Engineering Report

WATER DISTRIBUTION SYSTEM
Reliability Study and Master Plan

AEW No. 0175-0095

CITY OF PLEASANT RIDGE
23925 Woodward Avenue
Pleasant Ridge, Michigan 48069

January 2016

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Water Distribution System
Reliability Study and Master Plan

for the City of Pleasant Ridge

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Executive Summary

This study analyzes and evaluates the existing water distribution system in Pleasant Ridge. The analysis is performed with a pipe network analysis program, Pipe2014, professional version 7.022a, software by KYPipe LLC, using physical characteristics of the existing distribution system as input. Pipe2014 is a graphic user interface (GUI) for the KYPipe pipe network analysis engine/program developed at the University of Kentucky. The model outputs flow, pressure and head loss information for each pipe in the system. This output, State of Michigan Safe Drinking Water Act standards, fire flow requirements and fire insurance premium guidelines are the basis for system evaluation.

This study also develops and evaluates a master water distribution plan based on population projections, City needs and projected customer demands. The master distribution plan is modeled and evaluated for system performance and reliability.

Actual water consumption data from 2010-2014, provided by Southeastern Oakland County Water Authority, was reviewed by AEW. Average day demand is the annual consumption divided by 365 calendar days. Five (5) years of actual water consumption was averaged to generate the average day demand for the system. These values were compared to the contract values in Pleasant Ridge' water service contract with the Southeastern Oakland County Water Authority (SOCWA) and the theoretical demand associated with the design standard of 100 gallons per capita per day. The model incorporated the actual average day demand calculated from water consumption records.

Utilizing existing demand and peaking factors, a model of the existing water distribution system for Pleasant Ridge was developed with the use of Pipe2014 modeling software. The model was calibrated with data obtained from hydrant flow tests performed by AEW personnel on October 22nd, 2015.

The computer model was used to run steady state simulations of the existing system under average day, maximum day and peak hour demands. The existing system performed well with operating pressures in the range of 44.61 to 69.89 psi throughout the system.

Fire demand is simulated in the model by performing a Fire Flow and Hydrant Analysis. Fire Flow and Hydrant Analysis is a function of Pipe2014 that calculates the available fire flow at each model node based upon specified system conditions while maintaining a specified minimum pressure within the distribution system. Pressures below 20 psi anywhere within the system may allow for groundwater infiltration that could contaminate the water supply. As such, 20 psi is specified as the minimum system pressure for all Fire Flow and Hydrant Analyses.

Based on the model's output, it is immediately apparent the majority of the distribution system cannot provide the desired flow of 1,000 gpm to residential areas. The area between Ridge Road and Woodward Avenue, from Oakland Park to the South City Limits, is the only area where the model predicts hydrants have the capability of delivering the recommended fire flow while maintaining 20 psi within the distribution system. The

primary factor impacting available fire flow appears to be the age of the water mains and the prevalence of 6 inch water mains.

A five (5) year capital improvement program (CIP), based upon available funding, is recommended to improve available fire flow. Pleasant Ridge wishes to transition the 12 inch emergency connection to SOCWA on Eastbound 10 Mile Road (I-696 Service Drive) at Oakdale into a second SOCWA supply connection in continuous use. Transition to continuous use will require construction of a meter vault and a pressure reduction valve to control the supply pressure and balance the flows with the existing supply connection. The interim improvements proposed were added to the existing model to predict effect on the distribution system. The model was run for the existing maximum day scenario to determine in general how well the distribution system will theoretically work and to predict the available fire flow while maintaining 20 psi within the distribution system. Based on the model's output for this scenario, the water system, with interim improvements, continues to generally work well during the existing maximum day demand. Predicted pressures throughout the system ranged from 58.05 to 69.92 psi. Additionally, the available fire flow situation showed significant improvement. The model predicts almost all of Pleasant Ridge will be able to provide the desired flow of 1,000 gpm. Deficiencies in available fire flow remain in the southeastern corner of the City, primarily along the dead end water mains on Woodward Heights and Fairwood.

In addition to current demand, future (2035) demand from Pleasant Ridge was analyzed. The model, including the Interim Capital Improvement Program, was adjusted to reflect the future maximum day demand and 20 years of additional pipe aging. The model predicts the distribution system will continue to operate well during this future demand scenario. Predicted pressures throughout the system ranged from 58.03 to 69.84 psi. The model predicts the city-wide improvement with respect to available fire flow after the interim improvements generally remained despite the additional pipe aging and slight increase in demand. However, the deficiencies in predicted available fire flows in the southeastern corner of the City also remain.

Based upon results from the water distribution system model, replacement of the City's mains was further prioritized based on a number of factors. These factors include age, size, streets scheduled for repaving and the importance placed on the pipe by the model. A twenty (20) year master plan capital improvement program was developed through multiple iterations of the model and incorporated into the ultimate future model of the distribution system. This future distribution system, including all master plan proposed improvements, showed significant improvement in performance when analyzed under the future maximum day scenario. Predicted pressures ranged from 58.05 to 69.95 psi. Additionally, the model predicted significant improvement to available fire flow. The proposed variable minimum desired fire flows based on zoning are being met, city-wide, with the exception of a few dead end water mains where city limits restrict reasonable looping solutions.

Finally, a sensitivity analysis was performed to examine the future performance of the distribution system assuming all six (6) inch diameter water mains were replaced with eight (8) inch diameter, all cast iron pipes have been replaced with ductile iron water

mains and all pipes have a roughness (“C”) factor of 90. The model was then run again for the future maximum day scenario to determine how these changes would impact the distribution system and the available fire flow while maintaining 20 psi within the system. Based on the model’s output, the water distribution system continues to generally work well during the future maximum day demand. Predicted pressures throughout the system generally ran between 58.17 and 70.41. There were no deficiencies in predicted available fire flow within the system under these conditions, with all hydrants able to provide in excess of 3000 gpm.

Anderson, Eckstein and Westrick, Inc. recommends the following to maintain a safe, healthy and reliable public water distribution system:

- The Gate Valve and Hydrant Inspection and Exercise Program (CIP #2) should be implemented in 2016. Pleasant Ridge should inspect and exercise every gate valve and inspect and flush every hydrant in the City, and perform any repairs necessary (including replacement, if needed), to ensure they are fully operational within the next five (5) years. AEW recommends Pleasant Ridge establish five to ten “districts” and schedule 1 to 2 districts per year. This should be an annual program that is maintained perpetually after the initial inspections and repairs are completed. The schedule can be more aggressive if personnel and funding permits, but at minimum it is recommended that every valve and hydrant be inspected and exercised at least once every five years. (*)
- Initiate discussion with SOCWA related to transitioning the emergency connection at Eastbound 10 Mile Road and Oakdale into a second supply connection in continuous use (CIP#1). If SOCWA permits, this interim improvement would have the largest impact on improving available fire flow city-wide.
- Complete the three (3) projects identified as master plan improvements (CIP #3 – 5) within the next six (6) to twenty (20) years as the applicable street is repaved. (**)
- Continue and improve the methodical system of tracking detailed locations of water main breaks and repairs to identify and potentially re-prioritize aging water mains that should be retired and replaced. Existing pipe material and diameters should be noted during all repairs to improve the available “as-built” information about the distribution system.
- As a rule of thumb, aging water mains being retired should be replaced with a minimum 8 inch diameter pipe on all residential streets. The 10 inch to 12 inch transmission mains on Woodward Avenue and Oxford Boulevard are not proposed for replacement and the effects of a reduction in size has not yet been studied. If proposed due to reprioritizing, AEW can evaluate at that time.

(*) Staffing and budget issues, coupled with the size of the distribution system, may make programs to address <u>all</u> hydrants or valves annually unfeasible. At minimum, the system should be divided into districts such that annual programs address <u>all</u> hydrants and valves every five (5) years.

(**) Projects recommended for completion in years six (6) through twenty (20) may be reprioritized, and additional needs identified, based upon continued tracking of water main breaks.

The distribution system model created for this report is a valuable tool for future evaluation. Continued updates to the model are recommended as the distribution system is improved and as additional information becomes available. The information provided by future metered flows and hydrant flow tests will allow for continued refinement of the model's calibration and may assist with decision-making relative to identifying and prioritizing improvements.

Scope of Work

The Michigan Department of Environmental Quality (MDEQ) requires municipal consumers to conduct a Water Reliability Study and General Plan. The City of Pleasant Ridge engaged Anderson, Eckstein & Westrick, Inc. (AEW) to prepare a Water Reliability Study and General Study in accordance with Part 12 of the Administrative Rules promulgated under the Michigan Safe Drinking Water Act (1976 PA 399) and Master Plan for the municipal water distribution system. As part of this Water Reliability Study and General Plan, the City's system was modeled and evaluated for its ability to adequately serve its customers during peak periods, as well as provide firefighting capability while maintaining an adequate pressure in the system.

Since the City is completely built out and does not anticipate future expansion or other significant changes in demand, the City of Pleasant Ridge's master plan addresses looping, replacement and rehabilitation of aging water mains experiencing frequent water main breaks and upsizing of aging water mains to provide adequate pressure and capacity. The City's water main master plan was modeled to determine its effectiveness in improving the reliability of City water service.

Based on the model's results and information reported by the City's Water Department, the Southeastern Oakland County Water Authority (SOCWA), and the Royal Oak Department of Public Services (DPS), a 20 year capital improvement plan was developed.

Governing Standards

Accepted design standards, in accordance with the Michigan Safe Drinking Water Act, require distribution systems to have sufficient capacity to meet instantaneous peak demands, including fire flow demands. These standards also suggest that normal working pressure not fall below 35 pounds per square inch (psi). Under peak demand, including fire flow, 20 psi must be maintained at all times throughout the system. Pressures below 20 psi may allow for groundwater infiltration into the water system, resulting in contamination of the water supply.

Beyond safe drinking water standards, fire insurance premiums also influence water system planning and design. Fire flow requirements of the rating agencies reflect the generally conservative nature of the insurance business. Minimum fire insurance premiums require very large fire flows. These flows must be in quantities and pressures and for durations acceptable to the insurance companies. The National Fire Protection Association (NFPA) and the Insurance Services Office (ISO) publish data on the fire flow requirements necessary to qualify property for minimum fire insurance rates.

The length of time for which the required flows must be available varies. The distribution system must provide the minimum required fire flow of 500 gallons per minute (gpm) for at least 2 hours and the maximum flow of 12,000 gpm for 10 hours. The latter rate and duration draws over 7 million gallons of water from the supply system. Few systems are designed to deliver maximum flow rates. Economic constraints preclude construction of the storage and pumping facilities and the large diameter mains needed to deliver such

a large amount of water in the given time period. Thus, the design of municipal water systems balances the cost of constructing the system with the benefit of reduced insurance premiums, which results in a more realistic and economical system at the cost of greater fire insurance risk.

Although most water supply systems do not minimize the fire insurance risk to business, businesses do have options available to them to further reduce their risk. If zoning permits, buildings may be sited so they do not pose a risk to adjacent buildings. Businesses may also construct water storage facilities for firefighting, or install automatic sprinkler systems. All of these measures keep losses in a fire and insurance premiums to a minimum.

Pleasant Ridge desires the following minimum available fire flow, based on zoning, for analysis.

Zoning	Demand (gpm)
Single Family and Duplexes	1000
Multi- Family and Commercial	2000
Industrial	3000

Table 1 – Fire Flow Demand Based on Zoning

Current Flow Demands

Background

The City of Pleasant Ridge encompasses approximately 0.57 square miles in southeastern Oakland County. Development in the City consists primarily of single family residential areas. Commercial development lies predominately along northbound Woodward Avenue. There is some light industrial development along the CN Railroad ROW at the northeastern corner of the City.

The residential population for Pleasant Ridge, based on the 2010 Census is 2,526 people. Seasonal fluctuations are negligible. Table 2 presents the estimated existing population for the study area, based on Census 2000 and Census 2010.

Census 2000	2,594	people
Census 2010	2,526	people

Table 2 – City Wide Population

The Southeast Michigan Council of Governments (SEMCOG) develops population projections as part of their regional planning for Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw and Wayne Counties. SEMCOG uses the most recent U.S. census figures as the basis of their projections. SEMCOG provides the population projections for Pleasant Ridge for the current year as well as the next 5, 10, 15, 20 and 25 years from 2015. The estimated populations presented in Table 3 are based on SEMCOG's 2040 Forecast produced in 2012, and should not be directly compared to Census 2000 and Census 2010 numbers.

2015	2,476	people
2020	2,399	people
2025	2,429	people
2030	2,378	people
2035	2,415	people
2040	2,370	people

Table 3 – Estimated Population, SEMCOG 2040 Forecast

User Demand

Actual Pleasant Ridge water purchase data from 2010-2014 was reviewed by AEW. Average day demand is the annual consumption divided by 365 calendar days. Five (5) years of actual water purchase was averaged to generate an average day demand of 0.238 million gallons per day (mgd). Pleasant Ridge contracts with the Southeastern Oakland County Water Authority (SOCWA) for long term delivery of up to 1.96 mgd of potable water through a contract that dates back to April 14, 1960. SOCWA maintains a water supply system for the purposes of transporting, pumping and storing the potable water received under SOCWA's contract with the City of Detroit's Water and Sewerage Department (DWSD) for delivery to Pleasant Ridge and all members of SOCWA. This study accordingly uses 0.238 mgd as the average daily demand.

Maximum day demand illustrates the Pleasant Ridge demand that would usually be applied during the theoretical "worst" day per year, averaged over a 24 hour period. This would simulate a worst case scenario: a hot, dry summer day when many people are watering lawns, filling swimming pools and washing cars in addition to their usual water consumption for showers, toilets, laundry, dishes and other household activities. It would also include the night hours, when water consumption is lower. Maximum day demand, based upon actual water purchases from 2012-2014, was available from SOCWA. The three (3) year average maximum day demand was 0.490 mgd. This equates to an average day to maximum day peaking factor of 2.06 for the City of Pleasant Ridge. This study incorporates a more conservative maximum day peaking factor of 2.5 which equates to a maximum day demand of 0.595 mgd.

Peak hour demand illustrates demand on the system that would be applied during the peak hour. This would most likely occur during the morning hours when water consumption is high due to morning showers, cooking, lawn sprinkling, etc. and often occurs on the maximum day. The peak hour may also occur early each evening when water consumption is high due to dinner preparation, dishes, laundry, lawn sprinkling, evening showers, etc. and also often occurs on the maximum day. Metered flow, reported in cubic feet per minute (CFM), was provided by SOCWA for the maximum day water purchases for the years 2012-2014. The three (3) year average peak hour demand was 0.940 mgd. This equates to an average day to peak hour peaking factor of 3.95 for the City of Pleasant Ridge. This study incorporates a slightly more conservative peak hour peaking factor of 4.0 which equates to a peak hour demand of 0.952 mgd. The average day, maximum day, and peak hour demands used for this study are presented in the table below.

Existing Demands (mgd)		
Average Day	**Maximum Day**	**Peak Hour**
0.238	(x2.5) = 0.595	(x4.0) = 0.952

Table 4 – Summary of Existing System Model Demands

Additionally, the Pleasant Ridge Water Department reviewed August 2012 through July 2015 water billing records for every commercial account to identify their annual demand. A summary of these 23 customers is presented in Table 5.

Customer	Address	Demand (gpm)
Vogue Vintage	23622 Woodward	0.014
Occupant	23634 Woodward	0.062
Occupant	23647 Woodward	0.073
Occupant	23650 Woodward	0.206
Occupant	23701 Woodward	0.338
Occupant	23733 Woodward	0.058
Occupant	23900 Woodward	0.037
Occupant	23906 Woodward	0.040
Occupant	23908 Woodward	0.052
Occupant	24052 Woodward	0.047
Occupant	24126 Woodward	0.052
Occupant	24200 Woodward	0.087
Occupant	23700 Woodward	0.031
Romano Law	23880 Woodward	0.052
Valter Xhomaqi	24060 Woodward	0.385
Occupant	24100 Woodward	0.234
Occupant	24280 Woodward	0.331
Occupant	24242 Woodward	0.037
Comerica Bank	24028 Woodward	0.069
Occupant	23810 Woodward	0.707
Occupant	23708 Woodward	0.139
Hello World	404 E. 10 Mile Road	0.437
Walker Wire – Mittal	660 E. 10 Mile Road	0.003
	TOTAL	**3.494**

Table 5 - Commercial Water Consumers based upon 2012-2015 Billings in the City of Pleasant Ridge

Ten States Standards dictates a design average day of 100 gallons per capita per day (gcd). For a population of 2,476 (2015 SEMCOG Projection), the design average day demand calculates as 0.248 mgd. For purposes of accurately modeling the existing system, the demands calculated from actual records of consumption from the City of Pleasant Ridge (Table 4) were used rather than theoretical demand. The demand of the commercial customers was deducted from the average day demand within the City. The remaining demand was then divided by the SEMCOG number of single family, duplex, townhouses and attached condominium housing units. Based on this data, 1,170 metered service connections utilized an average of 0.233 mgd of water. Using the SEMCOG average household size of 2.23, this calculates to roughly 89.29 gcd, 199.12 gallons per

day per household unit or 0.1383 gpm for each residential meter. This value was assigned as the average day demand for each residential meter within the model.

Note that system demand was based upon wholesale data. The methodology referenced above includes line losses and other unallocated water losses in the residential meters to distribute proportionately throughout the system.

Pleasant Ridge aerial records and parcel maps were reviewed and compared to the water distribution model. Each recorded demand from the 23 commercial customers was placed at the node in the model nearest the location of the actual customer. The number of readily identifiable household units adjacent to each section of water main was then counted and a corresponding number of residential meters were assigned to the applicable pipe section. The total demand from the 23 commercial customers and the identified household units was then deducted from the known total demand within the City. This remaining unallocated demand was then assigned to various nodes within the model based upon locations of multi-unit housing developments and community gathering facilities such as the Community Center/Pool.

Fire Demand

Fire demand is the demand placed on the system when a fire occurs in the City. This demand is imposed at a single point in the system and varies based on the nature of the fire. Typically, fire demand is less in residential areas than in commercial and industrial areas due to smaller structures in residential areas which hold fewer flammable materials. Desired available fire flow for each type of zoning is listed in Table 6.

Zoning	Demand (gpm)
Single Family and Duplexes	1000
Multi- Family and Commercial	2000
Industrial	3000

Table 6 – Fire Flow Demand Based on Zoning

Fire demand is simulated in the model by performing a Fire Flow and Hydrant Analysis. Fire Flow and Hydrant Analysis is a function of Pipe2014 that calculates the available fire flow at each model node based upon specified system conditions while maintaining a specified minimum pressure within the distribution system. Pressures below 20 psi anywhere within the system may allow for groundwater infiltration that could contaminate the water supply. As such, 20 psi is specified as the minimum system pressure for all Fire Flow and Hydrant Analysis. Available fire flow is analyzed in the existing, interim and future models (under average day, maximum day, and peak hour demands) to evaluate the distribution system for its ability to provide fire flow.

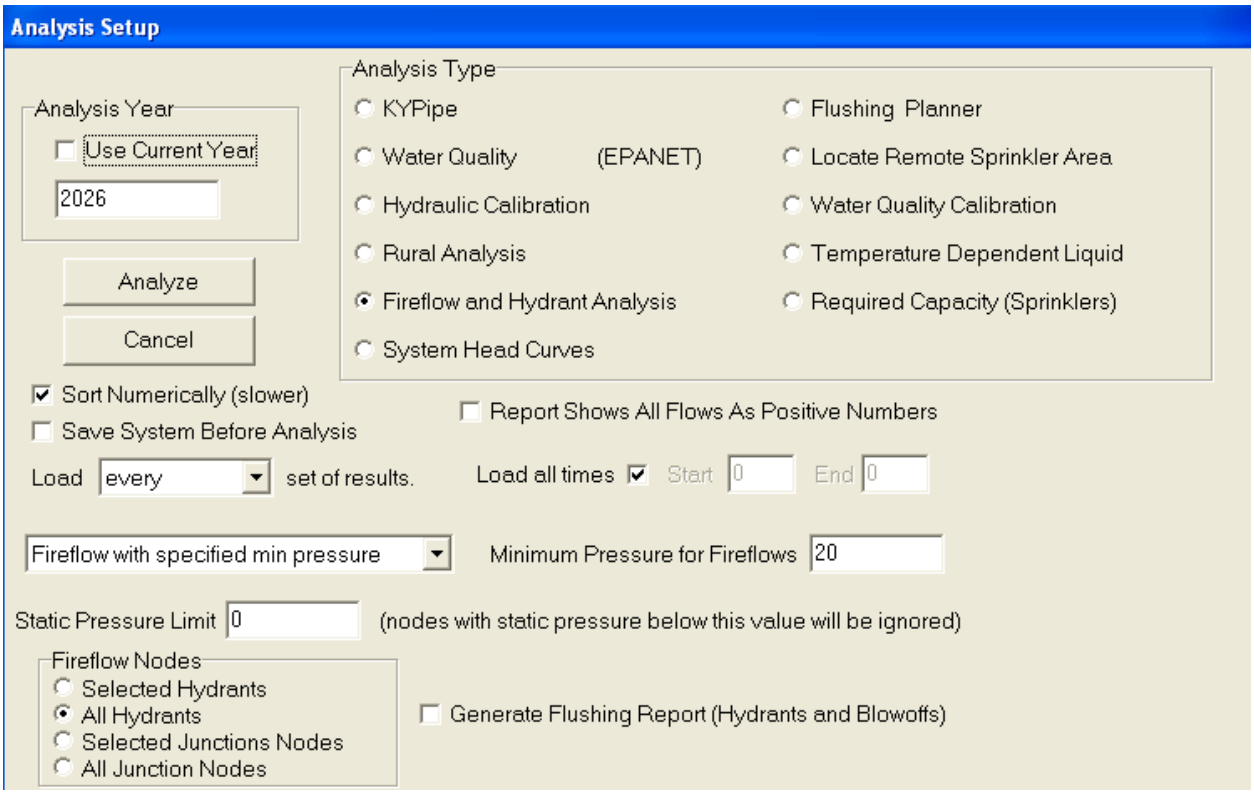

Figure 1 – Sample Fire Flow and Hydrant Analysis Set-up Screen

Existing System

System Overview

The City of Pleasant Ridge receives water from SOCWA. Water is delivered by SOCWA to Pleasant Ridge through one (1) metered connection to a SOCWA Transmission Main. The meter location is as follows:

- PR-01 – 12 inch Connection from 30 inch SOCWA Transmission Main to a Meter Pit located at Woodward Avenue and Oxford Boulevard.

There are four (4) emergency connections in the event of a loss of water service at PR-01:

- 12 inch Connection to Ferndale on Eastbound 10 Mile at Eprize
- 10 inch Connection to Ferndale on Woodward South of Cambridge
- 6 inch Connection to Ferndale on Fairwood at Gainsboro
- 12 inch Connection to SOCWA on Eastbound 10 Mile at Oakdale (Gates on North and South side of I-696)

No other sources of supply such as pumps, wells or water storage exist. SOCWA and Pleasant Ridge report supply pressure typically ranges in the high 60's psi. AEW reviewed 24 hours of supply pressure data reported in one (1) minute increments to further supplement the available supply information.

Parameter	PR-01
Pressure Min. (psi)	62
Pressure Max. (psi)	72
Pressure Mode (psi)	68
Pressure Average (psi)	67.02

Table 7 – SOCWA Supply Parameters

As previously discussed, the existing average day demand was determined by analysis of water consumption data from 2010-2014. Future demand was estimated by applying the design standard of 100 gallons per capita per day to the SEMCOG 2035 population projection. Future maximum day and peak hour demands were estimated by application of the peaking factors previously discussed.

Calendar Year	Model Demands (mgd)		
	Average Day	Maximum Day	Peak Hour
2015	0.238	0.595	0.952
2035	0.242	0.604	0.966

Table 8 – Summary of Existing and Future Model Demands

Calendar Year	Pressure Range (psi)			
	Meter PR-01			
	Min.	Max.	Avg.	Mode
2015	62	72	67.02	68
2035	62	72	67.02	68

Table 9 – Supply Pressures

The City of Pleasant Ridge is a fully developed community, containing a network of approximately 10.57 miles of water distribution mains throughout the entire community ranging from six (6) inches in diameter to twelve (12) inches in diameter. The system provides water service to approximately 1,170 residential and 23 commercial service connections. The City of Pleasant Ridge contracts with the City of Royal Oak DPS to provide operation and maintenance of the Pleasant Ridge water distribution system.

AEW has detailed information about water mains constructed since 1995. Additionally, AEW reviewed the archives of Pate, Hirn & Bogue, Inc. (Pleasant Ridge consulting engineer prior to AEW) to get detailed information about any water mains constructed between 1961 and 1995. However, the City experiences relatively few water main breaks and has not replaced any water mains in the last 50+ years due to performance or reliability issues. The only water main renewals have been associated with the work of outside agencies. The Michigan Department of Transportation replaced almost 3,000 feet of 12 inch water main in the 10 Mile Road (I-696 Service Drive) Right-of-Way (ROW) in 1985. SOCWA replaced approximately 17 feet of 12 inch water main adjacent to the water meter at Woodward and Oxford in 2000 when they renewed their 30 inch transition main. The only information available for the majority of the water mains within the distribution system was location and diameter. Pleasant Ridge and Royal Oak personnel assume the water distribution system in Pleasant Ridge to be circa 1920.

The model incorporates pipe ages based upon these references. As can be seen in Table 10 below, almost 95% of the water mains have an assumed construction date of very limited accuracy.

Age (Assumed)	Miles of Pipe	% of Current System
1920's	10.01	94.69
1985	0.56	5.28
2000	0.00	0.03
Total	10.57	100.00

Table 10 – History of Water Distribution System Development

As such, water main conditions range from poor to good. Water mains constructed prior to 1985 are assumed to be cast iron.

Maps showing the existing water distribution system are provided in Appendix A. A summary of water mains, based upon available records and assumptions, is presented below.

Pipe Material	Approximate Length (feet)
Cast Iron	52,838
Ductile Iron	2,963
Total Footage	**55,801**

Table 11 - Summary of Water Mains by Pipe Material

Pipe Diameter (inches)	Approximate Length (feet)
6	31,277
8	8,277
10	7,621
12	8,626
Total Footage	**55,801**

Table 12 - Summary of Water Mains by Pipe Diameter

Pipe Material	Dia. (in)	Approx. Length (feet)
Cast Iron	6	31,277
Cast Iron	8	8,277
Cast Iron	10	7,621
Cast Iron	12	5,664
Ductile Iron	12	2,962
Total Footage		**55,801**

Table 13 - Summary of Water Mains by Diameter and Pipe Material

Firefighting demand can severely reduce pressures in a system of small diameter pipe. Undersized pipe results in excessive head loss and a corresponding decrease in flow, even when adequate pressures are maintained in larger, nearby mains. Industry standards recommend a minimum size pipe of 6 inches. However, many communities in southeast Michigan have installed nothing smaller than 8 inch diameter pipe in recent years, to ensure adequate flows and pressures. The City's water main system is extensively looped, but more than 5.9 miles of water mains in the system are still 6 inch diameter, which could present a problem, especially as the aging system continues to deteriorate.

The pictures below show tuberculation in 6 inch cast iron water mains that had been in service over 50 years. The picture on the left is a water main that was removed in October 2015 in the City of Fraser, approximately 12 miles Northeast of Pleasant Ridge. The middle and right pictures are a water main that was removed a few years ago in Clawson, approximately 5 miles due North of Pleasant Ridge. The pictures show approximately 1/3 of the pipes' cross sections are encumbered with scale buildup, effectively causing the mains to become undersized over time.

Picture 1 – 50+ Year-old 6 inch Cast Iron Water Mains

Model Development

The model of the existing water distribution system was developed with the pipe network analysis program, Pipe2014, professional version 7.022a, software by KYPipe LLC. Pipe2014 is a graphic user interface (GUI) for the KYPipe pipe network analysis engine/program developed at the University of Kentucky. This program performs regular simulations of steady state pressure and flow in pipe networks transporting liquids. The Pipe2014 program is extremely powerful and capable of modeling very complex pipe networks.

As powerful as Pipe2014 is, accurate data input to the program is essential to obtain meaningful results. Every effort was made in configuring the model to accurately reflect the existing system. Water main layout was entered based upon system maps provided by the City of Pleasant Ridge. These system maps included pipe diameter, hydrant and valve locations. A master list of installation year and pipe material for the water distribution system, by street, is unavailable. The previous section of this report outlines the archive and reference resource searches and the assumptions used to acquire additional data on pipe materials and age of construction. Construction year is useful data as Pipe2014 adjusts pipe roughness C-factors based upon age. Pipe layout was drawn to the scale of

the map provided. Minor losses were incorporated by including pipe fittings (bends, tees, valves, etc.) on the applicable pipes.

Elevation for node pressure junctions were assumed to be at ground level. Node elevations were interpolated from Google Earth Pro software version 7.1.2.2041.

Demands were allocated throughout the system as previously discussed.

The SOCWA supply is represented in the model by a reservoir at the connection point. Use of a reservoir as the supply allows grade adjustments to easily edit the supply pressure based upon conditions. Supply pressures used in the model was the average daily supply pressure. The following is a summary of the pressures entering the system at each connection point in model.

Meter	Location	Meter Elev. (ft)	Hydraulic Grade (ft)	Pressure (psi)
PR-01	Woodward and Oxford	648.0	802.77	67.0

Table 14 – SOCWA Supply at Connection Point

Fire hydrant flow tests are an essential tool used in calibrating the computer model. These tests provide actual data on the system's performance, including static pressures within the system, residual pressures while the system is under demand, flows produced by measured drops in system pressure and estimates of the condition of the interior smoothness of the pipe in the system. From the results of a hydrant flow test, the theoretical flow available from the system may be calculated at any residual pressure desired. The formula used to calculate the theoretical flow is as follows:

$$Q_R = Q_F \times \frac{H_R^{0.54}}{H_F^{0.54}}$$

where:

Q_R = theoretical flow at the desired residual pressure

Q_F = actual flow measured during the test

H_R = the drop in pressure from static to desired residual

H_F = the drop in pressure from static to actual residual during the test

In order to provide standardized results from hydrant flow tests, flows are calculated from the above formula at a desired residual pressure of 20 psi. This pressure is chosen because public health guidelines require water distribution systems to maintain a minimum of 20 psi during fire flow events. This minimum residual pressure provides protection against backflow and possible system contamination.

Eight (8) hydrant flow tests were performed by AEW personnel on October 22nd, 2015. The hydrant test results are included in Appendix A. A summary of the test results, including the theoretical fire flow available at 20 psi under conditions at the time of testing, is presented in the table below.

Test No.	Flow Hydrant Test Location	Residual Hydrant		Flow (gpm)	GPM @ 20 psi residual
		Static Pressure (psi)	Residual Pressure (psi)		
1	8 Millington	56	7	840	700
2	4 Kenberton	59	17	530	500
3	139 Maplefield	59	12	760	700
4	111 Elm Park	57	17	530	500
5	24060 Woodward (@Amherst)	62	12	1310	1200
6	42 Fairwood	62	36	530	700
7	60 Amherst	64	40	380	500
8	99 Kensington	61	12	530	500

Table 15 – Hydrant Flow Test Data Summary

To calibrate the model, Pipe2014 uses a function called “calibration wizard”. Each pipe within the distribution system is assigned a calibration group based upon similar diameter and pipe material. Flow test results are then entered into this function as a separate “case” for each test. The discharge measured during the test was input as a demand at the model node corresponding to the flow hydrant, the residual pressure measured during the test was input at the model node corresponding to the residual hydrant, and the static pressure at the SOCWS connection was entered by editing the reservoir grade. Instantaneous supply pressures at the SOCWA supply meter are recorded every minute by SOCWA. SOCWA provided this information to allow for accurate simulation of the boundary conditions at the time tests were conducted.

The “calibration wizard” then analyzed the system for each separate “case” to compare predicted pressures to actual test pressures measured during hydrant flow testing. Any discrepancy between the actual test pressure and the computer model’s predicted pressure is minimized by applying an adjustment factor to the pipe roughness C-factors of each calibration group. Pipe2014 continues to run iterations until the difference between actual and predicted pressures cannot be further minimized.

If standard deviation is more than desired, results are discarded and revisions are made before running “calibration wizard” again. Revisions include: editing elevations, assigning additional line losses to significantly aged pipes, reviewing the accuracy of pipe interconnections and closing pipes to simulate broken or closed valves in the system. The Royal Oak DPS was not aware of any known or suspected valves broken in the closed position.

The City of Pleasant Ridge does not presently have a regularly scheduled program to exercise and inspect system valves. There is a distinct possibility of valves that are unknowingly closed or “failed” in the closed position due to age. The fact the distribution system is well looped would prevent identification of these closures unless there are two adjacent closures or a program to periodically exercise and inspect all valves. Trial and error determined model accuracy was improved by closing the following valves:

6 inch Water Main between 10 Mile Road and Kensington along CN Railroad ROW
10 inch Water Main between Norwich and Oakland Park along Ridge Road

It must be noted there is insufficient evidence to identify these two locations as the specific location of a valve closure and/or failure, or that there are only two locations within the distribution system. Numerous locations and combinations of locations were simulated as valve closures with limited improvement in accuracy. However, when these two locations were simulated together, model accuracy improved from a standard deviation of 29.188% to 7.870%

The predicted residual pressures approximate those actually measured in the field with a 7.875% deviation. The results obtained from the model correlate generally well with the actual results. The table below compares the actual hydrant flow test results with the computer model's results. Hydrant flow test 2 was omitted from the calibration data as the results were identical to Hydrant flow test 4 as it was only one block north, on a similarly aged 6 inch diameter water main and had identical results. Hydrant flow test 6 was omitted from the calibration data as it was a dead end water main. Computer model calibration results are presented in Appendix B.

Hydrant Flow Test No.	Model Residual Node	Residual Pressure (psi)	
		Test	Model
1	J-69	7	5.8
2	Omitted from Calibration		
3	J-74	12	7.2
4	J-76	17	16.3
5	J-78	12	13.5
6	Omitted from Calibration		
7	J-81	40	50.1
8	J-83	12	11.4

Table 16 – Comparison of Actual vs. Predicted Hydrant Flow Test Results

Differences in residual pressure could reflect actual demands at the time of the tests varying from the average demand calculated from records. The average demand neglects the time-dependent nature of actual water usage, but that is a consistent source of deviation in all models. Specific deviation may also be caused by the instantaneous point demands from flow tests being impacted by the location of the valve "closures" within the model or by additional valve closure and/or failure. Additionally, the fact that 95% of the water mains in the model are of similarly assumed age and material will limit the potential accuracy.

However, the calibration tests show the model can predict generally well the system's response to varying demands when used as a "snap shot" of steady state conditions. Further refinement to the model would require extensive field surveying and additional hydrant flow testing with no certainty of improvement. Improved accuracy may not be possible without extensive excavation to verify pipe material and better estimate age of construction. Considering the City is fully developed without the capacity for large scale

development of new demands, the model can reliably indicate the system's performance and impacts of water main replacement projects.

Results

Average Day

The existing model was run for the average day scenario to determine in general how well the distribution system is currently working and calculate the available fire flow while maintaining 20 psi within the distribution system. Running the model requires system conditions at the time of the simulation. This required specification of system demand and pressure at the SOCWA supply. System demand under the average day conditions was allocated as discussed earlier in this report. The simulation was performed using the SOCWA supply pressure as shown in Table 14.

Steady state simulation results are presented in Appendix C. The existing water system operates well during the average day demand. Pressures throughout the system ranged from 57.21 to 69.89 psi and are graphically depicted through use of color gradients in Appendix C. However, when analyzing for available fire flow it is immediately apparent the majority of the distribution system cannot provide the desired flow of 1,000 gpm to residential areas. The area between Ridge Road and Woodward Avenue, from Oakland Park to the South City Limits, is the only area where the model predicts hydrants have the capability of delivering the recommended fire flow while maintaining 20 psi within the distribution system.

Available fire flow throughout the distribution system is depicted graphically through the use of colored gradients and is included in Appendix C. Generally speaking, areas trending from yellow toward the blue spectrum are good (can provide fire flow that exceeds 1,000 gpm). Areas trending toward the red spectrum are areas of concern (cannot provide the minimum 1,000 gpm fire flow required for residential zoning). The primary factor impacting available fire flow appears to be the age of the water mains and the prevalence of 6 inch water mains.

Maximum Day

The existing model was run for the maximum day scenario to determine in general how well the distribution system is currently working and calculate the available fire flow while maintaining 20 psi within the distribution system. System demand under the maximum day conditions was achieved by applying a global demand factor to the model. This increased the model's system-wide demand to match the maximum day demand while maintaining the distribution that was applied to the average day model (allocated as discussed earlier in this report). The simulation was performed using the SOCWA supply pressure as shown in Table 14.

Steady state simulation results are presented in Appendix D. The existing water system operates generally well during the maximum day demand. Pressures throughout the system ranged from 52.55 to 68.44 psi and are graphically depicted through use of color gradients in Appendix D. The city-wide deficiency in available fire flow remained, with the exception of the area bounded by Ridge Road and Woodward Avenue from Oakland Park to the South City Limits. However, this region where the model predicts hydrants are

capable of delivering the recommended fire flow appeared to slightly contract while the deficiency throughout the rest of the City worsened. A graphic depiction of available fire flow is also included in Appendix D.

Peak Hour

The existing model was run for the peak hour scenario to determine in general how well the distribution system is currently working and calculate the available fire flow while maintaining 20 psi within the distribution system. System demand under the peak conditions was achieved by applying a global demand factor to the model. This increased the model's system-wide demand to match the peak hour demand while maintaining the distribution that was applied to the average day and maximum day models (allocated as discussed earlier in this report). The simulation was performed using the SOCWA supply pressure as shown in Table 14.

Steady state simulation results are presented in Appendix E. The existing water system operates generally well during the peak hour demand. Pressures throughout the system ranged from 44.61 to 67.07 psi and are graphically depicted through use of color gradients in Appendix E. The city-wide deficiency in available fire flow remained, with the exception of the area bounded by Ridge Road and Woodward Avenue from Oakland Park to the South City Limits. However, this region where the model predicts hydrants are capable of delivering the recommended fire flow appeared to contract further while the deficiency throughout the rest of the City worsened. The model predicts the majority of the city, serviced by aging 6 inch water mains, cannot provide even 500 gpm. A graphic depiction of available fire flow is also included in Appendix E.

Interim Improvements

Proposed Improvements

A five (5) year Capital Improvement Program (CIP), based upon available funding, is recommended to improve available fire flow. Pleasant Ridge wishes to transition the 12 inch emergency connection to SOCWA on Eastbound 10 Mile Road (I-696 Service Drive) at Oakdale (Gates on North and South side of I-696) into a second SOCWA supply connection in continuous use (tentative designation PR-02). Transition to continuous use will require construction of a meter vault and a pressure reduction valve to control the supply pressure and balance the flows with PR-01. The proposed interim improvements are as follows:

CIP#	Limits	Diameter (in)		Length (ft)	Year Installed
		Ex.	Prop.		
1	Additional SOCWA Supply	12	12	n/a	1985
2	Gate Valve & Hydrant Inspection/Exercise	City-wide			

Table 17 – Proposed Interim Capital Improvement Plan

Maps showing the interim improvements water distribution system are provided in Appendix J.

Results

Maximum Day for Interim Improvements

The interim improvements proposed were added to the existing model to predict effect on the distribution system. The model was run for the existing maximum day scenario to determine in general how well the distribution system will theoretically work and to predict the available fire flow while maintaining 20 psi within the distribution system. System demand under the maximum day conditions was achieved by applying a global demand factor to the model. This increased the model's system-wide demand to match the maximum day demand while maintaining the distribution that was applied to the previous existing system models (allocated as discussed earlier in this report). The simulation was performed using the SOCWA supply pressure at PR-01 as shown in Table 14 while the pressure at PR-02 was set at 62.65.

Based on the model's output (Appendix F), the water system, with interim improvements, continues to generally work well during the existing maximum day demand. Predicted pressures throughout the system ranged from 58.05 to 69.92 psi, an increase from the results prior to the interim improvements. Additionally, the available fire flow situation showed significant improvement. The model predicts almost all of Pleasant Ridge will be able to provide the desired flow of 1,000 gpm. Deficiencies in available fire flow remain in the southeastern corner of the City, primarily along the dead end water mains on Woodward Heights and Fairwood. Graphic depictions of pressures and available fire flow are also included in Appendix F. Note the model predicts the maximum day demand was serviced almost equally between the two supplies with 49% of the flow through PR-01 and 51% of the flow through the new PR-02 under these conditions.

Future System

Future System Overview

The future model incorporated the interim improvements noted previously. Additionally, the roughness values determined during calibration of the existing model were reduced by five percent (5%) to simulate an additional 20 years of aging on the distribution system.

Future Demand

Pleasant Ridge is fully developed and no significant changes to the City's water demand are anticipated in the future. As noted earlier, SEMCOG forecasts the population to decline over the next 20 years.

2015	2,476	people
2020	2,399	people
2025	2,429	people
2030	2,378	people
2035	2,415	people
2040	2,370	people

Table 3 – Estimated Population, SEMCOG 2040 Forecast

These forecasts project a 2.5% decrease in population over the next twenty (20) years. This model applies the design standard of 100 gcd to the projected 2035 population to arrive at a 2035 average day demand of 0.242 mgd. Once again the ratio of maximum day demand to average day demand was assumed to be 2.5 and the ratio of peak hour demand to average day demand was assumed to be 4.0. The values used for this study are presented again in the tables below.

Calendar Year	Model Demands (mgd)		
	Average Day	Maximum Day	Peak Hour
2015	0.238	0.595	0.952
2035	0.242	0.604	0.966

Table 8 – Summary of Existing and Future Model Demands

Calendar Year	Pressure Range (psi)			
	Meter PR-01			
	Min.	Max.	Avg.	Mode
2015	62	72	67.02	68
2035	62	72	67.02	68

Table 9 – Supply Pressures

This total average day demand was then allocated to the future model. Recorded demands from the commercial customers remained unchanged in the future model. While ownership and some relocation of demand is likely, it is assumed that current records will be representative of both quantity and general distribution within the City. The number and location of residential meters remained constant, but the demand was adjusted. The demand from the commercial customers was deducted from the future average day demand within the City. The remaining demand was then divided by the SEMCOG number of single family, duplex, townhouse and attached condominium housing units. Based on this data, 1,170 metered service connections will utilize an average of 202.11 gpd, or 0.1404 gpm for each residential meter. This value was assigned as the average day demand for each residential meter within the model.

Results

Future Maximum Day for Interim Improvements

The future model was run for the maximum day scenario to predict in general how well the distribution system will work and the available fire flow while maintaining 20 psi within the distribution system. System demand under the maximum day conditions was achieved by applying a global demand factor to the model. This increased the model's system-wide demand to match the future maximum day demand while maintaining the distribution that was applied as discussed above. The simulation was performed using the SOCWA supply pressure at PR-01 as shown in Table 14 while the pressure at PR-02 was set at 62.65.

Based on the model's output (Appendix G), the water system, with interim improvements, generally works well during the future maximum day demand. Predicted pressures throughout the system generally ran between 58.03 and 69.84 psi, a slight decrease from the 58.05 to 69.92 psi range predicted prior to 20 years additional pipe aging. Additionally,

the city-wide improvement with respect to available fire flow after the interim improvements generally remained despite the additional pipe aging and slight increase in demand. However, the deficiencies in predicted available fire flows in the southeastern corner of the City also remain. Graphic depictions of pressures and available fire flow are also included in Appendix G. Note the model predicts the future maximum day demand will continue to be serviced almost equally between the two supplies with 49% of the flow through PR-01 and 51% of the flow through the new PR-02 under these conditions.

Master Planning

20 Year Capital Improvement Program

Despite the advanced age of the majority of the water distribution system, Pleasant Ridge experiences relatively few water main breaks. This is most likely the result of two factors. First, the soils in Pleasant Ridge are loamy sand (Spinks and Thetford complex soils) which drain quickly and do not retain a large amount of water. Second, the localized effects of I-696 and the Woodward underpass. The excavation and drainage systems associated with those projects has lowered the water table.

Pleasant Ridge began an ambitious program to repave their local streets in 1995. To date, all but six (6) streets have been replaced. These remaining streets received additional consideration in developing the master plan improvements.

The relative lack of water main breaks eliminates one important factor typically used to prioritize water main replacements. Therefore, replacement of Pleasant Ridge's aging water mains was prioritized based upon size, available fire flow, improved looping East of Woodward Avenue, streets scheduled for repaving in the next twenty (20) years and the importance placed on the pipe by the model.

Although all of the approximately 90+ year old mains should be replaced, a twenty year water distribution system CIP is recommended that will improve transmission and have the greatest impact on addressing the deficiencies in available fire flow identified in this study.

Over the next two decades, situations may arise which would prompt a review and/or change to this list. It should be noted that, overall, the current system is working well.

The following table provides the recommended 20 year capital improvement program. A map showing this program is included in Appendix J.

Years 1-5 – Interim Improvements				
CIP #	**Street Name**	**Project Limits**	**Length (ft)**	**Prop. Dia. (in)**
1	Additional SOCWA Supply	Eastbound 10 Mile at Oakdale	n/a	8
2	Gate Valve & Hydrant Insp./Exercise	City-wide	n/a	n/a
Continued on Next Page				

Years 6-20 – Master Plan Improvements				
CIP #	Street Name	Project Limits	Length (ft)	Prop. Dia. (in)
3	Ridge	10 Mile to South City Limit	2,525	8
4	Indiana	10 Mile to Woodward Heights	2,325	8
5	Bermuda	Sylvan to Woodward Heights	615	8
		Total Footage (Master Plan Improvements)	5,465	

Table 18- Proposed Master Plan Capital Improvement Program

Results

Future Maximum Day for Master Plan Improvements

The future model was run for the maximum day scenario to predict in general how well the distribution system will work and the available fire flow while maintaining 20 psi within the distribution system. System demand under the maximum day conditions was achieved by applying a global demand factor to the model. This increased the model's system-wide demand to match the future maximum day demand while maintaining the distribution that was applied as discussed previously. The simulation was performed using the SOCWA supply pressure at PR-01 as shown in Table 14 while the pressure at PR-02 was set at 62.65.

Based on the model's output (Appendix H), the water system, with all master plan improvement, generally works well during the future maximum day demand. Predicted pressures throughout the system generally ran between 58.05 and 69.95 psi, a slight increase from the 58.03 to 69.84 psi range predicted prior to the master plan improvements. Additionally, the model predicted significant improvement to available fire flow. The proposed variable minimum desired fire flows based on zoning are being met, city-wide, with the exception of a few dead end water mains where city limits prohibit reasonable looping solutions. Graphic depictions of pressures and available fire flow are also included in Appendix H. Note the model predicts the future maximum day demand will continue to be serviced almost equally between the two supplies with 46% of the flow through PR-01 and 54% of the flow through the new PR-02 under these conditions.

Sensitivity Analysis

A sensitivity analysis was performed to examine the future performance of the distribution system assuming all 6 inch water mains have been replaced with 8 inch diameter, all cast iron pipes have been replaced with ductile iron, and all pipes have a roughness ("C") factor of 90. The model was then run again for the future maximum day scenario to determine how these changes would impact the distribution system and the available fire flow while maintaining 20 psi within the system. The simulation was performed using the SOCWA supply pressure at PR-01 as shown in Table 14 while the pressure at PR-02 was set at 62.65.

Based on the model's output (Appendix I), the water system continues to generally work well during the future maximum day demand. Predicted pressures throughout the system generally ran between 58.17 and 70.41. No deficiencies in predicted available fire flow exist within the system under these conditions. Graphic depictions of pressures and available fire flow are also included in Appendix I. Note the model predicts the future maximum day demand will continue to be serviced almost equally between the two

supplies with 54% of the flow through PR-01 and 46% of the flow through the new PR-02 under these conditions.

Conclusion

Performance

The existing water distribution system generally works well during the average day scenario. Pressures throughout the system range between 57.21 and 69.89 psi with water supplied at the SOCWA connection as follows:

Meter	Location	Meter Elev. (ft)	Hydraulic Grade (ft)	Pressure (psi)
PR-01	Woodward and Oxford	648.0	802.77	67.0

Table 14 – SOCWA Supply at Connection Point

AEW is unaware of any complaints related to the service by Pleasant Ridge customers, further supporting the model predicted values. Ideal normal working pressures should not fall below 35 psi. Model analysis showed the system generally working well under maximum day conditions as well, with pressures throughout the system ranging between 52.55 and 68.44 psi, and under peak hour conditions, with pressures ranging between 44.61 and 67.07 psi.

However, when analyzing for available fire flow it is immediately apparent the majority of the distribution system cannot provide the desired flow of 1,000 gpm to residential areas. The area between Ridge Road and Woodward Avenue, from Oakland Park to the South City Limits, is the only area where the model predicts hydrants have the capability of delivering the recommended fire flow while maintaining 20 psi within the distribution system. As the model was analyzed for existing maximum day and peak hour demands, these deficiencies became more pronounced and the area capable of delivering the desired fire flow contracted.

The interim improvements proposed for construction showed marked improvement in system performance when added to the computer model and run under the current maximum day demand scenario. Predicted pressures throughout the system ranged from 58.05 to 69.92 psi, an increase from the 52.55 to 68.44 psi range without the improvements. Additionally, the available fire flow situation showed significant improvement. The model predicts almost all of Pleasant Ridge will be able to provide the desired flow of 1,000 gpm. Deficiencies in available fire flow remain in the southeastern corner of the City, primarily along the dead end water mains on Woodward Heights and Fairwood.

