DEXTER WILSON ENGINEERING, INC.

WATER • WASTEWATER • RECYCLED WATER

CONSULTING ENGINEERS

HYDRAULIC ANALYSIS REPORT
FOR THE
KELLER CROSSING PROJECT

April 21, 2021

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

HYDRAULIC ANALYSIS REPORT
FOR THE
KELLER CROSSING PROJECT

April 21, 2021

Prepared For:
Eastern Municipal Water District
2270 Trumble Road
Perris, CA 92572-8300

Prepared by:
Dexter Wilson Engineering, Inc.
2234 Faraday Avenue
Carlsbad, CA 92008
760-438-4422

Job No. 544-054

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April 21, 2021

544-054

Eastern Municipal Water District
2270 Trumble Road
Perris, CA 92570

Attention: New Business Development Department

Subject: Hydraulic Analysis Report for the Keller Crossing Project

A. OBJECTIVE

This letter report provides a hydraulic analysis for the proposed Keller Crossing project. The project is located along the north side of Keller Road between Pourroy Road and Highway 79 in Winchester. The project is proposed to be served by the Eastern Municipal Water District (EMWD) 1627 Zone water system.

The project consists of approximately 191 acres and proposes land uses that include single family residential, high density residential, commercial, park, and open space areas. Attachment A provides a vicinity map and land use plan for the project.

The objective of this study is to present EMWD with the proposed domestic water distribution system for the project and to provide supporting hydraulic calculations to verify the adequacy of the proposed system in support of the project Plan of Service.

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B. ANALYSIS CRITERIA

The analysis in this letter-report was prepared based on EMWD Water Facilities Master Plan Update, September 2016. The pertinent criteria from that document are summarized as follows:

- Medium Residential Average Day Demand (ADD) Factor – 440 gpd/unit
- High Density Residential Average Day Demand (ADD) Factor – 310 gpd/unit
- Commercial Average Day Demand (ADD) Factor – 2,200 gpd/acre
- Park/Recreation Average Day Demand (ADD) Factor – 2,200 gpd/acre
- Maximum Day Demand (MDD) Factor – 2.0 x ADD
- Peak Hour Demand (PHD) Factor – 4.0 x ADD
- Medium Residential Fire Flow Requirement – 1,500 gpm for 2 hours
- High Density Residential Fire Flow Requirement – 3,000 gpm for 2 hours
- Commercial Fire Flow Requirement – 3,000 gpm for 3 hours
- Static Service Pressure Range – 60 psi to 125 psi
- Peak Hour Service Pressure Range – 50 psi to 125 psi
- Minimum Pressure MDD + Fire – 20 psi
- Maximum Pipeline Velocity – 10 feet/sec
- Maximum Pipeline Velocity during Fire Flow – 15 feet/sec

C. HYDRAULIC ANALYSIS

This hydraulic analysis has been prepared based on EMWD planning criteria and evaluates the system under average day demand, peak hour demand, and maximum day demand plus fire flow scenarios. Table 1 provides the projected water demands for the project. Pad elevations on the project range in elevation from approximately 1,455 feet to 1,506 feet.

TABLE 1
KELLER CROSSING PROJECT
PROJECTED WATER DEMANDS

Land Use	Quantity	Unit Demand	Total Average Demand, gpd
SF Residential	356 units	440 gpd/unit	156,640
High Density Residential	80 units	310 gpd/unit	24,800
Commercial	18.04 AC	2,200 gpd/ac	39,688
Park	6.5 ac	0 gpd/ac[1]	2,000[1]
Total Average Day Demand (ADD)			**223,128**
Total Maximum Day Demand (MDD)			**446,256**
Total Peak Hour Demand			**892,512**

[1] Park is proposed to be irrigated with recycled water. A nominal allowance for potable water at the park for restrooms, drinking fountains, etc. was assumed.

The existing water system in the vicinity of the project includes an 18-inch transmission line at the intersection of Pourroy Road and Ruft Road and a 12-inch line in Washington Street. It is proposed to construct an onsite 12-inch water line from the Washington Street connection north to Keller Road. The 12-inch line will be extended west to Pourroy Road with a section of 16-inch line just east of Pourroy Road. A 36-inch transmission line has been master planned by EMWD in Pourroy Road to the connection with the existing 18-inch line at Ruft Road. Onsite piping will consist of the 12-inch and 16-inch pipeline in Keller Road and 8-inch and 12-inch lines to the developed areas to meet EMWD looping criteria and provide the required fire flow to the project.

Analysis of the proposed water distribution system was performed using KY pipe computer modeling software developed by the University of Kentucky. Attachment B provides the proposed water system for the project.

A summary of the modeled conditions and resulting pressure range within the project is summarized in Table 2 below. A detailed list of minimum and maximum static pressures for each lot is provided in the Plan of Service.

TABLE 2
HYDRAULIC MODELING SUMMARY

Description	POC1 Source HGL, feet	POC2 Source HGL, feet	Minimum Pressure psi[3]	Maximum Pressure Psi[3]
Static Conditions, Full Reservoir	1,627	1,627	52.6	74.5
Static Conditions Empty Reservoir	1,589	1,589	36.1	58.1
Average Day Demands	1,631[1]	1,631[1]	52.6	79.7
Maximum Day Demands	1,618[1]	1,616[1]	48.5	75.6
Peak Hour Demands	1,595[1]	1,591[1]	38.1	65.2
Maximum Day Demands plus 1,500 gpm fire flow at Node 44	1,614[1]	1,585[1]	33.3	69.4
Maximum Day Demands plus 3,000 gpm fire flow at Node 5	1,600[2]	1,555[2]	31.4	59.9
Maximum Day Demands plus 3,000 gpm fire flow at Node 18	1,600[2]	1,555[2]	22.8	59.7

[1] Based on boundary conditions from EMWD (See Attachment D).

[2] Extrapolated from EMWD boundary conditions.

[3] Minimum and maximum pressures are onsite.

The hydraulic modeling output and corresponding node and pipe diagram are provided as Attachment C. The analysis was based on the planning criteria provided previously as well as from the boundary condition results provided by EMWD that are included in Attachment D for reference. The results of the analysis indicate that the system as proposed is adequate to meet all maximum day demand plus fire flow scenarios. A section of piping in Keller Road was increased to 16-inch and some onsite piping was increased to 12-inch to meet the minimum pressure requirements. During peak hour demand conditions, there are some lots in the north portion of the project that will not meet the minimum pressure of 50 psi. Figure 2 in Attachment B identifies a few lots where pressures will be 38 to 40 psi during peak hour demand conditions and additional lots that will have pressures of 40 to 50 psi.

Recommendations

It is recommended that the project be served by constructing the proposed water system improvements as depicted on Figure 2 in Attachment B. The proposed water system consists of making connections to the existing water lines in Washington Street and Ruft Road and constructing a line between these connections to form a loop. The onsite lines will be 8-inch through 16-inch and looped to meet EMWD requirements and meet onsite fire flow requirements. There are lots identified on Figure 2 that will receive residual pressures of less than 50 psi during peak hour demand conditions. At a minimum, these lots will require a notice of marginal pressure to be issued with the sale of the lot and some lots may require private booster pumps to increase domestic pressures.

D. RECYCLED WATER SYSTEM

There is an existing 24-inch recycled water line located west of the project in Leon Road. It is proposed to construct an offsite 12-inch water line in Keller Road from Leon Road boundary. Onsite it is proposed to extend an 8-inch line to the park site and other use areas. A Recycled Water Use Exhibit (RWUE) will be prepared by others to identify the proposed use areas and recycled water system improvements within the project.

Dexter Wilson Engineering, Inc.

Stephen M. Nielsen

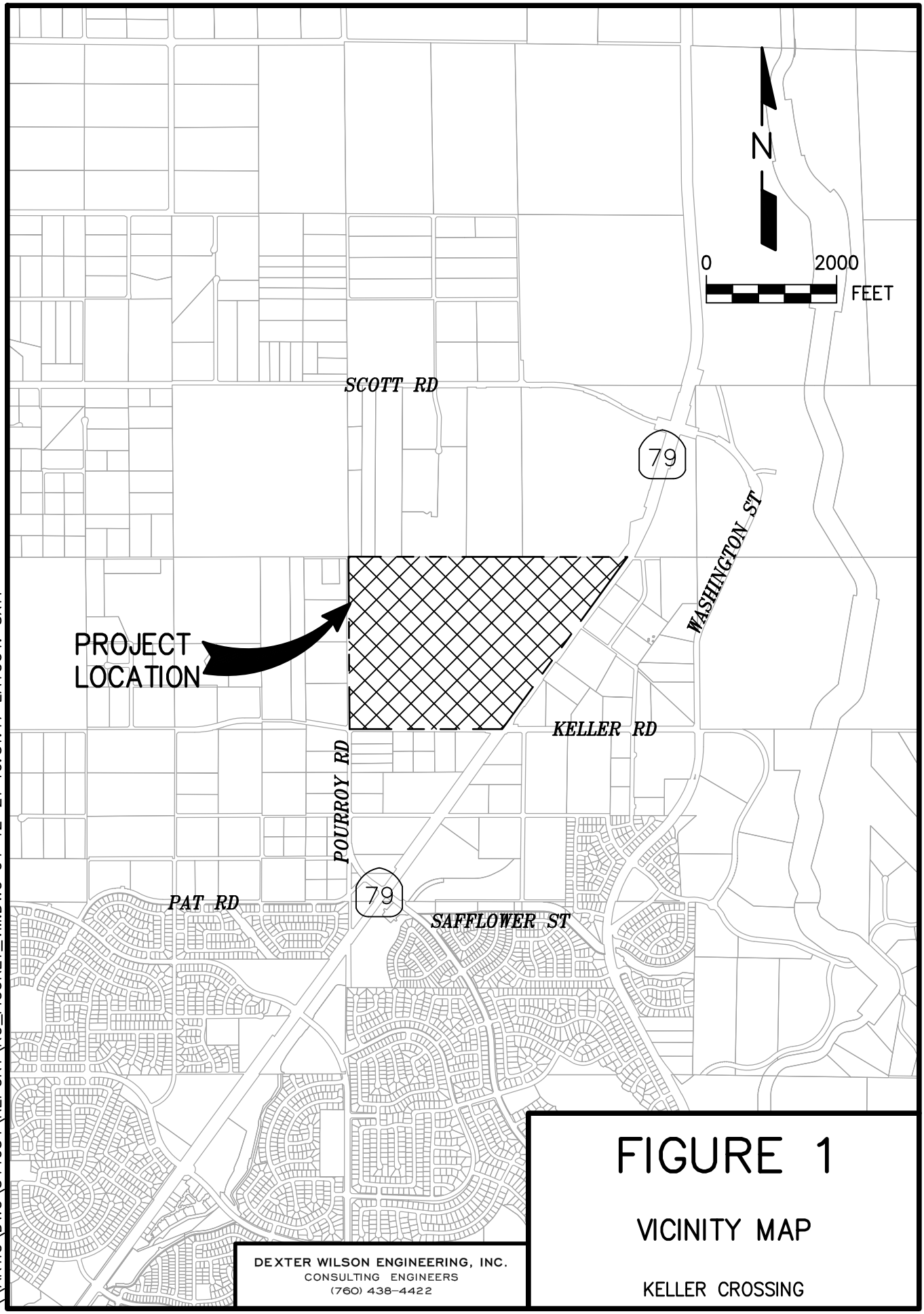
Stephen M. Nielsen, P.E.

SMN:ah

Attachment(s)

ATTACHMENT A

VICINITY MAP AND LAND USE PLAN



\\ARTIC\DWG\544054\REPORT\KC_FIGURE1_VM.DWG 04-12-21 10:31:17 LAYOUT: 8X11

FIGURE 1

VICINITY MAP

KELLER CROSSING

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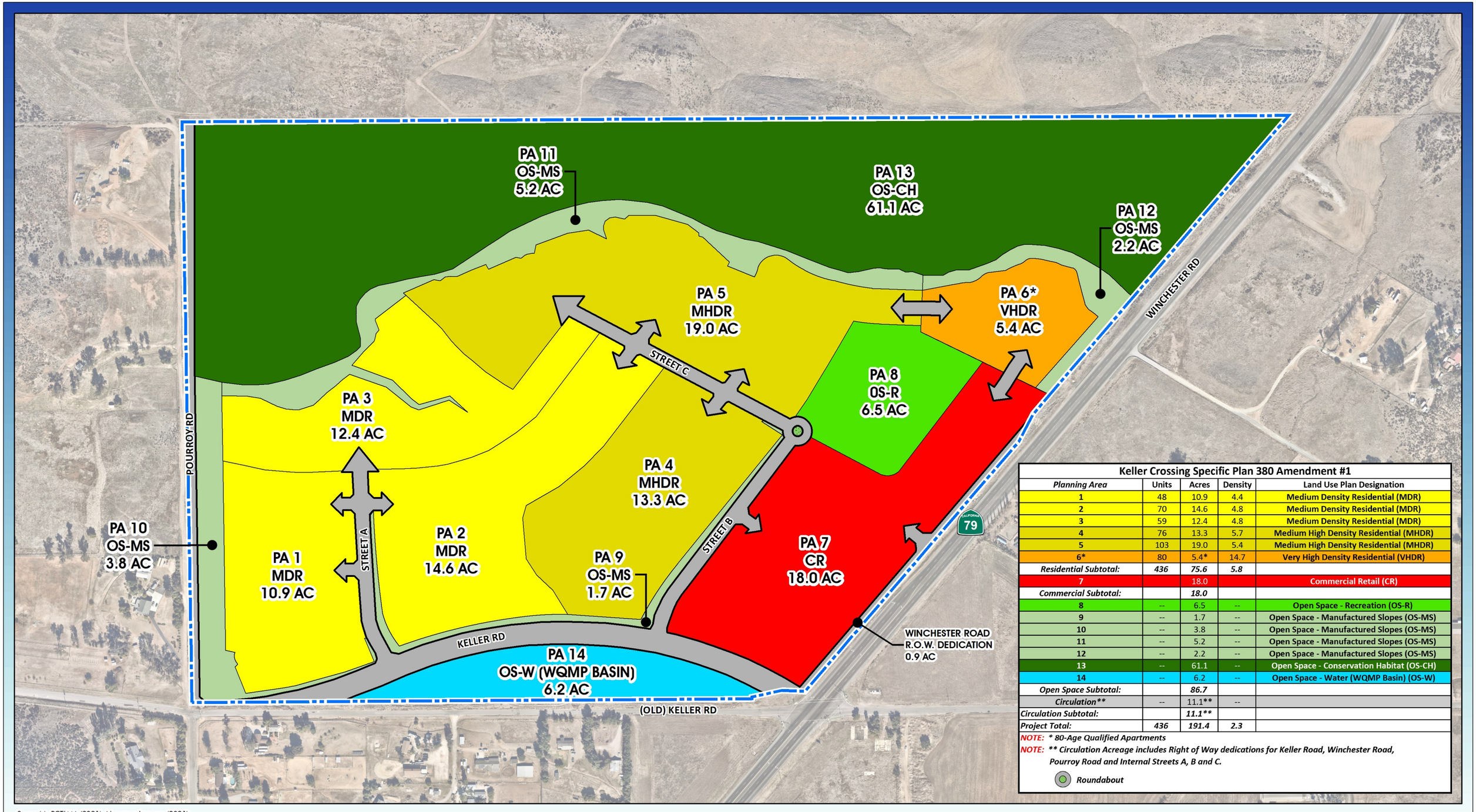

