The City of Clio
Water Reliability Study

May 2013

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I. Executive Summary

Following is a summary of this report's findings.

- **Supply** – Water is supplied by the Genesee County Drain Commissioner at three meter pits located at the city limits, although only two are typically used. There are no backup supply wells in the city.
- **Water Quality** – Water supplied from Genesee County is treated prior to supply to the city's distribution system. The city does not perform any additional water treatment operations. The water has concisely met applicable regulations.
- **Storage** –There are no active storage facilities in The City of Clio. Genesee County supplies adequate pressure and flow to meet the maximum day demands and fire flow needs.
- **Distribution System** – A computer model of the city's water system has been developed. The model provides the ability to simulate and evaluate a variety of demand conditions. Analysis indicates that the distribution system can normally supply the domestic demands of the city's current customers. The distribution system varies in size from two to twelve inches.
- **Fire Protection** –The ISO recommends a residential fire flow of 1,000 gpm and 2,000 to 5,000 gpm for commercial and industrial areas. Based on these recommendations, fire flow was found to be low in many areas throughout the city due to undersized watermains and dead end lines. The city has three emergency connections to Vienna Township located at the southern city limits on Pine Street, Allen Street and New Street. These connections are normally closed and are only opened in emergency situations, such as fire.

A. Recommendations

- **Distribution System** – It is recommended that the city implement distribution improvement projects that increase available fire flow by eliminating mains under 6 inches in diameter and dead end mains. Improvement projects can be implemented over time as funds become available.
- **System Maintenance** – It is recommended that the city implement a valve turning program where each valve is inspected and operated annually, or on a schedule that works with available manpower. A valve turning program has the benefit of identifying valves in need of repair or replacement, and extending the life of existing valves. In addition, it is recommended that the city flush hydrants annually. Hydrant flushing helps ensure the reliable service of the city's hydrants and flushes sediment form the mains.

II. Introduction

A. General

The City of Clio is located in Genesee County and owns and operates a water distribution system. The city purchases water from the Genesee County Drain Commissioner – Division of Water and Waste Services (GCDC-WWS). Water is supplied to Clio at metered locations located at the city limits.

The existing Clio system currently services the residents of the city. Approximately 177,000 gallons of water are used in the Clio system on an average day.

The distribution system consists of a network of two- to twelve-inch diameter watermains, control valves and metering pits. There are no backup wells or active water storage facilities. The water system provides water for residential and commercial use and water for firefighting for the service area. A map of the existing water system is shown in Figure II.1.

B. Purpose and Scope

The previous water study for the city was performed in August 2006. The purpose of this study is to conduct an updated general evaluation of the city's water distribution system. The scope of the study includes analyzing the distribution system's response to current and projected future water and firefighting demands, and to recommend distribution system improvements to address any deficiencies within the service area. The planning periods for this system evaluation are 5 years (year 2018) and 20 years (year 2033). The primary elements of this study include:

- Evaluation of historical trends of population growth, development, service area expansion and water use
- Projection of future population, service area and water requirements
- Evaluation of the adequacy of existing distribution facilities
- Hydraulic analyses of the pipeline network to determine the capability of the distribution system to meet current and future water demands
- Development of a master plan for the water distribution system, including recommended improvements

C. Evaluation Criteria

The following criteria have been established as the basis for the water system evaluation. The existing conditions and future requirements were developed in conjunction with City of Clio staff.

- Service Area - The City of Clio
- Design Period - 2013 through 2033
- Current City Demands (average is based on 2011/2012 GCDC-WWS purchase data; maximum day and peak hour are estimated)

Average Annual Day	177,000 gpd
Maximum Day	443,000 gpd
Peak Hour	708,000 gpd

- Future City Demands – 2018 (All demands are rounded off to the nearest thousand gallons)

Average Annual Day	186,000 gpd
Maximum Day	465,000 gpd
Peak Hour	744,000 gpd

- Future City Demands – 2033 (All demands are rounded off to the nearest thousand gallons)
  Average Annual Day 216,000 gpd
  Maximum Day 540,000 gpd
  Peak Hour 864,000 gpd
- Peaking Factors: *Maximum Day*: Average Annual Day x 2.5; *Peak Hour:* Average Annual Day x 4
- Minimum and Maximum Design Pressure – 35 psi, 70 psi
- Minimum Residual Pressure for Fire Flows – 20 psi
- Fire flow assumed concurrent with maximum day demand

(Note: The above listed evaluation design criteria is described in detail within the report.)

D. Abbreviations

Abbreviations used in this report are as follows:

AD	Average day demand
Gal	Gallons
GCDC-WWS	Genesee County Drain Commissioner – Division of Water and Waste Services
gpcd	Gallons per capita day
gpd	Gallons per day
gpm	Gallons per minute
ISO	Insurance Services Office
MD	Maximum day demand
MDEQ	Michigan Department of Environmental Quality
MG	Million gallons
mgd	Million gallons per day
PH	Peak hour demand
psi	Pounds per square inch
USGS	United States Geological Survey
WTP	Water treatment plant

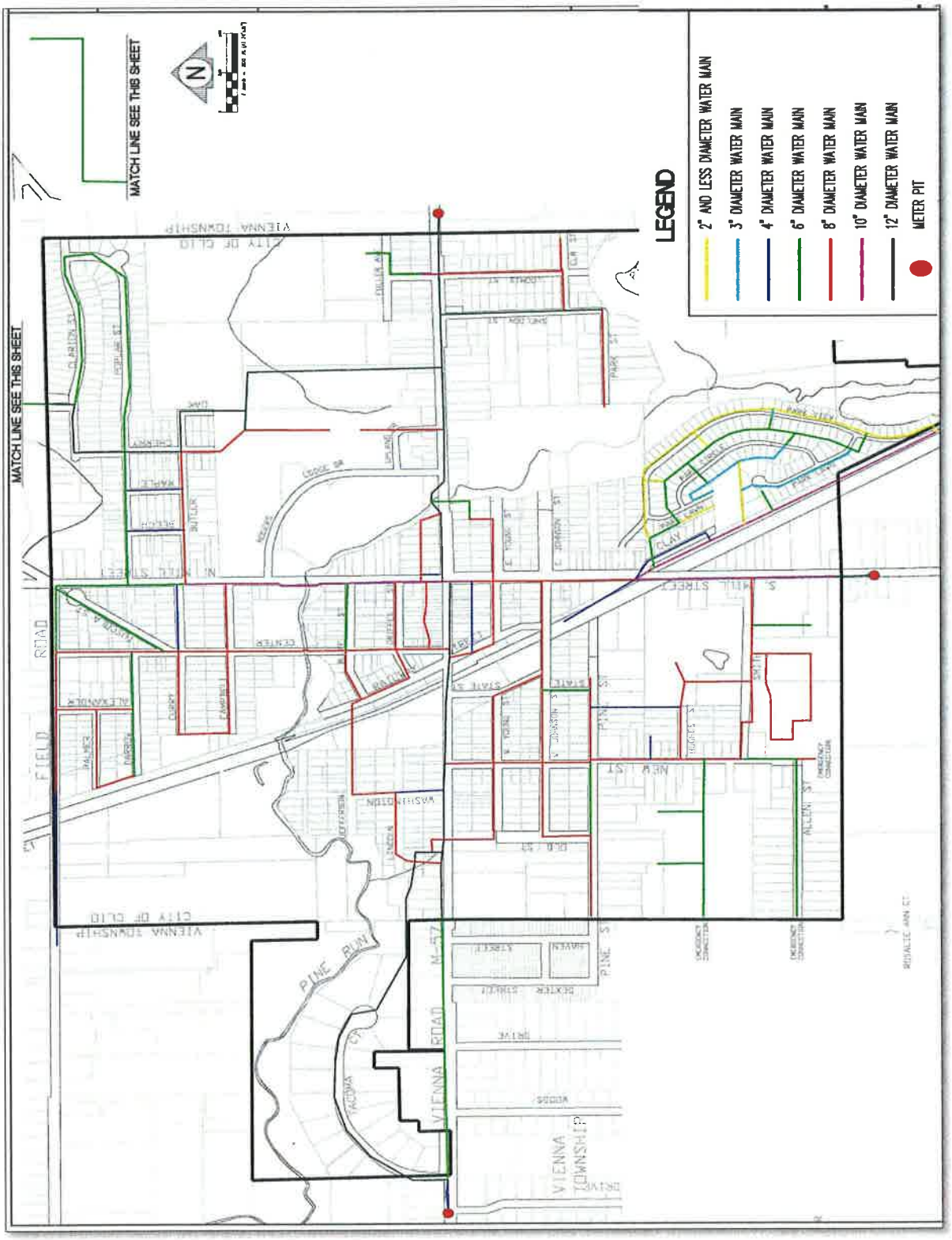


Figure II.1: Existing City Water System

III. Population

Historical population for the City of Clio has been obtained from the U.S. Census Bureau and is presented below.

Table III-1: Historical Population		
Year	The City of Clio Population	Annual Growth Rate
1970	2,357	N/A
1980	2,669	1.32%
1990	2,629	-0.15%
2000	2,483	-0.56%
2010	2,646	0.66%

The city showed a relatively significant population increase between 1970 and 1980. Between 1980 and 2000, the population began to decline before becoming more stable in 2010.

The Genesee County Metropolitan Planning Commission developed population projections for each community in Genesee County in December of 2007. The population projections for the City of Clio presented in that plan are used in this study to aid in the development of future water usage. The following table provides the projected population of the city for the project design period.

Table III-2: Projected Population			
Year	Population	Annual Growth Rate	Notes
2010	2,646	0.66	U.S. Census
2013	2,622	-0.30	Interpolated Between 2010 & 2015
2015	2,611	-0.26	Genesee County Population Estimates
2018	2,619	0.10	Interpolated Between 2015 & 2020
2020	2,618	0.05	Genesee County Population Estimates
2025	2,637	0.10	Genesee County Population Estimates
2030	2,660	0.16	Genesee County Population Estimates
2033	2,676	0.20	Interpolated Between 2030 & 2035
2035	2,679	0.14	Genesee County Population Estimates

IV. Water Requirements

A. Background

A water utility must be able to supply water at rates which fluctuate over a wide range. Yearly, monthly, daily, and hourly variations in water use are to be expected. Water use is typically higher during dry years since more water is used for lawn watering. Water use typically follows a pattern where usage is low at night and peaks in the early morning and late afternoon.

