMAND	Avg-Day	Max-Day	Max-Hr
From Table 3-8	3324.17	10,969.76	21,939.53
gpm	3,312.60	10,931.57	21,863.14
MGD	4.770	15.741	31.483

* gpm = units x (2.7 persons/unit) x (130 GPCD) x (1/1440 day/min)
*** For TH 101 Corridor, the demand is now double what it was in 2015.

No. of Nodes in Model	916
No. of Nodes in Table	899
Zero Nodes in Model	18
Extra Nodes in Model	-1
Total Demand in Model	3,641.59
Total Demand in Table	3,312.60
Extra Demand	328.99

Calculation of Hassan Township Population by 2015 using the no. of Units data

Residential Area	Total Units by 2015	Total Population by 2015
ECI-1	318	859
ECI-3	188	508
ECI-4	0	0
ECI-5	264	713
ECI-7	19	51
ECI-8	676	1825
FCR-4	36	97
FCR-5 (Residential)	30	81
FSE-1	103	278
FSE-2	183	494
FSE-3	43	116
FSE-4	261	705
FSE-5	106	286
FSE-6	36	97
FSE-7	31	84
FSE-8 (Residential)	47	127
FSE-14	355	959
FSE-15	261	705
FSW-6	111	300
FSW-7	114	308
Sub-Total	3182	8591

	Units/acre	Total Acre (on map)	Total Units by 2015	Total Population
Pink Area 4 (Jimmy Dean prop.)	1.5	80	120	324
Pink Area 3 (north of I-94)	1	1148.77	0	0
Pink area 2 (west of Willandale Road)	2	453.542	907	2449
Pink area 1 (south of Territorial Road)	2	230.09	460	1242
		Sub-Total	1,367	4016
		Total	**4,549**	**12,607**

Calculation of Hassan Township Population by 2030 using the no. of Units data

Residential Area	Total Units by 2030	Total Population by 2030
ECI-1	318	859
ECI-3	188	508
ECI-4	0	0
ECI-5	264	713
ECI-7	19	51
ECI-8	676	1825
FCR-4	36	97
FCR-5 (Residential)	30	81
FSE-1	103	278
FSE-2	183	494
FSE-3	43	116
FSE-4	261	705
FSE-5	106	286
FSE-6	36	97
FSE-7	31	84
FSE-8 (Residential)	47	127
FSE-14	355	959
FSE-15	261	705
FSW-6	111	300
FSW-7	114	308
Sub-Total	3182	8591

	Units/acre	**Total Acre (on map)**	**Total Units by 2030**	**Total Population**
Pink Area 4 (Jimmy Dean prop.)	1.5	80	120	324
Pink Area 3 (north of I-94)	1	1148.77	1,149	3102
Pink area 2 (west of Willandale Road)	2	453.542	907	2449
Pink area 1 (south of Territorial Road)	2	230.09	460	1242
		Sub-Total	2,516	7117
		Total	**5,698**	**15,709**

<u>**Calculation for Proposed Tank T-3 – High Pressure Zone**</u>

HYDROPILLAR STEEL TANK

Size of tank =1,000,000 gallons

Tank radiating surface = Surface area of tank $\left(\frac{\pi}{4}D^2\right)$ + (Tank circumference (πD) x Height)

$= 3369.554 + (65.5 \text{ x } \pi \text{ x } 40)$
$= 11600.53\ ft^2$

The lowest one-day mean temperature for Minneapolis area is $-23^0 F$.

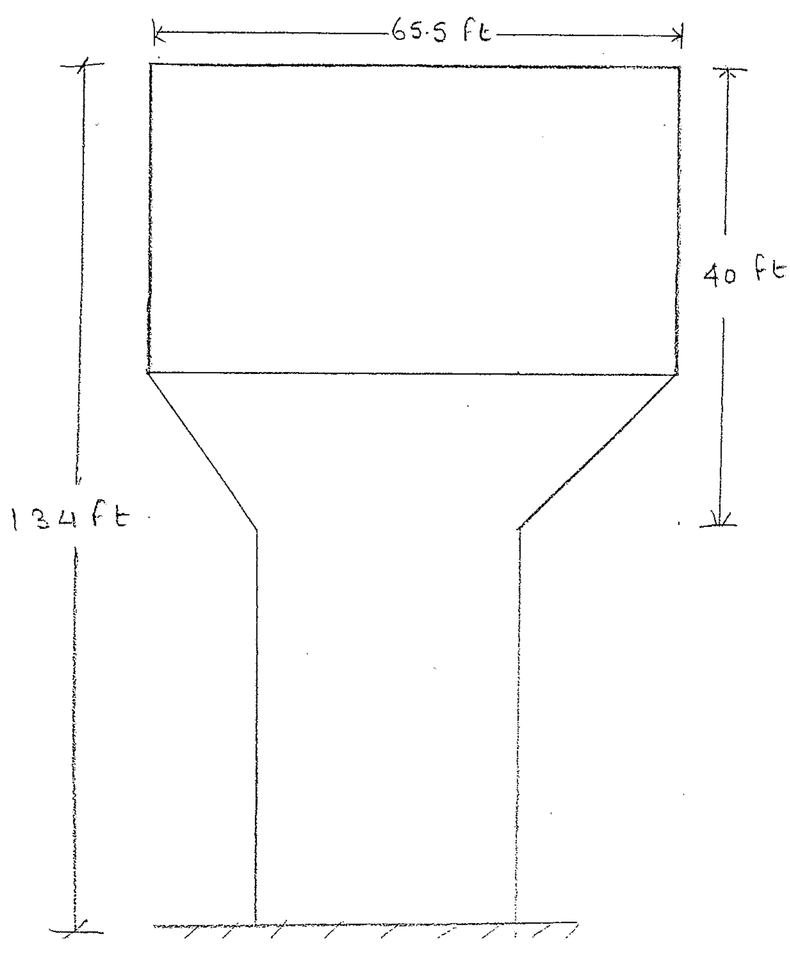
Heat (Btu) loss per sq.ft tank radiating surface for ($-23^0 F$) is 252.1 Btu/hr/sq.ft.

$\therefore$ Heat loss from tank per hour = 11600.53 x 252.1 = 2924493.6 Btu/hr

Heat of water to drop from $50^0 F - 32^0 F = 18^0 F$

Amount of water $= \frac{2924493.6}{60} \frac{Btu}{hr} \frac{hr}{\min} \times \frac{1}{18^0 F \times 8.34} \frac{gallons^o F}{Btu} = 324.68 gpm$

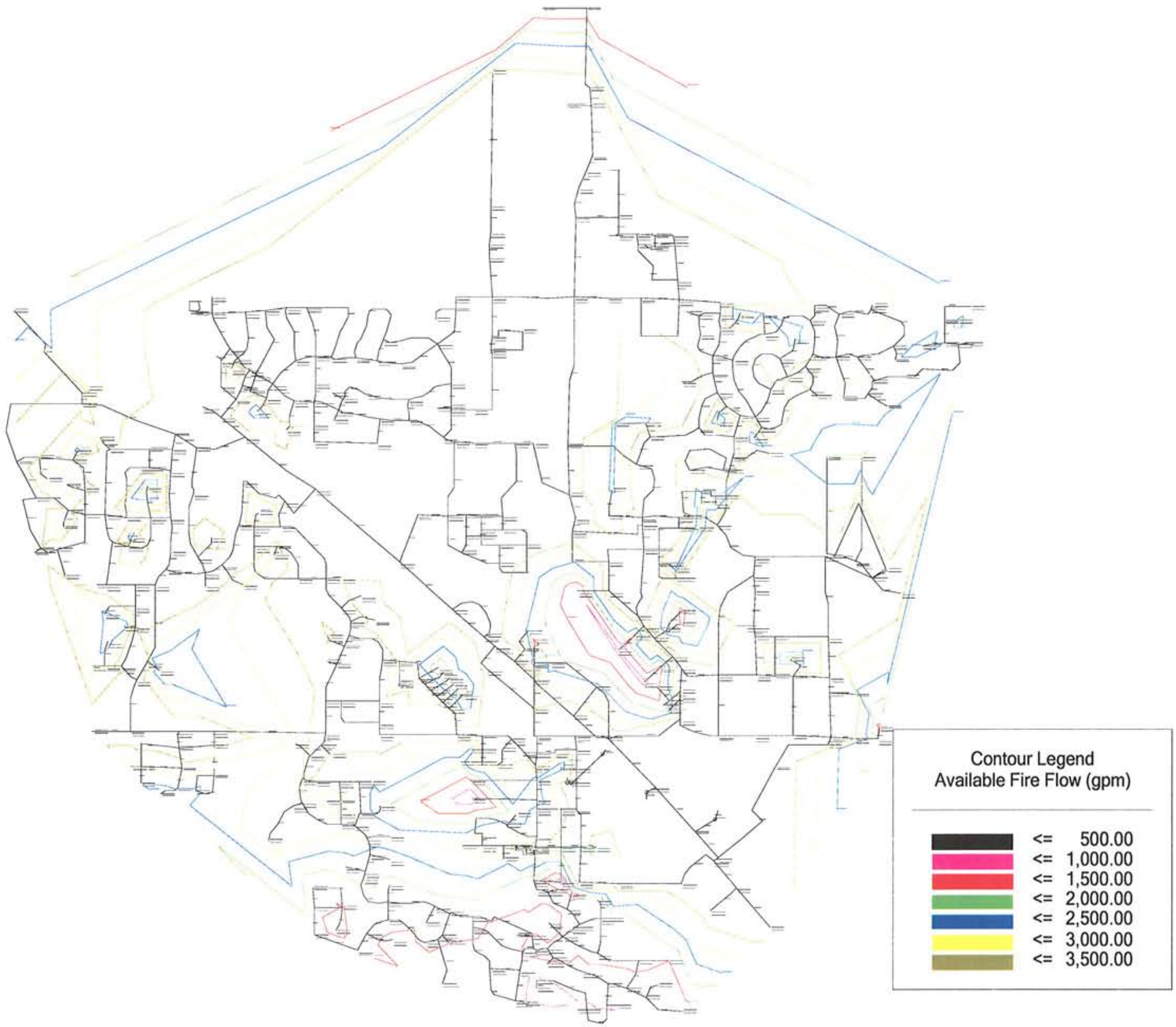
Note: 8.34 is a conversion amount of Btu needed to drop 1 gallons to 1 degree.