Keller Crossing Specific Plan 380 Amendment #1

Planning Area	Units	Acres	Density	Land Use Plan Designation
1	48	10.9	4.4	Medium Density Residential (MDR)
2	70	14.6	4.8	Medium Density Residential (MDR)
3	59	12.4	4.8	Medium Density Residential (MDR)
4	76	13.3	5.7	Medium High Density Residential (MHDR)
5	103	19.0	5.4	Medium High Density Residential (MHDR)
6*	80	5.4*	14.7	Very High Density Residential (VHDR)
Residential Subtotal:	*436*	*75.6*	*5.8*	
7		18.0		Commercial Retail (CR)
Commercial Subtotal:		*18.0*		
8	--	6.5	--	Open Space - Recreation (OS-R)
9	--	1.7	--	Open Space - Manufactured Slopes (OS-MS)
10	--	3.8	--	Open Space - Manufactured Slopes (OS-MS)
11	--	5.2	--	Open Space - Manufactured Slopes (OS-MS)
12	--	2.2	--	Open Space - Manufactured Slopes (OS-MS)
13	--	61.1	--	Open Space - Conservation Habitat (OS-CH)
14	--	6.2	--	Open Space - Water (WQMP Basin) (OS-W)
Open Space Subtotal:		*86.7*		
*Circulation***	--	11.1**	--	
Circulation Subtotal:		*11.1***		
Project Total:	*436*	*191.4*	*2.3*	

*NOTE: * 80-Age Qualified Apartments*

*NOTE: ** Circulation Acreage includes Right of Way dedications for Keller Road, Winchester Road, Pourroy Road and Internal Streets A, B and C.*

Roundabout

Source(s): RCTLMA (2021), Nearmap Imagery (2021)
Composite: K&A Engineering (01-21-2021)

KELLER CROSSING SPECIFIC PLAN SP380 A1

Date: 03-24-2021
Job #: 472-067

T&B PLANNING
3200 El Camino Real, Suite 100 Irvine, CA 92602
p. 714.505.6360
www.tbplanning.com

0 100 200 400 Feet

Conceptual Land Use Plan

ATTACHMENT B

PROPOSED WATER SYSTEM FIGURE

LEGEND

PROJECT BOUNDARY

EXISTING PUBLIC WATER LINE

PROPOSED PUBLIC WATER LINE

36" (16") SIZE REQUIRED (SIZE REQUIRED FOR PROJECT ONLY)

LOTS WHERE RESIDUAL PRESSURES OF 40–50 PSI OCCUR DURING PEAK HOUR DEMANDS

NOTE:
ALL PROPOSED WATER LINES ARE RECOMMENDED AS 8" UNLESS OTHERWISE NOTED.

MSHCP OPEN SPACE AREA

OPEN SPACE

OPEN SPACE

OPEN SPACE

CCRC/AGE QUALIFIED

VALLEY WIDE PARK

COMMERCIAL AREA

POURROY RD

ELMHURST LN

WASHINGTON ST

KELLER RD

OLD KELLER RD

KELLER RD

RUFT RD

SAFFLOWER ST

79

79

12"

16"

36" (16")

CONNECT TO EX.18" WATER LINE

EX.18"

EX.12"

CONNECT TO EX.12" WATER LINE

EX.8"

EX.12"

EX.8"

EX.12"

N

0 600 FEET

\\ARTIC\DWG\544054\REPORT\KC_WTR_FIGURE-2_PROFACILITIES.DWG 05-12-21 14:48:16 LAYOUT: 11X17

FIGURE 2

PROPOSED WATER FACILITIES

KELLER CROSSING

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ATTACHMENT C

HYDRAULIC MODELING OUTPUT AND DIAGRAM

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* * * * * * * * * * * * *  K Y P I P E  * * * * * * * * * * * * *
*                                                                 *
*  Pipe Network Modeling Software                                 *
*                                                                 *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)                     *
*  Version: 10.009  10/01/2019                                    *
*  Company:  Dexter        Serial #:  592169                      *
*  Interface:  KYnetic                                            *
*  Licensed for Pipe2018                                          *
*                                                                 *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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Date & Time: Wed May 12 14:23:46 2021

Master File : \\artic\eng\544054\ky pipe\2021-03-12 domestic water analysis.KYP\2021-03-12 domestic water analysis.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.
1	4	5	552.60	12.00	120.0000	0.00
3	5	6	552.60	12.00	120.0000	0.00
7	6	8	100.00	8.00	120.0000	0.00
9	10	6	200.00	12.00	120.0000	0.00
11	12	10	305.90	12.00	120.0000	0.00
13	14	12	314.90	12.00	120.0000	0.00
15	16	14	203.80	12.00	120.0000	0.00
17	16	18	574.30	12.00	120.0000	0.00
19	14	20	271.30	8.00	120.0000	0.00
21	20	22	269.60	8.00	120.0000	0.00
23	22	24	308.20	8.00	120.0000	0.00
25	24	10	230.00	12.00	120.0000	0.00
27	24	26	434.60	8.00	120.0000	0.00
29	26	28	428.40	8.00	120.0000	0.00
31	30	28	277.20	8.00	120.0000	0.00
33	32	30	271.90	8.00	120.0000	0.00
35	10	32	284.80	8.00	120.0000	0.00
37	24	38	274.50	12.00	120.0000	0.00
39	38	40	484.30	8.00	120.0000	0.00
41	38	42	280.00	12.00	120.0000	0.00
43	42	44	430.50	8.00	120.0000	0.00
45	42	46	283.00	8.00	120.0000	0.00
47	42	48	271.20	12.00	120.0000	0.00
49	48	50	456.40	8.00	120.0000	0.00
51	48	52	321.90	12.00	120.0000	0.00
53	52	54	509.20	8.00	120.0000	0.00
55	52	56	481.20	12.00	120.0000	0.00
57	56	58	119.70	8.00	120.0000	0.00
59	56	60	445.00	8.00	120.0000	0.00
61	38	62	376.00	8.00	120.0000	0.00

63	62	64	275.40	8.00	120.0000	0.00
65	64	66	260.50	8.00	120.0000	0.00
67	66	68	515.90	8.00	120.0000	0.00
69	66	70	260.00	8.00	120.0000	0.00
71	70	72	516.40	8.00	120.0000	0.00
73	70	74	177.00	8.00	120.0000	0.00
75	56	74	290.20	12.00	120.0000	0.00
77	74	78	435.70	8.00	120.0000	0.00
79	74	80	292.00	12.00	120.0000	0.00
81	80	82	446.30	8.00	120.0000	0.00
83	80	84	264.00	12.00	120.0000	0.00
85	84	86	470.32	8.00	120.0000	0.00
87	84	88	201.70	12.00	120.0000	0.00
101	2	R-1	1529.70	12.00	120.0000	0.00
103	4	2	3629.40	12.00	120.0000	0.00
105	4	88	889.30	12.00	120.0000	0.00
107	88	90	868.50	16.00	120.0000	0.00
109	90	R-2	1970.50	36.00	120.0000	0.00

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
2		0.00	1436.00	
4		0.00	1443.00	
5		27.60	1452.00	
6		0.00	1456.00	
8		1.40	1458.00	
10		0.00	1462.10	
12		3.40	1472.30	
14		3.10	1480.60	
16		1.22	1482.00	
18		17.20	1490.00	
20		2.80	1489.60	
22		3.10	1485.00	
24		0.00	1478.80	
26		5.51	1476.80	
28		5.51	1470.10	
30		6.12	1466.20	
32		6.43	1467.20	
38		0.00	1487.50	
40		5.81	1496.00	
42		0.00	1493.50	
44		3.67	1501.60	
46		3.06	1501.20	
48		3.06	1490.40	
50		5.51	1499.90	
52		3.67	1486.00	
54		4.00	1499.40	
56		0.00	1478.30	
58		2.14	1483.00	
60		4.30	1482.90	
62		3.67	1482.90	
64		4.00	1477.00	
66		1.22	1473.20	
68		5.51	1472.80	
70		1.22	1471.10	
72		5.80	1470.20	
74		0.00	1470.00	
78		4.90	1482.90	
80		0.00	1461.00	
82		4.90	1473.00	
84		0.00	1452.80	
86		4.90	1460.20	
88		0.00	1451.60	
90		0.00	1451.00	
R-1		----	1427.00	1627.00
R-2		----	1412.00	1627.00

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 = 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) = 48
NUMBER OF END NODES .....(J) = 43
NUMBER OF PRIMARY LOOPS .....(L) = 4
NUMBER OF SUPPLY NODES .....(F) = 2
NUMBER OF SUPPLY ZONES .....(Z) = 1

==========

Case: 0 = AVERAGE DAY DEMAND

RESULTS OBTAINED AFTER 9 TRIALS: ACCURACY = 0.38535E-05

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
1	4	5	72.58	0.01	0.00	0.21	0.02	0.02
3	5	6	44.98	0.01	0.00	0.13	0.01	0.01
7	6	8	1.40	0.00	0.00	0.01	0.00	0.00
9	10	6	-43.58	0.00	0.00	0.12	0.01	0.01
11	12	10	-22.54	0.00	0.00	0.06	0.00	0.00
13	14	12	-19.14	0.00	0.00	0.05	0.00	0.00
15	16	14	-18.42	0.00	0.00	0.05	0.00	0.00
17	16	18	17.20	0.00	0.00	0.05	0.00	0.00
19	14	20	-2.38	0.00	0.00	0.02	0.00	0.00
21	20	22	-5.18	0.00	0.00	0.03	0.00	0.00
23	22	24	-8.28	0.00	0.00	0.05	0.00	0.00
25	24	10	-7.89	0.00	0.00	0.02	0.00	0.00
27	24	26	10.42	0.00	0.00	0.07	0.00	0.00
29	26	28	4.91	0.00	0.00	0.03	0.00	0.00
31	30	28	0.60	0.00	0.00	0.00	0.00	0.00
33	32	30	6.72	0.00	0.00	0.04	0.00	0.00
35	10	32	13.15	0.00	0.00	0.08	0.01	0.01
37	24	38	-10.81	0.00	0.00	0.03	0.00	0.00
39	38	40	5.81	0.00	0.00	0.04	0.00	0.00
41	38	42	-14.31	0.00	0.00	0.04	0.00	0.00
43	42	44	3.67	0.00	0.00	0.02	0.00	0.00
45	42	46	3.06	0.00	0.00	0.02	0.00	0.00
47	42	48	-21.04	0.00	0.00	0.06	0.00	0.00
49	48	50	5.51	0.00	0.00	0.04	0.00	0.00
51	48	52	-29.61	0.00	0.00	0.08	0.00	0.00
53	52	54	4.00	0.00	0.00	0.03	0.00	0.00
55	52	56	-37.28	0.00	0.00	0.11	0.01	0.01
57	56	58	2.14	0.00	0.00	0.01	0.00	0.00
59	56	60	4.30	0.00	0.00	0.03	0.00	0.00
61	38	62	-2.31	0.00	0.00	0.01	0.00	0.00
63	62	64	-5.98	0.00	0.00	0.04	0.00	0.00
65	64	66	-9.98	0.00	0.00	0.06	0.00	0.00