Water demands or rates most important to the design and operation of a water system are average day (AD), maximum day (MD), and peak hour (PH). Average day use is the yearly total water use divided by the number of days in the year. Maximum day use is the maximum quantity of water used on any day of the year. The maximum day rate is used to size water supply and any treatment facilities to ensure that these facilities are capable of producing and treating an adequate quantity of water.

The greatest demands on a water system are generally experienced for short periods of time during the maximum demand day. These peak demands are referred to as peak hour demands which seldom last longer than a few hours. Although the duration of these extreme demands is relatively short, the rate of consumption during the peak hour period often taxes the capabilities of the pumping facilities, distribution mains and system storage. Instantaneous peak demands are generally met by flow from strategically located storage facilities. For the city's system, the lack of active storage means that all peak demands need to be provided through connections to the GCDC-WWS transmission facilities.

B. Historical Water Use

Water use is determined primarily by the size of the population being served and the extent of commercial and industrial activities within the service area. Because of the individual water use characteristics of each water system, historical purchase and sales records serve as the primary basis for predicting future requirements. The City of Clio purchase records from GCDC-WWS indicate the amount of water that is delivered to the distribution system, and show the metered sales for residential, industrial and commercial customers. These records permit the evaluation of water use and loss.

1. Water Consumption

The City of Clio's municipal water system supplies water to the homes and businesses in the city.

Historical water supply records from the GCDC-WWS were used to develop the service area's average water usage. Average day demands within the city's system were determined by dividing the total annual water purchased from GCDC-WWS by the number of days in the year. For the purpose of this report, a billing year is from July 1st to June 30th. Historical annual water use is listed in the following table.

Table IV-1: Historical Annual Water Use (Purchased from Genesee County)		
Year	Annual Usage (gallons)	Average Day (gallons)
2007/2008	74,725,948	204,729
2008/2009	74,471,628	203,474
2009/2010	81,411,572	223,045
2010/2011	73,387,028	201,060
2011/2012	64,449,924	176,575

For the purposes of this study, current water usage will be assumed to be the same as the 2011/2012 usage, which is the most recent year which presented representative water usage data.

The total volume of water pumped into the City of Clio system in 2011/2012 was 64,449,924 gallons, which corresponds to an average day demand of approximately 176,575 gallons. Detailed records of maximum day usage were not available for this study. To be consistent with the city's previous water reliability study, the current and projected maximum day demands will be computed in this study by multiplying 2.5 times the average day demand.

Peak hour demands have not been recorded. To be consistent with the previous water study for this system, this report assumed a peak hour demand of four times the average day demand. This is also consistent with common industry observations and practices for comparable water systems.

2. Unaccounted-for Water Use

The quantity of water pumped into the system is metered as it enters the system via the GCDC-WWS meter pits, located at the city limits. The water is then sold to city customers. Water sold to customers is metered at each customer's connection to the public water supply. The difference between the quantity of water supplied to the system from the GCDC-WWS connections and the quantity of water sold to city customers is termed "unaccounted-for" water.

Water in a public system can be "unaccounted-for" for numerous reasons. Water withdrawn from a fire hydrant, whether to fight a fire, flush a watermain, or any other reason, is unmetered and therefore unaccounted-for. Leaks or breaks in water pipes can also allow for water to be lost. In some municipalities, meters are not provided at municipal buildings or non-profit organizations because water is not sold to them. If some users are not metered, the percentage of water loss appears higher than it actually is. For the City of Clio, all water users are metered.

The following table offers a comparison of water purchase records from the GCDC-WWS to water sales records to customers in the city. For the billing year 2009/2010, water losses were approximately 26%, which is considerably larger than the 10%-19% average loss for similar systems. The two fiscal years since then show annual water loss within more typical ranges.

Table IV-2: Water Loss			
Year	Water Purchase from GCDC-WWS Yearly Total (gal)	Water Billed to Customers Yearly Total (gal)	Water Loss
2007/2008	74,725,948	63,636,933	14.8%
2008/2009	74,471,628	61,044,655	18.0%
2009/2010	81,411,572	60,437,000	25.8%
2010/2011	73,387,028	59,457,053	19.0%
2011/2012	64,449,924	57,896,000	10.2%

3. Metered Sales

For the purposes of this study, water users in the city have been divided into three categories, residential, commercial and industrial. Residential sales include water used in homes, irrigation systems, and apartments. The commercial category includes water users such as businesses, restaurants, and schools. Following is a table showing the top ten water users in the city. The usage amounts are per billing records from December 2011 to November 2012.

Table IV-3: Top Ten Water Users		
Name	Address	Usage (gal/year)
Roxbury Court	292 Smith Street	1,876,000
Fuller Apartments	400 Fuller	1,709,000
Clio High School	One Mustang Drive	1,697,000
Letavis Car Wash	400 W. Vienna	2,005,000
Jans Cleaner	130 Griffes	1,688,000
Mill Creek Apartments	303 Smith Street	881,000
Morgan Properties	425 W. Vienna	467,000
VG's	710 S. Mill Street	759,000
Oakbrook Apartments	528 Pine Street	489,000
Nite Cap	155 W. Vienna	253,000
Total		**11,824,000**

An analysis of the top ten water use customers indicates that their total yearly average demand is approximately 11,824,000 gallons, which is approximately 20% of the total water billing. The following table summarizes the type and number of water accounts in the city.

Table IV-4: Water Customers	
Account Class	**Number of Customers**
Residential	983
Commercial	821
Industrial	4
Total	**1,808**

C. Future Water Requirements

Projections of future water use are needed to evaluate the water utility through the twenty-year planning period. Also, if improvements are to be made to the city's water system, the improvements should be designed to accommodate future demands. We have shown in Section III that population projections for the city show slow steady increase in population anticipated over the next 20 years. Unless unexpected large commercial or industrial water users are brought to the city, it is not expected that there will be a significant increase in water usage in the city over the planning period of this study. The population projections in Section III show very slow growth; future water usage was assumed to increase by a rate of 1% to provide a conservative estimate associated with population growth. The following table summarizes water use as utilized in this study.

Table IV-5: Present and Future City of Clio Water Use			
Category	**Present (gpd)**	**Future Year 2018 (gpd)**	**Future Year 2033 (gpd)**
Average Daily Demand	177,000	186,000	216,000
Maximum Day Demand	443,000	465,000	540,000
Peak Hourly Demand	708,000	744,000	864,000

V. Existing Facilities

A. Water Supply

Water supply to the City of Clio is provided by GCDC-WWS. Raw water is pumped from Lake Huron, treated at the Detroit Water and Sewerage Department (DWSD) Lake Huron Water Treatment Plant, and conveyed approximately 60 miles to the City of Flint and Genesee County through a combination of 72 and 120 inch water transmission mains.

The City of Clio receives its water from GCDC-WWS at two primary locations. The primary supply locations are the meter pits located on South Mill Street at the southern city limits, and the meter pit on Vienna Road at the east city limits. A third metering pit is located at the western city limits on Vienna Road, but is not typically open.

The city also has three emergency connections to Vienna Township located at the southwestern city limits at Pine Street, Allen Street and New Street. These connections are normally closed and are only opened in emergency situations, such as a fire.

Since the 2006 water study, the city has made several upgrades to the water system. These upgrades involved replacing older undersized mains with larger diameter mains. The upgrades to the system since 2006 include:

A new twelve inch diameter watermain on:

- Oak Street from Butler to the Dead End
- Butler between Oak and Cherry
- Cherry between Butler and Clarion Street
- Clarion Street from Cherry to the property of the high school

A new eight inch diameter watermain on:

- Alley North of Vienna Road between Center and N. Mill Street

B. Distribution System

The water system in the City of Clio includes more than 15 miles of watermain ranging from two inches to twelve inches in diameter. Most of the watermain is constructed of cast iron, ductile iron and PVC. The following table summarizes the watermain in the city by diameter.

Table V-1: Existing City Watermain Inventory

Watermain Diameter (in)	Length (ft)
12 Inch Watermain	9,536
10 Inch Watermain	5,731
8 Inch Watermain	15,226
6 Inch Watermain	28,716
4 Inch Watermain	18,454
3 Inch Watermain	1,899
2 Inch Watermain	4,020
Total	**83,582**

The City of Clio has experienced several watermain breaks within the last few years. The following table presents a record of watermain breaks.

Table V-2: Recent History of Watermain Breaks	
Year	**Location**
Winter 2009/2010	Intersection of New Street & Pine Street
Winter 2010/2011	Intersection of New Street & Pine Street
Winter 2010/2011	Intersection of New Street & W. Johnson
Winter 2010/2011	South Mill Street between W. Johnson Street & W. Young Street
Winter 2010/2011	South Downtown Parking Lot near Veteran's Park
Winter 2011/2012	Sheldon Street at Park Street
Winter 2012/2013	Intersection of Cherry & Poplar
Winter 2012/2013	Vienna Street at West bank of Pine Run Creek
Winter 2012/2013	Alexander Street between Palmer & Field Road
Winter 2012/2013	South Downtown Parking

Watermain breaks contribute to water loss in the system as well as increased maintenance costs. Areas of frequent breaks will be considered in the recommendations.

C. Water Storage Reservoirs

The city currently has no water storage facilities, the county adequately supplies water to meet demands.

D. Water Treatment

Finished water is supplied to the City of Clio system. The city does not perform any additional water treatment operations.

point in the network is the difference between the hydraulic gradient and the ground elevation.

Using the hydraulic model, different system scenarios were evaluated to determine the most appropriate arrangement for meeting projected water demands. Analyses were performed for the following basic demand conditions:

- Maximum day which determines the ability of the system to meet fire flow requirements
- Peak hour which determines the ability of the system to maintain minimum residual pressures during periods of peak demand

C. Model Calibration

The hydraulic model is developed using existing water distribution maps and other available system information. Hydrant tests were performed in October 2012 by Insurance Services Office, Inc. This data was used to make adjustments to the model to better simulate actual system performance. These flow test results are shown in the following table.

