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WATER SYSTEM ANALYSIS
FOR THE OCEAN KAMP PROJECT
IN THE
CITY OF OCEANSIDE

December 21, 2020

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

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

Job No. 921-003

DEXTER WILSON ENGINEERING, INC.

DEXTER S. WILSON, P.E.
ANDREW M. OVEN, P.E.
STEPHEN M. NIELSEN, P.E.
NATALIE J. FRASCHETTI, P.E.
STEVEN J. HENDERSON, P.E.
FERNANDO FREGOSO, P.E.
KATHLEEN L. HEITT, P.E.

December 21, 2020

921-003

N4FL Worldwide
6006 El Tordo, 1st Floor
Rancho Santa Fe, CA 92067

Attention: Michael Grehl, Vice President – Real Estate

Subject: Water Study for the Ocean Kamp Project in the City of Oceanside

Introduction

The Ocean Kamp Project is located in the northern portion of the City of Oceanside. It is generally situated east of US Interstate 5 and west of El Camino Real. Specifically, it is bound by open space to the north, Mission Avenue and Highway 76 to the south, existing development on Fireside Street to the east, and Foussat Road and the San Luis Rey River to the west. See Figure 1 for the location of the project. Historically, the site has functioned as a drive-in movie theater and was until May of 2019 a meeting location for a weekly swap meet.

Additional features to note in proximity to the project are the City of Oceanside's reverse osmosis plant to the north and the two utility easements traversing the project. The larger of the two easements, in the eastern portion of the property, contains City of Oceanside water and sewer lines as well as San Diego Gas and Electric transmission lines. The easement in the western portion of the property is a prior extension of Foussat Road (referred to as Old Foussat Road) and contains City water and sewer pipelines.