67	66	68	5.51	0.00	0.00	0.04	0.00	0.00
69	66	70	-16.71	0.00	0.00	0.11	0.01	0.01
71	70	72	5.80	0.00	0.00	0.04	0.00	0.00
73	70	74	-23.73	0.00	0.00	0.15	0.02	0.02
75	56	74	-43.72	0.00	0.00	0.12	0.01	0.01
77	74	78	4.90	0.00	0.00	0.03	0.00	0.00
79	74	80	-72.35	0.01	0.00	0.21	0.02	0.02
81	80	82	4.90	0.00	0.00	0.03	0.00	0.00
83	80	84	-77.25	0.01	0.00	0.22	0.03	0.03
85	84	86	4.90	0.00	0.00	0.03	0.00	0.00
87	84	88	-82.15	0.01	0.00	0.23	0.03	0.03
101	2	R-1	-29.24	0.01	0.00	0.08	0.00	0.00
103	4	2	-29.24	0.02	0.00	0.08	0.00	0.00
105	4	88	-43.34	0.01	0.00	0.12	0.01	0.01
107	88	90	-125.49	0.01	0.00	0.20	0.02	0.02
109	90	R-2	-125.49	0.00	0.00	0.04	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
2		0.00	1626.99	1436.00	190.99	82.76
4		0.00	1626.98	1443.00	183.98	79.72
5		27.60	1626.97	1452.00	174.97	75.82
6		0.00	1626.96	1456.00	170.96	74.08
8		1.40	1626.96	1458.00	168.96	73.22
10		0.00	1626.96	1462.10	164.86	71.44
12		3.40	1626.96	1472.30	154.66	67.02
14		3.10	1626.96	1480.60	146.36	63.42
16		1.22	1626.96	1482.00	144.96	62.81
18		17.20	1626.96	1490.00	136.96	59.35
20		2.80	1626.96	1489.60	137.36	59.52
22		3.10	1626.96	1485.00	141.96	61.51
24		0.00	1626.96	1478.80	148.16	64.20
26		5.51	1626.96	1476.80	150.16	65.07
28		5.51	1626.96	1470.10	156.86	67.97
30		6.12	1626.96	1466.20	160.76	69.66
32		6.43	1626.96	1467.20	159.76	69.23
38		0.00	1626.96	1487.50	139.46	60.43
40		5.81	1626.96	1496.00	130.96	56.75
42		0.00	1626.96	1493.50	133.46	57.83
44		3.67	1626.96	1501.60	125.36	54.32
46		3.06	1626.96	1501.20	125.76	54.50
48		3.06	1626.96	1490.40	136.56	59.18
50		5.51	1626.96	1499.90	127.06	55.06
52		3.67	1626.96	1486.00	140.96	61.08
54		4.00	1626.96	1499.40	127.56	55.28
56		0.00	1626.96	1478.30	148.66	64.42
58		2.14	1626.96	1483.00	143.96	62.38
60		4.30	1626.96	1482.90	144.06	62.43
62		3.67	1626.96	1482.90	144.06	62.43
64		4.00	1626.96	1477.00	149.96	64.98
66		1.22	1626.96	1473.20	153.76	66.63
68		5.51	1626.96	1472.80	154.16	66.80
70		1.22	1626.96	1471.10	155.86	67.54
72		5.80	1626.96	1470.20	156.76	67.93
74		0.00	1626.97	1470.00	156.97	68.02
78		4.90	1626.97	1482.90	144.07	62.43
80		0.00	1626.97	1461.00	165.97	71.92
82		4.90	1626.97	1473.00	153.97	66.72
84		0.00	1626.98	1452.80	174.18	75.48
86		4.90	1626.98	1460.20	166.78	72.27
88		0.00	1626.99	1451.60	175.39	76.00
90		0.00	1627.00	1451.00	176.00	76.27
R-1		----	1627.00	1427.00	200.00	86.67
R-2		----	1627.00	1412.00	215.00	93.17

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-2	93.17	44	54.32
R-1	86.67	46	54.50
2	82.76	50	55.06
4	79.72	54	55.28
90	76.27	40	56.75

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
87	0.23	31	0.00
83	0.22	7	0.01
1	0.21	57	0.01
79	0.21	61	0.01
107	0.20	19	0.02

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
87	0.03	31	0.00
83	0.03	7	0.00
1	0.02	57	0.00
79	0.02	61	0.00
73	0.02	19	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
87	0.03	31	0.00
83	0.03	7	0.00
1	0.02	57	0.00
79	0.02	61	0.00
73	0.02	19	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	29.24	
R-2	125.49	

NET SYSTEM INFLOW = 154.73
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 154.73

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Case: 1 = MAXIMUM DAY DEMAND NO FIRE

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 R-1 has a new HGL of 1616.000
TANK at node R-2 has a new HGL of 1618.000

RESULTS OBTAINED AFTER 6 TRIALS: ACCURACY = 0.13340E-04

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
1	4	5	41.51	0.00	0.00	0.12	0.01	0.01
3	5	6	-13.69	0.00	0.00	0.04	0.00	0.00
7	6	8	2.80	0.00	0.00	0.02	0.00	0.00
9	10	6	16.49	0.00	0.00	0.05	0.00	0.00
11	12	10	-39.13	0.00	0.00	0.11	0.01	0.01
13	14	12	-32.33	0.00	0.00	0.09	0.01	0.01
15	16	14	-36.84	0.00	0.00	0.10	0.01	0.01
17	16	18	34.40	0.00	0.00	0.10	0.01	0.01
19	14	20	-10.71	0.00	0.00	0.07	0.00	0.00
21	20	22	-16.31	0.00	0.00	0.10	0.01	0.01
23	22	24	-22.51	0.01	0.00	0.14	0.02	0.02
25	24	10	78.37	0.01	0.00	0.22	0.03	0.03
27	24	26	24.39	0.01	0.00	0.16	0.02	0.02
29	26	28	13.37	0.00	0.00	0.09	0.01	0.01
31	30	28	-2.35	0.00	0.00	0.01	0.00	0.00
33	32	30	9.89	0.00	0.00	0.06	0.00	0.00
35	10	32	22.75	0.01	0.00	0.15	0.02	0.02
37	24	38	-125.27	0.02	0.00	0.36	0.06	0.06
39	38	40	11.62	0.00	0.00	0.07	0.01	0.01
41	38	42	-102.31	0.01	0.00	0.29	0.04	0.04
43	42	44	7.34	0.00	0.00	0.05	0.00	0.00
45	42	46	6.12	0.00	0.00	0.04	0.00	0.00
47	42	48	-115.77	0.01	0.00	0.33	0.05	0.05
49	48	50	11.02	0.00	0.00	0.07	0.01	0.01
51	48	52	-132.91	0.02	0.00	0.38	0.07	0.07
53	52	54	8.00	0.00	0.00	0.05	0.00	0.00
55	52	56	-148.25	0.04	0.00	0.42	0.09	0.09
57	56	58	4.28	0.00	0.00	0.03	0.00	0.00
59	56	60	8.60	0.00	0.00	0.05	0.00	0.00
61	38	62	-34.58	0.02	0.00	0.22	0.04	0.04
63	62	64	-41.92	0.02	0.00	0.27	0.06	0.06
65	64	66	-49.92	0.02	0.00	0.32	0.08	0.08
67	66	68	11.02	0.00	0.00	0.07	0.01	0.01
69	66	70	-63.38	0.03	0.00	0.40	0.13	0.13
71	70	72	11.60	0.00	0.00	0.07	0.01	0.01
73	70	74	-77.42	0.03	0.00	0.49	0.19	0.19
75	56	74	-161.13	0.03	0.00	0.46	0.10	0.10
77	74	78	9.80	0.00	0.00	0.06	0.00	0.00
79	74	80	-248.35	0.07	0.00	0.70	0.22	0.22
81	80	82	9.80	0.00	0.00	0.06	0.00	0.00
83	80	84	-258.15	0.06	0.00	0.73	0.24	0.24
85	84	86	9.80	0.00	0.00	0.06	0.00	0.00
87	84	88	-267.95	0.05	0.00	0.76	0.26	0.26
101	2	R-1	279.77	0.43	0.00	0.79	0.28	0.28
103	4	2	279.77	1.01	0.00	0.79	0.28	0.28
105	4	88	-321.28	0.32	0.00	0.91	0.36	0.36
107	88	90	-589.23	0.24	0.00	0.94	0.27	0.27
109	90	R-2	-589.23	0.01	0.00	0.19	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	1616.43	1436.00	180.43	78.18
4		0.00	1617.43	1443.00	174.43	75.59
5		55.20(2.00)	1617.43	1452.00	165.43	71.69
6		0.00	1617.43	1456.00	161.43	69.95
8		2.80(2.00)	1617.43	1458.00	159.43	69.09
10		0.00	1617.43	1462.10	155.33	67.31
12		6.80(2.00)	1617.43	1472.30	145.13	62.89
14		6.20(2.00)	1617.43	1480.60	136.83	59.29
16		2.44(2.00)	1617.43	1482.00	135.43	58.68
18		34.40(2.00)	1617.42	1490.00	127.42	55.22
20		5.60(2.00)	1617.43	1489.60	127.83	55.39
22		6.20(2.00)	1617.43	1485.00	132.43	57.39
24		0.00	1617.44	1478.80	138.64	60.08
26		11.02(2.00)	1617.43	1476.80	140.63	60.94
28		11.02(2.00)	1617.42	1470.10	147.32	63.84
30		12.24(2.00)	1617.42	1466.20	151.22	65.53
32		12.86(2.00)	1617.42	1467.20	150.22	65.10
38		0.00	1617.45	1487.50	129.95	56.31
40		11.62(2.00)	1617.45	1496.00	121.45	52.63
42		0.00	1617.47	1493.50	123.97	53.72
44		7.34(2.00)	1617.46	1501.60	115.86	50.21
46		6.12(2.00)	1617.47	1501.20	116.27	50.38
48		6.12(2.00)	1617.48	1490.40	127.08	55.07
50		11.02(2.00)	1617.48	1499.90	117.58	50.95
52		7.34(2.00)	1617.50	1486.00	131.50	56.98
54		8.00(2.00)	1617.50	1499.40	118.10	51.18
56		0.00	1617.54	1478.30	139.24	60.34
58		4.28(2.00)	1617.54	1483.00	134.54	58.30
60		8.60(2.00)	1617.54	1482.90	134.64	58.35
62		7.34(2.00)	1617.47	1482.90	134.57	58.31
64		8.00(2.00)	1617.49	1477.00	140.49	60.88
66		2.44(2.00)	1617.51	1473.20	144.31	62.53
68		11.02(2.00)	1617.50	1472.80	144.70	62.71
70		2.44(2.00)	1617.54	1471.10	146.44	63.46
72		11.60(2.00)	1617.54	1470.20	147.34	63.85
74		0.00	1617.57	1470.00	147.57	63.95
78		9.80(2.00)	1617.57	1482.90	134.67	58.36
80		0.00	1617.64	1461.00	156.64	67.88
82		9.80(2.00)	1617.64	1473.00	144.64	62.68
84		0.00	1617.70	1452.80	164.90	71.46
86		9.80(2.00)	1617.70	1460.20	157.50	68.25
88		0.00	1617.75	1451.60	166.15	72.00
90		0.00	1617.99	1451.00	166.99	72.36
R-1		----	1616.00	1427.00	189.00	81.90
R-2		----	1618.00	1412.00	206.00	89.27

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-2	89.27	44	50.21
R-1	81.90	46	50.38
2	78.18	50	50.95
4	75.59	54	51.18
90	72.36	40	52.63

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
107	0.94	31	0.01
105	0.91	7	0.02
103	0.79	57	0.03
101	0.79	3	0.04
87	0.76	45	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)
105	0.36	31	0.00
103	0.28	7	0.00
101	0.28	57	0.00
107	0.27	3	0.00
87	0.26	9	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
105	0.36	31	0.00
103	0.28	7	0.00
101	0.28	57	0.00
107	0.27	3	0.00
87	0.26	9	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	-279.77	
R-2	589.23	

NET SYSTEM INFLOW = 589.23
NET SYSTEM OUTFLOW = -279.77
NET SYSTEM DEMAND = 309.46

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Case: 2 = PEAK HOUR DEMAND

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 R-1 has a new HGL of 1591.000
TANK at node R-2 has a new HGL of 1595.000

RESULTS OBTAINED AFTER 4 TRIALS: ACCURACY = 0.81041E-06

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
1	4	5	148.23	0.05	0.00	0.42	0.09	0.09
3	5	6	37.83	0.00	0.00	0.11	0.01	0.01
7	6	8	5.60	0.00	0.00	0.04	0.00	0.00
9	10	6	-32.23	0.00	0.00	0.09	0.01	0.01
11	12	10	-84.14	0.01	0.00	0.24	0.03	0.03
13	14	12	-70.54	0.01	0.00	0.20	0.02	0.02
15	16	14	-73.68	0.00	0.00	0.21	0.02	0.02
17	16	18	68.80	0.01	0.00	0.20	0.02	0.02
19	14	20	-15.54	0.00	0.00	0.10	0.01	0.01
21	20	22	-26.74	0.01	0.00	0.17	0.03	0.03
23	22	24	-39.14	0.02	0.00	0.25	0.05	0.05
25	24	10	101.10	0.01	0.00	0.29	0.04	0.04
27	24	26	45.08	0.03	0.00	0.29	0.07	0.07
29	26	28	23.04	0.01	0.00	0.15	0.02	0.02
31	30	28	-1.00	0.00	0.00	0.01	0.00	0.00
33	32	30	23.48	0.01	0.00	0.15	0.02	0.02
35	10	32	49.20	0.02	0.00	0.31	0.08	0.08
37	24	38	-185.33	0.04	0.00	0.53	0.13	0.13
39	38	40	23.24	0.01	0.00	0.15	0.02	0.02
41	38	42	-157.87	0.03	0.00	0.45	0.10	0.10
43	42	44	14.68	0.00	0.00	0.09	0.01	0.01
45	42	46	12.24	0.00	0.00	0.08	0.01	0.01
47	42	48	-184.79	0.03	0.00	0.52	0.13	0.13
49	48	50	22.04	0.01	0.00	0.14	0.02	0.02
51	48	52	-219.07	0.06	0.00	0.62	0.18	0.18
53	52	54	16.00	0.01	0.00	0.10	0.01	0.01
55	52	56	-249.75	0.11	0.00	0.71	0.23	0.23
57	56	58	8.56	0.00	0.00	0.05	0.00	0.00
59	56	60	17.20	0.01	0.00	0.11	0.01	0.01
61	38	62	-50.70	0.03	0.00	0.32	0.08	0.08
63	62	64	-65.38	0.04	0.00	0.42	0.14	0.14
65	64	66	-81.38	0.05	0.00	0.52	0.20	0.20
67	66	68	22.04	0.01	0.00	0.14	0.02	0.02
69	66	70	-108.30	0.09	0.00	0.69	0.35	0.35
71	70	72	23.20	0.01	0.00	0.15	0.02	0.02
73	70	74	-136.38	0.09	0.00	0.87	0.53	0.53
75	56	74	-275.51	0.08	0.00	0.78	0.27	0.27
77	74	78	19.60	0.01	0.00	0.13	0.01	0.01
79	74	80	-431.49	0.18	0.00	1.22	0.62	0.62
81	80	82	19.60	0.01	0.00	0.13	0.01	0.01
83	80	84	-451.09	0.18	0.00	1.28	0.67	0.67
85	84	86	19.60	0.01	0.00	0.13	0.01	0.01
87	84	88	-470.69	0.15	0.00	1.34	0.73	0.73
101	2	R-1	380.86	0.75	0.00	1.08	0.49	0.49
103	4	2	380.86	1.79	0.00	1.08	0.49	0.49
105	4	88	-529.09	0.80	0.00	1.50	0.90	0.90