Table VI-1: Hydrant Flow Tests

Residual Hydrant Location	Pressure (psi)		Flow (gpm)
	Static	Residual	
Hydrant Tests Performed on October 12, 2012			
Old Street & Pine Street	46	5	380
Smith Street, 1st hydrant E. of New Street	46	29	650
Park Circle, 1st hydrant E. of Park Lawn	46	27	770
Vienna Street & State Street	46	34	960
Mill Street & Smith Street	45	35	820
Carter Middle School, S/E corner hydrant	45	33	770
Field Road & Center Street	46	41	440
Clio High School, S/W corner hydrant	46	29	790
Loomis Avenue & Fuller Street	46	29	560
Tacoma Court, 3rd hydrant N/E of Vienna Road	63	31	860

Notes:
The discharge nozzle diameter was 2-1/2"

D. Storage Facilities

Storage is provided to meet peak demands and provide reliability. The need for storage will be evaluated based on:

- The ability of GCDC-WWS to reliably meet city's peak demands
- The degree of system reliability desired

VII. Results and Recommendations

The results of the system evaluation and recommendations from the hydraulic analyses are presented below.

A. Water Distribution System

The WATERCAD computer model was used to analyze the ability of the distribution system to meet current and future maximum day and peak hour water demands. Results of the analyses indicate that the existing distribution system does meet current maximum day and peak hour water demands, as well as the projected future maximum day and peak hour demands. Pressure contour maps are included in Figures 2, 3 and 4 in the Appendix.

In addition to providing water customers with adequate pressure for normal consumption, it is also desirable to provide water for fighting fires. The flows needed to fight a fire are much greater than those needed to meet peak customer demands. A system that can provide adequate flow and pressure for normal and peak customer demands is not necessarily capable of providing enough water to fight a fire. The system should be able to support a fire flow and still maintain a minimum residual pressure of 20 psi throughout the service area.

For purposes of determining required fire flows, the ISO Commercial Risk Services' 1,000 gallon per minute (gpm) minimum for residential areas is used as the minimum acceptable fire flow for the service area. Flows of 2,000 to 5,000 gpm are often recommended for protection of commercial and industrial areas. For the purpose of this study, it is assumed that 1,000 gpm for two hours is desired for firefighting in residential neighborhoods and 2,500 gpm for commercial and industrial areas.

The water distribution system was evaluated for its ability to convey fire flow. The fire flow drawing in Figure 6 in the Appendix shows flow currently available for fighting fires. The available flows shown are those available while maintaining system pressures above 20 psi and providing customers with their maximum day demands. The model indicated that many areas in the city's water distribution system do not meet the recommended fire flow. Residential areas that do not meet the minimum required fire flow are primarily serviced by mains less than eight inches in diameter and/or by dead end lines.

The city is serviced by two-inch to twelve-inch mains. Diameters below six inches are typically undersized for residential flows. Long stretches of six-inch mains can also result in significant drops in available fire flow. There are a few dead-end mains where fire flows could be improved by extending the main to close the loop, and some long stretches of four and six-inch mains that could benefit from upgrades to at least eight inches. It is recommended that the city work to eliminate dead-end mains by tying them to other nearby watermains. This would not only improve fire flows, but minimize the potential for water quality problems and for a single watermain break to leave these areas without water. A minimum pipe size of eight inches in residential areas and twelve inches in commercial areas is recommended.

The computer model developed for this study is a dynamic tool. Each time the city makes improvements to its system, the model should be updated. This will allow these main improvements to be modeled and analyzed prior to making any final sizing recommendations for future improvements.

1. Current System Analysis

The "current system model" analyzes the city's water distribution system as it currently exists. The GCDC-WWS purchase data from 2012 is used to represent the current water demands. The model includes all watermains within the city and the supply connections to GCDC-WWS. Results of the maximum day and peak hour analyses for the current water demands indicate that the pressures in the city range from 45 psi to 67 psi. The recommended residential fire flow of 1,000 gpm is not available in many sections of the city. Flows of less than 1,000 gpm were identified in six residential areas. These locations are typically on a dead-end main, or where the watermain is less than 8" in diameter. Figure VII.1 below shows the location of these areas within the city.

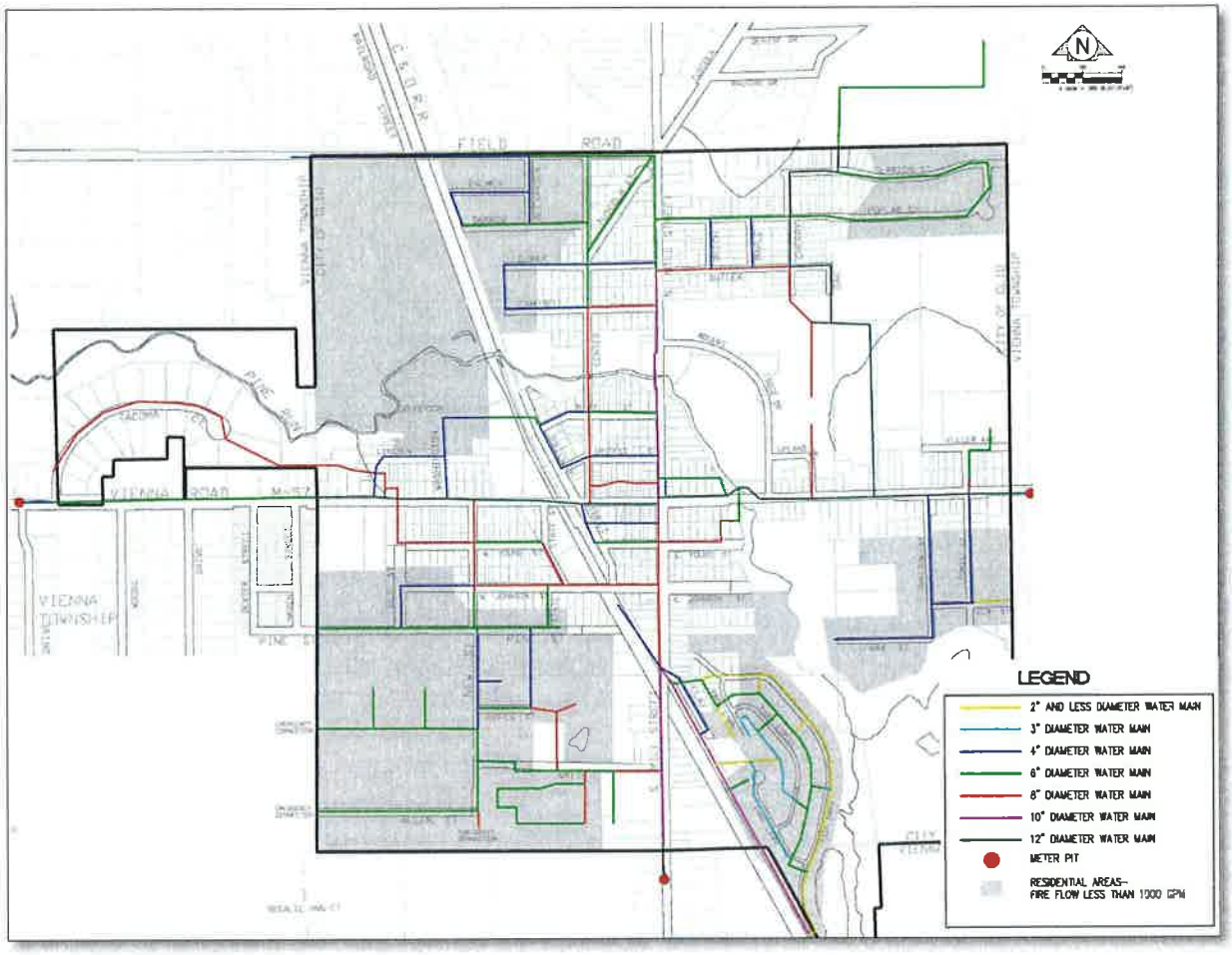


Figure VII.1: Residential Areas below 1000 gpm Fire Flow

Commercial and industrial areas are shown in the city's zoning map in Appendix A. The industrial area at the west city limits does not meet the recommended fire flows. The dead-end main limits the available fire flow. Additionally, commercial development along S. Mill Street and Vienna Road were found to have available fire flows below recommended values. These areas can be seen in Figure VII.2 below.

