Appendix K. Water System Analysis

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WATER SYSTEM ANALYSIS
FOR THE
MARJA ACRES PROJECT
IN THE CITY OF CARLSBAD

August 3, 2018

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

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8-3-2018

Prepared by:
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Job No. 736-013

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August 3, 2018

736-013

New Urban West, Inc.
16935 West Bernardo Drive, Suite 260
San Diego, CA 92127

Attention: Jonathan P. Frankel, Project Manager

Subject: Water System Analysis for the Marja Acres Project in the City of Carlsbad

Introduction

The Marja Acres project is located in the north-central portion of the City of Carlsbad. It is situated along El Camino Real to the southeast of Kelly Drive. See Figure 1 for the location of the project.

The Marja Acres project is proposing to develop a total of 298 residential units (252 townhome units and 46 apartment units) and 9,700 square feet of commercial space spread across approximately 24 acres.

The Marja Acres project will receive water service from the Carlsbad Municipal Water District and is located within the 241 Pressure Zone. The purpose of this letter report is to provide an analysis of water service to the Marja Acres project.

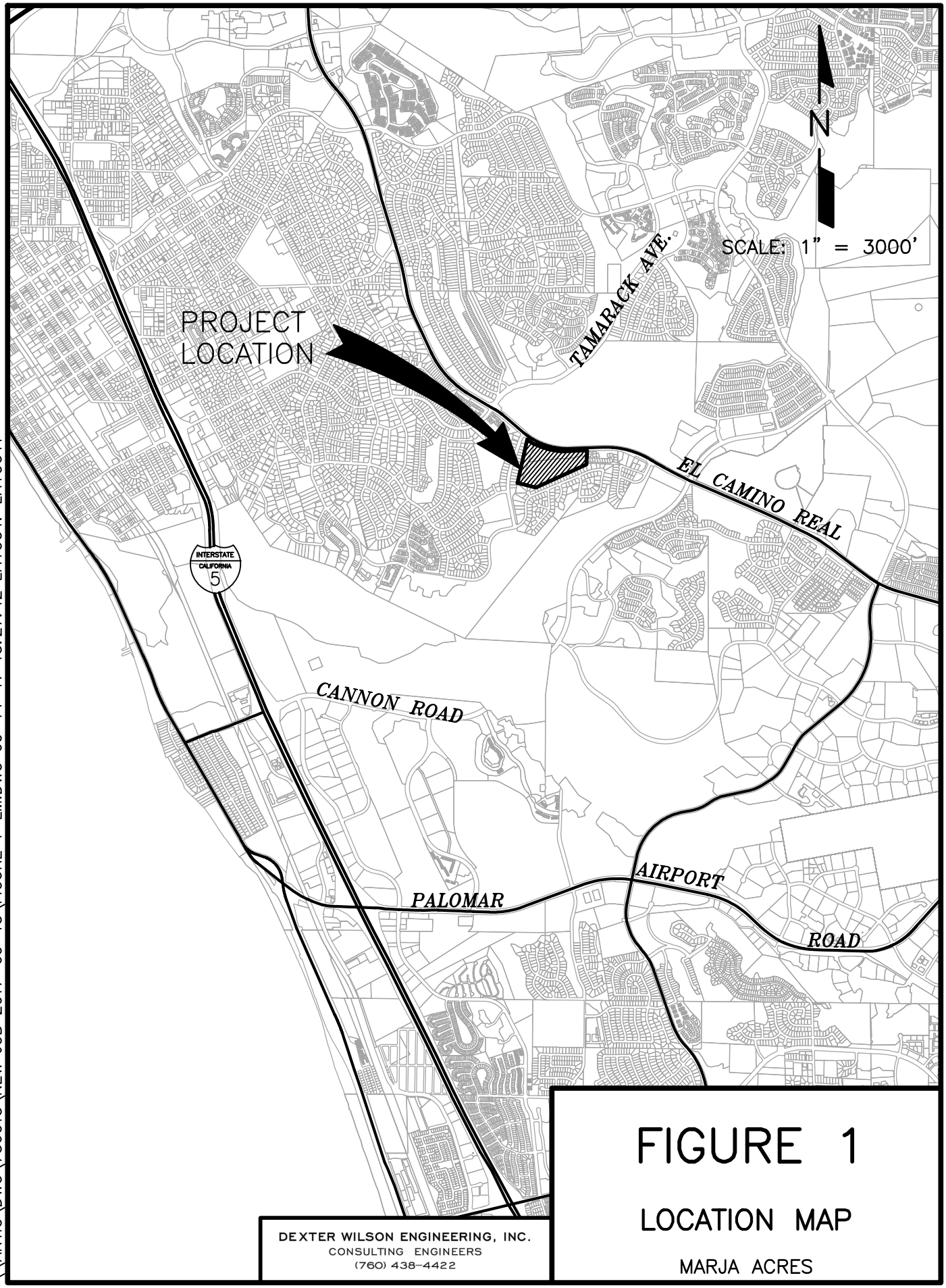

FIGURE 1

LOCATION MAP

MARJA ACRES

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\\ARTIC\DWG\736013\NEW JOB 2017-09-13\FIGURE 1-LM.DWG 09-14-17 13:27:42 LAYOUT: LAYOUT1

Water System Design Criteria

The design criteria used in sizing the water distribution system piping for the Marja Acres project are consistent with the City of Carlsbad Engineering Standards, Volume 2, Potable and Recycled Water Standards, 2016 Edition. Appendix A includes an excerpt of the first portion of Chapter 3 which includes the City's potable water design criteria.

These criteria include a minimum static pressure of 60 psi and a maximum static pressure of 150 psi. Under peak hour demand conditions, minimum residual pressure at any location must not be less than 40 psi. Under a maximum day demand with fire flow, a minimum residual pressure of 20 psi must be maintained in the water system. Peaking factors used in analyzing various demand scenarios were 1.65 for average day to maximum day demands, and 2.90 for average day to peak hour demands.

Projected Water Demand

The expected water demand for the Marja Acres project was estimated using water demand criteria from the City's Engineering Standards. Table 1 below presents the estimated onsite water demand for the project.

TABLE 1
MARJA ACRES PROJECT WATER DEMAND

Land Use	Quantity	Demand Factor[1]	Average Demand
Residential (Townhomes)	252 DUs	550 gpd/DU	138,600 gpd
Residential (Apartments)	46 DUs	250 gpd/DU	11,500 gpd
Commercial	9,700 sq. ft.	2,300 gpd/10,000 sq. ft.	2,231 gpd
TOTAL			**152,331 gpd**

[1]Section 3.2.1.A from the City's Engineering Standards, Appendix A.

Maximum day demand for the Marja Acres project is 251,346 gpd or 175 gpm. The peak hour demand is 441,760 gpd or 307 gpm.

Fire Flow Requirements

The fire flow requirement for the Marja Acres project is based on the City Engineering Standards. This requirement is 3,000 gpm split between any two fire hydrants for multi-family residential and 4,000 gpm split between four hydrants for commercial areas. This fire hydrant flow requirement is analyzed under a Maximum Day Demand scenario. Residual pressures in the water system under a fire flow scenario must be 20 psi or greater.

Existing Water System

The Marja Acres project is within the City of Carlsbad and will obtain water service from the Carlsbad Municipal Water District's public water system. The nearest existing public potable water line in the vicinity of the Marja Acres project is a 12-inch 241 Zone water line in El Camino Real. There are also existing 490 and 446 Zone public water lines in the vicinity of the project.

Note that the 241 Zone in the City is also referred to as the 255 Zone. For the purposes of this report, and to be conservative in the hydraulic calculations, the pressure zone will be referred to as the 241 Zone.

There are existing recycled water lines adjacent to the project as well. The 384 Zone in the District's recycled water system was extended in El Camino Real northward from Cannon Road from previous projects in Marja Acres' vicinity.