107	88	90	-999.78	0.63	0.00	1.60	0.72	0.72
109	90	R-2	-999.78	0.03	0.00	0.32	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	1591.75	1436.00	155.75	67.49
4		0.00	1593.54	1443.00	150.54	65.23
5		110.40(4.00)	1593.49	1452.00	141.49	61.31
6		0.00	1593.49	1456.00	137.49	59.58
8		5.60(4.00)	1593.49	1458.00	135.49	58.71
10		0.00	1593.49	1462.10	131.39	56.93
12		13.60(4.00)	1593.48	1472.30	121.18	52.51
14		12.40(4.00)	1593.47	1480.60	112.87	48.91
16		4.88(4.00)	1593.47	1482.00	111.47	48.30
18		68.80(4.00)	1593.45	1490.00	103.45	44.83
20		11.20(4.00)	1593.47	1489.60	103.87	45.01
22		12.40(4.00)	1593.48	1485.00	108.48	47.01
24		0.00	1593.50	1478.80	114.70	49.70
26		22.04(4.00)	1593.47	1476.80	116.67	50.56
28		22.04(4.00)	1593.46	1470.10	123.36	53.46
30		24.48(4.00)	1593.46	1466.20	127.26	55.15
32		25.72(4.00)	1593.46	1467.20	126.26	54.71
38		0.00	1593.53	1487.50	106.03	45.95
40		23.24(4.00)	1593.52	1496.00	97.52	42.26
42		0.00	1593.56	1493.50	100.06	43.36
44		14.68(4.00)	1593.56	1501.60	91.96	39.85
46		12.24(4.00)	1593.56	1501.20	92.36	40.02
48		12.24(4.00)	1593.59	1490.40	103.19	44.72
50		22.04(4.00)	1593.59	1499.90	93.69	40.60
52		14.68(4.00)	1593.65	1486.00	107.65	46.65
54		16.00(4.00)	1593.65	1499.40	94.25	40.84
56		0.00	1593.76	1478.30	115.46	50.03
58		8.56(4.00)	1593.76	1483.00	110.76	48.00
60		17.20(4.00)	1593.75	1482.90	110.85	48.04
62		14.68(4.00)	1593.56	1482.90	110.66	47.95
64		16.00(4.00)	1593.60	1477.00	116.60	50.53
66		4.88(4.00)	1593.65	1473.20	120.45	52.20
68		22.04(4.00)	1593.65	1472.80	120.85	52.37
70		4.88(4.00)	1593.74	1471.10	122.64	53.15
72		23.20(4.00)	1593.73	1470.20	123.53	53.53
74		0.00	1593.84	1470.00	123.84	53.66
78		19.60(4.00)	1593.83	1482.90	110.93	48.07
80		0.00	1594.02	1461.00	133.02	57.64
82		19.60(4.00)	1594.01	1473.00	121.01	52.44
84		0.00	1594.20	1452.80	141.40	61.27
86		19.60(4.00)	1594.19	1460.20	133.99	58.06
88		0.00	1594.34	1451.60	142.74	61.86
90		0.00	1594.97	1451.00	143.97	62.39
R-1		----	1591.00	1427.00	164.00	71.07
R-2		----	1595.00	1412.00	183.00	79.30

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-2	79.30	44	39.85
R-1	71.07	46	40.02
2	67.49	50	40.60
4	65.23	54	40.84
90	62.39	40	42.26

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
107	1.60	31	0.01
105	1.50	7	0.04
87	1.34	57	0.05
83	1.28	45	0.08
79	1.22	9	0.09

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
105	0.90	31	0.00
87	0.73	7	0.00
107	0.72	57	0.00
83	0.67	9	0.01
79	0.62	45	0.01

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
105	0.90	31	0.00
87	0.73	7	0.00
107	0.72	57	0.00
83	0.67	9	0.01
79	0.62	45	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	-380.86	
R-2	999.78	

NET SYSTEM INFLOW = 999.78
NET SYSTEM OUTFLOW = -380.86
NET SYSTEM DEMAND = 618.92

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Case: 3 = MAXIMUM DAY DEMAND + FIRE NODE 44

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 R-1 has a new HGL of 1585.000
TANK at node R-2 has a new HGL of 1614.000

RESULTS OBTAINED AFTER 5 TRIALS: ACCURACY = 0.24656E-04

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
1	4	5	473.37	0.41	0.00	1.34	0.74	0.74
3	5	6	418.17	0.32	0.00	1.19	0.59	0.59
7	6	8	2.80	0.00	0.00	0.02	0.00	0.00
9	10	6	-415.37	0.12	0.00	1.18	0.58	0.58
11	12	10	-91.97	0.01	0.00	0.26	0.04	0.04
13	14	12	-85.17	0.01	0.00	0.24	0.03	0.03
15	16	14	-36.84	0.00	0.00	0.10	0.01	0.01
17	16	18	34.40	0.00	0.00	0.10	0.01	0.01
19	14	20	42.13	0.02	0.00	0.27	0.06	0.06
21	20	22	36.53	0.01	0.00	0.23	0.05	0.05
23	22	24	30.33	0.01	0.00	0.19	0.03	0.03
25	24	10	-268.69	0.06	0.00	0.76	0.26	0.26
27	24	26	-7.57	0.00	0.00	0.05	0.00	0.00
29	26	28	-18.59	0.01	0.00	0.12	0.01	0.01
31	30	28	29.61	0.01	0.00	0.19	0.03	0.03
33	32	30	41.85	0.02	0.00	0.27	0.06	0.06
35	10	32	54.71	0.03	0.00	0.35	0.10	0.10
37	24	38	306.59	0.09	0.00	0.87	0.33	0.33
39	38	40	11.62	0.00	0.00	0.07	0.01	0.01
41	38	42	591.55	0.31	0.00	1.68	1.11	1.11
43	42	44	1507.00	19.49	0.00	9.62	45.28	45.28
45	42	46	6.12	0.00	0.00	0.04	0.00	0.00
47	42	48	-921.57	0.69	0.00	2.61	2.53	2.53
49	48	50	11.02	0.00	0.00	0.07	0.01	0.01
51	48	52	-938.71	0.84	0.00	2.66	2.62	2.62
53	52	54	8.00	0.00	0.00	0.05	0.00	0.00
55	52	56	-954.05	1.30	0.00	2.71	2.70	2.70
57	56	58	4.28	0.00	0.00	0.03	0.00	0.00
59	56	60	8.60	0.00	0.00	0.05	0.00	0.00
61	38	62	-296.58	0.84	0.00	1.89	2.23	2.23
63	62	64	-303.92	0.64	0.00	1.94	2.33	2.33
65	64	66	-311.92	0.64	0.00	1.99	2.45	2.45
67	66	68	11.02	0.00	0.00	0.07	0.01	0.01
69	66	70	-325.38	0.69	0.00	2.08	2.65	2.65
71	70	72	11.60	0.00	0.00	0.07	0.01	0.01
73	70	74	-339.42	0.51	0.00	2.17	2.86	2.86
75	56	74	-966.93	0.80	0.00	2.74	2.76	2.76
77	74	78	9.80	0.00	0.00	0.06	0.00	0.00
79	74	80	-1316.15	1.43	0.00	3.73	4.89	4.89
81	80	82	9.80	0.00	0.00	0.06	0.00	0.00
83	80	84	-1325.95	1.31	0.00	3.76	4.96	4.96
85	84	86	9.80	0.00	0.00	0.06	0.00	0.00
87	84	88	-1335.75	1.01	0.00	3.79	5.03	5.03
101	2	R-1	1102.39	5.39	0.00	3.13	3.52	3.52
103	4	2	1102.39	12.79	0.00	3.13	3.52	3.52
105	4	88	-1575.76	6.07	0.00	4.47	6.83	6.83
107	88	90	-2911.51	4.55	0.00	4.65	5.24	5.24
109	90	R-2	-2911.51	0.20	0.00	0.92	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
2		0.00	1590.39	1436.00	154.39	66.90
4		0.00	1603.18	1443.00	160.18	69.41
5		55.20(2.00)	1602.77	1452.00	150.77	65.33
6		0.00	1602.45	1456.00	146.45	63.46
8		2.80(2.00)	1602.45	1458.00	144.45	62.59
10		0.00	1602.33	1462.10	140.23	60.77
12		6.80(2.00)	1602.32	1472.30	130.02	56.34
14		6.20(2.00)	1602.31	1480.60	121.71	52.74
16		2.44(2.00)	1602.31	1482.00	120.31	52.13
18		34.40(2.00)	1602.30	1490.00	112.30	48.67
20		5.60(2.00)	1602.29	1489.60	112.69	48.83
22		6.20(2.00)	1602.28	1485.00	117.28	50.82
24		0.00	1602.27	1478.80	123.47	53.50
26		11.02(2.00)	1602.27	1476.80	125.47	54.37
28		11.02(2.00)	1602.28	1470.10	132.18	57.28
30		12.24(2.00)	1602.29	1466.20	136.09	58.97
32		12.86(2.00)	1602.30	1467.20	135.10	58.54
38		0.00	1602.18	1487.50	114.68	49.69
40		11.62(2.00)	1602.18	1496.00	106.18	46.01
42		0.00	1601.87	1493.50	108.37	46.96
44		1507.00(**)	1582.37	1501.60	80.77	35.00
46		6.12(2.00)	1601.87	1501.20	100.67	43.62
48		6.12(2.00)	1602.55	1490.40	112.15	48.60
50		11.02(2.00)	1602.55	1499.90	102.65	44.48
52		7.34(2.00)	1603.40	1486.00	117.40	50.87
54		8.00(2.00)	1603.39	1499.40	103.99	45.06
56		0.00	1604.69	1478.30	126.39	54.77
58		4.28(2.00)	1604.69	1483.00	121.69	52.73
60		8.60(2.00)	1604.69	1482.90	121.79	52.78
62		7.34(2.00)	1603.02	1482.90	120.12	52.05
64		8.00(2.00)	1603.66	1477.00	126.66	54.89
66		2.44(2.00)	1604.30	1473.20	131.10	56.81
68		11.02(2.00)	1604.30	1472.80	131.50	56.98
70		2.44(2.00)	1604.99	1471.10	133.89	58.02
72		11.60(2.00)	1604.99	1470.20	134.79	58.41
74		0.00	1605.50	1470.00	135.50	58.71
78		9.80(2.00)	1605.49	1482.90	122.59	53.12
80		0.00	1606.92	1461.00	145.92	63.23
82		9.80(2.00)	1606.92	1473.00	133.92	58.03
84		0.00	1608.23	1452.80	155.43	67.35
86		9.80(2.00)	1608.23	1460.20	148.03	64.15
88		0.00	1609.25	1451.60	157.65	68.31
90		0.00	1613.80	1451.00	162.80	70.55
R-1		----	1585.00	1427.00	158.00	68.47
R-2		----	1614.00	1412.00	202.00	87.53

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-2	87.53	44	35.00
90	70.55	46	43.62
4	69.41	50	44.48
R-1	68.47	54	45.06
88	68.31	40	46.01

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
43	9.62	7	0.02
107	4.65	57	0.03
105	4.47	45	0.04
87	3.79	27	0.05
83	3.76	53	0.05

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
43	45.28	7	0.00
105	6.83	57	0.00
107	5.24	45	0.00
87	5.03	27	0.00
83	4.96	53	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
43	45.28	7	0.00
105	6.83	57	0.00
107	5.24	45	0.00
87	5.03	27	0.00
83	4.96	53	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	-1102.39	
R-2	2911.51	

NET SYSTEM INFLOW = 2911.51
NET SYSTEM OUTFLOW = -1102.39
NET SYSTEM DEMAND = 1809.12

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Case: 4 = MAXIMUM DAY DEMAND + FIRE NODE 5

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 R-1 has a new HGL of 1555.000
TANK at node R-2 has a new HGL of 1600.000