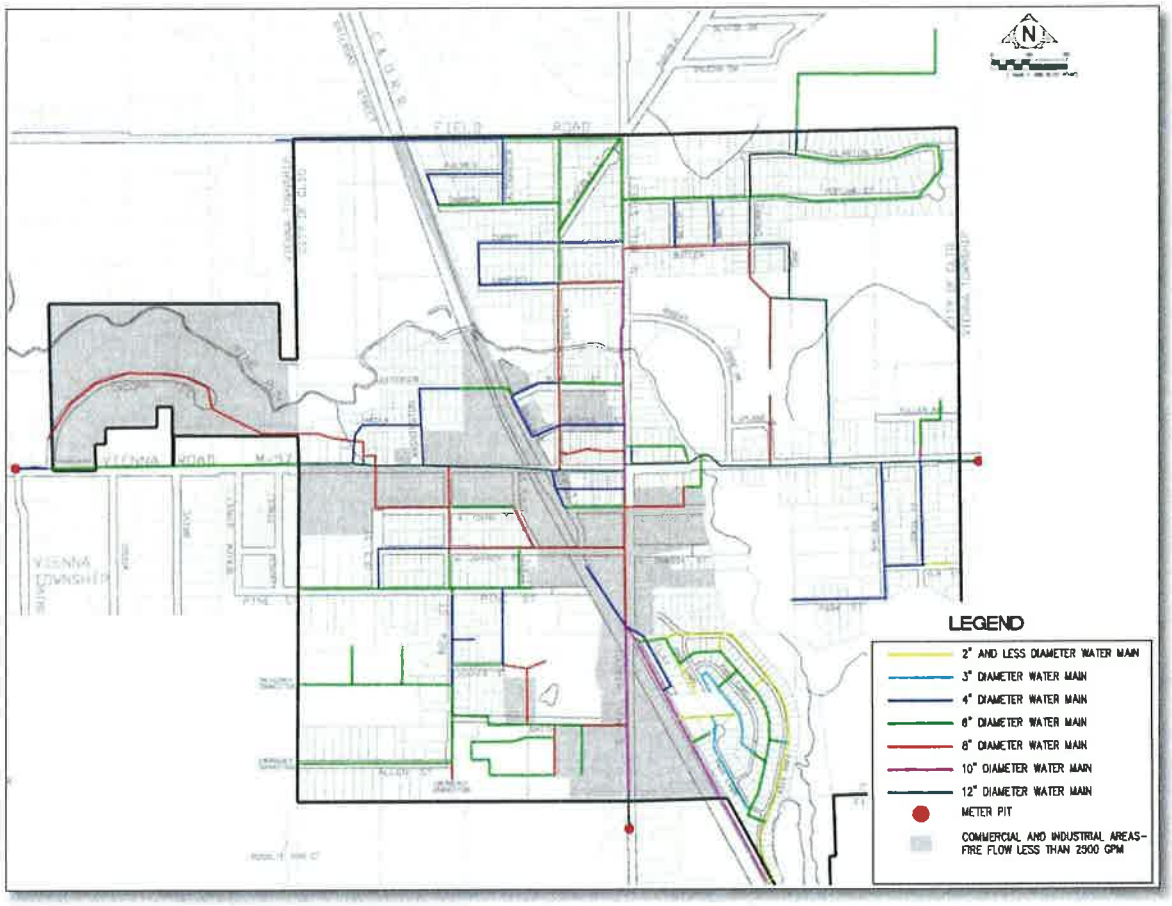


Figure VII.2: Commercial and Industrial Areas below 2500 gpm Fire Flow

2. Year 2018 Demand Analysis

This model analyzes the recommended 5-year improvements to the existing water distribution system with anticipated demands in the year 2018. The results indicate significant improvement in available fire flow in the vicinity of the proposed projects. Figures 4 and 7 in Appendix B show the 5-Year Improved Conditions.

3. Year 2033 Demand Analysis

This model analyzes the recommended 20-year improvements to the existing water distribution system with anticipated demands in the year 2033. The results indicate significant improvement in available fire flow throughout the city. Figures 5 and 8 in Appendix B show the 20-Year Improved Conditions.

4. Distribution System Recommendation Summary

The recommendations to the water distribution system have been placed in one of two categories; "High Priority Project" or "Secondary Priority Project". The recommended projects can be seen below. The high priority projects are those projects that address public health and safety and are included with the five-year improvement plan. The secondary priority projects are included in the twenty-year plan.

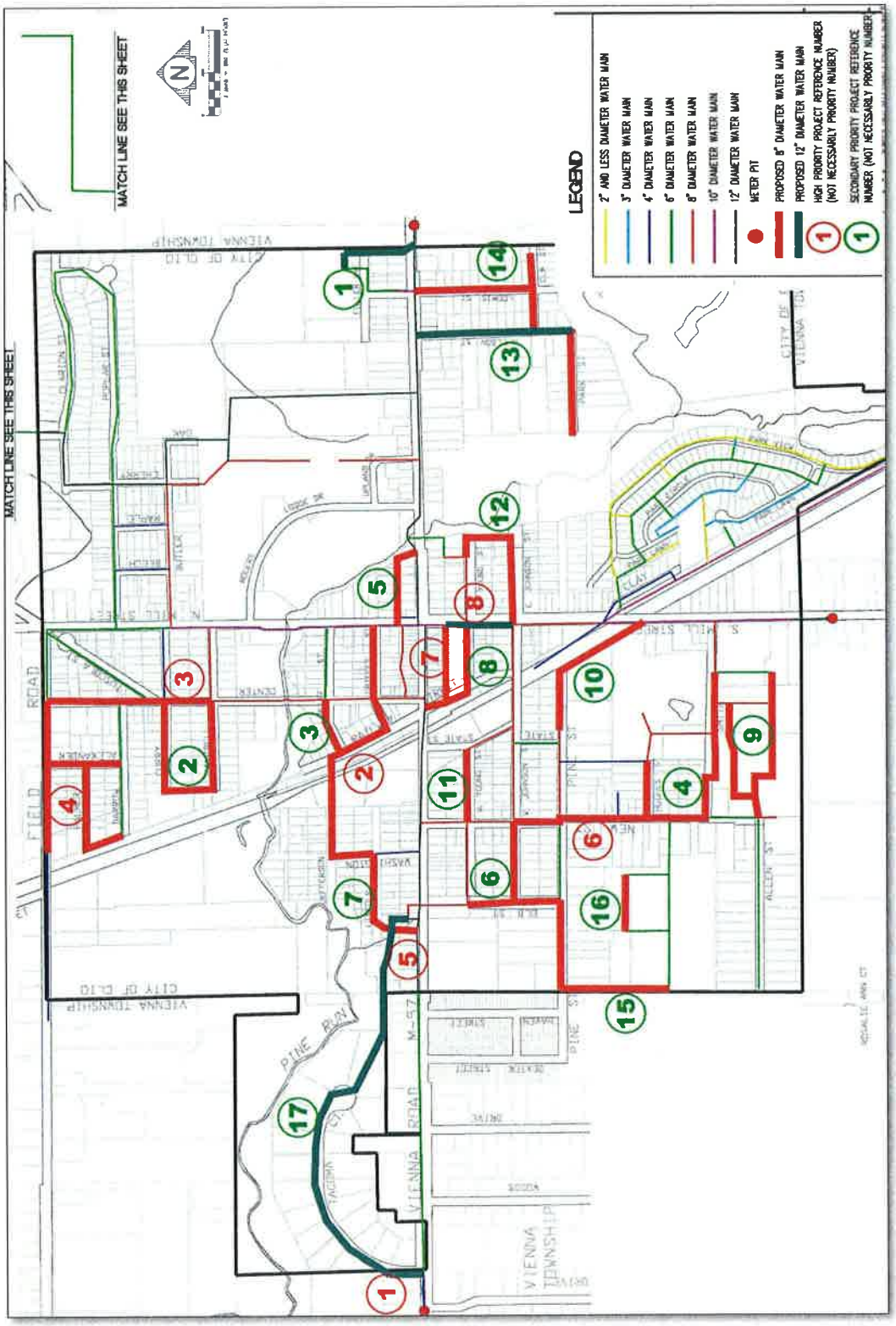


Figure VII.3: Proposed Distribution System

Project recommendations are system improvements that will enhance fire flow in the system and improve areas of frequent maintenance concerns. The combination of the high priority and secondary priority projects will increase most fire flows to meet the recommended residential and commercial fire flows, as applicable. Figures 4, 5, 7 & 8 in Appendix B show the system pressure and fire flows with the system improvements.

An Engineer's opinion of probable project costs for each project is included in the tables below.

Table VII-1: High Priority Projects

Project Number	Project Description	Estimated Cost
1	Install 250' of 12" Main West End Tacoma Court to Vienna Road	$50,000
2	Replace 4" & 6" Main with 8" Main along Griffins, Railway, Jefferson and Washington	$380,625
3	Replace 6" Main with 8" Main along Center Street from Campbell to Field Road	$201,250
4	Replace 4" & 6" Main with 8" Main along Field Road, Alexander, Palmer, Darrow and Railroad	$428,750
5	Replace 4" Main with 8" Main from Vienna to Intersection of existing 8" and 6" Main	$31,500
6	Replace 4" & 6" Main with 8" Main along New Street from W. Johnson to existing 6" Main South of Hughes	$166,250
7	Replace 4" Main with 8" Main South Downtown Parking Lot.	$95,550
8	Replace 8" Main with 12" Main along S. Mill Street from South Downtown Parking Lot to E. Johnson Street	$93,800
Total Costs for High Priority Projects		**$1,447,725**

Notes:
The cost given per lineal foot of watermain includes a typical number of valves, connections, sand backfill, and engineering. The costs do not include copper services or curb stops, remove and replace roads or sidewalks, unusual amounts of traffic control, clean-up, legal and administrative fees, or other incidental costs. The costs can vary based on fluctuation of material prices.

Project numbers 7 and 8 are recommended due to frequent main breaks. Other areas that experience main breaks should be replaced by the city in coordination with repairs made to the sanitary collection system to reduce construction costs.

Table VII-2: Secondary Priority Projects		
Project Number	**Project Description**	**Estimated Cost**
1	Install 630' of 12" Main Vienna Road to North of Fuller Avenue along east City Limits	$126,000
2	Replace 4" Main with 8" Main along Curry & Campbell and between Curry and Campbell	$288,750
3	Replace 4" Main with 8" Main along Bluff Street from Center Street to Railway Street	$70,000
4	Replace 6" Main with 8" Main along Hughes and Smith and New Street 8" Main on Smith	$303,625
5	Replace 6" Main in N. Alley between N. Mill and Vienna Road	$106,750
6	Replace 4" Main with 8" Main along W. Johnson and Old Street and extend 8" Main along Old Street to W. Young Street	$212,625
7	Replace 4" Main with 8" Main along Lincoln west from Washington	$107,625
8	Replace 4" & 6" Main with 8" Main along E. Young Street and Railroad west of S. Mill Street	$139,125
9	Replace 6" Main with 8" Main on loop south of Smith Street east of Allen Street	$320,250
10	Install 8" Main from end of Pine to S. Mill Street along Railroad right of way	$192,500
11	Replace 6" Main with 8" Main along W. Young Street between State and New Street	$89,250
12	Replace 4" Main with 8" Main E. Young to E. Johnson and E. Johnson east of S. Mill Street	$174,125
13	Replace 4" Main with 12" Main on Sheldon Street	$217,000
14	Replace 2" & 4" Main with 8" Main Loomis south of Vienna & Park and Elm St.	$366,625
15	Install 8" Main from west end of Pine south to existing 6" Main along west City Limits	$133,000
16	Install 8" Main between existing 6" Main south of Pine Street	$70,000
17	Replace 8" Main with 12"Main Tacoma Court	$535,500
Total Costs for Secondary Priority Projects		**$1,258,375**

Notes:
The cost given per lineal foot of watermain includes a typical number of valves, connections, sand backfill, and engineering. The costs do not include copper services or curb stops, remove and replace roads or sidewalks, unusual amounts of traffic control, clean-up, legal and administrative fees, or other incidental costs. The costs can vary based on fluctuation of material prices.

B. Storage

Based on the ability for GCDC-WWS to reliably meet demand no storage recommendations are made at this time.