APPENDIX C

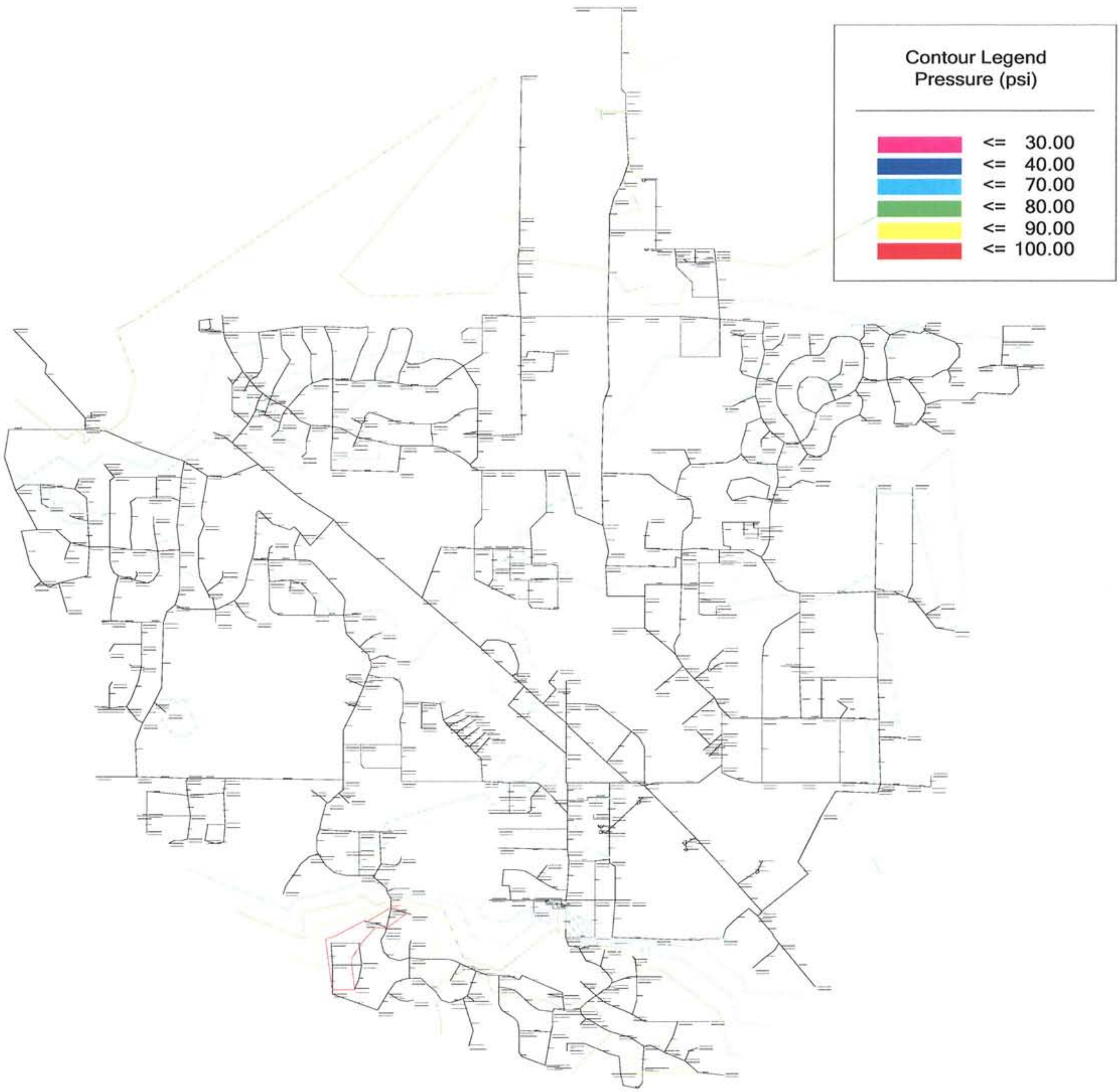
Water System Computer Model Results

Contour Plot - Available Fire Flow
Scenario: Base Demand 2006

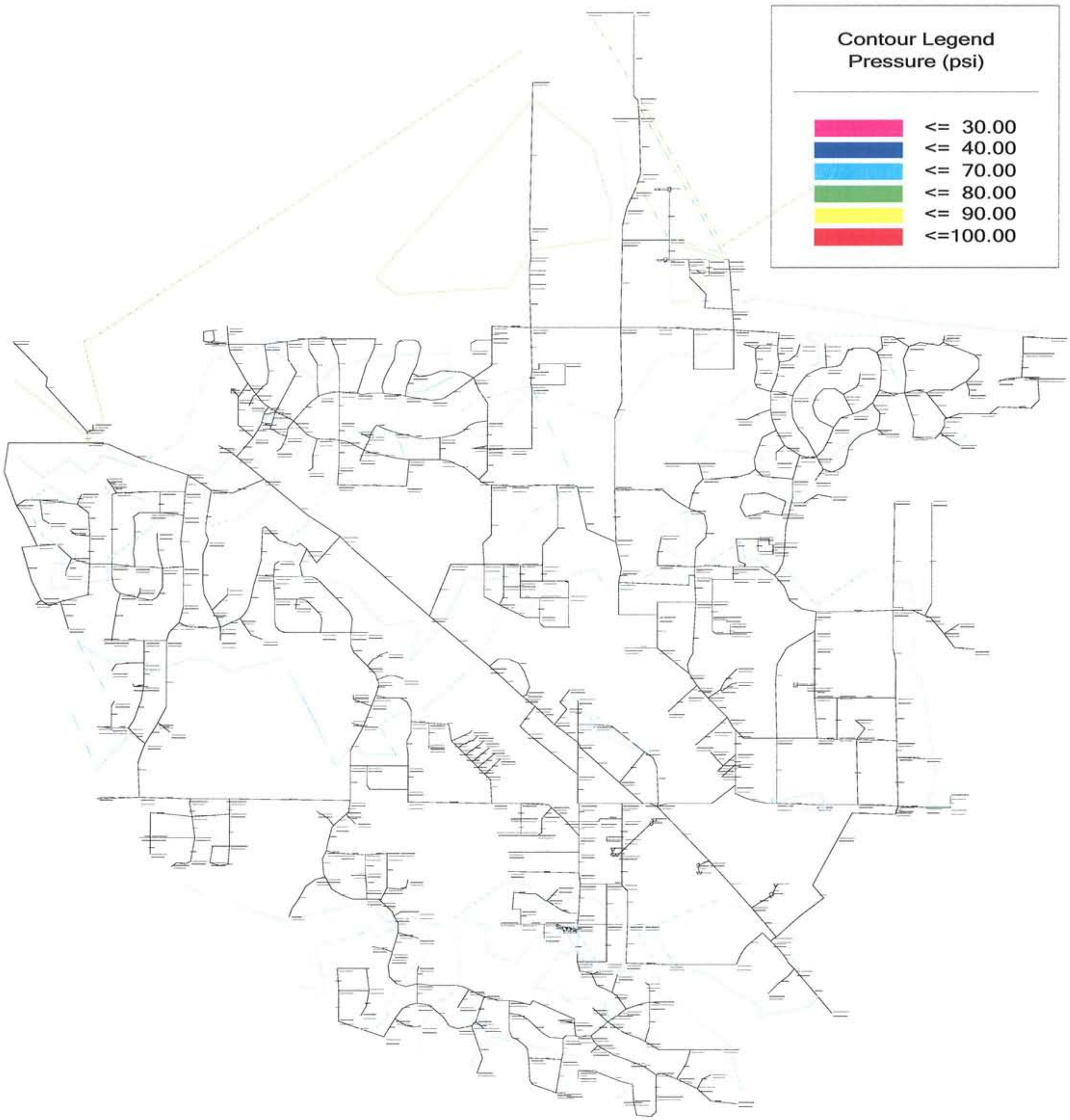


Contour Plot - Available Fire Flow
Scenario: Max Hour 2006

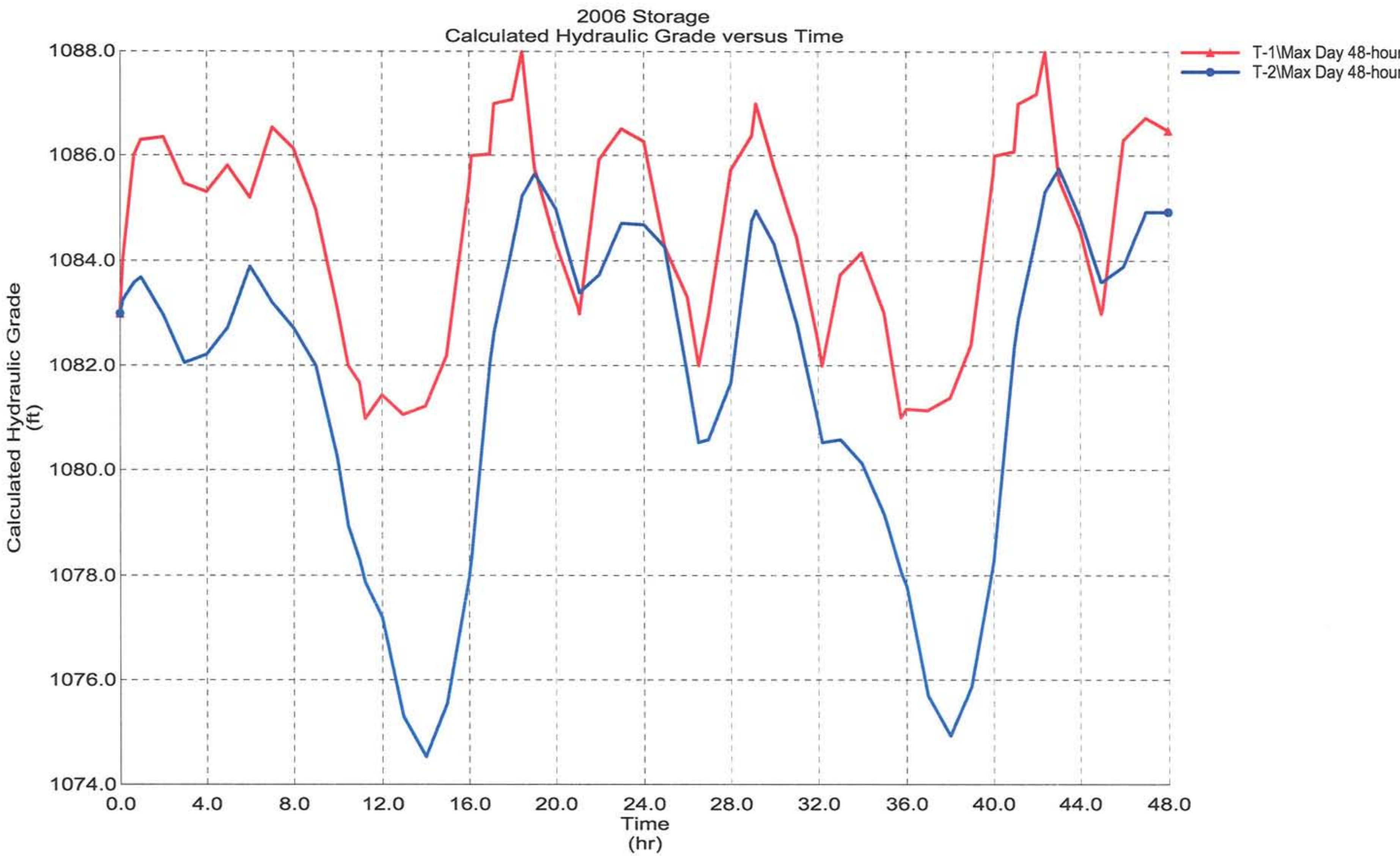
Contour Plot - Pressure
Scenario: Base Demand 2006



Contour Plot - Pressure
Scenario: Max Hour 2006

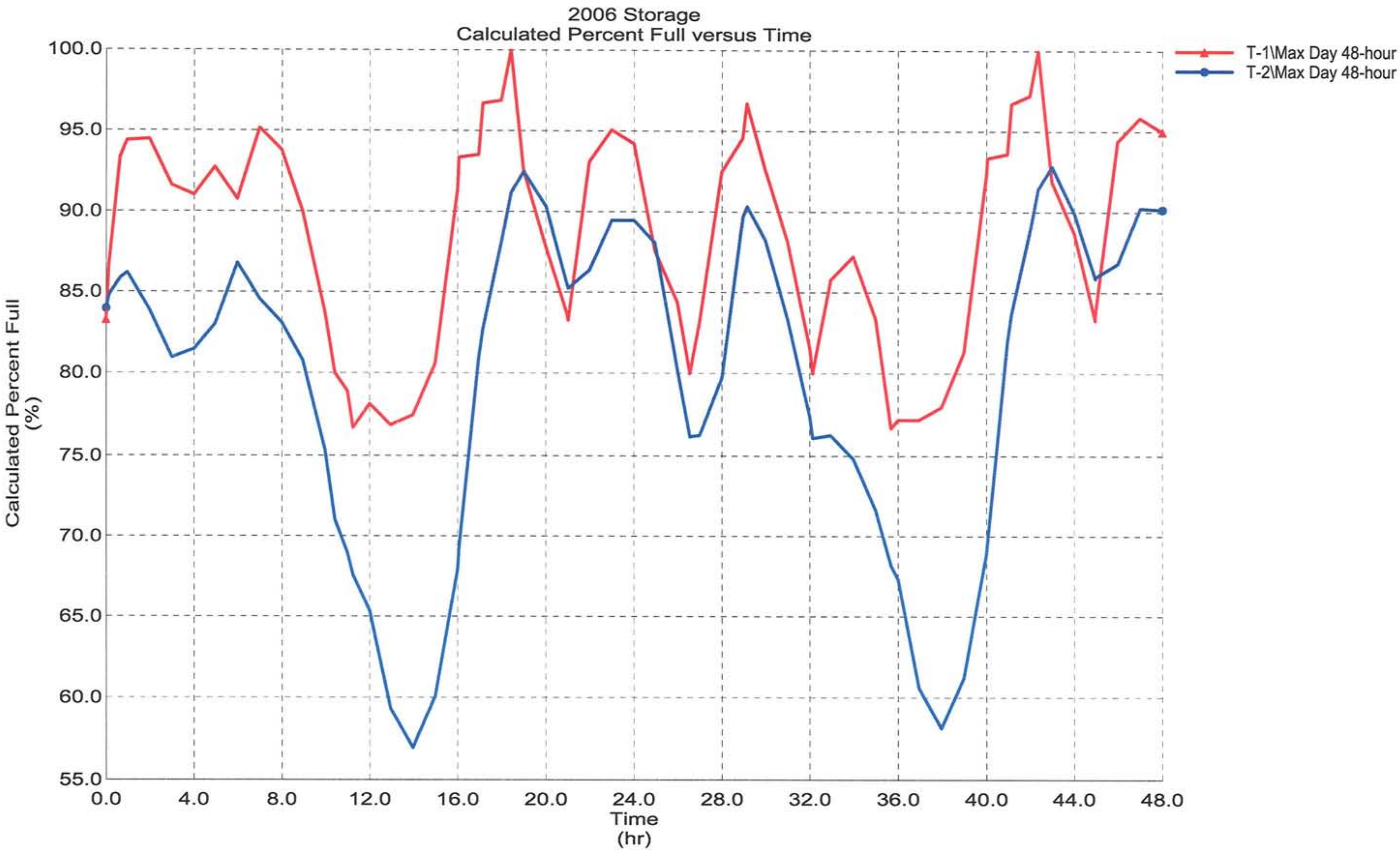


Graph



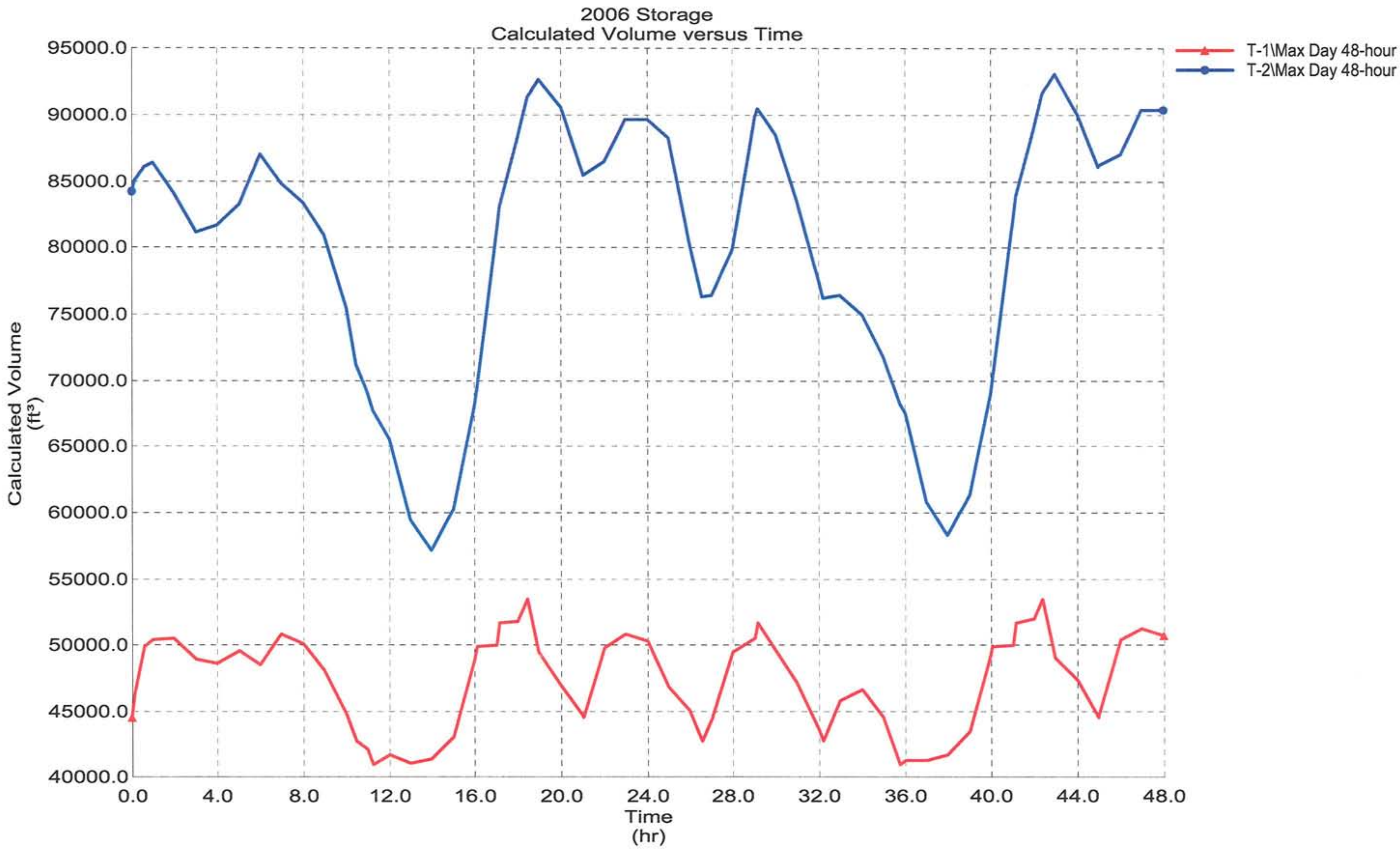
2006 Storage
Calculated Hydraulic Grade versus Time
Calculated Hydraulic Grade
(ft)
1088.0
1086.0
1084.0
1082.0
1080.0
1078.0
1076.0
1074.0
0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0
36.0
40.0
44.0
48.0
Time
(hr)
T-1\Max Day 48-hour
T-2\Max Day 48-hour