RESULTS OBTAINED AFTER 4 TRIALS: ACCURACY = 0.14239E-05

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
1	4	5	1581.43	3.80	0.00	4.49	6.87	6.87
3	5	6	-1473.77	3.33	0.00	4.18	6.03	6.03
7	6	8	2.80	0.00	0.00	0.02	0.00	0.00
9	10	6	1476.57	1.21	0.00	4.19	6.05	6.05
11	12	10	144.91	0.03	0.00	0.41	0.08	0.08
13	14	12	151.71	0.03	0.00	0.43	0.09	0.09
15	16	14	-36.84	0.00	0.00	0.10	0.01	0.01
17	16	18	34.40	0.00	0.00	0.10	0.01	0.01
19	14	20	-194.75	0.28	0.00	1.24	1.02	1.02
21	20	22	-200.35	0.29	0.00	1.28	1.08	1.08
23	22	24	-206.55	0.35	0.00	1.32	1.14	1.14
25	24	10	1217.39	0.97	0.00	3.45	4.23	4.23
27	24	26	161.42	0.31	0.00	1.03	0.72	0.72
29	26	28	150.40	0.27	0.00	0.96	0.63	0.63
31	30	28	-139.38	0.15	0.00	0.89	0.55	0.55
33	32	30	-127.14	0.13	0.00	0.81	0.46	0.46
35	10	32	-114.28	0.11	0.00	0.73	0.38	0.38
37	24	38	-1585.35	1.90	0.00	4.50	6.90	6.90
39	38	40	11.62	0.00	0.00	0.07	0.01	0.01
41	38	42	-1157.09	1.08	0.00	3.28	3.85	3.85
43	42	44	7.34	0.00	0.00	0.05	0.00	0.00
45	42	46	6.12	0.00	0.00	0.04	0.00	0.00
47	42	48	-1170.55	1.07	0.00	3.32	3.94	3.94
49	48	50	11.02	0.00	0.00	0.07	0.01	0.01
51	48	52	-1187.69	1.30	0.00	3.37	4.04	4.04
53	52	54	8.00	0.00	0.00	0.05	0.00	0.00
55	52	56	-1203.03	1.99	0.00	3.41	4.14	4.14
57	56	58	4.28	0.00	0.00	0.03	0.00	0.00
59	56	60	8.60	0.00	0.00	0.05	0.00	0.00
61	38	62	-439.89	1.74	0.00	2.81	4.63	4.63
63	62	64	-447.23	1.31	0.00	2.85	4.77	4.77
65	64	66	-455.23	1.29	0.00	2.91	4.93	4.93
67	66	68	11.02	0.00	0.00	0.07	0.01	0.01
69	66	70	-468.69	1.35	0.00	2.99	5.21	5.21
71	70	72	11.60	0.00	0.00	0.07	0.01	0.01
73	70	74	-482.73	0.97	0.00	3.08	5.50	5.50
75	56	74	-1215.91	1.23	0.00	3.45	4.22	4.22
77	74	78	9.80	0.00	0.00	0.06	0.00	0.00
79	74	80	-1708.43	2.32	0.00	4.85	7.93	7.93
81	80	82	9.80	0.00	0.00	0.06	0.00	0.00
83	80	84	-1718.24	2.12	0.00	4.87	8.01	8.01
85	84	86	9.80	0.00	0.00	0.06	0.00	0.00
87	84	88	-1728.04	1.63	0.00	4.90	8.10	8.10
101	2	R-1	1108.54	5.44	0.00	3.14	3.56	3.56
103	4	2	1108.54	12.92	0.00	3.14	3.56	3.56
105	4	88	-2689.97	16.35	0.00	7.63	18.38	18.38
107	88	90	-4418.00	9.86	0.00	7.05	11.35	11.35
109	90	R-2	-4418.00	0.43	0.00	1.39	0.22	0.22

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	1560.44	1436.00	124.44	53.93
4		0.00	1573.36	1443.00	130.36	56.49
5		3055.20(**)	1569.57	1452.00	117.57	50.95
6		0.00	1572.90	1456.00	116.90	50.66
8		2.80(2.00)	1572.90	1458.00	114.90	49.79
10		0.00	1574.11	1462.10	112.01	48.54
12		6.80(2.00)	1574.13	1472.30	101.83	44.13
14		6.20(2.00)	1574.16	1480.60	93.56	40.54
16		2.44(2.00)	1574.16	1482.00	92.16	39.94
18		34.40(2.00)	1574.16	1490.00	84.16	36.47
20		5.60(2.00)	1574.44	1489.60	84.84	36.76
22		6.20(2.00)	1574.73	1485.00	89.73	38.88
24		0.00	1575.08	1478.80	96.28	41.72
26		11.02(2.00)	1574.77	1476.80	97.97	42.45
28		11.02(2.00)	1574.50	1470.10	104.40	45.24
30		12.24(2.00)	1574.34	1466.20	108.14	46.86
32		12.86(2.00)	1574.22	1467.20	107.02	46.37
38		0.00	1576.98	1487.50	89.48	38.77
40		11.62(2.00)	1576.98	1496.00	80.98	35.09
42		0.00	1578.06	1493.50	84.56	36.64
44		7.34(2.00)	1578.06	1501.60	76.46	33.13
46		6.12(2.00)	1578.06	1501.20	76.86	33.30
48		6.12(2.00)	1579.13	1490.40	88.73	38.45
50		11.02(2.00)	1579.12	1499.90	79.22	34.33
52		7.34(2.00)	1580.43	1486.00	94.43	40.92
54		8.00(2.00)	1580.43	1499.40	81.03	35.11
56		0.00	1582.42	1478.30	104.12	45.12
58		4.28(2.00)	1582.42	1483.00	99.42	43.08
60		8.60(2.00)	1582.42	1482.90	99.52	43.12
62		7.34(2.00)	1578.72	1482.90	95.82	41.52
64		8.00(2.00)	1580.03	1477.00	103.03	44.65
66		2.44(2.00)	1581.32	1473.20	108.12	46.85
68		11.02(2.00)	1581.32	1472.80	108.52	47.02
70		2.44(2.00)	1582.67	1471.10	111.57	48.35
72		11.60(2.00)	1582.67	1470.20	112.47	48.74
74		0.00	1583.65	1470.00	113.65	49.25
78		9.80(2.00)	1583.64	1482.90	100.74	43.66
80		0.00	1585.96	1461.00	124.96	54.15
82		9.80(2.00)	1585.96	1473.00	112.96	48.95
84		0.00	1588.08	1452.80	135.28	58.62
86		9.80(2.00)	1588.08	1460.20	127.88	55.41
88		0.00	1589.71	1451.60	138.11	59.85
90		0.00	1599.57	1451.00	148.57	64.38
R-1		----	1555.00	1427.00	128.00	55.47
R-2		----	1600.00	1412.00	188.00	81.47

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-2	81.47	44	33.13
90	64.38	46	33.30
88	59.85	50	34.33
84	58.62	40	35.09
4	56.49	54	35.11

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
105	7.63	7	0.02
107	7.05	57	0.03
87	4.90	45	0.04
83	4.87	43	0.05
79	4.85	53	0.05

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
105	18.38	7	0.00
107	11.35	57	0.00
87	8.10	45	0.00
83	8.01	43	0.00
79	7.93	53	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
105	18.38	7	0.00
107	11.35	57	0.00
87	8.10	45	0.00
83	8.01	43	0.00
79	7.93	53	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	-1108.54	
R-2	4418.00	

NET SYSTEM INFLOW = 4418.00
NET SYSTEM OUTFLOW = -1108.54
NET SYSTEM DEMAND = 3309.46

==========

Case: 5 = MAXIMUM DAY DEMAND + FIRE NODE 18

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 R-1 has a new HGL of 1555.000
TANK at node R-2 has a new HGL of 1600.000

RESULTS OBTAINED AFTER 4 TRIALS: ACCURACY = 0.55656E-04

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
1	4	5	1307.26	2.67	0.00	3.71	4.83	4.83
3	5	6	1252.06	2.46	0.00	3.55	4.46	4.46
7	6	8	2.80	0.00	0.00	0.02	0.00	0.00
9	10	6	-1249.26	0.89	0.00	3.54	4.44	4.44
11	12	10	-2346.59	4.37	0.00	6.66	14.27	14.27
13	14	12	-2339.79	4.47	0.00	6.64	14.20	14.20
15	16	14	-3036.84	4.69	0.00	8.61	23.01	23.01
17	16	18	3034.40	13.20	0.00	8.61	22.98	22.98
19	14	20	-703.25	2.99	0.00	4.49	11.04	11.04
21	20	22	-708.85	3.02	0.00	4.52	11.20	11.20
23	22	24	-715.05	3.51	0.00	4.56	11.38	11.38
25	24	10	1007.75	0.69	0.00	2.86	2.98	2.98
27	24	26	136.71	0.23	0.00	0.87	0.53	0.53
29	26	28	125.69	0.19	0.00	0.80	0.45	0.45
31	30	28	-114.67	0.11	0.00	0.73	0.38	0.38
33	32	30	-102.43	0.08	0.00	0.65	0.31	0.31
35	10	32	-89.57	0.07	0.00	0.57	0.24	0.24
37	24	38	-1859.52	2.55	0.00	5.27	9.28	9.28
39	38	40	11.62	0.00	0.00	0.07	0.01	0.01
41	38	42	-1355.28	1.45	0.00	3.84	5.16	5.16
43	42	44	7.34	0.00	0.00	0.05	0.00	0.00
45	42	46	6.12	0.00	0.00	0.04	0.00	0.00
47	42	48	-1368.74	1.43	0.00	3.88	5.26	5.26
49	48	50	11.02	0.00	0.00	0.07	0.01	0.01
51	48	52	-1385.88	1.73	0.00	3.93	5.38	5.38
53	52	54	8.00	0.00	0.00	0.05	0.00	0.00
55	52	56	-1401.22	2.64	0.00	3.97	5.49	5.49
57	56	58	4.28	0.00	0.00	0.03	0.00	0.00
59	56	60	8.60	0.00	0.00	0.05	0.00	0.00
61	38	62	-515.85	2.34	0.00	3.29	6.22	6.22
63	62	64	-523.19	1.76	0.00	3.34	6.38	6.38
65	64	66	-531.19	1.71	0.00	3.39	6.57	6.57
67	66	68	11.02	0.00	0.00	0.07	0.01	0.01
69	66	70	-544.65	1.79	0.00	3.48	6.88	6.88
71	70	72	11.60	0.00	0.00	0.07	0.01	0.01
73	70	74	-558.69	1.28	0.00	3.57	7.21	7.21
75	56	74	-1414.10	1.62	0.00	4.01	5.59	5.59
77	74	78	9.80	0.00	0.00	0.06	0.00	0.00
79	74	80	-1982.60	3.05	0.00	5.62	10.45	10.45
81	80	82	9.80	0.00	0.00	0.06	0.00	0.00
83	80	84	-1992.40	2.78	0.00	5.65	10.54	10.54
85	84	86	9.80	0.00	0.00	0.06	0.00	0.00
87	84	88	-2002.20	2.15	0.00	5.68	10.64	10.64
101	2	R-1	1172.47	6.04	0.00	3.33	3.95	3.95
103	4	2	1172.47	14.33	0.00	3.33	3.95	3.95
105	4	88	-2479.74	14.06	0.00	7.03	15.81	15.81
107	88	90	-4481.94	10.12	0.00	7.15	11.66	11.66
109	90	R-2	-4481.94	0.44	0.00	1.41	0.22	0.22

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	1561.04	1436.00	125.04	54.18
4		0.00	1575.37	1443.00	132.37	57.36
5		55.20(2.00)	1572.70	1452.00	120.70	52.31
6		0.00	1570.24	1456.00	114.24	49.50
8		2.80(2.00)	1570.24	1458.00	112.24	48.64
10		0.00	1569.35	1462.10	107.25	46.48
12		6.80(2.00)	1564.98	1472.30	92.68	40.16
14		6.20(2.00)	1560.51	1480.60	79.91	34.63
16		2.44(2.00)	1555.82	1482.00	73.82	31.99
18		3034.40(**)	1542.63	1490.00	52.63	22.81
20		5.60(2.00)	1563.51	1489.60	73.91	32.03
22		6.20(2.00)	1566.53	1485.00	81.53	35.33
24		0.00	1570.04	1478.80	91.24	39.54
26		11.02(2.00)	1569.81	1476.80	93.01	40.30
28		11.02(2.00)	1569.61	1470.10	99.51	43.12
30		12.24(2.00)	1569.51	1466.20	103.31	44.77
32		12.86(2.00)	1569.42	1467.20	102.22	44.30
38		0.00	1572.58	1487.50	85.08	36.87
40		11.62(2.00)	1572.58	1496.00	76.58	33.19
42		0.00	1574.03	1493.50	80.53	34.90
44		7.34(2.00)	1574.03	1501.60	72.43	31.39
46		6.12(2.00)	1574.03	1501.20	72.83	31.56
48		6.12(2.00)	1575.46	1490.40	85.06	36.86
50		11.02(2.00)	1575.45	1499.90	75.55	32.74
52		7.34(2.00)	1577.19	1486.00	91.19	39.52
54		8.00(2.00)	1577.19	1499.40	77.79	33.71
56		0.00	1579.83	1478.30	101.53	44.00
58		4.28(2.00)	1579.83	1483.00	96.83	41.96
60		8.60(2.00)	1579.83	1482.90	96.93	42.00
62		7.34(2.00)	1574.92	1482.90	92.02	39.88
64		8.00(2.00)	1576.68	1477.00	99.68	43.19
66		2.44(2.00)	1578.39	1473.20	105.19	45.58
68		11.02(2.00)	1578.39	1472.80	105.59	45.75
70		2.44(2.00)	1580.18	1471.10	109.08	47.27
72		11.60(2.00)	1580.18	1470.20	109.98	47.66
74		0.00	1581.45	1470.00	111.45	48.30
78		9.80(2.00)	1581.45	1482.90	98.55	42.71
80		0.00	1584.50	1461.00	123.50	53.52
82		9.80(2.00)	1584.50	1473.00	111.50	48.32
84		0.00	1587.29	1452.80	134.49	58.28
86		9.80(2.00)	1587.29	1460.20	127.09	55.07
88		0.00	1589.43	1451.60	137.83	59.73
90		0.00	1599.56	1451.00	148.56	64.37
R-1		----	1555.00	1427.00	128.00	55.47
R-2		----	1600.00	1412.00	188.00	81.47

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-2	81.47	18	22.81
90	64.37	44	31.39
88	59.73	46	31.56
84	58.28	16	31.99
4	57.36	20	32.03

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
15	8.61	7	0.02
17	8.61	57	0.03
107	7.15	45	0.04
105	7.03	43	0.05
11	6.66	53	0.05

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
15	23.01	7	0.00
17	22.98	57	0.00
105	15.81	45	0.00
11	14.27	43	0.00
13	14.20	53	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
15	23.01	7	0.00
17	22.98	57	0.00
105	15.81	45	0.00
11	14.27	43	0.00
13	14.20	53	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	-1172.47	
R-2	4481.94	

NET SYSTEM INFLOW = 4481.94
NET SYSTEM OUTFLOW = -1172.47
NET SYSTEM DEMAND = 3309.46

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

LEGEND

PROJECT BOUNDARY

EXISTING PUBLIC WATER LINE

PROPOSED PUBLIC WATER LINE

(2) COMPUTER MODEL NODE NUMBER

[1] COMPUTER MODEL PIPE NUMBER

N

0 250 FEET

MSHCP OPEN SPACE AREA

OPEN SPACE

OPEN SPACE

OPEN SPACE

CCRC/AGE QUALIFIED

VALLEY WIDE PARK

COMMERCIAL AREA

POURROY RD

ELMHURST LN

WASHINGTON ST

KELLER RD

OLD KELLER RD

KELLER RD

RUFT RD

SAFFLOWER ST

CONNECT TO EX.18" WATER LINE

CONNECT TO EX.12" WATER LINE

EX.18"

EX.12"

EX.8"

EX.8"

EX.12"

R-1

R-2

79

79

DEXTER WILSON ENGINEERING, INC.
CONSULTING ENGINEERS
2234 FARADAY AVENUE
CARLSBAD, CA 92008
(760) 438-4422

EXHIBIT A

NODE AND PIPE DIAGRAM

KELLER CROSSING

ATTACHMENT D

REFERENCE DATA

COMPUTER MODEL TEST

Grid Number:	35-C	**Date:**	April 6, 2021
Customer Name:	K&A Engineering, Inc	**Address:**	357 N. Sheridan St, Suite 117
City, State Zip:	Corona, CA 92878		
Contact Name:	Fred Irianto		
Phone:	951-279-1800 (ext. 154)	**Cell:**	951-545-5520
Fax:		**Email:**	fredi@kaengineering.com
Project Record Number:	WS 2021-0325	**WO/CO:**	
Project Name:	Keller Crossing	**APN:**	472-110-001, -002, -003, -004, -007, -008, -009, -032, -033, -034
(Approximate) Test & Hydrant Location:	The hydrant is located inside the Keller Crossing tract development.		