C. Water Supply

Currently, the city is supplied water from three direct metered connections to GCDC-WWS's water transmission mains. The multiple connections provide redundancy, which allows the city to still receive water in the event one of the connections is taken off-line for maintenance or repairs. GCDC-WWS supplies an adequate amount of water to meet the city's current and projected water needs. If a major water user proposes to move to Clio, it is recommended that this issue be revisited.

D. System Maintenance

The city currently does not annually flush its hydrants. It is recommended that the city flush hydrants in late fall to help ensure the reliable service of the city's hydrants and flushes sediment from the mains.

A valve turning program has the benefit of identifying valves in need of repair or replacement, and extending the life of existing valves. The city does not currently have a valve turning program. Currently, valves are typically only operated when a main needs to be shut down. It is recommended that the city implement a valve turning program where each valve is inspected and operated at scheduled intervals.

If a valve is found to be in disrepair it should be repaired or replaced. Also, as new watermains are added to the system, care should be taken to make certain that the new watermain is adequately valved, and that all of the new system is accurately recorded and added to the system map.

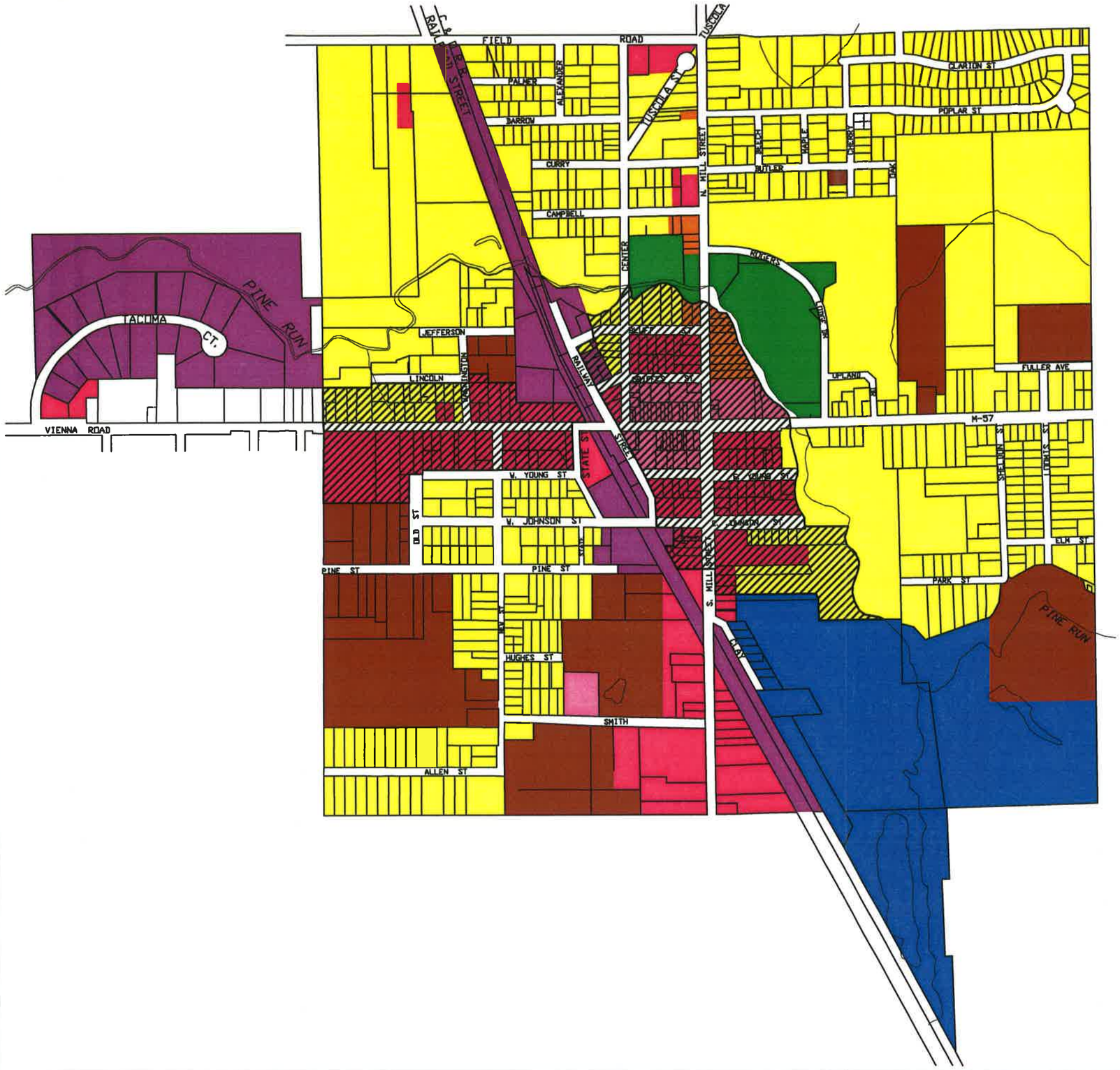
E. Water Quality

Water is treated prior to entering the City of Clio system. There are no known water quality issues.

APPENDIX

Appendix A – Zoning Map
Appendix B – Available Pressure and Fire Flow Maps
- Figure 1: Existing Distribution System
- Figure 2: Proposed Distribution System
- Figure 3: Available Pressure – Existing System with Current Demands
- Figure 4: Available Pressure – Improved 5 Year Conditions with 5 Year Demands
- Figure 5: Available Pressure – Improved 20 Year Conditions with 20 Year Demands
- Figure 6: Available Fire Flow – Existing System with Current Demands
- Figure 7: Available Fire Flow – Improved 5 Year Conditions with 5 Year Demands
- Figure 8: Available Fire Flow – Improved 20 Year Conditions with 20 Year Demands

APPENDIX A
Zoning Map



CITY OF CLIO ZONING MAP

ZONING DISTRICT

- R-1 ONE FAMILY RESIDENTIAL
- R-3 TWO FAMILY RESIDENTIAL
- MULTIPLE FAMILY RESIDENTIAL
- MOBILE HOME PARK DISTRICT
- C-1 CENTRAL BUSINESS DISTRICT
- C-2 GENERAL BUSINESS DISTRICT
- INDUSTRIAL DISTRICT
- RECREATION DISTRICT
- RESIDENTIAL/COMMERCIAL TRANSITION ZONE

This is to certify that this is the OFFICIAL ZONING MAP referred to in Article 4 Section 301 of the Zoning Ordinance of the City of Clio, Michigan. Adopted September 15, 2003

Mayor _____

Clerk _____

On the dates below, by official action of the City Commission the following changes were made to the Official Zoning Map

#	Date	From	To

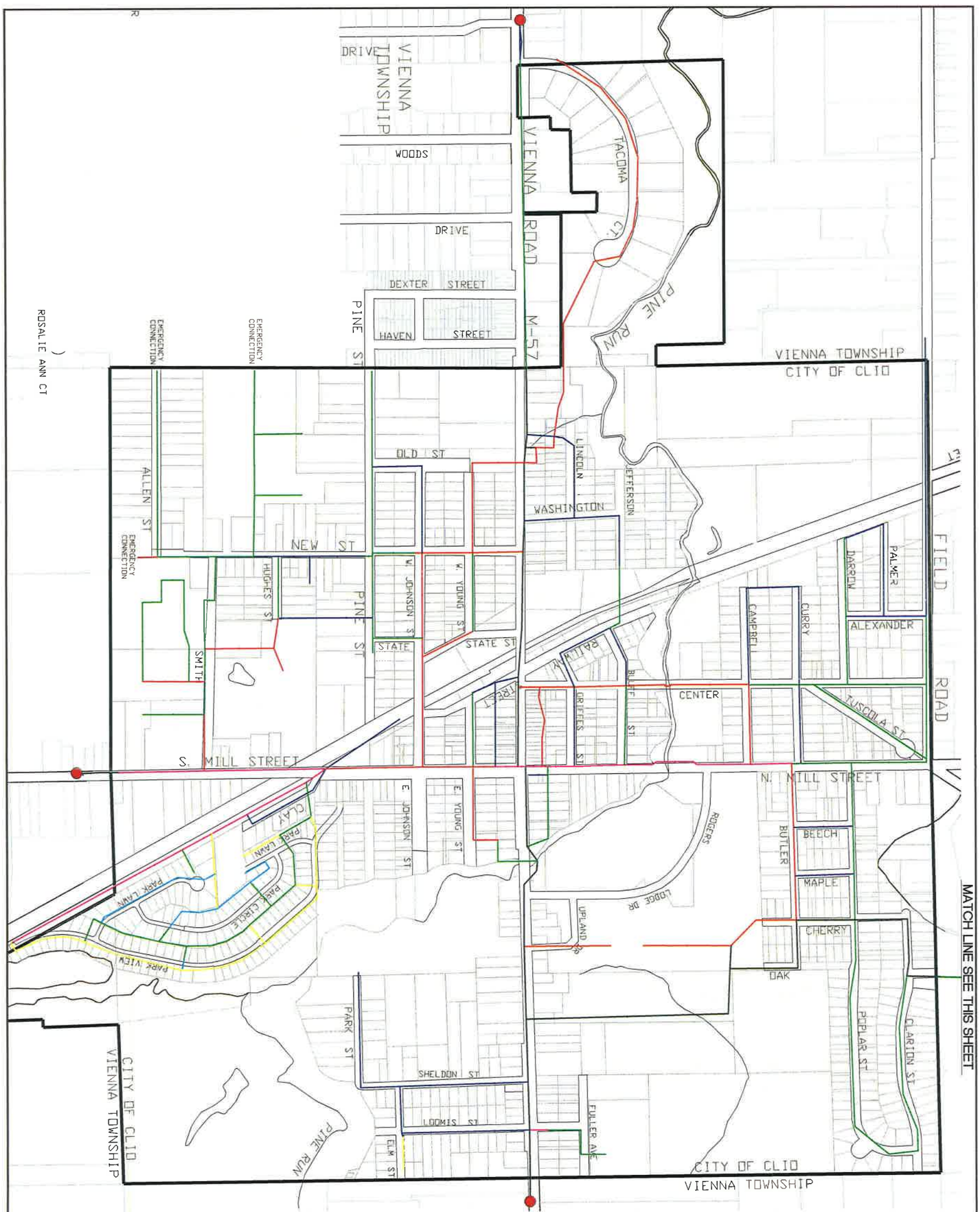
ORIGINAL MAP PREPARED BY WADE TRIM

ROWE

APPENDIX B

Available Pressure and Fire Flow Maps

Figure 1: Existing Distribution System
Figure 2: Proposed Distribution System
Figure 3: Available Pressure – Existing System with Current Demands
Figure 4: Available Pressure – Improved 5-Year Conditions with 5-Year Demands
Figure 5: Available Pressure – Improved 20-Year Conditions with 20-Year Demands
Figure 6: Available Fire Flow – Existing System with Current Demands
Figure 7: Available Fire Flow – Improved 5-Year Conditions with 5-Year Demands
Figure 8: Available Fire Flow – Improved 20-Year Conditions with 20-Year Demands



