Appendix M

Water System Analysis (2023)

DEXTER WILSON ENGINEERING, INC.

WATER • WASTEWATER • RECYCLED WATER

CONSULTING ENGINEERS

WATER SYSTEM ANALYSIS
FOR THE
GUAJOME LAKE ROAD PROJECT
IN THE CITY OF OCEANSIDE

March 30, 2023

2234 FARADAY AVENUE • CARLSBAD, CA • (760) 438-4422

WATER SYSTEM ANALYSIS
FOR THE
GUAJOME LAKE ROAD PROJECT
IN THE CITY OF OCEANSIDE

March 30, 2023

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Job No. 574-021

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March 30, 2023 574-021

Pasco Laret Suiter & Associates
1411 San Diego Ave., Suite 100
San Diego, CA 92110

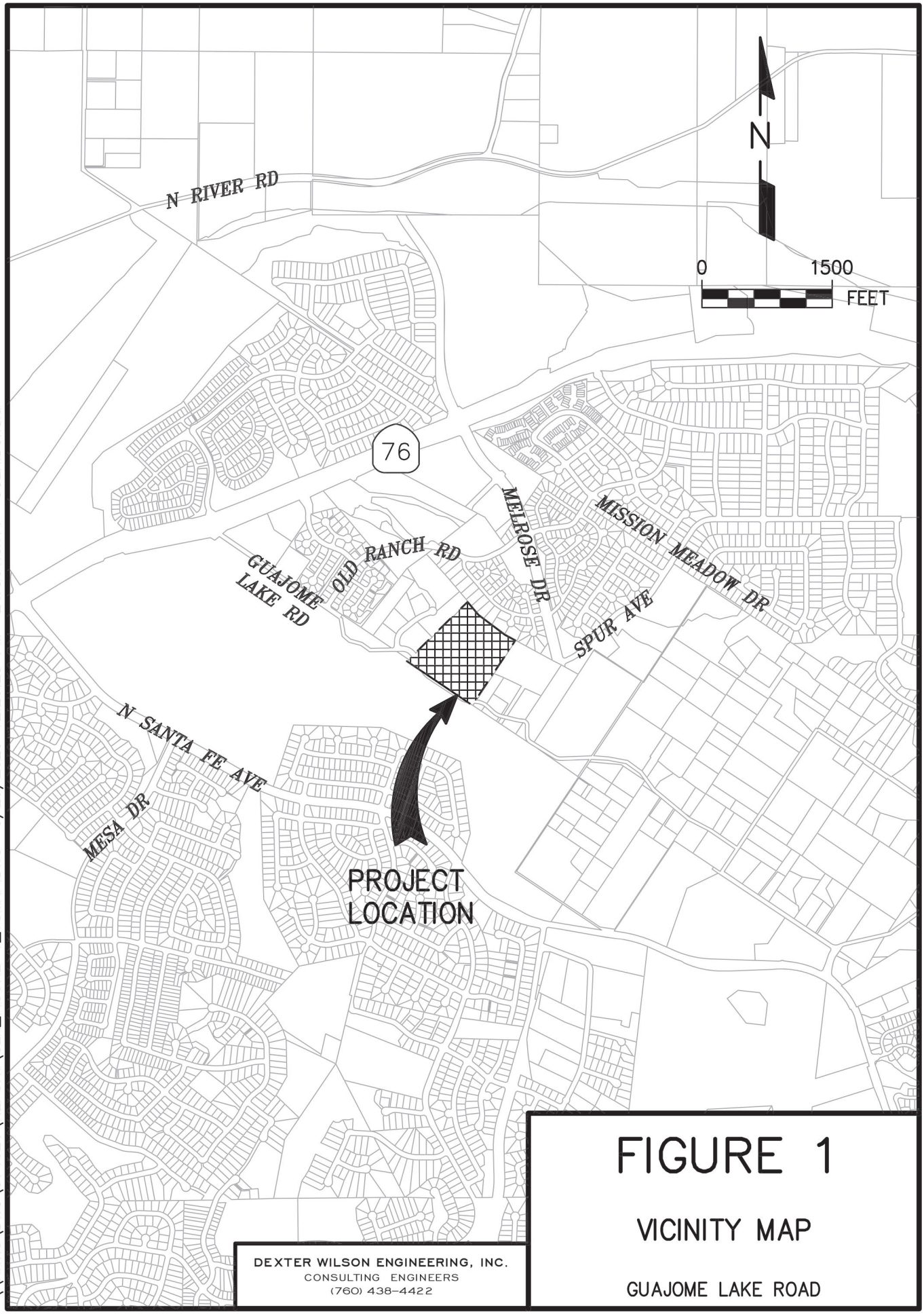
Attention: Tyler Lawson, P.E., Associate Principal

Subject: Public Water System Analysis for the Guajome Lake Road Project in the City of Oceanside

Introduction

This letter-report provides a public water system analysis for the Guajome Lake Road project in the City of Oceanside (City). This letter-report will present the recommended onsite sizing of new public potable water infrastructure, as well as the sizing of extensions of the existing system to the project site. This report will also present recommendations of potable water services.

The Guajome Lake Road project is located south of the I-76 along Guajome Lake Road. The project is proposing a residential development that includes 83 single-family units on a 16.8 acre site. A vicinity map for the project is provided in Figure 1.



\\ARTIC\DWG\574021\REPORT\GLR_FIGURE-1_VCMAP.DWG 3/29/2023 12:20:23 PM LAYOUT:8x11 USER:Donald

FIGURE 1

VICINITY MAP

GUAJOME LAKE ROAD

DEXTER WILSON ENGINEERING, INC.
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Water System Design Criteria

Water system planning and design criteria for the Guajome Lake Road project are based on Section 2 of the City of Oceanside Design and Construction Manual, revised August 1, 2017 and City design requirements established for the project. The average day demand for the project is 2,400 gallons per day per acre (gpd/ac) based on the land use category which is "Single Family Res. (4-8 DU/ac)". The maximum day and peak hourly demand factors are 2.0 and 3.0, respectively. During maximum demands, residual pressures must be greater than 45 psi and during peak hour demand residual pressure must be greater than 35 psi.

The fire flow requirement for the project is anticipated to be 1,500 gpm for single-family residential land use. During fire flow demands, residual pressure must be greater than 20 psi in the water system. Appendix A presents the planning and design requirements for the project.

Estimated Water Demand for the Guajome Lake Road Project

Based on the water demand factors from the City's Design and Construction Manual the estimated water demand for the project is calculated in Table 1.

TABLE 1
GUAJOME LAKE ROAD
ESTIMATED AVERAGE WATER DEMAND

Land Use Category	Average Demand Factor[1]	Acreage	Average Water Demand, gpd
Single Family Res. (4-8 DU/ac)	2,400 gpd/ac	16.8	40,272
Average Day Demand			**40,272 gpd 28 gpm**
Maximum Day Demand			**80,544 gpd 56 gpm**
Peak Hour Demand			**120,816 gpd 84 gpm**

1. City of Oceanside Design and Construction Manual, revised August 1, 2017.

As previously mentioned, the maximum day demand factor of 2.0 and the peak hourly factor is 3.0. Thus, the maximum day demand and peak hour demand for the Guajome Lake Road project are 80,544 gpd (56.0 gpm) and 120,816 gpd (84.0 gpm) respectively.