Water Service Overview

The Marja Acres project is proposing to obtain potable water service from the existing 241 Zone system. This will be accomplished by establishing two connections off of the existing 12-inch 241 Zone pipeline in El Camino Real. This will provide a looped system through the project site. The proposed onsite layout is shown on Figure 2.

The approximate range of elevations on the project, 60 to 89 feet, results in expected maximum static pressures to be approximately between 65 and 78 psi.

The planned recycled water uses for Marja Acres include irrigation of the common areas, the community recreation area, and proposed slopes. The existing and proposed recycled water system is shown on Figure 3.

Available Hydraulic Grade Line

The available hydraulic grade line (HGL) for the 241 Pressure Zone supplying the Marja Acres project is set at 241 feet HGL by the 1.5 million-gallon Skyline Tank at the intersection of Hillside Drive and Skyline Road.

Additional data which provides available pressure in the public water system adjacent to the Marja Acres project is a fire flow analysis prepared by the City of Carlsbad. This Water Availability Form identifies a flow and pressure at a given existing fire hydrant on the existing public water system via a computer model simulated hydrant flow test. This Water Availability Form is provided in Appendix B. How this is used in the hydraulic analysis for the Marja Acres site will be discussed later in this report.

Water System Computer Model

The University of Kentucky KYPIPE program was used to create a computer model of the existing and proposed water system for the Marja Acres project. This computer program utilizes the Hazen-Williams equation for determining head-loss in pipes; the Hazen-Williams "C" value used for all pipes is 120.

\\ARTIC\DWG\736013\NEW JOB 2017-09-13\WATER\MA_WTR_FIGURE-2_PROWAT.DWG 08-03-18 08:02:59 LAYOUT: LAYOUT

LEGEND

- PROJECT BOUNDARY
- EXISTING WATER (ZONE 241)
- EXISTING WATER (ZONE 446)
- EXISTING WATER (ZONE 490)
- EXISTING PUBLIC FIRE HYDRANT
- EXISTING PRESSURE REDUCING STATION
- PROPOSED WATER (ZONE 241)
- PROPOSED PUBLIC FIRE HYDRANT

N

SCALE: 1" = 200'

0 200 FEET

KELLY PRS(4"&6")

LAGUNA RIVIERA PRS (6")

EL CAMINO REAL

KELLY DR.

PARK DR.

FIGURE 2

EXISTING AND PROPOSED WATER SYSTEM

MARJA ACRES

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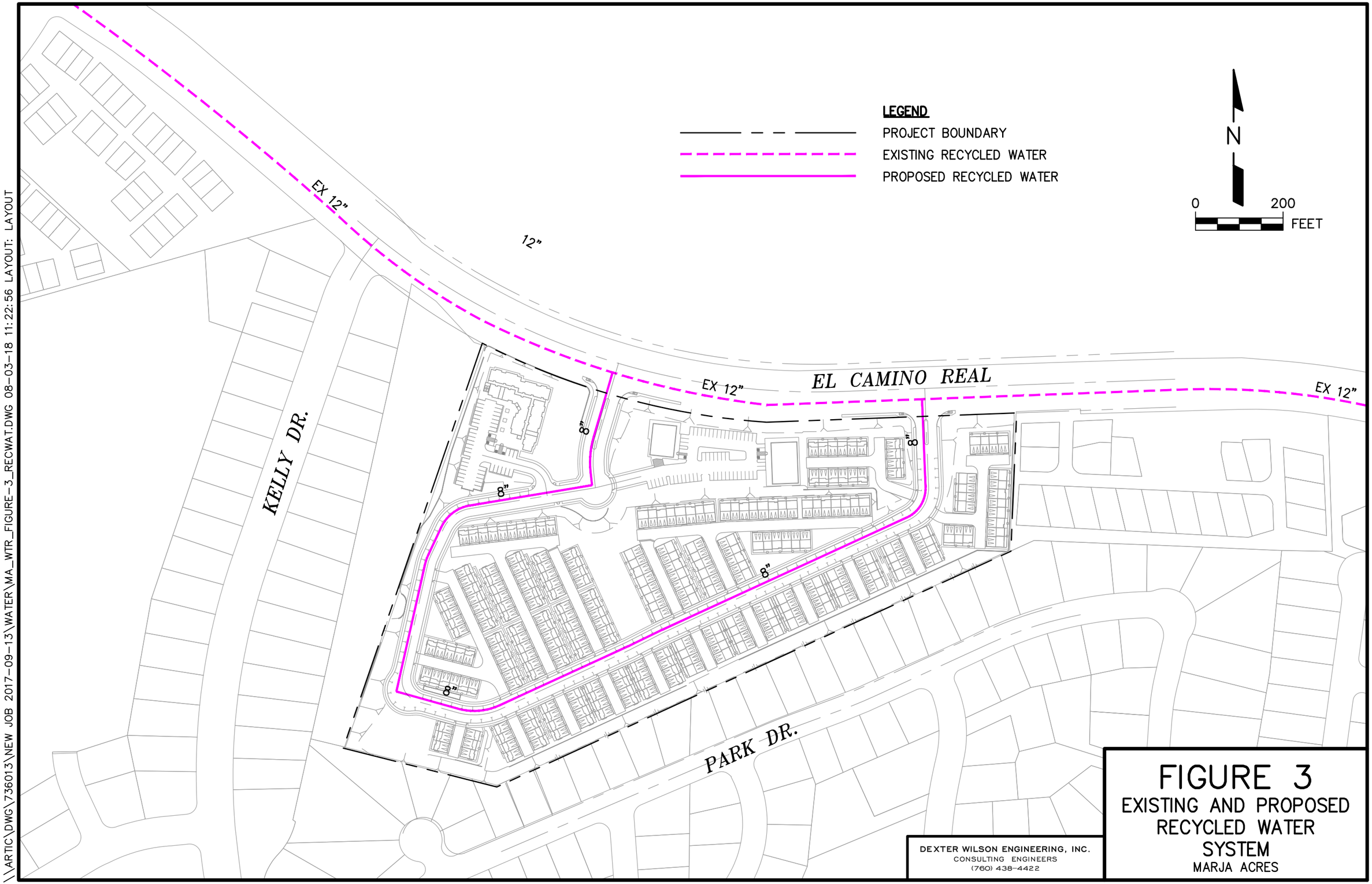
CONSULTING ENGINEERS
(760) 438-4422



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(760) 438-4422

FIGURE 3
EXISTING AND PROPOSED RECYCLED WATER SYSTEM
MARJA ACRES

\\ARTIC\DWG\736013\NEW JOB 2017-09-13\WATER\MA_WTR_FIGURE-3_RECWAT.DWG 08-03-18 11:22:56 LAYOUT: LAYOUT

The existing and proposed water system was modeled with an estimated HGL adjacent to the project site of 222.6 feet at 3,000 gpm and 209.7 feet at 4,000 gpm. This location is along El Camino Real adjacent to the project boundary. This HGL was obtained using the City's Water Availability Form described earlier in this report. Using the data provided by the form, an extrapolation calculation was done to determine the HGL at various flow points. The Water Availability Form and corresponding fire flow calculation was performed assuming the test hydrant, and project, is located in the 255 Zone. As stated earlier, the actual pressure zone for the project is the 241 Zone. This correction is reflected in the extrapolation calculation. A copy of the extrapolation calculation is included in Appendix B along with the Water Availability Form.

The location of the test hydrant in the Water Availability Form is along El Camino Real adjacent to the project. This location was also chosen as the source ("0" Node) of the water model. Making the test hydrant the location of the water model source allows for a more accurate calculation of the HGL in the vicinity of the project.