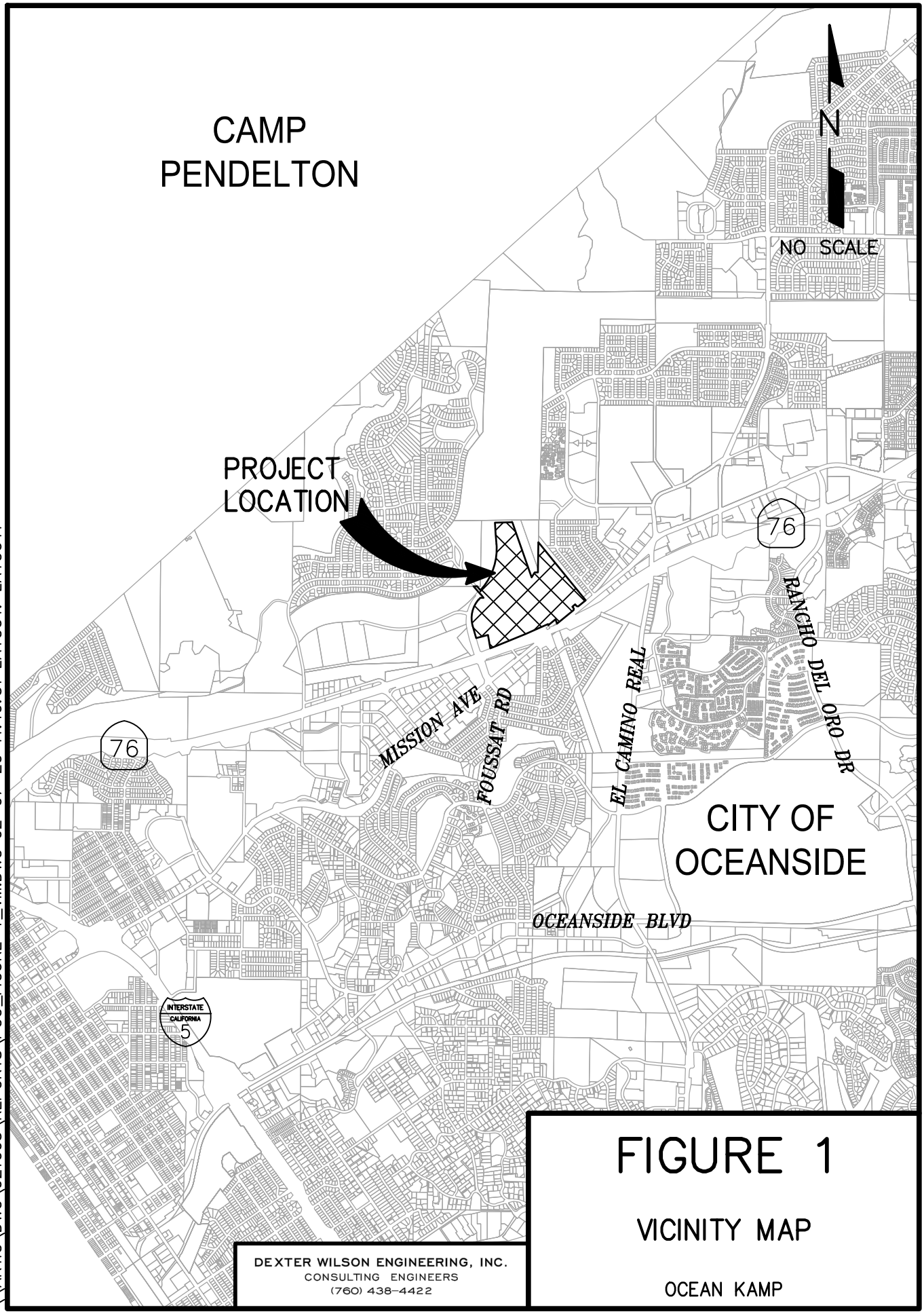

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FIGURE 1

VICINITY MAP

OCEAN KAMP

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Ocean Kamp Development Plan

The Ocean Kamp project proposes to construct a combination of resort and residential development. The central portion of the project consists of a 300-room hotel, a wave pool and associated amenities, and 126,000 square feet of commercial space. The residential component will include 700 multi-family residential dwelling units.

The project site is divided by the north-south SDG&E utility corridor within which are overhead power lines. The City of Oceanside has water, sewer, and recycled water utilities buried within this joint use easement. The west side of the project contains all the wave park facilities including the hotel and commercial/retail space and an estimated 400 residential dwelling units. The east side of the SDG&E corridor is planned to be developed with approximately 300 residential dwelling units.

Water service to the project, which includes domestic and fire protection, shall be provided by a combination of public and private water systems. Public water distribution mains onsite will connect to the City of Oceanside's public water system piping in Mission Avenue and Foussat Road.

There are three existing water mains located in the Old Foussat Road alignment extending north-south on the western portion of the property. The existing 24- and 30-inch water mains will be relocated into Foussat Road and connected to the existing pipes at the north and south ends. The existing 12-inch water main will be relocated into Loop Road North, along the eastern frontage of the project, and connected to the existing pipes at the north and sound ends.

A private fire protection system will be included within the onsite development to provide service to onsite fire hydrants located in and among the commercial buildings on the project. This private fire protection system will connect to the City public water system piping at two locations. Each location will include a backflow preventer.

The Ocean Kamp project proposes to construct public water lines in the streets accessing the multi-family areas to provide domestic and fire protection service to these residential lots.

Purpose for the Water Study

The purpose of this letter report is to present the results of a hydraulic analysis of the proposed onsite public and private water systems which will provide domestic and fire protection service to the Ocean Kamp project. The hydraulic analysis is the basis for the recommended pipe sizes for both the public and private water lines within the development project.

A second purpose is to identify the existing water utilities within the project site and outline where they will be relocated. The pipeline relocation is proposed to be accomplished in the early phase of the development project in order that the necessary grading for the project can be accomplished.

The irrigation system for the Ocean Kamp project will be supplied by a separate meter from the domestic water system, and therefore has not been included in this analysis. The design of fire-sprinkler systems for the onsite buildings is premature at this time and therefore has not been included within the hydraulic analysis.

Water System Design Criteria

The Ocean Kamp project's water system has been designed in accordance with the City of Oceanside's *Water, Sewer, and Reclaimed Water Design and Construction Manual*, August 2005 edition and August 2017 revisions. Relevant excerpts from this design guide are provided in Appendix A.

Water Demand. The average daily domestic water demand for the project is based on the design guide. Maximum day demand and peak hour demand are based on the average day demand multiplied by peak factors of 2 and 3, respectively. Irrigation demand will be supplied to the project through a separate meter and is not incorporated into this analysis.

Pressure Criteria. A minimum residual pressure of 35 psi (pounds per square inch) must be maintained during a peak hour demand scenario and 20 psi during the maximum day demand plus fire flow scenario.

Water Mains. Water mains are required to have a minimum diameter of 8 inches. Pipeline velocity must not exceed 7.5 fps (feet per second) during maximum flow conditions. Under fire flow conditions, new mains shall not exceed 15 fps. Existing mains smaller than 12-inch shall not exceed 15 fps and 12-inch and larger existing mains shall not exceed 10 fps.

Fire Flows. Fire hydrant flow requirements vary by the type of land use. As specified in the City's design manual, the fire flow requirement is 4,000 gpm (gallons per minute) for commercial areas and 3,000 gpm for multi-family residential areas.

Project Water Demands

Domestic demands for the Ocean Kamp project were determined based on the above discussed design criteria. Table 1 details the calculated demands for the project. Since the proposed wave pool is an uncharacteristic land use in the City of Oceanside, a conservative estimate is included in the water demands for this facility.

The basis for the water use for the wave pool has two components. First is evaporation, and second is water waste from backwashing the filters. Evaporation is estimated to be 10,000 gpd based on a pool area of 3.1 acres and an average evaporation rate of 40 inches per year. The backwash waste is estimated to be 15,000 gpd.

As the design of the Ocean Kamp development proceeds, the water use for the wave pool will be better defined so that the domestic water meter for that facility can be properly sized.