Graph



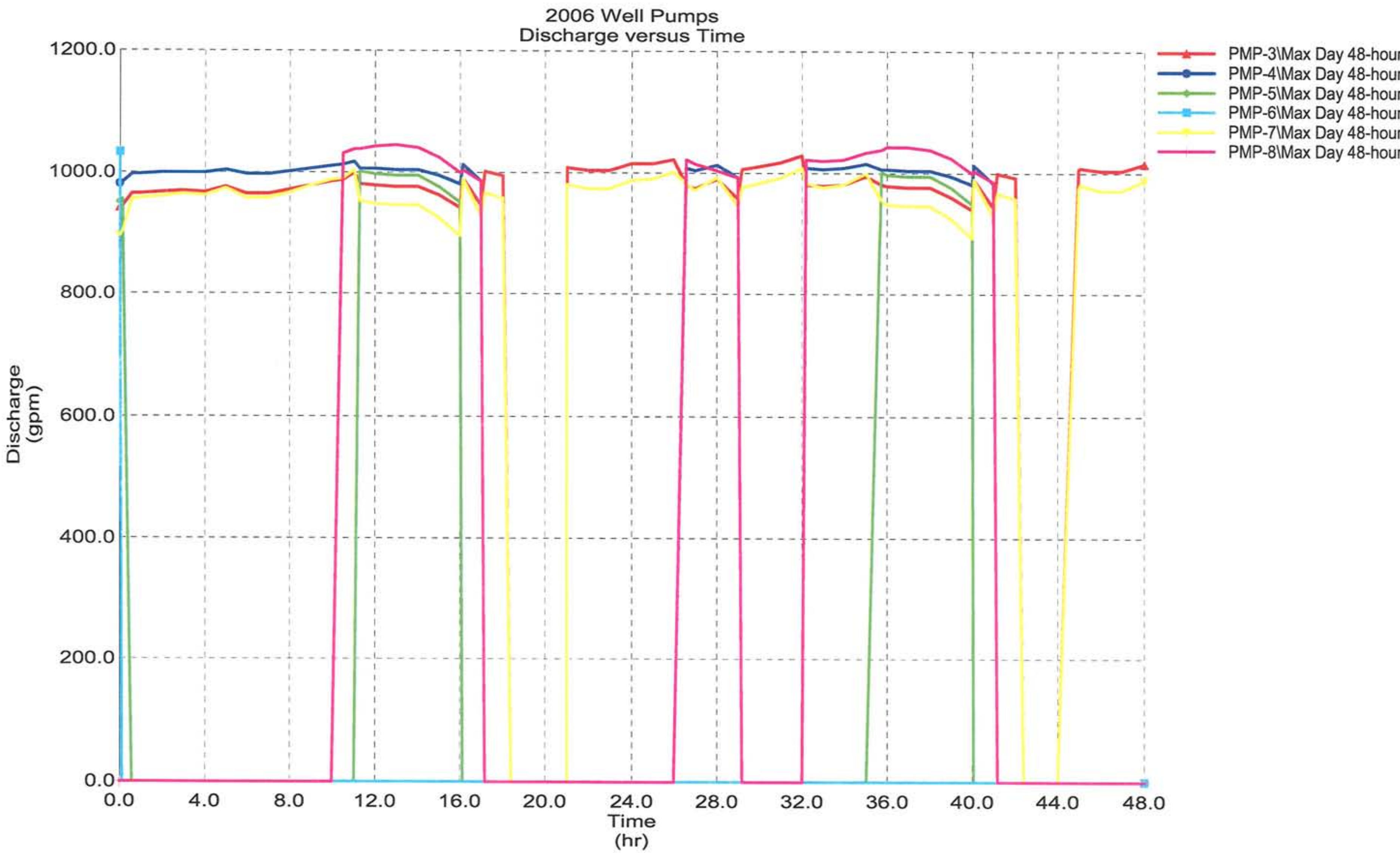
2006 Storage
Calculated Percent Full versus Time
Calculated Percent Full
(%)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0
36.0
40.0
44.0
48.0
Time
(hr)
T-1\Max Day 48-hour
T-2\Max Day 48-hour

Graph



2006 Storage
Calculated Volume versus Time
T-1\Max Day 48-hour
T-2\Max Day 48-hour
Calculated Volume
(ft³)
95000.0
90000.0
85000.0
80000.0
75000.0
70000.0
65000.0
60000.0
55000.0
50000.0
45000.0
40000.0
0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0
36.0
40.0
44.0
48.0
Time
(hr)

Graph



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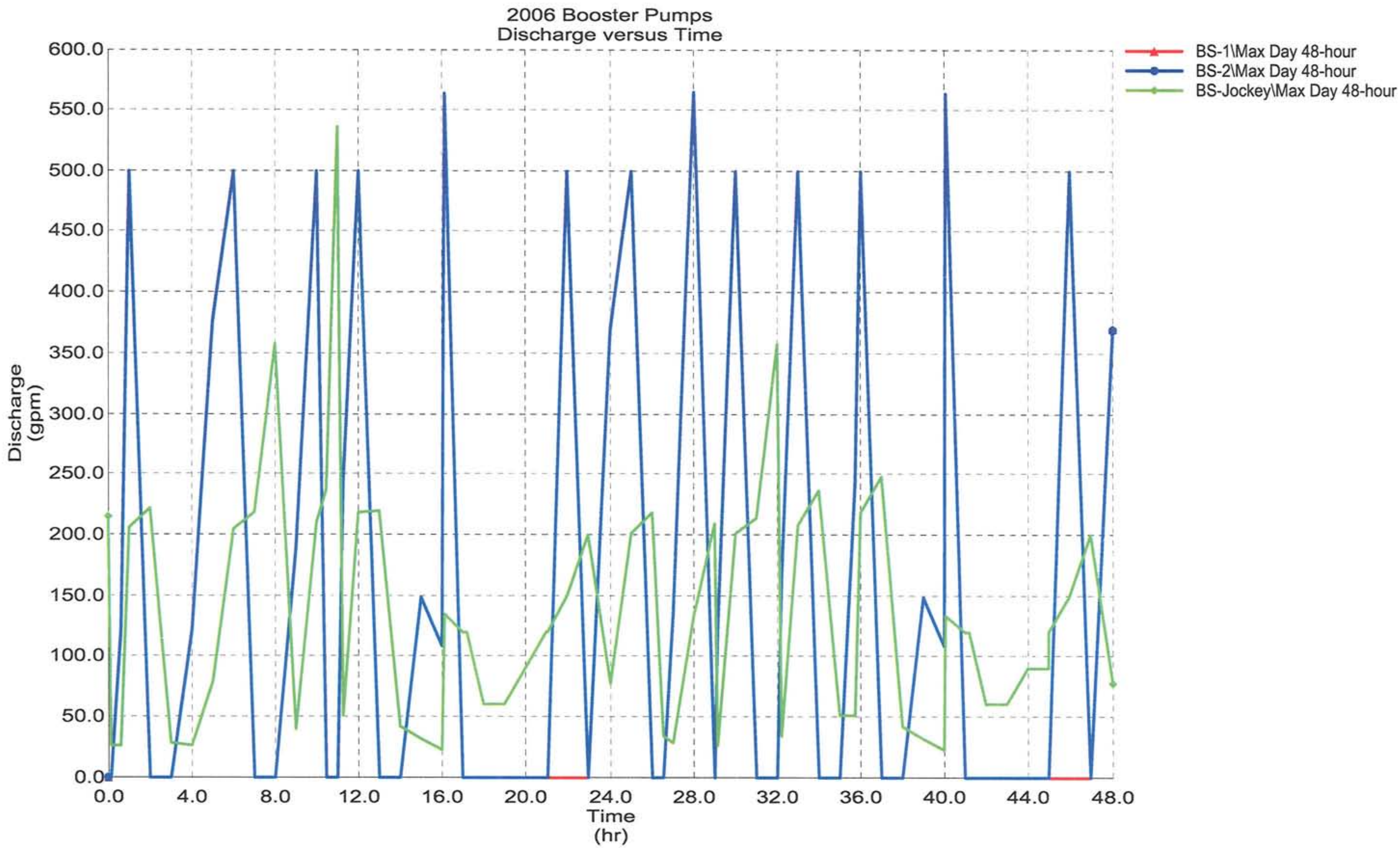
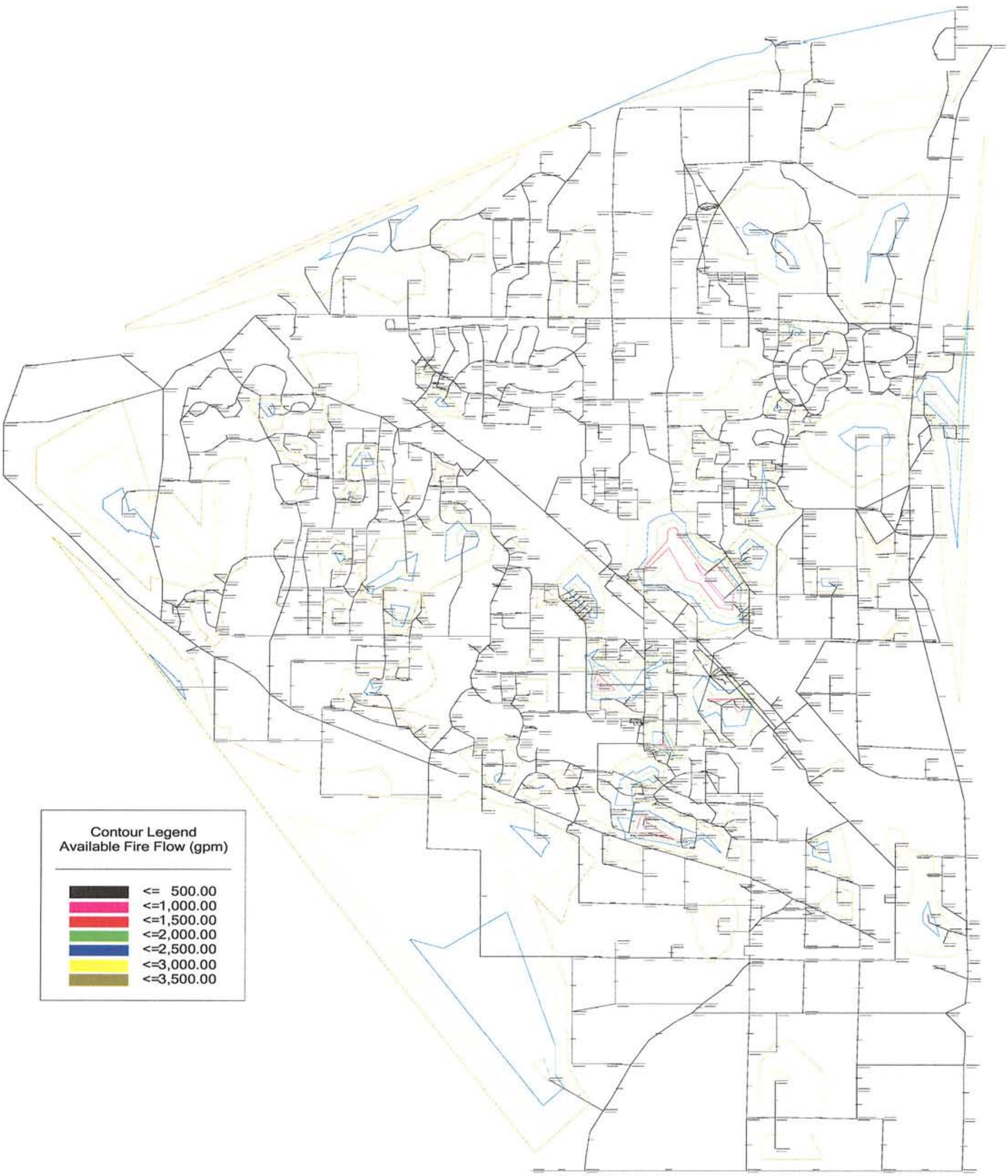
02/07/07 09:13:09 PM

Project Engineer: saw
WaterCAD v7.0 [07.00.049.00]

Graph


2006 Booster Pumps
Discharge versus Time
Discharge
(gpm)
600.0
550.0
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0
36.0
40.0
44.0
48.0
Time
(hr)
BS-1\Max Day 48-hour
BS-2\Max Day 48-hour
BS-Jockey\Max Day 48-hour