MODEL	**DS_MM_wya20181018_POS-DC_Combined MDD and FF Diurnals_v3.mxd**				
POC Test Location:	**EMWD RESULTS**			**Requested**	**Flow Availability for Fire Department**
	FH 1/POC 1	**FH 2/POC 2**		**Requested**	
Elevation*:	1412.0	1427.0			
Steady State, Dynamic (psi):	93.2	86.5			
Residual Pressure (psi):	87.2	68.4			
Tested FF (gpm):	1526	1526		1526	
Combined Total (gpm):	MDD 218 gpm** plus 1526 gpm fire flow			1744	
Number of Hydrants:	2 FH			2	
Duration Tested @:	Two Hours			2	
Demand Conditions:	Max Day				
Pressure Zone/Tank Name(s)/Level(s):	1627 / Menifee Village 1 / Base Elevation 1589.0 ft				
Pump Operating Status:	ON	**Computer Model Setting:**	EPS		

Number of Points of connections (POC):	**POC (Circle One)**		**Reason (Circle what Applies)**				
	One	Two or More (circled)	Plan of Service	Limited Capacity (Existing System)	Supply Redundancy	Conditions of Approval	Fire Sprinkler Connection(s)

Comments: The water system is capable of providing 1744 GPM for two hours at a minimum of 20 psi, as shown in Figure 1. These Fire Flow test results may need to be complemented by a Plan of Service and do not include all facility conditioning that may be required for this project. Fire Agency Conditions were not provided, if any Fire Flow changes occur in the Fire Agency Conditions, you may need to resubmit another Fire Flow test at the requester's expense.

The above results are not a guarantee the District's system will supply water to the project at any specific flows or pressures. These results were determined from a computer simulation of the District's water system and/or from hydraulic calculations pertaining to distribution pipelines: The capacity of the service laterals, meters, backflow assemblies, on-site fire system, and other appurtenances were not considered in these results. The design and sizing of service laterals and downstream facilities shall be the responsibility of the Project Sponsor.

EMWD's Fire Flow test results are valid for twelve months from the date of testing.

Completed By: Elizabeth Caliva

Should you have any questions or need additional information, please contact me at (951) 928-3777, ext. 4478.

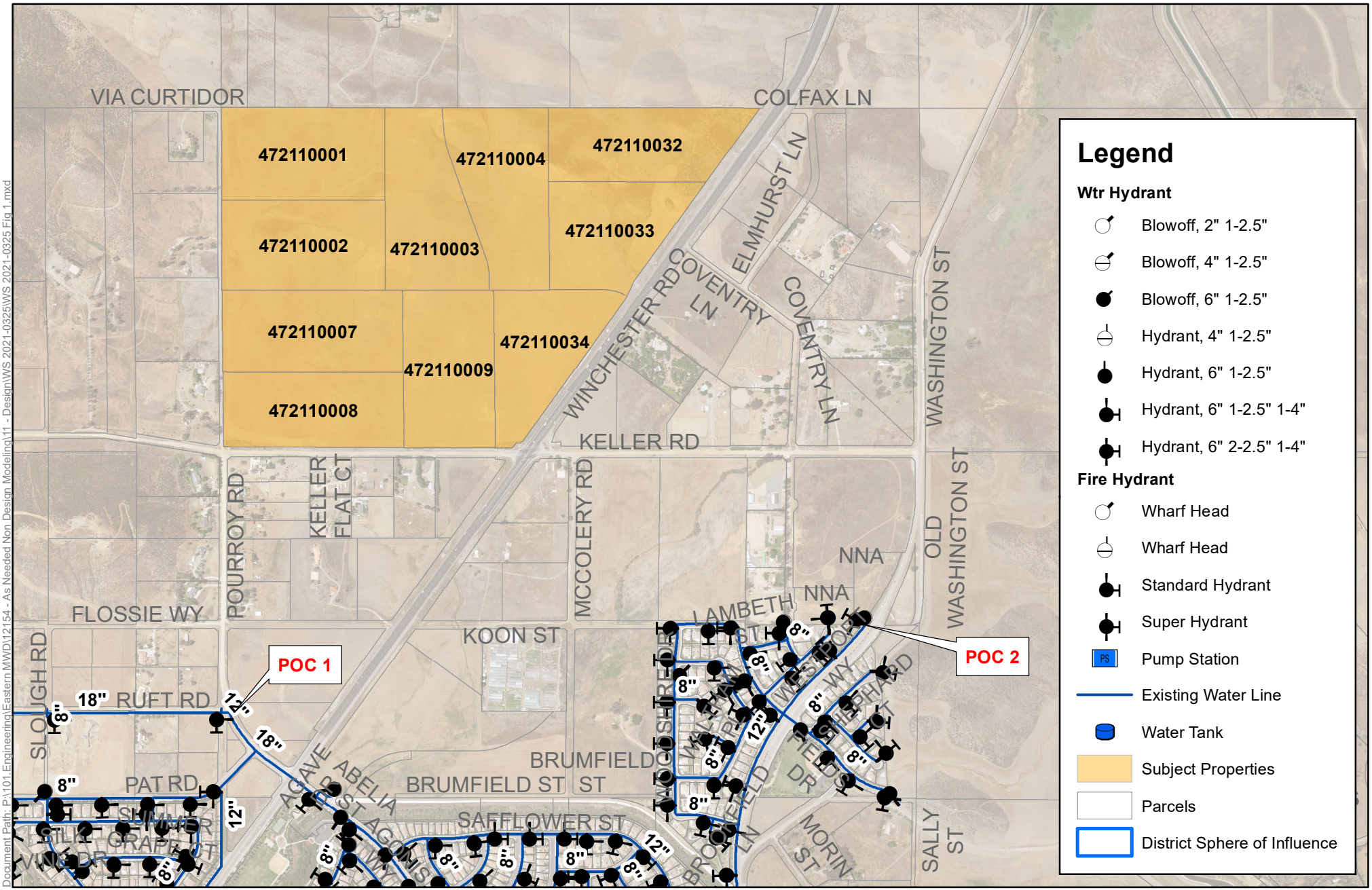
Sincerely, Elizabeth Caliva Date: 4/7/21

Rudy Esparza
Sr. Engineering Technician
New Business Development

DRAFT - Pending Formal Fire Agency Conditions

Reviewed By: RE Date: 4-7-2021

* Elevation based on Riverside County Flood Control digital data.
** Assumed 189.5 AC (average day demand = 440 gpd/AC, Max Day Demand (MDD) is 2 times average day).



Date Saved: 4/6/2021 10:31:04 AM
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0 500 1,000 Feet

emwd EASTERN MUNICIPAL WATER DISTRICT

FIGURE 1

APN 472-110-001, -002, -003, -004, -007, -008, -009, -032, -033, & -034
FIRE FLOW & HYDRAULIC BOUNDARY CONDITION

Hydraulic Boundary Conditions, In The Main Water Pipeline[6][7], Based on Hydraulic Model Results

Project Name: Keller Crossing
Pressure Zone: 1627, WS 2021-0325
Model Version [12]: DS_MM_wya20181018_POS-DC_Combined MDD and FF Diurnals_v3.mxd

ADD (GPM): 109
FFD (GPM): 1526
Duration (Hours): 2

POC Location: POC 1 (Model Junction Name)
Elevation (ft): 1412.0
APN: 472-110-001, -002, -003, -004, -007, -008, -009, -032, -033, -034 (See Attached Figure 1)

	Modeling Scenario [12]	Operational Conditions:	Project's Domestic Water Demands[2][3][11] (gpm)	Fire Flow Demand[4] (gpm)	Existing system (With No Improvements) HGL (ft)	Existing system (With No Improvements) Pressure (psi)	Existing system (With Improvements)[1] HGL (ft)	Existing system (With Improvements)[1] Pressure (psi)
Operational Demand	EPS, MDD, Pumps On (8)	MDD	218		1618	89		
	EPS, MDD, Pumps On (8)	PHD	436		1595	79		
	EPS, ADD, Pumps On (8)	MHD	36		1631	95		
Fire Flow Demand		FFD + MDD						
	EPS, MDD, Pumps On (8)	FFD + MDD	218	1526	1614	87		87

Footnotes (see page 2 for additional footnotes):
(1) If improvements are required, please describe the improvements here:

Minimum Pressure Criteria:

50 PSI	...under PHD, MDD, and MHD
20 PSI	...under MDD + FFD

Minimum Criteria, Velocities in Pipelines:
Equal to or less than 5 fps: ...for MDD
Equal to or less than 10 fps: ...for PHD
Equal to or less than 15 fps: ...for FF + MDD

	Adequate?
Available Firm Pumping Capacity:	TBD
Available Firm Pumping Capacity, w/ Electrical Outage :	TBD
Available Storage Capacity:	TBD

Comments: (TBD indicates To Be Determined) Capacity availability shall be verified separately by the customer and reviewed by Development Services Engineers.

Additional Comments:

Prepared by: _____ Date: April 6, 2021

Reviewed by: RE Date: 4-7-2021

Hydraulic Boundary Conditions, In The Main Water Pipeline[6][7], Based on Hydraulic Model Results

Project Name:	Keller Crossing	**ADD (GPM):**	109
Pressure Zone:	1627, WS 2021-0325	**FFD (GPM):**	1526
Model Version [12]:	DS_MM_wya20181018_POS-DC_Combined MDD and FF Diurnals_v3.mxd	**Duration (Hours):**	2

Acronyms:

ADD: Average Day Demand, in GPM
EPS: Extended Period Simulation
FFD[3]: Fire Flow Demand, in GPM
FPS: Feet per second
GPM: Gallons Per Minute
HGL: Hydraulic Grade-Line, in feet
MDD: Maximum Day Demand, in GPM
MHD: Minimum Hour Demand, in GPM
PHD: Peak-Hour Demand, in GPM
POC: Point Of Connection
PSI: Pounds Per Inch
SSS: Steady State Simulation

Footnotes (Ct'd):

(2) Project Demands include ADD of the proposed project, peaked for each test scenario, in accordance with the latest EMWD Water Master Plan Design Criteria

(3) Domestic water demands from existing services are already included in the Model

(4) This is NOT a Fire Flow Test Report: The customer shall verify with the Fire Marshall if a separate Fire Flow Test Report/Letter is required for Jurisdictional Project approval.

(5) All required storage and pumping shall be evaluated in a POS report, per the latest EMWD Master Plan Design Criteria

(6) Applicants, or their designees, shall design service laterals, commencing from the point of connection(s) in EMWD's main pipeline(s), including main extension(s), lateral(s), meter(s), and all post-meter appurtenances, taking into consideration resulting head losses, pad elevations, and building height, such that the pressure delivered to each floor level and service is adequate to meet jurisdictional requirements.

(7) In addition to design requirements, operational minimum and maximum pressures are used to identify and record Service Agreements for Low and High pressure conditions in Residential use. Commercial, Institutional, and Industrial uses do not require low and high pressure recordation.

(8) Storage tanks: Initial levels set at 75% full in EPS

(9) Storage tanks: Initial levels set at 50% full in SSS, Pumps Off

(10) Storage tanks: Initial levels set at 50% full in SSS, Pumps On

(11) Existing demands are based on COINS data, calendar-year 2013

(12) For EPS modeling, use file name: ***DS_MM_wya20181018_POS-DC_Combined MDD and FF Diurnals_v3.mxd***

Hydraulic Boundary Conditions, In The Main Water Pipeline[6][7], Based on Hydraulic Model Results

Project Name: Keller Crossing
Pressure Zone: 1627, WS 2021-0325
Model Version [12]: DS_MM_wya20181018_POS-DC_Combined MDD and FF Diurnals_v3.mxd

ADD (GPM): 109
FFD (GPM): 1526
Duration (Hours): 2

POC Location: POC 2 (Model Junction Name)
Elevation (ft): 1427.0
APN: 472-110-001, -002, -003, -004, -007, -008, -009, -032, -033, -034 (See Attached Figure 1)

	Modeling Scenario [12]	Operational Conditions:	Project Demands[2][3][11] (gpm): Project's Domestic Water Demands[2][3][11] (gpm)	Project Demands[2][3][11] (gpm): Fire Flow Demand[4] (gpm)	Existing system (With No Improvements): HGL (ft)	Existing system (With No Improvements): Pressure (psi)	Existing system (With Improvements)[1]: HGL (ft)	Existing system (With Improvements)[1]: Pressure (psi)
Operational Demand	EPS, MDD, Pumps On (8)	MDD	218		1616	82		
Operational Demand	EPS, MDD, Pumps On (8)	PHD	436		1591	71		
Operational Demand	EPS, ADD, Pumps On (8)	MHD	36		1631	88		
Fire Flow Demand		FFD + MDD						
Fire Flow Demand	EPS, MDD, Pumps On (8)	FFD + MDD	218	1526	1585	68		68

Footnotes (see page 2 for additional footnotes):
(1) If improvements are required, please describe the improvements here:

Minimum Pressure Criteria:

50 PSI	...under PHD, MDD, and MHD
20 PSI	...under MDD + FFD

Minimum Criteria, Velocities in Pipelines:
Equal to or less than 5 fps: ...for MDD
Equal to or less than 10 fps: ...for PHD
Equal to or less than 15 fps: ...for FF + MDD

	Adequate?
Available Firm Pumping Capacity:	TBD
Available Firm Pumping Capacity, w/ Electrical Outage :	TBD
Available Storage Capacity:	TBD

Comments: (TBD indicates To Be Determined) Capacity availability shall be verified separately by the customer and reviewed by Development Services Engineers.