TABLE 1 OCEAN KAMP PROJECT WATER DEMANDS				
Land Use	**Quantity**	**Demand Rate**	**Demand, gpd**	**Demand, gpm**
Development West of SDG&E Easement				
Commercial	126,000 SF, 10.3 gross ac	1,850 gpd/ac	19,055	13.2
Hotel	300 rooms	120 gpd/room	36,000	25.0
Wave Pool	3.1 acres	--	25,000	17.4
Residential	420 units	200 gpd/unit	84,000	58.3
Subtotal West Side			**164,055**	**113.9**
Development East of SDG&E Easement				
Residential	280 units	200 gpd/unit	56,000	38.9
Subtotal East Side			**56,000**	**38.9**
Total Average Day Demand			**220,055**	**152.8**
Total Maximum Day Demand		**ADD x 2**	**440,110**	**305.6**
Total Peak Hour Demand		**ADD x 3**	**660,165**	**458.4**

Existing Water System

The Ocean Kamp project is within the City of Oceanside and will receive service from the City's public water system. The project will be served by the City's 320 Pressure Zone where 320 corresponds to the high-water level (in feet) within the storage reservoirs. The 320 Zone in the vicinity of the project is supplied by two primary sources, Wire Mountain Reservoir and John Paul Steiger (JPS) Reservoir, both with low water levels of 290 feet. The Wire

Mountain Reservoir is located northwest of the project on the north side of the San Luis Rey River and the JPS Reservoir is located southeast of the project, along Rancho Del Oro Drive.

From the Wire Mountain Reservoir, a 30-inch transmission main carries water east to the Foussat Road Bridge where it crosses the San Luis Rey River. After crossing the river, the 30-inch transmission main travels south through the Ocean Kamp project via the western utility easement (Old Foussat Road) and connects to the 24-inch transmission main in Mission Avenue. This 24-inch transmission main continues east along Mission Avenue and eventually connects to the JPS Reservoir, providing customers in this area with two sources of water supply.

From the 30-inch transmission main, an 18-inch connection is made on the north side of the Foussat Road Bridge. This 18-inch, paralleling the 30-inch, becomes a 12-inch after crossing the bridge and continues to parallel the larger transmission piping in Old Foussat Road into Mission Avenue. Figure 2 shows the existing water facilities within and in the near vicinity of the Ocean Kamp project.

The existing 18-inch water main in Mission Avenue and along the east utility corridor is related to the ground water recovery plant to the northeast of the Ocean Kamp site. The potable water output from the City's ground water recovery plant is connected to the 511 Pressure Zone, not the 320 Pressure Zone. Thus, the hydraulic analyses in this report are based on having the project supplied only by the Wire Mountain and JPS Reservoir sources.

PROJECT BOUNDARY

200' ± UTILITY EASEMENT SDG&E CORRIDOR

TO JOHN PAUL STEIGER RESERVOIR

TO WIRE MOUNTAIN RESERVOIR

BENET RD

EX.24" (511)

EX.30" (320)

EX.18" (320)

FOUSSAT RD

EX.12" (320)

SAN LUIS REY RIVER

LOT 1

LOT 2

LOT 3

LOT 4

LOT 5

LOT 6

LOT 7

LOT 8

LOT 9

LOT A

LOT B

LOT C

LOT D

LOT E

LOT F

EX.16" RW

HERITAGE ST

EX.8" (320)

FIRESIDE ST

EX.12" (320)

EX.30" (320)

EX.24" (320)

EX 4" WATER SERVICE FOR FORMER SWAP MEET

EX.4" (320)

MISSION AVE

HIGHWAY 76

EX.10" (320)

EX.8" (320)

N

0 400 FEET

LEGEND

PROJECT BOUNDARY

EXISTING PUBLIC WATER SYSTEM

EXISTING PUBLIC RW SYSTEM

(320) PRESSURE ZONE

FIGURE 2

EXISTING WATER SYSTEM

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Relocation of Existing Water Facilities

Figure 3 shows the proposed relocation of the water pipelines which are currently located in the Old Foussat Road alignment. This includes the existing 30-inch 320 Pressure Zone Transmission Main, the existing 24-inch 320 Pressure Zone Transmission Main, and the existing 12-inch 320 Pressure Zone Distribution Main.

Both the 30-inch and 24-inch Transmission Mains will be relocated into Foussat Road along the west side of the Ocean Kamp development. The existing 12-inch distribution pipeline will be relocated into the onsite Loop Road for the development. This loop road is a public road (right-of-way) for certain segments and a private road for other segments. The distinction of public and private is shown on Figure 3.

The water utilities within the SDG&E corridor will not be affected by the Ocean Kamp development. This is primarily because of the extremely limited ability for Ocean Kamp to perform grading or construct any improvements within the SDG&E easement. The existing 4-inch water line which provided service to the swap meet is proposed to be replaced with a 12-inch water main. The new 12-inch pipe will be extended south to the existing 12-inch water main in Mission Avenue. The existing 4-inch connection to the existing 12-inch water main in Mission Avenue will be replaced with a 12-inch connection.

At the extreme east end of the Ocean Kamp site are two 18-inch pipelines and a 30-inch 320 Pressure Zone Transmission Main. The two 18-inch pipelines are associated with the ground water recovery plant. To the west of these utilities is a storm water channel. All of these improvements are proposed to remain in place and no development is proposed in this area.

Available Water System Pressure

Water service to the project will be from the 320 Pressure Zone of the City's public water system. Finished floor elevations within the project range from 45 feet to 48 feet. Based on the high-water level within this zone (320 feet), the maximum static water pressure on the project will range from 117 psi to 119 psi.