Computer Model Analysis

Computer modeling of the proposed onsite and existing offsite water system for the Marja Acres project was performed to confirm the pipe sizes necessary to provide adequate water service. The water system was analyzed under two fire flow scenarios: an onsite maximum day demand plus 3,000 gpm scenario and an onsite maximum day demand plus 4,000 gpm scenario.

Appendix C provides the results of the computer modeling for the analyzed water system. Exhibit A at the back of this report provides the Node and Pipe Diagram for the computer model.

The results in Appendix C show that the proposed water system for the Marja Acres project is adequate for domestic service and fire protection. The results of the computer runs show that 3,000 gpm fire flow can be provided onsite with a minimum residual pressure of 35 psi and that 4,000 gpm fire flow can be provided with a minimum residual pressure of 28 psi. Under peak hour demand, the minimum residual pressure on the project site is 65 psi.

Available Fire Flow at 20 psi Residual. Fire flow available at a single point of the Marja Acres project was extrapolated to 20 psi residual. Table 2 below shows the theoretical available fire flow at a proposed fire hydrant with that particular proposed hydrant flowing individually. Appendix C presents the computer model calculation results.

TABLE 2
AVAILABLE FIRE FLOW AT A SINGLE POINT

Node	Fire Flow Capability, gpm	Residual Pressure at Fire Hydrant, psi
52	3,800	20.2

The available fire flow at each fire hydrant is qualified as theoretical because the calculated flows cannot be extracted from a single fire hydrant. It is more accurate to describe the extrapolated flows at 20 psi residual to be indicative of what the water distribution system can deliver to a certain area.

Conclusion and Recommendations

The following recommendations and conclusions are presented based upon the water system analysis performed for the Marja Acres project.

1. Water service to the project will be provided by the Carlsbad Municipal Water District's public water system.

2. The Carlsbad Municipal Water District's public water system does front the proposed project with an existing 241 Zone 12-inch water line in El Camino Real.

3. Elevations within the project range from approximately 60 to 89 feet resulting in a range of maximum static water pressures of approximately 65 to 78 psi.

4. Figure 2 presents the recommended onsite water system layout and required distribution pipe sizes.

5. The fire flow available to the project site meets the 3,000 and 4,000 gpm fire flow requirement when connected to the existing public water system adjacent to the project.

6. The City's existing recycled water system will be extended into the project for irrigation of the common areas, the community recreation area, and proposed slopes. The existing and proposed recycled water system is shown on Figure 3.

7. Fire sprinkler laterals which would supply the individual building fire sprinkler systems shall be sized by the fire sprinkler designer employed for the Marja Acres project and are not included in the scope of this report.

8. The public water system improvements shall be designed and constructed in accordance with the guidelines, standards, and approved materials of the Carlsbad Municipal Water District.

9. All new potable water pipelines recommended for the project are to be designed to meet AWWA C900 DR 18 Class 235 for PVC pipe. The water system design must conform to the requirements of the City of Carlsbad.

Thank you for the opportunity to assist you with the water system planning for this project. If you have any questions regarding the information presented in this report, please do not hesitate to call.

Dexter Wilson Engineering, Inc.

Steven Henderson, P.E.

DSW:SH:pjs

Attachments

APPENDIX A

CARLSBAD MUNICIPAL WATER DISTRICT DESIGN CRITERIA

3.2 PLANNING AND DESIGN CRITERIA

3.2.1 Water Flow Generation

The following domestic water supply demands are used in the development of the water system.

A. Residential

Average daily flow 550 GPD/Single Family per dwelling unit
250 GPD/Multi-Family per dwelling unit

B. Non-Residential

Average daily flow 2,300 GPD/10,000 Sq. Ft.

C. Fire Flow

As a general guide, the following design criteria shall be used for determining fire flow requirements. The Fire Marshal will normally determine the specific fire flow criteria for a project.

1. Residential dwelling units shall use a minimum of 1,500 gpm from any two hydrants at a minimum of 20 psi of residual pressure at the main for 2 hours duration.

2. Multi-family residential units shall use a minimum of 3,000 gpm from any two hydrants at a minimum of 20 psi of residual pressure at the main for 2 hours duration.

3. Schools, commercial and industrial areas shall use a minimum of 4,000 gpm for 4 hours duration out of four hydrants at a minimum of 20 psi of residual pressure at the main. Higher requirements may be required if building floor area exceeds 300,000 square feet or is located near open space.

3.2.2 District Pipeline Sizing Criteria (Maximum Friction, Slopes, Velocities, Etc.)

A. Water System Design Criteria

1. Approximately one pressure zone is required for each 100 feet change in elevation.

2. Minimum static pressure of 60 psi.

3. Maximum static pressure of 125 psi. Pressures up to 150 psi may be allowed with specific approval of the City Engineer.

4. Use existing pressure zones if they are compatible.

5. Static pressures are figured from the tank floor of existing or proposed tanks for determination of minimum static pressure. The static pressure at the tank overflow elevation shall be used for maximum static pressure.

6. A small amount of pressure zone overlap (where one can be served water with sufficient pressure from either zone) should be included at boundaries of each pressure zone.

B. Hydraulic analysis of the System (Dynamic Pressures) shall address the following requirements:

1. Under peak hour demand and no fire flow, minimum pressure should be no less than 40 psi, should not exceed 3.5 feet/1,000 ft. head loss in the pipe, and velocity shall be below 8 ft/s. Maximum desirable head loss shall be 5.0 feet/1,000 ft. of pipe and maximum allowable head loss shall be no greater than 10 feet/1,000 feet of pipe at peak flow. The maximum allowable velocity shall be 10 ft/s.

2. Under maximum day demand plus fire flow, pressure in the system should not be less than 20 psi for the period of the fire incident (assume tank to be half full). During fire, pumps should be assumed to be off and the fire flow requirement is to be delivered 100% from storage tanks.

3. The maximum desired pressure drop between static pressures and dynamic pressures is 25 psi.

4. At least two sources of water from two different streets should be available for each development (i.e., looped). Two sources from the same transmission line are acceptable if source from a different street is unavailable. Dead-end water lines longer than 150-feet are not permitted, unless approved by the District. Looped systems are required as described above.

5. Dead-end water lines are to serve no more than 18 residences. A looped water line is required for 19 or more residences. Commercial / Industrial developments require looped water systems unless approved otherwise by the District and the Fire Marshal.

6. No more than one fire hydrant shall be allowed on a dead-end line. Water systems requiring 2 or more fire hydrants shall be looped. Minimum line size shall be 8-inches.

7. Approved double check detector assemblies (DCDAs) are required for all non-residential fire sprinkler systems per CSD W-22. This is particularly important for schools and commercial developments.

8. Dynamic pressures shall be analyzed with reservoir levels half full.

3.2.3 Water Master Plan Peaking Factors

Average Day Demand (ADD)	1.0
Maximum Month Demand (MMD)	1.5 x ADD
Maximum Day Demand (MDD)	1.65 x ADD
Peak Hour Demand (PHD)	2.90 x ADD

APPENDIX B

CARLSBAD FIRE DEPARTMENT WATER AVAILABILITY FORM AND EXTRAPOLATION CALCULATION

No. 125

CARLSBAD FIRE DEPARTMENT
Fire Prevention Division
1635 Faraday Avenue – Carlsbad, CA 92008
760.602.4665

WATER AVAILABILITY FORM

SECTION A: TO BE COMPLETED BY CUSTOMER

PROJECT NAME: Marja Acres SR#: _____ (Assigned upon plan submittal)

PROJECT ADDRESS: El Camino Real and Kelly Drive CITY: Carlsbad

PHONE: (760) 438-4422 (Dexter Wilson Engineering) FAX NUMBER: (760) 438-0173

Largest Building (ft.^{2}): _____ Sprinkled? YES Construction Type: _____

SECTION B: TO BE COMPLETED BY LOCAL WATER COMPANY. CUSTOMER TO PROVIDE RESULTS TO CFD.