PREPARED FOR

CITY OF CLIO
WATER RELIABILITY STUDY

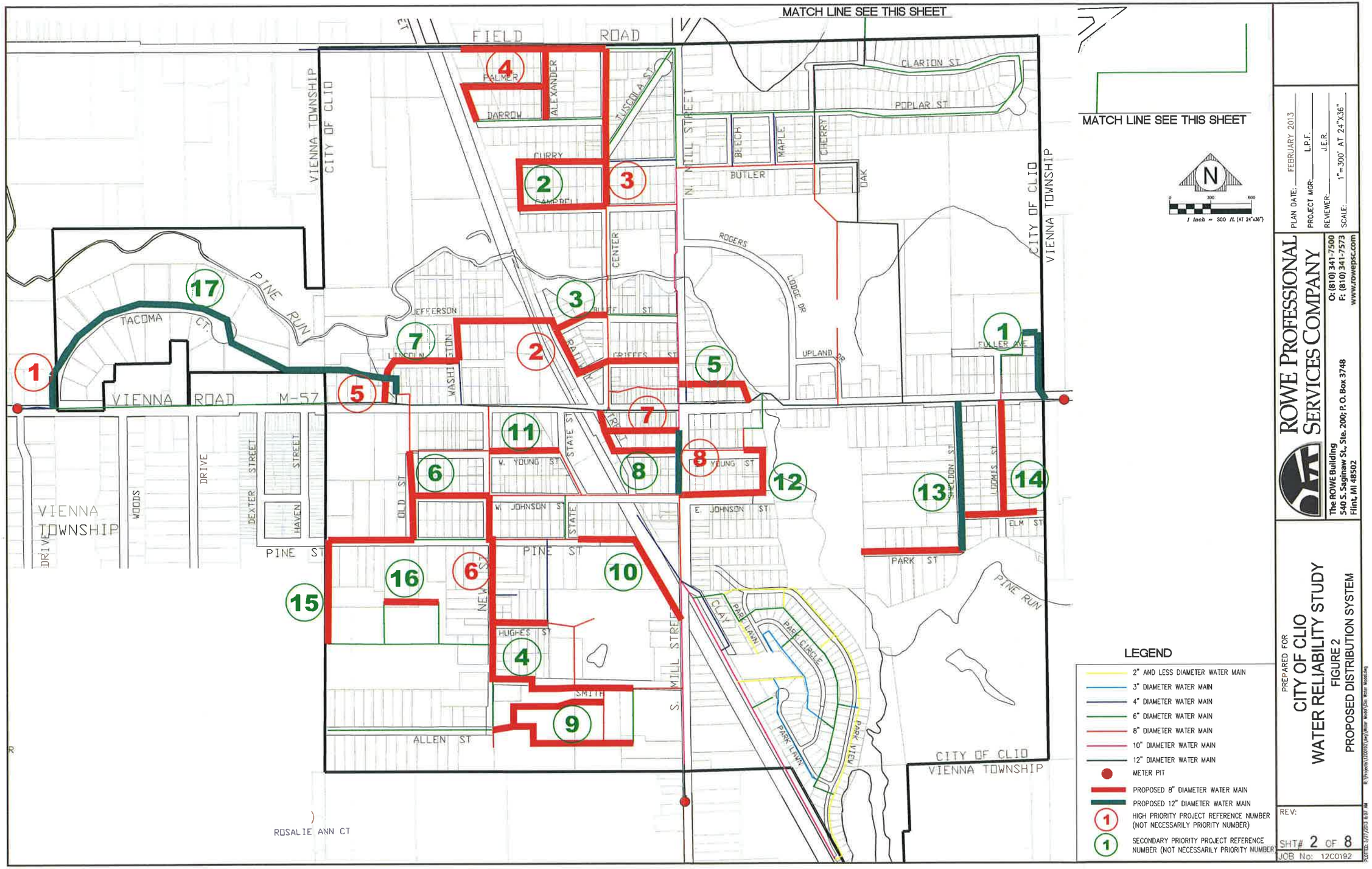
FIGURE 1
EXISTING DISTRIBUTION SYSTEM

REV:
SHT# 1 OF 8
JOB No. 12CC0192

ROWE PROFESSIONAL SERVICES COMPANY
The ROWE Building
540 S. Saginaw St., Ste. 200; P. O. Box 3748
Flint, MI 48502
O: (810) 341-7500
F: (810) 341-7573
www.rowepsc.com

PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1"=300' AT 24"X36"

PLOTTED: 3/14/2013 1:12 PM R:\Projects\12CC0192\dwg\Water Model\Clio Water Model.dwg



PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1"=300' AT 24"X36"

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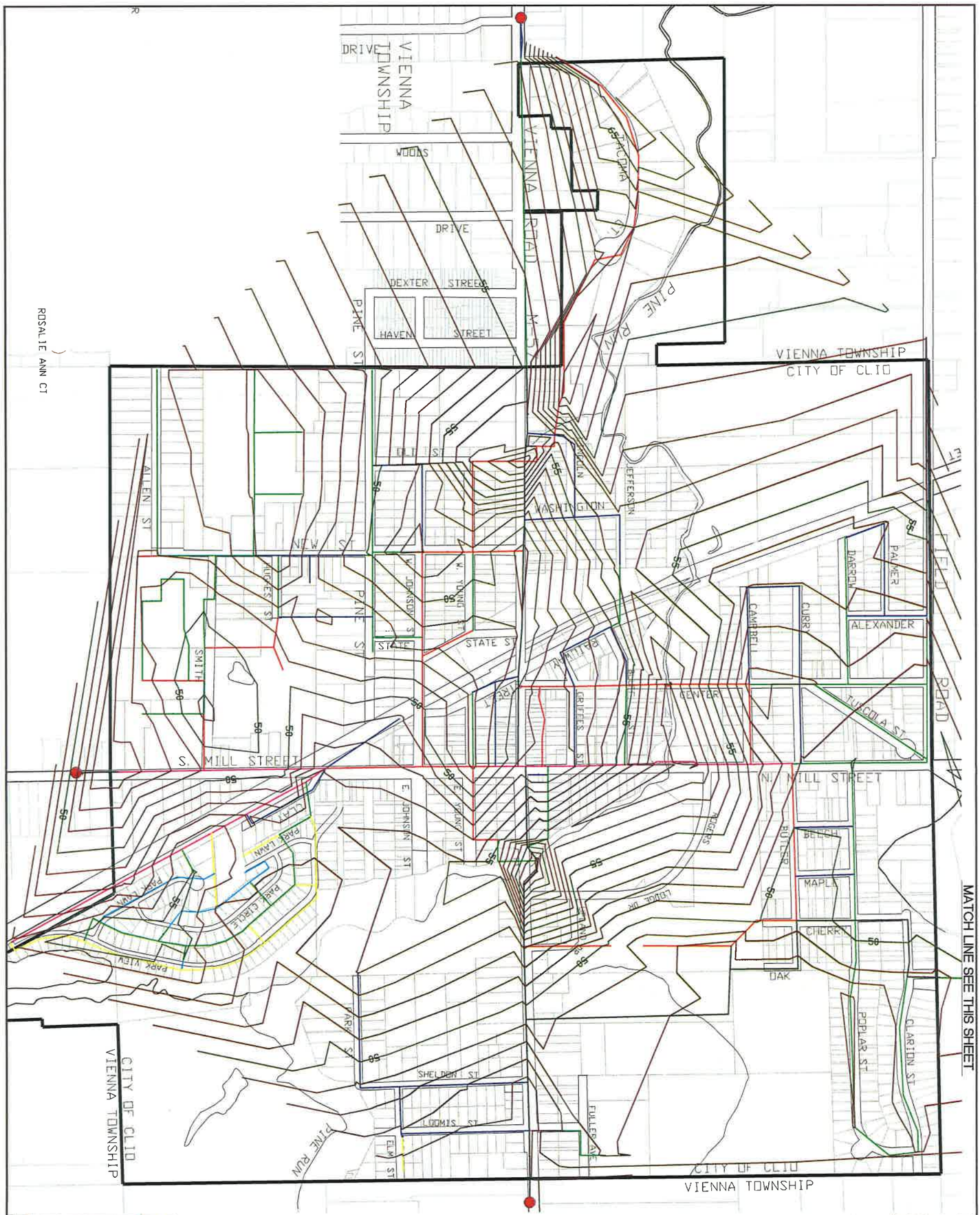
WATER RELIABILITY STUDY
FIGURE 2
PROPOSED DISTRIBUTION SYSTEM

REV:
SHT# 2 OF 8
JOB No: 12C0192



LEGEND

- 2" AND LESS DIAMETER WATER MAIN
- 3" DIAMETER WATER MAIN
- 4" DIAMETER WATER MAIN
- 6" DIAMETER WATER MAIN
- 8" DIAMETER WATER MAIN
- 10" DIAMETER WATER MAIN
- 12" DIAMETER WATER MAIN
- METER PIT
- MINOR PRESSURE CONTOUR (1 PSI INTERVAL)
- MAJOR PRESSURE CONTOUR (5 PSI INTERVAL)

1 inch = 300 ft (AT 24"x36")

REV:

SHT# 3 OF 8

JOB No. 12C0192

PREPARED FOR

CITY OF CLIO
WATER RELIABILITY STUDY

FIGURE 3

EXISTING CONDITIONS PEAK HOUR PRESSURE

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PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1"=300' AT 24"X36"