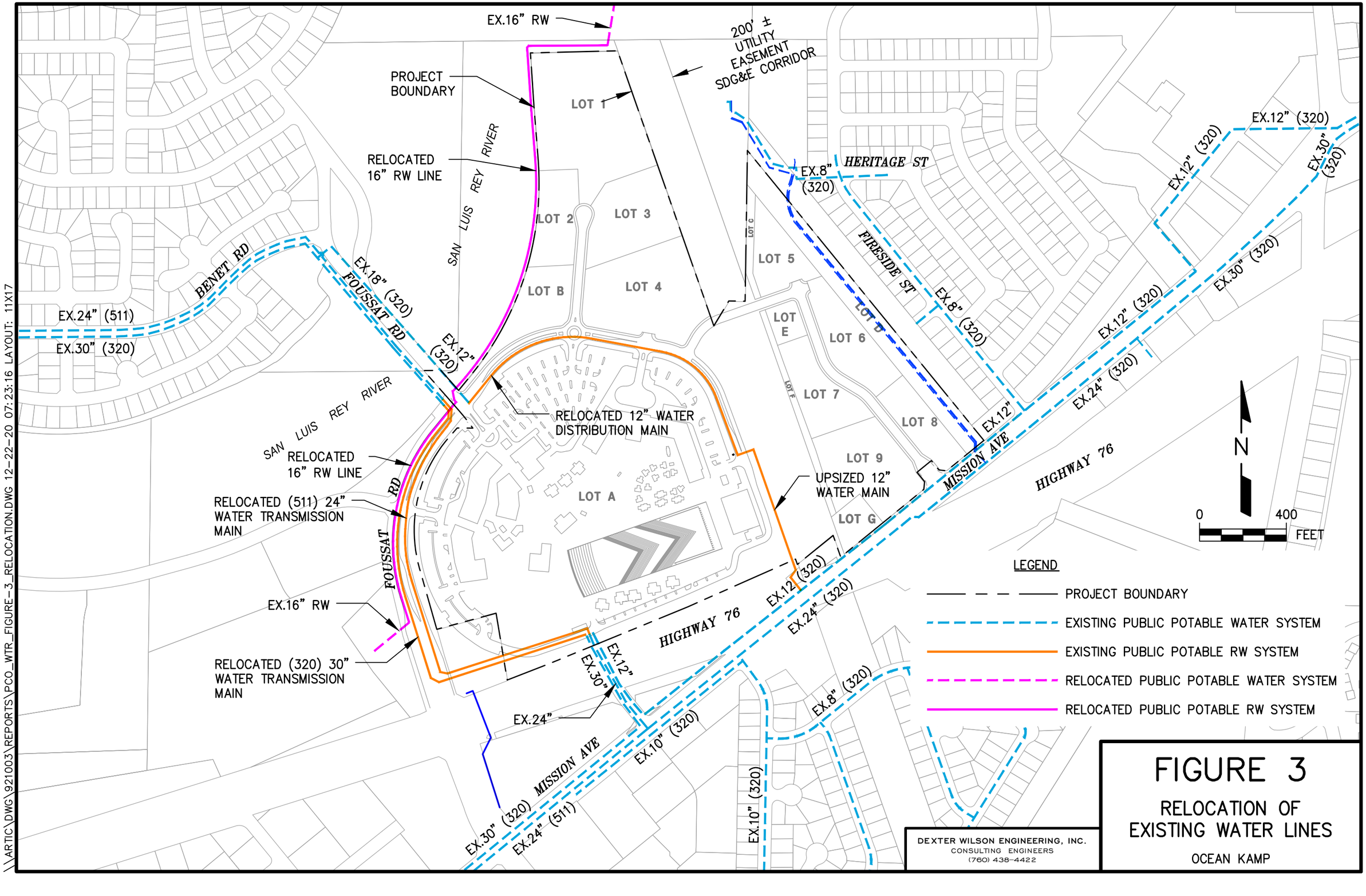

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FIGURE 3

RELOCATION OF EXISTING WATER LINES

OCEAN KAMP

Pressure regulators will be required within the Ocean Kamp project for each building supply to limit building service pressures to 80 psi for compliance with the Uniform Plumbing Code and City of Oceanside requirements. To allow for a conservative analysis, the computer model hydraulic calculations are based on both reservoirs being half full at 305 feet.

Proposed Onsite Water System

The Ocean Kamp project is proposing to connect to the City of Oceanside's public water system at four locations. Two connection points are for the west side of the development, and two locations are to provide service to the east side development which is all multi-family residential. See Figure 4.

West Side Development. The two locations needed for the west side development are on the existing 12-inch 320 Pressure Zone water line at the north end and south end of the Old Foussat Road utility corridor. The existing 12-inch distribution pipeline will be relocated into Loop Road by constructing these two connections and building a new 12-inch water main within the Ocean Kamp Loop Road.

Domestic water services and private fire protection services for the west side of development will be connected to the relocated 12-inch distribution water main in Loop Road. In addition, a secondary 12-inch loop will be connected to the 12-inch relocated distribution main in order to provide service to the multi-family residential lots at the north end of the west side development.