Water Purveyor: City of Carlsbad

Location of test (reference map required): El Camino Real and Kelly Drive

TEST INFORMATION IS VALID FOR 6 MONTHS FROM DATE PERFORMED

Flow Test Results	
Static pressure: 89 PSI	Hydrant Number (if applicable): H61042
Elevation of test: 50 (est) Feet	Main Size: 12 INCH
Pressure Zone: 255 Feet	Date/Time of Test[1]:
Pitot Tube Reading: PSI	Corresponding Flow: GPM
Total Flow: 3,400 GPM	**Residual Pressure 79 PSI**
At peak demand, this water system is capable of providing a fire flow discharge at 20 psi in the vicinity of the fire in excess of 8,000 gpm. However, this flow exceeds the District's maximum velocity criteria of 10 fps. Therefore, the maximum allowable fire flow at this location is 3,400 gpm.	

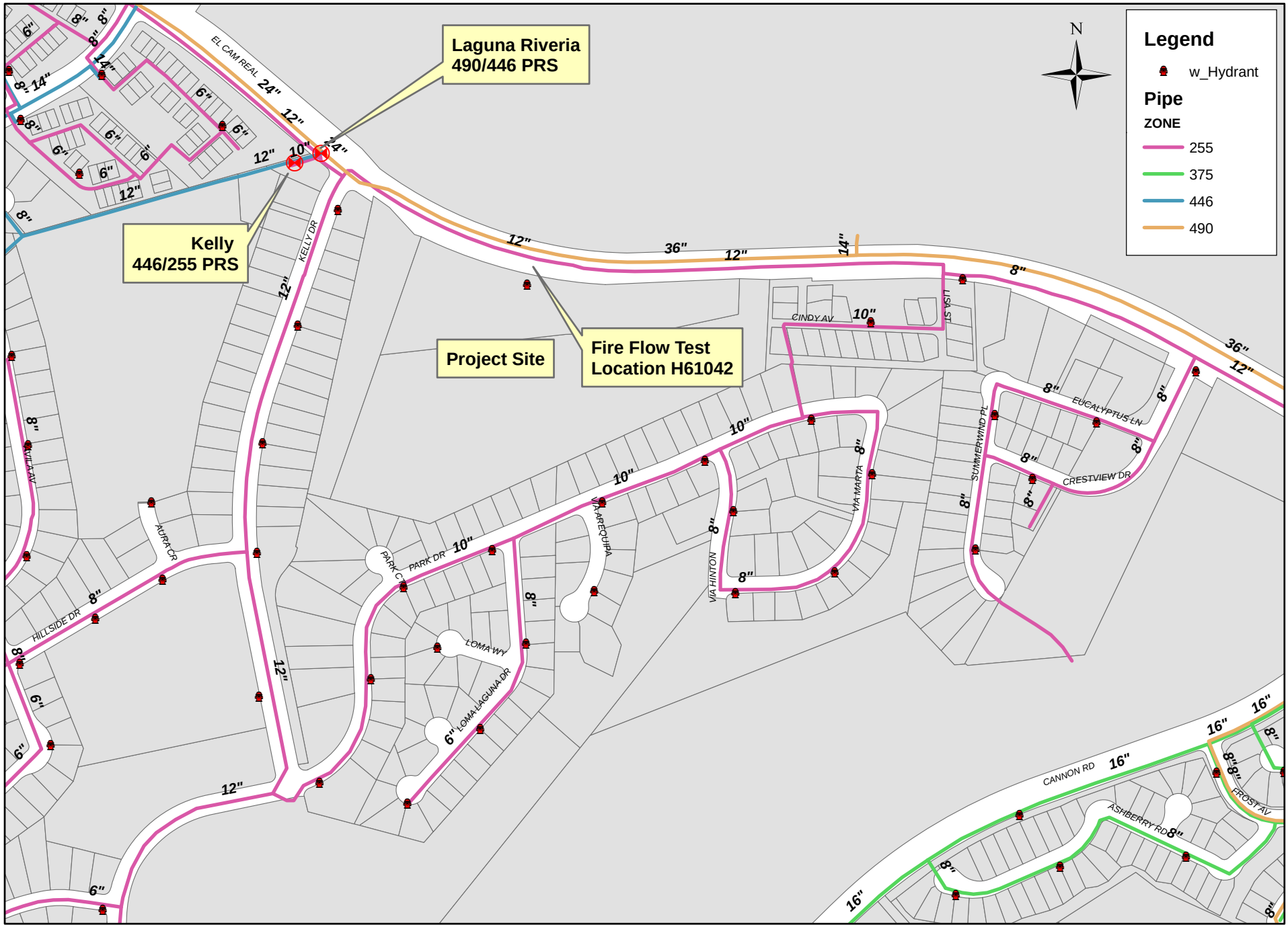
[1] Test to be performed as close as possible to the time the most conservative flows and pressures are expected.

Note: If the water availability information was obtained in a manner other than a flow test (i.e. computer modeling), fill out the information above as applicable and check here: x

Name: Jennifer R. Mael, P.E. Eng. Lic. No. (if applicable): C69606

Signature: _____

Title/Org: Project Manager Date: 10/2/2017



Marja Acres - Fire Flow Analysis

Fire Hydrant Flow Test Date October 2, 2017

Input Flow Test Results

Static Pressure*	82.7 PSI	* Adjusted from Water
Residual Pressure*	72.7 PSI	Availability Form to reflect the
Hydrant Flow	3400 GPM	255 Zone to 241 Zone correction

Actual Hydrant Elevation	50 Feet	HGL	240.9 Feet
Estimated Hydrant Elevation	50 Feet	HGL	240.9 Feet

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

k = 6.76083E-06

Extrapolated Calculations

Q, gpm	Residual Pressure			Available HGL	
1000	81.7	psi		238.5	ft
1250	81.1	psi		237.2	ft
1500	80.5	psi		235.8	ft
1600	80.2	psi		235.1	ft
1800	79.6	psi		233.8	ft
2000	79.0	psi		232.2	ft
2200	78.2	psi		230.6	ft
2400	77.5	psi		228.8	ft
2600	76.6	psi		226.8	ft
2800	75.7	psi		224.8	ft
3000	74.8	psi		222.6	ft
3200	73.8	psi		220.2	ft
3400	72.7	psi		217.8	ft
3500	72.1	psi		216.5	ft
3600	71.6	psi		215.2	ft
3800	70.4	psi		212.5	ft
4000	69.2	psi		209.7	ft

Residual Pressure, psi	Available Flow, gpm
0 psi	10,652
10 psi	9,935
20 psi	9,171
30 psi	8,349
40 psi	7,452
50 psi	6,451
60 psi	5,296
70 psi	3,869
80 psi	1,675
90 psi	Residual Pressure Exceeds Static Pressure

APPENDIX C

COMPUTER RUNS

EXISTING AND PROPOSED WATER SYSTEM ANALYSIS

NODE AND PIPE DIAGRAM REFERENCE:

Exhibit A

CONDITIONS MODELED:

1. Average Day Demands
2. Maximum Day Demands
3. Peak Hour Demands
4. Maximum Day Demand plus 3,000 gpm Multi-Family Fire Flow split between Nodes 40 and 44
5. Maximum Day Demand plus 3,000 gpm Multi-Family Fire Flow split between Nodes 52 and 64
6. Maximum Day Demand plus 3,000 gpm Multi-Family Fire Flow split between Nodes 72 and 80
7. Maximum Day Demand plus 4,000 gpm Commercial Fire Flow split between Nodes 12, 64, 68 and 80
8. Maximum Capable Flow at 20 psi Residual Pressure

FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

PIPE NO.	NODE NOS.		LENGTH (FEET)	DIAMETER (INCHES)	ROUGHNESS	MINOR LOSS K	FIXED GRADE
1	0	2	20.0	6.0	120.0	.00	240.00
3	2	4	50.0	12.0	120.0	.00	
7	4	8	299.0	12.0	120.0	.00	
11	8	12	329.0	12.0	120.0	.00	
15	8	16	169.0	12.0	120.0	.00	
19	16	20	315.0	12.0	120.0	.00	
23	16	24	294.0	8.0	120.0	.00	
27	24	28	69.0	8.0	120.0	.00	
31	28	32	229.0	8.0	120.0	.00	
33	28	36	199.0	8.0	120.0	.00	
35	32	36	311.0	8.0	120.0	.00	
39	36	40	245.0	8.0	120.0	.00	
41	24	48	355.0	8.0	120.0	.00	
43	40	44	290.0	8.0	120.0	.00	
47	48	44	175.0	8.0	120.0	.00	
51	44	52	239.0	8.0	120.0	.00	
55	52	56	80.0	8.0	120.0	.00	
57	56	60	459.0	8.0	120.0	.00	
59	68	60	305.0	8.0	120.0	.00	
63	56	64	320.0	8.0	120.0	.00	
67	64	68	190.0	8.0	120.0	.00	
71	60	72	199.0	8.0	120.0	.00	
75	72	76	50.0	8.0	120.0	.00	
79	76	80	236.0	8.0	120.0	.00	
83	76	84	234.0	8.0	120.0	.00	
87	2	84	722.0	12.0	120.0	.00	

JUNCTION NUMBER	DEMAND	ELEVATION	CONNECTING PIPES		
2	.00	51.00	1	3	87
4	.00	51.00	3	7	
8	.00	64.40	7	11	15
12	5.90	70.40	11		
16	5.90	66.30	15	19	23
20	5.90	60.00	19		
24	5.90	77.10	23	27	41
28	5.90	77.90	27	31	33
32	5.90	80.20	31	35	
36	5.90	75.70	33	35	39
40	5.90	75.00	39	43	
44	5.90	83.60	43	47	51
48	5.90	81.50	41	47	
52	5.90	87.50	51	55	

56	5.90	88.60	55	57	63
60	5.90	84.90	57	59	71
64	5.90	84.00	63	67	
68	5.90	84.50	59	67	
72	5.90	78.60	71	75	
76	5.90	76.00	75	79	83
80	5.90	70.00	79		
84	.00	61.80	83	87	

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD
3 VALUES ARE OUTPUT FOR MAXIMUM AND MINIMUM PRESSURES

THIS SYSTEM HAS 26 PIPES WITH 22 JUNCTIONS , 4 LOOPS AND 1 FGNS

THE RESULTS ARE OBTAINED AFTER 8 TRIALS WITH AN ACCURACY = .00023

Marja Acres **File: 736013B1**
Water System Analysis Computer Hydraulic Model
Average Day Demands

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	106.20	.03	.00	.00	1.20	1.35
3	2	4	61.93	.00	.00	.00	.18	.02
7	4	8	61.93	.01	.00	.00	.18	.02
11	8	12	5.90	.00	.00	.00	.02	.00
15	8	16	56.03	.00	.00	.00	.16	.01
19	16	20	5.90	.00	.00	.00	.02	.00
23	16	24	44.23	.02	.00	.00	.28	.07
27	24	28	24.87	.00	.00	.00	.16	.02
31	28	32	8.73	.00	.00	.00	.06	.00
33	28	36	10.24	.00	.00	.00	.07	.00
35	32	36	2.83	.00	.00	.00	.02	.00
39	36	40	7.17	.00	.00	.00	.05	.00
41	24	48	13.46	.00	.00	.00	.09	.01
43	40	44	1.27	.00	.00	.00	.01	.00
47	48	44	7.56	.00	.00	.00	.05	.00
51	44	52	2.93	.00	.00	.00	.02	.00
55	52	56	-2.97	.00	.00	.00	-.02	.00
57	56	60	-9.58	.00	.00	.00	-.06	.00
59	68	60	-11.09	.00	.00	.00	-.07	-.01
63	56	64	.71	.00	.00	.00	.00	.00
67	64	68	-5.19	.00	.00	.00	-.03	.00
71	60	72	-26.57	-.01	.00	.00	-.17	-.03
75	72	76	-32.47	.00	.00	.00	-.21	-.04
79	76	80	5.90	.00	.00	.00	.04	.00
83	76	84	-44.27	-.02	.00	.00	-.28	-.07
87	2	84	44.27	.01	.00	.00	.13	.01

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	239.97	51.00	81.89
4	.00	239.97	51.00	81.89

8	.00	239.97	64.40	76.08
12	5.90	239.97	70.40	73.48
16	5.90	239.96	66.30	75.25
20	5.90	239.96	60.00	77.98
24	5.90	239.95	77.10	70.57
28	5.90	239.94	77.90	70.22
32	5.90	239.94	80.20	69.22
36	5.90	239.94	75.70	71.17
40	5.90	239.94	75.00	71.47
44	5.90	239.94	83.60	67.75
48	5.90	239.94	81.50	68.66
52	5.90	239.94	87.50	66.06
56	5.90	239.94	88.60	65.58
60	5.90	239.94	84.90	67.19
64	5.90	239.94	84.00	67.57
68	5.90	239.94	84.50	67.36
72	5.90	239.95	78.60	69.92
76	5.90	239.95	76.00	71.05
80	5.90	239.95	70.00	73.65
84	.00	239.97	61.80	77.21

MAXIMUM PRESSURES

2	.00	239.97	51.00	81.89
4	.00	239.97	51.00	81.89
20	5.90	239.96	60.00	77.98

MINIMUM PRESSURES

56	5.90	239.94	88.60	65.58
52	5.90	239.94	87.50	66.06
60	5.90	239.94	84.90	67.19

THE NET SYSTEM DEMAND = 106.20

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
1	106.20

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 106.20
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 1.65

THE RESULTS ARE OBTAINED AFTER 2 TRIALS WITH AN ACCURACY = .00000

Marja Acres
Maximum Day Demands

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	175.23	.07	.00	.00	1.99	3.42
3	2	4	102.18	.00	.00	.00	.29	.04
7	4	8	102.18	.01	.00	.00	.29	.04
11	8	12	9.74	.00	.00	.00	.03	.00
15	8	16	92.44	.01	.00	.00	.26	.04
19	16	20	9.74	.00	.00	.00	.03	.00
23	16	24	72.97	.05	.00	.00	.47	.17
27	24	28	41.03	.00	.00	.00	.26	.06
31	28	32	14.40	.00	.00	.00	.09	.01
33	28	36	16.90	.00	.00	.00	.11	.01
35	32	36	4.67	.00	.00	.00	.03	.00
39	36	40	11.83	.00	.00	.00	.08	.01
41	24	48	22.21	.01	.00	.00	.14	.02
43	40	44	2.09	.00	.00	.00	.01	.00
47	48	44	12.47	.00	.00	.00	.08	.01
51	44	52	4.83	.00	.00	.00	.03	.00
55	52	56	-4.91	.00	.00	.00	-.03	.00
57	56	60	-15.81	.00	.00	.00	-.10	-.01
59	68	60	-18.31	.00	.00	.00	-.12	-.01
63	56	64	1.16	.00	.00	.00	.01	.00
67	64	68	-8.57	.00	.00	.00	-.05	.00
71	60	72	-43.85	-.01	.00	.00	-.28	-.06
75	72	76	-53.58	.00	.00	.00	-.34	-.09
79	76	80	9.74	.00	.00	.00	.06	.00
83	76	84	-73.05	-.04	.00	.00	-.47	-.17
87	2	84	73.05	.02	.00	.00	.21	.02