Existing Water System

Water service for the Guajome Lake Road project will be provided by the City of Oceanside. The project is situated in the central northern portion of the City in an area served by the Talone 320 Pressure Zone. The nearest existing 320 Pressure Zone public water lines in the vicinity of the project are a 10-inch and 12-inch water line in Guajome Lake Road southwest of the project and an 8-inch water line at the intersection of Melrose Drive and Spur Avenue to the northeast of the project. The existing water system within the vicinity of the project is shown in Figure 2.

Water Service Overview

Water service to the project will be from the City of Oceanside Talone 320 Pressure Zone**.** Pad elevations for the Guajome Lake Road project range between 147 feet and 180 feet. This results in a maximum static water pressure range of 60 psi to 74 psi within the project boundary.

The proposed public water system for the Guajome Lake Road project will make two connections to the existing 10-inch public water line in Guajome Lake Road. All onsite public water mains will be 8-inches in diameter.

Meter and Service. Per the City of Oceanside Design and Construction Manual, the minimum lateral size for new homes is 1-inch. The maximum capacity of a 1-inch service lateral per the 2019 California Plumbing Code (CPC) is 39 fixture units. Each home within the project has an estimated fixture unit count of 33 FUs per the CPC, so a 1-inch lateral is sufficient for each home within the Guajome Lake Road project.

STIRRUPS WAY
OLD RANCH RD
TENDERFOOT LN
ROCKING HORSE LN
ALBRIGHT ST
GUAJOME LAKE RD
SEATTLE SLEW WAY
CHARLIE HORSE WAY
MUSTANG WAY
BRONCO WAY
HORSESHOE WAY
MELROSE DR
ARABIAN WAY
APPALOOSA WAY
SPUR AVE

EX.8"
EX.10"
EX.12"
EX.6"

LEGEND

PROJECT BOUNDARY

EXISTING PUBLIC WATER LINE

EXISTING PUBLIC FIRE HYDRANT

N

0 200 FEET

FIGURE 2

EXISTING WATER SYSTEM

GUAJOME LAKE ROAD

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(760) 438-4422

A fixture unit count of 33 translates to a demand of 21 gpm for each home within the Guajome Lake Road project. Per the American Water Works Association C700-20, a minimum ¾-inch meter has a maximum capacity of 30 gpm, therefore each home is proposed to have a ¾-inch meter installed. Appendix B provides the calculations supporting the service lateral and meter sizing.

Each residence shall also have a fire sprinkler system with a Residential Dual Check Valve provided after the residential meter per City of Oceanside Standard Drawing W-30. When static pressures exceed 80 psi, the California Plumbing Code requires pressure regulating valves at each building supply. All building supplies within the Guajome Lake Road project will not be required to have individual pressure regulating valves.

Available Hydraulic Grade Line

The available hydraulic grade line (HGL) in the vicinity of the Guajome Lake Road project was estimated based on a fire hydrant flow test provided by CJ. Suppression, Inc. The fire hydrant flow test identifies a flow and pressure at an existing fire hydrant approximately 2,250 feet from the project on Guajome Lake Road. Appendix B includes a copy of the fire hydrant flow test for reference.

Also included in Appendix B is a calculation spreadsheet used to estimate the available hydraulic grade line (HGL) at the test hydrant under various flow rates, including a fire flow of 1,500 gpm, as the physical test presents only one flow condition. From the calculation spreadsheet in Appendix B, the available hydraulic grade line at 1,500 gpm is 285.9 feet. The tested fire hydrant was used as the source node ("R-1" Node) for the modeling presented in subsequent sections of this report.

Water System Analysis

A computer model was prepared to analyze the water system. Average day, maximum day, peak hour, and maximum day plus fire flow scenarios were modeled which provided data upon which the recommended pipe sizing for the onsite water system is based. The recommended public onsite water system sizing and configuration is presented on Figure 3.