East Side Development. The third connection to the existing water system will be made to the 12-inch distribution water main in Mission Avenue at the east end of the Ocean Kamp project. This connection will be made with a 12-inch water line which will extend north through the east side multi-family residential lots in a proposed public water line easement. The proposed onsite 12-inch public water main will extend north and connect to the existing 8-inch water line in Heritage Street. This is shown in Figure 4.

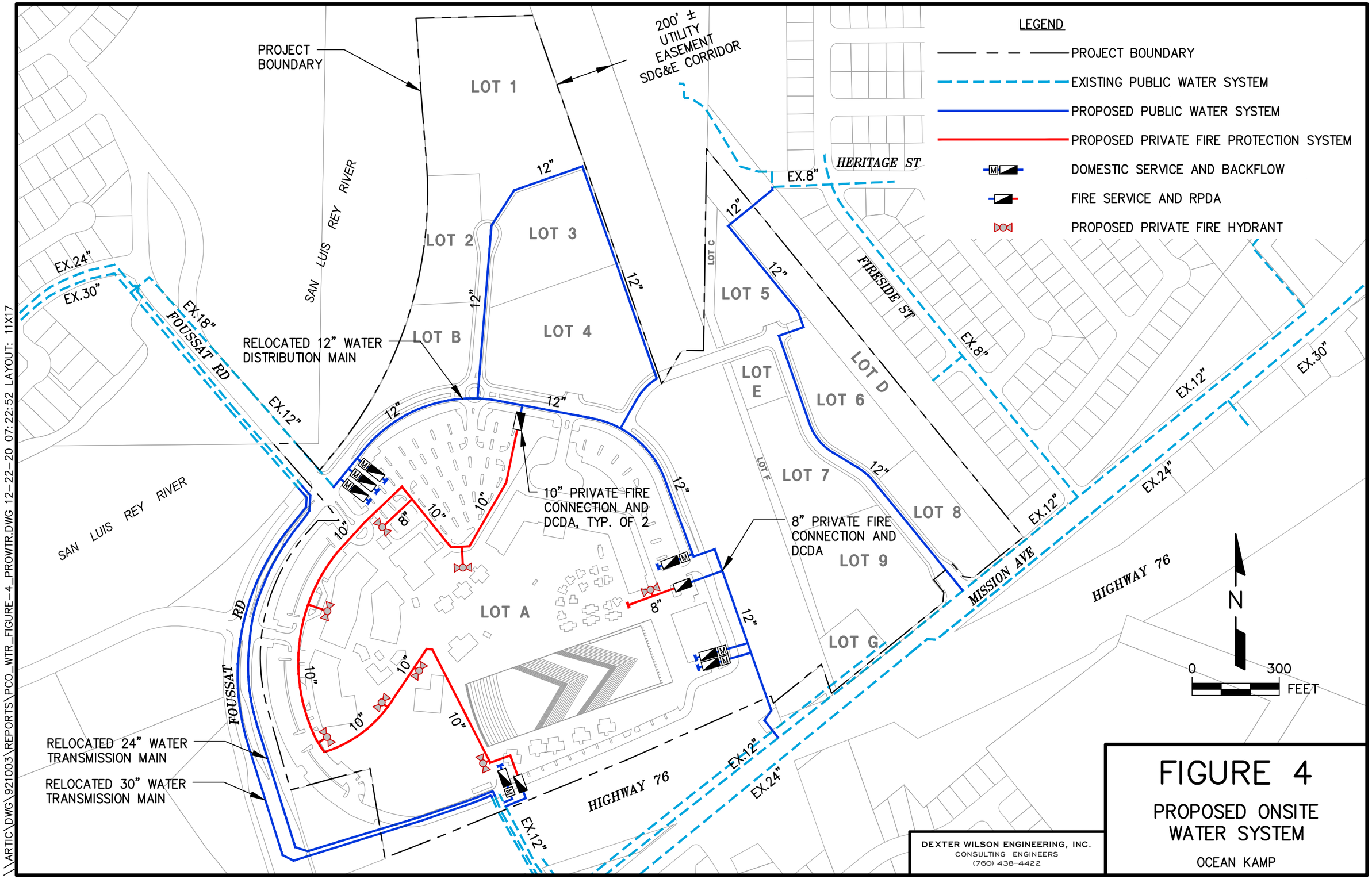

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FIGURE 4

PROPOSED ONSITE WATER SYSTEM

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Onsite Private Water System. Private onsite water mains will consist of the private fire protection system to provide fire hydrant flow, and the domestic building supply lines extended from the domestic water meters.

Private Fire Protection System. For the private fire system, three connections to the public water system for fire protection will include a double check detector backflow preventer. The backflow assemblies will be placed in proximity to the City's public water line, and all piping and appurtenances downstream of the backflow will be private and the responsibility of the Ocean Kamp project.

Domestic Water Meters and Private Supply Piping. The Ocean Kamp project will have several domestic water meters within the project. The following domestic meters are anticipated based on the proposed land uses and project configuration.