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	239.93	51.00	81.87
4	.00	239.93	51.00	81.87
8	.00	239.92	64.40	76.06
12	9.74	239.92	70.40	73.46
16	9.74	239.91	66.30	75.23
20	9.74	239.91	60.00	77.96
24	9.74	239.86	77.10	70.53
28	9.74	239.86	77.90	70.18
32	9.74	239.86	80.20	69.18
36	9.74	239.86	75.70	71.13
40	9.74	239.85	75.00	71.44
44	9.74	239.85	83.60	67.71
48	9.74	239.86	81.50	68.62
52	9.74	239.85	87.50	66.02
56	9.74	239.85	88.60	65.54
60	9.74	239.86	84.90	67.15
64	9.74	239.85	84.00	67.54
68	9.74	239.85	84.50	67.32
72	9.74	239.87	78.60	69.88
76	9.74	239.88	76.00	71.01
80	9.74	239.88	70.00	73.61
84	.00	239.91	61.80	77.18
	MAXIMUM PRESSURES			
2	.00	239.93	51.00	81.87
4	.00	239.93	51.00	81.87
20	9.74	239.91	60.00	77.96

MINIMUM PRESSURES

56	9.74	239.85	88.60	65.54
52	9.74	239.85	87.50	66.02
60	9.74	239.86	84.90	67.15

THE NET SYSTEM DEMAND = 175.23

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
1	175.23

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 175.23
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 2.90

THE RESULTS ARE OBTAINED AFTER 2 TRIALS WITH AN ACCURACY = .00000

Marja Acres
Peak Hour Demand

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	307.98	.19	.00	.00	3.49	9.71
3	2	4	179.59	.01	.00	.00	.51	.12
7	4	8	179.59	.04	.00	.00	.51	.12
11	8	12	17.11	.00	.00	.00	.05	.00
15	8	16	162.48	.02	.00	.00	.46	.10
19	16	20	17.11	.00	.00	.00	.05	.00
23	16	24	128.26	.14	.00	.00	.82	.47
27	24	28	72.12	.01	.00	.00	.46	.16
31	28	32	25.31	.01	.00	.00	.16	.02
33	28	36	29.70	.01	.00	.00	.19	.03
35	32	36	8.20	.00	.00	.00	.05	.00
39	36	40	20.79	.00	.00	.00	.13	.02
41	24	48	39.03	.02	.00	.00	.25	.05
43	40	44	3.68	.00	.00	.00	.02	.00
47	48	44	21.92	.00	.00	.00	.14	.02
51	44	52	8.49	.00	.00	.00	.05	.00
55	52	56	-8.62	.00	.00	.00	-.06	.00
57	56	60	-27.78	-.01	.00	.00	-.18	-.03
59	68	60	-32.18	-.01	.00	.00	-.21	-.04
63	56	64	2.04	.00	.00	.00	.01	.00
67	64	68	-15.07	.00	.00	.00	-.10	-.01
71	60	72	-77.06	-.04	.00	.00	-.49	-.18
75	72	76	-94.17	-.01	.00	.00	-.60	-.27
79	76	80	17.11	.00	.00	.00	.11	.01
83	76	84	-128.39	-.11	.00	.00	-.82	-.47
87	2	84	128.39	.05	.00	.00	.36	.07

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	239.81	51.00	81.82
4	.00	239.80	51.00	81.81
8	.00	239.76	64.40	75.99
12	17.11	239.76	70.40	73.39
16	17.11	239.75	66.30	75.16
20	17.11	239.75	60.00	77.89
24	17.11	239.61	77.10	70.42
28	17.11	239.60	77.90	70.07
32	17.11	239.59	80.20	69.07
36	17.11	239.59	75.70	71.02
40	17.11	239.59	75.00	71.32
44	17.11	239.59	83.60	67.59
48	17.11	239.59	81.50	68.51
52	17.11	239.58	87.50	65.90
56	17.11	239.58	88.60	65.43
60	17.11	239.60	84.90	67.04
64	17.11	239.58	84.00	67.42
68	17.11	239.59	84.50	67.20
72	17.11	239.63	78.60	69.78
76	17.11	239.65	76.00	70.91
80	17.11	239.64	70.00	73.51
84	.00	239.76	61.80	77.12
	MAXIMUM PRESSURES			
2	.00	239.81	51.00	81.82
4	.00	239.80	51.00	81.81
20	17.11	239.75	60.00	77.89
	MINIMUM PRESSURES			
56	17.11	239.58	88.60	65.43
52	17.11	239.58	87.50	65.90
60	17.11	239.60	84.90	67.04

THE NET SYSTEM DEMAND = 307.98

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
1	307.98

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 307.98
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 1.65

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND
40	1509.80
44	1509.80

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

FOR PIPE NUMBER 1 THE VALUE OF THE FIXED GRADE IS CHANGED TO 220.0

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00213

Marja Acres
Maximum Day Demand plus 3000 gpm Multi Family Fire Flow
Fire Flow split between Nodes 40 and 44

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	3175.36	14.62	.00	.00	36.03	730.88
3	2	4	1916.19	.49	.00	.00	5.44	9.81
7	4	8	1916.19	2.93	.00	.00	5.44	9.81
11	8	12	9.74	.00	.00	.00	.03	.00
15	8	16	1906.45	1.64	.00	.00	5.41	9.72
19	16	20	9.74	.00	.00	.00	.03	.00
23	16	24	1886.98	20.19	.00	.00	12.04	68.67
27	24	28	1064.34	1.64	.00	.00	6.79	23.78
31	28	32	392.06	.86	.00	.00	2.50	3.74
33	28	36	662.54	1.97	.00	.00	4.23	9.88
35	32	36	382.32	1.11	.00	.00	2.44	3.57
39	36	40	1035.13	5.53	.00	.00	6.61	22.59
41	24	48	812.91	5.13	.00	.00	5.19	14.44
43	40	44	-474.67	-1.55	.00	.00	-3.03	-5.33
47	48	44	803.18	2.47	.00	.00	5.13	14.12
51	44	52	-1181.29	-6.89	.00	.00	-7.54	-28.85
55	52	56	-1191.03	-2.34	.00	.00	-7.60	-29.29
57	56	60	-698.24	-5.00	.00	.00	-4.46	-10.89
59	68	60	-522.00	-1.94	.00	.00	-3.33	-6.36
63	56	64	-502.53	-1.90	.00	.00	-3.21	-5.92
67	64	68	-512.26	-1.17	.00	.00	-3.27	-6.14
71	60	72	-1229.97	-6.19	.00	.00	-7.85	-31.09
75	72	76	-1239.70	-1.58	.00	.00	-7.91	-31.54
79	76	80	9.74	.00	.00	.00	.06	.00
83	76	84	-1259.17	-7.60	.00	.00	-8.04	-32.47
87	2	84	1259.17	3.25	.00	.00	3.57	4.51

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	205.38	51.00	66.90
4	.00	204.89	51.00	66.69
8	.00	201.96	64.40	59.61
12	9.74	201.96	70.40	57.01
16	9.74	200.32	66.30	58.07
20	9.74	200.32	60.00	60.80
24	9.74	180.13	77.10	44.65
28	9.74	178.49	77.90	43.59
32	9.74	177.63	80.20	42.22
36	9.74	176.52	75.70	43.69
40	1509.80	170.99	75.00	41.59
44	1509.80	172.53	83.60	38.54
48	9.74	175.00	81.50	40.52
52	9.74	179.43	87.50	39.83
56	9.74	181.77	88.60	40.37