Additional Comments:

Prepared by: _____ Date: April 6, 2021

Reviewed by: _____ Date: 4-7-2021

Hydraulic Boundary Conditions, In The Main Water Pipeline[6][7], Based on Hydraulic Model Results

Project Name:	Keller Crossing	**ADD (GPM):**	109
Pressure Zone:	1627, WS 2021-0325	**FFD (GPM):**	1526
Model Version [12]:	DS_MM_wya20181018_POS-DC_Combined MDD and FF Diurnals_v3.mxd	**Duration (Hours):**	2

Acronyms:

ADD: Average Day Demand, in GPM
EPS: Extended Period Simulation
FFD[3]: Fire Flow Demand, in GPM
FPS: Feet per second
GPM: Gallons Per Minute
HGL: Hydraulic Grade-Line, in feet
MDD: Maximum Day Demand, in GPM
MHD: Minimum Hour Demand, in GPM
PHD: Peak-Hour Demand, in GPM
POC: Point Of Connection
PSI: Pounds Per Inch
SSS: Steady State Simulation

Footnotes (Ct'd):

(2) Project Demands include ADD of the proposed project, peaked for each test scenario, in accordance with the latest EMWD Water Master Plan Design Criteria

(3) Domestic water demands from existing services are already included in the Model

(4) This is NOT a Fire Flow Test Report: The customer shall verify with the Fire Marshall if a separate Fire Flow Test Report/Letter is required for Jurisdictional Project approval.

(5) All required storage and pumping shall be evaluated in a POS report, per the latest EMWD Master Plan Design Criteria

(6) Applicants, or their designees, shall design service laterals, commencing from the point of connection(s) in EMWD's main pipeline(s), including main extension(s), lateral(s), meter(s), and all post-meter appurtenances, taking into consideration resulting head losses, pad elevations, and building height, such that the pressure delivered to each floor level and service is adequate to meet jurisdictional requirements.

(7) In addition to design requirements, operational minimum and maximum pressures are used to identify and record Service Agreements for Low and High pressure conditions in Residential use. Commercial, Institutional, and Industrial uses do not require low and high pressure recordation.

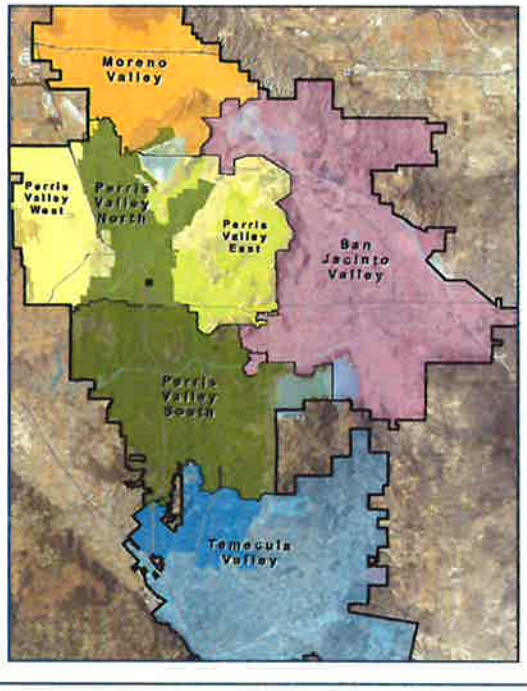
(8) Storage tanks: Initial levels set at 75% full in EPS

(9) Storage tanks: Initial levels set at 50% full in SSS, Pumps Off

(10) Storage tanks: Initial levels set at 50% full in SSS, Pumps On

(11) Existing demands are based on COINS data, calendar-year 2013

(12) For EPS modeling, use file name: ***DS_MM_wya20181018_POS-DC_Combined MDD and FF Diurnals_v3.mxd***



REPORT

EASTERN MUNICIPAL WATER DISTRICT

2015 Water Facilities Master Plan Update

VOLUME 1

WEST YOST ASSOCIATES

5.1 CHAPTER OVERVIEW

This chapter summarizes recommended planning and sizing criteria used for the WFMP. Criteria developed for the 2009 WFMP were used as a starting point. The District's Capital Plan Technical Team provided input for refinements to criteria in several categories.

This chapter summarizes the following planning and operational criteria for the District's water system:

- Demands
- Distribution System Performance
- Facilities Sizing

Subsequent sections provide details for each criterion.

5.2 DEMANDS

5.2.1 Unit Demand Factors to Calculate Future Average Daily Demands

The demand methodology for projecting future water demands uses information from the DOPP projections and ultimate land use calculations, along with unit demand factors to estimate future demands. Details for the methodology for existing and future demand projections are discussed in Chapter 3.

The DOPP includes near-term planning information where project-specific planning information is available. DOPP ADD projections use unit water demand factors based on single family residential (SFR) EDUs and non-residential land use acreages. Buildout land use projections use residential unit water demand factors that relate residential DU's to SFR EDU's, and non-residential unit water demand factors that relate non-residential acreages to SFR EDU's. Flow factors are expressed in gallons per day (gpd) per DU for residential, or gpd/acre for non-residential uses. These factors are applied to parcels that are currently undeveloped and not included in the DOPP.

Table 5-1 summarizes unit water demand factors to be used in the WFMP analysis.

Table 5-1. Unit Potable Water Demand Factors to Compute Average Daily Demand

Land Use	DU/ac	EDU/DU or EDU/ac	gpd/DU or gpd/ac[a]
Residential – DOPP			
Single-Family Residential[b]	440 gpd/EDU		
Residential – Ultimate Land Use (EDU/DU and gpd/DU)[c]			
Open Space Rural (<0.1)	0.05	3	1320
Rural Mountains (0.05 to 0.1)	0.1	3	1320
Residential Rural (0.1 to 0.5)	0.2	3	1320
Estate Density (0.5 to 1)	0.5	1.5	660
Very Low Density (1 to 2)	1.0	1.5	660
Low Density (2-3)	2.0	1.3	570
Medium Density (3-6)	4.5	1.0	440
Medium/High Density (6 to 11)	6.0	0.9	400
High Density (11-17)	12.0	0.7	310
Very High Density (17 to 20)	17	0.65	290
Nonresidential – DOPP and Ultimate Land Use (EDU/ac and gpd/ac)[d]			
Public Facilities/Schools/Mixed Use Policy Area		5	2,200
Commercial/Business Park/Hospital		5	2,200
Business Park/Light Industrial/Warehouse		1.25	550
Industrial		7.5	3,300
Open Space/Ag/Recreation (EDU/ac and gpd/ac)[d]			
Agricultural, Open Space (Conservation, Landscape, Water)		0	0
Open Space Recreational		5	2200

(a) Values shown may not agree with calculated values due to rounding.
(b) DOPP projection factor specified by District staff. Incorporates permanent conservation savings for compliance with SB x7-7. Residential water use factors developed using SFR water use factor in gpd/EDU multiplied by the DU/EDU for the land use type to get gpd/DU.
(c) Non-residential land use factors developed using SFR water use factor, in gpd/EDU, multiplied by the EDU/acre, to get use in gpd/acre.
gpd = gallons per day
ac = acre

5.2.2 Peaking Factors

Water system facilities are generally sized for peak demands. The peaking conditions of most concern for water facility sizing are MDD plus fire flow and PHD on the maximum day. ADD is the average annual water use divided by the number of days in the year. MDD is the highest demand day of the year, averaged over a 24-hour period. PHD is the highest demand rate occurring over a 1-hour period during the MDD. Peak water use is typically expressed as a ratio, or peaking factor. The MDD peaking factor is calculated by dividing the maximum day water use by the average daily water use and the PHD peaking factor is calculated by dividing the peak hour water use by the maximum day water use. These peaking factors are then used, along with existing or future ADDs, to project maximum day and peak hour water use for existing or future conditions.

Table 5-2 summarizes peaking factors used in the WFMP evaluations. Two sets of peaking factors are used, one set for facility sizing and one set for system modeling. The peaking factors used for pump station facility sizing and storage tank sizing vary based on the demand in the pressure zone in which the facility is located. Smaller pressure zones, that are typically predominantly residential land use, have a higher MDD peaking factor, which reflects peak summer irrigation use. Larger pressure zones that have a mix of land use types typically have a lower MDD peaking factor.

For regional-scale system hydraulic modeling evaluations for the service areas and the backbone transmission system, a maximum day peaking factor of 2.0 times ADD and a peak hour peaking factor of 2.0 times MDD were used.

Table 5-2. Peaking Factors

Planning Evaluation	Max Day Demand (MDD/ADD)	Peak Hour Demand (PHD/MDD)
Facilities Sizing		
Small Pressure Zones (under 500 gpm ADD)	3.0	2.0
Medium Pressure Zones (500 to 2,000 gpm ADD)	2.5	2.0
Large Pressure Zones (2,000+ gpm ADD)	2.0	2.0
System Hydraulic Evaluations		
All Pressure Zones	2.0	2.0

MDD = Maximum Day Demand
ADD = Average Day Demand
PHD = Peak Hour Demand

5.3 DISTRIBUTION SYSTEM PERFORMANCE

5.3.1 Peak Supply Capacity

The District receives potable water from two sources: local groundwater and imported Metropolitan deliveries. Source capacity to any pressure zone is the source of water supply from turnout connections to regional transmission facilities, or direct connections to water treatment facilities, pump stations, regulators or wells. The peak supply capacity is sized to meet MDD for a pressure zone plus the flow through demands for other pressure zones(s) served from the pressure zone. Additional capacity may be required to supplement fire flow/emergency storage deficiencies. It is recommended that each pressure zone have two independent sources of water supply, where feasible.

5.3.2 Distribution System Pressures

Adequate system pressure is a basic indicator of acceptable distribution system performance. For normal operating conditions, the water system shall be capable of providing at least 40 pounds per square inch (psi) to existing customers and 50 psi to future customers, on the District side of the meter. Table 5-3 summarizes the performance criteria for the potable distribution system pressures.

Table 5-3. Potable Distribution System Pressure Requirements[1]

Condition	Pressure Required, psi		
	Existing System	Future Development	Zone Realignment
Minimum Pressure Allowed	40[(a)]	50[(a)]	40[(b)]
Maximum Pressure Allowed	110	110	80
Minimum Pressure for MDD plus fire flow	20	20	20
Maximum Pressure Increase Allowed	—	—	10[(c)]

(a) Represents the minimum pressure allowed at the peak hour on the MDD.
(b) Assumes existing system downstream of meter.
(c) Represents the allowable pressure increase without requiring an individual PRV.

These performance criteria are applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. Customers outside of the normal service elevation ranges may have an individual pressure regulator or booster pump installed.

5.3.3 Fire Flow Requirements

The District operates and maintains the water distribution system within the service area. The Riverside County Fire Department (RCFD) is concerned with the availability of adequate water supply for firefighting purposes and establishes minimum water flows and residual system pressures required during a firefighting event and provides these criteria to the District for use in master planning.

The RCFD uses the California Fire Code (CFC), 2010 edition, which establishes minimum fire flows, and durations for individual structures. In contrast, this WFMP evaluates available fire flows to assess distribution system adequacy under buildout demand conditions, using general land use categories that represent different types of development. Therefore, the fire flow requirements set forth in this WFMP are intended only for general planning purposes, and may not be reflective of the actual fire flow requirements sought for specific development approvals, and will not identify specific existing non-conforming developments.

Table 5-4 presents the recommended fire flow requirements for new development for the WFMP fire flow evaluation based on general land use designations and guidelines from RCFD. Areas within the District are assumed to meet the fire flow standards that were in place at the time of development, and the District does not replace existing system pipelines that do not meet current fire flow standards, unless improvements are also required for other purposes. Therefore, fire flow requirements were used for the evaluation of the buildout water system to identify future areas for improvement as pipeline replacements, or capacity increases are made for other purposes.

[1] The Uniform Plumbing Code (UPC) requires that individual services that exceed 80 psi have an individual pressure regulator on the service line.

Table 5-4. Fire Flow Requirements for New Development[a,b,c]			
Structure	Flow, gpm	Duration, hours	Number of Fire Hydrants
Single Family (Residential)	1,500	2	2
Multi-Family (Residential)	3,000	2	3
Light Commercial/Industrial (Including Schools)	3,000	3	3
Heavy Commercial/Industrial	5,000	4	4

(a) Construction type and fire flow calculation area are not generally known during the development of a master plan. Requirements shown are based on general land use designations.
(b) Unique projects or projects with alternate materials may require higher fire flow and should be reviewed by the Fire Marshal on a case-by-case basis.
(c) Fire flows to be supplied at a minimum residual pressure of 20 psi.

5.4 FACILITIES SIZING

5.4.1 Booster Pump Station Sizing

The District's distribution system relies heavily on booster pump stations for supplying water. Therefore, reliability at the booster pump stations is important. Pump station capacity calculations use firm pumping capacity, where firm capacity is defined as the capacity available with the largest pump reserved as a standby.