1. A dedicated domestic water meter for the wave pool.

2. A domestic water meter for the hotel and its associated casitas, recreation pool, spa, and amenities.

3. Several domestic water meters will be set for the commercial area. Separate water meters will be required by the City for restaurant uses compared with retail uses because the water billing rates are different. Where applicable, submeters will be installed for the commercial/retail tenants. The total number of individual water meters will not be known until building are leased and their uses are known. The public water system will be designed to accommodate flexibility such that future uses can be provided with separate meters as required by the City of Oceanside Water Utilities Department.

4. A master domestic water meter for each of the multi-family lots. The current project design includes a total of nine (9) separate residential lots: four lots on the west side development; and five lots on the east side development.

Sizing of domestic water meters will be done when architectural plans are prepared for the various project components and submitted for permit. Private building supply piping will be located among the onsite buildings within private property; private domestic piping will not be located in public rights-of-way.

As previously noted, pressure regulators will be required for each building supply service to maintain building pressures below 80 psi in accordance with the California Plumbing Code; pressure regulators prior to the City meters and private backflows will not be necessary.

Proposed Water System Sizing

To establish the appropriate pipe sizing of the onsite public water system and onsite private fire protection water system, a computer model was developed to evaluate the water system under various demand scenarios. The computer modeling also included portions of the existing public system in the project vicinity which connects the Ocean Kamp onsite water system to nearby supply reservoirs.

Model Development. The KYPIPE computer software developed by the University of Kentucky was used to evaluate the Ocean Kamp project's water system and the existing system in the vicinity of the project. The program utilizes the Hazen-Williams equation for determining head loss in pipes. The program also determines the flow and velocity in the pipes as well as the available pressure at nodes in the water system. An assumed roughness coefficient "C" value of 120 was used for all pipes.

Computer Modeling the 320 Pressure Zone System. As previously detailed, water to the Ocean Kamp project will be supplied by the 320 Pressure Zone from the Wire Mountain and JPS Reservoirs. The two water sources are modeled as fixed-grade reservoirs and are set based on the estimated working hydraulic grade line within the supply zone in the vicinity of the Ocean Kamp project. The supply fixed-grade sources were modeled at a hydraulic grade line of 305 feet which is equal to setting the supply reservoirs at half full.

A portion of the existing system was included in the water system computer model. This includes an existing 8-inch water line in Fireside Street, which serves 31 single-family dwelling units. The Ocean Kamp project will connect to this 8-inch water line by way of Heritage Street.

Fitting and Valve Losses. The pressure losses through pipe fittings and valves were modeled as minor losses with their respective "k" values within the computer modeling analysis. These "k" values are summarized in Table 2.

TABLE 2
ENERGY LOSS COEFFICIENTS
FOR PIPE FITTINGS AND VALVES

Fitting	K
45 Degree Elbow	0.35
90 Degree Elbow	0.75
Standard Tee, Through	0.3
Standard Tee, Branched	0.75
Gate Valve	0.17

Fire Service Backflow Assembly Losses. The pressure losses through the fire service double check detector assembly were modeled as a "loss element", which operates on a head/flow curve based on data provided in a head/flow table. Appendix B presents a candidate double check detector assembly. The manufacturer's literature includes charts which show pressure loss through the backflow preventer as a function of flow. These charts were used to approximate the pressure losses which were reflected in the computer modeling and show up as minor losses calculated in feet. Table 3 summarizes the input head/flow curve.

TABLE 3 HEAD/FLOW CURVE FOR CANDIDATE 10" DCDA	
Flow Rate, gpm	**Pressure Loss, psi**
0	6
1,800	6
2,900	8
3,500	11.5

Results of Computer Modeling for the Ocean Kamp Project

Computer modeling of the proposed water system for the Ocean Kamp project was performed to determine the pipe sizes necessary to provide adequate domestic and fire protection service. Appendix C presents the computer modeling results of the project's water system.

The water system was analyzed under average day demand, maximum day demand plus fire flow, and peak hour demand. During the peak hour demand scenario, all demands were met with residual pressures greater than the minimum 35 psi design guide requirement at all locations.

The maximum day plus fire flow demand scenario was modeled by splitting the fire flow between two hydrants. The fire flow demand is 4,000 gpm for commercial areas and 3,000 gpm for multi-family residential areas. Multiple scenarios under maximum day demand plus fire flow were analyzed to ensure that all areas of the project will be properly served. During all scenarios, all demands were met with residual pressures greater than the minimum 20 psi requirement at all locations. Table 4 summarizes the results of the analyzed water demand scenarios.

TABLE 4
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MAXIMUM DAY DEMAND PLUS FIRE FLOW SCENARIOS

Area	Nodes	Minimum Residual Pressure, psi	Size of Water Main Loop, in	Maximum Velocity, fps
Private Fire Protection System, 4,000 gpm Fire	35, 39	71	10	13
	41, 43	75	10	9
	45, 47	81	10	11
Public Multi-Family (West Side), 3,000 gpm Fire	11, 13	104	12	7
	17, 19	104	12	7
Public Multi-Family (East Side), 3,000 gpm Fire	69, 71	95	12	7

The computer model analyses confirmed that the pipe sizing and layout illustrated in Figure 4 can adequately supply the Ocean Kamp project with its domestic and fire protection needs. The proposed system includes 12-inch onsite public water system piping, and 10-inch private fire protection system piping.