60	9.74	186.77	84.90	44.14
64	9.74	183.66	84.00	43.19
68	9.74	184.83	84.50	43.48
72	9.74	192.95	78.60	49.55
76	9.74	194.53	76.00	51.36
80	9.74	194.53	70.00	53.96
84	.00	202.13	61.80	60.81
	MAXIMUM PRESSURES			
2	.00	205.38	51.00	66.90
4	.00	204.89	51.00	66.69
84	.00	202.13	61.80	60.81
	MINIMUM PRESSURES			
44	1509.80	172.53	83.60	38.54
52	9.74	179.43	87.50	39.83
56	9.74	181.77	88.60	40.37

THE NET SYSTEM DEMAND = 3175.36

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
1	3175.36

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 3175.36
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 1.65

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND
52	1509.80
64	1509.80

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

FOR PIPE NUMBER 1 THE VALUE OF THE FIXED GRADE IS CHANGED TO 220.0

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00179

Marja Acres
Maximum Day Demand plus 3000 gpm Multi Family Fire Flow
Fire Flow split between Nodes 52 and 64

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	3175.36	14.62	.00	.00	36.03	730.88
3	2	4	1559.15	.33	.00	.00	4.42	6.69
7	4	8	1559.15	2.00	.00	.00	4.42	6.69
11	8	12	9.74	.00	.00	.00	.03	.00

15	8	16	1549.41	1.12	.00	.00	4.40	6.62
19	16	20	9.74	.00	.00	.00	.03	.00
23	16	24	1529.94	13.69	.00	.00	9.76	46.57
27	24	28	720.17	.80	.00	.00	4.60	11.54
31	28	32	265.25	.42	.00	.00	1.69	1.81
33	28	36	445.18	.94	.00	.00	2.84	4.73
35	32	36	255.52	.53	.00	.00	1.63	1.69
39	36	40	690.97	2.62	.00	.00	4.41	10.68
41	24	48	800.03	4.98	.00	.00	5.11	14.02
43	40	44	681.23	3.02	.00	.00	4.35	10.41
47	48	44	790.30	2.40	.00	.00	5.04	13.70
51	44	52	1461.80	10.23	.00	.00	9.33	42.80
55	52	56	-48.00	-.01	.00	.00	-.31	-.08
57	56	60	-703.95	-5.08	.00	.00	-4.49	-11.06
59	68	60	-873.32	-5.03	.00	.00	-5.57	-16.49
63	56	64	646.22	3.02	.00	.00	4.12	9.44
67	64	68	-863.58	-3.07	.00	.00	-5.51	-16.15
71	60	72	-1587.01	-9.92	.00	.00	-10.13	-49.84
75	72	76	-1596.74	-2.52	.00	.00	-10.19	-50.40
79	76	80	9.74	.00	.00	.00	.06	.00
83	76	84	-1616.21	-12.06	.00	.00	-10.32	-51.55
87	2	84	1616.21	5.17	.00	.00	4.58	7.16

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	205.38	51.00	66.90
4	.00	205.05	51.00	66.75
8	.00	203.05	64.40	60.08
12	9.74	203.05	70.40	57.48
16	9.74	201.93	66.30	58.77
20	9.74	201.93	60.00	61.50
24	9.74	188.24	77.10	48.16
28	9.74	187.44	77.90	47.47
32	9.74	187.03	80.20	46.29
36	9.74	186.50	75.70	48.01
40	9.74	183.88	75.00	47.18
44	9.74	180.86	83.60	42.15
48	9.74	183.26	81.50	44.10
52	1509.80	170.63	87.50	36.02
56	9.74	170.64	88.60	35.55
60	9.74	175.72	84.90	39.35
64	1509.80	167.62	84.00	36.24
68	9.74	170.69	84.50	37.35
72	9.74	185.63	78.60	46.38
76	9.74	188.15	76.00	48.60
80	9.74	188.15	70.00	51.20
84	.00	200.22	61.80	59.98
	MAXIMUM PRESSURES			
2	.00	205.38	51.00	66.90
4	.00	205.05	51.00	66.75
20	9.74	201.93	60.00	61.50
	MINIMUM PRESSURES			
56	9.74	170.64	88.60	35.55
52	1509.80	170.63	87.50	36.02
64	1509.80	167.62	84.00	36.24

THE NET SYSTEM DEMAND = 3175.36

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
1	3175.36

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 3175.36
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 1.65

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND
72	1509.80
80	1509.80

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

FOR PIPE NUMBER 1 THE VALUE OF THE FIXED GRADE IS CHANGED TO 220.0

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00017

Marja Acres
Maximum Day Demand plus 3000 gpm Multi Family Fire Flow
Fire Flow split between Nodes 72 and 80

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	3175.36	14.62	.00	.00	36.03	730.88
3	2	4	1115.68	.18	.00	.00	3.16	3.60
7	4	8	1115.68	1.08	.00	.00	3.16	3.60
11	8	12	9.74	.00	.00	.00	.03	.00
15	8	16	1105.94	.60	.00	.00	3.14	3.54
19	16	20	9.74	.00	.00	.00	.03	.00
23	16	24	1086.47	7.26	.00	.00	6.93	24.70
27	24	28	514.09	.43	.00	.00	3.28	6.18
31	28	32	189.32	.22	.00	.00	1.21	.97
33	28	36	315.04	.50	.00	.00	2.01	2.49
35	32	36	179.59	.27	.00	.00	1.15	.88
39	36	40	484.89	1.36	.00	.00	3.09	5.54
41	24	48	562.64	2.59	.00	.00	3.59	7.30
43	40	44	475.15	1.55	.00	.00	3.03	5.34
47	48	44	552.91	1.24	.00	.00	3.53	7.07
51	44	52	1018.33	5.24	.00	.00	6.50	21.91
55	52	56	1008.59	1.72	.00	.00	6.44	21.53
57	56	60	570.76	3.44	.00	.00	3.64	7.50
59	68	60	408.63	1.23	.00	.00	2.61	4.04
63	56	64	428.10	1.41	.00	.00	2.73	4.40
67	64	68	418.36	.80	.00	.00	2.67	4.22
71	60	72	969.65	3.98	.00	.00	6.19	20.01

75	72	76	-540.15	-.34	.00	.00	-3.45	-6.77
79	76	80	1509.80	10.72	.00	.00	9.64	45.44
83	76	84	-2059.68	-18.90	.00	.00	-13.15	-80.77
87	2	84	2059.68	8.09	.00	.00	5.84	11.21

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	205.38	51.00	66.90
4	.00	205.20	51.00	66.82
8	.00	204.13	64.40	60.55
12	9.74	204.13	70.40	57.95
16	9.74	203.53	66.30	59.46
20	9.74	203.53	60.00	62.19
24	9.74	196.26	77.10	51.64
28	9.74	195.84	77.90	51.11
32	9.74	195.61	80.20	50.01
36	9.74	195.34	75.70	51.84
40	9.74	193.98	75.00	51.56
44	9.74	192.43	83.60	47.16
48	9.74	193.67	81.50	48.61
52	9.74	187.20	87.50	43.20
56	9.74	185.47	88.60	41.98
60	9.74	182.03	84.90	42.09
64	9.74	184.07	84.00	43.36
68	9.74	183.26	84.50	42.80
72	1509.80	178.05	78.60	43.09
76	9.74	178.39	76.00	44.37
80	1509.80	167.66	70.00	42.32
84	.00	197.29	61.80	58.71
	MAXIMUM PRESSURES			
2	.00	205.38	51.00	66.90
4	.00	205.20	51.00	66.82
20	9.74	203.53	60.00	62.19
	MINIMUM PRESSURES			
56	9.74	185.47	88.60	41.98
60	9.74	182.03	84.90	42.09
80	1509.80	167.66	70.00	42.32

THE NET SYSTEM DEMAND = 3175.36

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
1	3175.36

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 3175.36
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :
JUNCTION NUMBER DEMAND