PLOTTED: 1/3/2013 2:20 PM R:\Projects\12C0192\dwg\Water Model\Clio Water Model.dwg

MATCH LINE SEE THIS SHEET

MATCH LINE SEE THIS SHEET

N

1 inch = 300 ft (AT 24"x36")

PREPARED FOR
CITY OF CLIO
WATER RELIABILITY STUDY
FIGURE 4
IMPROVED 5 YEAR CONDITIONS PEAK HOUR PRESSURE

PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1"=300' AT 24"X36"

REV:
SHT# 4 OF 8
JOB No: 12C0192

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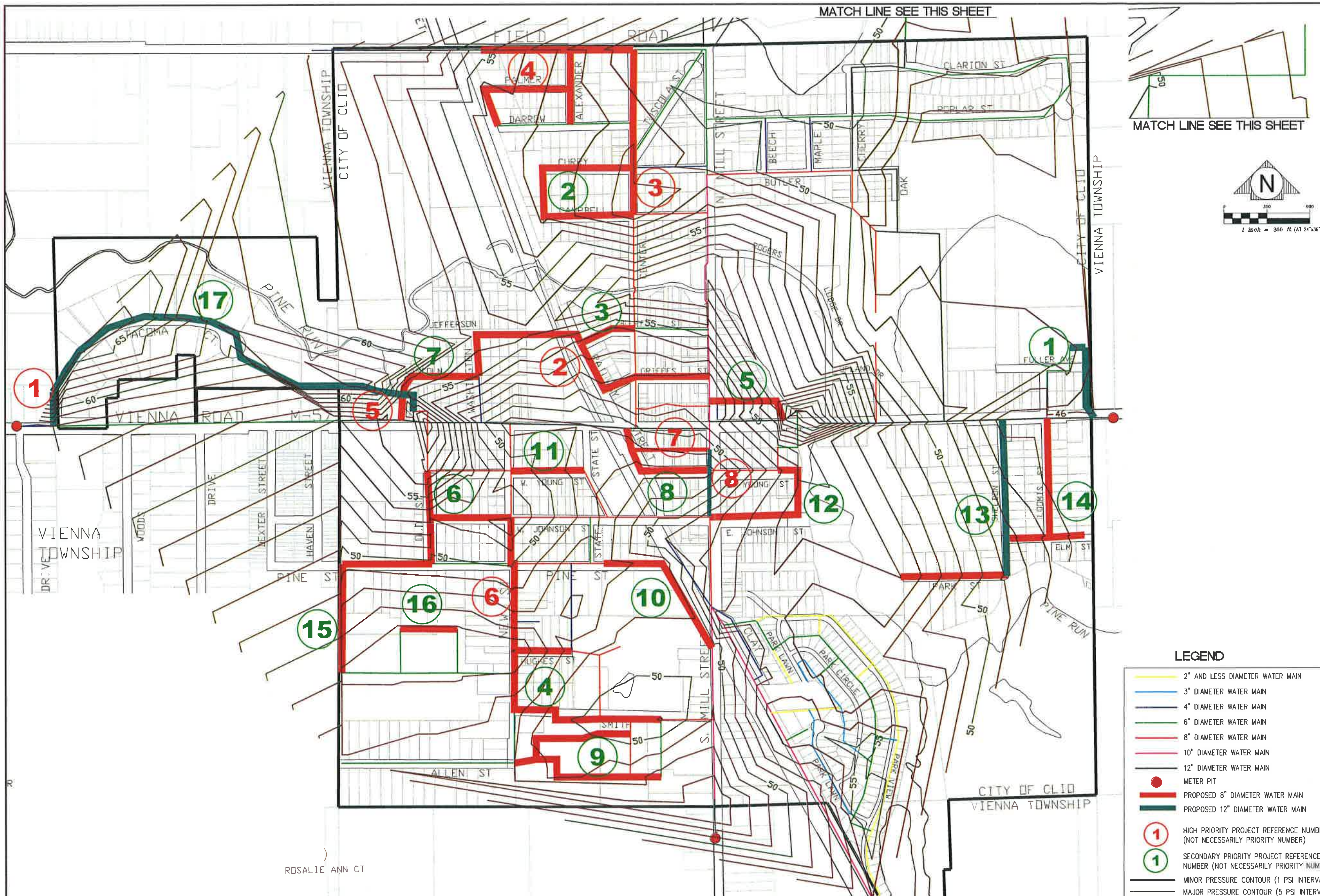
LEGEND

- 2" AND LESS DIAMETER WATER MAIN
- 3" DIAMETER WATER MAIN
- 4" DIAMETER WATER MAIN
- 6" DIAMETER WATER MAIN
- 8" DIAMETER WATER MAIN
- 10" DIAMETER WATER MAIN
- 12" DIAMETER WATER MAIN
- METER PIT
- PROPOSED 8" DIAMETER WATER MAIN
- PROPOSED 12" DIAMETER WATER MAIN
- (1) HIGH PRIORITY PROJECT REFERENCE NUMBER (NOT NECESSARILY PRIORITY NUMBER)
- MINOR PRESSURE CONTOUR (1 PSI INTERVAL)
- MAJOR PRESSURE CONTOUR (5 PSI INTERVAL)



PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1"=300' AT 24"X36"

ROWE PROFESSIONAL SERVICES COMPANY
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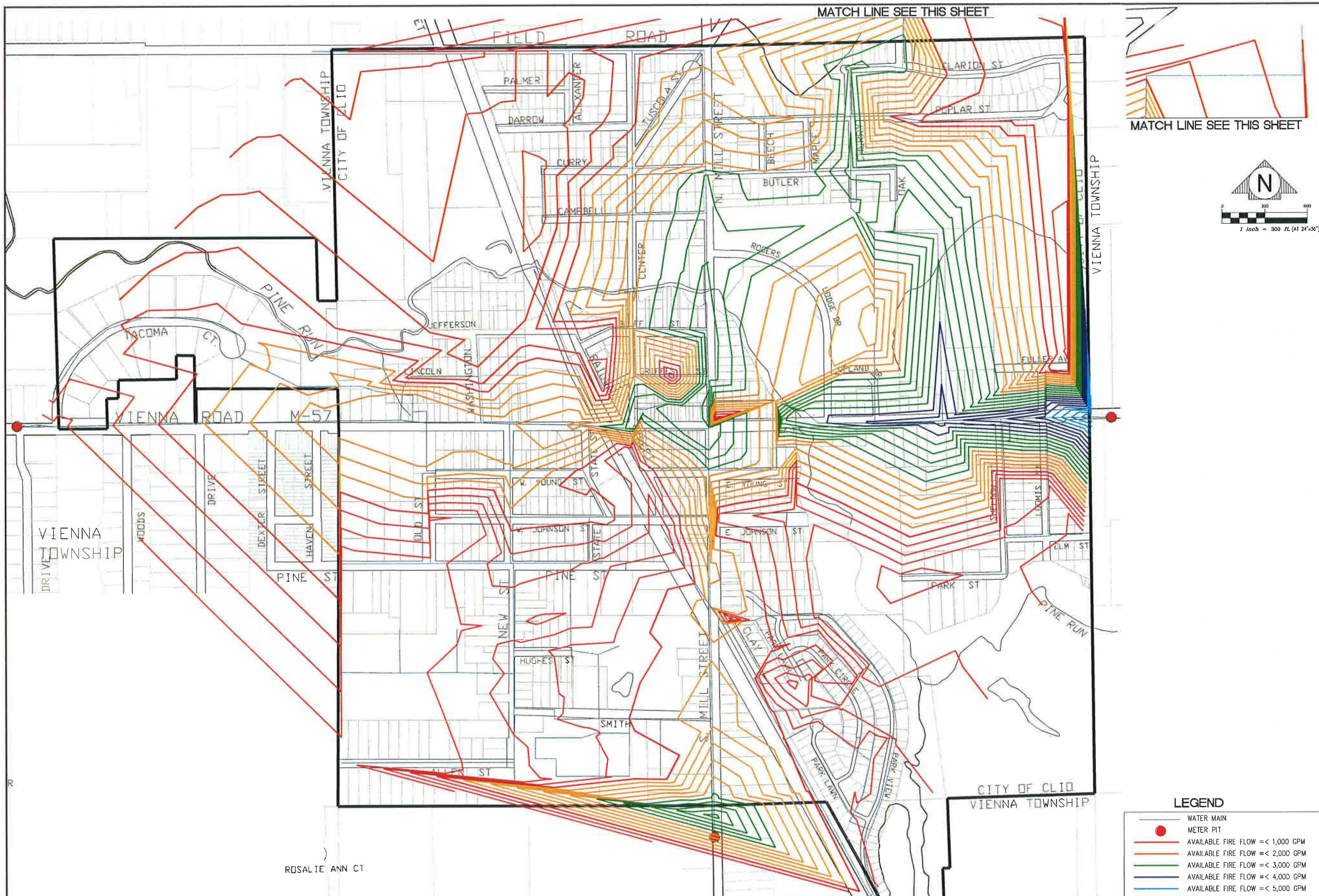
PREPARED FOR
CITY OF CLIO
WATER RELIABILITY STUDY
FIGURE 5
IMPROVED 20 YEAR CONDITIONS PEAK HOUR PRESSURE

REV:
SHT# 5 OF 8
JOB No: 12C0192



PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1"=300' AT 24"X36"