Contour Plot - Available Fire Flow
Scenario: Base Demand 2030



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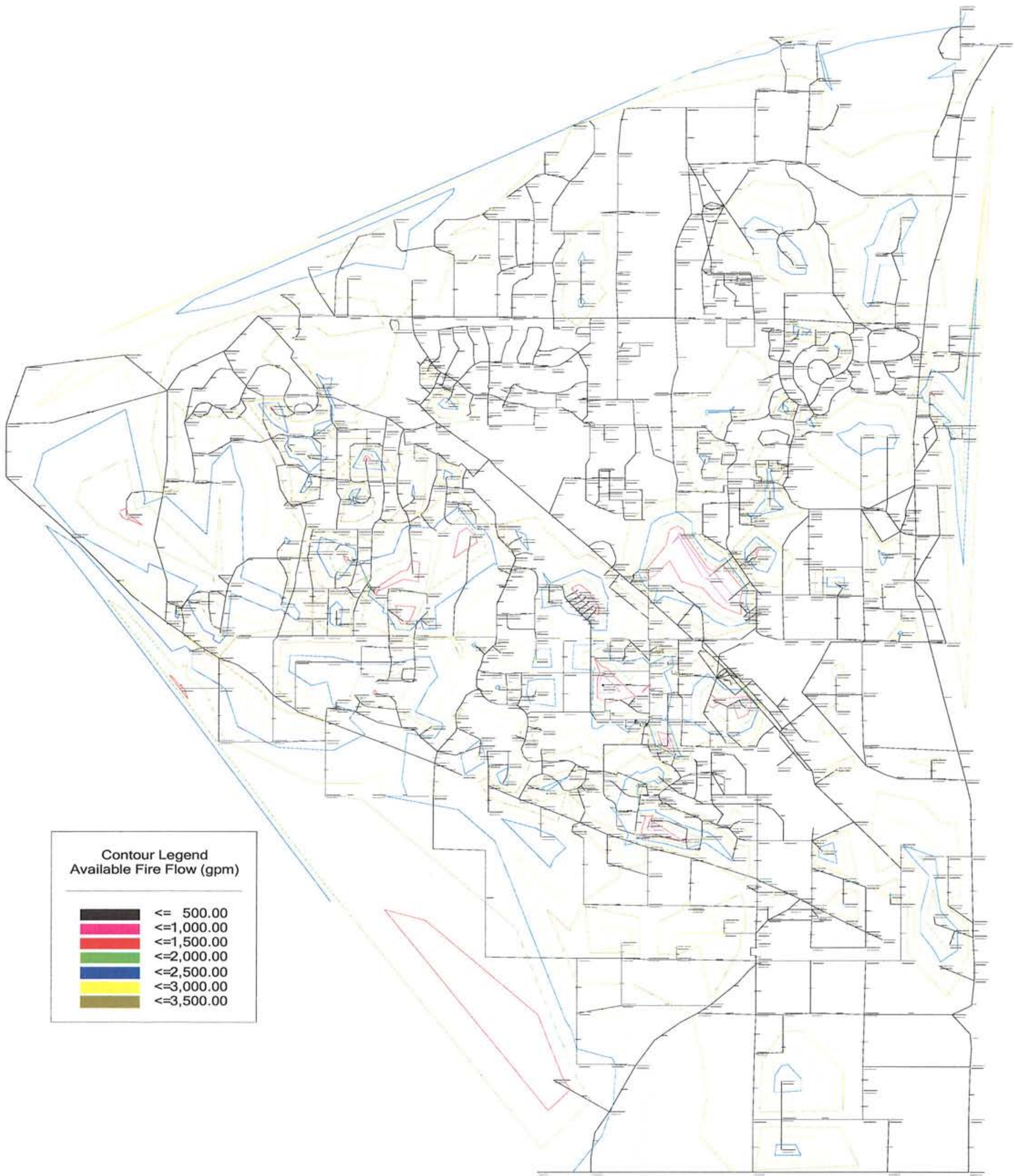
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Contour Plot - Available Fire Flow
Scenario: Max Hour 2030



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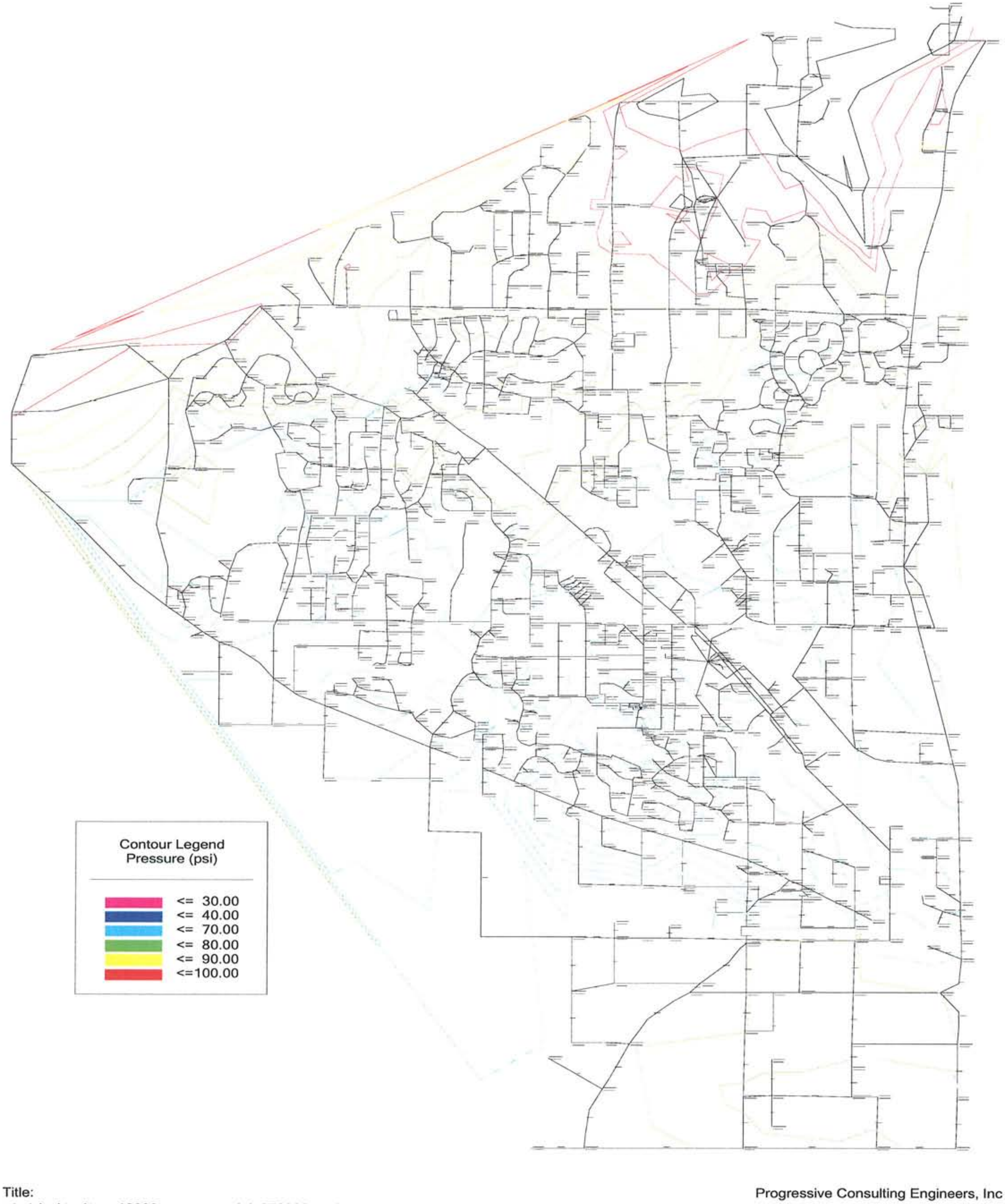
02/07/07 08:48:15 PM

Progressive Consulting Engineers, Inc
PCE Project No. 06026

Contour Plot - Pressure
Scenario: Base Demand 2030



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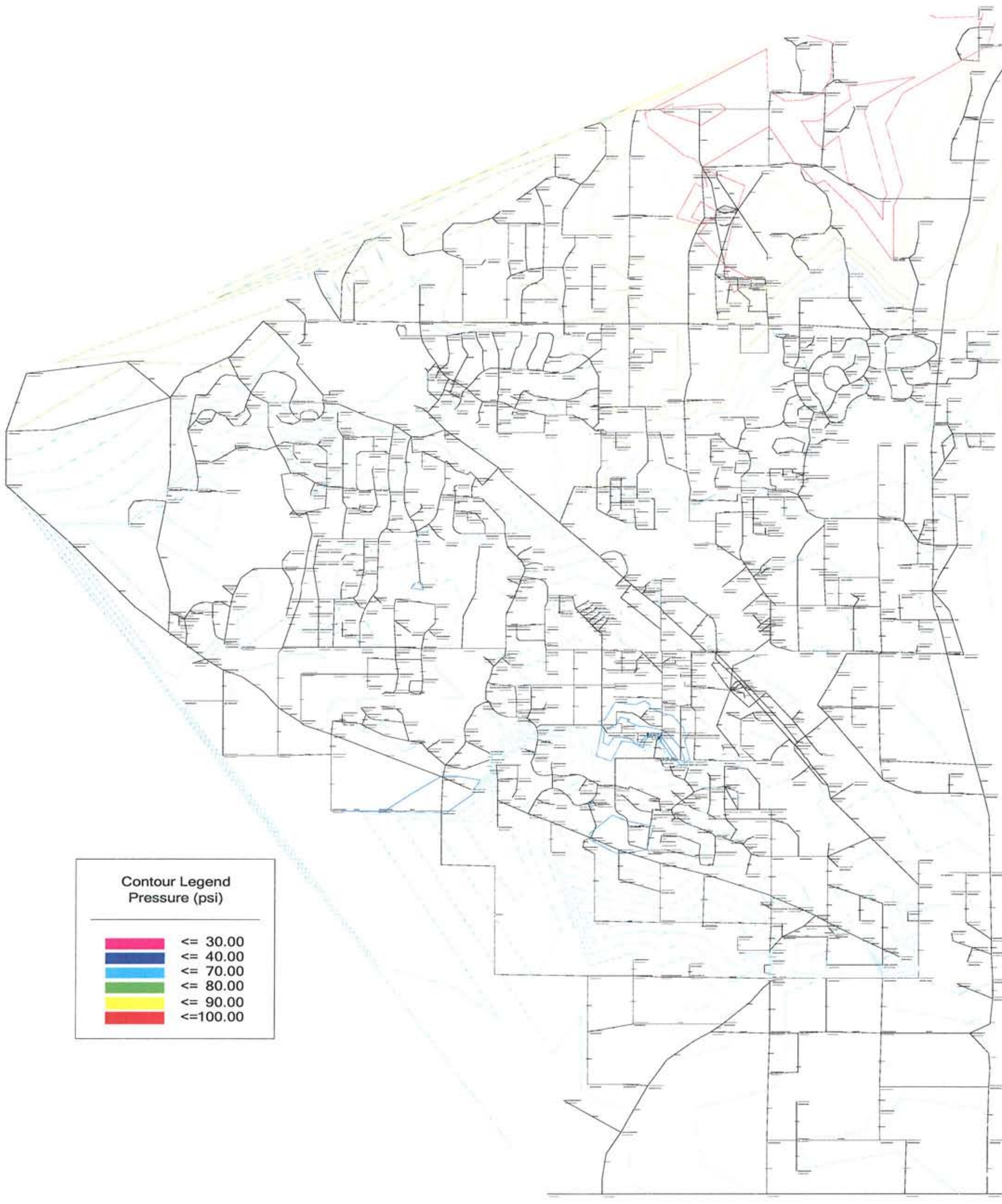
02/07/07 08:43:56 PM

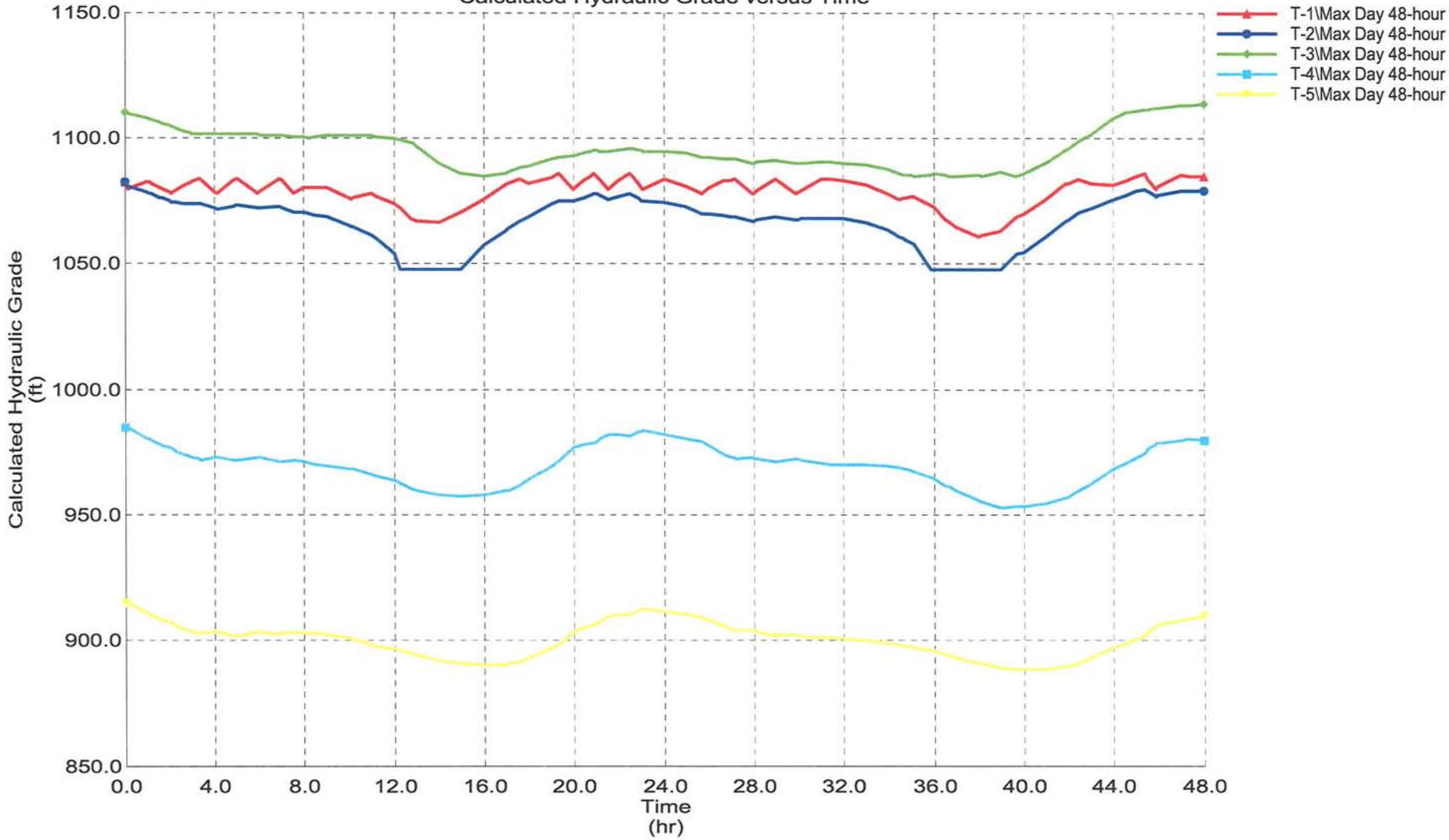
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Contour Plot - Pressure
Scenario: Max Hour 2030