12	1009.80
64	1009.80
68	1009.80
80	1009.80

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

FOR PIPE NUMBER 1 THE VALUE OF THE FIXED GRADE IS CHANGED TO 209.0

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00073

Marja Acres
Maximum Day Demand plus 4000 gpm Commercial Fire Flow
Fire Flow split between Nodes 12 64 68 and 80

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	4121.80	23.70	.00	.00	46.77	1184.85
3	2	4	2216.24	.64	.00	.00	6.29	12.84
7	4	8	2216.24	3.84	.00	.00	6.29	12.84
11	8	12	1009.80	.99	.00	.00	2.86	2.99
15	8	16	1206.44	.70	.00	.00	3.42	4.16
19	16	20	5.90	.00	.00	.00	.02	.00
23	16	24	1194.64	8.66	.00	.00	7.62	29.45
27	24	28	560.72	.50	.00	.00	3.58	7.26
31	28	32	206.54	.26	.00	.00	1.32	1.14
33	28	36	348.28	.60	.00	.00	2.22	3.00
35	32	36	200.64	.34	.00	.00	1.28	1.08
39	36	40	543.02	1.68	.00	.00	3.47	6.84
41	24	48	628.02	3.18	.00	.00	4.01	8.95
43	40	44	537.12	1.94	.00	.00	3.43	6.70
47	48	44	622.12	1.54	.00	.00	3.97	8.80
51	44	52	1153.34	6.59	.00	.00	7.36	27.59
55	52	56	1147.44	2.19	.00	.00	7.32	27.33
57	56	60	135.16	.24	.00	.00	.86	.52
59	68	60	-1013.22	-6.62	.00	.00	-6.47	-21.71
63	56	64	1006.38	6.86	.00	.00	6.42	21.44
67	64	68	-3.42	.00	.00	.00	-.02	.00
71	60	72	-883.96	-3.36	.00	.00	-5.64	-16.86
75	72	76	-889.86	-.85	.00	.00	-5.68	-17.07
79	76	80	1009.80	5.09	.00	.00	6.44	21.57
83	76	84	-1905.56	-16.36	.00	.00	-12.16	-69.93
87	2	84	1905.56	7.01	.00	.00	5.41	9.71

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	185.30	51.00	58.20
4	.00	184.66	51.00	57.92
8	.00	180.82	64.40	50.45
12	1009.80	179.84	70.40	47.42
16	5.90	180.12	66.30	49.32
20	5.90	180.12	60.00	52.05
24	5.90	171.46	77.10	40.89
28	5.90	170.96	77.90	40.33
32	5.90	170.70	80.20	39.22
36	5.90	170.36	75.70	41.02
40	5.90	168.69	75.00	40.60

44	5.90	166.74	83.60	36.03
48	5.90	168.28	81.50	37.61
52	5.90	160.15	87.50	31.48
56	5.90	157.96	88.60	30.06
60	5.90	157.72	84.90	31.56
64	1009.80	151.10	84.00	29.08
68	1009.80	151.10	84.50	28.86
72	5.90	161.08	78.60	35.74
76	5.90	161.93	76.00	37.24
80	1009.80	156.84	70.00	37.63
84	.00	178.29	61.80	50.48
	MAXIMUM PRESSURES			
2	.00	185.30	51.00	58.20
4	.00	184.66	51.00	57.92
20	5.90	180.12	60.00	52.05
	MINIMUM PRESSURES			
68	1009.80	151.10	84.50	28.86
64	1009.80	151.10	84.00	29.08
56	5.90	157.96	88.60	30.06

THE NET SYSTEM DEMAND = 4121.80

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
1	4121.80

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 4121.80
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND
52	3800.00

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

FOR PIPE NUMBER 1 THE VALUE OF THE FIXED GRADE IS CHANGED TO 212.5

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00067

Marja Acres
Maximum Capable Flow at 20 psi Residual Pressure

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	2	3900.30	21.39	.00	.00	44.25	1069.64
3	2	4	1997.24	.53	.00	.00	5.67	10.59
7	4	8	1997.24	3.17	.00	.00	5.67	10.59

11	8	12	5.90	.00	.00	.00	.02	.00
15	8	16	1991.34	1.78	.00	.00	5.65	10.53
19	16	20	5.90	.00	.00	.00	.02	.00
23	16	24	1979.54	22.06	.00	.00	12.63	75.04
27	24	28	925.43	1.27	.00	.00	5.91	18.35
31	28	32	340.91	.66	.00	.00	2.18	2.89
33	28	36	578.62	1.53	.00	.00	3.69	7.69
35	32	36	335.01	.87	.00	.00	2.14	2.80
39	36	40	907.73	4.34	.00	.00	5.79	17.71
41	24	48	1048.21	8.21	.00	.00	6.69	23.12
43	40	44	901.83	5.07	.00	.00	5.76	17.50
47	48	44	1042.31	4.00	.00	.00	6.65	22.88
51	44	52	1938.24	17.25	.00	.00	12.37	72.17
55	52	56	-1861.76	-5.36	.00	.00	-11.88	-66.98
57	56	60	-1080.78	-11.23	.00	.00	-6.90	-24.47
59	68	60	-798.68	-4.26	.00	.00	-5.10	-13.97
63	56	64	-786.88	-4.35	.00	.00	-5.02	-13.59
67	64	68	-792.78	-2.62	.00	.00	-5.06	-13.78
71	60	72	-1885.36	-13.64	.00	.00	-12.03	-68.57
75	72	76	-1891.26	-3.45	.00	.00	-12.07	-68.96
79	76	80	5.90	.00	.00	.00	.04	.00
83	76	84	-1903.06	-16.32	.00	.00	-12.15	-69.76
87	2	84	1903.06	6.99	.00	.00	5.40	9.68

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
2	.00	191.11	51.00	60.71
4	.00	190.58	51.00	60.48
8	.00	187.41	64.40	53.30
12	5.90	187.41	70.40	50.70
16	5.90	185.63	66.30	51.71
20	5.90	185.63	60.00	54.44
24	5.90	163.57	77.10	37.47
28	5.90	162.30	77.90	36.57
32	5.90	161.64	80.20	35.29
36	5.90	160.77	75.70	36.86
40	5.90	156.43	75.00	35.29
44	5.90	151.36	83.60	29.36
48	5.90	155.36	81.50	32.01
52	**3800.00**	**134.11**	**87.50**	**20.20**
56	5.90	139.47	88.60	22.04
60	5.90	150.70	84.90	28.51
64	5.90	143.82	84.00	25.92
68	5.90	146.44	84.50	26.84
72	5.90	164.34	78.60	37.16
76	5.90	167.79	76.00	39.78
80	5.90	167.79	70.00	42.38
84	.00	184.12	61.80	53.00
	MAXIMUM PRESSURES			
2	.00	191.11	51.00	60.71
4	.00	190.58	51.00	60.48
20	5.90	185.63	60.00	54.44
	MINIMUM PRESSURES			
52	3800.00	134.11	87.50	20.20
56	5.90	139.47	88.60	22.04
64	5.90	143.82	84.00	25.92

```
 THE NET SYSTEM DEMAND =   3900.30

 SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

    PIPE NUMBER    FLOWRATE
         1        3900.30

 THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES =   3900.30
 THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES =       .00
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LEGEND

- PROJECT BOUNDARY
- EXISTING WATER (ZONE 241)
- EXISTING PUBLIC FIRE HYDRANT
- PROPOSED WATER (ZONE 241)
- PROPOSED PUBLIC FIRE HYDRANT
- (24) COMPUTER MODEL NODE NUMBER
- [87] COMPUTER MODEL PIPE NUMBER

N

0 150 FEET

EL CAMINO REAL

KELLY DR.

PARK DR.

EXHIBIT A

NODE AND PIPE DIAGRAM

MARJA ACRES

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