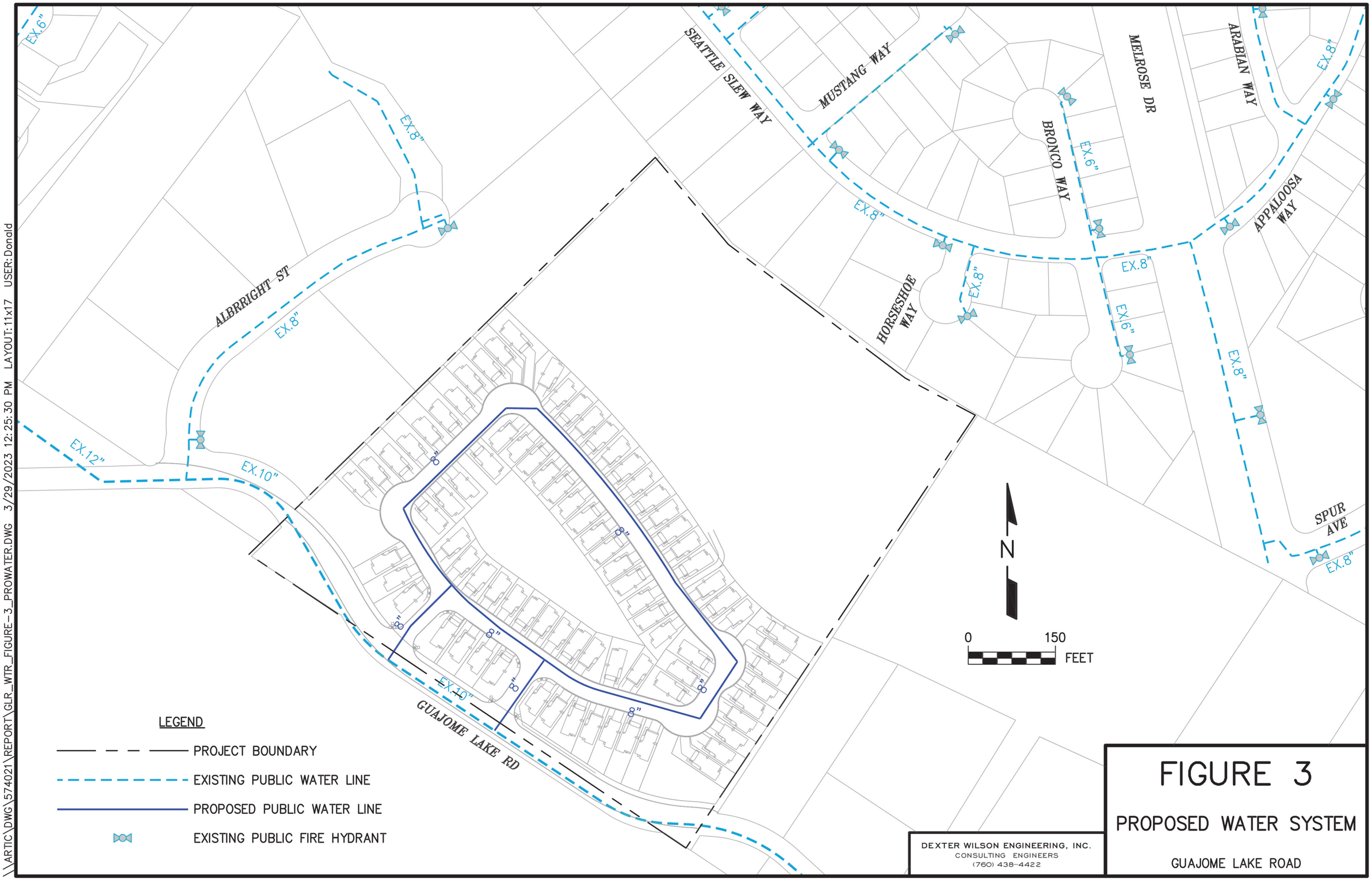


FIGURE 3

PROPOSED WATER SYSTEM

GUAJOME LAKE ROAD

DEXTER WILSON ENGINEERING, INC.
CONSULTING ENGINEERS
(760) 438-4422

Water System Computer Model. Analysis using the KYPIPE computer software program developed by the University of Kentucky determined residual pressures throughout the water system. This computer software utilizes the Hazen-Williams equation for determining headloss in pipes. The Hazen-Williams "C" value used for all pipe sizes is 120. To simulate minor losses through pipe fittings and valves, all pipe lengths included in the hydraulic model were increased by 10 percent.

Results of Computer Modeling for the Guajome Lake Road Project

Appendix D presents the computer modeling results for the water system analyses. Exhibit A presents the corresponding Node and Pipe Diagram for the computer model. Average day demand, maximum day demand, and peak hour demand were analyzed at an HGL of 316 feet. Maximum day demand plus fire flow was analyzed at an HGL of 283.8 feet at three locations across the project. The results of the computer modeling analyses are summarized in Table 2.

TABLE 2
GUAJOME LAKE ROAD PROJECT
WATER SYSTEM ANALYSIS RESULTS

Demand Scenario	Minimum Residual Pressure, psi	Required Minimum Residual Pressure, psi
Average Day Demand	59	--
Maximum Day Demand	59	45
Peak Hour Demand	59	35
Maximum Day Demand Plus Fire Flow at Node 110	29	20
Maximum Day Demand Plus Fire Flow at Node 108	32	20
Maximum Day Demand Plus Fire Flow at Node 114	33	20

As shown in Table 2, under each scenario, the minimum pressures are above the requirements. As such, the proposed water distribution system presented in Figure 3 is adequate to serve the needs of the Guajome Lake Road project.

Conclusions and Recommendations

The following conclusions and recommendations are summarized based on the water system analysis prepared for the Guajome Lake Road project.

1. Water service to the project will be provided by the City of Oceanside Talone 320 Pressure Zone public water system.

2. Pad elevations within the project range from approximately 147 to 180 feet resulting in a range of maximum static water pressures of 60 psi to 74 psi.

3. The fire flow available to the project site exceeds a 1,500 gpm fire flow requirement at a minimum of 20 psi residual pressure when connected to the existing public water system adjacent to the project.

4. The public water system within the Guajome Lake Road project site will be connected to the existing 10-inch public water line in Guajome Lake Road. Internal to the project, the water system will consist of 8-inch piping.

5. Figure 3 provides a layout of the Guajome Lake Road project showing the recommended public onsite water system pipeline sizes and configuration.

6. Each home will have its own 1-inch water service with a ¾-inch meter in accordance with Section 2 of the City of Oceanside Design and Construction Manual and the City of Oceanside Standard Drawing No. W-4.

7. The proposed public water system shall be designed and constructed in accordance with the guidelines, standards, and approved materials of the City of Oceanside or as otherwise specified in Appendix A.

Thank you for the opportunity to provide water system planning services for the Guajome Lake Road project. Please feel free to contact us to further discuss any aspect of the information presented in this letter-report.

Dexter Wilson Engineering, Inc.

Kathleen Heitt, P.E.

KH:ru

Attachments

APPENDIX A

DESIGN CRITERIA

2. Pressure Regulating Stations
3. Pressure Relief Stations
4. Reservoirs
5. Wells

H. Demands:

1. Average daily water demands shall be:

LAND USE CATEGORY	GALLONS PER DAY/PER ACRE
Single Family Res. (1-2 DU/ac)	1,200
Single Family Res. (2-4 DU/ac)	2,100
Single Family Res. (4-8 DU/ac)	2,400
Single Family Res. (8-12 DU/ac)	2,500
Single Family Res. (12-15 DU/ac)	2,800
Single Family Res. (15-20 DU/ac)	3,200
Single Family Res. (20-30 DU/ac)	4,100
Agricultural Acres	1,750
Industrial Acres	2,000
Open Space Acres	1,300
Commercial Acres	1,850
Institutional Acres	1,675

DU – Dwelling Unit

2. Peak Factors:

a. Average Daily Demand ADD = 1.00
b. Maximum Daily Demand MDD = 2.0*ADD
c. Peak Hourly Demand PHD = 3.0*ADD

2.2 FIRE FLOWS

The City of Oceanside currently utilizes the latest edition California Fire Code (CFC) requirements for determining fire flow requirements for buildings. The latest edition CFC incorporates many factors in determining fire flows, such as building construction type, building square footage, and fire protection systems. Several factors are combined to determine the minimum required fire flow requirements.

Although General Guidelines contained in Table 2.1 represent typical fire flows for various land use categories, minimum fire flow calculations are governed by the latest edition CFC, Section 507, for each specific building type and construction.

The typical fire flow for the different land use categories are shown in the following Table. All fire flows are measured with a 20-PSI Residual Pressure.

TABLE 2.1: General Fire Flow Guidelines

Land Use Classifications	Design Fire Flow (GPM)	Duration (HOURS)	Residual Pressure (PSI)
Residential - Single Family	1500	2	20
Residential - Multi-Family	3000	2	20
Commercial	4000	4	20
Industrial	4000	4	20
Governmental - Institutional	4000	4	20

All new developments that are required to have a fire suppression system shall have the system approved by the Fire Marshall. Sprinkler calculations shall be provided to the Fire Department for review and to verify the fire service connection and backflow assembly is properly sized.

2.3 PRESSURES

A. Minimum residual pressure shall be 20 PSI at design fire flow plus maximum day domestic demand.

B. Minimum residual pressure shall be 35 PSI at peak hour domestic demand.

C. Minimum residual pressure shall be 45 PSI at peak day.

D. When static pressures exceed 80 PSI at property line, pressure-reducing valves will be required at the building. The pressure regulator shall be Class 150 or greater.

E. All new single-family residential water service in each pressure zone shall be provided with a minimum static pressure of 50 PSI at the water meter.