The distribution system, including the interim improvements, generally performed well when analyzed instantaneously under the future 2035 maximum day demand scenario. Predicted pressures throughout the system ranged from 58.03 to 69.84 psi, a slight drop attributed to further aging of the existing pipes. Additionally, the city-wide improvement with respect to available fire flow after the interim improvements generally remained despite the additional pipe aging and slight increase in demand. However, the

deficiencies in predicted available fire flows in the southeastern corner of the City also remain.

Finally, the distribution system, including all master plan proposed improvements, showed significant improvement in performance when analyzed under the future 2035 maximum day scenario. Predicted pressures ranged from 58.05 to 69.95 psi, a slight increase from the 58.03 to 69.84 psi range. Additionally, the model predicted significant improvement to available fire flow. The proposed variable minimum desired fire flows based on zoning are being met, city-wide, with the exception of a few dead end water mains where city limits prohibit reasonable looping solutions.

Benefits of the Capital Improvement Program Projects

As a whole, the interim and master plan Capital Improvement Program projects will improve available fire flow while maintaining a water distribution system that serves existing customers well. Independently, each of the CIP projects will provide immediate benefits to various portions of the water distribution system.

The potential benefits of each are summarized below:

CIP #1 <u>New SOCWA Supply at Eastbound 10 Mile Road and Oakdale</u>

This project will improve reliability and performance by replacing transitioning an emergency 12 inch emergency connection to SOCWA on Eastbound 10 Mile Road (I-696 Service Drive) at Oakdale (Gates on North and South side of I-696) into a second SOCWA supply connection in continuous use. Transition to continuous use will require construction of a meter vault and a pressure reduction valve to control the supply pressure and balance the flows with PR-01. This second supply point will increase static pressure in the Northern and Western portions of the City and greatly improve available fire flow city-wide.

Preliminary Estimate $1,411,590

CIP #2 <u>Gate Valve & Hydrant Inspection & Exercise Programs</u>

This project will improve reliability and function of the distribution system by ensuring the unimpeded flow of water throughout the distribution network through functioning gate valves and hydrants. It will also potentially limit the number of customers impacted by a temporary loss of service as additional gates would not need to be closed to perform any emergency repairs. Hydrant and valve repair and/or replacement would be scheduled annually based upon this programs results.

Negotiate service with Royal Oak DPS; Repairs/Replacements tbd

CIP #3 <u>Replace Ex. 10” CI with 8” DI on Ridge from 10 Mile Road to South City Limit</u>

This project will improve reliability and performance by replacing an existing 10 inch diameter cast iron water main that is estimated to be 95+ years old with a new 8 inch ductile iron water main. The new main will permit greater flow throughout the Western half of the City and greatly improve available fire flow in this area. Larger water mains were considered but the model predicted limited benefit.

Preliminary Estimate $572,495 (~2,525 FT)

CIP #4 New 8" DI on Indiana from 10 Mile Road to Woodward Heights
This project will improve reliability and performance by creating a second North-South water loop East of Woodward Avenue. Completion of this second loop will permit greater flow throughout the Eastern half of the City and improve available fire flow.
Preliminary Estimate $459,495 (~2,325 FT)

CIP #5 New 8" DI on Bermuda from Sylvan to Woodward Heights
This project will improve reliability and performance by creating a second North-South water loop between Sylvan and Woodward Heights. This reduces the length of dead end water mains on Fairwood and Woodward Heights by over 800 feet. Elimination of the dead ends on these streets is not feasible due to lack of a North-South Right-of-Way (ROW) along Pleasant Ridge's Eastern border with Ferndale on these blocks. Completion of this second loop will improve available fire flow in this area.
Preliminary Estimate $155,975 (~615 FT)

Recommendations
As previously referenced, Pleasant Ridge experiences relatively few water main breaks. The distribution system is relatively well looped and the community is fully developed. These factors have resulted in the absence of any "red flags" that would indicate a critical need and justified the community's hands off approach to the system. Although the water distribution system continues to operate well Pleasant Ridge should begin efforts to renew the aging infrastructure to prevent serious issues from developing.

Overall, the distribution system is well looped, which greatly enhances reliability. Looped mains reduce the impacted area and lessen the likelihood of prolonged water service interruption in the event of a water main break. However, there remain sporadic locations throughout the City where improved looping can improve reliability and available fire flow.

Pleasant Ridge should initiate efforts to replace water mains that have been in service for 95+ years and, at time of replacement, eliminate the existing 6 inch diameter water mains by installing 8 inch diameter water mains that will provide improved performance.

Note that fire-fighting demand can severely reduce pressures in a system of small diameter pipe. Undersized pipe results in excessive head loss and a corresponding decrease in flow, even when adequate pressures are maintained in larger, nearby mains. Industry standards recommend a minimum size pipe of 6 inch. However, many communities require a minimum 8 inch diameter for new pipe in residential zoning and a minimum 12 inch diameter for new pipe in multi-family, commercial and industrial zoning.

If current revenues are not sufficient to begin implementation of the recommended CIP projects, Pleasant Ridge should consider funding alternatives. Options to consider include a rate study to potentially incorporate/increase a replacement reserve into the water rate and application for a low interest loan through Michigan's Drinking Water Revolving Fund (DWRF).

Anderson, Eckstein and Westrick, Inc. recommends the following to maintain a safe, healthy and reliable public water distribution system:

- The Gate Valve and Hydrant Inspection and Exercise Program (CIP #2) should be implemented in 2016. Pleasant Ridge should inspect and exercise every gate valve and inspect and flush every hydrant in the City, and perform any repairs necessary (including replacement, if needed), to ensure they are fully operational within the next five (5) years. AEW recommends Pleasant Ridge establish five to ten "districts" and schedule 1 to 2 districts per year. This should be an annual program that is maintained perpetually after the initial inspections and repairs are completed. The schedule can be more aggressive if personnel and funding permits, but at minimum it is recommended that every valve and hydrant be inspected and exercised at least once every five years. (*)
- Initiate discussion with SOCWA related to transitioning the emergency connection at Eastbound 10 Mile Road and Oakdale into a second supply connection in continuous use (CIP#1). If SOCWA permits, this interim improvement would have the largest impact on improving available fire flow city-wide.
- Complete the three (3) projects identified as master plan improvements (CIP #3 – 5) within the next six (6) to twenty (20) years as the applicable street is repaved. (**)
- Continue and improve the methodical system of tracking detailed locations of water main breaks and repairs to identify and potentially re-prioritize aging water mains that should be retired and replaced. Existing pipe material and diameters should be noted during all repairs to improve the available "as-built" information about the distribution system.
- As a rule of thumb, aging water mains being retired should be replaced with a minimum 8 inch diameter pipe on all residential streets. The 10 inch to 12 inch transmission mains on Woodward Avenue and Oxford Boulevard are not proposed for replacement and the effects of a reduction in size has not yet been studied. If proposed due to reprioritizing, AEW can evaluate at that time.

(*) Staffing and budget issues, coupled with the size of the distribution system, may make programs to address <u>all</u> hydrants or valves annually unfeasible. At minimum, the system should be divided into districts such that annual programs address <u>all</u> hydrants and valves every five (5) years.

(**) Projects recommended for completion in years six (6) through twenty (20) may be reprioritized, and additional needs identified, based upon continued tracking of water main breaks.

The distribution system model created for this report is a valuable tool for future evaluation. Continued updates to the model are recommended as the distribution system is improved and as additional information becomes available. The information provided by future metered flows and hydrant flow tests will allow for continued refinement of the model's calibration and may assist with decision-making relative to identifying and prioritizing improvements.

APPENDIX A

Existing Water Distribution System; Map and Hydrant Flow Test Data

Includes:
Hydrant Flow Test Results
Existing Water Distribution System Map Panels

		1	2	3		4	5	6	7
	Hydrant No. 2 (FLOW)				Hydrant No. 1 (RESIDUAL)				
Test No.	Hydrant Location	Outlet Diameter [D] (IN)	Pitot Pressure [P] (PSI)	Discharge Coefficient [C]	Hydrant Location	Static Pressure [Ps] (PSI)	Residual Pressure [Pt] (PSI)	Flow at Hydrant No. 2 [Qf] (GPM)	Flow Available at Hyd No. 2 @ 20 PSI [Qr] (GPM)
1	8 Millington	3.75	5	0.9	22 Millington	56	7	840	700
2	4 Kenberton	3.75	2	0.9	14 Kenberton	59	17	530	500
	30 Oakland Park Ave	3.75			18 Oakland Park Ave	Aborted due to Hydrant Dated 7/12/1898			
3	139 Maplefield	3.75	4	0.9	103 Maplefield	59	12	760	700
4	111 Elm Park	3.75	2	0.9	125 Elm Park	57	17	530	500
5	24060 Woodward (@ Amherst)	3.75	12	0.9	23800 Woodward (@ Sylvan)	62	12	1310	1200
6	42 Fairwood	3.75	2	0.9	68 Fairwood	62	36	530	700
7	60 Amherst	3.75	1	0.9	88 Amherst	64	40	380	500
8	99 Kensington	3.75	2	0.9	55 Kensington	61	12	530	500

1 [D] - Measured

2 [P] - Measured at Hydrant No. 2 (Flowed Hydrant)

3 [C] - Based on Shape of Outlet: 0.9 = Smooth & Round, 0.8 = Sharp Edge, Square, 0.7 = Opening Projects into Hydrant

4 [Ps] - Measured at Hydrant No. 1 (Residual Hydrant, No Flow)

5 [Pt] - Measured at Hydrant No. 1 (Residual Hydrant, During Test)

6 [Qf] = 29.83 * C * D^2 * P^1/2

[Qf] = 29.83 * 3 * 1^2 * 2^1/2

7 [Qr] = Qf * {(Ps-Pr)/(Ps-Pt)}^0.54 where Pr = 20 psi

[Qr] = 6 * {(4-20)/(4-5)}^0.54

City of Huntington Woods

City of Royal Oak

City of Oak Park

I-696

I-696 SERVICE DR.

EMERGENCY CONNECTION TO SOCWA

WOODSIDE PARK BLVD. (80')

MILLINGTON RD. (50')

WOODWARD AVE. (M-1)

MAIN STREET

POPLAR PARK AVE. (100')

KENBERTON DR. (50')

KENBERTON DR. (60')

RIDGE RD. (50')

MAHLEFELD RD (50')

OAKDALE BLVD. (76')

ELM PARK AVE. (50')

ELM PARK AVE. (100')

NORWICH RD. (50')

OAKLAND PARK AVE. (100')

J-45 12" P-126 J-8 12" P-125 J-21 12" P-286 J-46 12" P-130 J-36 12" P-120 J-31

J-30 J-69 J-50

J-54 12" P-157 J-53 12" P-285 J-39

J-52 J-37

J-29 J-20 J-32

J-28 J-25

J-72 J-71 J-22

J-27 J-24

J-76 J-75 J-23

11"d-49 9"d-49 6"d-48 8"d-49

8" P-63 10" P-83 8" P-67 8" P-5 8" P-4 10" P-82 10" P-81 6" P-84 12" P-69 12" P-71 12" P-271 6" P-174 12" P-175 10" P-82 10" P-61 6" P-7 6" P-6 6" P-51 10" P-60 8" P-149 6" P-49 6" P-11 6" P-10 10" P-57

ANDERSON, ECKSTEIN AND WESTRICK, INC.
Civil Engineers • Surveyors • Architects
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Phone 586-726-1234 Fax 586-726-8780

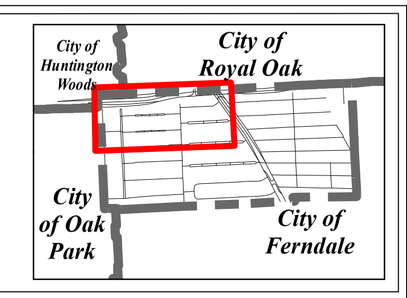
PLOT DATE: December 21, 2015	DRAWING DATE: December 17, 2015
PLOT SCALE: NTS	DRAWING SCALE: 24" x 36"
PLOT CONFIG:	PROJECT NO: 0175-0095
SCRIPT FILE:	FILE NAME: Water Basemap 24X36.mxd
ATTACH XREF:	DRAWN BY: GIS DEPT / CHK'D BY: GIS DEPT

CITY OF PLEASANT RIDGE OAKLAND COUNTY MICHIGAN SEAL INCORPORATED 1928

- Intermediate Node
- Node
- Water Main

CITY of PLEASANT RIDGE

EXISTING WATER MAIN SYSTEM



PANEL NUMBER: 1

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City of Royal Oak

City of Ferndale

I-696 SERVICE DR.

I-696

EMERGENCY CONNECTION TO FERNDALE

J-54 12" P-157 J-53

J-39

12" P-271

J-52

12" P-175

10" P-92

J-37

12" P-69

6" P-84

J-32

12" P-71

ELM PARK AVE. (100')

8" P-149

J-33

12" P-170

J-41

12" P-171

J-55

J-38

J-77

10" P-189

J-43

12" P-172

12" P-285

J-34

12" P-264

6" P-156

J-6

6" P-21

J-84

J-83

6" P-174

6" P-13

J-5

6" P-87

J-40

6" P-155

6" P-97

6" P-154

J-82

6" P-103

6" P-18

J-81

J-42

6" P-178

J-44

6" P-107

6" P-265

12" P-148

J-35

J-47

6" P-152

J-48

KENSINGTON BLVD. (60')

DEVONSHIRE RD. (60')

INDIANA AVE.

WELLESLEY DR. (60')

AMHERST RD. (60)

MAYWOOD AVE. (60')

EPRIZE DR. (50')

MAIN STREET

CANADIAN NATIONAL RAIL ROAD

GAINSBORO AVE.

24280

24242

24200

24126

24100

24060

24072

24028

24025

400

404

660

ANDERSON, ECKSTEIN AND WESTRICK, INC.
Civil Engineers • Surveyors • Architects
51301 Schoenherr Road, Shelby Township, Michigan 48315
Phone 586-726-1234 Fax 586-726-8760

PLOT DATE: December 21, 2015	DRAWING DATE: December 17, 2015	
PLOT SCALE: NTS	DRAWING SCALE: 24" x 36"	
PLOT CONFIG:	PROJECT NO: 0175-0095	
SCRIPT FILE:	FILE NAME: Water Basemap 24X36.mxd	
ATTACH XREF:	DRAWN BY: GIS DEPT	CHKD BY: GIS DEPT

PLEASANT RIDGE CITY SEAL — INCORPORATED 1928 — OAKLAND COUNTY MICHIGAN

- Intermediate Node
- Node
- Water Main

CITY of PLEASANT RIDGE

EXISTING WATER MAIN SYSTEM

City of Huntington Woods | *City of Royal Oak* | *City of Oak Park* | *City of Ferndale*

PANEL NUMBER: **2**

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PLOT DATE: December 21, 2015	DRAWING DATE: December 17, 2015
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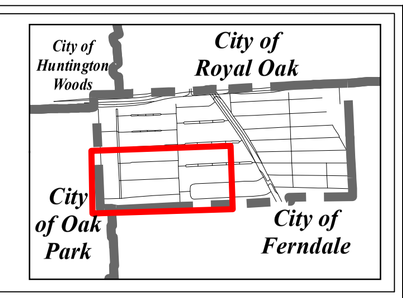
SCRIPT FILE:	FILE NAME: Water Basemap 24X36.mxd
ATTACH XREF:	DRAWN BY: GIS DEPT / CHK'D BY: GIS DEPT

- Intermediate Node
- Node
- Water Main

CITY of PLEASANT RIDGE

EXISTING WATER MAIN SYSTEM



PANEL NUMBER: **3**

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City of Ferndale

ANDERSON, ECKSTEIN AND WESTRICK, INC.
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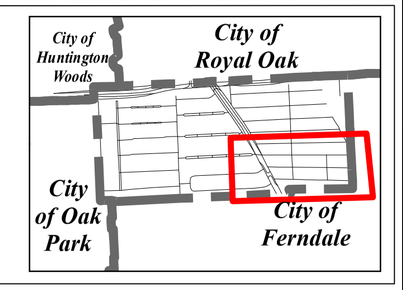
PLOT DATE: December 21, 2015	DRAWING DATE: December 17, 2015
PLOT SCALE: NTS	DRAWING SCALE: 24" x 36"
PLOT CONFIG:	PROJECT NO: 0175-0095
SCRIPT FILE:	FILE NAME: Water Basemap 24X36.mxd
ATTACH XREF:	DRAWN BY: GIS DEPT / CHKD BY: GIS DEPT

- Intermediate Node
- Node
- Water Main

CITY of PLEASANT RIDGE

EXISTING WATER MAIN SYSTEM



PANEL NUMBER: **4**

CAUTION

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APPENDIX B

Existing Water Distribution System; Calibration Results

Includes:
Computer Model Final Calibration Run

```
* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

Date & Time: Sat Dec 05 14:54:37 2015

Master File : m:\0175\0175-0095\gen\reports\kypipe\import\watermodel2015.KYP\CalWiz.P2K

S U M M A R Y O F O R I G I N A L D A T A

U N I T S S P E C I F I E D

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

P I P E L I N E D A T A

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

P I P E N A M E	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.14	130.0000	0.00
P-10	J-75	J-24	557.86	6.08	130.0000	1.27
P-103	J-38	J-82	1375.77	6.08	130.0000	1.54
P-107	J-43	J-44	2058.36	6.08	130.0000	1.37
P-11	J-76	J-75	402.54	6.08	130.0000	0.40
P-12	J-77	J-38	19.18	10.16	130.0000	0.17
P-120	J-31	J-36	972.64	12.34	120.0000	2.37
P-125	J-8	J-21	445.59	12.34	120.0000	0.70
P-126	J-45	J-8	160.81	12.34	120.0000	0.00
P-13	J-5	J-6	373.36	6.08	130.0000	0.00
P-130	J-36	J-46	1250.08	12.34	120.0000	1.79
P-14	J-78	J-61	266.57	10.16	130.0000	0.17
P-148	J-47	J-35	190.47	12.14	130.0000	0.17
P-149	J-27	J-33	1489.24	8.18	130.0000	2.98
P-15	J-79	J-80	597.22	6.08	130.0000	0.57
P-152	J-48	J-35	445.75	6.08	130.0000	0.57
P-154	J-42	J-40	362.71	6.08	130.0000	0.70
P-155	J-40	J-5	415.41	6.08	130.0000	1.27
P-156-XX	J-6	J-34	275.42	6.08	130.0000	0.17
P-157	J-53	J-54	124.93	12.14	130.0000	0.75
P-16	J-80	J-61	1275.42	6.08	130.0000	0.57
P-17	J-81	J-42	72.50	6.08	130.0000	0.17
P-170	J-33	J-55	209.02	12.14	130.0000	0.34
P-171	J-41	J-55	134.03	12.14	130.0000	0.00

P-172	J-37	J-41	362.21	12.14	130.0000	0.00
P-174	J-52	J-84	1394.38	6.08	130.0000	1.54
P-175	J-37	J-52	349.33	12.14	130.0000	0.69
P-178	J-44	J-42	304.86	6.08	130.0000	0.35
P-179	J-56	J-49	2164.85	6.08	130.0000	2.06
P-18	J-82	J-81	575.79	6.08	130.0000	0.57
P-188	J-26	J-1	1732.31	8.18	130.0000	1.89
P-189	J-43	J-77	250.49	10.16	130.0000	0.57
P-19	J-83	J-6	42.96	6.08	130.0000	0.17
P-191	J-14	J-51	1820.36	10.16	130.0000	2.81
P-192	J-59	J-60	171.60	10.16	130.0000	0.17
P-192a	J-60	J-68	67.12	10.16	130.0000	0.17
P-195	J-56	J-78	45.89	10.16	130.0000	0.40
P-197	J-56	J-43	304.88	10.16	130.0000	0.57
P-2	J-70	J-60	22.81	10.16	130.0000	0.00
P-20	J-7	J-73	152.54	8.18	130.0000	0.57
P-201	J-62	J-79	95.36	6.08	130.0000	0.57
P-209	J-13	J-63	324.39	10.16	130.0000	0.34
P-21	J-84	J-83	716.44	6.08	130.0000	0.40
P-210	J-59	J-13	198.02	10.16	130.0000	0.17
P-217	J-64	J-59	236.90	10.16	130.0000	0.17
P-219	J-64	J-65	1762.12	6.08	130.0000	1.49
P-221	J-61	J-64	294.29	10.16	130.0000	0.17
P-239	J-12	J-14	275.83	10.16	130.0000	0.17
P-24	J-9	J-7	245.04	8.18	130.0000	0.17
P-243	J-16	J-18	408.03	6.08	130.0000	0.17
P-25	J-10	J-11	270.51	6.08	130.0000	0.00
P-255	J-51	J-70	16.36	10.16	130.0000	0.00
P-264	J-34	J-35	559.29	12.14	130.0000	1.62
P-265	J-44	J-49	287.63	6.08	130.0000	0.17
P-266-XX	J-26	J-19	95.17	10.16	130.0000	0.00
P-268	J-3	PR-1	17.14	12.34	120.0000	0.00
P-269	J-51	J-3	30.19	10.16	130.0000	7.09
P-27	J-12	J-10	61.27	6.08	130.0000	0.17
P-271	J-52	J-53	156.58	12.14	130.0000	0.00
P-272	J-66	J-4	8.87	6.08	130.0000	0.17
P-275	J-1	J-4	9.76	12.14	130.0000	0.00
P-285	J-53	J-34	2026.54	12.14	130.0000	0.34
P-286	J-46	J-21	116.24	12.34	120.0000	0.87
P-29	J-13	J-14	2021.68	6.08	130.0000	2.52
P-3	J-4	J-70	436.95	12.14	130.0000	0.70
P-31	J-15	J-10	1335.13	6.08	130.0000	1.14
P-32	J-15	J-7	455.35	8.18	130.0000	1.84
P-34	J-16	J-15	416.64	6.08	130.0000	0.17
P-35	J-16	J-17	1343.13	6.08	130.0000	1.14
P-38	J-18	J-19	1348.06	6.08	130.0000	1.84
P-4	J-50	J-31	303.86	8.18	130.0000	0.52
P-41	J-20	J-21	168.80	6.08	130.0000	0.34
P-44	J-22	J-20	381.01	6.08	130.0000	0.17
P-46	J-23	J-22	387.52	6.08	130.0000	0.00
P-48	J-18	J-23	325.49	6.08	130.0000	0.57
P-49	J-23	J-76	391.70	6.08	130.0000	1.27
P-5	J-69	J-50	401.89	8.18	130.0000	0.40
P-51	J-25	J-71	454.23	6.08	130.0000	1.27
P-55	J-17	J-12	318.63	10.16	130.0000	0.00
P-56	J-26	J-17	306.82	10.16	130.0000	0.00
P-57	J-24	J-19	373.15	10.16	130.0000	0.00

P-58	J-27	J-24	43.67	10.16	130.0000	0.00
P-6	J-71	J-72	388.95	6.08	130.0000	0.40
P-60	J-25	J-27	300.24	10.16	130.0000	0.17
P-61	J-28	J-25	187.57	10.16	130.0000	0.00
P-63	J-29	J-20	1346.63	8.18	130.0000	1.14
P-67	J-30	J-69	223.04	8.18	130.0000	0.57
P-69	J-31	J-32	521.13	12.14	130.0000	0.00
P-7	J-72	J-22	509.45	6.08	130.0000	0.87
P-71	J-33	J-32	543.94	12.14	130.0000	0.00
P-8	J-73	J-74	479.27	8.18	130.0000	0.40
P-81	J-29	J-28	196.49	10.16	130.0000	0.17
P-82	J-30	J-29	151.25	10.16	130.0000	0.00
P-83	J-36	J-30	129.33	10.16	130.0000	0.00
P-84	J-32	J-28	1184.63	6.08	130.0000	1.14
P-87	J-5	J-37	2251.87	6.08	130.0000	2.51
P-9	J-74	J-8	1448.13	8.18	130.0000	2.94
P-92	J-38	J-39	1173.25	10.16	130.0000	0.87
P-97	J-40	J-41	2063.01	6.08	130.0000	2.34

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		2.07	646.90	
J-10		2.56	665.57	
J-11		0.21	666.78	
J-12		0.41	666.41	
J-13		3.39	650.77	
J-14		6.57	663.73	
J-15		3.94	660.87	
J-16		4.49	659.23	
J-17		3.11	663.22	
J-18		3.94	662.56	
J-19		2.35	668.34	
J-2		0.50	648.06	
J-20		2.21	657.89	
J-21		1.59	657.51	
J-22		2.35	658.30	
J-23		2.28	662.32	
J-24		0.83	664.89	
J-25		0.62	665.93	
J-26		2.28	666.12	
J-27		1.94	665.03	
J-28		1.59	665.85	
J-29		1.18	664.95	
J-3		0.00	648.42	
J-30		0.35	665.84	
J-31		0.28	642.05	
J-32		1.38	651.80	
J-33		1.73	649.84	
J-34		0.00	645.38	
J-35		0.44	640.76	
J-36		2.18	665.80	
J-37		5.07	650.49	
J-38		4.11	648.18	

J-39		0.00	655.00	
J-4		0.00	646.84	
J-40		5.74	641.08	
J-41		5.83	650.63	
J-42		0.21	642.94	
J-43		5.70	648.38	
J-44		4.63	640.70	
J-45		0.07	655.58	
J-46	EC-SOCWA	2.35	658.00	
J-47		0.00	641.36	
J-48		0.00	642.16	
J-49		4.43	643.24	
J-5		4.70	642.66	
J-50	1F	1.04	661.00	
J-51		3.18	648.00	
J-52		3.60	654.88	
J-53		0.00	655.33	
J-54		0.00	653.00	
J-55		0.00	650.63	
J-56		4.55	646.80	
J-59		0.40	649.53	
J-6		0.00	643.53	
J-60		0.00	648.00	
J-61		3.59	649.02	
J-62	EC-Ferndale	0.14	643.00	
J-63	EC-Ferndale	0.00	648.19	
J-64		5.16	647.71	
J-65		4.73	642.19	
J-66		0.00	646.83	
J-68		0.00	648.00	
J-69	1R	1.11	663.00	
J-7		1.66	658.64	
J-70		0.00	648.00	
J-71	2F	0.97	665.00	
J-72	2R	1.24	662.00	
J-73	3F	1.59	657.00	
J-74	3R	4.56	654.00	
J-75	4F	1.31	663.00	
J-76	4R	1.24	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	1.66	641.00	
J-8		3.66	654.08	
J-80	6F	4.36	648.00	
J-81	7R	1.87	641.00	
J-82	7F	5.05	640.00	
J-83	8F	2.42	642.00	
J-84	8R	6.02	644.00	
J-9		0.55	659.92	
PR-1	PR-1	----	648.00	802.77

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

Case: 0

C H A N G E S F O R N E X T S I M U L A T I O N (Change Number = 1)

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

TANK at node PR-1 has a new HGL of 802.770

Case: 0

C H A N G E S F O R N E X T S I M U L A T I O N (Change Number = 2)

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

TANK at node PR-1 has a new HGL of 798.150

Case: 0

C H A N G E S F O R N E X T S I M U L A T I O N (Change Number = 3)

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

TANK at node PR-1 has a new HGL of 800.460

Case: 0

C H A N G E S F O R N E X T S I M U L A T I O N (Change Number = 4)

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

TANK at node PR-1 has a new HGL of 798.150

Case: 0

C H A N G E S F O R N E X T S I M U L A T I O N (Change Number = 5)

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

TANK at node PR-1 has a new HGL of 795.840

Case: 0

C H A N G E S F O R N E X T S I M U L A T I O N (Change Number = 6)

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

TANK at node PR-1 has a new HGL of 793.530

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) =	99
NUMBER OF END NODES .....(J) =	81
NUMBER OF PRIMARY LOOPS .....(L) =	18
NUMBER OF SUPPLY NODES .....(F) =	1
NUMBER OF SUPPLY ZONES .....(Z) =	1

==========

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	0.50	0.00	0.00	0.00	0.00	0.00
P-10	J-75	J-24	1.84	0.00	0.00	0.02	0.00	0.00
P-103	J-38	J-82	18.67	0.06	0.00	0.21	0.04	0.04
P-107	J-43	J-44	15.13	0.06	0.00	0.17	0.03	0.03
P-11	J-76	J-75	3.15	0.00	0.00	0.03	0.00	0.00
P-12	J-77	J-38	22.78	0.00	0.00	0.09	0.01	0.01
P-120	J-31	J-36	-3.12	0.00	0.00	0.01	0.00	0.00
P-125	J-8	J-21	14.39	0.00	0.00	0.04	0.00	0.00
P-126	J-45	J-8	-0.07	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	8.22	0.00	0.00	0.09	0.01	0.01
P-130	J-36	J-46	-7.59	0.00	0.00	0.02	0.00	0.00
P-14	J-78	J-61	-63.01	0.01	0.00	0.25	0.03	0.03
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	1.25	0.00	0.00	0.01	0.00	0.00
P-15	J-79	J-80	-1.80	0.00	0.00	0.02	0.00	0.00
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	32.46	0.04	0.00	0.36	0.13	0.12
P-155	J-40	J-5	17.56	0.02	0.00	0.19	0.04	0.04
P-156-XX	J-6	J-34						
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-61	-6.15	0.01	0.00	0.07	0.01	0.01
P-17	J-81	J-42	11.75	0.00	0.00	0.13	0.02	0.02
P-170	J-33	J-55	1.35	0.00	0.00	0.00	0.00	0.00
P-171	J-41	J-55	-1.35	0.00	0.00	0.00	0.00	0.00
P-172	J-37	J-41	-4.68	0.00	0.00	0.01	0.00	0.00
P-174	J-52	J-84	0.22	0.00	0.00	0.00	0.00	0.00
P-175	J-37	J-52	4.25	0.00	0.00	0.01	0.00	0.00
P-178	J-44	J-42	20.91	0.02	0.00	0.23	0.05	0.05
P-179	J-56	J-49	14.85	0.06	0.00	0.16	0.03	0.03
P-18	J-82	J-81	13.62	0.01	0.00	0.15	0.02	0.02
P-188	J-26	J-1	-24.53	0.03	0.00	0.15	0.02	0.02
P-189	J-43	J-77	22.78	0.00	0.00	0.09	0.01	0.01
P-19	J-83	J-6	-8.22	0.00	0.00	0.09	0.01	0.01
P-191	J-14	J-51	-41.73	0.03	0.00	0.17	0.02	0.02
P-192	J-59	J-60	-93.27	0.01	0.00	0.37	0.07	0.07
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-63.01	0.00	0.00	0.25	0.04	0.03
P-197	J-56	J-43	43.61	0.01	0.00	0.17	0.02	0.02
P-2	J-70	J-60	93.27	0.00	0.00	0.37	0.07	0.07
P-20	J-7	J-73	24.28	0.00	0.00	0.15	0.02	0.02
P-201	J-62	J-79	-0.14	0.00	0.00	0.00	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	-5.80	0.00	0.00	0.06	0.01	0.01
P-210	J-59	J-13	10.23	0.00	0.00	0.04	0.00	0.00
P-217	J-64	J-59	-82.64	0.01	0.00	0.33	0.06	0.06
P-219	J-64	J-65	4.73	0.01	0.00	0.05	0.00	0.00
P-221	J-61	J-64	-72.75	0.01	0.00	0.29	0.05	0.04
P-239	J-12	J-14	-42.00	0.00	0.00	0.17	0.02	0.02
P-24	J-9	J-7	-0.55	0.00	0.00	0.00	0.00	0.00
P-243	J-16	J-18	23.02	0.03	0.00	0.25	0.06	0.06
P-25	J-10	J-11	0.21	0.00	0.00	0.00	0.00	0.00

P-255	J-51	J-70	120.37	0.00	0.00	0.48	0.11	0.11
P-264	J-34	J-35	0.44	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	-10.42	0.00	0.00	0.12	0.01	0.01
P-266-XX	J-26	J-19						
P-268	J-3	PR-1	-165.27	0.00	0.00	0.44	0.09	0.09
P-269	J-51	J-3	-165.27	0.01	0.05	0.65	1.76	0.20
P-27	J-12	J-10	31.39	0.01	0.00	0.35	0.12	0.11
P-271	J-52	J-53	0.44	0.00	0.00	0.00	0.00	0.00
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-27.10	0.00	0.00	0.08	0.00	0.00
P-285	J-53	J-34	0.44	0.00	0.00	0.00	0.00	0.00
P-286	J-46	J-21	-9.94	0.00	0.00	0.03	0.00	0.00
P-29	J-13	J-14	6.84	0.01	0.00	0.08	0.01	0.01
P-3	J-4	J-70	-27.10	0.00	0.00	0.08	0.00	0.00
P-31	J-15	J-10	-28.63	0.13	0.00	0.32	0.10	0.10
P-32	J-15	J-7	26.49	0.01	0.00	0.16	0.02	0.02
P-34	J-16	J-15	1.81	0.00	0.00	0.02	0.00	0.00
P-35	J-16	J-17	-29.32	0.14	0.00	0.32	0.10	0.10
P-38	J-18	J-19	6.69	0.01	0.00	0.07	0.01	0.01
P-4	J-50	J-31	-0.18	0.00	0.00	0.00	0.00	0.00
P-41	J-20	J-21	-2.86	0.00	0.00	0.03	0.00	0.00
P-44	J-22	J-20	1.41	0.00	0.00	0.02	0.00	0.00
P-46	J-23	J-22	5.71	0.00	0.00	0.06	0.00	0.00
P-48	J-18	J-23	12.39	0.01	0.00	0.14	0.02	0.02
P-49	J-23	J-76	4.40	0.00	0.00	0.05	0.00	0.00
P-5	J-69	J-50	0.86	0.00	0.00	0.01	0.00	0.00
P-51	J-25	J-71	0.27	0.00	0.00	0.00	0.00	0.00
P-55	J-17	J-12	-10.19	0.00	0.00	0.04	0.00	0.00
P-56	J-26	J-17	22.24	0.00	0.00	0.09	0.00	0.00
P-57	J-24	J-19	-4.34	0.00	0.00	0.02	0.00	0.00
P-58	J-27	J-24	-5.35	0.00	0.00	0.02	0.00	0.00
P-6	J-71	J-72	-0.70	0.00	0.00	0.01	0.00	0.00
P-60	J-25	J-27	-2.16	0.00	0.00	0.01	0.00	0.00
P-61	J-28	J-25	-1.27	0.00	0.00	0.01	0.00	0.00
P-63	J-29	J-20	-2.06	0.00	0.00	0.01	0.00	0.00
P-67	J-30	J-69	1.96	0.00	0.00	0.01	0.00	0.00
P-69	J-31	J-32	2.66	0.00	0.00	0.01	0.00	0.00
P-7	J-72	J-22	-1.94	0.00	0.00	0.02	0.00	0.00
P-71	J-33	J-32	-1.83	0.00	0.00	0.01	0.00	0.00
P-8	J-73	J-74	22.69	0.01	0.00	0.14	0.02	0.01
P-81	J-29	J-28	0.87	0.00	0.00	0.00	0.00	0.00
P-82	J-30	J-29	-0.01	0.00	0.00	0.00	0.00	0.00
P-83	J-36	J-30	2.30	0.00	0.00	0.01	0.00	0.00
P-84	J-32	J-28	-0.55	0.00	0.00	0.01	0.00	0.00
P-87	J-5	J-37	4.64	0.01	0.00	0.05	0.00	0.00
P-9	J-74	J-8	18.13	0.01	0.00	0.11	0.01	0.01
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-41	9.16	0.02	0.00	0.10	0.01	0.01

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		2.07	793.47	646.90	146.57	63.51
J-10		2.56	793.43	665.57	127.86	55.41

J-11		0.21	793.43	666.78	126.65	54.88
J-12		0.41	793.44	666.41	127.03	55.05
J-13		3.39	793.46	650.77	142.69	61.83
J-14		6.57	793.45	663.73	129.72	56.21
J-15		3.94	793.30	660.87	132.44	57.39
J-16		4.49	793.30	659.23	134.07	58.10
J-17		3.11	793.44	663.22	130.22	56.43
J-18		3.94	793.28	662.56	130.71	56.64
J-19		2.35	793.27	668.34	124.93	54.14
J-2		0.50	793.47	648.06	145.42	63.01
J-20		2.21	793.27	657.89	135.37	58.66
J-21		1.59	793.27	657.51	135.76	58.83
J-22		2.35	793.27	658.30	134.97	58.49
J-23		2.28	793.27	662.32	130.95	56.74
J-24		0.83	793.27	664.89	128.38	55.63
J-25		0.62	793.27	665.93	127.33	55.18
J-26		2.28	793.44	666.12	127.33	55.17
J-27		1.94	793.27	665.03	128.24	55.57
J-28		1.59	793.27	665.85	127.42	55.21
J-29		1.18	793.27	664.95	128.32	55.61
J-3		0.00	793.53	648.42	145.10	62.88
J-30		0.35	793.27	665.84	127.42	55.22
J-31		0.28	793.27	642.05	151.22	65.53
J-32		1.38	793.27	651.80	141.46	61.30
J-33		1.73	793.27	649.84	143.43	62.15
J-34		0.00	793.27	645.38	147.89	64.08
J-35		0.44	793.27	640.76	152.50	66.08
J-36		2.18	793.27	665.80	127.47	55.24
J-37		5.07	793.27	650.49	142.77	61.87
J-38		4.11	793.41	648.18	145.24	62.94
J-39		0.00	793.41	655.00	138.41	59.98
J-4		0.00	793.47	646.84	146.63	63.54
J-40		5.74	793.29	641.08	152.21	65.96
J-41		5.83	793.27	650.63	142.64	61.81
J-42		0.21	793.34	642.94	150.40	65.17
J-43		5.70	793.42	648.38	145.04	62.85
J-44		4.63	793.35	640.70	152.66	66.15
J-45		0.07	793.27	655.58	137.69	59.67
J-46	EC-SOCWA	2.35	793.27	658.00	135.27	58.62
J-47		0.00	793.27	641.36	151.90	65.82
J-48		0.00	793.27	642.16	151.11	65.48
J-49		4.43	793.36	643.24	150.11	65.05
J-5		4.70	793.28	642.66	150.61	65.27
J-50	1F	1.04	793.27	661.00	132.27	57.32
J-51		3.18	793.48	648.00	145.48	63.04
J-52		3.60	793.27	654.88	138.38	59.97
J-53		0.00	793.27	655.33	137.94	59.77
J-54		0.00	793.27	653.00	140.27	60.78
J-55		0.00	793.27	650.63	142.64	61.81
J-56		4.55	793.42	646.80	146.62	63.54
J-59		0.40	793.46	649.53	143.93	62.37
J-6		0.00	793.27	643.53	149.74	64.89
J-60		0.00	793.47	648.00	145.47	63.04
J-61		3.59	793.43	649.02	144.41	62.58
J-62	EC-Ferndale	0.14	793.42	643.00	150.42	65.18
J-63	EC-Ferndale	0.00	793.46	648.19	145.27	62.95
J-64		5.16	793.45	647.71	145.73	63.15

J-65		4.73	793.44	642.19	151.25	65.54
J-66		0.00	793.47	646.83	146.64	63.54
J-68		0.00	793.47	648.00	145.47	63.04
J-69	1R	1.11	793.27	663.00	130.27	56.45
J-7		1.66	793.29	658.64	134.65	58.35
J-70		0.00	793.47	648.00	145.47	63.04
J-71	2F	0.97	793.27	665.00	128.27	55.58
J-72	2R	1.24	793.27	662.00	131.27	56.88
J-73	3F	1.59	793.29	657.00	136.29	59.06
J-74	3R	4.56	793.28	654.00	139.28	60.36
J-75	4F	1.31	793.27	663.00	130.27	56.45
J-76	4R	1.24	793.27	661.00	132.27	57.32
J-77	5F	0.00	793.41	648.00	145.41	63.01
J-78	5R	0.00	793.42	647.00	146.42	63.45
J-79	6R	1.66	793.42	641.00	152.42	66.05
J-8		3.66	793.27	654.08	139.19	60.32
J-80	6F	4.36	793.43	648.00	145.43	63.02
J-81	7R	1.87	793.34	641.00	152.34	66.01
J-82	7F	5.05	793.35	640.00	153.35	66.45
J-83	8F	2.42	793.27	642.00	151.27	65.55
J-84	8R	6.02	793.27	644.00	149.27	64.68
J-9		0.55	793.29	659.92	133.37	57.79
PR-1	PR-1	----	793.53	648.00	145.53	63.06

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
J-82	66.45	J-19	54.14
J-44	66.15	J-11	54.88
J-35	66.08	J-12	55.05
J-79	66.05	J-26	55.17
J-81	66.01	J-25	55.18

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	0.65	P-82	0.00
P-255	0.48	P-126	0.00
P-268	0.44	P-4	0.00
P-192	0.37	P-264	0.00
P-2	0.37	P-271	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	1.76	P-82	0.00

P-154	0.13	P-126	0.00
P-27	0.12	P-271	0.00
P-255	0.11	P-285	0.00
P-35	0.10	P-264	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	0.20	P-82	0.00
P-154	0.12	P-126	0.00
P-27	0.11	P-271	0.00
P-255	0.11	P-264	0.00
P-35	0.10	P-285	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
PR-1	165.27	PR-1

NET SYSTEM INFLOW = 165.27
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 165.27

==========

Calibration Data
SUMMARY OF CALIBRATION DATA :

Number of fire-flow test cases = 6

Summary of Decision Variables:

Age factors are adjusted for 5 group(s):
The corresponding Bounds are:

Group Number	Upper Bound	Lower Bound
1	3.000	0.500
2	3.000	0.500
3	3.000	0.500
4	3.000	0.500
5	3.000	0.500

Demands of the Following Types are adjusted

Demand Type	Percent Tolerance

Type-1	5.000

Junction (Fire) Flows are Adjusted for Each Change

Change	Percent Tolerance
1	15.00
2	15.00
3	15.00
4	15.00
5	15.00
6	15.00

Fireflow data:

Change	Node	Measured Flow
1	J-50	840.000
2	J-73	760.000
3	J-75	530.000
4	J-77	1310.000
5	J-82	380.000
6	J-83	530.000

==========

Design Results

SUMMARY OF DESIGN RESULTS:

Percent Deviation between MEASURED and TARGET Values = 7.870

OPTIMAL values for the Decision variables:

Age Factor for group number 1 is 2.9194 [3.0000< > 0.5000]
Age Factor for group number 2 is 2.3548 [3.0000< > 0.5000]
Age Factor for group number 3 is 2.9194 [3.0000< > 0.5000]
Age Factor for group number 4 is 2.8387 [3.0000< > 0.5000]
Age Factor for group number 5 is 1.7903 [3.0000< > 0.5000]

zdmd: 1 -0.368209094 0.00000000E+00 1.03709674
No demand adjustments are made.
Demand Tolerance is meant for re-distributing
demands among nodes of diff demand types, keeping
the total demand constant. There must be at least
TWO types of demands to use this feature.

Junction (Fire) Flow(s) for Change 1 are INCREASED by 3.71%
Junction (Fire) Flow(s) for Change 2 are DECREASED by 15.00%
Junction (Fire) Flow(s) for Change 3 are DECREASED by 3.39%
Junction (Fire) Flow(s) for Change 4 are DECREASED by 1.45%
Junction (Fire) Flow(s) for Change 5 are INCREASED by 15.00%
Junction (Fire) Flow(s) for Change 6 are INCREASED by 14.03%

Measured and Target pressures (psi or kPa):

TEST CASE	NODE NUMBER	MEASURED PRESSURE	OPTIMAL PRESSURE
1	J-69	7.0	5.8
2	J-74	12.0	7.2
3	J-76	17.0	16.3
4	J-78	12.0	13.5
5	J-81	40.0	50.1
6	J-83	12.0	11.4

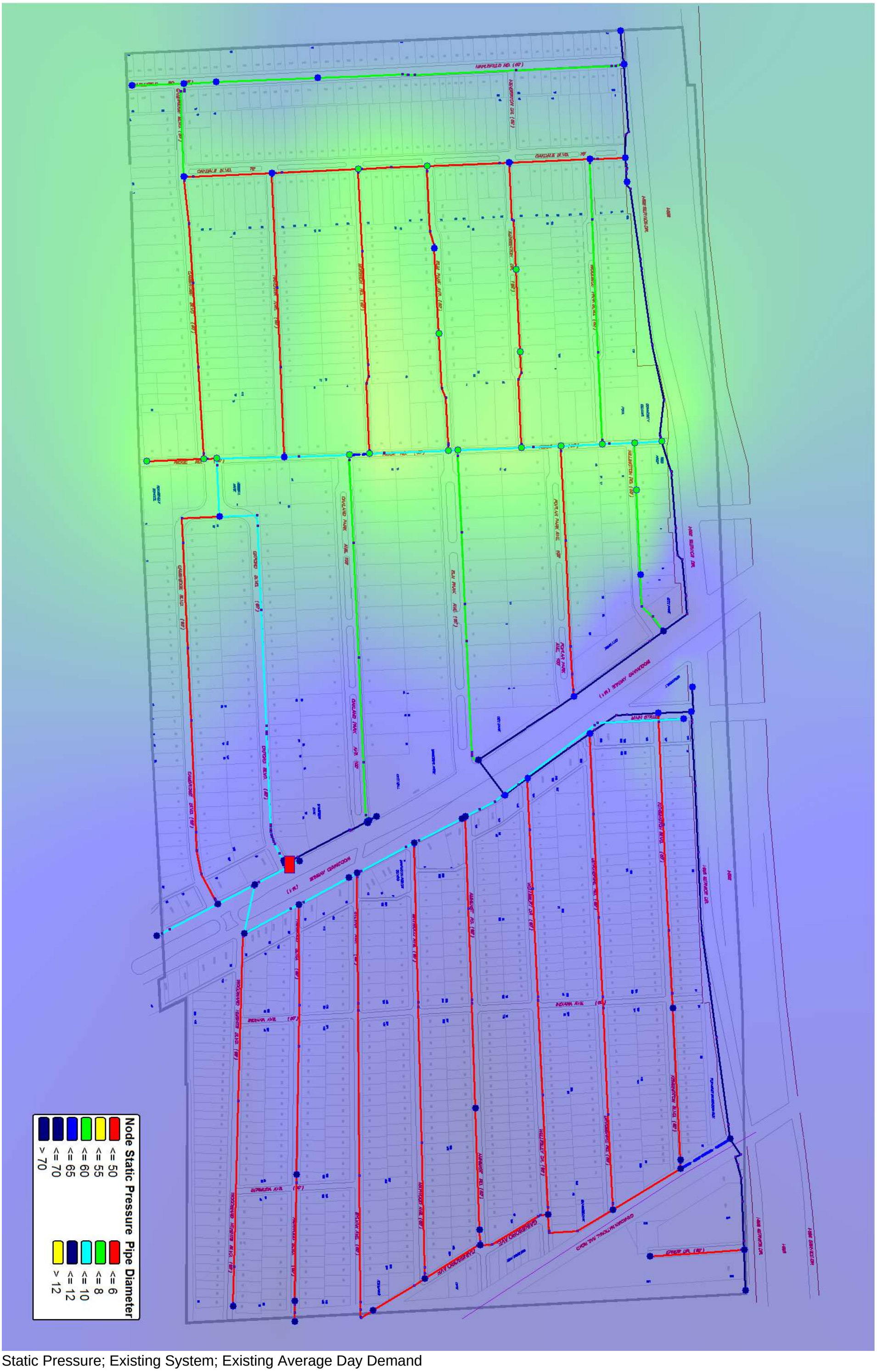
Date & Time: Sat Dec 05 14:54:41 2015

------- NETWORK CALIBRATION COMPLETED --------

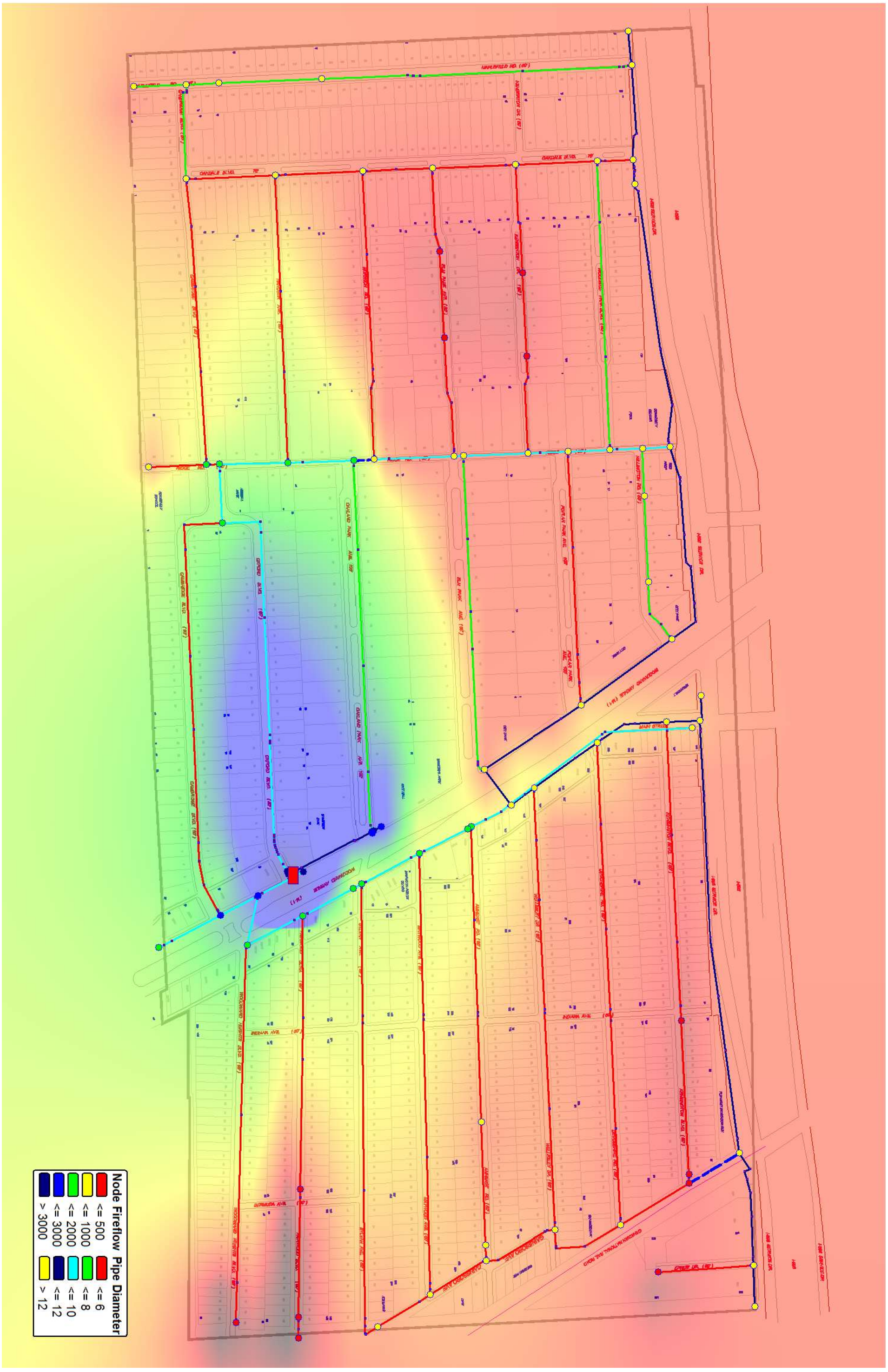
APPENDIX C

Existing Water Distribution System; Existing Average Day Demand Results

Includes:
Static Pressure Gradient Map; Existing System, Existing Average Day Demand
Available Fire Flow Gradient Map; Existing System, Existing Average Day Demand
Computer Model Simulation; Existing System, Existing Average Day Demand



Static Pressure; Existing System; Existing Average Day Demand



Available Fire Flow; Existing System; Existing Average Day Demand

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* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 Date & Time:  Wed Jan 13 09:17:56 2016

 Master File : m:\0175\0175-0095\gen\reports\kypipe\import\socwa
revision\watermodel2015.KYP\watermodel2015.P2K
```