Table 5-5 summarizes the pumping capacity requirements. Generally, pump stations are sized to provide MDD in the zone being served plus pump through demands. Sizing also takes into account whether a zone has equalization or fire storage. The WFMP does not include sizing criteria for pump stations that may be operated on time-of-use electric utility rate schedules, or super off peak electric rate schedules. Sizing for time-of-use operation would be taken into account during facility design.

Table 5-5. Pumping Capacity Requirements	
Pump Station/Zone Type	Required Capacity
All pump stations	Sized for firm capacity to meet MDD, with the largest pump reserved as a stand-by
No equalization storage available	Firm capacity to meet PHD
No fire storage available	Firm capacity to meet MDD plus fire flow capacity
No equalization storage or fire storage available	Firm capacity to meet PHD plus fire flow capacity

5.4.2 Water Storage Sizing

The total water storage capacity requirement is based on providing storage capacity to cover fluctuations in system demands, provide water for fire suppression, and provide supply for emergencies. The total storage required is determined by summing the storage volume for the following three components:

- Operational Storage
- Fire Storage
- Emergency Storage

Storage requirements based on these three components define the "usable storage," in the tank, the volume between the normal high water level and the "dead" or unusable storage, below the tank outlet. Usable storage is in contrast to the "nominal storage," which is calculated based on the volume of water between the bottom tank elevation and the tank overflow.

Figure 5-1 illustrates tank nominal and usable storage volumes. For the WFMP, calculations of required tank volumes are assumed to be usable storage. For developing tank sizes for capital costing, required tank volumes are computed based on a 40-foot high tank, where the usable storage is multiplied by 1.2 to compute the tank design volume.

5.4.2.1 Operational Storage

The District's operational storage criterion consists of equalization storage and pump-through storage. Equalization storage is used to balance the difference between supply to the zone and demands in the zone. Supply is typically provided at a rate equal to MDD.

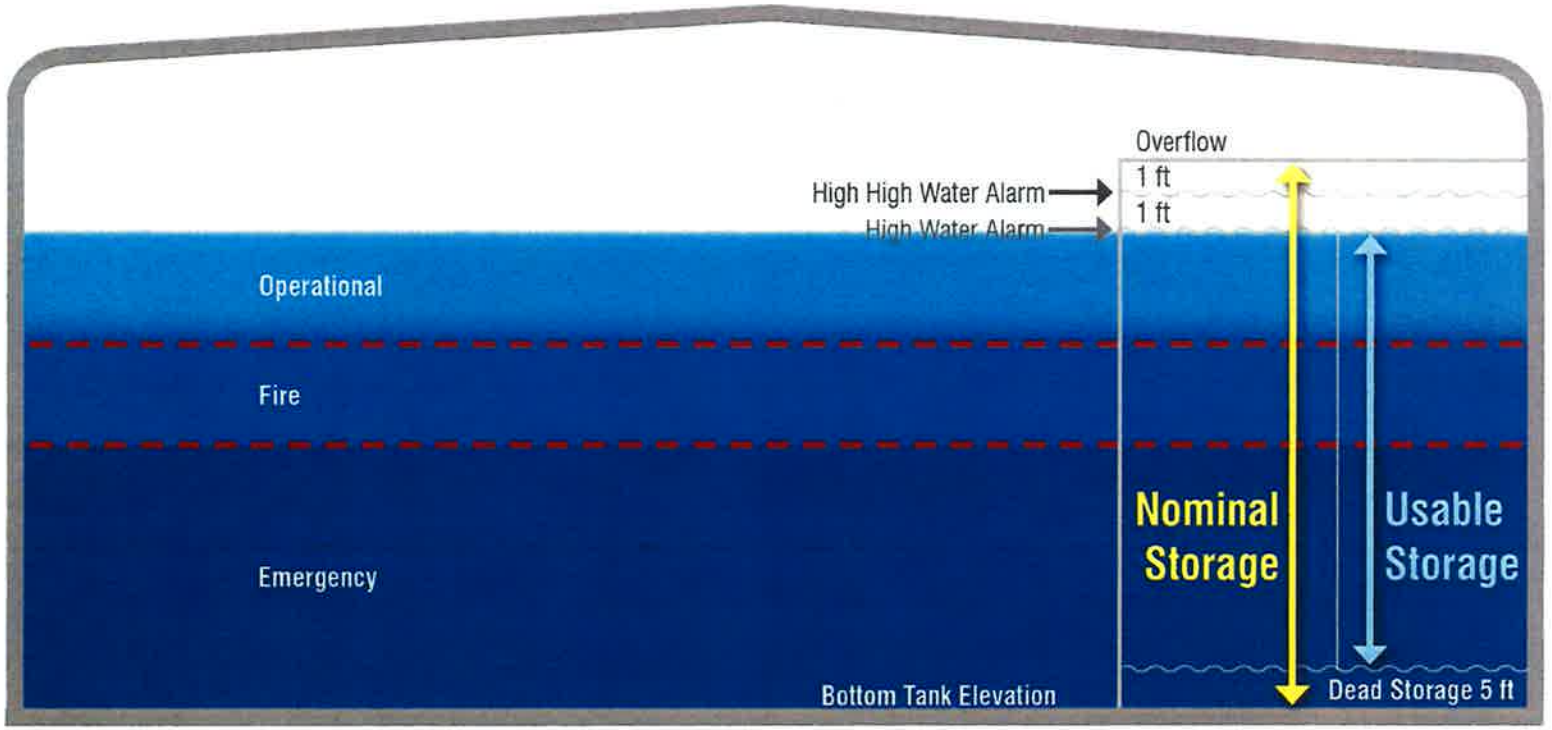
Pump-through storage applies to zones that receive water pumped from a lower zone, and then pump water out to serve a higher zone. In instances where zone demand is small relative to the pump through capacity, storage needs to be adequately sized to accommodate both in-zone equalization demands and balancing storage required for pumping operations. To account for the additional storage needs for balancing pumping operations, storage should be increased by 10 percent of the pump-through flow.

Each pressure zone shall have at least the required operational storage summarized in Table 5-6.

Table 5-6. Operational Storage Requirements

Storage Type	Design Criteria
Equalization	0.25 x MDD
Pump Through[a]	0.10 x flow pumped to higher pressure zone

[a] Pump through requirements apply to zones that are supplied by one or more pump stations and pump water to one or more pressure zones.



Usable Storage: High Water Level to top of dead storage

Nominal Storage: Overflow to Bottom of Tank

40-foot high tank: Design Volume = Usable Storage x 1.2

32-foot high tank: Design Volume = Usable Storage x 1.25

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Figure 5-1

Definitions of Usable and Nominal Storage

Eastern Municipal Water District
Water Facilities Master Plan

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5.4.2.2 Fire Storage

Fire storage is the volume of storage water reserved for fire flows. The fire storage volume is determined by multiplying the required maximum fire flow rate, determined based on land uses within the zone, by the required duration. The required fire storage is summarized in Table 5-7.

Table 5-7. Fire Storage Requirements

Land Use Category	Required Fire Storage Volume, MG[a]
Single Family (Residential)	0.18
Multi-Family[b] (Residential)	0.36
Light Commercial/Industrial (Including Schools)	0.54
Heavy Commercial/Industrial	1.20

[a] Flow rate and duration provided in Table 5-5.
[b] Five or more units per acre.

For very small pressure zones, the fire storage volume is significantly larger than the operational and emergency storage volumes, which are based on a percentage of the maximum day demand. For the WFMP, storage recommendations are based on total storage requirements, including the fire storage requirements shown in Table 5-7. The District will be conducting a separate study to evaluate whether pump station improvements could be made (e.g., larger pumps, on-site generator with automatic transfer switch) to provide reliability equivalent to fire storage, and reduce zone storage requirements.

For most pressure zones, it is assumed that no more than one fire flow event would occur in the pressure zone at a given time. For zones that cover large geographical areas, where fire flow in one area of the zone may not be accessible if a fire were to occur in another area of the zone, fire flow storage was provided assuming concurrent fire flow events, as summarized in Table 5-8.

Table 5-8. Concurrent Fire Flow Events and Storage Requirements

Pressure Zone	Number of Concurrent Fire Flow Events	Required Fire Storage Volume, MG[a]
1627 Perris Valley	Three – North, Central, South	3.6
1705 Cajalco	Two – North, South	2.4
1764 Pettit	Two – West, East	2.4
1967 Kalmia	Three – West, Central, East	3.6

[a] Flow rate and duration based on heavy commercial/industrial land use for each concurrent fire flow event, provided in Table 5-5.

5.4.2.3 Emergency Storage

A reserve of stored water is required to meet demands during an emergency. The District defines two types of emergency which may occur: daily emergencies and reduced service emergencies. Daily emergencies can be resolved by assuring the zone has adequate emergency storage, backup power generators (onsite or portable), portable pumps, and/or emergency interconnections. Reduced service emergencies require demand reductions, whether they are voluntary or mandatory.

The District's emergency storage criterion is to provide an emergency storage volume of 0.5 times MDD to ensure each pressure zone is capable of providing MDD for 12 hours with the largest pump station out of service. For zones with multiple pump stations, a minimum volume of 25 percent of MDD is required. Table 5-9 summarizes the recommended emergency storage requirements.

Table 5-9. Emergency Storage Requirements

Zone Type	Design Criteria
Zone with single pump station	0.50 x MDD
Zone with multiple pump stations	0.5 x (MDD minus flow from pump stations supplying zone, with largest pump station out of service)
Minimum volume for zone with multiple pump stations	0.25 x MDD

5.4.3 Pressure Regulating Station Sizing

The District has pressure zones that are served solely by pressure regulating stations. For pressure zones without storage and where one or more pressure regulating stations are the sole supply source, the total station capacity should be equal to a PHD plus fire flow condition. For pressure zones with storage and where the pressure regulating station(s) is the sole supply source, the total station capacity should be equal to a MDD. For sizing new valves for pressure regulating stations, the manufacturer's maximum recommended continuous flowrate is used to specify valve capacity.

5.4.4 Hydropneumatic System Sizing

The District has a small number of pressure zones where customers are served by a booster pump station with a hydropneumatic tank to maintain operating pressures, and no zone storage exists other than the nominally sized hydropneumatic tank. For hydropneumatic pressure zones, the firm pump station capacity should be equal to the PHD plus fire flow condition.

Hydropneumatic systems generally serve pressure zones with a small number of residential customers, and no non-residential use. For the WFMP, the maximum demand assumed to be served by a hydropneumatic system is an average daily demand of 60 gpm, which is the demand associated with approximately 200 single family residential connections. Existing hydropneumatic pressure zones with future growth that results in a total zone ADD in excess of 60 gpm were assumed to be converted to an open zone with a storage tank.

5.4.5 Water Transmission and Distribution Pipeline Sizing

Table 5-10 summarizes planning and design criteria used for evaluating existing pipelines and sizing new distribution and transmission pipelines.

Table 5-10. Transmission and Distribution System Pipeline Sizing

Transmission/Distribution	Sizing
Pipeline Head Losses	
Pipelines with flows up to 20 cfs	3.0 feet of head loss per 1000 feet of pipeline
Pipelines with flows of 20 to 50 cfs	2 feet of head loss per 1000 feet of pipeline
Pipelines with flows greater than 50 cfs	1 foot of head loss per 1000 feet of pipeline
Pipeline Velocities	
MDD	Less than 5 feet/second
PHD	Less than 10 feet/second
Maximum Day Plus Fire Flow	Less than 15 feet/second

The District uses pipeline velocity and headloss criteria for establishing pipeline deficiencies and sizing new pipelines. The District's existing water system will be evaluated using system pressure as the primary criterion. Secondary criteria, such as pipeline velocity, head loss, age, and material type, are used as indicators to locate, and to help prioritize where water system improvements may be needed. Therefore, deficiencies identified in the District's existing system will be evaluated on a case-by-case basis. For example, if an existing pipeline experiences velocity or head loss in excess of the criteria presented in Table 5-10, this condition, by itself, does not necessarily indicate a problem as long as the minimum system pressure criterion is satisfied. Other conditions such as pipeline age, material type, and location in the system will also be considered.

For sizing new pipelines, either the velocity or headloss criterion will govern, depending on the pipeline diameter and flowrate. In general, pipelines are to be sized using velocity criteria, with a check of head losses, once initial pipeline sizing is established.

For pipelines that serve as an inlet/outlet to a tank, minimum sizing criteria are established to ensure that tank storage is accessible for operational, fire and emergency purposes. Table 5-11 summarizes minimum tank inlet/outlet pipeline diameters for different operational and fire flow requirements. The table summarizes requirements for three conditions: 1) deep-cycle filling in 8 hours; 2) operational filling in 8 hours; and 3) fire flow criterion for the pressure zone. Pipeline inlet/outlet diameter should be the maximum of the three values. Fill pipeline sizing criteria are based on pipeline velocities of less than 6 feet per second (fps). MDD plus fire flow pipeline sizing criteria are based on pipeline velocities of less than 8 fps.

Table 5-11. Minimum Tank Inlet/Outlet Pipeline Diameter Requirements

Tank Volume, MG	Minimum Tank Inlet/Outlet Pipeline Diameter, inches				
	Deep Cycle Fill in 8 hours[a]	Operational Fill in 8 hours[a]	MDD+FF[b]		
			1,500 gpm	3,000 gpm	5,000 gpm
0.5	8	8	12	n/a	n/a
1	10	8	12	18	n/a
2	12	12	12	18	18
4	18	18	18	24	24
5	24	18	18	24	24
6	24	24	n/a	24	24
7	24	24	n/a	24	24
8	24	24	n/a	24	30
10	30	30	n/a	30	30
12	30	30	n/a	30	30
15	36	36	n/a	36	36

(a) Pipeline sizing to meet operational fill criteria based on velocities of < 6 fps.
(b) Pipeline sizing to meet MDD+FF criteria based on velocities of < 8 fps.