2.4 MAINS

A. Minimum diameter shall be 8 inches.

B. All mains not meeting the minimum main diameter and material requirements shall be replaced to meet current design standards. This is applicable for all new commercial, industrial, institutional, and residential developments of four (4) units or more. Where the full replacement length along the frontage property is deemed in excess of the overall project cost, the developer may pay an in-lieu fee upon the approval of the Water Utilities Director.

C. All lines are to be looped.

D. Minimum depth of cover required:

1. 36 inches for 12-inch mains and smaller.

2. Mains over 12 inches require special design.

E. Design shall be based on maximum day requirements plus fire flow. Maximum velocity shall be 7.5 FPS not including fire flow.

APPENDIX B

WATER SERVICE LATERAL AND METER SIZING

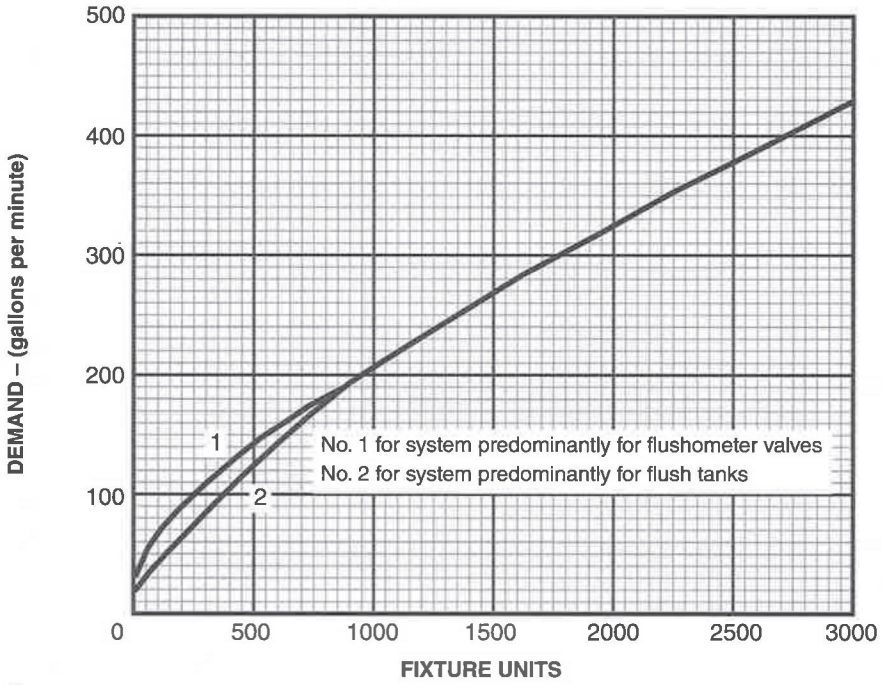
Project Name Lake Guajome Road

Water Fixture Units

The basis for the Water Fixture Units is "Private" per the 2019 California Plumbing Code.

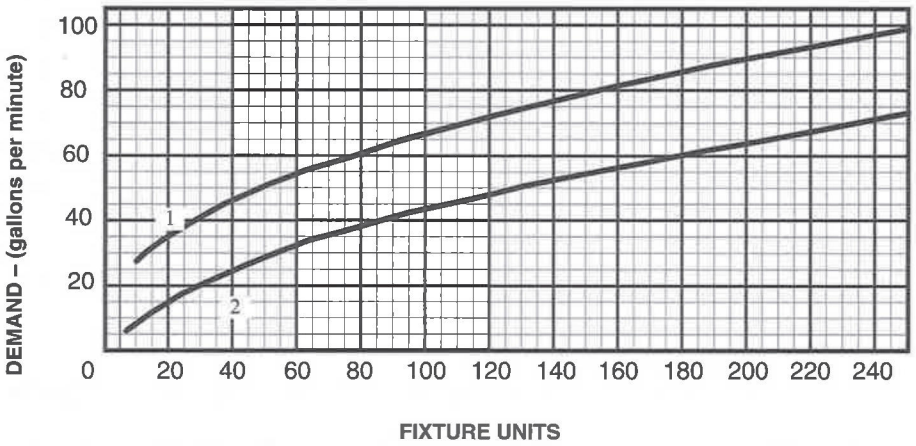
DESCRIPTION	PLAN 1A			PLAN 2A			PLAN 3A		
	QUANTITY	FIXTURE UNITS EACH	TOTAL FIXTURE UNITS	QUANTITY	FIXTURE UNITS EACH	TOTAL FIXTURE UNITS	QUANTITY	FIXTURE UNITS EACH	TOTAL FIXTURE UNITS
CLOTHES WASHER	1	4	4	1	4	4	1	4	4
LAUNDRY SINK		1.5	0		1.5	0		1.5	0
TUB/SHOWER	2	4	8	2	4	8	2	4	8
SHOWER	1	2	2	1	2	2	1	2	2
KITCHEN SINK	1	1.5	1.5	1	1.5	1.5	1	1.5	1.5
DISHWASHER	1	1.5	1.5	1	1.5	1.5	1	1.5	1.5
LAVATORY	5	1	5	5	1	5	5	1	5
WATER CLOSET (1.6 GPF)	3	2.5	7.5	3	2.5	7.5	3	2.5	7.5
HOSE BIBB	1	2.5	2.5	1	2.5	2.5	1	2.5	2.5
EACH ADDTL HB	1	1	1	1	1	1	1	1	1
OTHER			0			0			0
TOTAL			33			33			33

CHART A 103.1(1)
ESTIMATE CURVES FOR DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s

CHART A 103.1(2)
ENLARGED SCALE DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s

APPENDIX C

FIRE HYDRANT FLOW TEST
AND
CALCULATION SPREADSHEET

11/13/2012

- SOURCE: MERRICK 2009 ORTHOPHOTO AND CONTOURS
- THIS MAP PREPARED SOLELY FOR ILLUSTRATION PURPOSE & IS NOT TO BE RELIED UPON FOR ENGINEERING DRAWINGS.
- SOME INFORMATION MAY NOT BE ACCURATE.