S U M M A R Y O F O R I G I N A L D A T A

U N I T S S P E C I F I E D

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

P I P E L I N E D A T A

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.14	36.7943	0.00
P-10	J-75	J-24	557.86	6.08	34.1458	1.27
P-103	J-38	J-82	1375.77	6.08	34.1458	1.54
P-107	J-43	J-44	2058.36	6.08	34.1458	1.37
P-11	J-76	J-75	402.54	6.08	34.1458	0.40
P-12	J-77	J-38	19.18	10.16	34.1458	0.17
P-120	J-31	J-36	972.64	12.34	80.3947	2.37
P-125	J-8	J-21	445.59	12.34	80.3947	0.70
P-126	J-45	J-8	160.81	12.34	80.3947	0.00
P-13	J-5	J-6	373.36	6.08	34.1458	0.00
P-130	J-36	J-46	1250.08	12.34	80.3947	1.79
P-14	J-78	J-61	266.57	10.16	34.1458	0.17
P-148	J-47	J-35	190.47	12.14	36.7943	0.17
P-149	J-27	J-33	1489.24	8.18	52.6812	2.98
P-15	J-79	J-80	597.22	6.08	34.1458	0.57
P-152	J-48	J-35	445.75	6.08	34.1458	0.57
P-154	J-42	J-40	362.71	6.08	34.1458	0.70
P-155	J-40	J-5	415.41	6.08	34.1458	1.27
P-156-XX	J-6	J-34	275.42	6.08	34.1458	0.17
P-157	J-53	J-54	124.93	12.14	36.7943	0.75
P-16	J-80	J-61	1275.42	6.08	34.1458	0.57
P-17	J-81	J-42	72.50	6.08	34.1458	0.17
P-170	J-33	J-55	209.02	12.14	36.7943	0.34

P-171	J-41	J-55	134.03	12.14	36.7943	0.00
P-172	J-37	J-41	362.21	12.14	36.7943	0.00
P-174	J-52	J-84	1394.38	6.08	34.1458	1.54
P-175	J-37	J-52	349.33	12.14	36.7943	0.69
P-178	J-44	J-42	304.86	6.08	34.1458	0.35
P-179	J-56	J-49	2164.85	6.08	34.1458	2.06
P-18	J-82	J-81	575.79	6.08	34.1458	0.57
P-188	J-26	J-1	1732.31	8.18	52.6812	1.89
P-189	J-43	J-77	250.49	10.16	34.1458	0.57
P-19	J-83	J-6	42.96	6.08	34.1458	0.17
P-191	J-14	J-51	1820.36	10.16	34.1458	2.81
P-192	J-59	J-60	171.60	10.16	34.1458	0.17
P-192a	J-60	J-68	67.12	10.16	34.1458	0.17
P-195	J-56	J-78	45.89	10.16	34.1458	0.40
P-197	J-56	J-43	304.88	10.16	34.1458	0.57
P-2	J-70	J-60	22.81	10.16	34.1458	0.00
P-20	J-7	J-73	152.54	8.18	52.6812	0.57
P-201	J-62	J-79	95.36	6.08	34.1458	0.57
P-209	J-13	J-63	324.39	10.16	34.1458	0.34
P-21	J-84	J-83	716.44	6.08	34.1458	0.40
P-210	J-59	J-13	198.02	10.16	34.1458	0.17
P-217	J-64	J-59	236.90	10.16	34.1458	0.17
P-219	J-64	J-65	1762.12	6.08	34.1458	1.49
P-221	J-61	J-64	294.29	10.16	34.1458	0.17
P-239	J-12	J-14	275.83	10.16	34.1458	0.17
P-24	J-9	J-7	245.04	8.18	52.6812	0.17
P-243	J-16	J-18	408.03	6.08	34.1458	0.17
P-25	J-10	J-11	270.51	6.08	34.1458	0.00
P-255	J-51	J-70	16.36	10.16	34.1458	0.00
P-264	J-34	J-35	559.29	12.14	36.7943	1.62
P-265	J-44	J-49	287.63	6.08	34.1458	0.17
P-266-XX	J-26	J-19	95.17	10.16	34.1458	0.00
P-268	J-3	PR-1	17.14	12.34	95.9564	0.00
P-269	J-51	J-3	30.19	10.16	34.1458	7.09
P-27	J-12	J-10	61.27	6.08	34.1458	0.17
P-271	J-52	J-53	156.58	12.14	36.7943	0.00
P-272	J-66	J-4	8.87	6.08	34.1458	0.17
P-275	J-1	J-4	9.76	12.14	36.7943	0.00
P-285	J-53	J-34	2026.54	12.14	36.7943	0.34
P-286	J-46	J-21	116.24	12.34	80.3947	0.87
P-29	J-13	J-14	2021.68	6.08	34.1458	2.52
P-3	J-4	J-70	436.95	12.14	36.7943	0.70
P-31	J-15	J-10	1335.13	6.08	34.1458	1.14
P-32	J-15	J-7	455.35	8.18	52.6812	1.84
P-34	J-16	J-15	416.64	6.08	34.1458	0.17
P-35	J-16	J-17	1343.13	6.08	34.1458	1.14
P-38	J-18	J-19	1348.06	6.08	34.1458	1.84
P-4	J-50	J-31	303.86	8.18	52.6812	0.52
P-41	J-20	J-21	168.80	6.08	34.1458	0.34
P-44	J-22	J-20	381.01	6.08	34.1458	0.17
P-46	J-23	J-22	387.52	6.08	34.1458	0.00
P-48	J-18	J-23	325.49	6.08	34.1458	0.57
P-49	J-23	J-76	391.70	6.08	34.1458	1.27
P-5	J-69	J-50	401.89	8.18	52.6812	0.40
P-51	J-25	J-71	454.23	6.08	34.1458	1.27
P-55	J-17	J-12	318.63	10.16	34.1458	0.00
P-56	J-26	J-17	306.82	10.16	34.1458	0.00

P-57	J-24	J-19	373.15	10.16	34.1458	0.00
P-58	J-27	J-24	43.67	10.16	34.1458	0.00
P-6	J-71	J-72	388.95	6.08	34.1458	0.40
P-60	J-25	J-27	300.24	10.16	34.1458	0.17
P-61	J-28	J-25	187.57	10.16	34.1458	0.00
P-63	J-29	J-20	1346.63	8.18	52.6812	1.14
P-67	J-30	J-69	223.04	8.18	52.6812	0.57
P-69	J-31	J-32	521.13	12.14	36.7943	0.00
P-7	J-72	J-22	509.45	6.08	34.1458	0.87
P-71	J-33	J-32	543.94	12.14	36.7943	0.00
P-8	J-73	J-74	479.27	8.18	52.6812	0.40
P-81	J-29	J-28	196.49	10.16	34.1458	0.17
P-82	J-30	J-29	151.25	10.16	34.1458	0.00
P-83	J-36	J-30	129.33	10.16	34.1458	0.00
P-84	J-32	J-28	1184.63	6.08	34.1458	1.14
P-87	J-5	J-37	2251.87	6.08	34.1458	2.51
P-9	J-74	J-8	1448.13	8.18	52.6812	2.94
P-92	J-38	J-39	1173.25	10.16	34.1458	0.87
P-97	J-40	J-41	2063.01	6.08	34.1458	2.34

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		2.07	646.90	
J-10		2.56	665.57	
J-11		0.21	666.78	
J-12		0.41	666.41	
J-13		3.39	650.77	
J-14		6.57	663.73	
J-15		3.94	660.87	
J-16		4.49	659.23	
J-17		3.11	663.22	
J-18		3.94	662.56	
J-19		2.35	668.34	
J-2		0.50	648.06	
J-20		2.21	657.89	
J-21		1.59	657.51	
J-22		2.35	658.30	
J-23		2.28	662.32	
J-24		0.83	664.89	
J-25		0.62	665.93	
J-26		2.28	666.12	
J-27		1.94	665.03	
J-28		1.59	665.85	
J-29		1.18	664.95	
J-3		0.00	648.42	
J-30		0.35	665.84	
J-31		0.28	642.05	
J-32		1.38	651.80	
J-33		1.73	649.84	
J-34		0.00	645.38	
J-35		0.44	640.76	
J-36		2.18	665.80	
J-37		5.07	650.49	

J-38		4.11	648.18	
J-39		0.00	655.00	
J-4		0.00	646.84	
J-40		5.74	641.08	
J-41		5.83	650.63	
J-42		0.21	642.94	
J-43		5.70	648.38	
J-44		4.63	640.70	
J-45		0.07	655.58	
J-46	EC-SOCWA	2.35	658.00	
J-47	EC-Ferndale	0.00	641.36	
J-48		0.00	642.16	
J-49		4.43	643.24	
J-5		4.70	642.66	
J-50	1F	1.04	661.00	
J-51		3.18	648.00	
J-52		3.60	654.88	
J-53		0.00	655.33	
J-54		0.00	653.00	
J-55		0.00	650.63	
J-56		4.55	646.80	
J-59		0.40	649.53	
J-6		0.00	643.53	
J-60		0.00	648.00	
J-61		3.59	649.02	
J-62	EC-Ferndale	0.14	643.00	
J-63	EC-Ferndale	0.00	648.19	
J-64		5.16	647.71	
J-65		4.73	642.19	
J-66		0.00	646.83	
J-68		0.00	648.00	
J-69	1R	1.11	663.00	
J-7		1.66	658.64	
J-70		0.00	648.00	
J-71	2F	0.97	665.00	
J-72	2R	1.24	662.00	
J-73	3F	1.59	657.00	
J-74	3R	4.56	654.00	
J-75	4F	1.31	663.00	
J-76	4R	1.24	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	1.66	641.00	
J-8		3.66	654.08	
J-80	6F	4.36	648.00	
J-81	7R	1.87	641.00	
J-82	7F	5.05	640.00	
J-83	8F	2.42	642.00	
J-84	8R	6.02	644.00	
J-9		0.55	659.92	
PR-1	PR-1	----	648.00	802.77

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5

MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) = 99
NUMBER OF END NODES .....(J) = 81
NUMBER OF PRIMARY LOOPS .....(L) = 18
NUMBER OF SUPPLY NODES .....(F) = 1
NUMBER OF SUPPLY ZONES .....(Z) = 1

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Case: 0

RESULTS OBTAINED AFTER 11 TRIALS: ACCURACY = 0.54309E-03

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

Existing System; Existing Average Day Demand

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	0.50	0.00	0.00	0.00	0.00	0.00
P-10	J-75	J-24	0.92	0.00	0.00	0.01	0.00	0.00
P-103	J-38	J-82	18.21	0.68	0.00	0.20	0.50	0.50
P-107	J-43	J-44	14.72	0.69	0.00	0.16	0.33	0.33
P-11	J-76	J-75	2.23	0.00	0.00	0.02	0.01	0.01
P-12	J-77	J-38	22.31	0.00	0.00	0.09	0.06	0.06
P-120	J-31	J-36	-5.92	0.00	0.00	0.02	0.00	0.00
P-125	J-8	J-21	19.41	0.00	0.00	0.05	0.00	0.00
P-126	J-45	J-8	-0.07	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	7.80	0.04	0.00	0.09	0.10	0.10
P-130	J-36	J-46	-12.68	0.00	0.00	0.03	0.00	0.00
P-14	J-78	J-61	-61.75	0.10	0.00	0.24	0.39	0.39
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	0.99	0.00	0.00	0.01	0.00	0.00
P-15	J-79	J-80	-1.80	0.00	0.00	0.02	0.01	0.01
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	31.21	0.49	0.00	0.34	1.35	1.35
P-155	J-40	J-5	16.84	0.18	0.00	0.19	0.43	0.43
P-156-XX	J-6	J-34						
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-61	-6.15	0.08	0.00	0.07	0.07	0.07
P-17	J-81	J-42	11.29	0.01	0.00	0.12	0.21	0.20
P-170	J-33	J-55	2.60	0.00	0.00	0.01	0.00	0.00
P-171	J-41	J-55	-2.60	0.00	0.00	0.01	0.00	0.00
P-172	J-37	J-41	-5.40	0.00	0.00	0.01	0.00	0.00
P-174	J-52	J-84	0.63	0.00	0.00	0.01	0.00	0.00
P-175	J-37	J-52	4.67	0.00	0.00	0.01	0.00	0.00
P-178	J-44	J-42	20.12	0.18	0.00	0.22	0.60	0.60
P-179	J-56	J-49	14.46	0.70	0.00	0.16	0.32	0.32
P-18	J-82	J-81	13.16	0.16	0.00	0.15	0.27	0.27

P-188	J-26	J-1	-31.44	0.25	0.00	0.19	0.14	0.14
P-189	J-43	J-77	22.31	0.01	0.00	0.09	0.06	0.06
P-19	J-83	J-6	-7.80	0.00	0.00	0.09	0.10	0.10
P-191	J-14	J-51	-37.55	0.28	0.00	0.15	0.16	0.16
P-192	J-59	J-60	-90.53	0.14	0.00	0.36	0.80	0.79
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-61.75	0.02	0.00	0.24	0.40	0.39
P-197	J-56	J-43	42.73	0.06	0.00	0.17	0.20	0.20
P-2	J-70	J-60	90.53	0.02	0.00	0.36	0.79	0.79
P-20	J-7	J-73	29.29	0.02	0.00	0.18	0.13	0.13
P-201	J-62	J-79	-0.14	0.00	0.00	0.00	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	-5.38	0.04	0.00	0.06	0.05	0.05
P-210	J-59	J-13	8.74	0.00	0.00	0.03	0.01	0.01
P-217	J-64	J-59	-81.39	0.15	0.00	0.32	0.65	0.65
P-219	J-64	J-65	4.73	0.07	0.00	0.05	0.04	0.04
P-221	J-61	J-64	-71.50	0.15	0.00	0.28	0.51	0.51
P-239	J-12	J-14	-36.34	0.04	0.00	0.14	0.15	0.15
P-24	J-9	J-7	-0.55	0.00	0.00	0.00	0.00	0.00
P-243	J-16	J-18	19.26	0.22	0.00	0.21	0.55	0.55
P-25	J-10	J-11	0.21	0.00	0.00	0.00	0.00	0.00
P-255	J-51	J-70	124.54	0.02	0.00	0.49	1.43	1.43
P-264	J-34	J-35	0.44	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	-10.04	0.05	0.00	0.11	0.16	0.16
P-266-XX	J-26	J-19						
P-268	J-3	PR-1	-165.28	0.00	0.00	0.44	0.14	0.14
P-269	J-51	J-3	-165.28	0.07	0.05	0.65	3.98	2.42
P-27	J-12	J-10	32.12	0.09	0.00	0.35	1.42	1.42
P-271	J-52	J-53	0.44	0.00	0.00	0.00	0.00	0.00
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-34.01	0.00	0.00	0.09	0.05	0.05
P-285	J-53	J-34	0.44	0.00	0.00	0.00	0.00	0.00
P-286	J-46	J-21	-15.03	0.00	0.00	0.04	0.00	0.00
P-29	J-13	J-14	5.35	0.10	0.00	0.06	0.05	0.05
P-3	J-4	J-70	-34.01	0.02	0.00	0.09	0.05	0.05
P-31	J-15	J-10	-29.36	1.60	0.00	0.32	1.20	1.20
P-32	J-15	J-7	31.51	0.07	0.00	0.19	0.15	0.14
P-34	J-16	J-15	6.09	0.03	0.00	0.07	0.07	0.07
P-35	J-16	J-17	-29.84	1.66	0.00	0.33	1.24	1.24
P-38	J-18	J-19	5.27	0.07	0.00	0.06	0.05	0.05
P-4	J-50	J-31	-1.01	0.00	0.00	0.01	0.00	0.00
P-41	J-20	J-21	-2.78	0.00	0.00	0.03	0.02	0.02
P-44	J-22	J-20	0.60	0.00	0.00	0.01	0.00	0.00
P-46	J-23	J-22	4.28	0.01	0.00	0.05	0.03	0.03
P-48	J-18	J-23	10.04	0.05	0.00	0.11	0.17	0.16
P-49	J-23	J-76	3.48	0.01	0.00	0.04	0.02	0.02
P-5	J-69	J-50	0.02	0.00	0.00	0.00	0.00	0.00
P-51	J-25	J-71	0.89	0.00	0.00	0.01	0.00	0.00
P-55	J-17	J-12	-3.80	0.00	0.00	0.02	0.00	0.00
P-56	J-26	J-17	29.16	0.03	0.00	0.12	0.10	0.10
P-57	J-24	J-19	-2.92	0.00	0.00	0.01	0.00	0.00
P-58	J-27	J-24	-3.01	0.00	0.00	0.01	0.00	0.00
P-6	J-71	J-72	-0.08	0.00	0.00	0.00	0.00	0.00
P-60	J-25	J-27	-0.09	0.00	0.00	0.00	0.00	0.00
P-61	J-28	J-25	1.42	0.00	0.00	0.01	0.00	0.00
P-63	J-29	J-20	-1.17	0.00	0.00	0.01	0.00	0.00
P-67	J-30	J-69	1.13	0.00	0.00	0.01	0.00	0.00

P-69	J-31	J-32	4.63	0.00	0.00	0.01	0.00	0.00
P-7	J-72	J-22	-1.33	0.00	0.00	0.01	0.00	0.00
P-71	J-33	J-32	-3.34	0.00	0.00	0.01	0.00	0.00
P-8	J-73	J-74	27.70	0.05	0.00	0.17	0.11	0.11
P-81	J-29	J-28	3.11	0.00	0.00	0.01	0.00	0.00
P-82	J-30	J-29	3.11	0.00	0.00	0.01	0.00	0.00
P-83	J-36	J-30	4.59	0.00	0.00	0.02	0.00	0.00
P-84	J-32	J-28	-0.10	0.00	0.00	0.00	0.00	0.00
P-87	J-5	J-37	4.34	0.08	0.00	0.05	0.03	0.03
P-9	J-74	J-8	23.14	0.12	0.00	0.14	0.08	0.08
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-41	8.63	0.26	0.00	0.10	0.12	0.12

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		2.07	802.60	646.90	155.70	67.47
J-10		2.56	802.24	665.57	136.66	59.22
J-11		0.21	802.24	666.78	135.45	58.70
J-12		0.41	802.32	666.41	135.91	58.90
J-13		3.39	802.47	650.77	151.70	65.74
J-14		6.57	802.36	663.73	138.63	60.07
J-15		3.94	800.63	660.87	139.76	60.56
J-16		4.49	800.66	659.23	141.43	61.29
J-17		3.11	802.32	663.22	139.11	60.28
J-18		3.94	800.43	662.56	137.87	59.74
J-19		2.35	800.37	668.34	132.03	57.21
J-2		0.50	802.60	648.06	154.55	66.97
J-20		2.21	800.37	657.89	142.47	61.74
J-21		1.59	800.37	657.51	142.86	61.91
J-22		2.35	800.37	658.30	142.07	61.56
J-23		2.28	800.38	662.32	138.05	59.82
J-24		0.83	800.36	664.89	135.47	58.71
J-25		0.62	800.36	665.93	134.43	58.25
J-26		2.28	802.35	666.12	136.24	59.04
J-27		1.94	800.36	665.03	135.34	58.65
J-28		1.59	800.36	665.85	134.51	58.29
J-29		1.18	800.36	664.95	135.42	58.68
J-3		0.00	802.77	648.42	154.34	66.88
J-30		0.35	800.37	665.84	134.52	58.29
J-31		0.28	800.37	642.05	158.31	68.60
J-32		1.38	800.36	651.80	148.56	64.38
J-33		1.73	800.36	649.84	150.53	65.23
J-34		0.00	800.36	645.38	154.98	67.16
J-35		0.44	800.36	640.76	159.60	69.16
J-36		2.18	800.37	665.80	134.57	58.31
J-37		5.07	800.36	650.49	149.87	64.94
J-38		4.11	801.96	648.18	153.79	66.64
J-39		0.00	801.96	655.00	146.96	63.68
J-4		0.00	802.60	646.84	155.76	67.50
J-40		5.74	800.62	641.08	159.54	69.14
J-41		5.83	800.36	650.63	149.74	64.89
J-42		0.21	801.11	642.94	158.17	68.54
J-43		5.70	801.98	648.38	153.60	66.56

J-44		4.63	801.29	640.70	160.60	69.59
J-45		0.07	800.37	655.58	144.79	62.74
J-46	EC-SOCWA	2.35	800.37	658.00	142.37	61.69
J-47	EC-Ferndale	0.00	800.36	641.36	159.00	68.90
J-48		0.00	800.36	642.16	158.20	68.55
J-49		4.43	801.34	643.24	158.10	68.51
J-5		4.70	800.44	642.66	157.78	68.37
J-50	1F	1.04	800.37	661.00	139.37	60.39
J-51		3.18	802.65	648.00	154.65	67.01
J-52		3.60	800.36	654.88	145.48	63.04
J-53		0.00	800.36	655.33	145.04	62.85
J-54		0.00	800.36	653.00	147.36	63.86
J-55		0.00	800.36	650.63	149.74	64.89
J-56		4.55	802.04	646.80	155.24	67.27
J-59		0.40	802.47	649.53	152.94	66.27
J-6		0.00	800.40	643.53	156.87	67.98
J-60		0.00	802.61	648.00	154.61	67.00
J-61		3.59	802.16	649.02	153.14	66.36
J-62	EC-Ferndale	0.14	802.08	643.00	159.08	68.93
J-63	EC-Ferndale	0.00	802.47	648.19	154.28	66.85
J-64		5.16	802.32	647.71	154.60	67.00
J-65		4.73	802.24	642.19	160.05	69.36
J-66		0.00	802.60	646.83	155.77	67.50
J-68		0.00	802.61	648.00	154.61	67.00
J-69	1R	1.11	800.37	663.00	137.37	59.52
J-7		1.66	800.56	658.64	141.92	61.50
J-70		0.00	802.62	648.00	154.62	67.00
J-71	2F	0.97	800.36	665.00	135.36	58.66
J-72	2R	1.24	800.36	662.00	138.36	59.96
J-73	3F	1.59	800.54	657.00	143.54	62.20
J-74	3R	4.56	800.49	654.00	146.49	63.48
J-75	4F	1.31	800.37	663.00	137.37	59.53
J-76	4R	1.24	800.37	661.00	139.37	60.39
J-77	5F	0.00	801.97	648.00	153.97	66.72
J-78	5R	0.00	802.06	647.00	155.06	67.19
J-79	6R	1.66	802.08	641.00	161.08	69.80
J-8		3.66	800.37	654.08	146.29	63.39
J-80	6F	4.36	802.08	648.00	154.08	66.77
J-81	7R	1.87	801.12	641.00	160.12	69.39
J-82	7F	5.05	801.28	640.00	161.28	69.89
J-83	8F	2.42	800.40	642.00	158.40	68.64
J-84	8R	6.02	800.36	644.00	156.36	67.76
J-9		0.55	800.56	659.92	140.64	60.94
PR-1	PR-1	----	802.77	648.00	154.77	67.07

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
J-82	69.89	J-19	57.21
J-79	69.80	J-25	58.25
J-44	69.59	J-28	58.29
J-81	69.39	J-30	58.29
J-65	69.36	J-36	58.31

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	0.65	P-5	0.00
P-255	0.49	P-126	0.00
P-268	0.44	P-60	0.00
P-192	0.36	P-6	0.00
P-2	0.36	P-84	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	3.98	P-126	0.00
P-255	1.43	P-5	0.00
P-27	1.42	P-60	0.00
P-154	1.35	P-271	0.00
P-35	1.24	P-285	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	2.42	P-126	0.00
P-255	1.43	P-5	0.00
P-27	1.42	P-60	0.00
P-154	1.35	P-264	0.00
P-35	1.24	P-271	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
PR-1	165.28	PR-1

NET SYSTEM INFLOW = 165.28
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 165.27

==========

FireFlow/Hydrant Report
Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

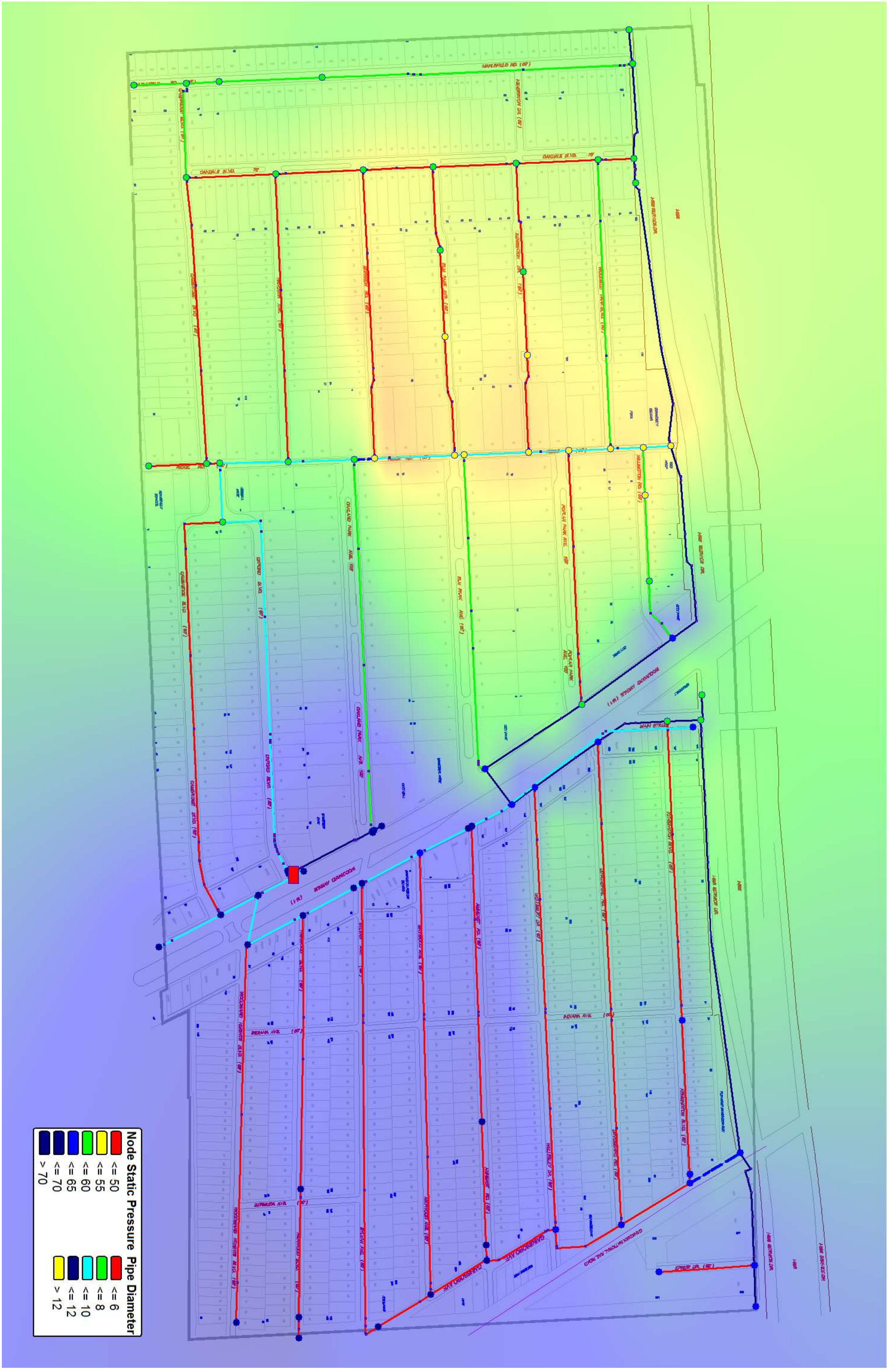
Hydrant Node	Hydrant Constant	Elevation	Demand gpm	Static Pressure	Flow-1 gpm	Flow-2 gpm	Node-2
J-1	0.0	646.9	2.1	67.5	3066.3	3048.7	J-2
J-10	0.0	665.6	2.6	59.2	1094.4	1086.1	J-11
J-11	0.0	666.8	0.2	58.7	512.8		
J-12	0.0	666.4	0.4	58.9	1569.5		
J-13	0.0	650.8	3.4	65.7	2073.4		
J-14	0.0	663.7	6.6	60.1	1648.0		
J-15	0.0	660.9	3.9	60.6	625.6		
J-16	0.0	659.2	4.5	61.3	618.3		
J-17	0.0	663.2	3.1	60.3	1555.2		
J-18	0.0	662.6	3.9	59.7	546.1		
J-19	0.0	668.3	2.4	57.2	544.2		
J-2	0.0	648.1	0.5	67.0	2934.9		
J-20	0.0	657.9	2.2	61.7	589.8	585.3	J-19
J-21	0.0	657.5	1.6	61.9	621.6	587.0	J-19
J-22	0.0	658.3	2.4	61.6	537.0		
J-23	0.0	662.3	2.3	59.8	526.2		
J-24	0.0	664.9	0.8	58.7	577.6	564.7	J-19
J-25	0.0	665.9	0.6	58.3	578.1	574.2	J-19
J-26	0.0	666.1	2.3	59.0	1479.5		
J-27	0.0	665.0	1.9	58.6	580.2	568.0	J-19
J-28	0.0	665.9	1.6	58.3	581.9	579.1	J-19
J-29	0.0	664.9	1.2	58.7	588.4	582.2	J-19
J-3	0.0	648.4	0.0	66.9	54004.8	47652.3	J-19
J-30	0.0	665.8	0.3	58.3	585.8	583.2	J-19
J-31	0.0	642.1	0.3	68.6	677.7	583.6	J-19
J-32	0.0	651.8	1.4	64.4	641.3	584.3	J-19
J-33	0.0	649.8	1.7	65.2	649.9	586.8	J-19
J-34	0.0	645.4	0.0	67.2	573.4		
J-35	0.0	640.8	0.4	69.2	572.6	568.5	J-48
J-36	0.0	665.8	2.2	58.3	589.9	585.9	J-19
J-37	0.0	650.5	5.1	64.9	641.6	595.2	J-19
J-38	0.0	648.2	4.1	66.6	1106.0	1065.8	J-39
J-39	0.0	655.0	0.0	63.7	745.7		
J-4	0.0	646.8	0.0	67.5	3083.4	3065.6	J-2
J-40	0.0	641.1	5.7	69.1	662.0		
J-41	0.0	650.6	5.8	64.9	648.6	593.8	J-19
J-42	0.0	642.9	0.2	68.5	738.0		
J-43	0.0	648.4	5.7	66.6	1216.8	1175.1	J-39
J-44	0.0	640.7	4.6	69.6	718.4		
J-45	0.0	655.6	0.1	62.7	625.5	586.2	J-19
J-46	0.0	658.0	2.4	61.7	620.4	587.6	J-19
J-47	0.0	641.4	0.0	68.9	565.5		

J-48	0.0	642.2	0.0	68.6	367.3		
J-49	0.0	643.2	4.4	68.5	592.1		
J-5	0.0	642.7	4.7	68.4	558.0		
J-50	0.0	661.0	1.0	60.4	592.8	584.4	J-19
J-51	0.0	648.0	3.2	67.0	5524.7	4875.9	J-19
J-52	0.0	654.9	3.6	63.0	614.5	594.8	J-19
J-53	0.0	655.3	0.0	62.8	603.5	591.2	J-19
J-54	0.0	653.0	0.0	63.9	607.4	591.2	J-19
J-55	0.0	650.6	0.0	64.9	643.7	586.9	J-19
J-56	0.0	646.8	4.6	67.3	1379.5	1323.5	J-39
J-59	0.0	649.5	0.4	66.3	2746.9	2688.1	J-39
J-6	0.0	643.5	0.0	68.0	463.2		
J-60	0.0	648.0	0.0	67.0	4367.3	4074.7	J-19
J-61	0.0	649.0	3.6	66.4	1590.0	1549.4	J-39
J-62	0.0	643.0	0.1	68.9	226.9		
J-63	0.0	648.2	0.0	66.9	1516.7		
J-64	0.0	647.7	5.2	67.0	2004.4	1944.6	J-39
J-65	0.0	642.2	4.7	69.4	248.1		
J-66	0.0	646.8	0.0	67.5	2415.2		
J-68	0.0	648.0	0.0	67.0	3325.6		
J-69	0.0	663.0	1.1	59.5	586.7	584.3	J-19
J-7	0.0	658.6	1.7	61.5	618.0	613.1	J-9
J-70	0.0	648.0	0.0	67.0	4942.5	4413.9	J-19
J-71	0.0	665.0	1.0	58.7	443.9		
J-72	0.0	662.0	1.2	60.0	442.8		
J-73	0.0	657.0	1.6	62.2	620.9	618.0	J-9
J-74	0.0	654.0	4.6	63.5	628.4	626.5	J-19
J-75	0.0	663.0	1.3	59.5	443.6		
J-76	0.0	661.0	1.2	60.4	453.0		
J-77	0.0	648.0	0.0	66.7	1109.8	1068.4	J-39
J-78	0.0	647.0	0.0	67.2	1401.3	1346.4	J-39
J-79	0.0	641.0	1.7	69.8	236.6	234.4	J-62
J-8	0.0	654.1	3.7	63.4	636.2	589.8	J-19
J-80	0.0	648.0	4.4	66.8	281.1		
J-81	0.0	641.0	1.9	69.4	701.0		
J-82	0.0	640.0	5.0	69.9	573.1		
J-83	0.0	642.0	2.4	68.6	463.6		
J-84	0.0	644.0	6.0	67.8	423.1		
J-9	0.0	659.9	0.6	60.9	581.0		

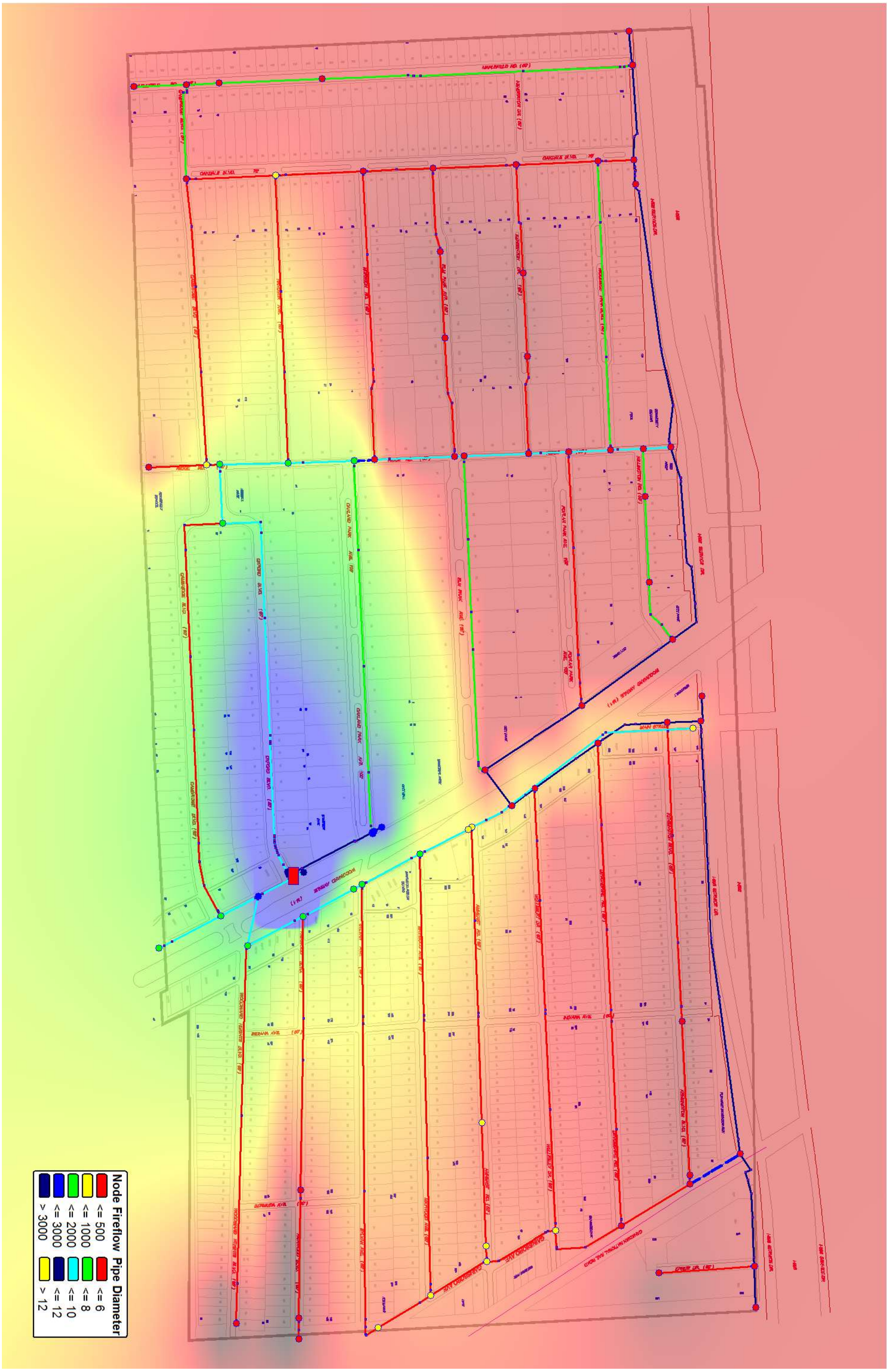
APPENDIX D

Existing Water Distribution System; Existing Maximum Day Demand Results

Includes:
Static Pressure Gradient Map; Existing System, Existing Maximum Day Demand
Available Fire Flow Gradient Map; Existing System, Existing Maximum Day Demand
Computer Model Simulation; Existing System, Existing Maximum Day Demand



Static Pressure; Existing System; Existing Maximum Day Demand



Available Fire Flow; Existing System; Existing Maximum Day Demand

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* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 Date & Time:  Wed Jan 13 09:28:22 2016

 Master File : m:\0175\0175-0095\gen\reports\kypipe\import\socwa
revision\watermodel2015.KYP\watermodel2015.P2K
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SUMMARY OF ORIGINAL DATA

UNITS SPECIFIED

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

PIPELINE DATA

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.14	36.7943	0.00
P-10	J-75	J-24	557.86	6.08	34.1458	1.27
P-103	J-38	J-82	1375.77	6.08	34.1458	1.54
P-107	J-43	J-44	2058.36	6.08	34.1458	1.37
P-11	J-76	J-75	402.54	6.08	34.1458	0.40
P-12	J-77	J-38	19.18	10.16	34.1458	0.17
P-120	J-31	J-36	972.64	12.34	80.3947	2.37
P-125	J-8	J-21	445.59	12.34	80.3947	0.70
P-126	J-45	J-8	160.81	12.34	80.3947	0.00
P-13	J-5	J-6	373.36	6.08	34.1458	0.00
P-130	J-36	J-46	1250.08	12.34	80.3947	1.79
P-14	J-78	J-61	266.57	10.16	34.1458	0.17
P-148	J-47	J-35	190.47	12.14	36.7943	0.17
P-149	J-27	J-33	1489.24	8.18	52.6812	2.98
P-15	J-79	J-80	597.22	6.08	34.1458	0.57
P-152	J-48	J-35	445.75	6.08	34.1458	0.57
P-154	J-42	J-40	362.71	6.08	34.1458	0.70
P-155	J-40	J-5	415.41	6.08	34.1458	1.27
P-156-XX	J-6	J-34	275.42	6.08	34.1458	0.17
P-157	J-53	J-54	124.93	12.14	36.7943	0.75
P-16	J-80	J-61	1275.42	6.08	34.1458	0.57
P-17	J-81	J-42	72.50	6.08	34.1458	0.17
P-170	J-33	J-55	209.02	12.14	36.7943	0.34

P-171	J-41	J-55	134.03	12.14	36.7943	0.00
P-172	J-37	J-41	362.21	12.14	36.7943	0.00
P-174	J-52	J-84	1394.38	6.08	34.1458	1.54
P-175	J-37	J-52	349.33	12.14	36.7943	0.69
P-178	J-44	J-42	304.86	6.08	34.1458	0.35
P-179	J-56	J-49	2164.85	6.08	34.1458	2.06
P-18	J-82	J-81	575.79	6.08	34.1458	0.57
P-188	J-26	J-1	1732.31	8.18	52.6812	1.89
P-189	J-43	J-77	250.49	10.16	34.1458	0.57
P-19	J-83	J-6	42.96	6.08	34.1458	0.17
P-191	J-14	J-51	1820.36	10.16	34.1458	2.81
P-192	J-59	J-60	171.60	10.16	34.1458	0.17
P-192a	J-60	J-68	67.12	10.16	34.1458	0.17
P-195	J-56	J-78	45.89	10.16	34.1458	0.40
P-197	J-56	J-43	304.88	10.16	34.1458	0.57
P-2	J-70	J-60	22.81	10.16	34.1458	0.00
P-20	J-7	J-73	152.54	8.18	52.6812	0.57
P-201	J-62	J-79	95.36	6.08	34.1458	0.57
P-209	J-13	J-63	324.39	10.16	34.1458	0.34
P-21	J-84	J-83	716.44	6.08	34.1458	0.40
P-210	J-59	J-13	198.02	10.16	34.1458	0.17
P-217	J-64	J-59	236.90	10.16	34.1458	0.17
P-219	J-64	J-65	1762.12	6.08	34.1458	1.49
P-221	J-61	J-64	294.29	10.16	34.1458	0.17
P-239	J-12	J-14	275.83	10.16	34.1458	0.17
P-24	J-9	J-7	245.04	8.18	52.6812	0.17
P-243	J-16	J-18	408.03	6.08	34.1458	0.17
P-25	J-10	J-11	270.51	6.08	34.1458	0.00
P-255	J-51	J-70	16.36	10.16	34.1458	0.00
P-264	J-34	J-35	559.29	12.14	36.7943	1.62
P-265	J-44	J-49	287.63	6.08	34.1458	0.17
P-266-XX	J-26	J-19	95.17	10.16	34.1458	0.00
P-268	J-3	PR-1	17.14	12.34	95.9564	0.00
P-269	J-51	J-3	30.19	10.16	34.1458	7.09
P-27	J-12	J-10	61.27	6.08	34.1458	0.17
P-271	J-52	J-53	156.58	12.14	36.7943	0.00
P-272	J-66	J-4	8.87	6.08	34.1458	0.17
P-275	J-1	J-4	9.76	12.14	36.7943	0.00
P-285	J-53	J-34	2026.54	12.14	36.7943	0.34
P-286	J-46	J-21	116.24	12.34	80.3947	0.87
P-29	J-13	J-14	2021.68	6.08	34.1458	2.52
P-3	J-4	J-70	436.95	12.14	36.7943	0.70
P-31	J-15	J-10	1335.13	6.08	34.1458	1.14
P-32	J-15	J-7	455.35	8.18	52.6812	1.84
P-34	J-16	J-15	416.64	6.08	34.1458	0.17
P-35	J-16	J-17	1343.13	6.08	34.1458	1.14
P-38	J-18	J-19	1348.06	6.08	34.1458	1.84
P-4	J-50	J-31	303.86	8.18	52.6812	0.52
P-41	J-20	J-21	168.80	6.08	34.1458	0.34
P-44	J-22	J-20	381.01	6.08	34.1458	0.17
P-46	J-23	J-22	387.52	6.08	34.1458	0.00
P-48	J-18	J-23	325.49	6.08	34.1458	0.57
P-49	J-23	J-76	391.70	6.08	34.1458	1.27
P-5	J-69	J-50	401.89	8.18	52.6812	0.40
P-51	J-25	J-71	454.23	6.08	34.1458	1.27
P-55	J-17	J-12	318.63	10.16	34.1458	0.00
P-56	J-26	J-17	306.82	10.16	34.1458	0.00

P-57	J-24	J-19	373.15	10.16	34.1458	0.00
P-58	J-27	J-24	43.67	10.16	34.1458	0.00
P-6	J-71	J-72	388.95	6.08	34.1458	0.40
P-60	J-25	J-27	300.24	10.16	34.1458	0.17
P-61	J-28	J-25	187.57	10.16	34.1458	0.00
P-63	J-29	J-20	1346.63	8.18	52.6812	1.14
P-67	J-30	J-69	223.04	8.18	52.6812	0.57
P-69	J-31	J-32	521.13	12.14	36.7943	0.00
P-7	J-72	J-22	509.45	6.08	34.1458	0.87
P-71	J-33	J-32	543.94	12.14	36.7943	0.00
P-8	J-73	J-74	479.27	8.18	52.6812	0.40
P-81	J-29	J-28	196.49	10.16	34.1458	0.17
P-82	J-30	J-29	151.25	10.16	34.1458	0.00
P-83	J-36	J-30	129.33	10.16	34.1458	0.00
P-84	J-32	J-28	1184.63	6.08	34.1458	1.14
P-87	J-5	J-37	2251.87	6.08	34.1458	2.51
P-9	J-74	J-8	1448.13	8.18	52.6812	2.94
P-92	J-38	J-39	1173.25	10.16	34.1458	0.87
P-97	J-40	J-41	2063.01	6.08	34.1458	2.34

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		5.19	646.90	
J-10		6.40	665.57	
J-11		0.52	666.78	
J-12		1.04	666.41	
J-13		8.47	650.77	
J-14		16.42	663.73	
J-15		9.85	660.87	
J-16		11.24	659.23	
J-17		7.78	663.22	
J-18		9.85	662.56	
J-19		5.88	668.34	
J-2		1.25	648.06	
J-20		5.53	657.89	
J-21		3.98	657.51	
J-22		5.88	658.30	
J-23		5.70	662.32	
J-24		2.07	664.89	
J-25		1.56	665.93	
J-26		5.70	666.12	
J-27		4.84	665.03	
J-28		3.98	665.85	
J-29		2.94	664.95	
J-3		0.00	648.42	
J-30		0.86	665.84	
J-31		0.69	642.05	
J-32		3.46	651.80	
J-33		4.32	649.84	
J-34		0.00	645.38	
J-35		1.10	640.76	
J-36		5.44	665.80	
J-37		12.68	650.49	

J-38		10.27	648.18	
J-39		0.00	655.00	
J-4		0.00	646.84	
J-40		14.35	641.08	
J-41		14.57	650.63	
J-42		0.52	642.94	
J-43		14.26	648.38	
J-44		11.58	640.70	
J-45		0.17	655.58	
J-46	EC-SOCWA	5.88	658.00	
J-47	EC-Ferndale	0.00	641.36	
J-48		0.00	642.16	
J-49		11.06	643.24	
J-5		11.76	642.66	
J-50	1F	2.59	661.00	
J-51		7.95	648.00	
J-52		8.99	654.88	
J-53		0.00	655.33	
J-54		0.00	653.00	
J-55		0.00	650.63	
J-56		11.39	646.80	
J-59		0.99	649.53	
J-6		0.00	643.53	
J-60		0.00	648.00	
J-61		8.99	649.02	
J-62	EC-Ferndale	0.35	643.00	
J-63	EC-Ferndale	0.00	648.19	
J-64		12.90	647.71	
J-65		11.83	642.19	
J-66		0.00	646.83	
J-68		0.00	648.00	
J-69	1R	2.77	663.00	
J-7		4.15	658.64	
J-70		0.00	648.00	
J-71	2F	2.42	665.00	
J-72	2R	3.11	662.00	
J-73	3F	3.98	657.00	
J-74	3R	11.41	654.00	
J-75	4F	3.28	663.00	
J-76	4R	3.11	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	4.15	641.00	
J-8		9.16	654.08	
J-80	6F	10.89	648.00	
J-81	7R	4.67	641.00	
J-82	7F	12.62	640.00	
J-83	8F	6.05	642.00	
J-84	8R	15.04	644.00	
J-9		1.38	659.92	
PR-1	PR-1	----	648.00	802.77