Graph

2030 Storage
Calculated Hydraulic Grade versus Time



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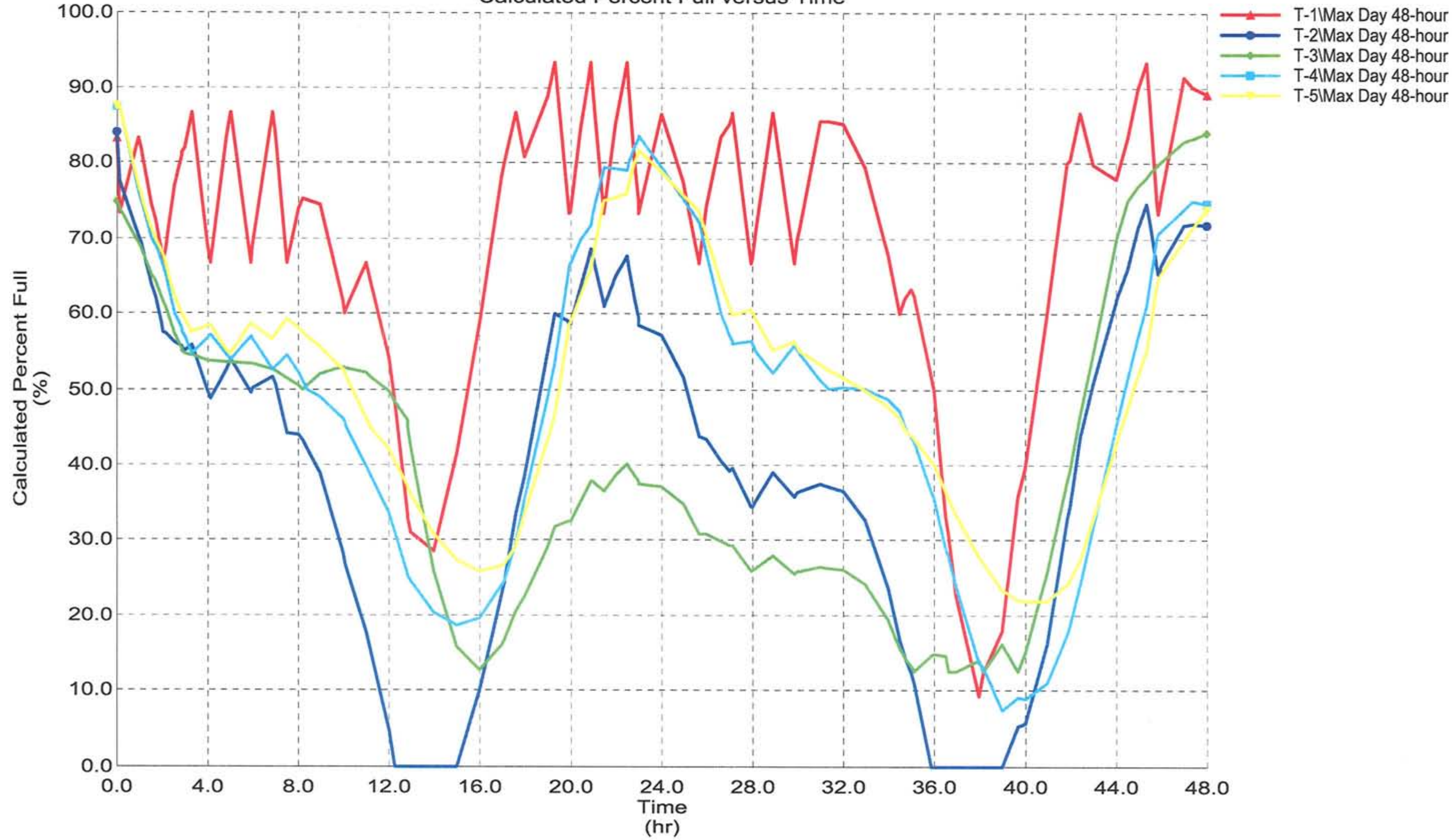
02/07/07 08:14:54 PM

Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph

2030 Storage
Calculated Percent Full versus Time



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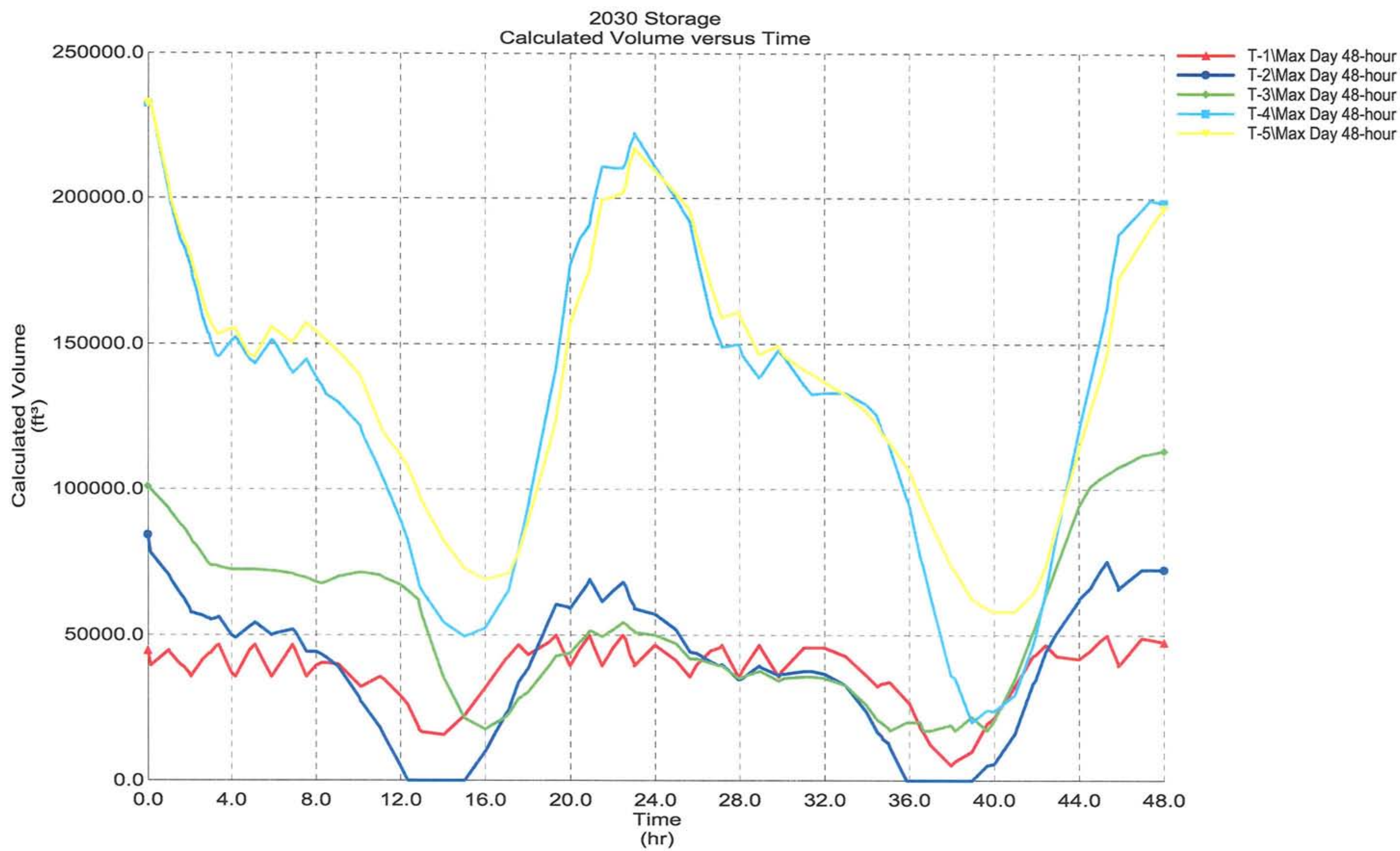
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph



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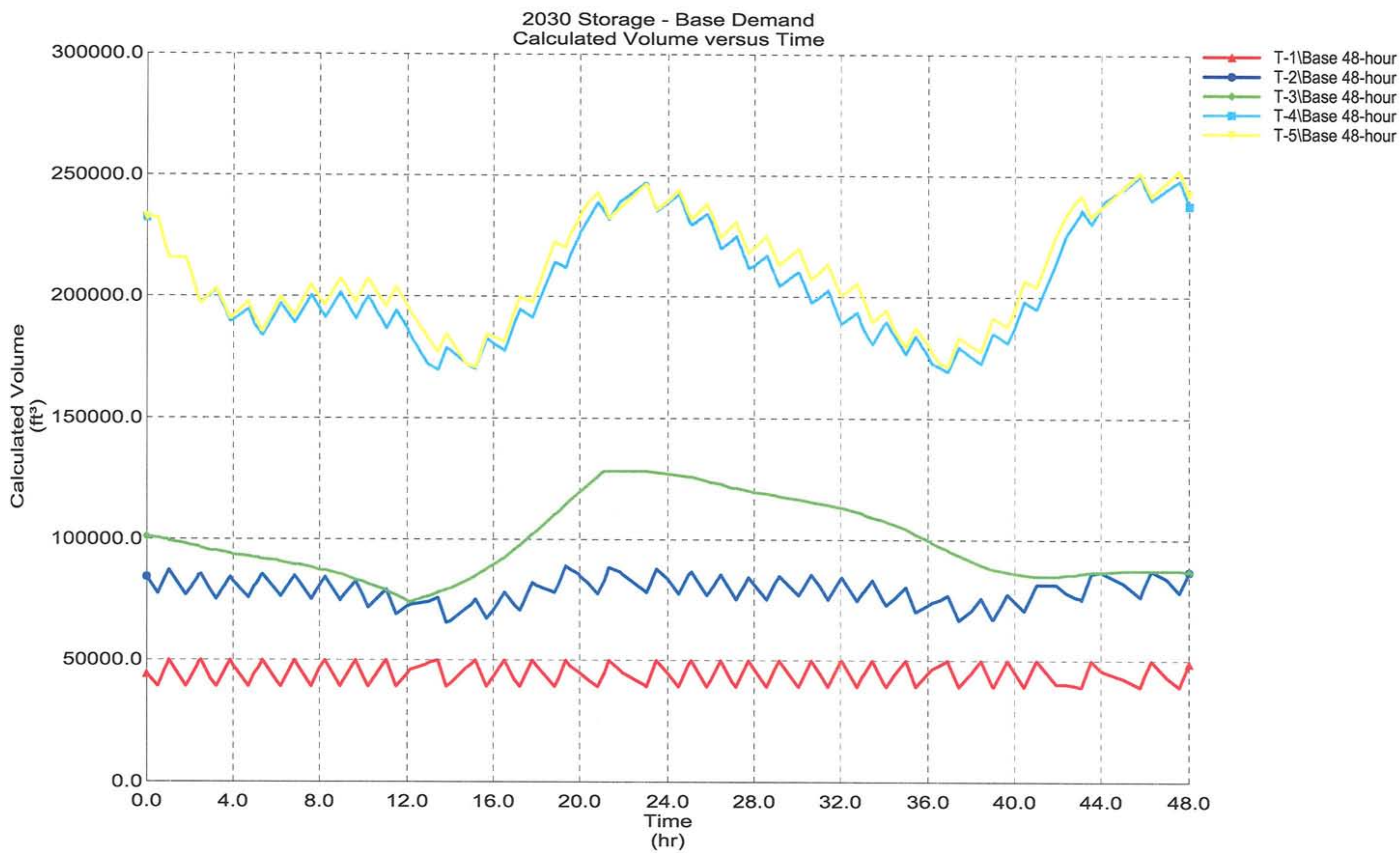
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph



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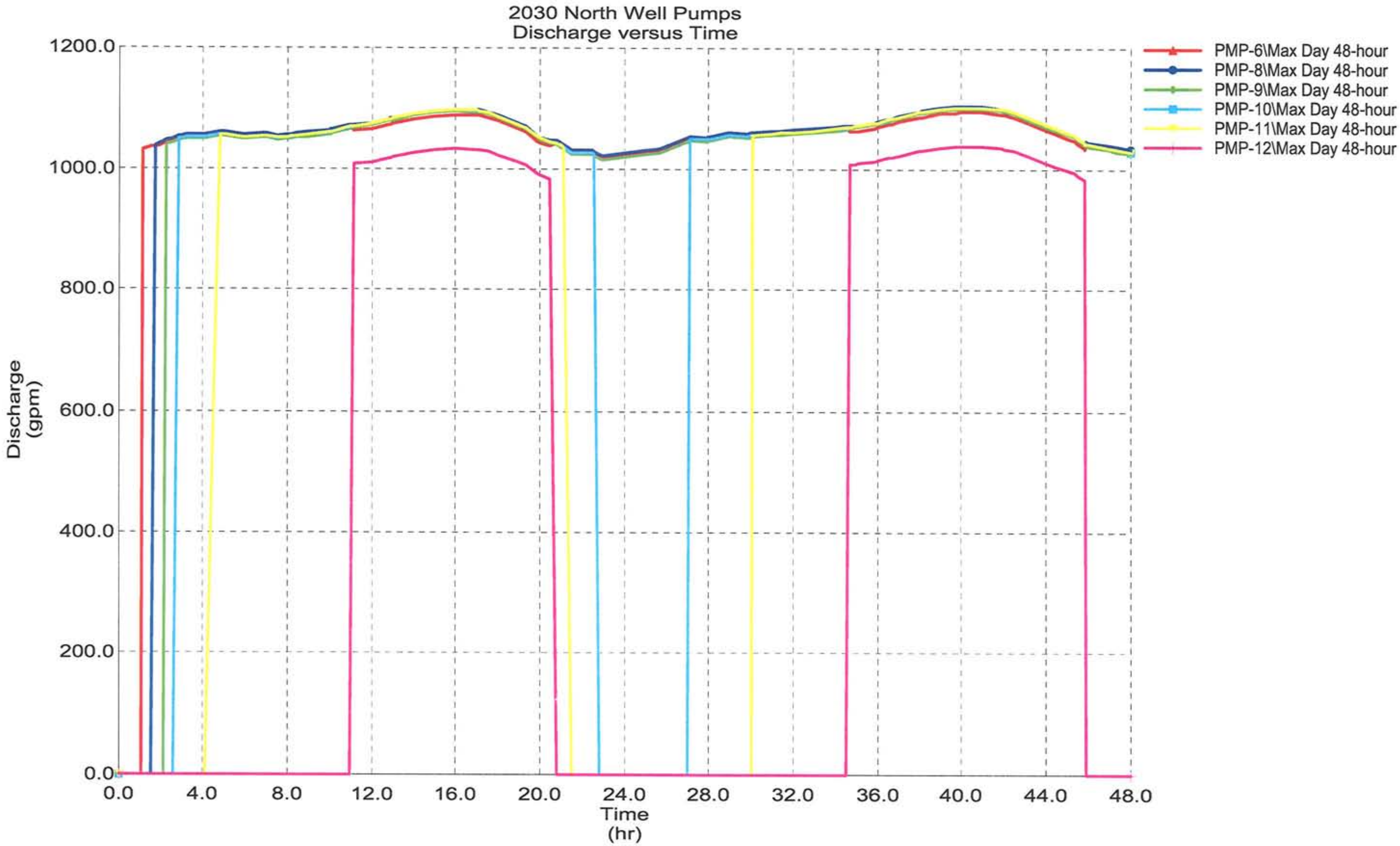
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph



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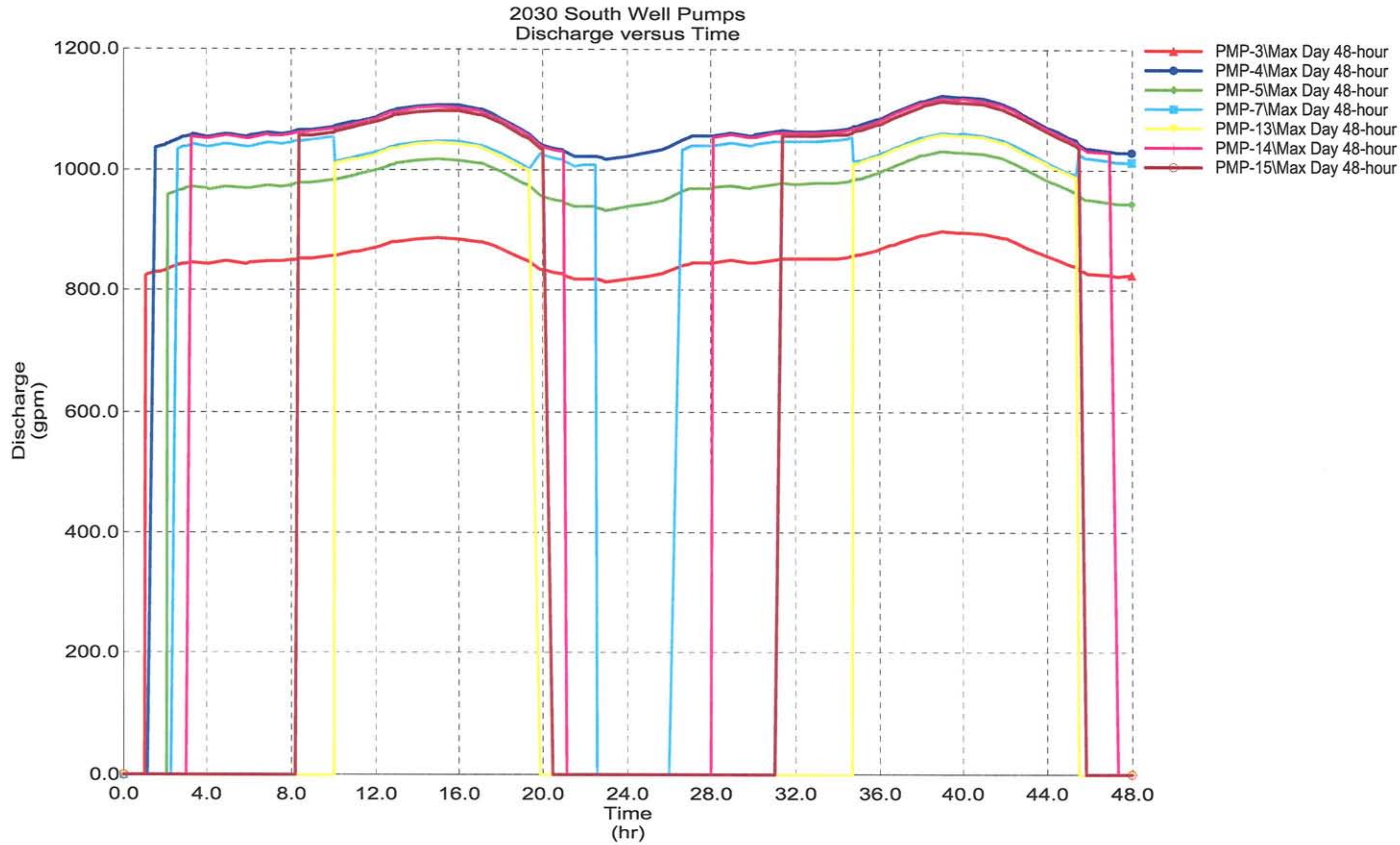
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph



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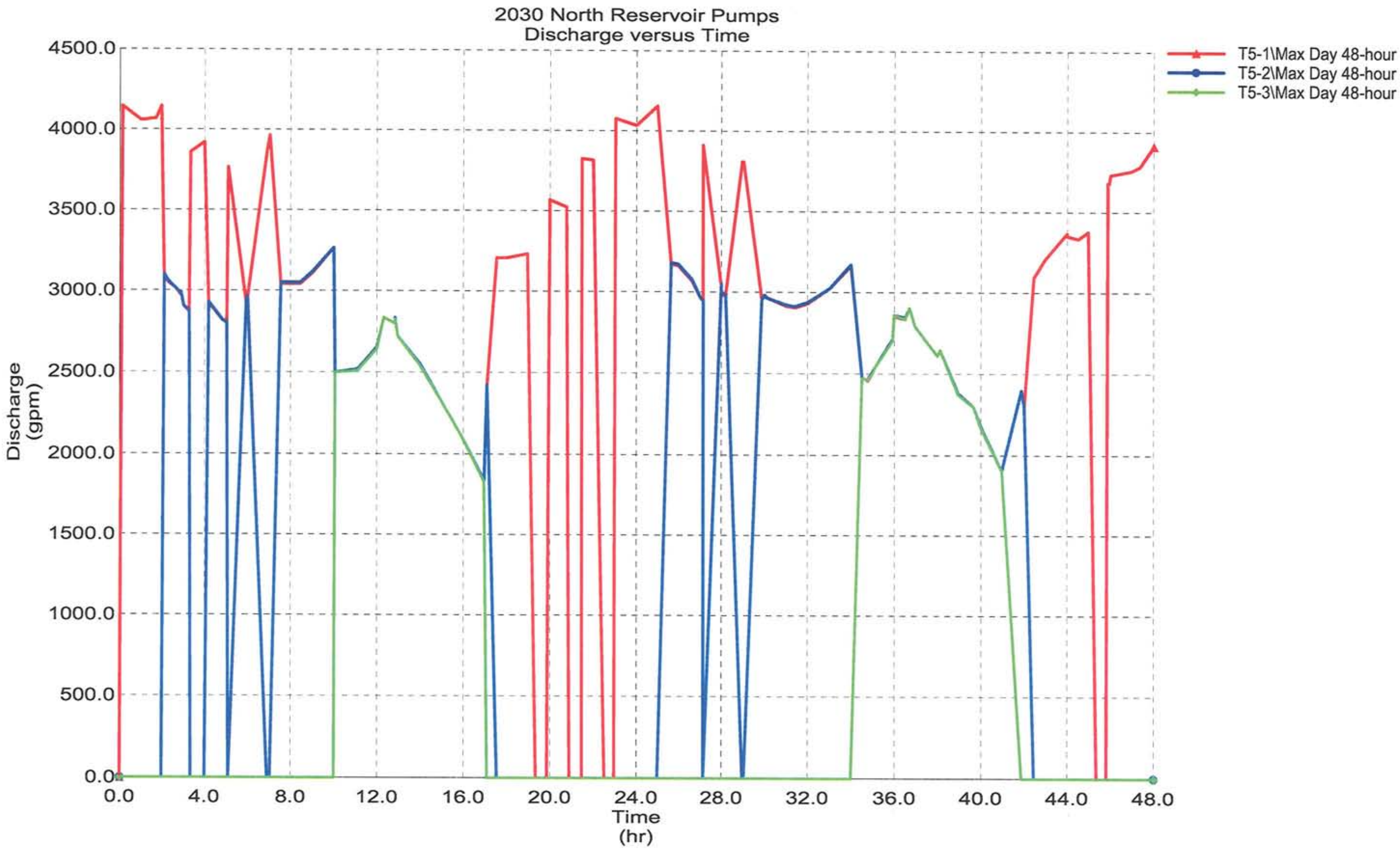
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph



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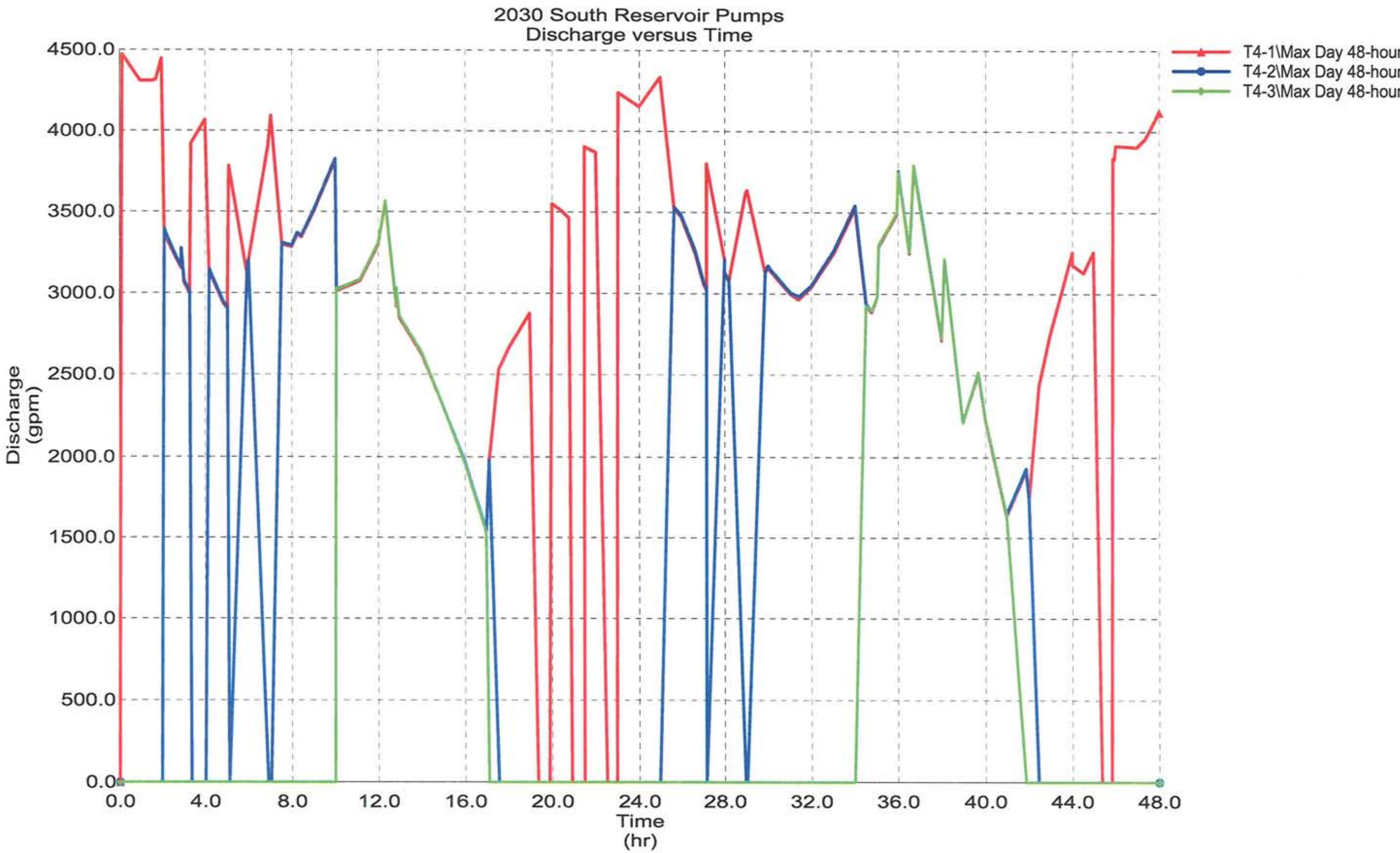
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph



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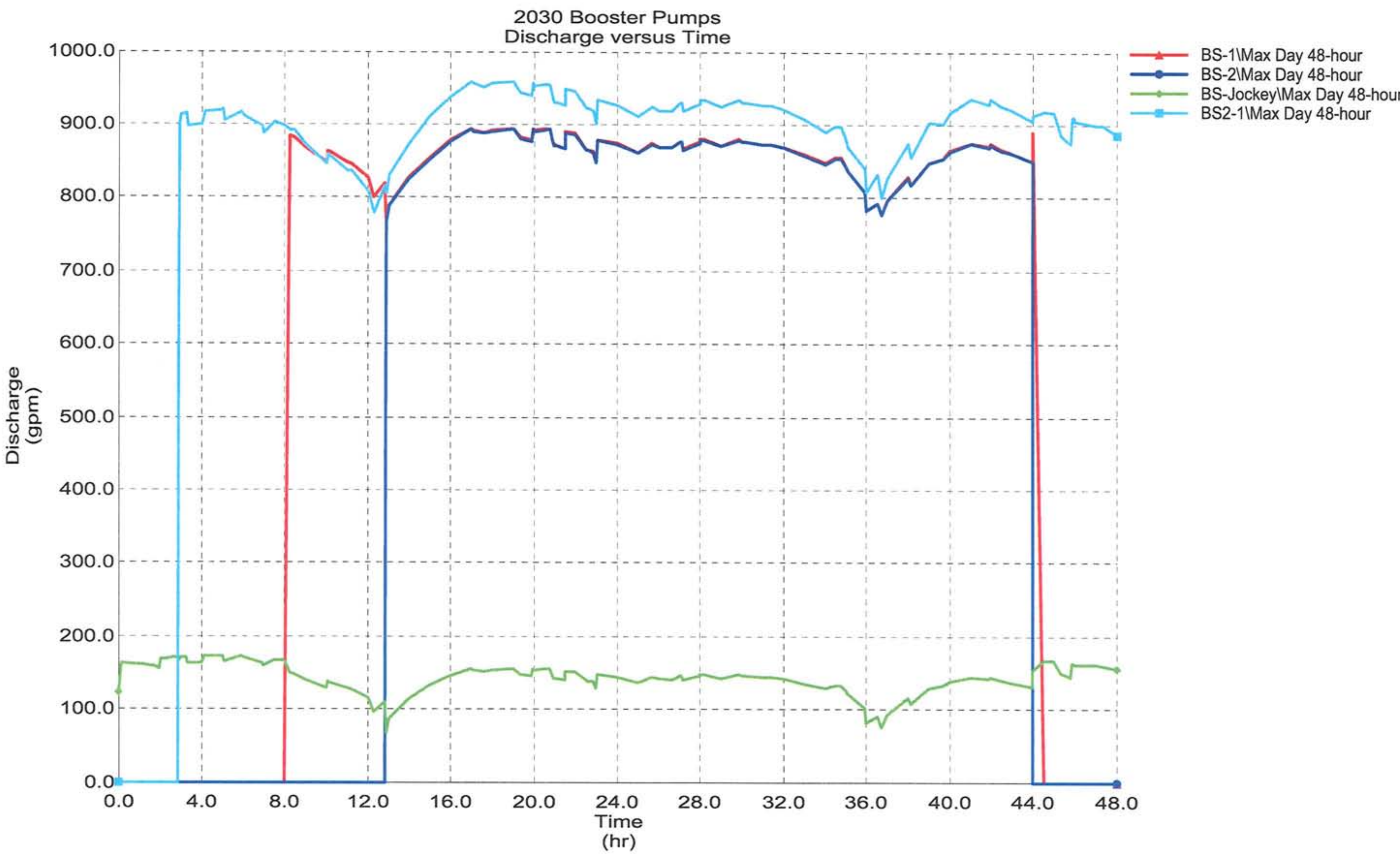
Progressive Consulting Engineers, Inc
PCE Project No. 06026

Graph



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Progressive Consulting Engineers, Inc
PCE Project No. 06026

Detailed Report for Tank: T-3

Scenario Summary	
Scenario	Max Day 48-hour
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Demand- MAX DAY 48-HOUR
Initial Settings Alternative	AD Settings
Operational Alternative	Base-Operational
Age Alternative	Base-Age Alternative
Constituent Alternative	Base-Constituent
Trace Alternative	Base-Trace Alternative
Fire Flow Alternative	Base-Fire Flow
Capital Cost Alternative	Base-Cost
Energy Cost Alternative	Base-Energy Cost
User Data Alternative	Base-User Data

Global Adjustments Summary			
	<None>	Roughness	<None>

Geometric Summary			
X	460,419.82 ft	Elevation	1,080.00 ft
Y	240,390.74 ft	Zone	Boosted

Demand Summary

Type	Base Flow (gpm)	Pattern
Demand	0.00	Fixed

Operating Range Summary			
Maximum Elevation	1,120.00 ft	Maximum Level	40.00 ft
Initial HGL	1,110.00 ft	Initial Level	30.00 ft
Minimum Elevation	1,080.00 ft	Minimum Level	0.00 ft
Base Elevation	1,080.00 ft		

Storage			
Section Type	Constant Area	Circular Tank Shape?	true
Diameter	65.50 ft	Average Area	3,369.6 ft²
Inactive Volume	0.000 ft³	Total Active Volume	134,782.179 ft³

User Data			
Date Installed		Date Retired	
Inspection Date		Observed Level	0.0 ft
Condition		Lining	
SCADA ID		Clearwell Storage	false
Elevated Tank	false	Existing	false
Metered	false		

Calculated Results Summary

Time (hr)	Calculated Hydraulic Grade (ft)	Calculated Level (ft)	Pressure (psi)	Calculated Percent Full (%)	Calculated Volume (ft³)	Inflow (gpm)	Outflow (gpm)	Current Status
0.00	1,110.00	30.00	13.01	75.0	1,086.634	-993.02	993.02	Draining
0.17	1,109.61	29.61	12.84	74.0	9,770.402	-953.68	953.68	Draining

Detailed Report for Tank: T-3

Calculated Results Summary

Time (hr)	Calculated Hydraulic Grade (ft)	Calculated Level (ft)	Pressure (psi)	Calculated Percent Full (%)	Calculated Volume (ft³)	Inflow (gpm)	Outflow (gpm)	Current Status
1.00	1,107.71	27.71	12.01	69.3	3,385.030	1,202.76	1,202.76	Draining
1.10	1,107.44	27.44	11.90	68.6	2,457.909	1,202.94	1,202.94	Draining
1.17	1,107.23	27.23	11.81	68.1	1,758.661	1,203.06	1,203.06	Draining
1.57	1,106.07	26.07	11.30	65.2	7,860.968	1,203.72	1,203.72	Draining
1.72	1,105.66	25.66	11.13	64.2	6,471.932	1,203.91	1,203.91	Draining
2.00	1,104.85	24.85	10.77	62.1	3,733.346	1,331.17	1,331.17	Draining
2.08	1,104.59	24.59	10.66	61.5	2,873.271	1,318.77	1,318.77	Draining
2.16	1,104.34	24.34	10.55	60.8	2,000.444	1,318.58	1,318.58	Draining
2.31	1,103.88	23.88	10.35	59.7	0,478.551	1,318.19	1,318.19	Draining
2.60	1,102.98	22.98	9.96	57.4	7,418.311	1,317.38	1,317.38	Draining
2.87	1,102.12	22.12	9.59	55.3	4,527.125	1,316.48	1,316.48	Draining
2.91	1,102.00	22.00	9.54	55.0	4,131.432	-419.09	419.09	Draining
3.00	1,101.91	21.91	9.50	54.8	3,820.472	-154.07	154.07	Draining
3.28	1,101.81	21.81	9.45	54.5	3,477.841	-153.20	153.20	Draining
3.35	1,101.78	21.78	9.44	54.4	3,386.938	-179.10	179.10	Draining
4.00	1,101.50	21.50	9.32	53.8	2,454.882	-52.74	52.74	Draining
4.15	1,101.48	21.48	9.31	53.7	2,389.893	-27.32	27.32	Draining
4.85	1,101.44	21.44	9.29	53.6	2,237.703	-22.69	22.69	Draining
5.00	1,101.43	21.43	9.29	53.6	2,210.145	-21.82	21.82	Draining
5.07	1,101.43	21.43	9.29	53.6	2,197.805	-44.20	44.20	Draining
5.91	1,101.34	21.34	9.25	53.3	1,901.241	-26.52	26.52	Draining
6.00	1,101.33	21.33	9.25	53.3	1,881.087	-157.96	157.96	Draining
6.89	1,101.00	21.00	9.10	52.5	0,749.127	-179.00	179.00	Draining
7.00	1,100.95	20.95	9.08	52.4	0,596.526	-316.58	316.58	Draining
7.53	1,100.55	20.55	8.91	51.4	9,244.098	-292.05	292.05	Draining
8.00	1,100.22	20.22	8.77	50.6	8,149.157	-422.55	422.55	Draining
8.22	1,100.00	20.00	8.67	50.0	7,391.089	438.59	-438.59	Filling
8.43	1,100.21	20.21	8.76	50.5	8,105.557	435.72	-435.72	Filling
9.00	1,100.81	20.81	9.02	52.0	0,109.109	148.49	-148.49	Filling
10.00	1,101.16	21.16	9.17	52.9	1,300.299	-158.88	158.88	Draining
10.08	1,101.13	21.13	9.16	52.8	1,197.468	-123.71	123.71	Draining
10.15	1,101.11	21.11	9.15	52.8	1,128.366	-124.52	124.52	Draining
11.00	1,100.86	20.86	9.04	52.1	0,279.808	-416.69	416.69	Draining
11.19	1,100.67	20.67	8.96	51.7	9,645.548	-420.41	420.41	Draining
12.00	1,099.86	19.86	8.61	49.6	6,913.544	-729.33	729.33	Draining
12.30	1,099.34	19.34	8.39	48.4	5,179.408	-802.73	802.73	Draining
12.83	1,098.32	18.32	7.94	45.8	1,734.993	3,860.30	3,860.30	Draining
12.87	1,098.00	18.00	7.80	45.0	0,651.158	3,290.03	3,290.03	Draining
13.00	1,096.95	16.95	7.35	42.4	7,125.301	2,771.89	2,771.89	Draining
14.00	1,090.36	10.36	4.49	25.9	4,892.493	1,705.51	1,705.51	Draining
15.00	1,086.30	6.30	2.73	15.7	1,212.727	-497.98	497.98	Draining
16.00	1,085.11	5.11	2.22	12.8	7,218.785	530.67	-530.67	Filling
17.00	1,086.37	6.37	2.76	15.9	1,475.151	1,641.54	1,641.54	Filling
17.08	1,086.69	6.69	2.90	16.7	2,542.945	1,271.01	1,271.01	Filling
17.59	1,088.22	8.22	3.57	20.6	7,711.213	776.99	-776.99	Filling
18.00	1,088.99	8.99	3.90	22.5	0,278.277	1,112.95	1,112.95	Filling
19.00	1,091.64	11.64	5.04	29.1	9,205.210	1,238.79	1,238.79	Filling
19.36	1,092.68	12.68	5.50	31.7	2,732.302	230.58	-230.58	Filling
19.90	1,092.98	12.98	5.63	32.5	3,746.212	55.59	-55.59	Filling
19.99	1,092.99	12.99	5.63	32.5	3,785.287	1,205.65	1,205.65	Filling
20.00	1,093.02	13.02	5.64	32.5	3,868.786	936.39	-936.39	Filling
20.47	1,094.06	14.06	6.10	35.2	7,377.779	1,038.70	1,038.70	Filling
20.77	1,094.82	14.82	6.42	37.0	9,921.397	1,082.63	1,082.63	Filling