Water Map No. P14

PAGE INDEX

O13	P13	Q13
O14	P14	Q14
O15	P15	Q15

N

1" = 200'

P14

Project Location

GUAJOME LAKE RD

STIRRUPS WAY

TENDERFOOT LN

OLD RANCH RD

ROCKING HORSE LN

ALBRIGHT ST

SEATTLE SLEW WAY

CHARLIE HORSE WAY

MUSTANG WAY

HORSESHOE WAY

ONTARIO ST

HURON CT

ERIE CT

12" AC 1964 HGL 320

8" AC 1973 R-03163 HGL 320

8" AC 1978 R-02578 HGL 320

8" AC 1977 R-02578 HGL 320

6" AC 1977 HGL 320

8" AC 1964 HGL 320

8" AC 1987 R-06831 HGL 320

10" AC 1964 HGL 320

W-00142

W-00143

R-05046 HGL 450

FLOW TEST SUMMARY REPORT page1

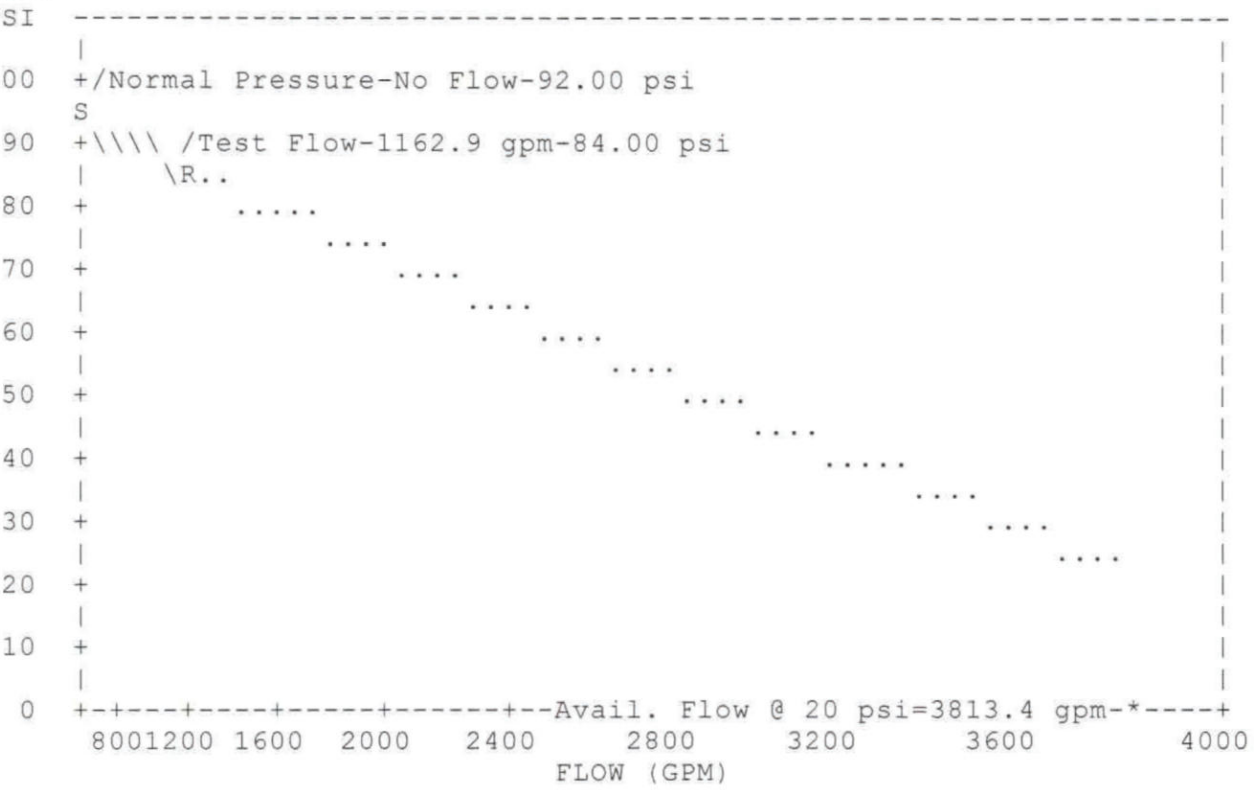
LOCATION:2839 Guajome Lake
2839 Guajome Lake, Oceanside

DATE: 3-23-2022
TIME: am

Static Hydrant Number:	1	Flowing Hydrant Number:	2
Elevation:	0	Elevation:	0
Dist. Between Hydrants:	350		
Diameter of Main:	8		
Outlet Diameter:	2.50 in	Number flowing: 1 Coeff.:	0.90
Static pressure:	92.00 psi	Residual pressure:	84.00 psi
Pitot Reading:	48.00 psi	Flow:	1162.9 gpm

Flow at 20 psi: 3813.4 gpm

GRAPH:

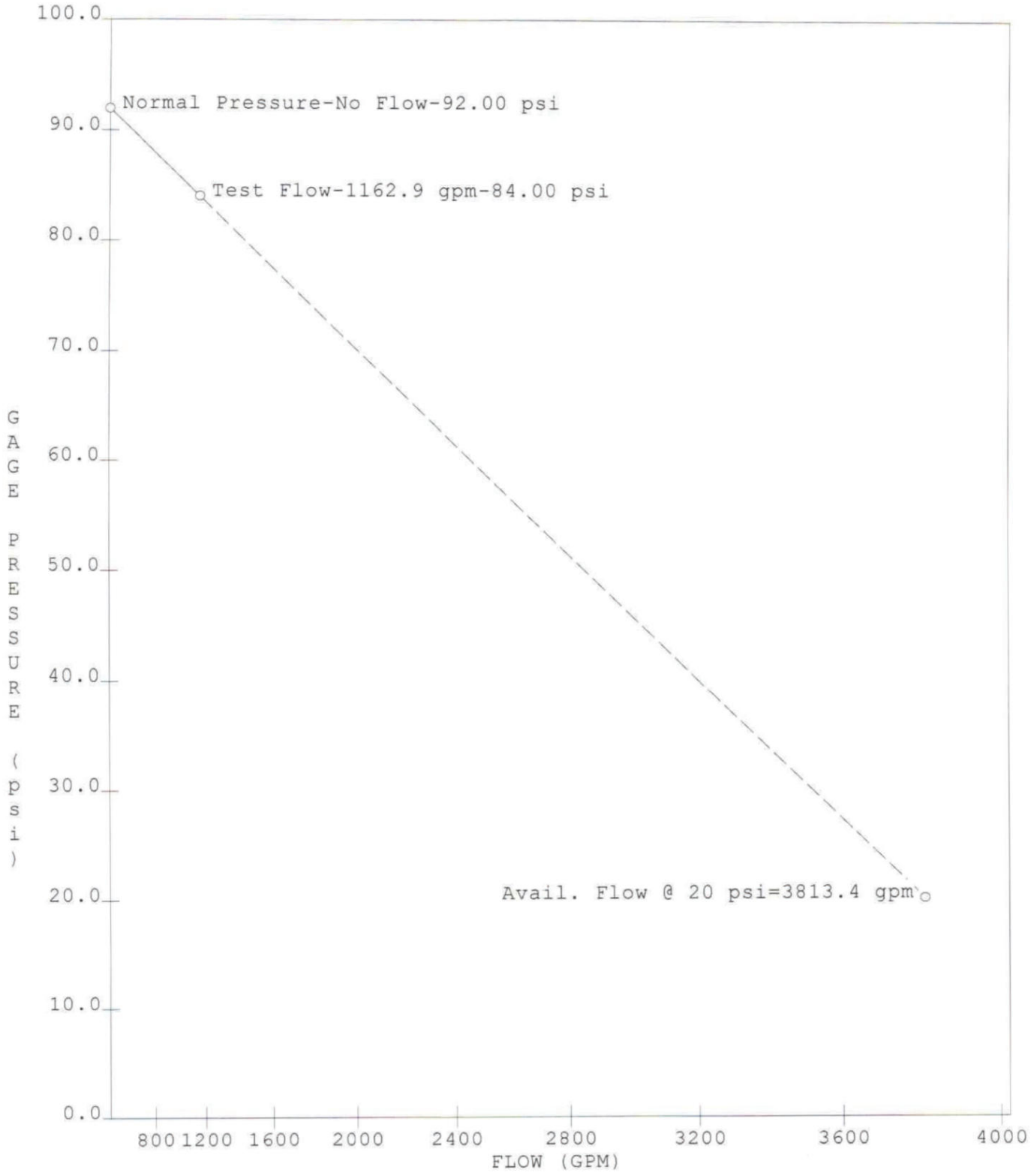


NOTES:

(1) Flowing hydrant is assumed to be on a circulating main or downstream of the pressure test hydrant on a dead-end system.