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5

MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) = 99
NUMBER OF END NODES .....(J) = 81
NUMBER OF PRIMARY LOOPS .....(L) = 18
NUMBER OF SUPPLY NODES .....(F) = 1
NUMBER OF SUPPLY ZONES .....(Z) = 1

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Case: 0

RESULTS OBTAINED AFTER 9 TRIALS: ACCURACY = 0.84901E-03

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

Existing System; Existing Maximum Day Demand

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	1.25	0.00	0.00	0.00	0.00	0.00
P-10	J-75	J-24	2.30	0.01	0.00	0.03	0.01	0.01
P-103	J-38	J-82	45.52	3.72	0.01	0.50	2.71	2.71
P-107	J-43	J-44	36.79	3.76	0.00	0.41	1.83	1.82
P-11	J-76	J-75	5.58	0.02	0.00	0.06	0.06	0.06
P-12	J-77	J-38	55.78	0.01	0.00	0.22	0.33	0.32
P-120	J-31	J-36	-14.89	0.00	0.00	0.04	0.00	0.00
P-125	J-8	J-21	48.50	0.01	0.00	0.13	0.02	0.02
P-126	J-45	J-8	-0.17	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	19.51	0.21	0.00	0.22	0.56	0.56
P-130	J-36	J-46	-31.70	0.01	0.00	0.09	0.01	0.01
P-14	J-78	J-61	-154.38	0.57	0.00	0.61	2.14	2.13
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	2.63	0.00	0.00	0.02	0.00	0.00
P-15	J-79	J-80	-4.49	0.02	0.00	0.05	0.04	0.04
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	78.02	2.66	0.01	0.86	7.36	7.34
P-155	J-40	J-5	42.10	0.97	0.00	0.47	2.35	2.34
P-156-XX	J-6	J-34						
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-61	-15.39	0.46	0.00	0.17	0.36	0.36
P-17	J-81	J-42	28.23	0.08	0.00	0.31	1.12	1.12
P-170	J-33	J-55	6.51	0.00	0.00	0.02	0.00	0.00
P-171	J-41	J-55	-6.51	0.00	0.00	0.02	0.00	0.00
P-172	J-37	J-41	-13.51	0.00	0.00	0.04	0.01	0.01
P-174	J-52	J-84	1.59	0.01	0.00	0.02	0.01	0.01
P-175	J-37	J-52	11.67	0.00	0.00	0.03	0.01	0.01
P-178	J-44	J-42	50.30	0.99	0.00	0.56	3.26	3.26
P-179	J-56	J-49	36.16	3.83	0.01	0.40	1.77	1.77
P-18	J-82	J-81	32.90	0.85	0.00	0.36	1.49	1.48

P-188	J-26	J-1	-78.59	1.36	0.01	0.48	0.79	0.79
P-189	J-43	J-77	55.78	0.08	0.00	0.22	0.33	0.32
P-19	J-83	J-6	-19.51	0.02	0.00	0.22	0.57	0.56
P-191	J-14	J-51	-93.88	1.54	0.01	0.37	0.85	0.85
P-192	J-59	J-60	-226.32	0.74	0.00	0.90	4.34	4.33
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-154.38	0.10	0.00	0.61	2.18	2.13
P-197	J-56	J-43	106.83	0.33	0.00	0.42	1.08	1.08
P-2	J-70	J-60	226.32	0.10	0.00	0.90	4.33	4.33
P-20	J-7	J-73	73.22	0.11	0.00	0.45	0.70	0.69
P-201	J-62	J-79	-0.35	0.00	0.00	0.00	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	-13.45	0.20	0.00	0.15	0.28	0.28
P-210	J-59	J-13	21.85	0.01	0.00	0.09	0.06	0.06
P-217	J-64	J-59	-203.47	0.84	0.00	0.81	3.56	3.55
P-219	J-64	J-65	11.83	0.39	0.00	0.13	0.22	0.22
P-221	J-61	J-64	-178.75	0.82	0.00	0.71	2.80	2.80
P-239	J-12	J-14	-90.84	0.22	0.00	0.36	0.80	0.80
P-24	J-9	J-7	-1.38	0.00	0.00	0.01	0.00	0.00
P-243	J-16	J-18	48.16	1.23	0.00	0.53	3.01	3.00
P-25	J-10	J-11	0.52	0.00	0.00	0.01	0.00	0.00
P-255	J-51	J-70	311.35	0.13	0.00	1.23	7.82	7.82
P-264	J-34	J-35	1.10	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	-25.10	0.26	0.00	0.28	0.90	0.90
P-266-XX	J-26	J-19						
P-268	J-3	PR-1	-413.19	0.01	0.00	1.11	0.76	0.76
P-269	J-51	J-3	-413.19	0.40	0.29	1.64	22.95	13.20
P-27	J-12	J-10	80.31	0.47	0.00	0.89	7.78	7.75
P-271	J-52	J-53	1.10	0.00	0.00	0.00	0.00	0.00
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-85.03	0.00	0.00	0.24	0.26	0.26
P-285	J-53	J-34	1.10	0.00	0.00	0.00	0.00	0.00
P-286	J-46	J-21	-37.58	0.00	0.00	0.10	0.01	0.01
P-29	J-13	J-14	13.38	0.57	0.00	0.15	0.28	0.28
P-3	J-4	J-70	-85.03	0.11	0.00	0.24	0.26	0.26
P-31	J-15	J-10	-73.39	8.75	0.01	0.81	6.56	6.56
P-32	J-15	J-7	78.75	0.36	0.01	0.48	0.80	0.79
P-34	J-16	J-15	15.21	0.15	0.00	0.17	0.36	0.36
P-35	J-16	J-17	-74.61	9.08	0.01	0.82	6.77	6.76
P-38	J-18	J-19	13.19	0.37	0.00	0.15	0.27	0.27
P-4	J-50	J-31	-2.41	0.00	0.00	0.01	0.00	0.00
P-41	J-20	J-21	-6.94	0.01	0.00	0.08	0.08	0.08
P-44	J-22	J-20	1.52	0.00	0.00	0.02	0.01	0.01
P-46	J-23	J-22	10.72	0.07	0.00	0.12	0.19	0.19
P-48	J-18	J-23	25.11	0.29	0.00	0.28	0.90	0.90
P-49	J-23	J-76	8.69	0.05	0.00	0.10	0.13	0.13
P-5	J-69	J-50	0.18	0.00	0.00	0.00	0.00	0.00
P-51	J-25	J-71	2.22	0.00	0.00	0.02	0.01	0.01
P-55	J-17	J-12	-9.50	0.00	0.00	0.04	0.01	0.01
P-56	J-26	J-17	72.89	0.16	0.00	0.29	0.53	0.53
P-57	J-24	J-19	-7.31	0.00	0.00	0.03	0.01	0.01
P-58	J-27	J-24	-7.53	0.00	0.00	0.03	0.01	0.01
P-6	J-71	J-72	-0.20	0.00	0.00	0.00	0.00	0.00
P-60	J-25	J-27	-0.06	0.00	0.00	0.00	0.00	0.00
P-61	J-28	J-25	3.71	0.00	0.00	0.01	0.00	0.00
P-63	J-29	J-20	-2.93	0.00	0.00	0.02	0.00	0.00
P-67	J-30	J-69	2.94	0.00	0.00	0.02	0.00	0.00

P-69	J-31	J-32	11.78	0.00	0.00	0.03	0.01	0.01
P-7	J-72	J-22	-3.32	0.01	0.00	0.04	0.02	0.02
P-71	J-33	J-32	-8.20	0.00	0.00	0.02	0.00	0.00
P-8	J-73	J-74	69.25	0.30	0.00	0.42	0.62	0.62
P-81	J-29	J-28	7.56	0.00	0.00	0.03	0.01	0.01
P-82	J-30	J-29	7.57	0.00	0.00	0.03	0.01	0.01
P-83	J-36	J-30	11.38	0.00	0.00	0.05	0.02	0.02
P-84	J-32	J-28	0.12	0.00	0.00	0.00	0.00	0.00
P-87	J-5	J-37	10.84	0.43	0.00	0.12	0.19	0.19
P-9	J-74	J-8	57.84	0.64	0.01	0.35	0.45	0.45
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-41	21.57	1.40	0.00	0.24	0.68	0.68

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		5.19	801.82	646.90	154.92	67.13
J-10		6.40	799.82	665.57	134.24	58.17
J-11		0.52	799.82	666.78	133.03	57.65
J-12		1.04	800.29	666.41	133.88	58.02
J-13		8.47	801.08	650.77	150.32	65.14
J-14		16.42	800.51	663.73	136.78	59.27
J-15		9.85	791.05	660.87	130.19	56.41
J-16		11.24	791.20	659.23	131.97	57.19
J-17		7.78	800.29	663.22	137.07	59.40
J-18		9.85	789.97	662.56	127.41	55.21
J-19		5.88	789.61	668.34	121.27	52.55
J-2		1.25	801.82	648.06	153.76	66.63
J-20		5.53	789.61	657.89	131.71	57.08
J-21		3.98	789.62	657.51	132.11	57.25
J-22		5.88	789.61	658.30	131.31	56.90
J-23		5.70	789.68	662.32	127.36	55.19
J-24		2.07	789.60	664.89	124.71	54.04
J-25		1.56	789.60	665.93	123.67	53.59
J-26		5.70	800.45	666.12	134.34	58.21
J-27		4.84	789.60	665.03	124.57	53.98
J-28		3.98	789.60	665.85	123.75	53.63
J-29		2.94	789.60	664.95	124.66	54.02
J-3		0.00	802.76	648.42	154.33	66.88
J-30		0.86	789.61	665.84	123.76	53.63
J-31		0.69	789.61	642.05	147.55	63.94
J-32		3.46	789.60	651.80	137.80	59.71
J-33		4.32	789.60	649.84	139.76	60.56
J-34		0.00	789.59	645.38	144.21	62.49
J-35		1.10	789.59	640.76	148.83	64.49
J-36		5.44	789.61	665.80	123.81	53.65
J-37		12.68	789.60	650.49	139.10	60.28
J-38		10.27	798.34	648.18	150.16	65.07
J-39		0.00	798.34	655.00	143.34	62.11
J-4		0.00	801.82	646.84	154.98	67.16
J-40		14.35	791.00	641.08	149.92	64.97
J-41		14.57	789.60	650.63	138.97	60.22
J-42		0.52	793.67	642.94	150.73	65.32
J-43		14.26	798.43	648.38	150.05	65.02

J-44		11.58	794.67	640.70	153.97	66.72
J-45		0.17	789.63	655.58	134.05	58.09
J-46	EC-SOCWA	5.88	789.62	658.00	131.62	57.03
J-47	EC-Ferndale	0.00	789.59	641.36	148.23	64.23
J-48		0.00	789.59	642.16	147.43	63.89
J-49		11.06	794.92	643.24	151.68	65.73
J-5		11.76	790.02	642.66	147.36	63.86
J-50	1F	2.59	789.60	661.00	128.60	55.73
J-51		7.95	802.06	648.00	154.06	66.76
J-52		8.99	789.59	654.88	134.71	58.37
J-53		0.00	789.59	655.33	134.27	58.18
J-54		0.00	789.59	653.00	136.59	59.19
J-55		0.00	789.60	650.63	138.97	60.22
J-56		11.39	798.76	646.80	151.96	65.85
J-59		0.99	801.09	649.53	151.56	65.68
J-6		0.00	789.81	643.53	146.28	63.39
J-60		0.00	801.84	648.00	153.84	66.66
J-61		8.99	799.42	649.02	150.40	65.17
J-62	EC-Ferndale	0.35	798.94	643.00	155.94	67.57
J-63	EC-Ferndale	0.00	801.08	648.19	152.89	66.25
J-64		12.90	800.25	647.71	152.54	66.10
J-65		11.83	799.86	642.19	157.66	68.32
J-66		0.00	801.82	646.83	154.99	67.16
J-68		0.00	801.84	648.00	153.84	66.66
J-69	1R	2.77	789.60	663.00	126.60	54.86
J-7		4.15	790.69	658.64	132.05	57.22
J-70		0.00	801.94	648.00	153.94	66.71
J-71	2F	2.42	789.60	665.00	124.60	53.99
J-72	2R	3.11	789.60	662.00	127.60	55.29
J-73	3F	3.98	790.58	657.00	133.58	57.88
J-74	3R	11.41	790.28	654.00	136.28	59.05
J-75	4F	3.28	789.61	663.00	126.61	54.86
J-76	4R	3.11	789.63	661.00	128.63	55.74
J-77	5F	0.00	798.34	648.00	150.34	65.15
J-78	5R	0.00	798.86	647.00	151.86	65.80
J-79	6R	4.15	798.94	641.00	157.94	68.44
J-8		9.16	789.63	654.08	135.55	58.74
J-80	6F	10.89	798.96	648.00	150.96	65.42
J-81	7R	4.67	793.75	641.00	152.75	66.19
J-82	7F	12.62	794.61	640.00	154.61	67.00
J-83	8F	6.05	789.79	642.00	147.79	64.04
J-84	8R	15.04	789.59	644.00	145.59	63.09
J-9		1.38	790.69	659.92	130.77	56.66
PR-1	PR-1	----	802.77	648.00	154.77	67.07

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
J-79	68.44	J-19	52.55
J-65	68.32	J-25	53.59
J-62	67.57	J-28	53.63
J-66	67.16	J-30	53.63
J-4	67.16	J-36	53.65

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	1.64	P-60	0.00
P-255	1.23	P-126	0.00
P-268	1.11	P-5	0.00
P-192	0.90	P-84	0.00
P-2	0.90	P-6	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	22.95	P-126	0.00
P-255	7.82	P-60	0.00
P-27	7.78	P-5	0.00
P-154	7.36	P-84	0.00
P-35	6.77	P-271	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	13.20	P-126	0.00
P-255	7.82	P-60	0.00
P-27	7.75	P-5	0.00
P-154	7.34	P-84	0.00
P-35	6.76	P-264	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
PR-1	413.19	PR-1

NET SYSTEM INFLOW = 413.19
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 413.19

==========

FireFlow/Hydrant Report

Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

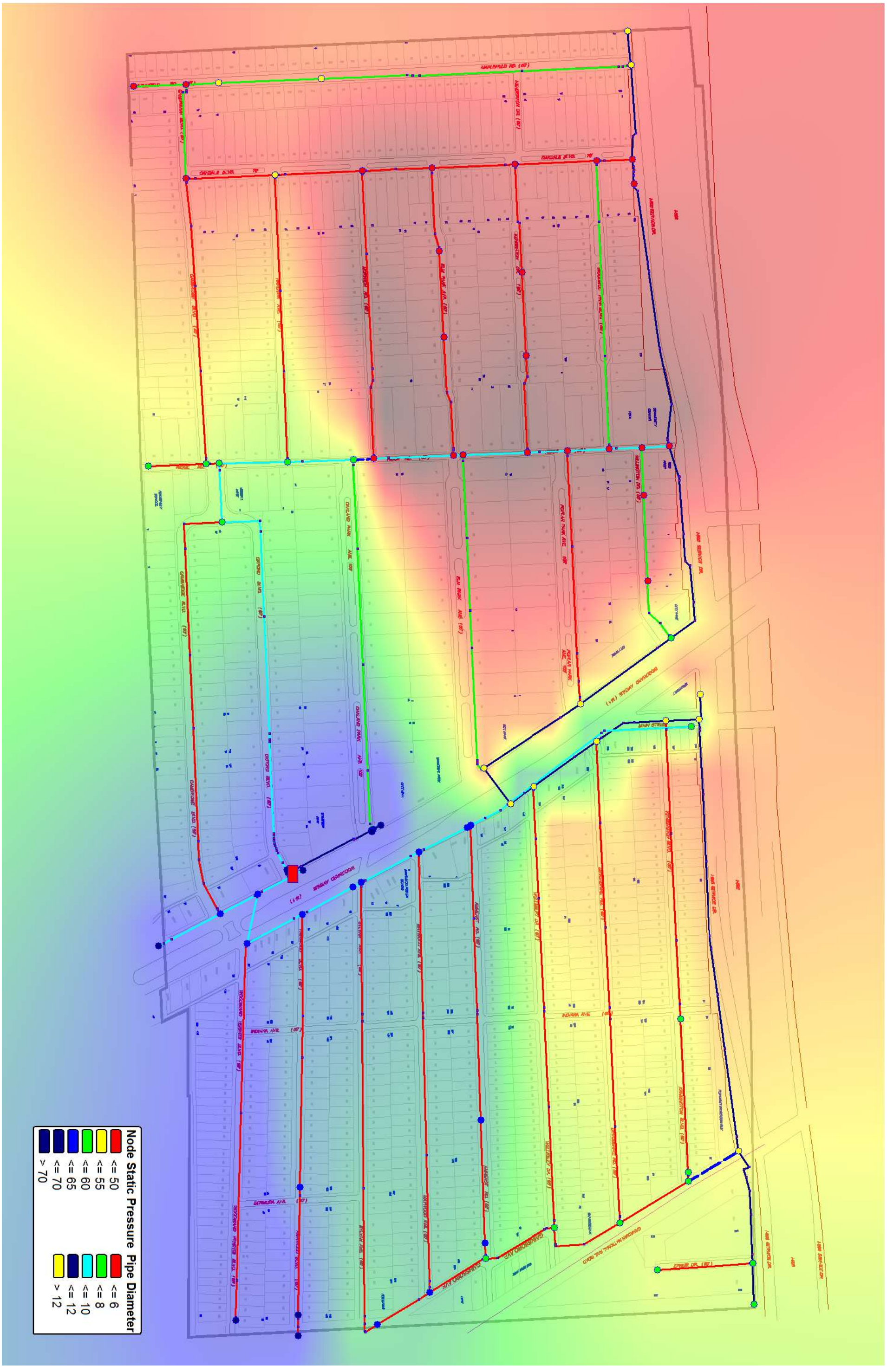
Hydrant Node	Hydrant Constant	Elevation	Demand gpm	Static Pressure	Flow-1 gpm	Flow-2 gpm	Node-2
J-1	0.0	646.9	5.2	67.1	2939.7	2922.0	J-2
J-10	0.0	665.6	6.4	58.2	1003.2	994.8	J-11
J-11	0.0	666.8	0.5	57.6	481.4		
J-12	0.0	666.4	1.0	58.0	1419.3	1416.6	J-11
J-13	0.0	650.8	8.5	65.1	1963.2		
J-14	0.0	663.7	16.4	59.3	1516.5		
J-15	0.0	660.9	9.9	56.4	503.5	496.7	J-19
J-16	0.0	659.2	11.2	57.2	505.2		
J-17	0.0	663.2	7.8	59.4	1417.5		
J-18	0.0	662.6	9.9	55.2	438.7		
J-19	0.0	668.3	5.9	52.5	421.4		
J-2	0.0	648.1	1.2	66.6	2814.2		
J-20	0.0	657.9	5.5	57.1	464.5	446.3	J-19
J-21	0.0	657.5	4.0	57.2	484.6	446.0	J-19
J-22	0.0	658.3	5.9	56.9	429.5		
J-23	0.0	662.3	5.7	55.2	418.6		
J-24	0.0	664.9	2.1	54.0	444.3	431.0	J-19
J-25	0.0	665.9	1.6	53.6	442.5	436.4	J-19
J-26	0.0	666.1	5.7	58.2	1359.5		
J-27	0.0	665.0	4.8	54.0	447.7	435.1	J-19
J-28	0.0	665.9	4.0	53.6	446.8	441.2	J-19
J-29	0.0	664.9	2.9	54.0	451.5	442.3	J-19
J-3	0.0	648.4	0.0	66.9	53756.9	44073.1	J-19
J-30	0.0	665.8	0.9	53.6	447.0	441.4	J-19
J-31	0.0	642.1	0.7	63.9	538.8	441.5	J-19
J-32	0.0	651.8	3.5	59.7	504.3	444.1	J-19
J-33	0.0	649.8	4.3	60.6	513.0	446.3	J-19
J-34	0.0	645.4	0.0	62.5	464.0	445.7	J-19
J-35	0.0	640.8	1.1	64.5	468.7	446.8	J-19
J-36	0.0	665.8	5.4	53.7	453.2	446.5	J-19
J-37	0.0	650.5	12.7	60.3	512.8	457.7	J-19
J-38	0.0	648.2	10.3	65.1	1004.6	963.8	J-39
J-39	0.0	655.0	0.0	62.1	684.2		
J-4	0.0	646.8	0.0	67.2	2952.9	2934.9	J-2
J-40	0.0	641.1	14.3	65.0	558.8	540.2	J-19
J-41	0.0	650.6	14.6	60.2	518.7	458.3	J-19
J-42	0.0	642.9	0.5	65.3	632.9		
J-43	0.0	648.4	14.3	65.0	1103.5	1060.4	J-39
J-44	0.0	640.7	11.6	66.7	640.1		
J-45	0.0	655.6	0.2	58.1	487.2	442.6	J-19
J-46	0.0	658.0	5.9	57.0	484.6	447.8	J-19
J-47	0.0	641.4	0.0	64.2	462.4	445.7	J-19

J-48	0.0	642.2	0.0	63.9	315.6		
J-49	0.0	643.2	11.1	65.7	538.1		
J-5	0.0	642.7	11.8	63.9	467.2		
J-50	0.0	661.0	2.6	55.7	460.0	443.4	J-19
J-51	0.0	648.0	8.0	66.8	5281.6	4314.0	J-19
J-52	0.0	654.9	9.0	58.4	486.6	454.7	J-19
J-53	0.0	655.3	0.0	58.2	472.3	445.7	J-19
J-54	0.0	653.0	0.0	59.2	477.9	445.7	J-19
J-55	0.0	650.6	0.0	60.2	504.8	443.0	J-19
J-56	0.0	646.8	11.4	65.8	1248.9	1188.8	J-39
J-59	0.0	649.5	1.0	65.7	2565.3	2485.2	J-39
J-6	0.0	643.5	0.0	63.4	386.6		
J-60	0.0	648.0	0.0	66.7	4138.6	3604.1	J-19
J-61	0.0	649.0	9.0	65.2	1447.6	1397.3	J-39
J-62	0.0	643.0	0.3	67.6	214.2		
J-63	0.0	648.2	0.0	66.3	1449.9		
J-64	0.0	647.7	12.9	66.1	1850.9	1774.5	J-39
J-65	0.0	642.2	11.8	68.3	243.3		
J-66	0.0	646.8	0.0	67.2	2330.8		
J-68	0.0	648.0	0.0	66.7	3186.0		
J-69	0.0	663.0	2.8	54.9	453.4	443.5	J-19
J-7	0.0	658.6	4.1	57.2	493.8	481.3	J-19
J-70	0.0	648.0	0.0	66.7	4700.5	3882.2	J-19
J-71	0.0	665.0	2.4	54.0	356.8		
J-72	0.0	662.0	3.1	55.3	359.3		
J-73	0.0	657.0	4.0	57.9	496.7	478.2	J-19
J-74	0.0	654.0	11.4	59.1	508.0	477.1	J-19
J-75	0.0	663.0	3.3	54.9	359.5		
J-76	0.0	661.0	3.1	55.7	367.9		
J-77	0.0	648.0	0.0	65.1	1001.3	959.3	J-39
J-78	0.0	647.0	0.0	65.8	1262.6	1203.0	J-39
J-79	0.0	641.0	4.1	68.4	225.6	223.3	J-62
J-8	0.0	654.1	9.2	58.7	502.8	451.6	J-19
J-80	0.0	648.0	10.9	65.4	269.7		
J-81	0.0	641.0	4.7	66.2	610.9		
J-82	0.0	640.0	12.6	67.0	522.7		
J-83	0.0	642.0	6.1	64.0	391.9		
J-84	0.0	644.0	15.0	63.1	364.1		
J-9	0.0	659.9	1.4	56.7	465.4		

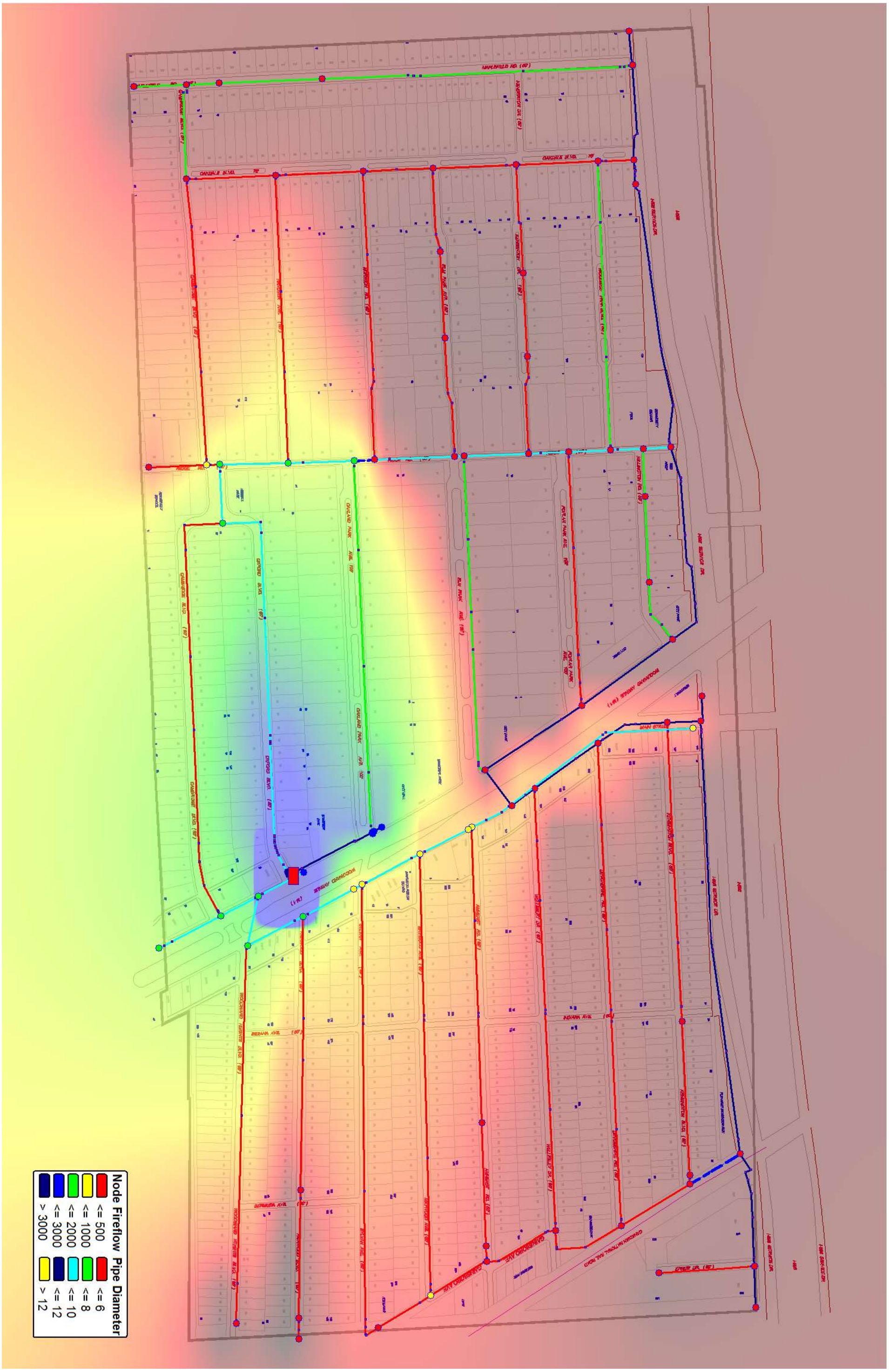
APPENDIX E

Existing Water Distribution System; Existing Peak Hour Demand Results

Includes:
Static Pressure Gradient Map; Existing System, Existing Peak Hour Demand
Available Fire Flow Gradient Map; Existing System, Existing Peak Hour Demand
Computer Model Simulation; Existing System, Existing Peak Hour Demand



Static Pressure; Existing System; Existing Peak Hour Demand



Available Fire Flow; Existing System; Existing Peak Hour Demand

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* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 Date & Time:  Wed Jan 13 09:57:36 2016