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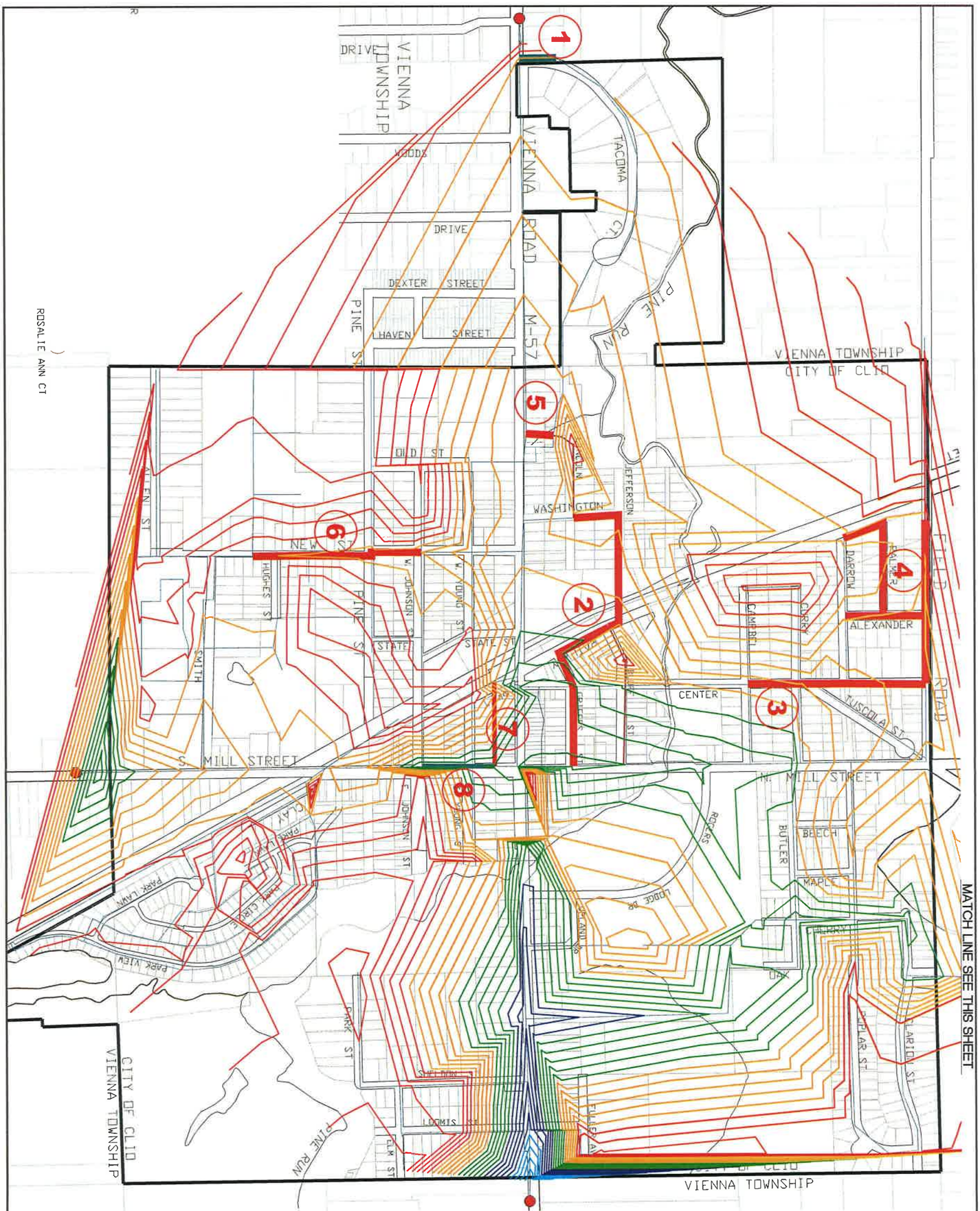
WATER RELIABILITY STUDY
FIGURE 6
EXISTING CONDITIONS AVAILABLE FIRE FLOW

REV:
SHT# 6 OF 8
JOB No: 12C0192



LEGEND

- WATER MAIN
- METER PIT
- PROPOSED 8" DIAMETER WATER MAIN
- PROPOSED 12" DIAMETER WATER MAIN
- HIGH PRIORITY PROJECT REFERENCE NUMBER (NOT NECESSARILY PRIORITY NUMBER)
- AVAILABLE FIRE FLOW =< 1,000 GPM
- AVAILABLE FIRE FLOW =< 2,000 GPM
- AVAILABLE FIRE FLOW =< 3,000 GPM
- AVAILABLE FIRE FLOW =< 4,000 GPM
- AVAILABLE FIRE FLOW =< 5,000 GPM

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CITY OF CLIO
WATER RELIABILITY STUDY

FIGURE 7

IMPROVED 5 YEAR CONDITIONS AVAILABLE FIRE FLOW

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Flint, MI 48502
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www.rowepsc.com

PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1"=300' AT 24"X36"

JOB No: 12C0192
SHT# 7 OF 8
REV:

PLOTTED: 3/27/2013 11:46 AM
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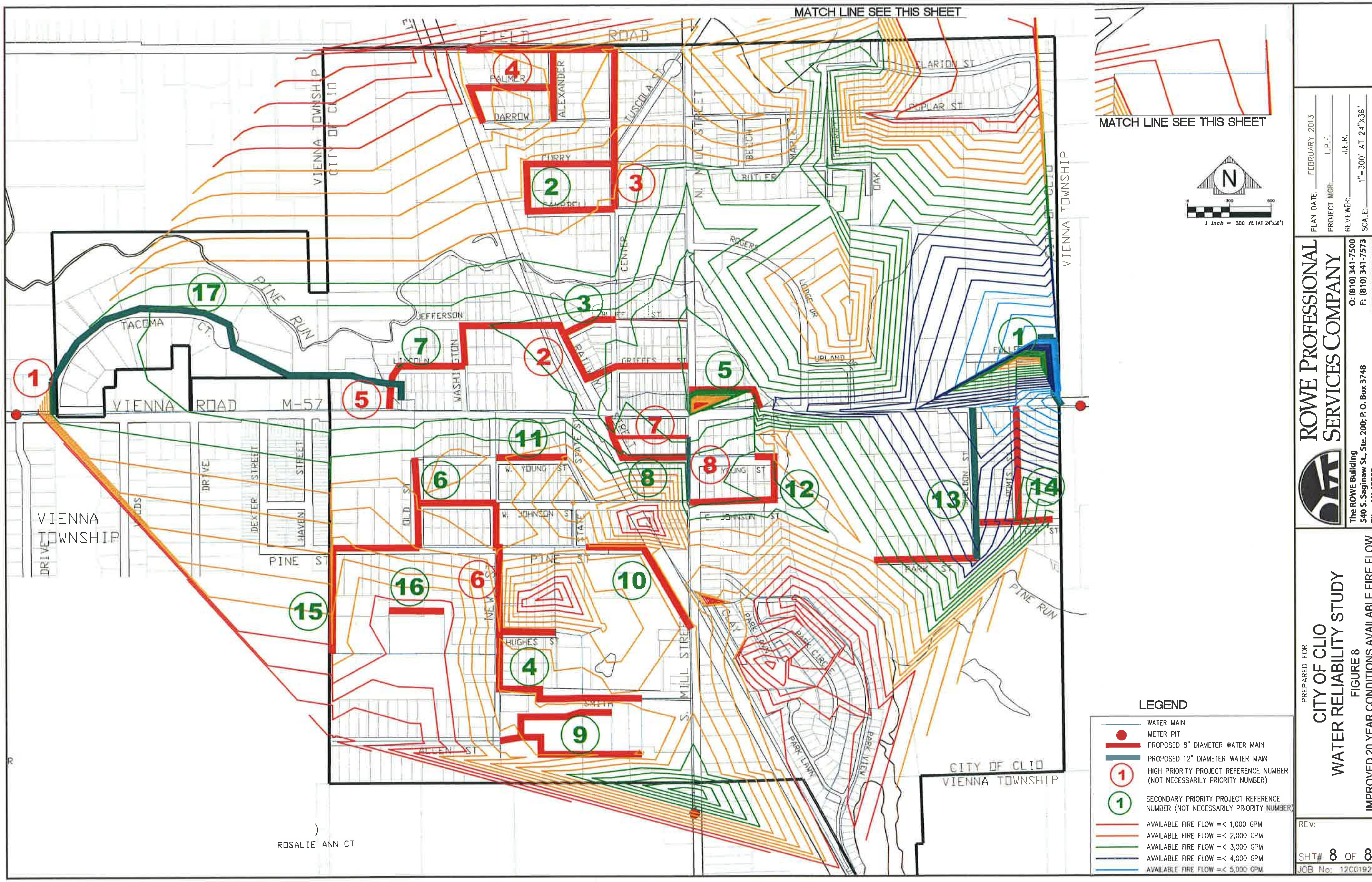
MATCH LINE SEE THIS SHEET
FIELD ROAD
VIENNA ROAD M-57
VIENNA TOWNSHIP
CITY OF CLIO
TACOMA CT
PINE RUN
JEFFERSON
LINCOLN
WASHINGTON
PALMER
DARROW
ALEXANDER
CURRY
CAMPBELL
TUSCOLA ST
CENTER
N. MILL STREET
S. MILL STREET
BEECH
MAPLE
BUTLER
OAK
CLARION ST
POPLAR ST
ROGERS
LEDGE DR
UPLAND
GRIFFES
W. YOUNG ST
YOUNG ST
W. JOHNSON ST
E. JOHNSON ST
STATE ST
OLD ST
NEW ST
PINE ST
PARK ST
HUGHES ST
SMITH
ALLEN ST
DEXTER STREET
HAVEN STREET
DRIVE
WOODS
CLAY
PARK CIRCLE
PARK LAWN
PARK VIEW
ROSALIE ANN CT
VIENNA TOWNSHIP
LEGEND
WATER MAIN
METER PIT
PROPOSED 8" DIAMETER WATER MAIN
PROPOSED 12" DIAMETER WATER MAIN
HIGH PRIORITY PROJECT REFERENCE NUMBER (NOT NECESSARILY PRIORITY NUMBER)
SECONDARY PRIORITY PROJECT REFERENCE NUMBER (NOT NECESSARILY PRIORITY NUMBER)
AVAILABLE FIRE FLOW =< 1,000 GPM
AVAILABLE FIRE FLOW =< 2,000 GPM
AVAILABLE FIRE FLOW =< 3,000 GPM
AVAILABLE FIRE FLOW =< 4,000 GPM
AVAILABLE FIRE FLOW =< 5,000 GPM
N
1 inch = 300 ft (AT 24"x36")
PLAN DATE: FEBRUARY 2013
PROJECT MGR: L.P.F.
REVIEWER: J.E.R.
SCALE: 1" = 300' AT 24"X36"
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WATER RELIABILITY STUDY
FIGURE 8
IMPROVED 20 YEAR CONDITIONS AVAILABLE FIRE FLOW
REV:
SHT# 8 OF 8
JOB No: 12C0192