(2) Flow analysis assumes a gravity flow system with no distribution pumps and having no demand, other than the test flow.

(3) Distance between hydrants, elevations & main diameter are for information only.


100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
GAGE PRESSURE (psi)
Normal Pressure-No Flow-92.00 psi
Test Flow-1162.9 gpm-84.00 psi
Avail. Flow @ 20 psi=3813.4 gpm
800 1200 1600 2000 2400 2800 3200 3600 4000
FLOW (GPM)

Fire Hydrant Flow Test Date 4/18/2021

Input Flow Test Results

Static Pressure	92 PSI			
Residual Pressure	84 PSI			
Hydrant Flow	1145 GPM			
Actual Hydrant Elevation		Feet	HGL	Feet
Estimated Hydrant Elevation	104	Feet	HGL	316.3 Feet

Equation $\Delta H = k Q^{1.85}$

k = 4.05075E-05

Extrapolated Calculations

Q, gpm	Residual Pressure	Available HGL
28	92.0 psi	316.3 ft
56	92.0 psi	316.3 ft
84	91.9 psi	316.2 ft
500	90.3 psi	312.3 ft
750	88.3 psi	307.9 ft
1000	85.8 psi	302.0 ft
1300	81.9 psi	293.0 ft
1500	78.8 psi	285.9 ft
1556	77.9 psi	283.8 ft
1700	75.4 psi	278.0 ft
1900	71.6 psi	269.2 ft
2000	69.6 psi	264.5 ft
2100	67.4 psi	259.6 ft
2300	62.9 psi	249.2 ft
2500	58.1 psi	238.0 ft
2700	52.9 psi	226.1 ft
2900	47.4 psi	213.3 ft
3100	41.5 psi	199.8 ft
3300	35.3 psi	185.5 ft
3500	28.8 psi	170.4 ft
3700	21.9 psi	154.6 ft
3900	14.8 psi	138.1 ft
4000	11.1 psi	129.5 ft
4100	7.3 psi	120.8 ft
4300	-0.5 psi	102.8 ft
4500	-8.6 psi	84.1 ft
5000	-30.3 psi	34.1 ft
5760	-66.9 psi	-50.4 ft
5750	-66.4 psi	-49.2 ft

Residual Pressure, psi	Available Flow, gpm
0 psi	4,287
10 psi	4,028
20 psi	3,755
30 psi	3,463
40 psi	3,149
50 psi	2,806
60 psi	2,422
70 psi	1,978
80 psi	1,426
90 psi	541
100 psi	Residual Pressure Exceeds Static Pressure
110 psi	Residual Pressure Exceeds Static Pressure
120 psi	Residual Pressure Exceeds Static Pressure
130 psi	Residual Pressure Exceeds Static Pressure
140 psi	Residual Pressure Exceeds Static Pressure
150 psi	Residual Pressure Exceeds Static Pressure
160 psi	Residual Pressure Exceeds Static Pressure
170 psi	Residual Pressure Exceeds Static Pressure
180 psi	Residual Pressure Exceeds Static Pressure
190 psi	Residual Pressure Exceeds Static Pressure

APPENDIX D

COMPUTER RUNS

WATER SYSTEM ANALYSIS
FOR
FIRE HYDRANT FLOW

NODE AND PIPE DIAGRAM REFERENCE:

Exhibit A

CONDITIONS MODELED:

1. Average Day Demand
2. Maximum Day Demand
3. Peak Hour Demand
4. Maximum Day Demand plus Fire Flow of 1,500 gpm at Node 110
5. Maximum Day Demand plus Fire Flow of 1,500 gpm at Node 106
6. Maximum Day Demand plus Fire Flow of 1,500 gpm at Node 114

Date & Time: Thu Jun 02 10:41:35 2022

Master File : \\artic\eng\574021\water\ky pipe\574021 ky pipe.KYP\574021 ky pipe.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

PIPE NAME	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
1	R-1	2	1000.00	12.00	120.0000	0.00
3	2	4	1100.00	12.00	120.0000	0.00
5	6	4	910.00	10.00	120.0000	0.00
10	102	104	220.00	8.00	120.0000	0.00
101	6	102	150.00	8.00	120.0000	0.00
105	106	104	220.00	8.00	120.0000	0.00
107	106	108	285.00	8.00	120.0000	0.00
109	108	110	325.00	8.00	120.0000	0.00
111	110	112	150.00	8.00	120.0000	0.00
113	112	114	150.00	8.00	120.0000	0.00
115	114	116	245.00	8.00	120.0000	0.00
117	116	102	250.00	8.00	120.0000	0.00

P U M P/L O S S E L E M E N T D A T A

THERE IS A DEVICE AT NODE R-1 DESCRIBED BY THE FOLLOWING DATA: (ID= 1)

HEAD (ft)	FLOWRATE (gpm)	EFFICIENCY (%)
212.31	0.00	75.00
193.85	1145.00	75.00
145.66	2290.00	75.00

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
2		0.00	133.00	
4		0.00	138.00	
6		0.00	140.00	
102		3.60	155.00	
104		3.60	166.00	
106		4.08	173.50	
108		5.10	178.00	
110		5.10	180.00	
112		2.04	169.00	
114		2.04	154.00	
116		4.08	151.00	
R-1		----	104.00	104.00

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 = 3
MAXIMUM AND MINIMUM VELOCITIES = 3
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 3

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

NUMBER OF PIPES .....(P) = 12
NUMBER OF END NODES .....(J) = 11
NUMBER OF PRIMARY LOOPS .....(L) = 1
NUMBER OF SUPPLY NODES .....(F) = 1
NUMBER OF SUPPLY ZONES .....(Z) = 1