 Master File : m:\0175\0175-0095\gen\reports\kypipe\import\socwa
revision\watermodel2015.KYP\watermodel2015.P2K
```

SUMMARY OF ORIGINAL DATA

UNITS SPECIFIED

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

PIPELINE DATA

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.14	36.7943	0.00
P-10	J-75	J-24	557.86	6.08	34.1458	1.27
P-103	J-38	J-82	1375.77	6.08	34.1458	1.54
P-107	J-43	J-44	2058.36	6.08	34.1458	1.37
P-11	J-76	J-75	402.54	6.08	34.1458	0.40
P-12	J-77	J-38	19.18	10.16	34.1458	0.17
P-120	J-31	J-36	972.64	12.34	80.3947	2.37
P-125	J-8	J-21	445.59	12.34	80.3947	0.70
P-126	J-45	J-8	160.81	12.34	80.3947	0.00
P-13	J-5	J-6	373.36	6.08	34.1458	0.00
P-130	J-36	J-46	1250.08	12.34	80.3947	1.79
P-14	J-78	J-61	266.57	10.16	34.1458	0.17
P-148	J-47	J-35	190.47	12.14	36.7943	0.17
P-149	J-27	J-33	1489.24	8.18	52.6812	2.98
P-15	J-79	J-80	597.22	6.08	34.1458	0.57
P-152	J-48	J-35	445.75	6.08	34.1458	0.57
P-154	J-42	J-40	362.71	6.08	34.1458	0.70
P-155	J-40	J-5	415.41	6.08	34.1458	1.27
P-156-XX	J-6	J-34	275.42	6.08	34.1458	0.17
P-157	J-53	J-54	124.93	12.14	36.7943	0.75
P-16	J-80	J-61	1275.42	6.08	34.1458	0.57
P-17	J-81	J-42	72.50	6.08	34.1458	0.17
P-170	J-33	J-55	209.02	12.14	36.7943	0.34

P-171	J-41	J-55	134.03	12.14	36.7943	0.00
P-172	J-37	J-41	362.21	12.14	36.7943	0.00
P-174	J-52	J-84	1394.38	6.08	34.1458	1.54
P-175	J-37	J-52	349.33	12.14	36.7943	0.69
P-178	J-44	J-42	304.86	6.08	34.1458	0.35
P-179	J-56	J-49	2164.85	6.08	34.1458	2.06
P-18	J-82	J-81	575.79	6.08	34.1458	0.57
P-188	J-26	J-1	1732.31	8.18	52.6812	1.89
P-189	J-43	J-77	250.49	10.16	34.1458	0.57
P-19	J-83	J-6	42.96	6.08	34.1458	0.17
P-191	J-14	J-51	1820.36	10.16	34.1458	2.81
P-192	J-59	J-60	171.60	10.16	34.1458	0.17
P-192a	J-60	J-68	67.12	10.16	34.1458	0.17
P-195	J-56	J-78	45.89	10.16	34.1458	0.40
P-197	J-56	J-43	304.88	10.16	34.1458	0.57
P-2	J-70	J-60	22.81	10.16	34.1458	0.00
P-20	J-7	J-73	152.54	8.18	52.6812	0.57
P-201	J-62	J-79	95.36	6.08	34.1458	0.57
P-209	J-13	J-63	324.39	10.16	34.1458	0.34
P-21	J-84	J-83	716.44	6.08	34.1458	0.40
P-210	J-59	J-13	198.02	10.16	34.1458	0.17
P-217	J-64	J-59	236.90	10.16	34.1458	0.17
P-219	J-64	J-65	1762.12	6.08	34.1458	1.49
P-221	J-61	J-64	294.29	10.16	34.1458	0.17
P-239	J-12	J-14	275.83	10.16	34.1458	0.17
P-24	J-9	J-7	245.04	8.18	52.6812	0.17
P-243	J-16	J-18	408.03	6.08	34.1458	0.17
P-25	J-10	J-11	270.51	6.08	34.1458	0.00
P-255	J-51	J-70	16.36	10.16	34.1458	0.00
P-264	J-34	J-35	559.29	12.14	36.7943	1.62
P-265	J-44	J-49	287.63	6.08	34.1458	0.17
P-266-XX	J-26	J-19	95.17	10.16	34.1458	0.00
P-268	J-3	PR-1	17.14	12.34	95.9564	0.00
P-269	J-51	J-3	30.19	10.16	34.1458	7.09
P-27	J-12	J-10	61.27	6.08	34.1458	0.17
P-271	J-52	J-53	156.58	12.14	36.7943	0.00
P-272	J-66	J-4	8.87	6.08	34.1458	0.17
P-275	J-1	J-4	9.76	12.14	36.7943	0.00
P-285	J-53	J-34	2026.54	12.14	36.7943	0.34
P-286	J-46	J-21	116.24	12.34	80.3947	0.87
P-29	J-13	J-14	2021.68	6.08	34.1458	2.52
P-3	J-4	J-70	436.95	12.14	36.7943	0.70
P-31	J-15	J-10	1335.13	6.08	34.1458	1.14
P-32	J-15	J-7	455.35	8.18	52.6812	1.84
P-34	J-16	J-15	416.64	6.08	34.1458	0.17
P-35	J-16	J-17	1343.13	6.08	34.1458	1.14
P-38	J-18	J-19	1348.06	6.08	34.1458	1.84
P-4	J-50	J-31	303.86	8.18	52.6812	0.52
P-41	J-20	J-21	168.80	6.08	34.1458	0.34
P-44	J-22	J-20	381.01	6.08	34.1458	0.17
P-46	J-23	J-22	387.52	6.08	34.1458	0.00
P-48	J-18	J-23	325.49	6.08	34.1458	0.57
P-49	J-23	J-76	391.70	6.08	34.1458	1.27
P-5	J-69	J-50	401.89	8.18	52.6812	0.40
P-51	J-25	J-71	454.23	6.08	34.1458	1.27
P-55	J-17	J-12	318.63	10.16	34.1458	0.00
P-56	J-26	J-17	306.82	10.16	34.1458	0.00

P-57	J-24	J-19	373.15	10.16	34.1458	0.00
P-58	J-27	J-24	43.67	10.16	34.1458	0.00
P-6	J-71	J-72	388.95	6.08	34.1458	0.40
P-60	J-25	J-27	300.24	10.16	34.1458	0.17
P-61	J-28	J-25	187.57	10.16	34.1458	0.00
P-63	J-29	J-20	1346.63	8.18	52.6812	1.14
P-67	J-30	J-69	223.04	8.18	52.6812	0.57
P-69	J-31	J-32	521.13	12.14	36.7943	0.00
P-7	J-72	J-22	509.45	6.08	34.1458	0.87
P-71	J-33	J-32	543.94	12.14	36.7943	0.00
P-8	J-73	J-74	479.27	8.18	52.6812	0.40
P-81	J-29	J-28	196.49	10.16	34.1458	0.17
P-82	J-30	J-29	151.25	10.16	34.1458	0.00
P-83	J-36	J-30	129.33	10.16	34.1458	0.00
P-84	J-32	J-28	1184.63	6.08	34.1458	1.14
P-87	J-5	J-37	2251.87	6.08	34.1458	2.51
P-9	J-74	J-8	1448.13	8.18	52.6812	2.94
P-92	J-38	J-39	1173.25	10.16	34.1458	0.87
P-97	J-40	J-41	2063.01	6.08	34.1458	2.34

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		8.30	646.90	
J-10		10.23	665.57	
J-11		0.83	666.78	
J-12		1.66	666.41	
J-13		13.55	650.77	
J-14		26.28	663.73	
J-15		15.77	660.87	
J-16		17.98	659.23	
J-17		12.45	663.22	
J-18		15.77	662.56	
J-19		9.40	668.34	
J-2		2.00	648.06	
J-20		8.85	657.89	
J-21		6.36	657.51	
J-22		9.40	658.30	
J-23		9.13	662.32	
J-24		3.32	664.89	
J-25		2.49	665.93	
J-26		9.13	666.12	
J-27		7.74	665.03	
J-28		6.36	665.85	
J-29		4.70	664.95	
J-3		0.00	648.42	
J-30		1.38	665.84	
J-31		1.11	642.05	
J-32		5.53	651.80	
J-33		6.91	649.84	
J-34		0.00	645.38	
J-35		1.76	640.76	
J-36		8.70	665.80	
J-37		20.28	650.49	

J-38		16.43	648.18	
J-39		0.00	655.00	
J-4		0.00	646.84	
J-40		22.96	641.08	
J-41		23.31	650.63	
J-42		0.83	642.94	
J-43		22.81	648.38	
J-44		18.53	640.70	
J-45		0.28	655.58	
J-46	EC-SOCWA	9.40	658.00	
J-47	EC-Ferndale	0.00	641.36	
J-48		0.00	642.16	
J-49		17.70	643.24	
J-5		18.81	642.66	
J-50	1F	4.15	661.00	
J-51		12.72	648.00	
J-52		14.38	654.88	
J-53		0.00	655.33	
J-54		0.00	653.00	
J-55		0.00	650.63	
J-56		18.22	646.80	
J-59		1.58	649.53	
J-6		0.00	643.53	
J-60		0.00	648.00	
J-61		14.38	649.02	
J-62	EC-Ferndale	0.55	643.00	
J-63	EC-Ferndale	0.00	648.19	
J-64		20.63	647.71	
J-65		18.93	642.19	
J-66		0.00	646.83	
J-68		0.00	648.00	
J-69	1R	4.43	663.00	
J-7		6.64	658.64	
J-70		0.00	648.00	
J-71	2F	3.87	665.00	
J-72	2R	4.98	662.00	
J-73	3F	6.36	657.00	
J-74	3R	18.26	654.00	
J-75	4F	5.26	663.00	
J-76	4R	4.98	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	6.64	641.00	
J-8		14.66	654.08	
J-80	6F	17.43	648.00	
J-81	7R	7.47	641.00	
J-82	7F	20.19	640.00	
J-83	8F	9.68	642.00	
J-84	8R	24.06	644.00	
J-9		2.21	659.92	
PR-1	PR-1	----	648.00	802.77

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5

MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) = 99
NUMBER OF END NODES .....(J) = 81
NUMBER OF PRIMARY LOOPS .....(L) = 18
NUMBER OF SUPPLY NODES .....(F) = 1
NUMBER OF SUPPLY ZONES .....(Z) = 1

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Case: 0

RESULTS OBTAINED AFTER 9 TRIALS: ACCURACY = 0.60339E-03

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

Existing System; Existing Peak Hour Demand

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	2.00	0.00	0.00	0.01	0.00	0.00
P-10	J-75	J-24	3.68	0.01	0.00	0.04	0.03	0.03
P-103	J-38	J-82	72.83	8.89	0.02	0.80	6.47	6.46
P-107	J-43	J-44	58.86	8.97	0.01	0.65	4.36	4.36
P-11	J-76	J-75	8.93	0.05	0.00	0.10	0.13	0.13
P-12	J-77	J-38	89.25	0.01	0.00	0.35	0.79	0.77
P-120	J-31	J-36	-23.69	0.01	0.00	0.06	0.01	0.01
P-125	J-8	J-21	77.59	0.02	0.00	0.21	0.05	0.05
P-126	J-45	J-8	-0.28	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	31.21	0.50	0.00	0.34	1.35	1.35
P-130	J-36	J-46	-50.69	0.03	0.00	0.14	0.02	0.02
P-14	J-78	J-61	-247.00	1.36	0.00	0.98	5.10	5.09
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	4.03	0.00	0.00	0.02	0.00	0.00
P-15	J-79	J-80	-7.19	0.05	0.00	0.08	0.09	0.09
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	124.82	6.36	0.02	1.38	17.59	17.53
P-155	J-40	J-5	67.36	2.32	0.01	0.74	5.62	5.59
P-156-XX	J-6	J-34						
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-61	-24.62	1.11	0.00	0.27	0.87	0.87
P-17	J-81	J-42	45.17	0.19	0.00	0.50	2.68	2.67
P-170	J-33	J-55	10.42	0.00	0.00	0.03	0.01	0.01
P-171	J-41	J-55	-10.42	0.00	0.00	0.03	0.01	0.01
P-172	J-37	J-41	-21.62	0.01	0.00	0.06	0.02	0.02
P-174	J-52	J-84	2.54	0.02	0.00	0.03	0.01	0.01
P-175	J-37	J-52	18.68	0.01	0.00	0.05	0.02	0.02
P-178	J-44	J-42	80.49	2.37	0.00	0.89	7.79	7.78
P-179	J-56	J-49	57.86	9.14	0.01	0.64	4.23	4.22
P-18	J-82	J-81	52.64	2.04	0.00	0.58	3.55	3.54

P-188	J-26	J-1	-125.75	3.25	0.02	0.77	1.89	1.88
P-189	J-43	J-77	89.25	0.19	0.00	0.35	0.78	0.77
P-19	J-83	J-6	-31.21	0.06	0.00	0.34	1.35	1.35
P-191	J-14	J-51	-150.21	3.69	0.02	0.59	2.03	2.03
P-192	J-59	J-60	-362.11	1.77	0.01	1.43	10.37	10.34
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-247.00	0.23	0.01	0.98	5.22	5.09
P-197	J-56	J-43	170.93	0.78	0.00	0.68	2.59	2.57
P-2	J-70	J-60	362.11	0.24	0.00	1.43	10.34	10.34
P-20	J-7	J-73	117.14	0.25	0.00	0.72	1.68	1.65
P-201	J-62	J-79	-0.55	0.00	0.00	0.01	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	-21.53	0.48	0.00	0.24	0.68	0.68
P-210	J-59	J-13	34.97	0.03	0.00	0.14	0.14	0.14
P-217	J-64	J-59	-325.56	2.01	0.00	1.29	8.51	8.49
P-219	J-64	J-65	18.93	0.94	0.00	0.21	0.53	0.53
P-221	J-61	J-64	-285.99	1.97	0.00	1.13	6.69	6.68
P-239	J-12	J-14	-145.36	0.53	0.00	0.58	1.91	1.91
P-24	J-9	J-7	-2.21	0.00	0.00	0.01	0.00	0.00
P-243	J-16	J-18	77.07	2.93	0.00	0.85	7.18	7.18
P-25	J-10	J-11	0.83	0.00	0.00	0.01	0.00	0.00
P-255	J-51	J-70	498.16	0.31	0.00	1.97	18.66	18.66
P-264	J-34	J-35	1.76	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	-40.15	0.62	0.00	0.44	2.15	2.15
P-266-XX	J-26	J-19						
P-268	J-3	PR-1	-661.10	0.03	0.00	1.77	1.80	1.80
P-269	J-51	J-3	-661.10	0.95	0.75	2.62	56.47	31.52
P-27	J-12	J-10	128.49	1.13	0.01	1.42	18.58	18.50
P-271	J-52	J-53	1.76	0.00	0.00	0.00	0.00	0.00
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-136.05	0.01	0.00	0.38	0.62	0.62
P-285	J-53	J-34	1.76	0.00	0.00	0.00	0.00	0.00
P-286	J-46	J-21	-60.10	0.00	0.00	0.16	0.03	0.03
P-29	J-13	J-14	21.42	1.35	0.00	0.24	0.67	0.67
P-3	J-4	J-70	-136.05	0.27	0.00	0.38	0.62	0.62
P-31	J-15	J-10	-117.43	20.90	0.03	1.30	15.68	15.65
P-32	J-15	J-7	125.99	0.86	0.02	0.77	1.92	1.88
P-34	J-16	J-15	24.33	0.35	0.00	0.27	0.85	0.85
P-35	J-16	J-17	-119.37	21.68	0.03	1.32	16.16	16.14
P-38	J-18	J-19	21.11	0.88	0.00	0.23	0.65	0.65
P-4	J-50	J-31	-3.98	0.00	0.00	0.02	0.00	0.00
P-41	J-20	J-21	-11.13	0.03	0.00	0.12	0.20	0.20
P-44	J-22	J-20	2.43	0.00	0.00	0.03	0.01	0.01
P-46	J-23	J-22	17.15	0.17	0.00	0.19	0.44	0.44
P-48	J-18	J-23	40.19	0.70	0.00	0.44	2.15	2.15
P-49	J-23	J-76	13.91	0.12	0.00	0.15	0.30	0.30
P-5	J-69	J-50	0.16	0.00	0.00	0.00	0.00	0.00
P-51	J-25	J-71	3.54	0.01	0.00	0.04	0.02	0.02
P-55	J-17	J-12	-15.20	0.01	0.00	0.06	0.03	0.03
P-56	J-26	J-17	116.62	0.39	0.00	0.46	1.27	1.27
P-57	J-24	J-19	-11.71	0.01	0.00	0.05	0.02	0.02
P-58	J-27	J-24	-12.06	0.00	0.00	0.05	0.02	0.02
P-6	J-71	J-72	-0.33	0.00	0.00	0.00	0.00	0.00
P-60	J-25	J-27	-0.29	0.00	0.00	0.00	0.00	0.00
P-61	J-28	J-25	5.73	0.00	0.00	0.02	0.00	0.00
P-63	J-29	J-20	-4.71	0.01	0.00	0.03	0.00	0.00
P-67	J-30	J-69	4.59	0.00	0.00	0.03	0.00	0.00

P-69	J-31	J-32	18.60	0.01	0.00	0.05	0.02	0.02
P-7	J-72	J-22	-5.31	0.03	0.00	0.06	0.05	0.05
P-71	J-33	J-32	-13.31	0.00	0.00	0.04	0.01	0.01
P-8	J-73	J-74	110.78	0.71	0.00	0.68	1.49	1.48
P-81	J-29	J-28	12.34	0.00	0.00	0.05	0.02	0.02
P-82	J-30	J-29	12.33	0.00	0.00	0.05	0.02	0.02
P-83	J-36	J-30	18.30	0.01	0.00	0.07	0.04	0.04
P-84	J-32	J-28	-0.24	0.00	0.00	0.00	0.00	0.00
P-87	J-5	J-37	17.34	1.02	0.00	0.19	0.45	0.45
P-9	J-74	J-8	92.52	1.54	0.01	0.56	1.07	1.06
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-41	34.51	3.34	0.01	0.38	1.62	1.62

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		8.30	800.45	646.90	153.55	66.54
J-10		10.23	795.66	665.57	130.09	56.37
J-11		0.83	795.66	666.78	128.88	55.85
J-12		1.66	796.80	666.41	130.39	56.50
J-13		13.55	798.69	650.77	147.92	64.10
J-14		26.28	797.33	663.73	133.60	57.89
J-15		15.77	774.73	660.87	113.87	49.34
J-16		17.98	775.09	659.23	115.86	50.20
J-17		12.45	796.79	663.22	133.58	57.88
J-18		15.77	772.16	662.56	109.59	47.49
J-19		9.40	771.28	668.34	102.94	44.61
J-2		2.00	800.45	648.06	152.40	66.04
J-20		8.85	771.28	657.89	113.39	49.13
J-21		6.36	771.31	657.51	113.81	49.32
J-22		9.40	771.28	658.30	112.99	48.96
J-23		9.13	771.46	662.32	109.13	47.29
J-24		3.32	771.27	664.89	106.38	46.10
J-25		2.49	771.27	665.93	105.34	45.65
J-26		9.13	797.18	666.12	131.07	56.80
J-27		7.74	771.27	665.03	106.24	46.04
J-28		6.36	771.27	665.85	105.42	45.68
J-29		4.70	771.27	664.95	106.33	46.07
J-3		0.00	802.74	648.42	154.31	66.87
J-30		1.38	771.28	665.84	105.43	45.69
J-31		1.11	771.28	642.05	129.23	56.00
J-32		5.53	771.27	651.80	119.46	51.77
J-33		6.91	771.26	649.84	121.43	52.62
J-34		0.00	771.25	645.38	125.87	54.54
J-35		1.76	771.25	640.76	130.49	56.54
J-36		8.70	771.28	665.80	105.48	45.71
J-37		20.28	771.26	650.49	120.76	52.33
J-38		16.43	792.13	648.18	143.96	62.38
J-39		0.00	792.13	655.00	137.13	59.42
J-4		0.00	800.46	646.84	153.61	66.57
J-40		22.96	774.61	641.08	133.53	57.86
J-41		23.31	771.26	650.63	120.64	52.28
J-42		0.83	780.99	642.94	138.05	59.82
J-43		22.81	792.34	648.38	143.97	62.39

J-44		18.53	783.36	640.70	142.67	61.82
J-45		0.28	771.34	655.58	115.76	50.16
J-46	EC-SOCWA	9.40	771.31	658.00	113.31	49.10
J-47	EC-Ferndale	0.00	771.25	641.36	129.88	56.28
J-48		0.00	771.25	642.16	129.09	55.94
J-49		17.70	783.98	643.24	140.74	60.99
J-5		18.81	772.28	642.66	129.61	56.17
J-50	1F	4.15	771.28	661.00	110.28	47.79
J-51		12.72	801.03	648.00	153.03	66.31
J-52		14.38	771.25	654.88	116.37	50.43
J-53		0.00	771.25	655.33	115.92	50.23
J-54		0.00	771.25	653.00	118.25	51.24
J-55		0.00	771.26	650.63	120.64	52.28
J-56		18.22	793.13	646.80	146.33	63.41
J-59		1.58	798.71	649.53	149.18	64.64
J-6		0.00	771.77	643.53	128.24	55.57
J-60		0.00	800.49	648.00	152.49	66.08
J-61		14.38	794.73	649.02	145.71	63.14
J-62	EC-Ferndale	0.55	793.57	643.00	150.57	65.25
J-63	EC-Ferndale	0.00	798.69	648.19	150.50	65.22
J-64		20.63	796.70	647.71	148.99	64.56
J-65		18.93	795.76	642.19	153.57	66.55
J-66		0.00	800.46	646.83	153.63	66.57
J-68		0.00	800.49	648.00	152.49	66.08
J-69	1R	4.43	771.28	663.00	108.28	46.92
J-7		6.64	773.86	658.64	115.22	49.93
J-70		0.00	800.73	648.00	152.73	66.18
J-71	2F	3.87	771.26	665.00	106.26	46.05
J-72	2R	4.98	771.26	662.00	109.26	47.35
J-73	3F	6.36	773.60	657.00	116.60	50.53
J-74	3R	18.26	772.89	654.00	118.89	51.52
J-75	4F	5.26	771.28	663.00	108.28	46.92
J-76	4R	4.98	771.34	661.00	110.34	47.81
J-77	5F	0.00	792.15	648.00	144.15	62.46
J-78	5R	0.00	793.37	647.00	146.37	63.43
J-79	6R	6.64	793.57	641.00	152.57	66.11
J-8		14.66	771.34	654.08	117.26	50.81
J-80	6F	17.43	793.62	648.00	145.62	63.10
J-81	7R	7.47	781.18	641.00	140.18	60.75
J-82	7F	20.19	783.23	640.00	143.23	62.06
J-83	8F	9.68	771.72	642.00	129.72	56.21
J-84	8R	24.06	771.23	644.00	127.23	55.13
J-9		2.21	773.86	659.92	113.94	49.37
PR-1	PR-1	----	802.77	648.00	154.77	67.07

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
PR-1	67.07	J-19	44.61
J-3	66.87	J-25	45.65
J-66	66.57	J-28	45.68
J-4	66.57	J-30	45.69
J-65	66.55	J-36	45.71

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	2.62	P-126	0.00
P-255	1.97	P-5	0.00
P-268	1.77	P-60	0.00
P-192	1.43	P-84	0.00
P-2	1.43	P-6	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	56.47	P-126	0.00
P-255	18.66	P-5	0.00
P-27	18.58	P-60	0.00
P-154	17.59	P-84	0.00
P-35	16.16	P-271	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	31.52	P-126	0.00
P-255	18.66	P-5	0.00
P-27	18.50	P-60	0.00
P-154	17.53	P-84	0.00
P-35	16.14	P-271	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
PR-1	661.10	PR-1

NET SYSTEM INFLOW = 661.10
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 661.10

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FireFlow/Hydrant Report

Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

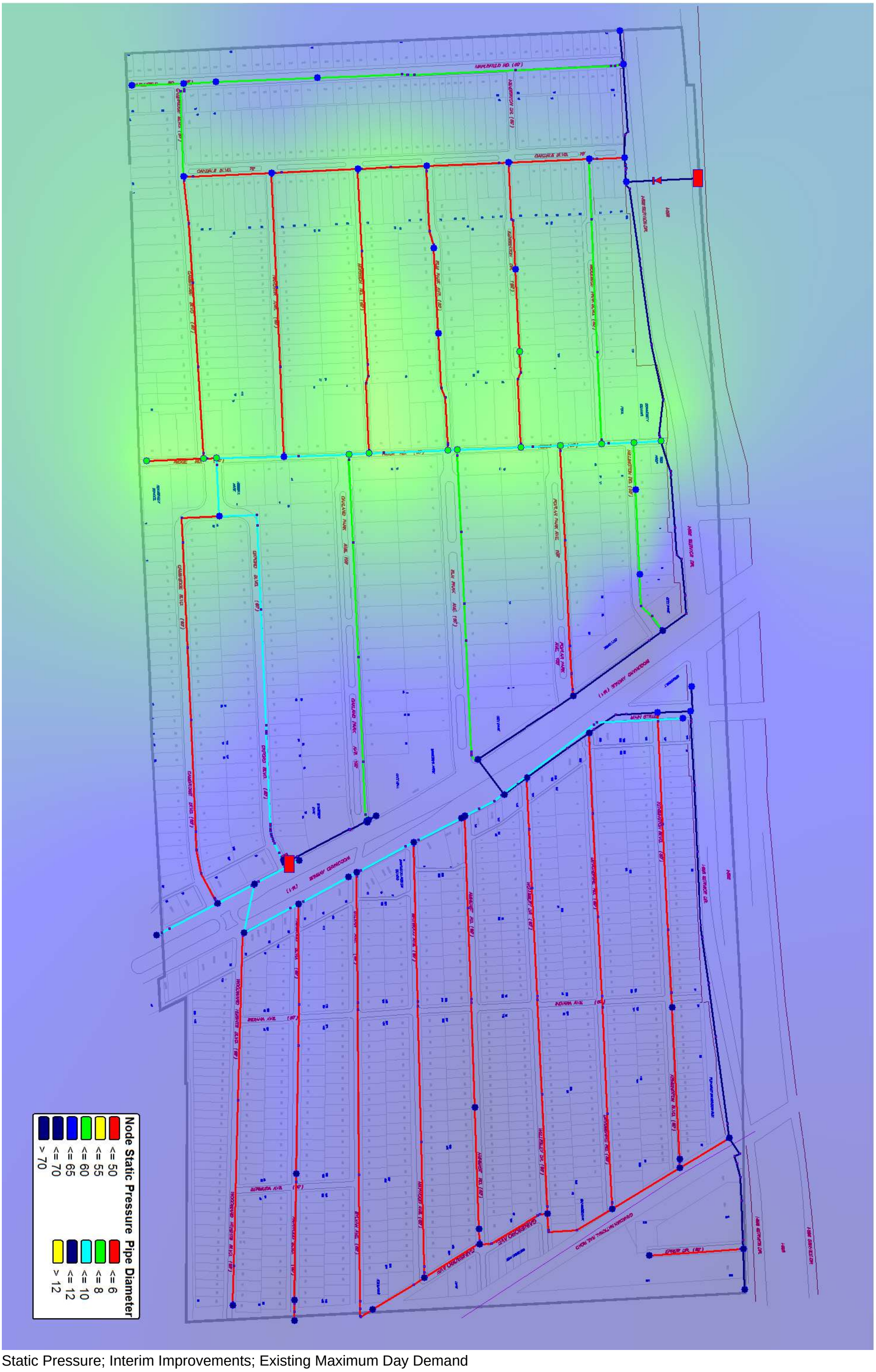
Hydrant Node	Hydrant Constant	Elevation	Demand gpm	Static Pressure	Flow-1 gpm	Flow-2 gpm	Node-2
J-1	0.0	646.9	8.3	66.5	2808.0	2492.4	J-19
J-10	0.0	665.6	10.2	56.4	890.3	878.6	J-19
J-11	0.0	666.8	0.8	55.8	444.3		
J-12	0.0	666.4	1.7	56.5	1259.1	1172.0	J-19
J-13	0.0	650.8	13.6	64.1	1843.8		
J-14	0.0	663.7	26.3	57.9	1374.4	1285.9	J-19
J-15	0.0	660.9	15.8	49.3	372.5	343.0	J-19
J-16	0.0	659.2	18.0	50.2	382.3	349.6	J-19
J-17	0.0	663.2	12.4	57.9	1265.9	1167.3	J-19
J-18	0.0	662.6	15.8	47.5	322.3	318.5	J-19
J-19	0.0	668.3	9.4	44.6	292.7		
J-2	0.0	648.1	2.0	66.0	2688.4	2486.1	J-19
J-20	0.0	657.9	8.9	49.1	334.2	304.6	J-19
J-21	0.0	657.5	6.4	49.3	344.5	302.6	J-19
J-22	0.0	658.3	9.4	49.0	314.3	305.6	J-19
J-23	0.0	662.3	9.1	47.3	302.4		
J-24	0.0	664.9	3.3	46.1	306.8	293.2	J-19
J-25	0.0	665.9	2.5	45.6	303.2	295.2	J-19
J-26	0.0	666.1	9.1	56.8	1225.9	1223.7	J-19
J-27	0.0	665.0	7.7	46.0	311.3	298.2	J-19
J-28	0.0	665.9	6.4	45.7	308.2	300.3	J-19
J-29	0.0	664.9	4.7	46.1	311.3	299.7	J-19
J-3	0.0	648.4	0.0	66.9	53509.0	37596.5	J-19
J-30	0.0	665.8	1.4	45.7	305.0	296.9	J-19
J-31	0.0	642.1	1.1	56.0	397.1	296.7	J-19
J-32	0.0	651.8	5.5	51.8	364.3	301.2	J-19
J-33	0.0	649.8	6.9	52.6	373.3	303.3	J-19
J-34	0.0	645.4	0.0	54.5	347.0	298.3	J-19
J-35	0.0	640.8	1.8	56.5	357.0	300.0	J-19
J-36	0.0	665.8	8.7	45.7	313.3	304.5	J-19
J-37	0.0	650.5	20.3	52.3	380.6	318.2	J-19
J-38	0.0	648.2	16.4	62.4	883.8	841.3	J-39
J-39	0.0	655.0	0.0	59.4	606.1		
J-4	0.0	646.8	0.0	66.6	2817.3	2492.4	J-19
J-40	0.0	641.1	23.0	57.9	444.8	365.6	J-19
J-41	0.0	650.6	23.3	52.3	385.8	320.5	J-19
J-42	0.0	642.9	0.8	59.8	512.7	434.5	J-19
J-43	0.0	648.4	22.8	62.4	972.3	876.9	J-19
J-44	0.0	640.7	18.5	61.8	546.3	508.0	J-19
J-45	0.0	655.6	0.3	50.2	345.5	296.8	J-19
J-46	0.0	658.0	9.4	49.1	345.5	305.6	J-19
J-47	0.0	641.4	0.0	56.3	351.2	298.3	J-19

J-48	0.0	642.2	0.0	55.9	253.3		
J-49	0.0	643.2	17.7	61.0	469.3		
J-5	0.0	642.7	18.8	56.2	368.2	344.6	J-19
J-50	0.0	661.0	4.1	47.8	323.1	299.8	J-19
J-51	0.0	648.0	12.7	66.3	5038.5	3477.3	J-19
J-52	0.0	654.9	14.4	50.4	354.7	312.7	J-19
J-53	0.0	655.3	0.0	50.2	336.6	298.3	J-19
J-54	0.0	653.0	0.0	51.2	343.7	298.3	J-19
J-55	0.0	650.6	0.0	52.3	362.9	296.9	J-19
J-56	0.0	646.8	18.2	63.4	1098.1	960.3	J-19
J-59	0.0	649.5	1.6	64.6	2366.0	1990.3	J-19
J-6	0.0	643.5	0.0	55.6	300.3		
J-60	0.0	648.0	0.0	66.1	3912.4	2915.4	J-19
J-61	0.0	649.0	14.4	63.1	1284.4	1132.4	J-19
J-62	0.0	643.0	0.6	65.2	199.6		
J-63	0.0	648.2	0.0	65.2	1379.9		
J-64	0.0	647.7	20.6	64.6	1677.2	1447.7	J-19
J-65	0.0	642.2	18.9	66.5	237.1		
J-66	0.0	646.8	0.0	66.6	2241.3		
J-68	0.0	648.0	0.0	66.1	3046.6	2915.4	J-19
J-69	0.0	663.0	4.4	46.9	316.0	300.1	J-19
J-7	0.0	658.6	6.6	49.9	361.3	325.5	J-19
J-70	0.0	648.0	0.0	66.2	4457.5	3124.4	J-19
J-71	0.0	665.0	3.9	46.0	258.7		
J-72	0.0	662.0	5.0	47.3	264.9		
J-73	0.0	657.0	6.4	50.5	364.5	322.9	J-19
J-74	0.0	654.0	18.3	51.5	380.4	328.6	J-19
J-75	0.0	663.0	5.3	46.9	264.3		
J-76	0.0	661.0	5.0	47.8	272.1		
J-77	0.0	648.0	0.0	62.5	873.5	829.7	J-39
J-78	0.0	647.0	0.0	63.4	1103.8	963.6	J-19
J-79	0.0	641.0	6.6	66.1	212.8	210.5	J-62
J-8	0.0	654.1	14.7	50.8	366.2	311.2	J-19
J-80	0.0	648.0	17.4	63.1	256.5		
J-81	0.0	641.0	7.5	60.7	505.5	448.9	J-19
J-82	0.0	640.0	20.2	62.1	458.2		
J-83	0.0	642.0	9.7	56.2	310.6		
J-84	0.0	644.0	24.1	55.1	295.4		
J-9	0.0	659.9	2.2	49.4	339.9	321.0	J-19

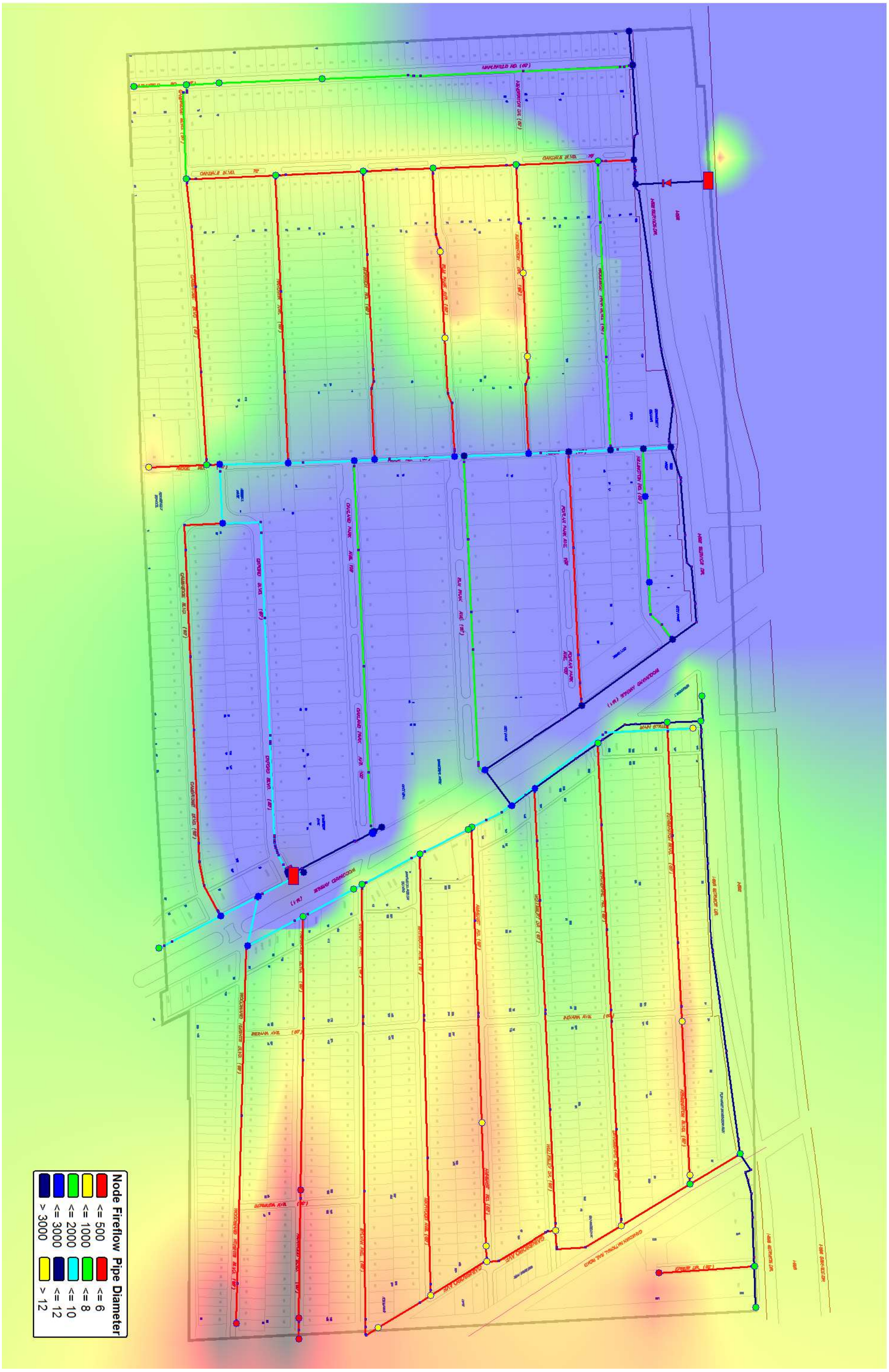
APPENDIX F

Interim Improvements Water Distribution System; Existing Maximum Day Demand Results

Includes:
Static Pressure Gradient Map; Interim Improvements, Existing Maximum Day Demand
Available Fire Flow Gradient Map; Interim Improvements, Existing Max. Day Demand
Computer Model Simulation; Interim Improvements, Existing Maximum Day Demand



Static Pressure; Interim Improvements; Existing Maximum Day Demand



Available Fire Flow; Interim Improvements; Existing Maximum Day Demand

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* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 Date & Time:  Wed Jan 13 10:52:17 2016

 Master File : m:\0175\0175-0095\gen\reports\kypipe\import\socwa
revision\watermodelinterim.KYP\watermodelinterim.P2K
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S U M M A R Y O F O R I G I N A L D A T A

U N I T S S P E C I F I E D

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

P I P E L I N E D A T A

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.14	36.7906	0.00
P-10	J-75	J-24	557.86	6.08	34.1420	1.27
P-103	J-38	J-82	1375.77	6.08	34.1420	1.54
P-107	J-43	J-44	2058.36	6.08	34.1420	1.37
P-11	J-76	J-75	402.54	6.08	34.1420	0.40
P-12	J-77	J-38	19.18	10.16	34.1420	0.17
P-120	J-31	J-36	972.64	12.34	78.7632	2.37
P-125	J-8	J-21	445.59	12.34	78.7632	0.70
P-126	J-45	J-8	160.81	12.34	78.7632	0.00
P-13	J-5	J-6	373.36	6.08	34.1420	0.00
P-130	J-36	J-46	1250.08	12.34	78.7632	1.79
P-14	J-78	J-61	266.57	10.16	34.1420	0.17
P-148	J-47	J-35	190.47	12.14	36.7906	0.17
P-149	J-27	J-33	1489.24	8.18	52.6781	2.98
P-15	J-79	J-80	597.22	6.08	34.1420	0.57
P-152	J-48	J-35	445.75	6.08	34.1420	0.57
P-154	J-42	J-40	362.71	6.08	34.1420	0.70
P-155	J-40	J-5	415.41	6.08	34.1420	1.27
P-156	J-6	J-34	275.42	6.08	34.1420	0.17
P-157	J-53	J-54	124.93	12.14	36.7906	0.75
P-16	J-80	J-61	1275.42	6.08	34.1420	0.57
P-17	J-81	J-42	72.50	6.08	34.1420	0.17
P-170	J-33	J-55	209.02	12.14	36.7906	0.34

P-171	J-41	J-55	134.03	12.14	36.7906	0.00
P-172	J-37	J-41	362.21	12.14	36.7906	0.00
P-174	J-52	J-84	1394.38	6.08	34.1420	1.54
P-175	J-37	J-52	349.33	12.14	36.7906	0.69
P-178	J-44	J-42	304.86	6.08	34.1420	0.35
P-179	J-56	J-49	2164.85	6.08	34.1420	2.06
P-18	J-82	J-81	575.79	6.08	34.1420	0.57
P-188	J-26	J-1	1732.31	8.18	52.6781	1.89
P-189	J-43	J-77	250.49	10.16	34.1420	0.57
P-19	J-83	J-6	42.96	6.08	34.1420	0.17
P-191	J-14	J-51	1820.36	10.16	34.1420	2.81
P-192	J-59	J-60	171.60	10.16	34.1420	0.17
P-192a	J-60	J-68	67.12	10.16	34.1420	0.17
P-195	J-56	J-78	45.89	10.16	34.1420	0.40
P-197	J-56	J-43	304.88	10.16	34.1420	0.57
P-2	J-70	J-60	22.81	10.16	34.1420	0.00
P-20	J-7	J-73	152.54	8.18	52.6781	0.57
P-201	J-62	J-79	95.36	6.08	34.1420	0.57
P-209	J-13	J-63	324.39	10.16	34.1420	0.34
P-21	J-84	J-83	716.44	6.08	34.1420	0.40
P-210	J-59	J-13	198.02	10.16	34.1420	0.17
P-217	J-64	J-59	236.90	10.16	34.1420	0.17
P-219	J-64	J-65	1762.12	6.08	34.1420	1.49
P-22-CV	PR-2	J-46	339.46	12.34	78.7632	1.74
P-221	J-61	J-64	294.29	10.16	34.1420	0.17
P-239	J-12	J-14	275.83	10.16	34.1420	0.17
P-24	J-9	J-7	245.04	8.18	52.6781	0.17
P-243	J-16	J-18	408.03	6.08	34.1420	0.17
P-25	J-10	J-11	270.51	6.08	34.1420	0.00
P-255	J-51	J-70	16.36	10.16	34.1420	0.00
P-264	J-34	J-35	559.29	12.14	36.7906	1.62
P-265	J-44	J-49	287.63	6.08	34.1420	0.17
P-266	J-26	J-19	95.17	10.16	34.1420	0.00
P-268-CV	PR-1	J-3	17.14	12.34	93.5192	0.00
P-269	J-51	J-3	30.19	10.16	34.1420	7.09
P-27	J-12	J-10	61.27	6.08	34.1420	0.17
P-271	J-52	J-53	156.58	12.14	36.7906	0.00
P-272	J-66	J-4	8.87	6.08	34.1420	0.17
P-275	J-1	J-4	9.76	12.14	36.7906	0.00
P-285	J-53	J-34	2026.54	12.14	36.7906	0.34
P-286	J-46	J-21	116.24	12.34	78.7632	0.87
P-29	J-13	J-14	2021.68	6.08	34.1420	2.52
P-3	J-4	J-70	436.95	12.14	36.7906	0.70
P-31	J-15	J-10	1335.13	6.08	34.1420	1.14
P-32	J-15	J-7	455.35	8.18	52.6781	1.84
P-34	J-16	J-15	416.64	6.08	34.1420	0.17
P-35	J-16	J-17	1343.13	6.08	34.1420	1.14
P-38	J-18	J-19	1348.06	6.08	34.1420	1.84
P-4	J-50	J-31	303.86	8.18	52.6781	0.52
P-41	J-20	J-21	168.80	6.08	34.1420	0.34
P-44	J-22	J-20	381.01	6.08	34.1420	0.17
P-46	J-23	J-22	387.52	6.08	34.1420	0.00
P-48	J-18	J-23	325.49	6.08	34.1420	0.57
P-49	J-23	J-76	391.70	6.08	34.1420	1.27
P-5	J-69	J-50	401.89	8.18	52.6781	0.40
P-51	J-25	J-71	454.23	6.08	34.1420	1.27
P-55	J-17	J-12	318.63	10.16	34.1420	0.00

P-56	J-26	J-17	306.82	10.16	34.1420	0.00
P-57	J-24	J-19	373.15	10.16	34.1420	0.00
P-58	J-27	J-24	43.67	10.16	34.1420	0.00
P-6	J-71	J-72	388.95	6.08	34.1420	0.40
P-60	J-25	J-27	300.24	10.16	34.1420	0.17
P-61	J-28	J-25	187.57	10.16	34.1420	0.00
P-63	J-29	J-20	1346.63	8.18	52.6781	1.14
P-67	J-30	J-69	223.04	8.18	52.6781	0.57
P-69	J-31	J-32	521.13	12.14	36.7906	0.00
P-7	J-72	J-22	509.45	6.08	34.1420	0.87
P-71	J-33	J-32	543.94	12.14	36.7906	0.00
P-8	J-73	J-74	479.27	8.18	52.6781	0.40
P-81	J-29	J-28	196.49	10.16	34.1420	0.17
P-82	J-30	J-29	151.25	10.16	34.1420	0.00
P-83	J-36	J-30	129.33	10.16	34.1420	0.00
P-84	J-32	J-28	1184.63	6.08	34.1420	1.14
P-87	J-5	J-37	2251.87	6.08	34.1420	2.51
P-9	J-74	J-8	1448.13	8.18	52.6781	2.94
P-92	J-38	J-39	1173.25	10.16	34.1420	0.87
P-97	J-40	J-41	2063.01	6.08	34.1420	2.34

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		5.19	646.90	
J-10		6.40	665.57	
J-11		0.52	666.78	
J-12		1.04	666.41	
J-13		8.47	650.77	
J-14		16.42	663.73	
J-15		9.85	660.87	
J-16		11.24	659.23	
J-17		7.78	663.22	
J-18		9.85	662.56	
J-19		5.88	668.34	
J-2		1.25	648.06	
J-20		5.53	657.89	
J-21		3.98	657.51	
J-22		5.88	658.30	
J-23		5.70	662.32	
J-24		2.07	664.89	
J-25		1.56	665.93	
J-26		5.70	666.12	
J-27		4.84	665.03	
J-28		3.98	665.85	
J-29		2.94	664.95	
J-3		0.00	648.42	
J-30		0.86	665.84	
J-31		0.69	642.05	
J-32		3.46	651.80	
J-33		4.32	649.84	
J-34		0.00	645.38	
J-35		1.10	640.76	
J-36		5.44	665.80	

J-37		12.68	650.49	
J-38		10.27	648.18	
J-39		0.00	655.00	
J-4		0.00	646.84	
J-40		14.35	641.08	
J-41		14.57	650.63	
J-42		0.52	642.94	
J-43		14.26	648.38	
J-44		11.58	640.70	
J-45		0.17	655.58	
J-46	EC-SOCWA	5.88	658.00	
J-47	EC-Ferndale	0.00	641.36	
J-48		0.00	642.16	
J-49		11.06	643.24	
J-5		11.76	642.66	
J-50	1F	2.59	661.00	
J-51		7.95	648.00	
J-52		8.99	654.88	
J-53		0.00	655.33	
J-54		0.00	653.00	
J-55		0.00	650.63	
J-56		11.39	646.80	
J-59		0.99	649.53	
J-6		0.00	643.53	
J-60		0.00	648.00	
J-61		8.99	649.02	
J-62	EC-Ferndale	0.35	643.00	
J-63	EC-Ferndale	0.00	648.19	
J-64		12.90	647.71	
J-65		11.83	642.19	
J-66		0.00	646.83	
J-68		0.00	648.00	
J-69	1R	2.77	663.00	
J-7		4.15	658.64	
J-70		0.00	648.00	
J-71	2F	2.42	665.00	
J-72	2R	3.11	662.00	
J-73	3F	3.98	657.00	
J-74	3R	11.41	654.00	
J-75	4F	3.28	663.00	
J-76	4R	3.11	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	4.15	641.00	
J-8		9.16	654.08	
J-80	6F	10.89	648.00	
J-81	7R	4.67	641.00	
J-82	7F	12.62	640.00	
J-83	8F	6.05	642.00	
J-84	8R	15.04	644.00	
J-9		1.38	659.92	
PR-1	PR-1	----	648.00	802.77
PR-2	PR-2	----	658.00	802.72

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT

MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) = 100
NUMBER OF END NODES .....(J) = 81
NUMBER OF PRIMARY LOOPS .....(L) = 18
NUMBER OF SUPPLY NODES .....(F) = 2
NUMBER OF SUPPLY ZONES .....(Z) = 1

==========

Case: 0

RESULTS OBTAINED AFTER 10 TRIALS: ACCURACY = 0.35743E-03

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

Revised Interim Improvements System with Second
SOCWA Supply; Existing Maximum Day Demand

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	1.25	0.00	0.00	0.00	0.00	0.00
P-10	J-75	J-24	-6.83	0.04	0.00	0.08	0.08	0.08
P-103	J-38	J-82	10.17	0.23	0.00	0.11	0.17	0.17
P-107	J-43	J-44	8.44	0.25	0.00	0.09	0.12	0.12
P-11	J-76	J-75	-3.54	0.01	0.00	0.04	0.02	0.02
P-12	J-77	J-38	20.43	0.00	0.00	0.08	0.05	0.05
P-120	J-31	J-36	-72.69	0.04	0.00	0.19	0.05	0.04
P-125	J-8	J-21	-44.46	0.01	0.00	0.12	0.02	0.02
P-126	J-45	J-8	-0.17	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	-14.19	0.12	0.00	0.16	0.31	0.31
P-130	J-36	J-46	-128.18	0.16	0.00	0.34	0.13	0.12
P-14	J-78	J-61	-63.81	0.11	0.00	0.25	0.42	0.42
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	22.94	0.12	0.00	0.14	0.08	0.08
P-15	J-79	J-80	-4.49	0.02	0.00	0.05	0.04	0.04
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	-12.55	0.09	0.00	0.14	0.25	0.25
P-155	J-40	J-5	-13.23	0.11	0.00	0.15	0.28	0.27
P-156	J-6	J-34	-23.66	0.22	0.00	0.26	0.81	0.81
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-61	-15.39	0.46	0.00	0.17	0.36	0.36
P-17	J-81	J-42	-7.12	0.01	0.00	0.08	0.09	0.09
P-170	J-33	J-55	97.08	0.07	0.00	0.27	0.33	0.33
P-171	J-41	J-55	-97.08	0.04	0.00	0.27	0.33	0.33
P-172	J-37	J-41	-68.84	0.06	0.00	0.19	0.17	0.17
P-174	J-52	J-84	11.63	0.30	0.00	0.13	0.22	0.22
P-175	J-37	J-52	45.37	0.03	0.00	0.13	0.08	0.08

P-178	J-44	J-42	-4.91	0.01	0.00	0.05	0.04	0.04
P-179	J-56	J-49	9.29	0.31	0.00	0.10	0.14	0.14
P-18	J-82	J-81	-2.45	0.01	0.00	0.03	0.01	0.01
P-188	J-26	J-1	-30.20	0.23	0.00	0.18	0.13	0.13
P-189	J-43	J-77	20.43	0.01	0.00	0.08	0.05	0.05
P-19	J-83	J-6	-9.46	0.01	0.00	0.10	0.15	0.15
P-191	J-14	J-51	-37.24	0.28	0.00	0.15	0.15	0.15
P-192	J-59	J-60	-120.24	0.23	0.00	0.48	1.35	1.34
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-63.81	0.02	0.00	0.25	0.42	0.42
P-197	J-56	J-43	43.13	0.06	0.00	0.17	0.20	0.20
P-2	J-70	J-60	120.24	0.03	0.00	0.48	1.34	1.34
P-20	J-7	J-73	-19.74	0.01	0.00	0.12	0.06	0.06
P-201	J-62	J-79	-0.35	0.00	0.00	0.00	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	-3.41	0.02	0.00	0.04	0.02	0.02
P-210	J-59	J-13	6.34	0.00	0.00	0.03	0.01	0.01
P-217	J-64	J-59	-112.91	0.28	0.00	0.45	1.20	1.19
P-219	J-64	J-65	11.83	0.39	0.00	0.13	0.22	0.22
P-22-CV	PR-2	J-46	211.11	0.11	0.01	0.57	0.34	0.31
P-221	J-61	J-64	-88.18	0.22	0.00	0.35	0.76	0.76
P-239	J-12	J-14	-18.69	0.01	0.00	0.07	0.04	0.04
P-24	J-9	J-7	-1.38	0.00	0.00	0.01	0.00	0.00
P-243	J-16	J-18	1.30	0.00	0.00	0.01	0.00	0.00
P-25	J-10	J-11	0.52	0.00	0.00	0.01	0.00	0.00
P-255	J-51	J-70	156.88	0.04	0.00	0.62	2.20	2.20
P-264	J-34	J-35	1.10	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	1.77	0.00	0.00	0.02	0.01	0.01
P-266	J-26	J-19	19.27	0.00	0.00	0.08	0.05	0.05
P-268-CV	PR-1	J-3	202.07	0.00	0.00	0.54	0.21	0.21
P-269	J-51	J-3	-202.07	0.11	0.07	0.80	5.84	3.51
P-27	J-12	J-10	9.83	0.01	0.00	0.11	0.16	0.16
P-271	J-52	J-53	24.76	0.00	0.00	0.07	0.03	0.03
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-36.64	0.00	0.00	0.10	0.05	0.05
P-285	J-53	J-34	24.76	0.05	0.00	0.07	0.03	0.03
P-286	J-46	J-21	77.06	0.01	0.00	0.21	0.05	0.05
P-29	J-13	J-14	-2.13	0.02	0.00	0.02	0.01	0.01
P-3	J-4	J-70	-36.64	0.02	0.00	0.10	0.05	0.05
P-31	J-15	J-10	-2.92	0.02	0.00	0.03	0.02	0.02
P-32	J-15	J-7	-14.20	0.02	0.00	0.09	0.03	0.03
P-34	J-16	J-15	-7.27	0.04	0.00	0.08	0.09	0.09
P-35	J-16	J-17	-5.27	0.07	0.00	0.06	0.05	0.05
P-38	J-18	J-19	-5.19	0.07	0.00	0.06	0.05	0.05
P-4	J-50	J-31	4.91	0.00	0.00	0.03	0.00	0.00
P-41	J-20	J-21	-28.63	0.19	0.00	0.32	1.15	1.15
P-44	J-22	J-20	-14.35	0.12	0.00	0.16	0.32	0.32
P-46	J-23	J-22	-8.64	0.05	0.00	0.10	0.12	0.12
P-48	J-18	J-23	-3.37	0.01	0.00	0.04	0.02	0.02
P-49	J-23	J-76	-0.43	0.00	0.00	0.00	0.00	0.00
P-5	J-69	J-50	7.50	0.00	0.00	0.05	0.01	0.01
P-51	J-25	J-71	5.71	0.03	0.00	0.06	0.06	0.06
P-55	J-17	J-12	-7.82	0.00	0.00	0.03	0.01	0.01
P-56	J-26	J-17	5.22	0.00	0.00	0.02	0.00	0.00
P-57	J-24	J-19	-8.21	0.00	0.00	0.03	0.01	0.01
P-58	J-27	J-24	0.69	0.00	0.00	0.00	0.00	0.00
P-6	J-71	J-72	3.29	0.01	0.00	0.04	0.02	0.02

P-60	J-25	J-27	28.47	0.03	0.00	0.11	0.09	0.09
P-61	J-28	J-25	35.73	0.03	0.00	0.14	0.14	0.14
P-63	J-29	J-20	-8.75	0.02	0.00	0.05	0.01	0.01
P-67	J-30	J-69	10.27	0.00	0.00	0.06	0.02	0.02
P-69	J-31	J-32	76.91	0.11	0.00	0.21	0.21	0.21
P-7	J-72	J-22	0.17	0.00	0.00	0.00	0.00	0.00
P-71	J-33	J-32	-78.46	0.12	0.00	0.22	0.22	0.22
P-8	J-73	J-74	-23.71	0.04	0.00	0.14	0.09	0.09
P-81	J-29	J-28	44.72	0.04	0.00	0.18	0.22	0.21
P-82	J-30	J-29	38.92	0.03	0.00	0.15	0.17	0.17
P-83	J-36	J-30	50.05	0.03	0.00	0.20	0.26	0.26
P-84	J-32	J-28	-5.02	0.05	0.00	0.06	0.05	0.05
P-87	J-5	J-37	-10.79	0.42	0.00	0.12	0.19	0.19
P-9	J-74	J-8	-35.12	0.26	0.00	0.21	0.18	0.18
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-41	-13.67	0.60	0.00	0.15	0.29	0.29

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		5.19	802.53	646.90	155.63	67.44
J-10		6.40	802.29	665.57	136.71	59.24
J-11		0.52	802.29	666.78	135.51	58.72
J-12		1.04	802.30	666.41	135.89	58.89
J-13		8.47	802.29	650.77	151.53	65.66
J-14		16.42	802.31	663.73	138.58	60.05
J-15		9.85	802.27	660.87	141.40	61.27
J-16		11.24	802.23	659.23	143.00	61.97
J-17		7.78	802.30	663.22	139.08	60.27
J-18		9.85	802.23	662.56	139.66	60.52
J-19		5.88	802.29	668.34	133.95	58.05
J-2		1.25	802.53	648.06	154.47	66.94
J-20		5.53	802.40	657.89	144.51	62.62
J-21		3.98	802.60	657.51	145.09	62.87
J-22		5.88	802.28	658.30	143.98	62.39
J-23		5.70	802.23	662.32	139.91	60.63
J-24		2.07	802.29	664.89	137.40	59.54
J-25		1.56	802.32	665.93	136.38	59.10
J-26		5.70	802.30	666.12	136.18	59.01
J-27		4.84	802.29	665.03	137.26	59.48
J-28		3.98	802.34	665.85	136.49	59.15
J-29		2.94	802.39	664.95	137.44	59.56
J-3		0.00	802.77	648.42	154.34	66.88
J-30		0.86	802.41	665.84	136.57	59.18
J-31		0.69	802.40	642.05	160.35	69.49
J-32		3.46	802.29	651.80	150.49	65.21
J-33		4.32	802.17	649.84	152.33	66.01
J-34		0.00	801.91	645.38	156.53	67.83
J-35		1.10	801.91	640.76	161.14	69.83
J-36		5.44	802.45	665.80	136.65	59.21
J-37		12.68	801.99	650.49	151.50	65.65
J-38		10.27	801.58	648.18	153.40	66.48
J-39		0.00	801.58	655.00	146.58	63.52
J-4		0.00	802.53	646.84	155.69	67.46

J-40		14.35	801.45	641.08	160.38	69.50
J-41		14.57	802.05	650.63	151.43	65.62
J-42		0.52	801.36	642.94	158.42	68.65
J-43		14.26	801.59	648.38	153.22	66.39
J-44		11.58	801.35	640.70	160.65	69.62
J-45		0.17	802.59	655.58	147.01	63.71
J-46	EC-SOCWA	5.88	802.60	658.00	144.60	62.66
J-47	EC-Ferndale	0.00	801.91	641.36	160.54	69.57
J-48		0.00	801.91	642.16	159.74	69.22
J-49		11.06	801.35	643.24	158.10	68.51
J-5		11.76	801.57	642.66	158.90	68.86
J-50	1F	2.59	802.40	661.00	141.40	61.27
J-51		7.95	802.59	648.00	154.59	66.99
J-52		8.99	801.96	654.88	147.08	63.73
J-53		0.00	801.96	655.33	146.63	63.54
J-54		0.00	801.96	653.00	148.96	64.55
J-55		0.00	802.10	650.63	151.47	65.64
J-56		11.39	801.66	646.80	154.86	67.11
J-59		0.99	802.29	649.53	152.76	66.20
J-6		0.00	801.68	643.53	158.15	68.53
J-60		0.00	802.52	648.00	154.52	66.96
J-61		8.99	801.79	649.02	152.76	66.20
J-62	EC-Ferndale	0.35	801.30	643.00	158.30	68.60
J-63	EC-Ferndale	0.00	802.29	648.19	154.10	66.78
J-64		12.90	802.01	647.71	154.30	66.86
J-65		11.83	801.62	642.19	159.42	69.08
J-66		0.00	802.53	646.83	155.70	67.47
J-68		0.00	802.52	648.00	154.52	66.96
J-69	1R	2.77	802.41	663.00	139.41	60.41
J-7		4.15	802.28	658.64	143.64	62.24
J-70		0.00	802.55	648.00	154.55	66.97
J-71	2F	2.42	802.29	665.00	137.29	59.49
J-72	2R	3.11	802.28	662.00	140.28	60.79
J-73	3F	3.98	802.29	657.00	145.29	62.96
J-74	3R	11.41	802.33	654.00	148.33	64.28
J-75	4F	3.28	802.24	663.00	139.24	60.34
J-76	4R	3.11	802.23	661.00	141.23	61.20
J-77	5F	0.00	801.58	648.00	153.58	66.55
J-78	5R	0.00	801.68	647.00	154.68	67.03
J-79	6R	4.15	801.30	641.00	160.30	69.46
J-8		9.16	802.59	654.08	148.51	64.36
J-80	6F	10.89	801.32	648.00	153.32	66.44
J-81	7R	4.67	801.36	641.00	160.36	69.49
J-82	7F	12.62	801.35	640.00	161.35	69.92
J-83	8F	6.05	801.68	642.00	159.68	69.19
J-84	8R	15.04	801.66	644.00	157.66	68.32
J-9		1.38	802.28	659.92	142.36	61.69
PR-1	PR-1	----	802.77	648.00	154.77	67.07
PR-2	PR-2	----	802.72	658.00	144.72	62.71

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi

J-82	69.92	J-19	58.05
J-35	69.83	J-11	58.72
J-44	69.62	J-12	58.89
J-47	69.57	J-26	59.01
J-40	69.50	J-25	59.10

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	0.80	P-126	0.00
P-255	0.62	P-7	0.00
P-22	0.57	P-58	0.00
P-268	0.54	P-264	0.00
P-192	0.48	P-1	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	5.84	P-126	0.00
P-255	2.20	P-264	0.00
P-192	1.35	P-7	0.00
P-2	1.34	P-58	0.00
P-217	1.20	P-1	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	3.51	P-126	0.00
P-255	2.20	P-264	0.00
P-192	1.34	P-7	0.00
P-2	1.34	P-58	0.00
P-217	1.19	P-1	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
PR-1	202.07	PR-1
PR-2	211.11	PR-2

NET SYSTEM INFLOW = 413.19
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 413.19

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FireFlow/Hydrant Report
Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

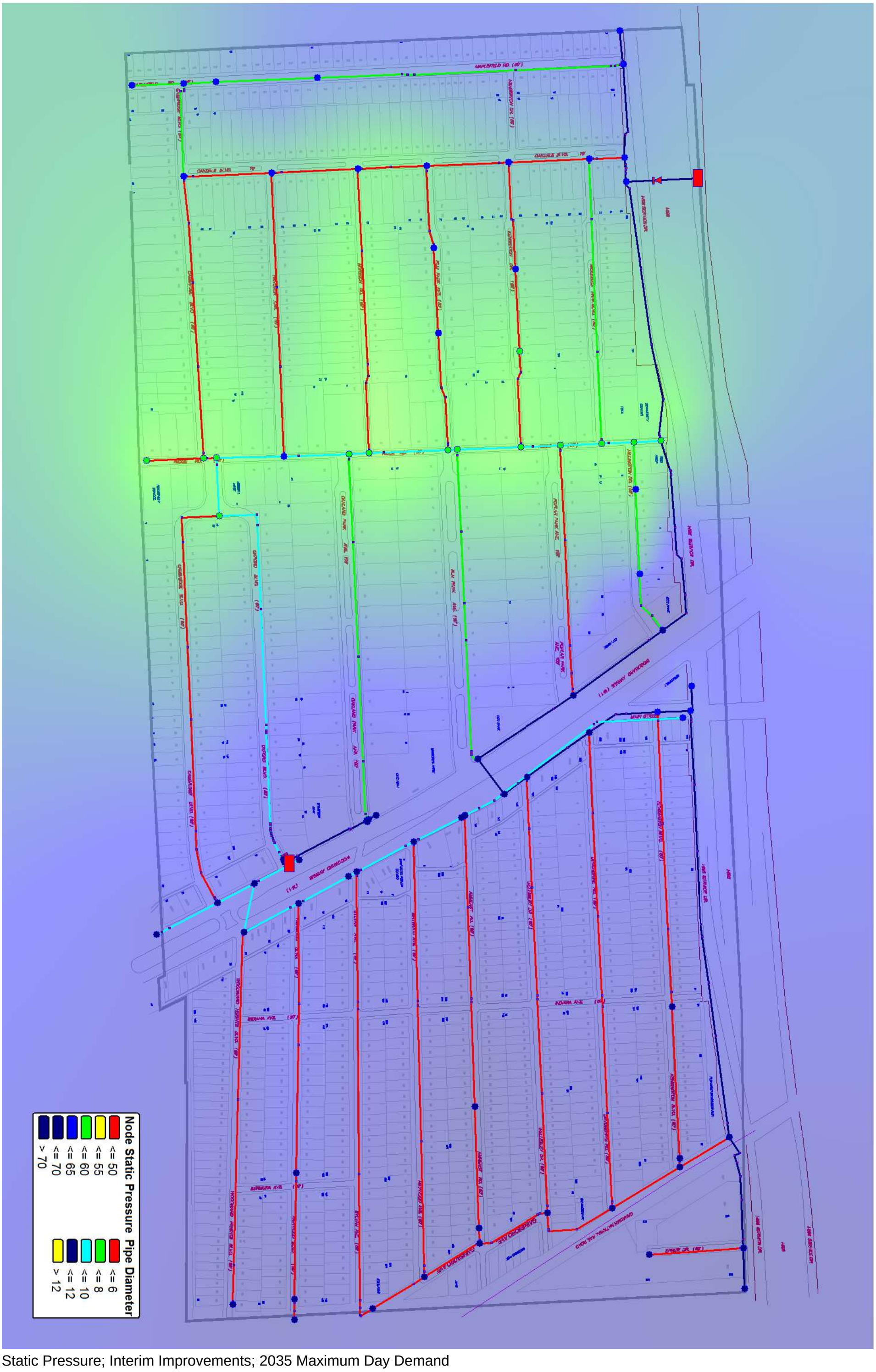
Hydrant Node	Hydrant Constant	Elevation	Demand gpm	Static Pressure	Flow-1 gpm	Flow-2 gpm	Node-2
J-1	0.0	646.9	5.2	67.4	3506.6	3486.3	J-2
J-10	0.0	665.6	6.4	59.2	1329.1	1319.4	J-11
J-11	0.0	666.8	0.5	58.7	539.3		
J-12	0.0	666.4	1.0	58.9	2276.1		
J-13	0.0	650.8	8.5	65.7	2190.3		
J-14	0.0	663.7	16.4	60.1	2188.6		
J-15	0.0	660.9	9.9	61.3	1220.2		
J-16	0.0	659.2	11.2	62.0	1052.8		
J-17	0.0	663.2	7.8	60.3	2522.8		
J-18	0.0	662.6	9.9	60.5	1028.3		
J-19	0.0	668.3	5.9	58.0	2793.0		
J-2	0.0	648.1	1.2	66.9	3320.2		
J-20	0.0	657.9	5.5	62.6	1985.4		
J-21	0.0	657.5	4.0	62.9	7562.9		
J-22	0.0	658.3	5.9	62.4	1129.2		
J-23	0.0	662.3	5.7	60.6	1041.2		
J-24	0.0	664.9	2.1	59.5	2988.7		
J-25	0.0	665.9	1.6	59.1	2901.1		
J-26	0.0	666.1	5.7	59.0	2866.3		
J-27	0.0	665.0	4.8	59.5	3040.3		
J-28	0.0	665.9	4.0	59.1	3044.9		
J-29	0.0	664.9	2.9	59.6	3466.2		
J-3	0.0	648.4	0.0	66.9	54007.3		
J-30	0.0	665.8	0.9	59.2	3870.7		
J-31	0.0	642.1	0.7	69.5	4386.5	4243.7	J-50
J-32	0.0	651.8	3.5	65.2	3155.4		
J-33	0.0	649.8	4.3	66.0	2716.7	2646.8	J-53
J-34	0.0	645.4	0.0	67.8	1287.8		
J-35	0.0	640.8	1.1	69.8	1188.9	1180.8	J-48
J-36	0.0	665.8	5.4	59.2	4719.3		
J-37	0.0	650.5	12.7	65.6	1951.7	1902.6	J-53
J-38	0.0	648.2	10.3	66.5	1161.3	1118.6	J-39
J-39	0.0	655.0	0.0	63.5	759.5		
J-4	0.0	646.8	0.0	67.5	3524.9	3505.7	J-2
J-40	0.0	641.1	14.3	69.5	951.7		
J-41	0.0	650.6	14.6	65.6	2264.9	2210.8	J-53

J-42	0.0	642.9	0.5	68.7	867.9		
J-43	0.0	648.4	14.3	66.4	1289.1	1245.1	J-39
J-44	0.0	640.7	11.6	69.6	781.4		
J-45	0.0	655.6	0.2	63.7	4808.4		
J-46	0.0	658.0	5.9	62.7	8996.9	8805.1	J-36
J-47	0.0	641.4	0.0	69.6	1148.3		
J-48	0.0	642.2	0.0	69.2	469.3		
J-49	0.0	643.2	11.1	68.5	620.0		
J-5	0.0	642.7	11.8	68.9	961.4		
J-50	0.0	661.0	2.6	61.3	2592.6		
J-51	0.0	648.0	8.0	67.0	6949.0	6866.2	J-39
J-52	0.0	654.9	9.0	63.7	1698.6	1695.2	J-53
J-53	0.0	655.3	0.0	63.5	1615.2		
J-54	0.0	653.0	0.0	64.5	1568.8		
J-55	0.0	650.6	0.0	65.6	2396.0	2340.7	J-53
J-56	0.0	646.8	11.4	67.1	1465.8	1409.1	J-39
J-59	0.0	649.5	1.0	66.2	3016.3	2988.9	J-39
J-6	0.0	643.5	0.0	68.5	1022.3		
J-60	0.0	648.0	0.0	67.0	5240.0	5174.2	J-39
J-61	0.0	649.0	9.0	66.2	1684.0	1650.9	J-39
J-62	0.0	643.0	0.3	68.6	220.2		
J-63	0.0	648.2	0.0	66.8	1557.0		
J-64	0.0	647.7	12.9	66.9	2140.0	2095.1	J-39
J-65	0.0	642.2	11.8	69.1	248.0		
J-66	0.0	646.8	0.0	67.5	2618.3		
J-68	0.0	648.0	0.0	67.0	3676.3		
J-69	0.0	663.0	2.8	60.4	2680.8		
J-7	0.0	658.6	4.1	62.2	1244.2	1235.1	J-9
J-70	0.0	648.0	0.0	67.0	6162.8	6076.3	J-39
J-71	0.0	665.0	2.4	59.5	735.1		
J-72	0.0	662.0	3.1	60.8	708.0		
J-73	0.0	657.0	4.0	63.0	1268.7		
J-74	0.0	654.0	11.4	64.3	1372.6		
J-75	0.0	663.0	3.3	60.3	710.7		
J-76	0.0	661.0	3.1	61.2	721.5		
J-77	0.0	648.0	0.0	66.6	1159.7	1115.8	J-39
J-78	0.0	647.0	0.0	67.0	1481.6	1427.2	J-39
J-79	0.0	641.0	4.1	69.5	231.9	229.7	J-62
J-8	0.0	654.1	9.2	64.4	5355.6	5312.5	J-45
J-80	0.0	648.0	10.9	66.4	278.6		
J-81	0.0	641.0	4.7	69.5	798.1		
J-82	0.0	640.0	12.6	69.9	603.4		
J-83	0.0	642.0	6.1	69.2	942.2		
J-84	0.0	644.0	15.0	68.3	597.9		
J-9	0.0	659.9	1.4	61.7	1053.3		

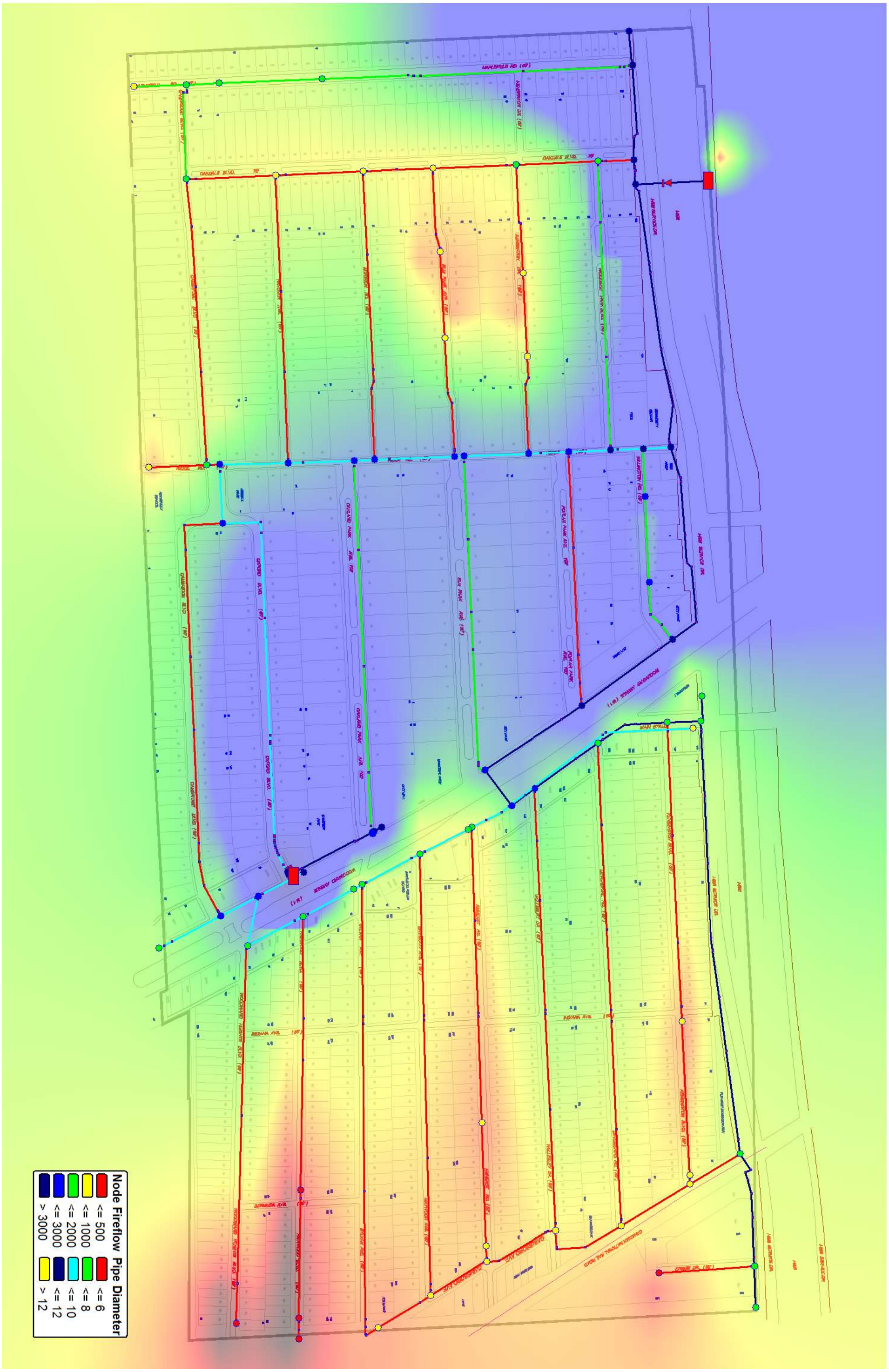
APPENDIX G

Interim Improvements Water Distribution System; 2035 Maximum Day Demand Results

Includes:
Static Pressures Gradient Map; Interim Improvements, 2035 Maximum Day Demand
Available Fire Flow Gradient Map; Interim Improvements, 2035 Max. Day Demand
Computer Model Simulation; Interim Improvements, 2035 Maximum Day Demand



Static Pressure; Interim Improvements; 2035 Maximum Day Demand



Available Fire Flow; Interim Improvements; 2035 Maximum Day Demand

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* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 Date & Time:  Wed Jan 13 11:53:43 2016

 Master File : m:\0175\0175-0095\gen\reports\kypipe\import\socwa
revision\watermodelinterim2035.KYP\watermodelinterim2035.P2K
```