The public water system within the Ocean Kamp project is recommended to be 12-inch diameter in all areas of the development site. The private fire protection system piping after the backflow assemblies is recommended to be a minimum of 10-inch diameter. The fire service backflows are sized to be 10-inch diameter.

Recommendations and Conclusions

The following recommendations and conclusions are presented based upon the water system analyses performed for the Ocean Kamp project.

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

2. Finished floor elevations for buildings within the Ocean Kamp project range from 45 feet to 48 feet resulting in a maximum static pressure range of 117 psi to 119 psi.

3. Individual pressure regulators will be required at each building supply to limit service pressures to 80 psi in accordance with Uniform Plumbing Code and City of Oceanside standards.

4. The existing public water mains within the Old Foussat Road alignment through the project site will be relocated. The 24-inch 511 Zone main and the 30-inch 320 Zone main will be relocated into New Foussat Road to the west of the project site. The existing 12-inch 320 Zone distribution main will be relocated into the onsite Loop Road to the east of the existing Old Foussat Road alignment and extend south to connect to the existing 12" 320 Zone water main in Mission Avenue. The southern portion of this new 12-inch public water main will be within the SDG&E utility corridor.

5. The east side of the development project will construct a 12-inch water main from the existing 12-inch water line in Mission Avenue north to the existing 8-inch water line in Heritage Street.

6. The west side of the development project will construct a new 12-inch public water main in Loop Road from the intersection of old Foussat Road and new Foussat Road east and south to Mission Avenue. The southern portion of this new 12-inch public water main will be within the SDG&E utility corridor.

7. A combination of public and private water lines will serve the Ocean Kamp project to supply the necessary flow and pressure for domestic demand and the required fire hydrant flow. A private fire protection system is proposed only for the west side of the development.

8. Each private fire service connection to the public water system shall include a double check detector backflow assembly according to the City of Oceanside's standards.

9. Each domestic water service connection will comprise a domestic water meter followed by a reduced pressure principle backflow preventer assembly.

10. The proposed water systems are shown on Figure 4 which includes onsite public and private water lines adequate to supply the domestic and fire protection needs of the Ocean Kamp project.

11. The fire flow available to the project meets the City of Oceanside's fire flow requirement of 4,000 gpm for commercial areas and 3,000 gpm for residential areas while maintaining a residual pressure of greater than 20 psi at all locations.

12. The Ocean Kamp development proposes to relocate the three water lines which are currently within the Old Foussat Road alignment. The 30-inch and 24-inch transmission mains will be relocated into Foussat Road to the west; the 12-inch distribution line will be relocated into the onsite Loop Road.

13. This report presents the sizing and a general schematic layout of the proposed water system. As part of the final design effort, the location of water lines, service laterals, and water meters is to be in accordance with the City of Oceanside's requirements.

14. For PVC pipe used for the water lines within the project, we recommend that 8-inch through 12-inch diameter piping be in accordance with AWWA C900 DR18 Class 235.

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

Dexter Wilson Engineering, Inc.

Andrew Oven, P.E.

AO:ah

Attachments

APPENDIX A

EXCERPTS FROM
CITY OF OCEANSIDE
DESIGN GUIDE

SECTION 2 – POTABLE WATER SYSTEMS DESIGN GUIDELINES

2.1 GENERAL

A. All water works construction shall conform to the most recent edition of the City of Oceanside's Water, Sewer, and Recycled Water Design & Construction Manual.

B. If a conflict arises between the requirements in this manual, the order of precedence shall take place:

   a. Sections 1-4, Required Notes, & Appendix

   b. Standard Drawings

   c. Standard Specifications

C. If the standard that is sought does not appear in this manual, then the following standards shall be utilized in the order listed:

   1. State Water Resources Control Board – Division of Drinking Water
   2. American Water Works Association (AWWA) Standards
   3. San Diego County Regional Standard Drawings
   4. Standard Specifications for Public Works Construction (SSPWC or "Greenbook"), latest Edition.

   Exceptions to this and all other guidelines appearing in this manual may be allowed only upon the written approval of the Water Utilities Director.

B. All fire hydrants, blow offs, detector checks, air/vacuum assemblies, water sampling stations, reduced pressure principle backflow (R.P.) devices, and meter services will be located out of driveways, sidewalks, walkways, and/or any concrete structures. All references to Section 3.15 of the Engineer's Design and Processing Manual must also be adhered to.

C. PVC per AWWA C-900 and C-905.

D. Transmission line construction materials shall be as determined by the Water Utilities Director. For steel and ductile iron pipe, lay drawings must be submitted and approved before ordering materials.

E. Pressure systems in excess of 200 psi may require specialized design and materials.

F. The construction of all water systems for fire protection, from the main line to the double check valve shall be governed by this section. The City of Oceanside Fire Department shall review and approve the underground fire systems from the double check valve to the building.