==========

Case: 1 = AVERAGE DAY DEMAND

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

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
1	R-1	2	29.64	0.00	0.00	0.08	0.00	0.00
3	2	4	29.64	0.00	0.00	0.08	0.00	0.00
5	6	4	-29.64	0.01	0.00	0.12	0.01	0.01
10	102	104	13.32	0.00	0.00	0.08	0.01	0.01
101	6	102	29.64	0.00	0.00	0.19	0.03	0.03
105	106	104	-9.72	0.00	0.00	0.06	0.00	0.00
107	106	108	5.64	0.00	0.00	0.04	0.00	0.00
109	108	110	0.54	0.00	0.00	0.00	0.00	0.00
111	110	112	-4.56	0.00	0.00	0.03	0.00	0.00
113	112	114	-6.60	0.00	0.00	0.04	0.00	0.00
115	114	116	-8.64	0.00	0.00	0.06	0.00	0.00
117	116	102	-12.72	0.00	0.00	0.08	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
2		0.00	316.28	133.00	183.28	79.42
4		0.00	316.28	138.00	178.28	77.25
6		0.00	316.27	140.00	176.27	76.38
102		3.60	316.26	155.00	161.26	69.88
104		3.60	316.26	166.00	150.26	65.11
106		4.08	316.26	173.50	142.76	61.86
108		5.10	316.26	178.00	138.26	59.91
110		5.10	316.26	180.00	136.26	59.05
112		2.04	316.26	169.00	147.26	63.81
114		2.04	316.26	154.00	162.26	70.31
116		4.08	316.26	151.00	165.26	71.61
R-1		----	316.29	104.00	212.29	91.99

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
R-1	91.99	110	59.05
2	79.42	108	59.91
4	77.25	106	61.86

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
101	0.19	109	0.00
5	0.12	111	0.03
10	0.08	107	0.04

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
101	0.03	109	0.00
5	0.01	111	0.00
10	0.01	107	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
101	0.03	109	0.00
5	0.01	111	0.00
10	0.01	107	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
R-1	29.64	

NET SYSTEM INFLOW = 29.64
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 29.64

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Case: 2 = MAXIMUM DAY DEMAND

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

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
1	R-1	2	59.28	0.02	0.00	0.17	0.02	0.02
3	2	4	59.28	0.02	0.00	0.17	0.02	0.02
5	6	4	-59.28	0.03	0.00	0.24	0.04	0.04
10	102	104	26.63	0.01	0.00	0.17	0.03	0.03
101	6	102	59.28	0.02	0.00	0.38	0.11	0.11
105	106	104	-19.43	0.00	0.00	0.12	0.01	0.01
107	106	108	11.27	0.00	0.00	0.07	0.01	0.01
109	108	110	1.07	0.00	0.00	0.01	0.00	0.00
111	110	112	-9.13	0.00	0.00	0.06	0.00	0.00
113	112	114	-13.21	0.00	0.00	0.08	0.01	0.01
115	114	116	-17.29	0.00	0.00	0.11	0.01	0.01
117	116	102	-25.45	0.01	0.00	0.16	0.02	0.02

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
2		0.00	316.22	133.00	183.22	79.39
4		0.00	316.20	138.00	178.20	77.22
6		0.00	316.16	140.00	176.16	76.34
102		7.20(2.00)	316.15	155.00	161.15	69.83
104		7.20(2.00)	316.14	166.00	150.14	65.06
106		8.16(2.00)	316.14	173.50	142.64	61.81
108		10.20(2.00)	316.14	178.00	138.14	59.86
110		10.20(2.00)	316.14	180.00	136.14	58.99
112		4.08(2.00)	316.14	169.00	147.14	63.76
114		4.08(2.00)	316.14	154.00	162.14	70.26
116		8.16(2.00)	316.14	151.00	165.14	71.56
R-1		----	316.23	104.00	212.23	91.97

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
R-1	91.97	110	58.99
2	79.39	108	59.86
4	77.22	106	61.81

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
101	0.38	109	0.01
5	0.24	111	0.06
10	0.17	107	0.07

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
101	0.11	109	0.00
5	0.04	111	0.00
10	0.03	107	0.01

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
101	0.11	109	0.00
5	0.04	111	0.00
10	0.03	107	0.01

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
R-1	59.28	

NET SYSTEM INFLOW = 59.28
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 59.28

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Case: 3 = PEAK HOUR DEMAND

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

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
1	R-1	2	88.92	0.03	0.00	0.25	0.03	0.03
3	2	4	88.92	0.04	0.00	0.25	0.03	0.03
5	6	4	-88.92	0.07	0.00	0.36	0.08	0.08
10	102	104	39.95	0.01	0.00	0.25	0.05	0.05
101	6	102	88.92	0.04	0.00	0.57	0.24	0.24
105	106	104	-29.15	0.01	0.00	0.19	0.03	0.03
107	106	108	16.91	0.00	0.00	0.11	0.01	0.01
109	108	110	1.61	0.00	0.00	0.01	0.00	0.00
111	110	112	-13.69	0.00	0.00	0.09	0.01	0.01
113	112	114	-19.81	0.00	0.00	0.13	0.01	0.01
115	114	116	-25.93	0.01	0.00	0.17	0.02	0.02
117	116	102	-38.17	0.01	0.00	0.24	0.05	0.05

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
2		0.00	316.11	133.00	183.11	79.35
4		0.00	316.08	138.00	178.08	77.17
6		0.00	316.00	140.00	176.00	76.27
102		10.80(3.00)	315.97	155.00	160.97	69.75
104		10.80(3.00)	315.95	166.00	149.95	64.98
106		12.24(3.00)	315.95	173.50	142.45	61.73
108		15.30(3.00)	315.94	178.00	137.94	59.78
110		15.30(3.00)	315.94	180.00	135.94	58.91
112		6.12(3.00)	315.95	169.00	146.95	63.68
114		6.12(3.00)	315.95	154.00	161.95	70.18
116		12.24(3.00)	315.95	151.00	164.95	71.48
R-1		----	316.15	104.00	212.15	91.93

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
R-1	91.93	110	58.91
2	79.35	108	59.78
4	77.17	106	61.73

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
101	0.57	109	0.01
5	0.36	111	0.09
10	0.25	107	0.11

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
101	0.24	109	0.00
5	0.08	111	0.01
10	0.05	107	0.01

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
101	0.24	109	0.00
5	0.08	111	0.01
10	0.05	107	0.01

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
R-1	88.92	

NET SYSTEM INFLOW = 88.92
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 88.92

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Case: 4 = MAXIMUM DAY DEMAND + 1,500 GPM FIRE FLOW AT NODE 110

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

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
1	R-1	2	1559.28	6.70	0.00	4.42	6.70	6.70
3	2	4	1559.28	7.37	0.00	4.42	6.70	6.70
5	6	4	-1559.28	14.81	0.00	6.37	16.27	16.27
10	102	104	721.49	2.55	0.00	4.60	11.57	11.57
101	6	102	1559.28	7.24	0.00	9.95	48.24	48.24
105	106	104	-714.29	2.50	0.00	4.56	11.36	11.36
107	106	108	706.13	3.17	0.00	4.51	11.12	11.12
109	108	110	695.93	3.52	0.00	4.44	10.83	10.83
111	110	112	-814.27	2.17	0.00	5.20	14.48	14.48
113	112	114	-818.35	2.19	0.00	5.22	14.62	14.62
115	114	116	-822.43	3.61	0.00	5.25	14.75	14.75
117	116	102	-830.59	3.76	0.00	5.30	15.02	15.02