SUMMARY OF ORIGINAL DATA

UNITS SPECIFIED

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

PIPELINE DATA

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.14	34.9545	0.00
P-10	J-75	J-24	557.86	6.08	32.4385	1.27
P-103	J-38	J-82	1375.77	6.08	32.4385	1.54
P-107	J-43	J-44	2058.36	6.08	32.4385	1.37
P-11	J-76	J-75	402.54	6.08	32.4385	0.40
P-12	J-77	J-38	19.18	10.16	32.4385	0.17
P-120	J-31	J-36	972.64	12.34	76.3750	2.37
P-125	J-8	J-21	445.59	12.34	76.3750	0.70
P-126	J-45	J-8	160.81	12.34	76.3750	0.00
P-13	J-5	J-6	373.36	6.08	32.4385	0.00
P-130	J-36	J-46	1250.08	12.34	76.3750	1.79
P-14	J-78	J-61	266.57	10.16	32.4385	0.17
P-148	J-47	J-35	190.47	12.14	34.9545	0.17
P-149	J-27	J-33	1489.24	8.18	50.0471	2.98
P-15	J-79	J-80	597.22	6.08	32.4385	0.57
P-152	J-48	J-35	445.75	6.08	32.4385	0.57
P-154	J-42	J-40	362.71	6.08	32.4385	0.70
P-155	J-40	J-5	415.41	6.08	32.4385	1.27
P-156	J-6	J-34	275.42	6.08	32.4385	0.17
P-157	J-53	J-54	124.93	12.14	34.9545	0.75
P-16	J-80	J-61	1275.42	6.08	32.4385	0.57
P-17	J-81	J-42	72.50	6.08	32.4385	0.17
P-170	J-33	J-55	209.02	12.14	34.9545	0.34

P-171	J-41	J-55	134.03	12.14	34.9545	0.00
P-172	J-37	J-41	362.21	12.14	34.9545	0.00
P-174	J-52	J-84	1394.38	6.08	32.4385	1.54
P-175	J-37	J-52	349.33	12.14	34.9545	0.69
P-178	J-44	J-42	304.86	6.08	32.4385	0.35
P-179	J-56	J-49	2164.85	6.08	32.4385	2.06
P-18	J-82	J-81	575.79	6.08	32.4385	0.57
P-188	J-26	J-1	1732.31	8.18	50.0471	1.89
P-189	J-43	J-77	250.49	10.16	32.4385	0.57
P-19	J-83	J-6	42.96	6.08	32.4385	0.17
P-191	J-14	J-51	1820.36	10.16	32.4385	2.81
P-192	J-59	J-60	171.60	10.16	32.4385	0.17
P-192a	J-60	J-68	67.12	10.16	32.4385	0.17
P-195	J-56	J-78	45.89	10.16	32.4385	0.40
P-197	J-56	J-43	304.88	10.16	32.4385	0.57
P-2	J-70	J-60	22.81	10.16	32.4385	0.00
P-20	J-7	J-73	152.54	8.18	50.0471	0.57
P-201	J-62	J-79	95.36	6.08	32.4385	0.57
P-209	J-13	J-63	324.39	10.16	32.4385	0.34
P-21	J-84	J-83	716.44	6.08	32.4385	0.40
P-210	J-59	J-13	198.02	10.16	32.4385	0.17
P-217	J-64	J-59	236.90	10.16	32.4385	0.17
P-219	J-64	J-65	1762.12	6.08	32.4385	1.49
P-22-CV	PR-2	J-46	339.46	12.34	76.3750	1.74
P-221	J-61	J-64	294.29	10.16	32.4385	0.17
P-239	J-12	J-14	275.83	10.16	32.4385	0.17
P-24	J-9	J-7	245.04	8.18	50.0471	0.17
P-243	J-16	J-18	408.03	6.08	32.4385	0.17
P-25	J-10	J-11	270.51	6.08	32.4385	0.00
P-255	J-51	J-70	16.36	10.16	32.4385	0.00
P-264	J-34	J-35	559.29	12.14	34.9545	1.62
P-265	J-44	J-49	287.63	6.08	32.4385	0.17
P-266	J-26	J-19	95.17	10.16	32.4385	0.00
P-268-CV	PR-1	J-3	17.14	12.34	91.1586	0.00
P-269	J-51	J-3	30.19	10.16	32.4385	7.09
P-27	J-12	J-10	61.27	6.08	32.4385	0.17
P-271	J-52	J-53	156.58	12.14	34.9545	0.00
P-272	J-66	J-4	8.87	6.08	32.4385	0.17
P-275	J-1	J-4	9.76	12.14	34.9545	0.00
P-285	J-53	J-34	2026.54	12.14	34.9545	0.34
P-286	J-46	J-21	116.24	12.34	76.3750	0.87
P-29	J-13	J-14	2021.68	6.08	32.4385	2.52
P-3	J-4	J-70	436.95	12.14	34.9545	0.70
P-31	J-15	J-10	1335.13	6.08	32.4385	1.14
P-32	J-15	J-7	455.35	8.18	50.0471	1.84
P-34	J-16	J-15	416.64	6.08	32.4385	0.17
P-35	J-16	J-17	1343.13	6.08	32.4385	1.14
P-38	J-18	J-19	1348.06	6.08	32.4385	1.84
P-4	J-50	J-31	303.86	8.18	50.0471	0.52
P-41	J-20	J-21	168.80	6.08	32.4385	0.34
P-44	J-22	J-20	381.01	6.08	32.4385	0.17
P-46	J-23	J-22	387.52	6.08	32.4385	0.00
P-48	J-18	J-23	325.49	6.08	32.4385	0.57
P-49	J-23	J-76	391.70	6.08	32.4385	1.27
P-5	J-69	J-50	401.89	8.18	50.0471	0.40
P-51	J-25	J-71	454.23	6.08	32.4385	1.27
P-55	J-17	J-12	318.63	10.16	32.4385	0.00

P-56	J-26	J-17	306.82	10.16	32.4385	0.00
P-57	J-24	J-19	373.15	10.16	32.4385	0.00
P-58	J-27	J-24	43.67	10.16	32.4385	0.00
P-6	J-71	J-72	388.95	6.08	32.4385	0.40
P-60	J-25	J-27	300.24	10.16	32.4385	0.17
P-61	J-28	J-25	187.57	10.16	32.4385	0.00
P-63	J-29	J-20	1346.63	8.18	50.0471	1.14
P-67	J-30	J-69	223.04	8.18	50.0471	0.57
P-69	J-31	J-32	521.13	12.14	34.9545	0.00
P-7	J-72	J-22	509.45	6.08	32.4385	0.87
P-71	J-33	J-32	543.94	12.14	34.9545	0.00
P-8	J-73	J-74	479.27	8.18	50.0471	0.40
P-81	J-29	J-28	196.49	10.16	32.4385	0.17
P-82	J-30	J-29	151.25	10.16	32.4385	0.00
P-83	J-36	J-30	129.33	10.16	32.4385	0.00
P-84	J-32	J-28	1184.63	6.08	32.4385	1.14
P-87	J-5	J-37	2251.87	6.08	32.4385	2.51
P-9	J-74	J-8	1448.13	8.18	50.0471	2.94
P-92	J-38	J-39	1173.25	10.16	32.4385	0.87
P-97	J-40	J-41	2063.01	6.08	32.4385	2.34

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		5.26	646.90	
J-10		6.49	665.57	
J-11		0.53	666.78	
J-12		1.05	666.41	
J-13		8.60	650.77	
J-14		16.67	663.73	
J-15		10.00	660.87	
J-16		11.41	659.23	
J-17		7.90	663.22	
J-18		10.00	662.56	
J-19		5.97	668.34	
J-2		1.25	648.06	
J-20		5.62	657.89	
J-21		4.04	657.51	
J-22		5.97	658.30	
J-23		5.79	662.32	
J-24		2.11	664.89	
J-25		1.58	665.93	
J-26		5.79	666.12	
J-27		4.91	665.03	
J-28		4.04	665.85	
J-29		2.98	664.95	
J-3		0.00	648.42	
J-30		0.88	665.84	
J-31		0.70	642.05	
J-32		3.51	651.80	
J-33		4.39	649.84	
J-34		0.00	645.38	
J-35		1.10	640.76	
J-36		5.48	665.80	

J-37		12.85	650.49	
J-38		10.39	648.18	
J-39		0.00	655.00	
J-4		0.00	646.84	
J-40		14.57	641.08	
J-41		14.78	650.63	
J-42		0.53	642.94	
J-43		14.43	648.38	
J-44		11.76	640.70	
J-45		0.18	655.58	
J-46	EC-SOCWA	5.97	658.00	
J-47	EC-Ferndale	0.00	641.36	
J-48		0.00	642.16	
J-49		11.23	643.24	
J-5		11.93	642.66	
J-50	1F	2.63	661.00	
J-51		8.07	648.00	
J-52		9.13	654.88	
J-53		0.00	655.33	
J-54		0.00	653.00	
J-55		0.00	650.63	
J-56		11.55	646.80	
J-59		0.99	649.53	
J-6		0.00	643.53	
J-60		0.00	648.00	
J-61		9.09	649.02	
J-62	EC-Ferndale	0.35	643.00	
J-63	EC-Ferndale	0.00	648.19	
J-64		13.07	647.71	
J-65		12.01	642.19	
J-66		0.00	646.83	
J-68		0.00	648.00	
J-69	1R	2.81	663.00	
J-7		4.21	658.64	
J-70		0.00	648.00	
J-71	2F	2.46	665.00	
J-72	2R	3.16	662.00	
J-73	3F	4.04	657.00	
J-74	3R	11.58	654.00	
J-75	4F	3.33	663.00	
J-76	4R	3.16	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	4.21	641.00	
J-8		9.30	654.08	
J-80	6F	11.06	648.00	
J-81	7R	4.74	641.00	
J-82	7F	12.81	640.00	
J-83	8F	6.14	642.00	
J-84	8R	15.27	644.00	
J-9		1.40	659.92	
PR-1	PR-1	----	648.00	802.77
PR-2	PR-2	----	658.00	802.72

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT

MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) = 100
NUMBER OF END NODES .....(J) = 81
NUMBER OF PRIMARY LOOPS .....(L) = 18
NUMBER OF SUPPLY NODES .....(F) = 2
NUMBER OF SUPPLY ZONES .....(Z) = 1

==========

Case: 0

RESULTS OBTAINED AFTER 10 TRIALS: ACCURACY = 0.39071E-03

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

Revised Interim Improvements System with Second
SOCWA Supply; Future 2035 Maximum Day Demand

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	1.25	0.00	0.00	0.00	0.00	0.00
P-10	J-75	J-24	-6.94	0.05	0.00	0.08	0.09	0.09
P-103	J-38	J-82	10.30	0.26	0.00	0.11	0.19	0.19
P-107	J-43	J-44	8.55	0.28	0.00	0.09	0.13	0.13
P-11	J-76	J-75	-3.60	0.01	0.00	0.04	0.03	0.03
P-12	J-77	J-38	20.70	0.00	0.00	0.08	0.06	0.06
P-120	J-31	J-36	-74.53	0.05	0.00	0.20	0.05	0.05
P-125	J-8	J-21	-45.11	0.01	0.00	0.12	0.02	0.02
P-126	J-45	J-8	-0.18	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	-14.43	0.13	0.00	0.16	0.35	0.35
P-130	J-36	J-46	-130.88	0.17	0.00	0.35	0.14	0.14
P-14	J-78	J-61	-64.66	0.12	0.00	0.26	0.47	0.47
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	23.09	0.13	0.00	0.14	0.09	0.09
P-15	J-79	J-80	-4.56	0.03	0.00	0.05	0.04	0.04
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	-12.79	0.10	0.00	0.14	0.28	0.28
P-155	J-40	J-5	-13.47	0.13	0.00	0.15	0.31	0.31
P-156	J-6	J-34	-24.03	0.25	0.00	0.27	0.91	0.91
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-61	-15.62	0.52	0.00	0.17	0.41	0.41
P-17	J-81	J-42	-7.25	0.01	0.00	0.08	0.10	0.10
P-170	J-33	J-55	98.57	0.08	0.00	0.27	0.38	0.37
P-171	J-41	J-55	-98.57	0.05	0.00	0.27	0.37	0.37
P-172	J-37	J-41	-69.89	0.07	0.00	0.19	0.20	0.20
P-174	J-52	J-84	11.81	0.34	0.00	0.13	0.24	0.24
P-175	J-37	J-52	46.07	0.03	0.00	0.13	0.09	0.09

P-178	J-44	J-42	-5.02	0.02	0.00	0.06	0.05	0.05
P-179	J-56	J-49	9.42	0.35	0.00	0.10	0.16	0.16
P-18	J-82	J-81	-2.51	0.01	0.00	0.03	0.01	0.01
P-188	J-26	J-1	-30.43	0.26	0.00	0.19	0.15	0.15
P-189	J-43	J-77	20.70	0.01	0.00	0.08	0.06	0.06
P-19	J-83	J-6	-9.60	0.01	0.00	0.11	0.17	0.17
P-191	J-14	J-51	-37.58	0.31	0.00	0.15	0.17	0.17
P-192	J-59	J-60	-121.77	0.26	0.00	0.48	1.51	1.51
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-64.66	0.02	0.00	0.26	0.48	0.47
P-197	J-56	J-43	43.68	0.07	0.00	0.17	0.23	0.23
P-2	J-70	J-60	121.77	0.03	0.00	0.48	1.51	1.51
P-20	J-7	J-73	-20.01	0.01	0.00	0.12	0.07	0.07
P-201	J-62	J-79	-0.35	0.00	0.00	0.00	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	-3.46	0.02	0.00	0.04	0.03	0.03
P-210	J-59	J-13	6.34	0.00	0.00	0.03	0.01	0.01
P-217	J-64	J-59	-114.45	0.32	0.00	0.45	1.35	1.35
P-219	J-64	J-65	12.01	0.44	0.00	0.13	0.25	0.25
P-22-CV	PR-2	J-46	214.85	0.12	0.01	0.58	0.37	0.34
P-221	J-61	J-64	-89.37	0.25	0.00	0.35	0.85	0.85
P-239	J-12	J-14	-18.65	0.01	0.00	0.07	0.05	0.05
P-24	J-9	J-7	-1.40	0.00	0.00	0.01	0.00	0.00
P-243	J-16	J-18	1.27	0.00	0.00	0.01	0.00	0.00
P-25	J-10	J-11	0.53	0.00	0.00	0.01	0.00	0.00
P-255	J-51	J-70	158.72	0.04	0.00	0.63	2.47	2.47
P-264	J-34	J-35	1.10	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	1.81	0.00	0.00	0.02	0.01	0.01
P-266	J-26	J-19	19.03	0.00	0.00	0.08	0.05	0.05
P-268-CV	PR-1	J-3	204.38	0.00	0.00	0.55	0.23	0.23
P-269	J-51	J-3	-204.38	0.12	0.07	0.81	6.33	3.94
P-27	J-12	J-10	9.97	0.01	0.00	0.11	0.18	0.18
P-271	J-52	J-53	25.13	0.00	0.00	0.07	0.03	0.03
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-36.95	0.00	0.00	0.10	0.06	0.06
P-285	J-53	J-34	25.13	0.06	0.00	0.07	0.03	0.03
P-286	J-46	J-21	78.00	0.01	0.00	0.21	0.06	0.05
P-29	J-13	J-14	-2.26	0.02	0.00	0.03	0.01	0.01
P-3	J-4	J-70	-36.95	0.03	0.00	0.10	0.06	0.06
P-31	J-15	J-10	-2.95	0.03	0.00	0.03	0.02	0.02
P-32	J-15	J-7	-14.39	0.02	0.00	0.09	0.04	0.04
P-34	J-16	J-15	-7.34	0.04	0.00	0.08	0.10	0.10
P-35	J-16	J-17	-5.33	0.08	0.00	0.06	0.06	0.06
P-38	J-18	J-19	-5.26	0.07	0.00	0.06	0.05	0.05
P-4	J-50	J-31	4.53	0.00	0.00	0.03	0.00	0.00
P-41	J-20	J-21	-28.86	0.22	0.00	0.32	1.28	1.28
P-44	J-22	J-20	-14.59	0.14	0.00	0.16	0.36	0.36
P-46	J-23	J-22	-8.82	0.06	0.00	0.10	0.14	0.14
P-48	J-18	J-23	-3.47	0.01	0.00	0.04	0.03	0.03
P-49	J-23	J-76	-0.44	0.00	0.00	0.00	0.00	0.00
P-5	J-69	J-50	7.16	0.00	0.00	0.04	0.01	0.01
P-51	J-25	J-71	5.81	0.03	0.00	0.06	0.07	0.07
P-55	J-17	J-12	-7.63	0.00	0.00	0.03	0.01	0.01
P-56	J-26	J-17	5.60	0.00	0.00	0.02	0.01	0.01
P-57	J-24	J-19	-7.80	0.00	0.00	0.03	0.01	0.01
P-58	J-27	J-24	1.24	0.00	0.00	0.00	0.00	0.00
P-6	J-71	J-72	3.36	0.01	0.00	0.04	0.02	0.02

P-60	J-25	J-27	29.24	0.03	0.00	0.12	0.11	0.11
P-61	J-28	J-25	36.64	0.03	0.00	0.14	0.16	0.16
P-63	J-29	J-20	-8.65	0.02	0.00	0.05	0.01	0.01
P-67	J-30	J-69	9.97	0.00	0.00	0.06	0.02	0.02
P-69	J-31	J-32	78.35	0.13	0.00	0.22	0.24	0.24
P-7	J-72	J-22	0.20	0.00	0.00	0.00	0.00	0.00
P-71	J-33	J-32	-79.86	0.14	0.00	0.22	0.25	0.25
P-8	J-73	J-74	-24.05	0.05	0.00	0.15	0.10	0.10
P-81	J-29	J-28	45.70	0.05	0.00	0.18	0.25	0.25
P-82	J-30	J-29	40.03	0.03	0.00	0.16	0.19	0.19
P-83	J-36	J-30	50.87	0.04	0.00	0.20	0.30	0.30
P-84	J-32	J-28	-5.02	0.06	0.00	0.06	0.05	0.05
P-87	J-5	J-37	-10.97	0.48	0.00	0.12	0.21	0.21
P-9	J-74	J-8	-35.63	0.29	0.00	0.22	0.20	0.20
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-41	-13.89	0.68	0.00	0.15	0.33	0.33

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		5.26	802.51	646.90	155.60	67.43
J-10		6.49	802.24	665.57	136.66	59.22
J-11		0.53	802.24	666.78	135.46	58.70
J-12		1.05	802.25	666.41	135.84	58.86
J-13		8.60	802.24	650.77	151.47	65.64
J-14		16.67	802.26	663.73	138.53	60.03
J-15		10.00	802.21	660.87	141.35	61.25
J-16		11.41	802.17	659.23	142.94	61.94
J-17		7.90	802.25	663.22	139.03	60.25
J-18		10.00	802.17	662.56	139.61	60.50
J-19		5.97	802.24	668.34	133.90	58.03
J-2		1.25	802.51	648.06	154.45	66.93
J-20		5.62	802.37	657.89	144.48	62.61
J-21		4.04	802.59	657.51	145.08	62.87
J-22		5.97	802.23	658.30	143.94	62.37
J-23		5.79	802.18	662.32	139.85	60.60
J-24		2.11	802.24	664.89	137.35	59.52
J-25		1.58	802.27	665.93	136.34	59.08
J-26		5.79	802.25	666.12	136.13	58.99
J-27		4.91	802.24	665.03	137.21	59.46
J-28		4.04	802.30	665.85	136.45	59.13
J-29		2.98	802.35	664.95	137.40	59.54
J-3		0.00	802.77	648.42	154.34	66.88
J-30		0.88	802.38	665.84	136.54	59.17
J-31		0.70	802.37	642.05	160.32	69.47
J-32		3.51	802.24	651.80	150.44	65.19
J-33		4.39	802.11	649.84	152.27	65.98
J-34		0.00	801.81	645.38	156.43	67.79
J-35		1.10	801.81	640.76	161.04	69.79
J-36		5.48	802.42	665.80	136.62	59.20
J-37		12.85	801.91	650.49	151.41	65.61
J-38		10.39	801.44	648.18	153.26	66.41
J-39		0.00	801.44	655.00	146.44	63.46
J-4		0.00	802.51	646.84	155.66	67.45

J-40		14.57	801.30	641.08	160.22	69.43
J-41		14.78	801.98	650.63	151.35	65.59
J-42		0.53	801.19	642.94	158.26	68.58
J-43		14.43	801.45	648.38	153.08	66.33
J-44		11.76	801.18	640.70	160.48	69.54
J-45		0.18	802.58	655.58	147.00	63.70
J-46	EC-SOCWA	5.97	802.59	658.00	144.59	62.66
J-47	EC-Ferndale	0.00	801.81	641.36	160.44	69.53
J-48		0.00	801.81	642.16	159.65	69.18
J-49		11.23	801.17	643.24	157.93	68.44
J-5		11.93	801.43	642.66	158.76	68.80
J-50	1F	2.63	802.37	661.00	141.37	61.26
J-51		8.07	802.58	648.00	154.58	66.98
J-52		9.13	801.87	654.88	146.99	63.70
J-53		0.00	801.87	655.33	146.54	63.50
J-54		0.00	801.87	653.00	148.87	64.51
J-55		0.00	802.03	650.63	151.40	65.61
J-56		11.55	801.52	646.80	154.73	67.05
J-59		0.99	802.24	649.53	152.71	66.17
J-6		0.00	801.56	643.53	158.03	68.48
J-60		0.00	802.50	648.00	154.50	66.95
J-61		9.09	801.67	649.02	152.65	66.15
J-62	EC-Ferndale	0.35	801.12	643.00	158.12	68.52
J-63	EC-Ferndale	0.00	802.24	648.19	154.05	66.76
J-64		13.07	801.92	647.71	154.21	66.82
J-65		12.01	801.48	642.19	159.29	69.02
J-66		0.00	802.51	646.83	155.68	67.46
J-68		0.00	802.50	648.00	154.50	66.95
J-69	1R	2.81	802.38	663.00	139.38	60.40
J-7		4.21	802.23	658.64	143.59	62.22
J-70		0.00	802.53	648.00	154.53	66.97
J-71	2F	2.46	802.24	665.00	137.24	59.47
J-72	2R	3.16	802.23	662.00	140.23	60.77
J-73	3F	4.04	802.24	657.00	145.24	62.94
J-74	3R	11.58	802.29	654.00	148.29	64.26
J-75	4F	3.33	802.19	663.00	139.19	60.32
J-76	4R	3.16	802.18	661.00	141.18	61.18
J-77	5F	0.00	801.44	648.00	153.44	66.49
J-78	5R	0.00	801.55	647.00	154.55	66.97
J-79	6R	4.21	801.12	641.00	160.12	69.39
J-8		9.30	802.58	654.08	148.50	64.35
J-80	6F	11.06	801.15	648.00	153.15	66.36
J-81	7R	4.74	801.18	641.00	160.18	69.41
J-82	7F	12.81	801.18	640.00	161.18	69.84
J-83	8F	6.14	801.55	642.00	159.55	69.14
J-84	8R	15.27	801.53	644.00	157.53	68.26
J-9		1.40	802.23	659.92	142.31	61.67
PR-1	PR-1	----	802.77	648.00	154.77	67.07
PR-2	PR-2	----	802.72	658.00	144.72	62.71

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi

J-82	69.84	J-19	58.03
J-35	69.79	J-11	58.70
J-44	69.54	J-12	58.86
J-47	69.53	J-26	58.99
J-31	69.47	J-25	59.08

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	0.81	P-126	0.00
P-255	0.63	P-7	0.00
P-22	0.58	P-264	0.00
P-268	0.55	P-1	0.00
P-192	0.48	P-201	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	6.33	P-126	0.00
P-255	2.47	P-264	0.00
P-192	1.51	P-1	0.00
P-2	1.51	P-7	0.00
P-217	1.35	P-58	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	3.94	P-126	0.00
P-255	2.47	P-264	0.00
P-2	1.51	P-1	0.00
P-192	1.51	P-7	0.00
P-217	1.35	P-58	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
PR-1	204.38	PR-1
PR-2	214.85	PR-2

NET SYSTEM INFLOW = 419.23
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 419.23

==========

FireFlow/Hydrant Report
Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

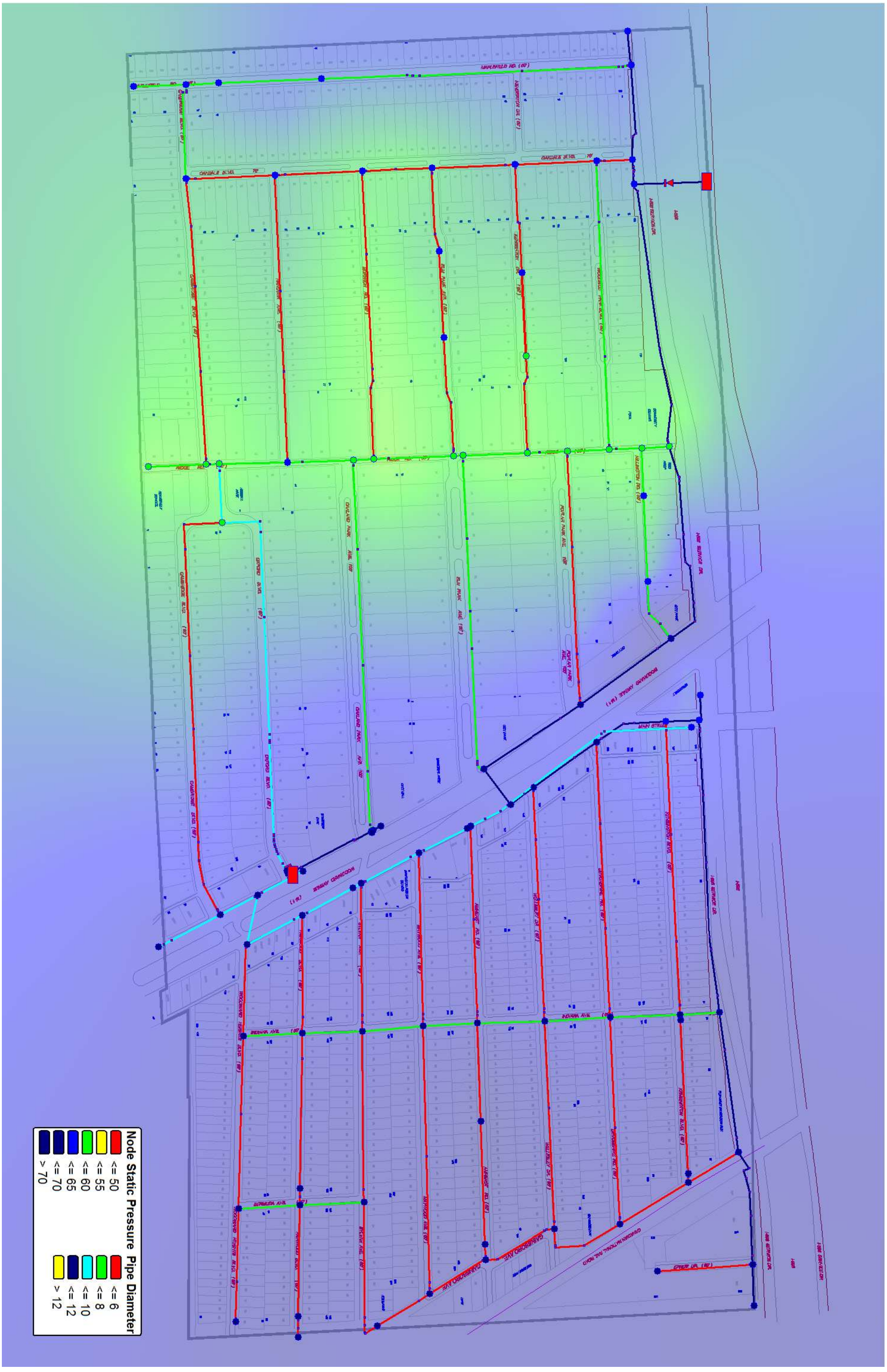
Hydrant Node	Hydrant Constant	Elevation	Demand gpm	Static Pressure	Flow-1 gpm	Flow-2 gpm	Node-2
J-1	0.0	646.9	5.3	67.4	3345.3	3325.9	J-2
J-10	0.0	665.6	6.5	59.2	1262.2	1253.0	J-11
J-11	0.0	666.8	0.5	58.7	512.0		
J-12	0.0	666.4	1.1	58.9	2162.0		
J-13	0.0	650.8	8.6	65.6	2081.0		
J-14	0.0	663.7	16.7	60.0	2080.2		
J-15	0.0	660.9	10.0	61.3	1158.4		
J-16	0.0	659.2	11.4	61.9	999.4		
J-17	0.0	663.2	7.9	60.2	2397.1		
J-18	0.0	662.6	10.0	60.5	976.1		
J-19	0.0	668.3	6.0	58.0	2654.8		
J-2	0.0	648.1	1.2	66.9	3166.0		
J-20	0.0	657.9	5.6	62.6	1887.6		
J-21	0.0	657.5	4.0	62.9	7334.3		
J-22	0.0	658.3	6.0	62.4	1072.2		
J-23	0.0	662.3	5.8	60.6	988.2		
J-24	0.0	664.9	2.1	59.5	2843.2		
J-25	0.0	665.9	1.6	59.1	2762.0		
J-26	0.0	666.1	5.8	59.0	2724.7		
J-27	0.0	665.0	4.9	59.5	2893.2		
J-28	0.0	665.9	4.0	59.1	2901.9		
J-29	0.0	664.9	3.0	59.5	3309.4		
J-3	0.0	648.4	0.0	66.9	52606.1		
J-30	0.0	665.8	0.9	59.2	3705.8		
J-31	0.0	642.1	0.7	69.5	4223.3	4085.3	J-50
J-32	0.0	651.8	3.5	65.2	3011.7		
J-33	0.0	649.8	4.4	66.0	2585.4	2518.1	J-53
J-34	0.0	645.4	0.0	67.8	1221.2		
J-35	0.0	640.8	1.1	69.8	1127.7	1120.0	J-48
J-36	0.0	665.8	5.5	59.2	4548.1		
J-37	0.0	650.5	12.9	65.6	1852.8	1805.9	J-53
J-38	0.0	648.2	10.4	66.4	1099.4	1058.8	J-39
J-39	0.0	655.0	0.0	63.5	719.2		
J-4	0.0	646.8	0.0	67.5	3362.6	3344.3	J-2
J-40	0.0	641.1	14.6	69.4	901.8		
J-41	0.0	650.6	14.8	65.6	2152.2	2100.4	J-53

J-42	0.0	642.9	0.5	68.6	820.9		
J-43	0.0	648.4	14.4	66.3	1220.5	1178.5	J-39
J-44	0.0	640.7	11.8	69.5	739.8		
J-45	0.0	655.6	0.2	63.7	4658.9		
J-46	0.0	658.0	6.0	62.7	8720.5	8523.4	J-36
J-47	0.0	641.4	0.0	69.5	1089.2		
J-48	0.0	642.2	0.0	69.2	445.4		
J-49	0.0	643.2	11.2	68.4	587.4		
J-5	0.0	642.7	11.9	68.8	911.4		
J-50	0.0	661.0	2.6	61.3	2473.7		
J-51	0.0	648.0	8.1	67.0	6740.5	6651.1	J-39
J-52	0.0	654.9	9.1	63.7	1611.7	1608.4	J-53
J-53	0.0	655.3	0.0	63.5	1531.8		
J-54	0.0	653.0	0.0	64.5	1488.0		
J-55	0.0	650.6	0.0	65.6	2277.4	2224.1	J-53
J-56	0.0	646.8	11.6	67.0	1387.7	1333.5	J-39
J-59	0.0	649.5	1.0	66.2	2868.0	2838.9	J-39
J-6	0.0	643.5	0.0	68.5	968.6		
J-60	0.0	648.0	0.0	67.0	5028.7	4959.0	J-39
J-61	0.0	649.0	9.1	66.1	1594.7	1562.4	J-39
J-62	0.0	643.0	0.4	68.5	208.3		
J-63	0.0	648.2	0.0	66.8	1478.3		
J-64	0.0	647.7	13.1	66.8	2029.5	1985.1	J-39
J-65	0.0	642.2	12.0	69.0	235.4		
J-66	0.0	646.8	0.0	67.5	2495.5		
J-68	0.0	648.0	0.0	67.0	3509.8		
J-69	0.0	663.0	2.8	60.4	2557.3		
J-7	0.0	658.6	4.2	62.2	1181.1	1172.4	J-9
J-70	0.0	648.0	0.0	67.0	5944.2	5853.1	J-39
J-71	0.0	665.0	2.5	59.5	698.1		
J-72	0.0	662.0	3.2	60.8	672.3		
J-73	0.0	657.0	4.0	62.9	1204.5		
J-74	0.0	654.0	11.6	64.3	1304.1		
J-75	0.0	663.0	3.3	60.3	674.8		
J-76	0.0	661.0	3.2	61.2	684.9		
J-77	0.0	648.0	0.0	66.5	1097.3	1055.5	J-39
J-78	0.0	647.0	0.0	67.0	1401.9	1349.8	J-39
J-79	0.0	641.0	4.2	69.4	219.6	217.5	J-62
J-8	0.0	654.1	9.3	64.4	5189.5	5147.7	J-45
J-80	0.0	648.0	11.1	66.4	264.1		
J-81	0.0	641.0	4.7	69.4	755.4		
J-82	0.0	640.0	12.8	69.8	571.9		
J-83	0.0	642.0	6.1	69.1	893.2		
J-84	0.0	644.0	15.3	68.3	567.4		
J-9	0.0	659.9	1.4	61.7	999.7		

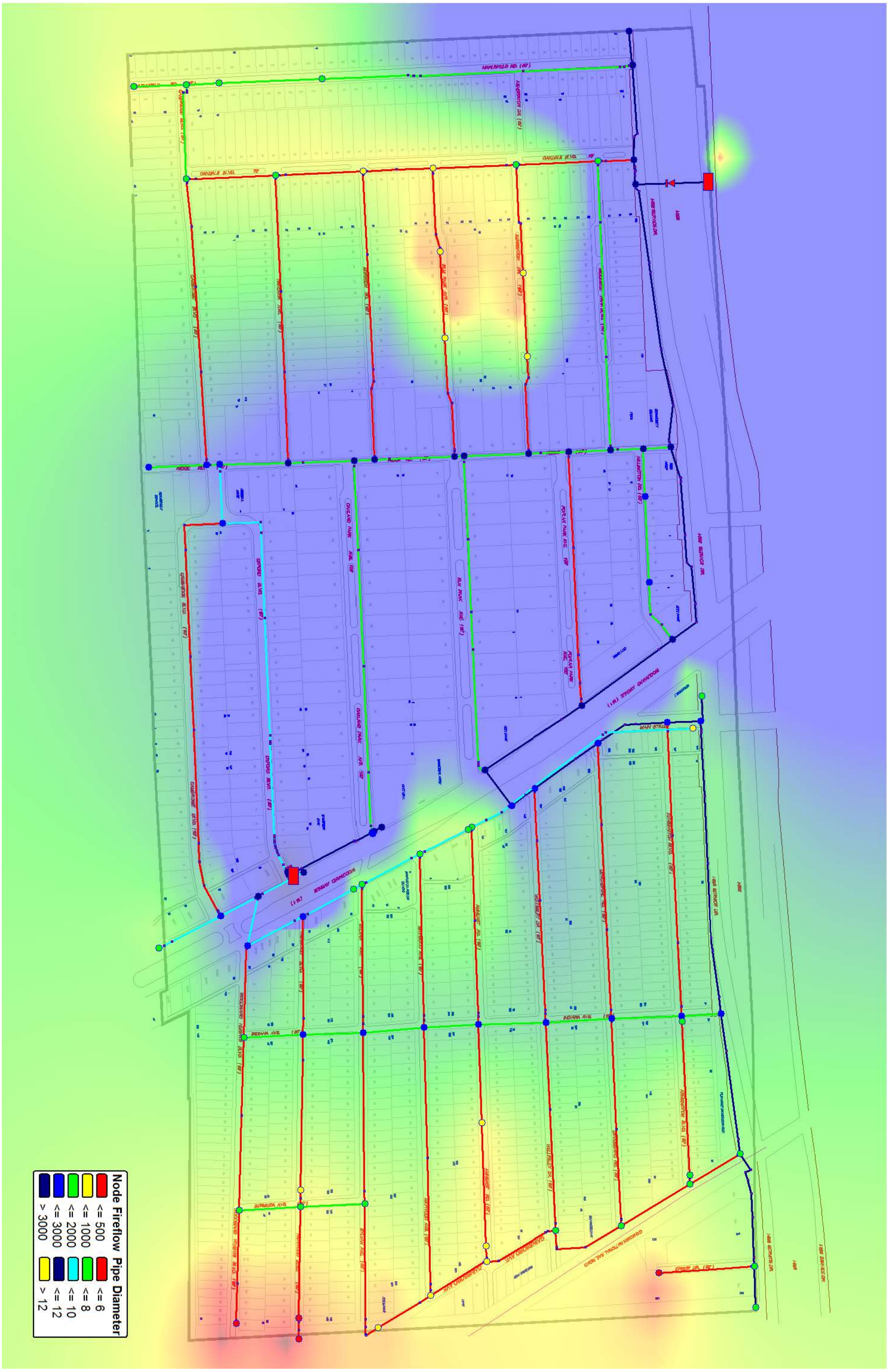
APPENDIX H

Master Plan Improvements Water Distribution System; 2035 Maximum Day Demand Results

Includes:
Static Pressure Gradient Map; Master Plan Improvements, 2035 Maximum Day Demand
Available Fire Flow Gradient Map; Master Plan Improvements, 2035 Max. Day Demand
Computer Model Simulation; Master Plan Improvements, 2035 Maximum Day Demand



Static Pressure; Master Plan Improvements; 2035 Maximum Day Demand



Available Fire Flow; Master Plan Improvements; 2035 Maximum Day Demand

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* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 Date & Time:  Wed Jan 13 14:28:28 2016

 Master File : m:\0175\0175-0095\gen\reports\kypipe\import\socwa
revision\watermodelfuture2035.KYP\watermodelfuture2035.P2K
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SUMMARY OF ORIGINAL DATA

UNITS SPECIFIED

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

PIPELINE DATA

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.14	34.9545	0.00
P-10	J-75	J-24	557.86	6.08	32.4385	1.27
P-103	J-38	J-86	918.61	6.08	32.4385	1.14
P-107	J-43	J-87	810.14	6.08	32.4385	0.57
P-11	J-76	J-75	402.54	6.08	32.4385	0.40
P-12	J-77	J-38	19.18	10.16	32.4385	0.17
P-120	J-31	J-36	972.64	12.34	76.3750	2.37
P-125	J-8	J-21	445.59	12.34	76.3750	0.70
P-126	J-45	J-8	160.81	12.34	76.3750	0.00
P-13	J-5	J-6	373.36	6.08	32.4385	0.00
P-130	J-36	J-46	1250.08	12.34	76.3750	1.79
P-14	J-78	J-61	266.57	10.16	32.4385	0.17
P-148	J-47	J-35	190.47	12.14	34.9545	0.17
P-149	J-27	J-33	1489.24	8.18	50.0471	2.98
P-15	J-79	J-90	519.77	6.08	32.4385	0.57
P-152	J-48	J-35	445.75	6.08	32.4385	0.57
P-154	J-42	J-40	362.71	6.08	32.4385	0.70
P-155	J-40	J-5	415.41	6.08	32.4385	1.27
P-156	J-6	J-34	275.42	6.08	32.4385	0.17
P-157	J-53	J-54	124.93	12.14	34.9545	0.75
P-16	J-80	J-92	723.98	6.08	32.4385	0.00
P-17	J-81	J-42	72.50	6.08	32.4385	0.17
P-170	J-33	J-55	209.02	12.14	34.9545	0.34

P-171	J-41	J-55	134.03	12.14	34.9545	0.00
P-172	J-37	J-41	362.21	12.14	34.9545	0.00
P-174	J-52	J-58	1368.63	6.08	32.4385	1.54
P-175	J-37	J-52	349.33	12.14	34.9545	0.69
P-178	J-44	J-42	304.86	6.08	32.4385	0.35
P-179	J-56	J-88	688.85	6.08	32.4385	0.57
P-18	J-82	J-81	575.79	6.08	32.4385	0.57
P-188	J-26	J-1	1732.31	8.18	50.0471	1.89
P-189	J-43	J-77	250.49	10.16	32.4385	0.57
P-19	J-83	J-6	42.96	6.08	32.4385	0.17
P-191	J-14	J-51	1820.36	10.16	32.4385	2.81
P-192	J-59	J-60	171.60	10.16	32.4385	0.17
P-192a	J-60	J-68	67.12	10.16	32.4385	0.17
P-195	J-56	J-78	45.89	10.16	32.4385	0.40
P-197	J-56	J-43	304.88	10.16	32.4385	0.57
P-2	J-70	J-60	22.81	10.16	32.4385	0.00
P-20	J-7	J-73	152.54	8.18	50.0471	0.57
P-201	J-62	J-79	95.36	6.08	32.4385	0.57
P-209	J-13	J-63	324.39	10.16	32.4385	0.34
P-21	J-84	J-83	716.44	6.08	32.4385	0.40
P-210	J-59	J-13	198.02	10.16	32.4385	0.17
P-217	J-64	J-59	236.90	10.16	32.4385	0.17
P-219	J-64	J-93	428.51	6.08	32.4385	0.52
P-22	J-57	J-34	658.95	12.14	34.9545	0.00
P-221	J-61	J-64	294.29	10.16	32.4385	0.17
P-23	J-58	J-84	25.75	6.08	32.4385	0.00
P-239	J-12	J-14	275.83	10.16	32.4385	0.17
P-24	J-9	J-7	245.04	8.18	50.0471	0.17
P-243	J-16	J-18	408.03	6.08	32.4385	0.17
P-25	J-10	J-11	270.51	8.27	114.0000	0.00
P-255	J-51	J-70	16.36	10.16	32.4385	0.00
P-26	J-67	J-37	1285.05	6.08	32.4385	1.14
P-264	J-34	J-35	559.29	12.14	34.9545	1.62
P-265	J-44	J-49	287.63	6.08	32.4385	0.17
P-266	J-26	J-19	95.17	8.27	114.0000	0.00
P-268-CV	PR-1	J-3	17.14	12.34	91.1586	0.00
P-269	J-51	J-3	30.19	10.16	32.4385	7.09
P-27	J-12	J-10	61.27	8.27	114.0000	0.17
P-271	J-52	J-53	156.58	12.14	34.9545	0.00
P-272	J-66	J-4	8.87	6.08	32.4385	0.17
P-275	J-1	J-4	9.76	12.14	34.9545	0.00
P-28	J-85	J-41	1092.79	6.08	32.4385	1.54
P-285	J-53	J-57	1367.61	12.14	34.9545	0.34
P-286	J-46	J-21	116.24	12.34	76.3750	0.87
P-29	J-13	J-14	2021.68	6.08	32.4385	2.52
P-3	J-4	J-70	436.95	12.14	34.9545	0.70
P-30	J-86	J-82	457.17	6.08	32.4385	0.40
P-31	J-15	J-10	1335.13	6.08	32.4385	1.14
P-32	J-15	J-7	455.35	8.18	50.0471	1.84
P-33	J-87	J-44	1248.22	6.08	32.4385	0.80
P-34	J-16	J-15	416.64	6.08	32.4385	0.17
P-35	J-16	J-17	1343.13	6.08	32.4385	1.14
P-36	J-88	J-89	798.25	6.08	32.4385	0.57
P-37	J-57	J-58	184.20	8.27	114.0000	0.34
P-38	J-18	J-19	1348.06	6.08	32.4385	1.84
P-39	J-58	J-67	327.35	8.27	114.0000	0.34
P-4	J-50	J-31	303.86	8.18	50.0471	0.52