Detailed Report for Tank: T-3

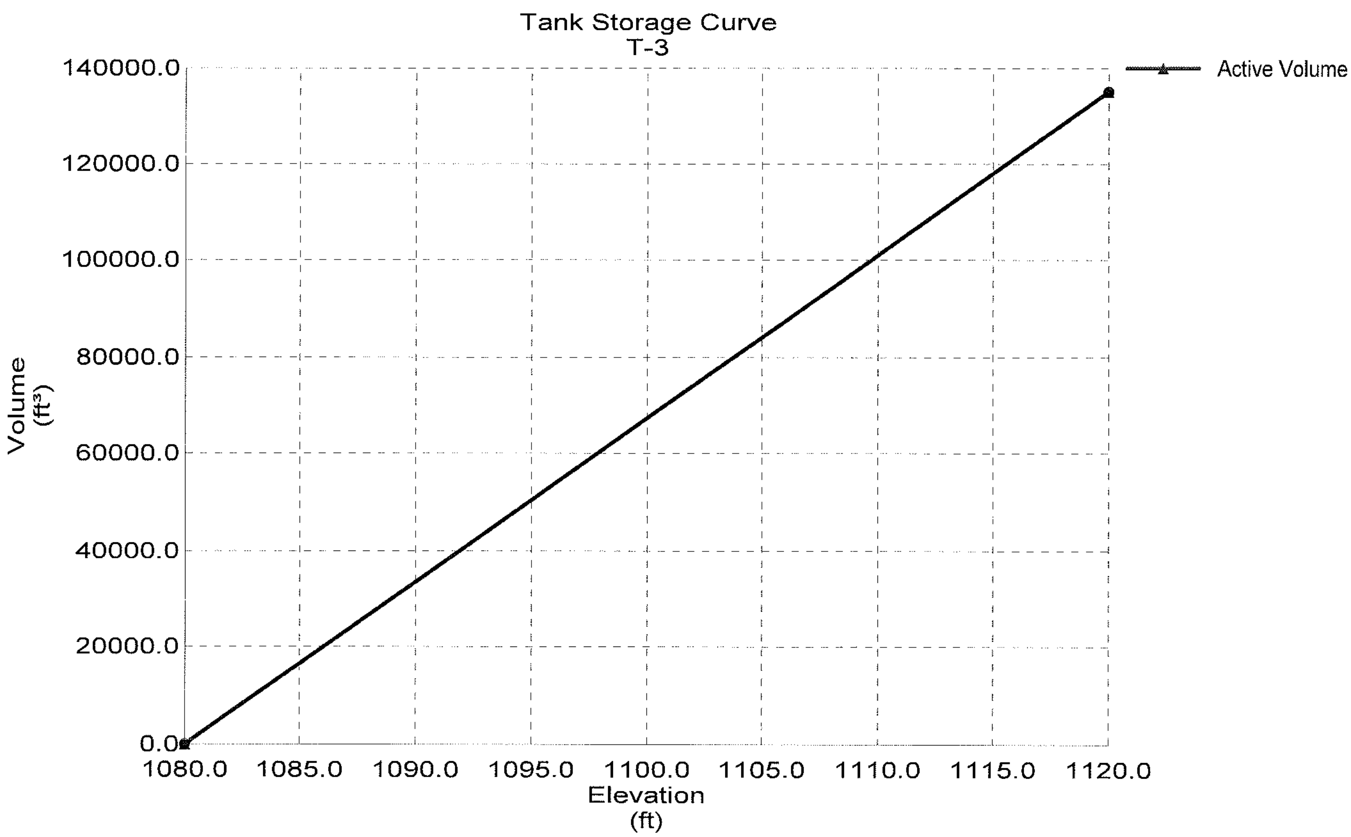
Calculated Results Summary

Time (hr)	Calculated Hydraulic Grade (ft)	Calculated Level (ft)	Pressure (psi)	Calculated Percent Full (%)	Calculated Volume (ft³)	Inflow (gpm)	Outflow (gpm)	Current Status
20.92	1,095.18	15.18	6.58	38.0	1,161.124	-96.94	96.94	Draining
21.00	1,095.16	15.16	6.57	37.9	1,095.312	-418.07	418.07	Draining
21.13	1,095.03	15.03	6.52	37.6	0,660.133	-463.55	463.55	Draining
21.51	1,094.62	14.62	6.34	36.5	9,256.700	-592.64	592.64	Draining
21.51	1,094.61	14.61	6.33	36.5	9,223.794	711.96	-711.96	Filling
22.00	1,095.43	15.43	6.69	38.6	1,997.754	527.59	-527.59	Filling
22.52	1,096.09	16.09	6.97	40.2	4,200.797	-765.24	765.24	Draining
22.60	1,095.95	15.95	6.91	39.9	3,735.180	-791.82	791.82	Draining
22.85	1,095.48	15.48	6.71	38.7	2,152.822	-877.83	877.83	Draining
23.00	1,095.15	15.15	6.57	37.9	1,065.285	1,567.96	1,567.96	Draining
23.04	1,095.01	15.01	6.51	37.5	0,579.925	-71.50	71.50	Draining
24.00	1,094.85	14.85	6.44	37.1	0,028.341	-386.72	386.72	Draining
25.00	1,093.93	13.93	6.04	34.8	6,926.558	-993.91	993.91	Draining
25.67	1,092.34	12.34	5.35	30.9	1,583.066	20.16	-20.16	Filling
26.00	1,092.36	12.36	5.36	30.9	1,636.538	-268.98	268.98	Draining
26.64	1,091.95	11.95	5.18	29.9	0,257.374	-300.82	300.82	Draining
27.00	1,091.69	11.69	5.07	29.2	9,387.015	167.09	-167.09	Filling
27.12	1,091.74	11.74	5.09	29.3	9,547.842	160.01	-160.01	Filling
27.16	1,091.75	11.75	5.09	29.4	9,596.790	-722.16	722.16	Draining
27.96	1,090.38	10.38	4.50	25.9	4,964.475	97.86	-97.86	Filling
28.00	1,090.39	10.39	4.50	26.0	4,997.381	352.42	-352.42	Filling
28.15	1,090.51	10.51	4.56	26.3	5,410.348	346.75	-346.75	Filling
28.95	1,091.17	11.17	4.84	27.9	7,648.766	-457.58	457.58	Draining
29.00	1,091.12	11.12	4.82	27.8	7,468.195	-464.03	464.03	Draining
29.85	1,090.18	10.18	4.41	25.4	4,301.423	364.18	-364.18	Filling
30.00	1,090.31	10.31	4.47	25.8	4,737.013	112.07	-112.07	Filling
30.11	1,090.34	10.34	4.48	25.8	4,834.086	114.95	-114.95	Filling
31.00	1,090.58	10.58	4.59	26.5	5,656.731	-73.19	73.19	Draining
31.40	1,090.51	10.51	4.56	26.3	5,423.099	-86.07	86.07	Draining
32.00	1,090.39	10.39	4.50	26.0	5,007.252	-311.32	311.32	Draining
33.00	1,089.65	9.65	4.18	24.1	2,510.524	-805.72	805.72	Draining
34.00	1,087.73	7.73	3.35	19.3	6,047.824	1,310.40	1,310.40	Draining
34.50	1,086.18	6.18	2.68	15.5	0,836.367	-716.99	716.99	Draining
34.70	1,085.84	5.84	2.53	14.6	9,668.623	-720.35	720.35	Draining
34.77	1,085.71	5.71	2.48	14.3	9,249.896	-721.57	721.57	Draining
35.00	1,085.32	5.32	2.31	13.3	7,926.671	1,181.88	1,181.88	Draining
35.11	1,085.00	5.00	2.17	12.5	6,846.950	433.08	-433.08	Filling
35.91	1,085.82	5.82	2.52	14.6	9,617.207	327.41	-327.41	Filling
36.00	1,085.89	5.89	2.55	14.7	9,850.016	-20.93	20.93	Draining
36.55	1,085.86	5.86	2.54	14.7	9,758.291	2,461.55	2,461.55	Draining
36.69	1,085.00	5.00	2.17	12.5	6,846.127	-47.21	47.21	Draining
37.00	1,084.97	4.97	2.15	12.4	6,730.134	281.84	-281.84	Filling
38.00	1,085.64	5.64	2.44	14.1	8,990.352	1,606.38	1,606.38	Draining
38.17	1,085.00	5.00	2.17	12.5	6,846.538	739.73	-739.73	Filling
39.00	1,086.47	6.47	2.80	16.2	1,792.692	-872.61	872.61	Draining
39.71	1,085.00	5.00	2.17	12.5	6,848.595	1,378.25	1,378.25	Filling
40.00	1,085.96	5.96	2.59	14.9	0,094.341	1,792.73	1,792.73	Filling
41.00	1,090.23	10.23	4.44	25.6	4,473.356	2,334.06	2,334.06	Filling
41.88	1,095.12	15.12	6.56	37.8	0,953.406	2,316.98	2,316.98	Filling
42.00	1,095.78	15.78	6.84	39.5	3,178.249	2,582.14	2,582.14	Filling
42.48	1,098.70	18.70	8.11	46.8	3,015.851	2,550.21	2,550.21	Filling
43.00	1,101.89	21.89	9.49	54.7	3,754.661	2,531.18	2,531.18	Filling
44.00	1,107.91	27.91	12.10	69.8	4,056.720	2,364.27	2,364.27	Filling

Detailed Report for Tank: T-3

Calculated Results Summary

Time (hr)	Calculated Hydraulic Grade (ft)	Calculated Level (ft)	Pressure (psi)	Calculated Percent Full (%)	Calculated Volume (ft³)	Inflow (gpm)	Outflow (gpm)	Current Status
44.02	1,108.00	28.00	12.14	70.0	4,346.703	1,585.81	1,585.81	Filling
44.55	1,110.00	30.00	13.01	75.0	1,087.868	713.33	-713.33	Filling
45.00	1,110.77	30.77	13.34	76.9	3,689.483	587.44	-587.44	Filling
45.37	1,111.29	31.29	13.57	78.2	5,438.016	540.88	-540.88	Filling
45.56	1,111.53	31.53	13.67	78.8	6,249.144	533.96	-533.96	Filling
45.84	1,111.89	31.89	13.82	79.7	7,443.624	523.45	-523.45	Filling
45.88	1,111.94	31.94	13.85	79.9	7,634.889	577.20	-577.20	Filling
45.93	1,112.01	32.01	13.88	80.0	7,856.181	577.60	-577.60	Filling
46.00	1,112.10	32.10	13.92	80.3	8,179.069	447.53	-447.53	Filling
47.00	1,113.17	33.17	14.38	82.9	1,768.681	193.09	-193.09	Filling
47.38	1,113.35	33.35	14.46	83.4	2,360.986	191.93	-191.93	Filling
48.00	1,113.63	33.63	14.58	84.1	3,311.552	-75.34	75.34	Draining



Notes:
NEW TOWER LOCATION 1

APPENDIX D

Water Quality and SDWA Regulations

EPA National Primary Drinking Water Standards

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Acrylamide	TT[8]	Nervous system or blood problems;	Added to water during sewage/wastewater increased risk of cancer treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha particles	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010 as of 1/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta particles and photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes	MRDLG=4[1]

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[7]; Action Level = 1.3	Short term exposure: Gastrointestinal distress. Long term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, live problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidneys problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadien e	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT[7]; Action Level = 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms (including fecal coliform and *E. coli*)	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste.	zero
DBP	Total Trihalomethanes (TTHMs)	0.10 0.080 after 12/31/03	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.20
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero
M	Turbidity	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing micro-organisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

NOTES

1 Definitions

- 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 and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium* (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
- *Giardia lamblia*: 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, for systems servicing >10,000, and January 14, 2005, for systems servicing <10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

4 No more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E. coli* fecal coliforms, system has an acute MCL violation.

5 Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

6 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

7 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

8 Each water system must certify, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05% dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent).

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

National Secondary Drinking Water Standards

National Secondary Drinking Water Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Office of Water (4606M)
EPA 816-F-03-016
www.epa.gov/safewater
June 2003

SECTION 12
UTILITIES - billed on UB Banyon software (11700 a/r)

			2004-06	2007
SEWER USAGE - per 1,000 gallons				
Residential usage			1.96	1.96
Commercial/Industrial usage				
Sewer Penalties				
WATER USAGE - per 1,000 gallons - pending rate study				
Residential usage			1.24	1.35
Residential basic charge				
Commercial/Industrial usage				
Commercial/Industrial basic charge				
Water Penalties				
WATER METER BASIC CHARGES - building permits - pending rate study				
- 0.60"	Per Mo.		1.25	1.25
- 0.75"	Per Mo.		1.42	1.42
- 1.00"	Per Mo.		1.75	1.75
- 1.50"	Per Mo.		2.25	2.25
- 2.00"	Per Mo.		3.67	3.67
- 3.00"	Per Mo.		13.75	13.75
- 4.00"	Per Mo.		17.50	17.50
STORM WATER UTILITY FEES (based on land use)				
Ag Property	Per Mo.		N/C	N/C
Single-Family Residential	Per Mo.		3.00	3.00
Townhouse / Two-Family Residential	Per Mo.		2.00	2.00
Schools / Churches /Institutional	Per Mo.		3.00	3.00
Commercial / Industrial/Retail	Per Mo.	Per Acre	16.00	16.00
Multi-Family / Apartments	Per Mo.	Per Acre	12.00	12.00
Impervious Charge	Per Mo.	Per Acre	21.70	21.70
Storm Sewer Penalties			21.70	21.70

APPENDIX E

Rogers Water Rate Structure

ORDINANCE NO. 2005-09

AN ORDINANCE AMENDING ORDINANCE NO. 55 ENTITLED: AN ORDINANCE PRESCRIBING RULES AND REGULATIONS FOR THE ADMINISTRATION OF THE MUNICIPAL WATER SYSTEM, AND PRESCRIBING PENALTIES FOR THE VIOLATION THEREOF

The Rogers City Council ordains as follows:

Section 1. Section 13 of Ordinance No. 55, as amended, is hereby further amended to read as follows:

Section 13. Water in Name of Owner/Rates.

B. Commodity Rate.

1. A bi-monthly water ("commodity") charge of ~~$1.24~~ $1.35 per thousand gallons

Strikeout indicates deletion and underline indicates new material.

Section 2. This Ordinance shall have full force and effect upon its passage and publication.

Passed by the City Council of the City of Rogers, Hennepin County, Minnesota, this 23rd day of August, 2005.

Leigh J. Stanley
Mayor

ATTEST:

Stacy Koloszewski
Clerk

ORDINANCE NO. 2003-10

AN ORDINANCE FURTHER AMENDING THE WATER RATES ESTABLISHED IN ORDINANCE NO. 55, ENTITLED: "AN ORDINANCE PRESCRIBING RULES AND REGULATIONS FOR THE ADMINISTRATION OF THE MUNICIPAL WATER SYSTEM, AND PRESCRIBING PENALTIES FOR THE VIOLATION THEREOF", AS AMENDED (INCLUDING AMENDMENT BY ORDINANCE NO. 2000-10) BY FURTHER RATE CHANGES

The City Council of the City of Rogers ordains:

Section 1. Section 13 of Ordinance No. 55 adopted May 11, 1956 and entitled "An Ordinance Prescribing Rules and Regulations for the Administration of the Municipal Water System, and Prescribing Penalties for the Violation Thereof", as amended (including amendment by Ordinance No. 2000-10) is hereby further amended as follows:

Section 2. Section 13 of said Ordinance No. 55, as amended, is hereby further amended to read as follows:

"Section 13. Water in Name of Owner/Rates.

"Where possible all accounts carried upon the books of the municipal water department shall be with the owner in fee simple of the property served, or the authorized agent for the owner and said owner shall at all times be liable for water used upon the premises, whether the owner is occupying the same or not. The water bill shall be sent bi-monthly to all customers and shall be due on or before the 20th of the following month. The following rates for water service rendered shall be charged:

A. Fixed Charges. A fixed bi-monthly meter charge of $2.50 per meter equivalent (as hereafter described). For purposes of this section, the meter equivalent charge shall be calculated in accordance with the following schedule:

Meter Size		Meter Equivalent
5/8"	equals	1
3/4"	"	1.133
1"	"	1.4
1½"	"	1.8
2"	"	2.9
3"	"	11
4"	"	14

B. Commodity Rate.

1. A bi-monthly water ("commodity") charge of $1.24 per 1,000 gallons.

C. Users Taking Directly from Hydrant.

1. A bi-monthly flat rate of $5.00 per 1,000 gallons for usage of zero (0) gallons to 100,000 gallons and $3.00 per 1,000 gallons for usage over 101,000 gallons.

D. Late Charges. In addition to the charges provided above, there will be added to the current bi-monthly billing, if not paid by due date, a late charge of 1.5% for each month or part thereof calculated against the arrears."

Section 3. This Ordinance shall be in full force and effect from and after its passage and publication.

Passed by the City Council this 8th day of July, 2003.

Mayor

ATTEST:

City Clerk

(Published in the North Crow River News July 28, 2003).

INSERT A

Water Distribution System Map – 2006

INSERT B

Water Distribution System Map – 2015

INSERT C

Water Distribution System Map – 2030