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
2		0.00	276.90	133.00	143.90	62.36
4		0.00	269.54	138.00	131.54	57.00
6		0.00	254.73	140.00	114.73	49.72
102		7.20(2.00)	247.50	155.00	92.50	40.08
104		7.20(2.00)	244.95	166.00	78.95	34.21
106		8.16(2.00)	242.45	173.50	68.95	29.88
108		10.20(2.00)	239.28	178.00	61.28	26.55
110		1510.20(**)	235.76	180.00	55.76	24.16
112		4.08(2.00)	237.93	169.00	68.93	29.87
114		4.08(2.00)	240.13	154.00	86.13	37.32
116		8.16(2.00)	243.74	151.00	92.74	40.19
R-1		----	283.60	104.00	179.60	77.83

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
R-1	77.83	110	24.16
2	62.36	108	26.55
4	57.00	112	29.87

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
101	9.95	1	4.42
5	6.37	3	4.42
117	5.30	109	4.44

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
101	48.24	3	6.70
5	16.27	1	6.70
117	15.02	109	10.83

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
101	48.24	3	6.70
5	16.27	1	6.70
117	15.02	109	10.83

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
R-1	1559.28	

NET SYSTEM INFLOW = 1559.28
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 1559.28

==========

Case: 5 = MAXIMUM DAY DEMAND + 1,500 GPM FIRE FLOW AT NODE 106

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

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
1	R-1	2	1559.32	6.70	0.00	4.42	6.70	6.70
3	2	4	1559.32	7.37	0.00	4.42	6.70	6.70
5	6	4	-1559.32	14.81	0.00	6.37	16.27	16.27
10	102	104	1001.22	4.67	0.00	6.39	21.24	21.24
101	6	102	1559.32	7.24	0.00	9.95	48.24	48.24
105	106	104	-994.02	4.61	0.00	6.34	20.95	20.95
107	106	108	-514.18	1.76	0.00	3.28	6.18	6.18
109	108	110	-524.38	2.08	0.00	3.35	6.41	6.41
111	110	112	-534.58	1.00	0.00	3.41	6.64	6.64
113	112	114	-538.66	1.01	0.00	3.44	6.74	6.74
115	114	116	-542.74	1.67	0.00	3.46	6.83	6.83
117	116	102	-550.90	1.76	0.00	3.52	7.02	7.02

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
2		0.00	276.90	133.00	143.90	62.36
4		0.00	269.54	138.00	131.54	57.00
6		0.00	254.73	140.00	114.73	49.72
102		7.20(2.00)	247.49	155.00	92.49	40.08
104		7.20(2.00)	242.82	166.00	76.82	33.29
106		1508.20(**)	238.21	173.50	64.71	28.04
108		10.20(2.00)	239.97	178.00	61.97	26.86
110		10.20(2.00)	242.06	180.00	62.06	26.89
112		4.08(2.00)	243.05	169.00	74.05	32.09
114		4.08(2.00)	244.06	154.00	90.06	39.03
116		8.16(2.00)	245.74	151.00	94.74	41.05
R-1		----	283.60	104.00	179.60	77.83

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
R-1	77.83	108	26.86
2	62.36	110	26.89
4	57.00	106	28.04

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
101	9.95	107	3.28
10	6.39	109	3.35
5	6.37	111	3.41

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
101	48.24	107	6.18
10	21.24	109	6.41
105	20.95	111	6.64

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
101	48.24	107	6.18
10	21.24	109	6.41
105	20.95	111	6.64

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
R-1	1559.32	

NET SYSTEM INFLOW = 1559.32
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 1559.32

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Case: 6 = MAXIMUM DAY DEMAND + 1,500 GPM FIRE FLOW AT NODE 114

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

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
1	R-1	2	1559.30	6.70	0.00	4.42	6.70	6.70
3	2	4	1559.30	7.37	0.00	4.42	6.70	6.70
5	6	4	-1559.30	14.81	0.00	6.37	16.27	16.27
10	102	104	581.26	1.71	0.00	3.71	7.76	7.76
101	6	102	1559.30	7.24	0.00	9.95	48.24	48.24
105	106	104	-574.06	1.67	0.00	3.66	7.58	7.58
107	106	108	565.90	2.10	0.00	3.61	7.38	7.38
109	108	110	555.70	2.32	0.00	3.55	7.14	7.14
111	110	112	545.50	1.03	0.00	3.48	6.90	6.90
113	112	114	541.42	1.02	0.00	3.46	6.80	6.80
115	114	116	-962.68	4.84	0.00	6.14	19.75	19.75
117	116	102	-970.84	5.01	0.00	6.20	20.06	20.06

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
2		0.00	276.90	133.00	143.90	62.36
4		0.00	269.54	138.00	131.54	57.00
6		0.00	254.73	140.00	114.73	49.72
102		7.20(2.00)	247.49	155.00	92.49	40.08
104		7.20(2.00)	245.79	166.00	79.79	34.57
106		8.16(2.00)	244.12	173.50	70.62	30.60
108		10.20(2.00)	242.02	178.00	64.02	27.74
110		10.20(2.00)	239.70	180.00	59.70	25.87
112		4.08(2.00)	238.66	169.00	69.66	30.19
114		1504.10(**)	237.64	154.00	83.64	36.25
116		8.16(2.00)	242.48	151.00	91.48	39.64
R-1		----	283.60	104.00	179.60	77.83

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
R-1	77.83	110	25.87
2	62.36	108	27.74
4	57.00	112	30.19

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
101	9.95	113	3.46
5	6.37	111	3.48
117	6.20	109	3.55

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
101	48.24	3	6.70
117	20.06	1	6.70
115	19.75	113	6.80

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
101	48.24	3	6.70
117	20.06	1	6.70
115	19.75	113	6.80

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
R-1	1559.30	

NET SYSTEM INFLOW = 1559.30
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 1559.30

***** HYDRAULIC ANALYSIS COMPLETED *****

STIRRUPS WAY
OLD RANCH RD
TENDERFOOT LN
ROCKING HORSE LN
GUAJOME LAKE RD
ALBRIGHT ST
SEATTLE SLEW WAY
CHARLIE HORSE WAY
MUSTANG WAY
BRONCO WAY
HORSESHOE WAY
MELROSE DR
ARABIAN WAY
APPALOOSA WAY
SPUR AVE

EX.8" EX.10" EX.12" EX.6"

R-1

1 2 3 4 5 6 7 8

110 111 112 113 114 115 116 117 119 101 102 103 104 105 106 107 108 109

8"

N

0 200 FEET

LEGEND

- PROJECT BOUNDARY
- EXISTING PUBLIC WATER LINE
- PROPOSED PUBLIC WATER LINE
- EXISTING PUBLIC FIRE HYDRANT
- (1) COMPUTER MODEL NODE NUMBER
- [2] COMPUTER MODEL PIPE NUMBER

EXHIBIT A

NODE AND PIPE DIAGRAM

GUAJOME LAKE ROAD

DEXTER WILSON ENGINEERING, INC.
CONSULTING ENGINEERS
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