P-40	J-67	J-85	305.77	8.27	114.0000	0.34
P-41	J-20	J-21	168.80	6.08	32.4385	0.34
P-42	J-85	J-86	315.17	8.27	114.0000	0.34
P-43	J-86	J-87	252.23	8.27	114.0000	0.34
P-44	J-22	J-20	381.01	6.08	32.4385	0.17
P-45	J-87	J-88	284.30	8.27	114.0000	0.34
P-46	J-23	J-22	387.52	6.08	32.4385	0.00
P-47	J-89	J-49	677.75	6.08	32.4385	1.32
P-48	J-18	J-23	325.49	6.08	32.4385	0.57
P-49	J-23	J-76	391.70	6.08	32.4385	1.27
P-5	J-69	J-50	401.89	8.18	50.0471	0.40
P-50	J-90	J-80	77.45	6.08	32.4385	0.57
P-51	J-25	J-71	454.23	6.08	32.4385	1.27
P-52	J-91	J-65	527.19	6.08	32.4385	0.57
P-53	J-89	J-90	299.25	8.27	114.0000	0.34
P-54	J-90	J-91	286.19	8.27	114.0000	0.34
P-55	J-17	J-12	318.63	8.27	114.0000	0.00
P-56	J-26	J-17	306.82	8.27	114.0000	0.00
P-57	J-24	J-19	373.15	8.27	114.0000	0.00
P-58	J-27	J-24	43.67	8.27	114.0000	0.00
P-59	J-92	J-61	551.44	6.08	32.4385	0.57
P-6	J-71	J-72	388.95	6.08	32.4385	0.40
P-60	J-25	J-27	300.24	8.27	114.0000	0.17
P-61	J-28	J-25	187.57	8.27	114.0000	0.00
P-62	J-93	J-91	806.42	6.08	32.4385	0.40
P-63	J-29	J-20	1346.63	8.18	50.0471	1.14
P-64	J-88	J-92	280.77	8.27	114.0000	0.34
P-65	J-92	J-93	276.28	8.27	114.0000	0.34
P-66-CV	PR-2	J-46	339.34	12.34	76.3750	1.74
P-67	J-30	J-69	223.04	8.18	50.0471	0.57
P-69	J-31	J-32	521.13	12.14	34.9545	0.00
P-7	J-72	J-22	509.45	6.08	32.4385	0.87
P-71	J-33	J-32	543.94	12.14	34.9545	0.00
P-8	J-73	J-74	479.27	8.18	50.0471	0.40
P-81	J-29	J-28	196.49	8.27	114.0000	0.17
P-82	J-30	J-29	151.25	8.27	114.0000	0.00
P-83	J-36	J-30	129.33	8.27	114.0000	0.00
P-84	J-32	J-28	1184.63	6.08	32.4385	1.14
P-87	J-5	J-67	966.84	6.08	32.4385	1.37
P-9	J-74	J-8	1448.13	8.18	50.0471	2.94
P-92	J-38	J-39	1173.25	10.16	32.4385	0.87
P-97	J-40	J-85	970.22	6.08	32.4385	0.97

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		5.26	646.90	
J-10		6.49	665.57	
J-11		0.53	666.78	
J-12		1.05	666.41	
J-13		8.60	650.77	
J-14		16.67	663.73	
J-15		10.00	660.87	
J-16		11.41	659.23	

J-17		7.90	663.22
J-18		10.00	662.56
J-19		5.97	668.34
J-2		1.25	648.06
J-20		5.62	657.89
J-21		4.04	657.51
J-22		5.97	658.30
J-23		5.79	662.32
J-24		2.11	664.89
J-25		1.58	665.93
J-26		5.79	666.12
J-27		4.91	665.03
J-28		4.04	665.85
J-29		2.98	664.95
J-3		0.00	648.42
J-30		0.88	665.84
J-31		0.70	642.05
J-32		3.51	651.80
J-33		4.39	649.84
J-34		0.00	645.38
J-35		1.10	640.76
J-36		5.48	665.80
J-37		7.06	650.49
J-38		6.88	648.18
J-39		0.00	655.00
J-4		0.00	646.84
J-40		7.72	641.08
J-41		7.06	650.63
J-42		0.53	642.94
J-43		6.18	648.38
J-44		8.25	640.70
J-45		0.18	655.58
J-46	EC-SOCWA	5.97	658.00
J-47	EC-Ferndale	0.00	641.36
J-48		0.00	642.16
J-49		2.81	643.24
J-5		5.79	642.66
J-50	1F	2.63	661.00
J-51		8.07	648.00
J-52		9.13	654.88
J-53		0.00	655.33
J-54		0.00	653.00
J-55		0.00	650.63
J-56		3.31	646.80
J-57		0.00	641.00
J-58		9.13	644.00
J-59		0.99	649.53
J-6		0.00	643.53
J-60		0.00	648.00
J-61		4.18	649.02
J-62	EC-Ferndale	0.35	643.00
J-63	EC-Ferndale	0.00	648.19
J-64		3.07	647.71
J-65		4.46	642.19
J-66		0.00	646.83
J-67		11.93	645.00
J-68		0.00	648.00

J-69	1R	2.81	663.00	
J-7		4.21	658.64	
J-70		0.00	648.00	
J-71	2F	2.46	665.00	
J-72	2R	3.16	662.00	
J-73	3F	4.04	657.00	
J-74	3R	11.58	654.00	
J-75	4F	3.33	663.00	
J-76	4R	3.16	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	3.86	641.00	
J-8		9.30	654.08	
J-80	6F	5.26	645.00	
J-81	7R	4.74	641.00	
J-82	7F	7.72	640.00	
J-83	8F	6.14	642.00	
J-84	8R	6.14	644.00	
J-85		14.57	645.00	
J-86		8.60	644.00	
J-87		11.76	644.00	
J-88		8.42	645.00	
J-89		8.25	642.00	
J-9		1.40	659.92	
J-90		3.86	643.00	
J-91		10.00	643.00	
J-92		7.20	644.00	
J-93		7.55	644.00	
PR-1	PR-1	----	648.00	802.77
PR-2		----	658.00	802.72

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) = 122
NUMBER OF END NODES .....(J) = 93
NUMBER OF PRIMARY LOOPS .....(L) = 28
NUMBER OF SUPPLY NODES .....(F) = 2
NUMBER OF SUPPLY ZONES .....(Z) = 1

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Case: 0

RESULTS OBTAINED AFTER 10 TRIALS: ACCURACY = 0.28043E-03

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

Revised Master Plan Improvements with Second
SOCWA Supply; Future 2035 Maximum Day Demand

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	1.25	0.00	0.00	0.00	0.00	0.00
P-10	J-75	J-24	-7.68	0.06	0.00	0.08	0.11	0.11
P-103	J-38	J-86	10.11	0.17	0.00	0.11	0.18	0.18
P-107	J-43	J-87	11.19	0.18	0.00	0.12	0.22	0.22
P-11	J-76	J-75	-4.34	0.02	0.00	0.05	0.04	0.04
P-12	J-77	J-38	16.99	0.00	0.00	0.07	0.04	0.04
P-120	J-31	J-36	-69.49	0.04	0.00	0.19	0.04	0.04
P-125	J-8	J-21	-43.27	0.01	0.00	0.12	0.02	0.02
P-126	J-45	J-8	-0.18	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	-7.37	0.04	0.00	0.08	0.10	0.10
P-130	J-36	J-46	-144.11	0.20	0.00	0.39	0.17	0.16
P-14	J-78	J-61	-51.43	0.08	0.00	0.20	0.31	0.31
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	30.84	0.23	0.00	0.19	0.15	0.15
P-15	J-79	J-90	-4.21	0.02	0.00	0.05	0.04	0.04
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	-6.91	0.03	0.00	0.08	0.09	0.09
P-155	J-40	J-5	-7.31	0.04	0.00	0.08	0.10	0.10
P-156	J-6	J-34	-9.02	0.04	0.00	0.10	0.15	0.15
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-92	-11.47	0.17	0.00	0.13	0.23	0.23
P-17	J-81	J-42	-0.78	0.00	0.00	0.01	0.00	0.00
P-170	J-33	J-55	108.21	0.09	0.00	0.30	0.45	0.44
P-171	J-41	J-55	-108.21	0.06	0.00	0.30	0.44	0.44
P-172	J-37	J-41	-87.00	0.11	0.00	0.24	0.30	0.30
P-174	J-52	J-58	8.50	0.18	0.00	0.09	0.13	0.13
P-175	J-37	J-52	69.26	0.07	0.00	0.19	0.20	0.19
P-178	J-44	J-42	-5.61	0.02	0.00	0.06	0.06	0.06
P-179	J-56	J-88	13.76	0.22	0.00	0.15	0.32	0.32
P-18	J-82	J-81	3.96	0.02	0.00	0.04	0.03	0.03
P-188	J-26	J-1	-29.31	0.24	0.00	0.18	0.14	0.14
P-189	J-43	J-77	16.99	0.01	0.00	0.07	0.04	0.04
P-19	J-83	J-6	-1.65	0.00	0.00	0.02	0.01	0.01
P-191	J-14	J-51	-36.16	0.29	0.00	0.14	0.16	0.16
P-192	J-59	J-60	-113.43	0.23	0.00	0.45	1.33	1.32
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-51.43	0.01	0.00	0.20	0.31	0.31
P-197	J-56	J-43	34.37	0.04	0.00	0.14	0.15	0.15
P-2	J-70	J-60	113.43	0.03	0.00	0.45	1.32	1.32
P-20	J-7	J-73	-18.17	0.01	0.00	0.11	0.06	0.06
P-201	J-62	J-79	-0.35	0.00	0.00	0.00	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	4.49	0.03	0.00	0.05	0.04	0.04
P-210	J-59	J-13	7.64	0.00	0.00	0.03	0.01	0.01
P-217	J-64	J-59	-104.80	0.27	0.00	0.41	1.15	1.14
P-219	J-64	J-93	27.34	0.50	0.00	0.30	1.16	1.16
P-22	J-57	J-34	10.12	0.00	0.00	0.03	0.01	0.01
P-221	J-61	J-64	-74.40	0.18	0.00	0.29	0.61	0.61
P-23	J-58	J-84	10.63	0.01	0.00	0.12	0.20	0.20
P-239	J-12	J-14	-18.52	0.01	0.00	0.07	0.05	0.05
P-24	J-9	J-7	-1.40	0.00	0.00	0.01	0.00	0.00

P-243	J-16	J-18	1.06	0.00	0.00	0.01	0.00	0.00
P-25	J-10	J-11	0.53	0.00	0.00	0.00	0.00	0.00
P-255	J-51	J-70	149.25	0.04	0.00	0.59	2.20	2.20
P-26	J-67	J-37	-10.67	0.26	0.00	0.12	0.20	0.20
P-264	J-34	J-35	1.10	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	5.31	0.02	0.00	0.06	0.06	0.06
P-266	J-26	J-19	16.15	0.00	0.00	0.10	0.01	0.01
P-268-CV	PR-1	J-3	193.48	0.00	0.00	0.52	0.20	0.20
P-269	J-51	J-3	-193.48	0.11	0.06	0.77	5.70	3.56
P-27	J-12	J-10	11.25	0.00	0.00	0.07	0.01	0.00
P-271	J-52	J-53	51.63	0.02	0.00	0.14	0.11	0.11
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-35.83	0.00	0.00	0.10	0.06	0.06
P-28	J-85	J-41	-14.15	0.37	0.00	0.16	0.34	0.34
P-285	J-53	J-57	51.63	0.15	0.00	0.14	0.11	0.11
P-286	J-46	J-21	75.66	0.01	0.00	0.20	0.05	0.05
P-29	J-13	J-14	-0.96	0.00	0.00	0.01	0.00	0.00
P-3	J-4	J-70	-35.83	0.03	0.00	0.10	0.06	0.06
P-30	J-86	J-82	11.68	0.11	0.00	0.13	0.24	0.24
P-31	J-15	J-10	-4.23	0.05	0.00	0.05	0.04	0.04
P-32	J-15	J-7	-12.56	0.01	0.00	0.08	0.03	0.03
P-33	J-87	J-44	7.95	0.15	0.00	0.09	0.12	0.12
P-34	J-16	J-15	-6.78	0.04	0.00	0.07	0.09	0.09
P-35	J-16	J-17	-5.69	0.08	0.00	0.06	0.06	0.06
P-36	J-88	J-89	11.03	0.17	0.00	0.12	0.22	0.22
P-37	J-57	J-58	41.51	0.01	0.00	0.25	0.06	0.05
P-38	J-18	J-19	-5.71	0.09	0.00	0.06	0.06	0.06
P-39	J-58	J-67	30.26	0.01	0.00	0.18	0.03	0.03
P-4	J-50	J-31	9.29	0.01	0.00	0.06	0.02	0.02
P-40	J-67	J-85	23.27	0.01	0.00	0.14	0.02	0.02
P-41	J-20	J-21	-28.36	0.21	0.00	0.31	1.24	1.24
P-42	J-85	J-86	15.53	0.00	0.00	0.09	0.01	0.01
P-43	J-86	J-87	5.35	0.00	0.00	0.03	0.00	0.00
P-44	J-22	J-20	-12.96	0.11	0.00	0.14	0.29	0.29
P-45	J-87	J-88	-3.17	0.00	0.00	0.02	0.00	0.00
P-46	J-23	J-22	-7.84	0.04	0.00	0.09	0.11	0.11
P-47	J-89	J-49	-2.50	0.01	0.00	0.03	0.01	0.01
P-48	J-18	J-23	-3.23	0.01	0.00	0.04	0.02	0.02
P-49	J-23	J-76	-1.18	0.00	0.00	0.01	0.00	0.00
P-5	J-69	J-50	11.92	0.01	0.00	0.07	0.03	0.03
P-50	J-90	J-80	-6.20	0.01	0.00	0.07	0.07	0.07
P-51	J-25	J-71	6.46	0.04	0.00	0.07	0.08	0.08
P-52	J-91	J-65	4.46	0.02	0.00	0.05	0.04	0.04
P-53	J-89	J-90	5.28	0.00	0.00	0.03	0.00	0.00
P-54	J-90	J-91	3.41	0.00	0.00	0.02	0.00	0.00
P-55	J-17	J-12	-6.22	0.00	0.00	0.04	0.00	0.00
P-56	J-26	J-17	7.37	0.00	0.00	0.04	0.00	0.00
P-57	J-24	J-19	-4.48	0.00	0.00	0.03	0.00	0.00
P-58	J-27	J-24	5.31	0.00	0.00	0.03	0.00	0.00
P-59	J-92	J-61	-18.78	0.32	0.00	0.21	0.58	0.58
P-6	J-71	J-72	4.01	0.01	0.00	0.04	0.03	0.03
P-60	J-25	J-27	41.06	0.02	0.00	0.25	0.05	0.05
P-61	J-28	J-25	49.10	0.01	0.00	0.29	0.07	0.07
P-62	J-93	J-91	11.05	0.17	0.00	0.12	0.22	0.22
P-63	J-29	J-20	-9.78	0.02	0.00	0.06	0.02	0.02
P-64	J-88	J-92	-8.86	0.00	0.00	0.05	0.00	0.00
P-65	J-92	J-93	-8.74	0.00	0.00	0.05	0.00	0.00

P-66-CV	PR-2	J-46	225.74	0.13	0.01	0.61	0.41	0.38
P-67	J-30	J-69	14.73	0.01	0.00	0.09	0.04	0.04
P-69	J-31	J-32	78.08	0.13	0.00	0.22	0.24	0.24
P-7	J-72	J-22	0.85	0.00	0.00	0.01	0.00	0.00
P-71	J-33	J-32	-81.76	0.14	0.00	0.23	0.26	0.26
P-8	J-73	J-74	-22.21	0.04	0.00	0.14	0.08	0.08
P-81	J-29	J-28	60.33	0.02	0.00	0.36	0.11	0.11
P-82	J-30	J-29	53.53	0.01	0.00	0.32	0.09	0.09
P-83	J-36	J-30	69.14	0.02	0.00	0.41	0.14	0.14
P-84	J-32	J-28	-7.19	0.12	0.00	0.08	0.10	0.10
P-87	J-5	J-67	-5.73	0.06	0.00	0.06	0.06	0.06
P-9	J-74	J-8	-33.79	0.26	0.00	0.21	0.18	0.18
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-85	-7.33	0.10	0.00	0.08	0.10	0.10

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		5.26	802.53	646.90	155.63	67.44
J-10		6.49	802.29	665.57	136.72	59.24
J-11		0.53	802.29	666.78	135.51	58.72
J-12		1.05	802.29	666.41	135.88	58.88
J-13		8.60	802.30	650.77	151.53	65.66
J-14		16.67	802.30	663.73	138.57	60.05
J-15		10.00	802.24	660.87	141.38	61.26
J-16		11.41	802.21	659.23	142.98	61.96
J-17		7.90	802.29	663.22	139.07	60.27
J-18		10.00	802.20	662.56	139.64	60.51
J-19		5.97	802.29	668.34	133.95	58.05
J-2		1.25	802.53	648.06	154.48	66.94
J-20		5.62	802.37	657.89	144.47	62.60
J-21		4.04	802.58	657.51	145.07	62.86
J-22		5.97	802.26	658.30	143.96	62.38
J-23		5.79	802.21	662.32	139.89	60.62
J-24		2.11	802.29	664.89	137.40	59.54
J-25		1.58	802.31	665.93	136.37	59.09
J-26		5.79	802.29	666.12	136.17	59.01
J-27		4.91	802.29	665.03	137.26	59.48
J-28		4.04	802.32	665.85	136.47	59.14
J-29		2.98	802.34	664.95	137.39	59.54
J-3		0.00	802.77	648.42	154.34	66.88
J-30		0.88	802.36	665.84	136.51	59.15
J-31		0.70	802.33	642.05	160.28	69.45
J-32		3.51	802.20	651.80	150.40	65.17
J-33		4.39	802.06	649.84	152.22	65.96
J-34		0.00	801.56	645.38	156.18	67.68
J-35		1.10	801.56	640.76	160.79	69.68
J-36		5.48	802.37	665.80	136.58	59.18
J-37		7.06	801.80	650.49	151.31	65.57
J-38		6.88	801.70	648.18	153.52	66.53
J-39		0.00	801.70	655.00	146.70	63.57
J-4		0.00	802.53	646.84	155.69	67.46
J-40		7.72	801.44	641.08	160.36	69.49
J-41		7.06	801.91	650.63	151.28	65.56

J-42		0.53	801.40	642.94	158.47	68.67
J-43		6.18	801.71	648.38	153.33	66.44
J-44		8.25	801.38	640.70	160.69	69.63
J-45		0.18	802.57	655.58	146.99	63.70
J-46	EC-SOCWA	5.97	802.58	658.00	144.58	62.65
J-47	EC-Ferndale	0.00	801.56	641.36	160.19	69.42
J-48		0.00	801.56	642.16	159.40	69.07
J-49		2.81	801.37	643.24	158.12	68.52
J-5		5.79	801.48	642.66	158.81	68.82
J-50	1F	2.63	802.34	661.00	141.34	61.25
J-51		8.07	802.59	648.00	154.59	66.99
J-52		9.13	801.73	654.88	146.85	63.63
J-53		0.00	801.71	655.33	146.39	63.43
J-54		0.00	801.71	653.00	148.71	64.44
J-55		0.00	801.97	650.63	151.34	65.58
J-56		3.31	801.75	646.80	154.96	67.15
J-57		0.00	801.56	641.00	160.56	69.58
J-58		9.13	801.55	644.00	157.55	68.27
J-59		0.99	802.30	649.53	152.77	66.20
J-6		0.00	801.52	643.53	157.99	68.46
J-60		0.00	802.53	648.00	154.53	66.96
J-61		4.18	801.85	649.02	152.83	66.23
J-62	EC-Ferndale	0.35	801.34	643.00	158.34	68.61
J-63	EC-Ferndale	0.00	802.30	648.19	154.11	66.78
J-64		3.07	802.03	647.71	154.32	66.87
J-65		4.46	801.34	642.19	159.15	68.96
J-66		0.00	802.53	646.83	155.70	67.47
J-67		11.93	801.54	645.00	156.54	67.83
J-68		0.00	802.53	648.00	154.53	66.96
J-69	1R	2.81	802.35	663.00	139.35	60.38
J-7		4.21	802.26	658.64	143.61	62.23
J-70		0.00	802.56	648.00	154.56	66.98
J-71	2F	2.46	802.27	665.00	137.27	59.48
J-72	2R	3.16	802.26	662.00	140.26	60.78
J-73	3F	4.04	802.26	657.00	145.26	62.95
J-74	3R	11.58	802.30	654.00	148.30	64.27
J-75	4F	3.33	802.23	663.00	139.23	60.33
J-76	4R	3.16	802.21	661.00	141.21	61.19
J-77	5F	0.00	801.70	648.00	153.70	66.60
J-78	5R	0.00	801.77	647.00	154.77	67.07
J-79	6R	3.86	801.34	641.00	160.34	69.48
J-8		9.30	802.57	654.08	148.49	64.35
J-80	6F	5.26	801.36	645.00	156.36	67.76
J-81	7R	4.74	801.40	641.00	160.40	69.51
J-82	7F	7.72	801.42	640.00	161.42	69.95
J-83	8F	6.14	801.51	642.00	159.51	69.12
J-84	8R	6.14	801.54	644.00	157.54	68.27
J-85		14.57	801.53	645.00	156.53	67.83
J-86		8.60	801.53	644.00	157.53	68.26
J-87		11.76	801.53	644.00	157.53	68.26
J-88		8.42	801.53	645.00	156.53	67.83
J-89		8.25	801.36	642.00	159.36	69.06
J-9		1.40	802.25	659.92	142.33	61.68
J-90		3.86	801.36	643.00	158.36	68.62
J-91		10.00	801.36	643.00	158.36	68.62
J-92		7.20	801.53	644.00	157.53	68.26
J-93		7.55	801.53	644.00	157.53	68.26

PR-1	PR-1	----	802.77	648.00	154.77	67.07
PR-2		----	802.72	658.00	144.72	62.71

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
J-82	69.95	J-19	58.05
J-35	69.68	J-11	58.72
J-44	69.63	J-12	58.88
J-57	69.58	J-26	59.01
J-81	69.51	J-25	59.09

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	0.77	P-126	0.00
P-66	0.61	P-264	0.00
P-255	0.59	P-25	0.00
P-268	0.52	P-1	0.00
P-192	0.45	P-201	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	5.70	P-126	0.00
P-255	2.20	P-25	0.00
P-192	1.33	P-264	0.00
P-2	1.32	P-1	0.00
P-41	1.24	P-201	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	3.56	P-126	0.00
P-255	2.20	P-25	0.00
P-192	1.32	P-264	0.00
P-2	1.32	P-1	0.00
P-41	1.24	P-201	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE

PR-1	193.48	PR-1
PR-2	225.74	

NET SYSTEM INFLOW = 419.23
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 419.23

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FireFlow/Hydrant Report

Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

Hydrant Node	Hydrant Constant	Elevation	Demand gpm	Static Pressure	Flow-1 gpm	Flow-2 gpm	Node-2
J-1	0.0	646.9	5.3	67.4	3439.8	3419.9	J-2
J-10	0.0	665.6	6.5	59.2	2804.9	2784.1	J-11
J-11	0.0	666.8	0.5	58.7	2308.7		
J-12	0.0	666.4	1.1	58.9	2919.4	2913.6	J-11
J-13	0.0	650.8	8.6	65.7	2261.1		
J-14	0.0	663.7	16.7	60.0	2438.1		
J-15	0.0	660.9	10.0	61.3	1169.0		
J-16	0.0	659.2	11.4	62.0	1006.7		
J-17	0.0	663.2	7.9	60.3	3270.9		
J-18	0.0	662.6	10.0	60.5	983.5		
J-19	0.0	668.3	6.0	58.0	3586.1		
J-2	0.0	648.1	1.2	66.9	3247.6		
J-20	0.0	657.9	5.6	62.6	1921.4		
J-21	0.0	657.5	4.0	62.9	7595.7		
J-22	0.0	658.3	6.0	62.4	1080.3		
J-23	0.0	662.3	5.8	60.6	995.8		
J-24	0.0	664.9	2.1	59.5	3928.8		
J-25	0.0	665.9	1.6	59.1	4030.0		
J-26	0.0	666.1	5.8	59.0	3592.7		
J-27	0.0	665.0	4.9	59.5	3974.5		
J-28	0.0	665.9	4.0	59.1	4198.7		
J-29	0.0	664.9	3.0	59.5	4543.9		
J-3	0.0	648.4	0.0	66.9	53081.9		
J-30	0.0	665.8	0.9	59.2	4793.8		
J-31	0.0	642.1	0.7	69.5	4702.2	4584.2	J-50
J-32	0.0	651.8	3.5	65.2	3439.8		

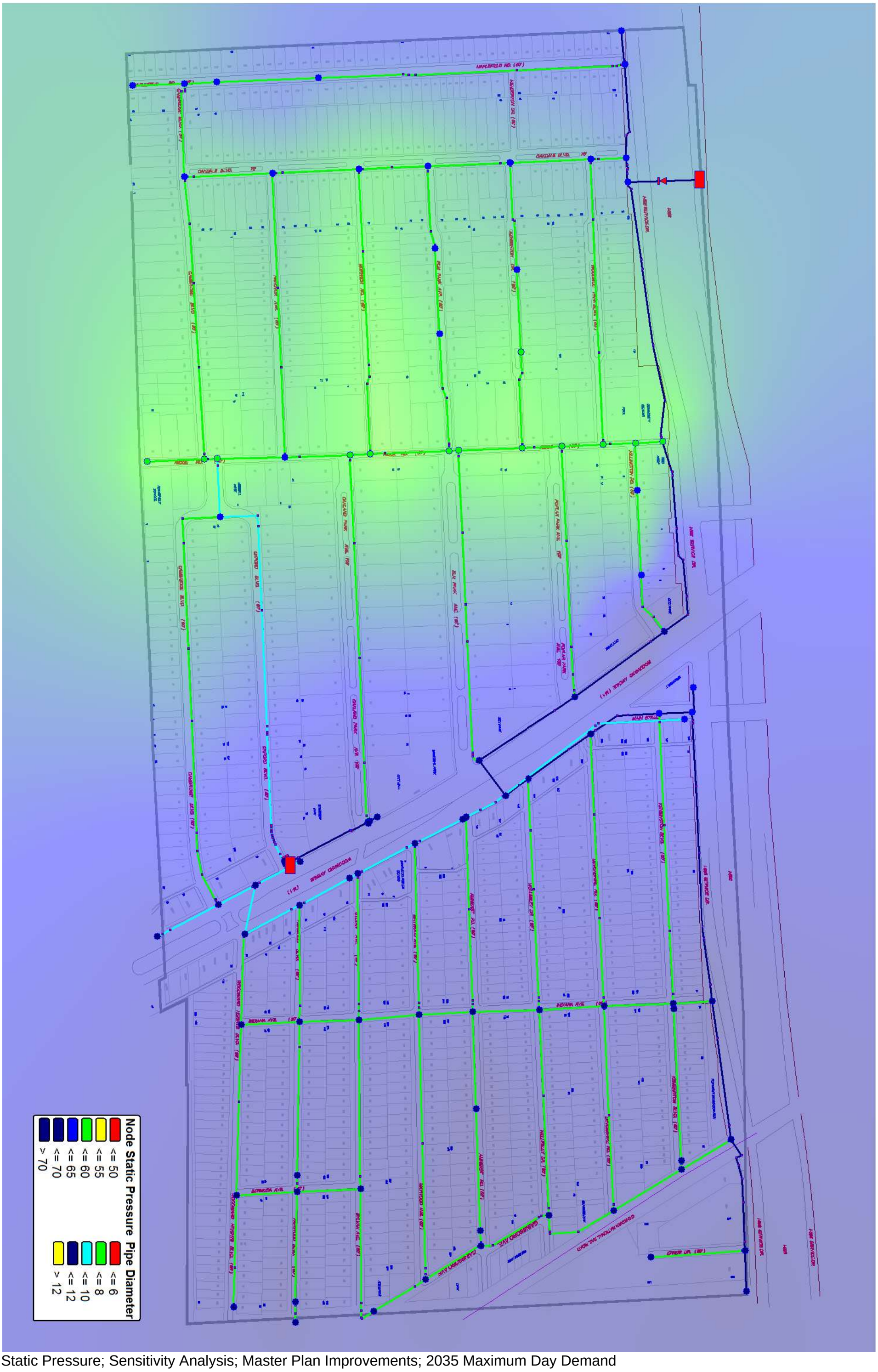
J-33	0.0	649.8	4.4	66.0	3126.1		
J-34	0.0	645.4	0.0	67.7	1736.1		
J-35	0.0	640.8	1.1	69.7	1476.3	1466.1	J-48
J-36	0.0	665.8	5.5	59.2	5176.8		
J-37	0.0	650.5	7.1	65.6	2415.8	2412.8	J-52
J-38	0.0	648.2	6.9	66.5	1425.9	1374.2	J-39
J-39	0.0	655.0	0.0	63.6	813.8		
J-4	0.0	646.8	0.0	67.5	3458.9	3440.2	J-2
J-40	0.0	641.1	7.7	69.5	1021.9		
J-41	0.0	650.6	7.1	65.6	2701.6		
J-42	0.0	642.9	0.5	68.7	985.9		
J-43	0.0	648.4	6.2	66.4	1635.4	1588.5	J-39
J-44	0.0	640.7	8.2	69.6	931.8		
J-45	0.0	655.6	0.2	63.7	4719.7		
J-46	0.0	658.0	6.0	62.7	9168.6		
J-47	0.0	641.4	0.0	69.4	1398.5		
J-48	0.0	642.2	0.0	69.1	462.7		
J-49	0.0	643.2	2.8	68.5	753.2		
J-5	0.0	642.7	5.8	68.8	1037.0		
J-50	0.0	661.0	2.6	61.2	2583.9		
J-51	0.0	648.0	8.1	67.0	7279.9		
J-52	0.0	654.9	9.1	63.6	2186.5		
J-53	0.0	655.3	0.0	63.4	2108.5		
J-54	0.0	653.0	0.0	64.4	1983.1		
J-55	0.0	650.6	0.0	65.6	2825.8		
J-56	0.0	646.8	3.3	67.1	1883.1	1855.1	J-39
J-57	0.0	641.0	0.0	69.6	2211.3	2165.9	J-34
J-58	0.0	644.0	9.1	68.3	2208.4		
J-59	0.0	649.5	1.0	66.2	3406.1	3395.3	J-13
J-6	0.0	643.5	0.0	68.5	1152.6		
J-60	0.0	648.0	0.0	67.0	5533.2		
J-61	0.0	649.0	4.2	66.2	2143.8		
J-62	0.0	643.0	0.4	68.6	376.8		
J-63	0.0	648.2	0.0	66.8	1544.0		
J-64	0.0	647.7	3.1	66.9	2625.7		
J-65	0.0	642.2	4.5	69.0	408.8		
J-66	0.0	646.8	0.0	67.5	2535.9		
J-67	0.0	645.0	11.9	67.8	2229.1		
J-68	0.0	648.0	0.0	67.0	3680.9		
J-69	0.0	663.0	2.8	60.4	2727.8		
J-7	0.0	658.6	4.2	62.2	1189.3	1180.7	J-9
J-70	0.0	648.0	0.0	67.0	6469.4		
J-71	0.0	665.0	2.5	59.5	704.9		
J-72	0.0	662.0	3.2	60.8	676.4		
J-73	0.0	657.0	4.0	62.9	1212.2		
J-74	0.0	654.0	11.6	64.3	1310.4		
J-75	0.0	663.0	3.3	60.3	680.1		
J-76	0.0	661.0	3.2	61.2	688.9		
J-77	0.0	648.0	0.0	66.6	1432.4	1379.7	J-39
J-78	0.0	647.0	0.0	67.1	1905.0	1892.6	J-39
J-79	0.0	641.0	3.9	69.5	414.3	410.3	J-62
J-8	0.0	654.1	9.3	64.3	5271.5	5228.9	J-45
J-80	0.0	645.0	5.3	67.8	962.2		
J-81	0.0	641.0	4.7	69.5	901.2		
J-82	0.0	640.0	7.7	69.9	784.5		
J-83	0.0	642.0	6.1	69.1	1069.6		
J-84	0.0	644.0	6.1	68.3	1641.0		

J-85	0.0	645.0	14.6	67.8	2245.2
J-86	0.0	644.0	8.6	68.3	2235.7
J-87	0.0	644.0	11.8	68.3	2210.0
J-88	0.0	645.0	8.4	67.8	2142.2
J-89	0.0	642.0	8.2	69.1	1108.9
J-9	0.0	659.9	1.4	61.7	1005.0
J-90	0.0	643.0	3.9	68.6	1099.9
J-91	0.0	643.0	10.0	68.6	1090.8
J-92	0.0	644.0	7.2	68.3	2083.3
J-93	0.0	644.0	7.5	68.3	1981.0

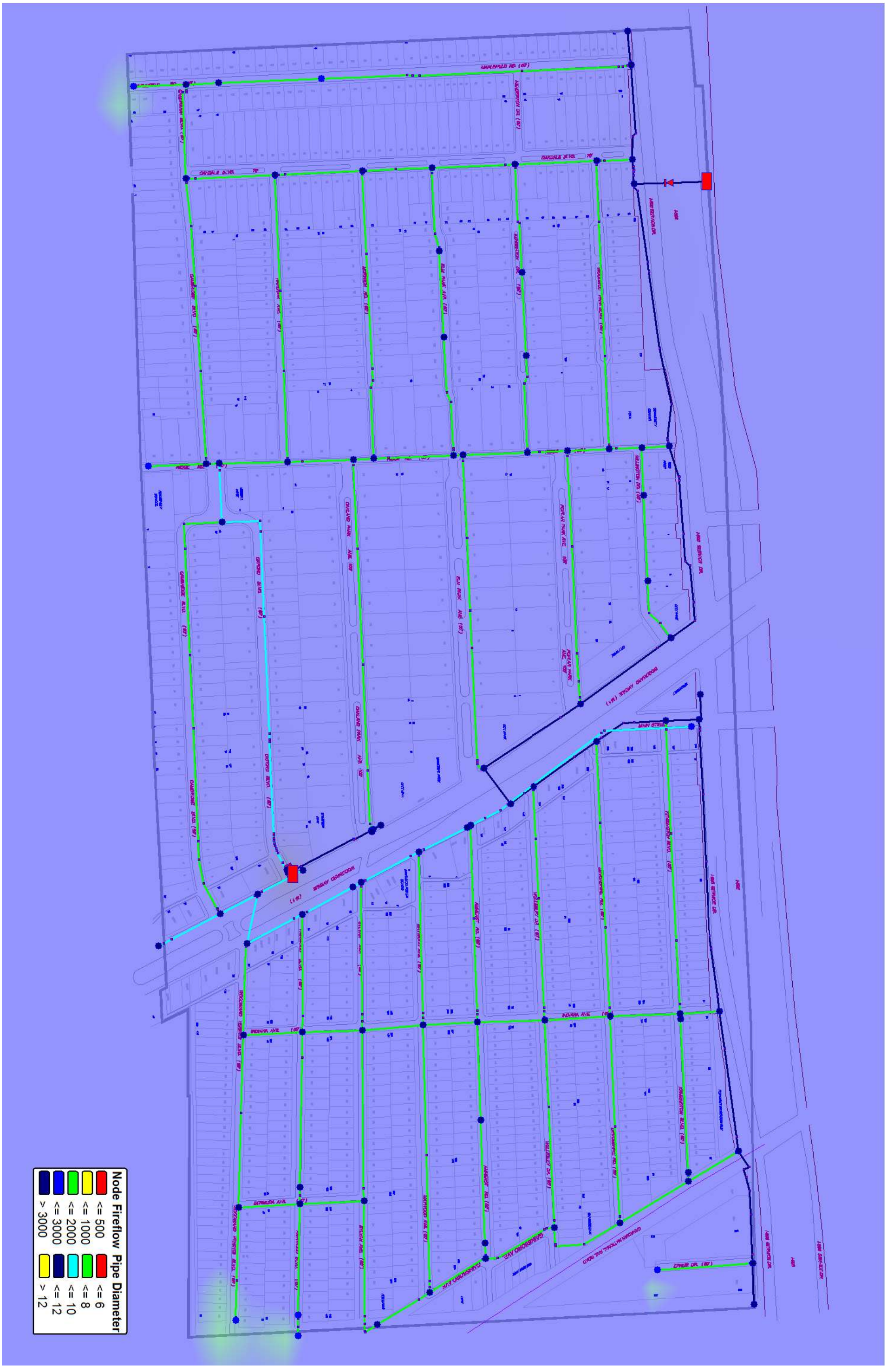
APPENDIX I

Master Plan Improvements Water Distribution System; 2035 Maximum Day Demand Sensitivity Analysis Results

Includes:
Static Pressures Gradient Map; Sensitivity Analysis
Available Fire Flow Gradient Map; Sensitivity Analysis
Computer Model Simulation; Sensitivity Analysis



Static Pressure; Sensitivity Analysis; Master Plan Improvements; 2035 Maximum Day Demand



Available Fire Flow; Sensitivity Analysis; Master Plan Improvements; 2035 Maximum Day Demand

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* * * * * * * * * * * * K Y P I P E * * * * * * * * * * * *
*                                                           *
*  Pipe Network Modeling Software                           *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 7.022a  07/08/2015                              *
*  Serial #:  6-5116761                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2014                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 Date & Time:  Wed Jan 13 15:11:12 2016

 Master File : m:\0175\0175-0095\gen\reports\kypipe\import\socwa
revision\watermodelsensitivity.KYP\watermodelsensitivity.P2K
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SUMMARY OF ORIGINAL DATA

UNITS SPECIFIED

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

PIPELINE DATA

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	39.45	12.34	90.0000	0.00
P-10	J-75	J-24	557.86	8.27	90.0000	1.27
P-103	J-38	J-86	918.61	8.27	90.0000	1.14
P-107	J-43	J-87	810.14	8.27	90.0000	0.57
P-11	J-76	J-75	402.54	8.27	90.0000	0.40
P-12	J-77	J-38	19.18	10.28	90.0000	0.17
P-120	J-31	J-36	972.64	12.34	90.0000	2.37
P-125	J-8	J-21	445.59	12.34	90.0000	0.70
P-126	J-45	J-8	160.81	12.34	90.0000	0.00
P-13	J-5	J-6	373.36	8.27	90.0000	0.00
P-130	J-36	J-46	1250.08	12.34	90.0000	1.79
P-14	J-78	J-61	266.57	10.28	90.0000	0.17
P-148	J-47	J-35	190.47	12.34	90.0000	0.17
P-149	J-27	J-33	1489.24	8.27	90.0000	2.98
P-15	J-79	J-90	519.77	8.27	90.0000	0.57
P-152	J-48	J-35	445.75	8.27	90.0000	0.57
P-154	J-42	J-40	362.71	8.27	90.0000	0.70
P-155	J-40	J-5	415.41	8.27	90.0000	1.27
P-156	J-6	J-34	275.42	8.27	90.0000	0.17
P-157	J-53	J-54	124.93	12.34	90.0000	0.75
P-16	J-80	J-92	723.98	8.27	90.0000	0.00
P-17	J-81	J-42	72.50	8.27	90.0000	0.17
P-170	J-33	J-55	209.02	12.34	90.0000	0.34

P-171	J-41	J-55	134.03	12.34	90.0000	0.00
P-172	J-37	J-41	362.21	12.34	90.0000	0.00
P-174	J-52	J-58	1368.63	8.27	90.0000	1.54
P-175	J-37	J-52	349.33	12.34	90.0000	0.69
P-178	J-44	J-42	304.86	8.27	90.0000	0.35
P-179	J-56	J-88	688.85	8.27	90.0000	0.57
P-18	J-82	J-81	575.79	8.27	90.0000	0.57
P-188	J-26	J-1	1732.31	8.27	90.0000	1.89
P-189	J-43	J-77	250.49	10.28	90.0000	0.57
P-19	J-83	J-6	42.96	8.27	90.0000	0.17
P-191	J-14	J-51	1820.36	10.28	90.0000	2.81
P-192	J-59	J-60	171.60	10.28	90.0000	0.17
P-192a	J-60	J-68	67.12	10.28	90.0000	0.17
P-195	J-56	J-78	45.89	10.28	90.0000	0.40
P-197	J-56	J-43	304.88	10.28	90.0000	0.57
P-2	J-70	J-60	22.81	10.28	90.0000	0.00
P-20	J-7	J-73	152.54	8.27	90.0000	0.57
P-201	J-62	J-79	95.36	8.27	90.0000	0.57
P-209	J-13	J-63	324.39	10.28	90.0000	0.34
P-21	J-84	J-83	716.44	8.27	90.0000	0.40
P-210	J-59	J-13	198.02	10.28	90.0000	0.17
P-217	J-64	J-59	236.90	10.28	90.0000	0.17
P-219	J-64	J-93	428.51	8.27	90.0000	0.52
P-22	J-57	J-34	658.95	12.34	90.0000	0.00
P-221	J-61	J-64	294.29	10.28	90.0000	0.17
P-23	J-58	J-84	25.75	8.27	90.0000	0.00
P-239	J-12	J-14	275.83	10.28	90.0000	0.17
P-24	J-9	J-7	245.04	8.27	90.0000	0.17
P-243	J-16	J-18	408.03	8.27	90.0000	0.17
P-25	J-10	J-11	270.51	8.27	90.0000	0.00
P-255	J-51	J-70	16.36	10.28	90.0000	0.00
P-26	J-67	J-37	1285.05	8.27	90.0000	1.14
P-264	J-34	J-35	559.29	12.34	90.0000	1.62
P-265	J-44	J-49	287.63	8.27	90.0000	0.17
P-266	J-26	J-19	95.17	8.27	90.0000	0.00
P-268-CV	PR-1	J-3	17.14	12.34	90.0000	0.00
P-269	J-51	J-3	30.19	10.28	90.0000	7.09
P-27	J-12	J-10	61.27	8.27	90.0000	0.17
P-271	J-52	J-53	156.58	12.34	90.0000	0.00
P-272	J-66	J-4	8.87	8.27	90.0000	0.17
P-275	J-1	J-4	9.76	12.34	90.0000	0.00
P-28	J-85	J-41	1092.79	8.27	90.0000	1.54
P-285	J-53	J-57	1367.61	12.34	90.0000	0.34
P-286	J-46	J-21	116.24	12.34	90.0000	0.87
P-29	J-13	J-14	2021.68	8.27	90.0000	2.52
P-3	J-4	J-70	436.95	12.34	90.0000	0.70
P-30	J-86	J-82	457.17	8.27	90.0000	0.40
P-31	J-15	J-10	1335.13	8.27	90.0000	1.14
P-32	J-15	J-7	455.35	8.27	90.0000	1.84
P-33	J-87	J-44	1248.22	8.27	90.0000	0.80
P-34	J-16	J-15	416.64	8.27	90.0000	0.17
P-35	J-16	J-17	1343.13	8.27	90.0000	1.14
P-36	J-88	J-89	798.25	8.27	90.0000	0.57
P-37	J-57	J-58	184.20	8.27	90.0000	0.34
P-38	J-18	J-19	1348.06	8.27	90.0000	1.84
P-39	J-58	J-67	327.35	8.27	90.0000	0.34
P-4	J-50	J-31	303.86	8.27	90.0000	0.52

P-40	J-67	J-85	305.77	8.27	90.0000	0.34
P-41	J-20	J-21	168.80	8.27	90.0000	0.34
P-42	J-85	J-86	315.17	8.27	90.0000	0.34
P-43	J-86	J-87	252.23	8.27	90.0000	0.34
P-44	J-22	J-20	381.01	8.27	90.0000	0.17
P-45	J-87	J-88	284.30	8.27	90.0000	0.34
P-46	J-23	J-22	387.52	8.27	90.0000	0.00
P-47	J-89	J-49	677.75	8.27	90.0000	1.32
P-48	J-18	J-23	325.49	8.27	90.0000	0.57
P-49	J-23	J-76	391.70	8.27	90.0000	1.27
P-5	J-69	J-50	401.89	8.27	90.0000	0.40
P-50	J-90	J-80	77.45	8.27	90.0000	0.57
P-51	J-25	J-71	454.23	8.27	90.0000	1.27
P-52	J-91	J-65	527.19	8.27	90.0000	0.57
P-53	J-89	J-90	299.25	8.27	90.0000	0.34
P-54	J-90	J-91	286.19	8.27	90.0000	0.34
P-55	J-17	J-12	318.63	8.27	90.0000	0.00
P-56	J-26	J-17	306.82	8.27	90.0000	0.00
P-57	J-24	J-19	373.15	8.27	90.0000	0.00
P-58	J-27	J-24	43.67	8.27	90.0000	0.00
P-59	J-92	J-61	551.44	8.27	90.0000	0.57
P-6	J-71	J-72	388.95	8.27	90.0000	0.40
P-60	J-25	J-27	300.24	8.27	90.0000	0.17
P-61	J-28	J-25	187.57	8.27	90.0000	0.00
P-62	J-93	J-91	806.42	8.27	90.0000	0.40
P-63	J-29	J-20	1346.63	8.27	90.0000	1.14
P-64	J-88	J-92	280.77	8.27	90.0000	0.34
P-65	J-92	J-93	276.28	8.27	90.0000	0.34
P-66-CV	PR-2	J-46	339.34	12.34	90.0000	1.74
P-67	J-30	J-69	223.04	8.27	90.0000	0.57
P-69	J-31	J-32	521.13	12.34	90.0000	0.00
P-7	J-72	J-22	509.45	8.27	90.0000	0.87
P-71	J-33	J-32	543.94	12.34	90.0000	0.00
P-8	J-73	J-74	479.27	8.27	90.0000	0.40
P-81	J-29	J-28	196.49	8.27	90.0000	0.17
P-82	J-30	J-29	151.25	8.27	90.0000	0.00
P-83	J-36	J-30	129.33	8.27	90.0000	0.00
P-84	J-32	J-28	1184.63	8.27	90.0000	1.14
P-87	J-5	J-67	966.84	8.27	90.0000	1.37
P-9	J-74	J-8	1448.13	8.27	90.0000	2.94
P-92	J-38	J-39	1173.25	10.28	90.0000	0.87
P-97	J-40	J-85	970.22	8.27	90.0000	0.97

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		5.26	646.90	
J-10		6.49	665.57	
J-11		0.53	666.78	
J-12		1.05	666.41	
J-13		8.60	650.77	
J-14		16.67	663.73	
J-15		10.00	660.87	
J-16		11.41	659.23	

J-17		7.90	663.22
J-18		10.00	662.56
J-19		5.97	668.34
J-2		1.25	648.06
J-20		5.62	657.89
J-21		4.04	657.51
J-22		5.97	658.30
J-23		5.79	662.32
J-24		2.11	664.89
J-25		1.58	665.93
J-26		5.79	666.12
J-27		4.91	665.03
J-28		4.04	665.85
J-29		2.98	664.95
J-3		0.00	648.42
J-30		0.88	665.84
J-31		0.70	642.05
J-32		3.51	651.80
J-33		4.39	649.84
J-34		0.00	645.38
J-35		1.10	640.76
J-36		5.48	665.80
J-37		7.06	650.49
J-38		6.88	648.18
J-39		0.00	655.00
J-4		0.00	646.84
J-40		7.72	641.08
J-41		7.06	650.63
J-42		0.53	642.94
J-43		6.18	648.38
J-44		8.25	640.70
J-45		0.18	655.58
J-46	EC-SOCWA	5.97	658.00
J-47	EC-Ferndale	0.00	641.36
J-48		0.00	642.16
J-49		2.81	643.24
J-5		5.79	642.66
J-50	1F	2.63	661.00
J-51		8.07	648.00
J-52		9.13	654.88
J-53		0.00	655.33
J-54		0.00	653.00
J-55		0.00	650.63
J-56		3.31	646.80
J-57		0.00	641.00
J-58		9.13	644.00
J-59		0.99	649.53
J-6		0.00	643.53
J-60		0.00	648.00
J-61		4.18	649.02
J-62	EC-Ferndale	0.35	643.00
J-63	EC-Ferndale	0.00	648.19
J-64		3.07	647.71
J-65		4.46	642.19
J-66		0.00	646.83
J-67		11.93	645.00
J-68		0.00	648.00

J-69	1R	2.81	663.00	
J-7		4.21	658.64	
J-70		0.00	648.00	
J-71	2F	2.46	665.00	
J-72	2R	3.16	662.00	
J-73	3F	4.04	657.00	
J-74	3R	11.58	654.00	
J-75	4F	3.33	663.00	
J-76	4R	3.16	661.00	
J-77	5F	0.00	648.00	
J-78	5R	0.00	647.00	
J-79	6R	3.86	641.00	
J-8		9.30	654.08	
J-80	6F	5.26	645.00	
J-81	7R	4.74	641.00	
J-82	7F	7.72	640.00	
J-83	8F	6.14	642.00	
J-84	8R	6.14	644.00	
J-85		14.57	645.00	
J-86		8.60	644.00	
J-87		11.76	644.00	
J-88		8.42	645.00	
J-89		8.25	642.00	
J-9		1.40	659.92	
J-90		3.86	643.00	
J-91		10.00	643.00	
J-92		7.20	644.00	
J-93		7.55	644.00	
PR-1	PR-1	----	648.00	802.77
PR-2		----	658.00	802.72

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(P) = 122
NUMBER OF END NODES .....(J) = 93
NUMBER OF PRIMARY LOOPS .....(L) = 28
NUMBER OF SUPPLY NODES .....(F) = 2
NUMBER OF SUPPLY ZONES .....(Z) = 1

==========

Case: 0

RESULTS OBTAINED AFTER 10 TRIALS: ACCURACY = 0.12938E-03

S I M U L A T I O N D E S C R I P T I O N (L A B E L)

Revised Master Plan Improvements with Second
SOCWA Supply; Future 2035 Maximum Day Demand;
Sensitivity Analysis (All DI Pipe, Minimum 8" Diameter,
All Roughness "C" Factors set to 90)

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-1	J-1	J-2	1.25	0.00	0.00	0.00	0.00	0.00
P-10	J-75	J-24	2.02	0.00	0.00	0.01	0.00	0.00
P-103	J-38	J-86	9.04	0.00	0.00	0.05	0.01	0.01
P-107	J-43	J-87	10.38	0.01	0.00	0.06	0.01	0.01
P-11	J-76	J-75	5.36	0.00	0.00	0.03	0.00	0.00
P-12	J-77	J-38	15.92	0.00	0.00	0.06	0.01	0.00
P-120	J-31	J-36	-50.60	0.02	0.00	0.14	0.02	0.02
P-125	J-8	J-21	-35.10	0.00	0.00	0.09	0.01	0.01
P-126	J-45	J-8	-0.18	0.00	0.00	0.00	0.00	0.00
P-13	J-5	J-6	-6.99	0.00	0.00	0.04	0.00	0.00
P-130	J-36	J-46	-84.86	0.06	0.00	0.23	0.05	0.05
P-14	J-78	J-61	-49.74	0.01	0.00	0.19	0.04	0.04
P-148	J-47	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-149	J-27	J-33	20.34	0.03	0.00	0.12	0.02	0.02
P-15	J-79	J-90	-4.21	0.00	0.00	0.03	0.00	0.00
P-152	J-48	J-35	0.00	0.00	0.00	0.00	0.00	0.00
P-154	J-42	J-40	-3.34	0.00	0.00	0.02	0.00	0.00
P-155	J-40	J-5	-5.50	0.00	0.00	0.03	0.00	0.00
P-156	J-6	J-34	-10.10	0.00	0.00	0.06	0.01	0.01
P-157	J-53	J-54	0.00	0.00	0.00	0.00	0.00	0.00
P-16	J-80	J-92	-14.71	0.01	0.00	0.09	0.01	0.01
P-17	J-81	J-42	-3.60	0.00	0.00	0.02	0.00	0.00
P-170	J-33	J-55	90.76	0.01	0.00	0.24	0.05	0.05
P-171	J-41	J-55	-90.76	0.01	0.00	0.24	0.05	0.05
P-172	J-37	J-41	-63.98	0.01	0.00	0.17	0.03	0.03
P-174	J-52	J-58	10.12	0.01	0.00	0.06	0.01	0.01
P-175	J-37	J-52	43.37	0.00	0.00	0.12	0.01	0.01
P-178	J-44	J-42	0.79	0.00	0.00	0.00	0.00	0.00
P-179	J-56	J-88	13.95	0.01	0.00	0.08	0.01	0.01
P-18	J-82	J-81	1.14	0.00	0.00	0.01	0.00	0.00
P-188	J-26	J-1	-27.80	0.07	0.00	0.17	0.04	0.04
P-189	J-43	J-77	15.92	0.00	0.00	0.06	0.01	0.00
P-19	J-83	J-6	-3.11	0.00	0.00	0.02	0.00	0.00
P-191	J-14	J-51	-46.90	0.07	0.00	0.18	0.04	0.04
P-192	J-59	J-60	-138.90	0.05	0.00	0.54	0.28	0.28
P-192a	J-60	J-68	0.00	0.00	0.00	0.00	0.00	0.00
P-195	J-56	J-78	-49.74	0.00	0.00	0.19	0.05	0.04
P-197	J-56	J-43	32.49	0.01	0.00	0.13	0.02	0.02
P-2	J-70	J-60	138.90	0.01	0.00	0.54	0.28	0.28
P-20	J-7	J-73	-10.01	0.00	0.00	0.06	0.01	0.01
P-201	J-62	J-79	-0.35	0.00	0.00	0.00	0.00	0.00
P-209	J-13	J-63	0.00	0.00	0.00	0.00	0.00	0.00
P-21	J-84	J-83	3.04	0.00	0.00	0.02	0.00	0.00
P-210	J-59	J-13	15.65	0.00	0.00	0.06	0.00	0.00
P-217	J-64	J-59	-122.26	0.05	0.00	0.47	0.22	0.22
P-219	J-64	J-93	42.38	0.04	0.00	0.25	0.09	0.09
P-22	J-57	J-34	11.20	0.00	0.00	0.03	0.00	0.00
P-221	J-61	J-64	-76.81	0.03	0.00	0.30	0.09	0.09

P-23	J-58	J-84	9.18	0.00	0.00	0.05	0.01	0.01
P-239	J-12	J-14	-37.28	0.01	0.00	0.14	0.02	0.02
P-24	J-9	J-7	-1.40	0.00	0.00	0.01	0.00	0.00
P-243	J-16	J-18	1.50	0.00	0.00	0.01	0.00	0.00
P-25	J-10	J-11	0.53	0.00	0.00	0.00	0.00	0.00
P-255	J-51	J-70	173.22	0.01	0.00	0.67	0.41	0.41
P-26	J-67	J-37	-13.55	0.01	0.00	0.08	0.01	0.01
P-264	J-34	J-35	1.10	0.00	0.00	0.00	0.00	0.00
P-265	J-44	J-49	-3.03	0.00	0.00	0.02	0.00	0.00
P-266	J-26	J-19	24.80	0.00	0.00	0.15	0.03	0.03
P-268-CV	PR-1	J-3	228.19	0.00	0.00	0.61	0.28	0.28
P-269	J-51	J-3	-228.19	0.02	0.09	0.88	3.53	0.69
P-27	J-12	J-10	17.76	0.00	0.00	0.11	0.02	0.02
P-271	J-52	J-53	24.12	0.00	0.00	0.06	0.00	0.00
P-272	J-66	J-4	0.00	0.00	0.00	0.00	0.00	0.00
P-275	J-1	J-4	-34.32	0.00	0.00	0.09	0.01	0.01
P-28	J-85	J-41	-19.71	0.02	0.00	0.12	0.02	0.02
P-285	J-53	J-57	24.12	0.01	0.00	0.06	0.00	0.00
P-286	J-46	J-21	100.21	0.01	0.00	0.27	0.07	0.06
P-29	J-13	J-14	7.05	0.01	0.00	0.04	0.00	0.00
P-3	J-4	J-70	-34.32	0.00	0.00	0.09	0.01	0.01
P-30	J-86	J-82	8.86	0.00	0.00	0.05	0.00	0.00
P-31	J-15	J-10	-10.74	0.01	0.00	0.06	0.01	0.01
P-32	J-15	J-7	-4.39	0.00	0.00	0.03	0.00	0.00
P-33	J-87	J-44	6.01	0.00	0.00	0.04	0.00	0.00
P-34	J-16	J-15	-5.13	0.00	0.00	0.03	0.00	0.00
P-35	J-16	J-17	-7.78	0.01	0.00	0.05	0.00	0.00
P-36	J-88	J-89	9.64	0.00	0.00	0.06	0.01	0.01
P-37	J-57	J-58	12.93	0.00	0.00	0.08	0.01	0.01
P-38	J-18	J-19	-4.58	0.00	0.00	0.03	0.00	0.00
P-39	J-58	J-67	4.75	0.00	0.00	0.03	0.00	0.00
P-4	J-50	J-31	12.38	0.00	0.00	0.07	0.01	0.01
P-40	J-67	J-85	2.05	0.00	0.00	0.01	0.00	0.00
P-41	J-20	J-21	-61.08	0.03	0.00	0.36	0.18	0.17
P-42	J-85	J-86	1.64	0.00	0.00	0.01	0.00	0.00
P-43	J-86	J-87	-6.78	0.00	0.00	0.04	0.00	0.00
P-44	J-22	J-20	-36.66	0.03	0.00	0.22	0.07	0.07
P-45	J-87	J-88	-14.17	0.00	0.00	0.08	0.01	0.01
P-46	J-23	J-22	-18.23	0.01	0.00	0.11	0.02	0.02
P-47	J-89	J-49	5.83	0.00	0.00	0.03	0.00	0.00
P-48	J-18	J-23	-3.92	0.00	0.00	0.02	0.00	0.00
P-49	J-23	J-76	8.51	0.00	0.00	0.05	0.00	0.00
P-5	J-69	J-50	15.01	0.01	0.00	0.09	0.01	0.01
P-50	J-90	J-80	-9.44	0.00	0.00	0.06	0.01	0.01
P-51	J-25	J-71	-6.85	0.00	0.00	0.04	0.00	0.00
P-52	J-91	J-65	4.46	0.00	0.00	0.03	0.00	0.00
P-53	J-89	J-90	-4.44	0.00	0.00	0.03	0.00	0.00
P-54	J-90	J-91	-3.07	0.00	0.00	0.02	0.00	0.00
P-55	J-17	J-12	-18.46	0.01	0.00	0.11	0.02	0.02
P-56	J-26	J-17	-2.79	0.00	0.00	0.02	0.00	0.00
P-57	J-24	J-19	-14.25	0.00	0.00	0.09	0.01	0.01
P-58	J-27	J-24	-14.16	0.00	0.00	0.08	0.01	0.01
P-59	J-92	J-61	-22.89	0.02	0.00	0.14	0.03	0.03
P-6	J-71	J-72	-9.30	0.00	0.00	0.06	0.01	0.01
P-60	J-25	J-27	11.08	0.00	0.00	0.07	0.01	0.01
P-61	J-28	J-25	5.82	0.00	0.00	0.03	0.00	0.00
P-62	J-93	J-91	17.53	0.01	0.00	0.10	0.02	0.02

P-63	J-29	J-20	-18.80	0.03	0.00	0.11	0.02	0.02
P-64	J-88	J-92	-18.29	0.01	0.00	0.11	0.02	0.02
P-65	J-92	J-93	-17.30	0.00	0.00	0.10	0.02	0.02
P-66-CV	PR-2	J-46	191.04	0.07	0.01	0.51	0.22	0.20
P-67	J-30	J-69	17.82	0.00	0.00	0.11	0.02	0.02
P-69	J-31	J-32	62.27	0.01	0.00	0.17	0.03	0.03
P-7	J-72	J-22	-12.46	0.00	0.00	0.07	0.01	0.01
P-71	J-33	J-32	-74.81	0.02	0.00	0.20	0.04	0.04
P-8	J-73	J-74	-14.04	0.01	0.00	0.08	0.01	0.01
P-81	J-29	J-28	25.90	0.01	0.00	0.15	0.04	0.04
P-82	J-30	J-29	10.08	0.00	0.00	0.06	0.01	0.01
P-83	J-36	J-30	28.78	0.01	0.00	0.17	0.04	0.04
P-84	J-32	J-28	-16.05	0.02	0.00	0.10	0.01	0.01
P-87	J-5	J-67	-4.31	0.00	0.00	0.03	0.00	0.00
P-9	J-74	J-8	-25.63	0.05	0.00	0.15	0.04	0.03
P-92	J-38	J-39	0.00	0.00	0.00	0.00	0.00	0.00
P-97	J-40	J-85	-5.56	0.00	0.00	0.03	0.00	0.00

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
J-1		5.26	802.65	646.90	155.75	67.49
J-10		6.49	802.58	665.57	137.01	59.37
J-11		0.53	802.58	666.78	135.80	58.85
J-12		1.05	802.58	666.41	136.17	59.01
J-13		8.60	802.60	650.77	151.83	65.79
J-14		16.67	802.59	663.73	138.86	60.17
J-15		10.00	802.57	660.87	141.71	61.41
J-16		11.41	802.57	659.23	143.34	62.12
J-17		7.90	802.58	663.22	139.36	60.39
J-18		10.00	802.57	662.56	140.01	60.67
J-19		5.97	802.57	668.34	134.24	58.17
J-2		1.25	802.65	648.06	154.59	66.99
J-20		5.62	802.61	657.89	144.71	62.71
J-21		4.04	802.64	657.51	145.13	62.89
J-22		5.97	802.58	658.30	144.28	62.52
J-23		5.79	802.57	662.32	140.25	60.77
J-24		2.11	802.57	664.89	137.68	59.66
J-25		1.58	802.57	665.93	136.64	59.21
J-26		5.79	802.58	666.12	136.46	59.13
J-27		4.91	802.57	665.03	137.54	59.60
J-28		4.04	802.57	665.85	136.72	59.25
J-29		2.98	802.58	664.95	137.63	59.64
J-3		0.00	802.77	648.42	154.34	66.88
J-30		0.88	802.58	665.84	136.74	59.25
J-31		0.70	802.57	642.05	160.52	69.56
J-32		3.51	802.55	651.80	150.75	65.33
J-33		4.39	802.54	649.84	152.70	66.17
J-34		0.00	802.50	645.38	157.12	68.08
J-35		1.10	802.50	640.76	161.73	70.08
J-36		5.48	802.59	665.80	136.79	59.27
J-37		7.06	802.51	650.49	152.01	65.87
J-38		6.88	802.50	648.18	154.32	66.87
J-39		0.00	802.50	655.00	147.50	63.92

J-4		0.00	802.65	646.84	155.80	67.51
J-40		7.72	802.49	641.08	161.41	69.95
J-41		7.06	802.52	650.63	151.89	65.82
J-42		0.53	802.49	642.94	159.55	69.14
J-43		6.18	802.50	648.38	154.12	66.79
J-44		8.25	802.49	640.70	161.79	70.11
J-45		0.18	802.63	655.58	147.05	63.72
J-46	EC-SOCWA	5.97	802.64	658.00	144.64	62.68
J-47	EC-Ferndale	0.00	802.50	641.36	161.13	69.82
J-48		0.00	802.50	642.16	160.33	69.48
J-49		2.81	802.49	643.24	159.25	69.01
J-5		5.79	802.49	642.66	159.83	69.26
J-50	1F	2.63	802.57	661.00	141.57	61.35
J-51		8.07	802.66	648.00	154.66	67.02
J-52		9.13	802.50	654.88	147.62	63.97
J-53		0.00	802.50	655.33	147.18	63.78
J-54		0.00	802.50	653.00	149.50	64.78
J-55		0.00	802.52	650.63	151.90	65.82
J-56		3.31	802.51	646.80	155.71	67.47
J-57		0.00	802.50	641.00	161.50	69.98
J-58		9.13	802.49	644.00	158.49	68.68
J-59		0.99	802.60	649.53	153.06	66.33
J-6		0.00	802.49	643.53	158.96	68.88
J-60		0.00	802.65	648.00	154.65	67.01
J-61		4.18	802.52	649.02	153.50	66.51
J-62	EC-Ferndale	0.35	802.49	643.00	159.49	69.11
J-63	EC-Ferndale	0.00	802.60	648.19	154.41	66.91
J-64		3.07	802.55	647.71	154.83	67.10
J-65		4.46	802.49	642.19	160.30	69.46
J-66		0.00	802.65	646.83	155.82	67.52
J-67		11.93	802.49	645.00	157.49	68.25
J-68		0.00	802.65	648.00	154.65	67.01
J-69	1R	2.81	802.58	663.00	139.58	60.48
J-7		4.21	802.57	658.64	143.93	62.37
J-70		0.00	802.65	648.00	154.65	67.02
J-71	2F	2.46	802.57	665.00	137.57	59.61
J-72	2R	3.16	802.58	662.00	140.58	60.92
J-73	3F	4.04	802.57	657.00	145.57	63.08
J-74	3R	11.58	802.58	654.00	148.58	64.38
J-75	4F	3.33	802.57	663.00	139.57	60.48
J-76	4R	3.16	802.57	661.00	141.57	61.35
J-77	5F	0.00	802.50	648.00	154.50	66.95
J-78	5R	0.00	802.51	647.00	155.51	67.39
J-79	6R	3.86	802.49	641.00	161.49	69.98
J-8		9.30	802.63	654.08	148.56	64.37
J-80	6F	5.26	802.49	645.00	157.49	68.25
J-81	7R	4.74	802.49	641.00	161.49	69.98
J-82	7F	7.72	802.49	640.00	162.49	70.41
J-83	8F	6.14	802.49	642.00	160.49	69.55
J-84	8R	6.14	802.49	644.00	158.49	68.68
J-85		14.57	802.49	645.00	157.49	68.25
J-86		8.60	802.49	644.00	158.49	68.68
J-87		11.76	802.49	644.00	158.49	68.68
J-88		8.42	802.50	645.00	157.50	68.25
J-89		8.25	802.49	642.00	160.49	69.55
J-9		1.40	802.57	659.92	142.65	61.82
J-90		3.86	802.49	643.00	159.49	69.11

J-91		10.00	802.49	643.00	159.49	69.11
J-92		7.20	802.50	644.00	158.50	68.68
J-93		7.55	802.51	644.00	158.51	68.69
PR-1	PR-1	----	802.77	648.00	154.77	67.07
PR-2		----	802.72	658.00	144.72	62.71

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
J-82	70.41	J-19	58.17
J-44	70.11	J-11	58.85
J-35	70.08	J-12	59.01
J-57	69.98	J-26	59.13
J-79	69.98	J-25	59.21

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-269	0.88	P-126	0.00
P-255	0.67	P-201	0.00
P-268	0.61	P-264	0.00
P-192	0.54	P-25	0.00
P-2	0.54	P-1	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-269	3.53	P-126	0.00
P-255	0.41	P-201	0.00
P-268	0.28	P-264	0.00
P-192	0.28	P-1	0.00
P-2	0.28	P-25	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-269	0.69	P-126	0.00
P-255	0.41	P-201	0.00
P-268	0.28	P-264	0.00
P-192	0.28	P-1	0.00
P-2	0.28	P-25	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
PR-1	228.19	PR-1
PR-2	191.04	

NET SYSTEM INFLOW = 419.23
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 419.23

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FireFlow/Hydrant Report
Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

Hydrant Node	Hydrant Constant	Elevation	Demand gpm	Static Pressure	Flow-1 gpm	Flow-2 gpm	Node-2
J-1	0.0	646.9	5.3	67.5	7332.9	7291.2	J-2
J-10	0.0	665.6	6.5	59.4	4804.3	4769.3	J-11
J-11	0.0	666.8	0.5	58.8	2794.2		
J-12	0.0	666.4	1.1	59.0	5421.2		
J-13	0.0	650.8	8.6	65.8	6266.3		
J-14	0.0	663.7	16.7	60.2	5545.4		
J-15	0.0	660.9	10.0	61.4	4206.0		
J-16	0.0	659.2	11.4	62.1	4752.9		
J-17	0.0	663.2	7.9	60.4	5272.7		
J-18	0.0	662.6	10.0	60.7	4929.8		
J-19	0.0	668.3	6.0	58.2	5436.6		
J-2	0.0	648.1	1.2	67.0	7051.3		
J-20	0.0	657.9	5.6	62.7	6789.3		
J-21	0.0	657.5	4.0	62.9	10324.1		
J-22	0.0	658.3	6.0	62.5	5504.5		
J-23	0.0	662.3	5.8	60.8	5096.3		
J-24	0.0	664.9	2.1	59.7	5797.0		
J-25	0.0	665.9	1.6	59.2	5688.8		
J-26	0.0	666.1	5.8	59.1	5517.6		
J-27	0.0	665.0	4.9	59.6	5838.7		
J-28	0.0	665.9	4.0	59.2	5883.2		
J-29	0.0	664.9	3.0	59.6	6144.7		
J-3	0.0	648.4	0.0	66.9	54049.0		

J-30	0.0	665.8	0.9	59.3	6420.7		
J-31	0.0	642.1	0.7	69.6	7538.2	7271.8	J-50
J-32	0.0	651.8	3.5	65.3	7109.5		
J-33	0.0	649.8	4.4	66.2	6829.2		
J-34	0.0	645.4	0.0	68.1	4623.8		
J-35	0.0	640.8	1.1	70.1	3917.5	3891.5	J-48
J-36	0.0	665.8	5.5	59.3	7337.2		
J-37	0.0	650.5	7.1	65.9	5813.6	5754.8	J-52
J-38	0.0	648.2	6.9	66.9	4544.4	4384.6	J-39
J-39	0.0	655.0	0.0	63.9	2435.0		
J-4	0.0	646.8	0.0	67.5	7367.9	7325.9	J-2
J-40	0.0	641.1	7.7	69.9	4831.0		
J-41	0.0	650.6	7.1	65.8	6329.2		
J-42	0.0	642.9	0.5	69.1	4767.6		
J-43	0.0	648.4	6.2	66.8	5119.6	5032.4	J-39
J-44	0.0	640.7	8.2	70.1	4582.5		
J-45	0.0	655.6	0.2	63.7	6093.0		
J-46	0.0	658.0	6.0	62.7	12146.7		
J-47	0.0	641.4	0.0	69.8	3719.9		
J-48	0.0	642.2	0.0	69.5	2350.6		
J-49	0.0	643.2	2.8	69.0	3918.3		
J-5	0.0	642.7	5.8	69.3	4703.6		
J-50	0.0	661.0	2.6	61.3	4480.9		
J-51	0.0	648.0	8.1	67.0	11154.1		
J-52	0.0	654.9	9.1	64.0	5258.2		
J-53	0.0	655.3	0.0	63.8	5069.0		
J-54	0.0	653.0	0.0	64.8	4797.7		
J-55	0.0	650.6	0.0	65.8	6476.5		
J-56	0.0	646.8	3.3	67.5	5599.8		
J-57	0.0	641.0	0.0	70.0	5129.0	5123.6	J-34
J-58	0.0	644.0	9.1	68.7	5087.2		
J-59	0.0	649.5	1.0	66.3	8261.2		
J-6	0.0	643.5	0.0	68.9	4653.0		
J-60	0.0	648.0	0.0	67.0	10308.0		
J-61	0.0	649.0	4.2	66.5	5987.5		
J-62	0.0	643.0	0.4	69.1	2168.0		
J-63	0.0	648.2	0.0	66.9	4347.7		
J-64	0.0	647.7	3.1	67.1	6786.8		
J-65	0.0	642.2	4.5	69.5	2217.9		
J-66	0.0	646.8	0.0	67.5	6844.9		
J-67	0.0	645.0	11.9	68.2	5285.5		
J-68	0.0	648.0	0.0	67.0	8195.9		
J-69	0.0	663.0	2.8	60.5	4586.9		
J-7	0.0	658.6	4.2	62.4	3164.4	3141.7	J-9
J-70	0.0	648.0	0.0	67.0	10821.2		
J-71	0.0	665.0	2.5	59.6	3710.1		
J-72	0.0	662.0	3.2	60.9	3712.5		
J-73	0.0	657.0	4.0	63.1	3058.5		
J-74	0.0	654.0	11.6	64.4	2949.6		
J-75	0.0	663.0	3.3	60.5	3626.5		
J-76	0.0	661.0	3.2	61.3	3752.1		
J-77	0.0	648.0	0.0	66.9	4575.7	4419.5	J-39
J-78	0.0	647.0	0.0	67.4	5611.1		
J-79	0.0	641.0	3.9	70.0	2352.9	2330.5	J-62
J-8	0.0	654.1	9.3	64.4	6935.2	6879.8	J-45
J-80	0.0	645.0	5.3	68.2	4210.4		
J-81	0.0	641.0	4.7	70.0	4491.3		

J-82	0.0	640.0	7.7	70.4	3993.3
J-83	0.0	642.0	6.1	69.5	4492.4
J-84	0.0	644.0	6.1	68.7	4873.3
J-85	0.0	645.0	14.6	68.2	5575.7
J-86	0.0	644.0	8.6	68.7	5549.5
J-87	0.0	644.0	11.8	68.7	5494.0
J-88	0.0	645.0	8.4	68.2	5491.3
J-89	0.0	642.0	8.2	69.5	4546.8
J-9	0.0	659.9	1.4	61.8	2384.4
J-90	0.0	643.0	3.9	69.1	4469.1
J-91	0.0	643.0	10.0	69.1	3855.5
J-92	0.0	644.0	7.2	68.7	5465.1
J-93	0.0	644.0	7.5	68.7	5064.1

APPENDIX J

Interim & Master Plan Capital Improvement Program

Includes:
Preliminary Engineering Estimate for Interim Capital Improvement Program Projects
Rough Budgetary Estimates for Master Plan Capital Improvement Program Projects
Water Distribution System Interim Capital Improvement Program Map Panels
Water Distribution System Master Plan Capital Improvement Program Map Panels

ANDERSON, ECKSTEIN & WESTRICK, INC.
51301 Schoenherr Road
Shelby Township, MI 48315
Phone: 586-726-1234
Fax No: 586-726-8780

PROJECT: **Water System Reliability Study**
2nd SOCWA Supply - 10 Mile & Oakdale

OWNER: Pleasant Ridge

PREPARED BY: Chris Frayer
DATE: 1/13/2015

PRELIMARY ESTIMATE

AEW PROJECT NO. 0175-0095

CHECKED BY: Mike Smith
DATE:

WORK ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Water Main, DI, 8 inch	100	FT	$ 80.00	$ 8,000.00
Water Main, DI, 12 inch	100	FT	$ 120.00	$ 12,000.00
Meter Vault with Appurtenances, complete	1	EA	$400,000.00	$ 400,000.00
Pressure Reducing Valve Chamber, complete	1	EA	$400,000.00	$ 400,000.00
Gate Valve & Well	8	EA	$ 5,500.00	$ 44,000.00
Water Main Connection, 12 inch	1	EA	$ 15,000.00	$ 15,000.00
Controls & Telemetry	1	LS	$ 50,000.00	$ 50,000.00
Bond, Insurance & Mobilization, (Max. 3%)	1	LS	$ 29,970.00	$ 29,970.00
Project Cleanup	1	LS	$ 10,000.00	$ 10,000.00
Audio Visual Record of Construction Area	1	LS	$ 10,000.00	$ 10,000.00
Traffic Maintenance & Control	1	LS	$ 50,000.00	$ 50,000.00
			ESTIMATED CONSTRUCTION COST	$ 1,028,970.00
			10% Construction Contingency	$ 102,897.00
			TOTAL CONSTRUCTION COST	$ 1,131,867.00
			CONSTRUCTION COST	$ 1,131,867.00
			Engineering Design Fee 6.2%	$ 70,328.00
			Design Survey 5%	$ 56,593.00
			Construction Observation 10%	$ 113,187.00
			Contract Administration 3%	$ 33,956.00
			As-Builts 1%	$ 5,659.00
			TOTAL COST	**$ 1,411,590.00**

Assumptions:
-Assume work will be under roadway Eastbound I-696 Service Drive and require road closure.
-No contact has been made with SOCWA regarding this proposed second connection.
-Supply connection would have an estimated demand of 80-330 gpm.
-AEW makes No assurances SOCWA would permit a second connection or this location would be permissible.

ANDERSON, ECKSTEIN & WESTRICK, INC.
51301 Schoenherr Road
Shelby Township, MI 48315
Phone: 586-726-1234
Fax No: 586-726-8780

PROJECT: **Water System Reliability Study**
Ridge - 10 Mile Rd to South City Limit

OWNER: Pleasant Ridge

PREPARED BY: Chris Frayer
DATE: 12/11/2015

PRELIMARY ESTIMATE

AEW PROJECT NO. 0175-0095

CHECKED BY: Mike Smith
DATE: 12/11/2015

WORK ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Water Main, DI, 8 inch	2525	FT	$ 80.00	$ 202,000.00
1" Short Side Waste Service Replacement	22	EA	$ 1,500.00	$ 33,000.00
1" Long Side Water Service Replacement	7	EA	$ 2,000.00	$ 14,000.00
Gate Valve & Well	17	EA	$ 3,500.00	$ 59,500.00
Water Main Connection, 8 inch	12	EA	$ 3,250.00	$ 39,000.00
Hydrant Assembly	7	EA	$ 3,800.00	$ 26,600.00
Bond, Insurance & Mobilization, (Max. 3%)	1	LS	$ 12,048.00	$ 12,048.00
Project Cleanup	1	LS	$ 10,000.00	$ 10,000.00
Audio Visual Record of Construction Area	1	LS	$ 7,500.00	$ 7,500.00
Traffic Maintenance & Control	1	LS	$ 10,000.00	$ 10,000.00
			TOTAL CONSTRUCTION COST	$ 413,648.00
			10% Construction Contingency	$ 41,365.00
			TOTAL CONSTRUCTION COST	$ 455,013.00
			CONSTRUCTION COST	$ 455,013.00
			Engineering Design Fee 7.3%	$ 33,305.00
			Design Survey 5%	$ 22,751.00
			Construction Observation 10%	$ 45,501.00
			Contract Administration 3%	$ 13,650.00
			As-Builts 1%	$ 2,275.00
			TOTAL COST	**$ 572,495.00**

Assumptions:
-Assume water main will be under roadway, overhead utilities in West greenbelt
-Driveway approaches, Pavement Repair, ADA Ramps & greenbelt restoration part of Ridge Road Replacement Project

ANDERSON, ECKSTEIN & WESTRICK, INC.
51301 Schoenherr Road
Shelby Township, MI 48315
Phone: 586-726-1234
Fax No: 586-726-8780

PROJECT: **Water System Reliability Study**
Indiana - 10 Mile Road to Woodward Heights

OWNER: Pleasant Ridge

PREPARED BY: Chris Frayer
DATE: 12/11/2015

PRELIMARY ESTIMATE

AEW PROJECT NO. 0175-0095

CHECKED BY: Mike Smith
DATE: 12/11/2015

WORK ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Water Main, DI, 8 inch	2325	FT	$ 80.00	$ 186,000.00
Gate Valve & Well	16	EA	$ 3,500.00	$ 56,000.00
Water Main Connection, 8 inch	9	EA	$ 3,250.00	$ 29,250.00
Hydrant Assembly	6	EA	$ 3,800.00	$ 22,800.00
Bond, Insurance & Mobilization, (Max. 3%)	1	LS	$ 9,647.00	$ 9,647.00
Project Cleanup	1	LS	$ 10,000.00	$ 10,000.00
Audio Visual Record of Construction Area	1	LS	$ 7,500.00	$ 7,500.00
Traffic Maintenance & Control	1	LS	$ 10,000.00	$ 10,000.00
			TOTAL CONSTRUCTION COST	$ 331,197.00
			10% Construction Contingency	$ 33,120.00
			TOTAL CONSTRUCTION COST	$ 364,317.00
			CONSTRUCTION COST	$ 364,317.00
			Engineering Design Fee 7.6%	$ 27,778.00
			Design Survey 5%	$ 18,216.00
			Construction Observation 10%	$ 36,432.00
			Contract Administration 3%	$ 10,930.00
			As-Builts 1%	$ 1,822.00
			TOTAL COST	**$ 459,495.00**

Assumptions:
-Assume water main will be under roadway
-Driveway approaches, Pavement Repair, ADA Ramps & greenbelt restoration part of Indiana Road Replacement Project

ANDERSON, ECKSTEIN & WESTRICK, INC.
51301 Schoenherr Road
Shelby Township, MI 48315
Phone: 586-726-1234
Fax No: 586-726-8780

PROJECT: **Water System Reliability Study**
Bermuda - Sylvan to Woodward Heights

OWNER: Pleasant Ridge

PREPARED BY: Chris Frayer
DATE: 12/11/2015

PRELIMARY ESTIMATE

AEW PROJECT NO. 0175-0095

CHECKED BY: Mike Smith
DATE: 12/11/2015

WORK ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Water Main, DI, 8 inch	615	FT	$ 80.00	$ 49,200.00
Gate Valve & Well	4	EA	$ 3,500.00	$ 14,000.00
Water Main Connection, 8 inch	3	EA	$ 3,250.00	$ 9,750.00
Hydrant Assembly	2	EA	$ 3,800.00	$ 7,600.00
Bond, Insurance & Mobilization, (Max. 3%)	1	LS	$ 3,242.00	$ 3,242.00
Project Cleanup	1	LS	$ 10,000.00	$ 10,000.00
Audio Visual Record of Construction Area	1	LS	$ 7,500.00	$ 7,500.00
Traffic Maintenance & Control	1	LS	$ 10,000.00	$ 10,000.00
			TOTAL CONSTRUCTION COST	$ 111,292.00
			10% Construction Contingency	$ 11,129.00
			TOTAL CONSTRUCTION COST	$ 122,421.00
			CONSTRUCTION COST	$ 122,421.00
			Engineering Design Fee 8.9%	$ 10,906.00
			Design Survey 5%	$ 6,121.00
			Construction Observation 10%	$ 12,242.00
			Contract Administration 3%	$ 3,673.00
			As-Builts 1%	$ 612.00
			TOTAL COST	**$ 155,975.00**

Assumptions:
-Assume water main will be under roadway
-Driveway approaches, Pavement Repair, ADA Ramps & greenbelt restoration part of Bermuda Road Replacement Project

City of Huntington Woods

City of Royal Oak

City of Oak Park

PR-2

12" P-22 (CIP #1)

CV-1

ADDITIONAL SOCWA SUPPLY

I-696

I-696 SERVICE DR.

12" P-130

12" P-120

J-36

J-31

J-54

12" P-157

12" P-285

J-53

J-39

12" P-271

6" P-174

J-52

12" P-175

10" P-82

J-37

MAIN STREET

10" P-83

8" P-67

8" P-5

8" P-4

J-69

J-50

J-30

WOODWARD AVE. (M-1)

12" P-69

MILLINGTON RD. (50')

J-45

12" P-126

J-8

12" P-125

J-21

12" P-286

J-46

WOODSIDE PARK BLVD. (80')

11-d-9

8" P-63

J-29

10" P-81

POPLAR PARK AVE. (100')

J-32

6" P-84

J-20

J-28

KENBERTON DR. (50')

KENBERTON DR. (60')

RIDGE RD. (50')

10" P-61

12" P-71

J-25

6" P-7

J-72

6" P-6

J-71

6" P-51

J-22

6-d-8

9-d-9

10" P-60

ELM PARK AVE. (50')

ELM PARK AVE. (100')

8" P-149

J-27

J-24

MAHLEFELD RD (50')

OAKDALE BLVD.

J-76

6" P-11

J-75

6" P-10

6" P-49

J-23

8-d-9

NORWICH RD. (50')

10" P-57

OAKLAND PARK

ANDERSON, ECKSTEIN AND WESTRICK, INC.
Civil Engineers • Surveyors • Architects
51301 Schoenherr Road, Shelby Township, Michigan 48315
Phone 586-726-1234 Fax 586-726-8780

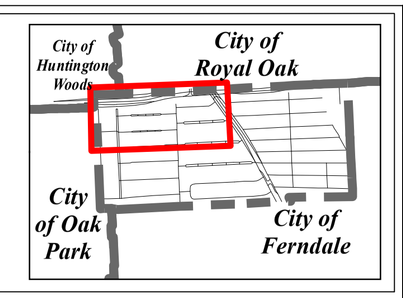
PLOT DATE: January 14, 2016	DRAWING DATE: December 17, 2015
PLOT SCALE: NTS	DRAWING SCALE: 24" x 36"
PLOT CONFIG:	PROJECT NO: 0175-0095
SCRIPT FILE:	FILE NAME: Water Basemap 24X36.mxd
ATTACH XREF:	DRAWN BY: GIS DEPT / CHK'D BY: GIS DEPT

CITY OF PLEASANT RIDGE INCORPORATED 1928 OAKLAND COUNTY MICHIGAN SEAL

- Intermediate Node
- Node
- Water Main
- 1-5 Year Improvement

CITY of PLEASANT RIDGE

INTERIM WATER MAIN IMPROVEMENT PLAN (Year 1-5)



PANEL NUMBER: 1

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City of Royal Oak

City of Ferndale

I-696 SERVICE DR.

I-696

EMERGENCY CONNECTION TO FERNDALE

J-54 J-53 J-39 J-52 J-37 J-32 J-41 J-55 J-33 J-38 J-77 J-43 J-34 J-35 J-47 J-6 J-83 J-84 J-48 J-5 J-40 J-82 J-81 J-42 J-44

12" P-157 12" P-271 12" P-285 12" P-264 12" P-148 6" P-156 6" P-152 6" P-21 6" P-174 6" P-13 6" P-87 6" P-155 6" P-97 6" P-154 6" P-17 6" P-18 6" P-178 6" P-107 6" P-265 10" P-92 12" P-175 12" P-69 6" P-84 12" P-172 12" P-71 12" P-171 12" P-170 8" P-149 6" P-103 10" P-189 10" P-197

MAIN STREET

EDWARD AVE. (M-1)

KENSINGTON BLVD. (60')

DEVONSHIRE RD. (60')

WELLESLEY DR. (60')

AMHERST RD. (60)

MAYWOOD AVE. (60')

INDIANA AVE.

EPRIZE DR. (50')

CANADIAN NATIONAL RAIL ROAD

GAINSBORO AVE.

ELM PARK AVE. (100')

24280 24242 24200 24126 24100 24060 24072 24028 24025

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ATTACH XREF:	DRAWN BY: GIS DEPT	CHKD BY: GIS DEPT

PLEASANT RIDGE CITY OAKLAND COUNTY MICHIGAN INCORPORATED 1928 SEAL

- Intermediate Node
- Node
- Water Main
- 1-5 Year Improvement

CITY of PLEASANT RIDGE

INTERIM WATER MAIN IMPROVEMENT PLAN (Year 1-5)

City of Huntington Woods · *City of Royal Oak* · *City of Oak Park* · *City of Ferndale*

PANEL NUMBER: **2**

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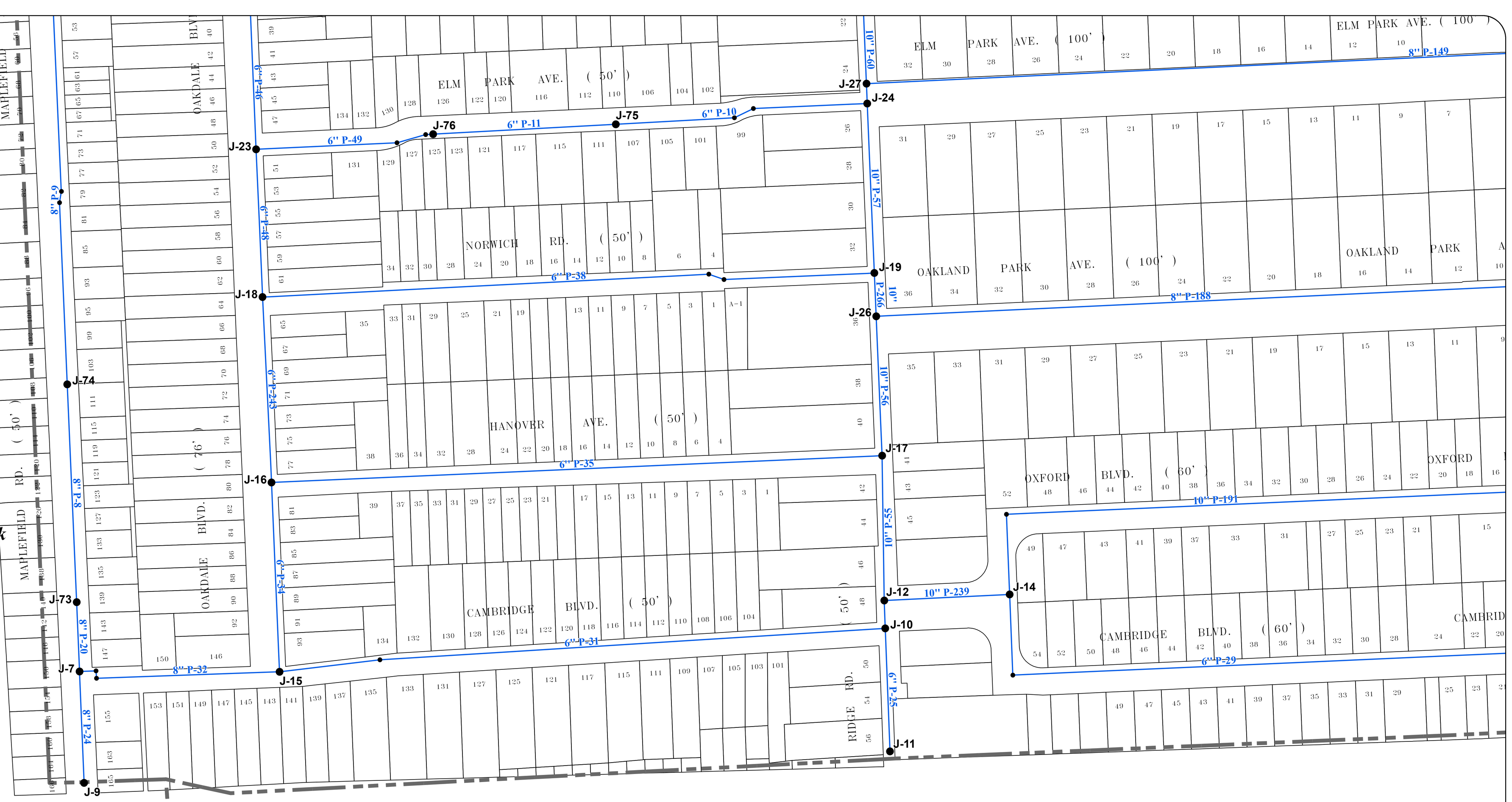

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Phone 586-726-1234 Fax 586-726-8780

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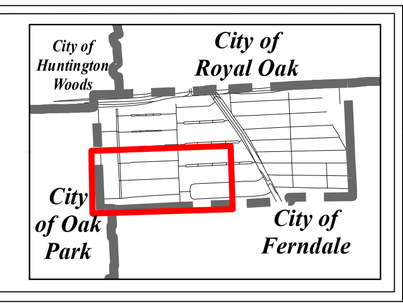
- Intermediate Node
- Node
- Water Main
- 1-5 Year Improvement

CITY of PLEASANT RIDGE

INTERIM WATER MAIN IMPROVEMENT PLAN (Year 1-5)



PANEL NUMBER: **3**

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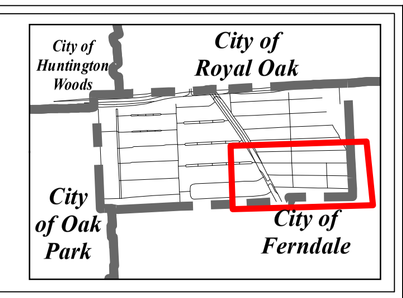
ATTACH XREF:	DRAWN BY: GIS DEPT / CHK'D BY: GIS DEPT

- Intermediate Node
- Node
- Water Main
- 1-5 Year Improvement

CITY of PLEASANT RIDGE

INTERIM WATER MAIN IMPROVEMENT PLAN (Year 1-5)



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City of Huntington Woods

City of Royal Oak

City of Oak Park

PR-2

12" P-66 (CIP #1)

CV-1

ADDITIONAL SOCWA SUPPLY

I-696

I-696 SERVICE DR.

12" P-130

12" P-120

12" P-125

12" P-126

12" P-286

12" P-157

12" P-285

12" P-271

6" P-174

10" P-82

12" P-175

12" P-69

8" P-83 (CIP #3)

8" P-82 (CIP #3)

8" P-81 (CIP #3)

8" P-61 (CIP #3)

8" P-60 (CIP #3)

8" P-57 (CIP #3)

8" P-67

8" P-5

8" P-4

8" P-63

6" P-84

12" P-71

8" P-149

6" P-7

6" P-6

6" P-51

6" P-49

6" P-11

6" P-10

11-d-9

9-d-9

8-d-9

6-d-8

J-45 J-8 J-21 J-46 J-20 J-22 J-23 J-72 J-71 J-76 J-75 J-36 J-30 J-69 J-50 J-31 J-29 J-28 J-25 J-27 J-24 J-32 J-54 J-53 J-39 J-52 J-37

MILLINGTON RD. (50')

WOODSIDE PARK BLVD. (80')

KENBERTON DR. (50')

KENBERTON DR. (60')

ELM PARK AVE. (50')

POPLAR PARK AVE. (100')

ELM PARK AVE. (100')

OAKLAND PARK AVE. (100')

NORWICH RD. (50')

RIDGE RD. (50')

MAHLEFELD RD (50')

OAKDALE BLVD.

WOODWARD AVE. (M-1)

MAIN STREET

ANDERSON, ECKSTEIN AND WESTRICK, INC.
Civil Engineers • Surveyors • Architects
51301 Schoenherr Road, Shelby Township, Michigan 48315
Phone 586-726-1234 Fax 586-726-8780

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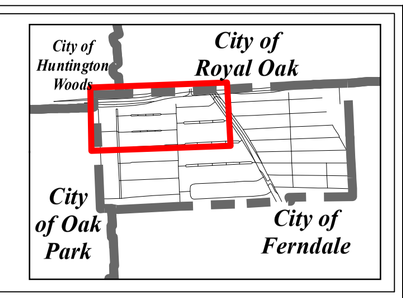
CITY OF PLEASANT RIDGE SEAL — INCORPORATED 1928 — OAKLAND COUNTY MICHIGAN

- Intermediate Node
- Node
- Water Main
- 1-5 Year Improvement
- 6-20 Year Improvement

CITY of PLEASANT RIDGE

MASTER WATER MAIN IMPROVEMENT PLAN (Year 5-20)



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City of Royal Oak

City of Ferndale

I-696 SERVICE DR.

EMERGENCY CONNECTION TO FERNDALE

J-54 J-53 J-39 J-52 J-58 J-84 J-57 J-34 J-35 J-47 J-6 J-83 J-48 J-5 J-67 J-37 J-32 J-41 J-55 J-33 J-38 J-77 J-86 J-85 J-40 J-82 J-81 J-42 J-87 J-43 J-44

12" P-157 12" P-271 12" P-285 12" P-22 12" P-264 12" P-148 6" P-156 6" P-152 6" P-21 6" P-174 6" P-13 6" P-87 12" P-175 10" P-92 12" P-69 6" P-84 6" P-26 12" P-172 12" P-71 6" P-155 6" P-97 6" P-28 12" P-171 12" P-170 6" P-154 6" P-30 6" P-18 6" P-17 8" P-149 6" P-103 6" P-178 10" P-189 6" P-107 6" P-33 10" P-197 6" P-265

8" P-37 (CIP #4) 8" P-39 (CIP #9) 8" P-40 (CIP #3) 8" P-42 (CIP #4) 8" P-43 (CIP #9) 8" P-45 (CIP #4)

MAIN STREET

EDWARD AVE. (M-1)

ELM PARK AVE. (100')

KENSINGTON BLVD. (60')

DEVONSHIRE RD. (60')

INDIANA AVE.

WELLESLEY DR. (60')

AMHERST RD. (60)

MAYWOOD AVE. (60')

EPRIZE DR. (50')

CANADIAN NATIONAL RAIL ROAD

GAINSBORO AVE.

24280 24242 24200 24126 24100 24060 24072 24028 24025

ANDERSON, ECKSTEIN AND WESTRICK, INC.
Civil Engineers • Surveyors • Architects
51301 Schoenherr Road, Shelby Township, Michigan 48315
Phone 586-726-1234 Fax 586-726-8760

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PLOT CONFIG:	PROJECT NO: 0175-0095
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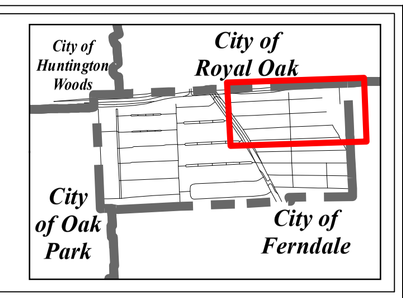
ATTACH XREF:	DRAWN BY: GIS DEPT / CHKD BY: GIS DEPT

PLEASANT RIDGE CITY OAKLAND COUNTY MICHIGAN SEAL INCORPORATED 1928

- Intermediate Node
- Node
- Water Main
- 1-5 Year Improvement
- 6-20 Year Improvement

CITY of PLEASANT RIDGE

MASTER WATER MAIN IMPROVEMENT PLAN (Year 5-20)



PANEL NUMBER: **2**

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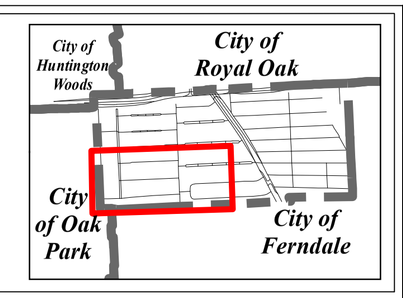
Civil Engineers • Surveyors • Architects
51301 Schoenherr Road, Shelby Township, Michigan 48315
Phone 586-726-1234 Fax 586-726-8780

PLOT DATE: January 14, 2016	DRAWING DATE: December 17, 2015
PLOT SCALE: NTS	DRAWING SCALE: 24" x 36"
PLOT CONFIG:	PROJECT NO: 0175-0095
SCRIPT FILE:	FILE NAME: Water Basemap 24X36.mxd
ATTACH XREF:	DRAWN BY: GIS DEPT / CHK'D BY: GIS DEPT

- Intermediate Node
- Node
- Water Main
- 1-5 Year Improvement
- 6-20 Year Improvement

CITY of PLEASANT RIDGE

MASTER WATER MAIN IMPROVEMENT PLAN (Year 5-20)



PANEL NUMBER: 3

CAUTION

THIS MAP IS INTENDED FOR REFERENCE PURPOSES ONLY.

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Intermediate Node

Node

Water Main

1-5 Year Improvement

6-20 Year Improvement

CITY of PLEASANT RIDGE

MASTER WATER MAIN IMPROVEMENT PLAN (Year 5-20)

PANEL NUMBER: 4

CAUTION

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City of Royal Oak
City of Huntington Woods
City of Oak Park
City of Ferndale

PLEASANT RIDGE CITY SEAL INCORPORATED 1928 OAKLAND COUNTY MICHIGAN

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