G. Telemetry and Control equipment is required for:

   1. Water Pump Stations

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

H. Demands:

1. Average daily water demands shall be:

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

DU – Dwelling Unit

2. Peak Factors:

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

2.2 FIRE FLOWS

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

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

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

TABLE 2.1: General Fire Flow Guidelines

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

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

2.3 PRESSURES

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

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

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

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

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

2.4 MAINS

A. Minimum diameter shall be 8 inches.

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

C. All lines are to be looped.

D. Minimum depth of cover required:

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

2. Mains over 12 inches require special design.

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

F. For fire flow conditions, velocities shall not exceed 15 FPS for less than 12-inch existing mains, and velocities shall not exceed 10 FPS for 12-inch existing mains and above. For new mains, velocities shall not exceed 10 FPS with the fire flow demand flowing through one hydrant.

G. Thrust blocks shall be installed in accordance with Standard Drawing W-27. When water pressures exceed 200 PSI and/or soil-bearing pressures are less than 2000 PSF a special design shall be required by a Registered Civil/Structural Engineer.

H. All mains shall be shown in profile on the improvement plans.

I. All water mains not located within the Public right-of-way shall be provided with a minimum 20-foot wide water easement. In some cases, a wider easement may be required, as determined by the Water Utilities Director.

J. Where water and sewer mains are located within the same easement, the minimum easement size shall be 30 feet wide.

K. Easements shall be easily accessible to City maintenance equipment. Access shall be unobstructed with all-weather driveways and capable of withstanding a 40 ton load.

L. No trees, plantings, fences, structures, or building overhang shall be located within City easements.

M. Homeowners who purchase property containing a City easement will be responsible for the maintenance of that easement property.

N. No building foundations will be allowed within 10 feet of the outside edge of a City easement.

O. The shortest pipe length shall be no less than 6 linear feet.

2.5 VALVES

A. Maximum valve spacing:

1. 500 feet in residential areas and high-point areas.

2. 1,000 feet on arteries and secondary feeders, supply lines and combination arteries and supply lines.

B. Valve locations: as required by the Water Utilities Director.

C. Butterfly Valves shall conform to the “Standard for Rubber Seated Butterfly Valves”, per AWWA C-504, as last revised and shall be tested and certified with the valve actuator installed on the valve.

D. Gate Valves sizes 3 inches through 12 inches shall conform to the “Standard for Resilient Wedge Gate Valves for Water and Sewerage Systems”, per AWWA C-509, and C-550 for Interior Epoxy coating, and C-110 for Ductile Iron 250 PSI, latest revision. Gate valves shall be as described in Section 2.12.

APPENDIX B

MANUFACTURER'S LITERATURE FOR A DCDA BACKFLOW PREVENTER

SPECIFICATION SHEET

FEBCO® MASTER series®

LEAD FREE*

MasterSeries® LF856

Double Check Detector Backflow Prevention Assemblies (Type II)

Size: 2½" - 10"

The FEBCO MasterSeries LF856 Double Check Detector Assemblies are designed to protect drinking water supplies from dangerous cross-connections in accordance with national plumbing codes and water authority requirements for non-health hazard non-potable service applications such as irrigation, fire line, or industrial processing. This Backflow Assembly is primarily used for protection of drinking water systems and fire sprinkler systems, where Local Governing Code mandates protection from non-potable quality water being pumped or siphoned back into the potable water system.

Model LF856 Double Check Detector Assembly

Features

Main Valve:

- Inline Serviceable Assembly
- No Special Tools Required for Servicing
- Captured Modular Spring Assembly
- Reversible & Replaceable Discs
- Field Replaceable Seats
- Ductile Iron Valve Body Design
- Stainless Steel Check Components
- Winterization feature with disc retainers and valve body drain ports
- Clapper Check Assembly
- Commonality between 1st & 2nd Check Components
- Captured O-ring Design

Auxiliary Bypass:

- Compact Bypass Design; Remains within Main Valve Assembly Profile
- Inline Serviceable ¾" Backflow Assembly
- No Special Tools Required for Servicing
- Field Replaceable Seats & Discs
- Detect Potential Underground Water Leaks
- Detect Unauthorized Water Usage

Specifications

The FEBCO MasterSeries LF856 Double Check Detector Valve Assembly shall be installed on the potable water supply and at each point of cross-connection to protect against possible backpressure and backsiphonage conditions for non-health hazard (i.e., pollutant) applications. The assembly shall consist of a main line valve body composed of two (2) independently acting approved clapper style check modules with replaceable seats and disc rubbers. Servicing of both check modules does not require any special tools and are accessed through independent top entry covers. This assembly shall be fitted with approved UL/FM inlet/outlet resilient seated shutoff valves and contain four (4) properly located resilient seated test cocks as specified by AWWA Standard C510. The auxiliary bypass line contains a ⅝"x ¾" (16 x 19mm) Water Meter that complies with ANSI/AWWA Standard C700 coupled with an approved check assembly. The bypass line is designed to detect leaks or unauthorized water usage of the water system while protecting against possible backpressure and backsiphonage conditions for non-health hazard (i.e., pollutant) application. Flow and pressure loss performance parameters shall meet the requirements of AWWA Standard C510.

NOTICE

The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

***The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.**

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

Options - Suffix

OSY: UL/FM Approved OS&Y Gate Valves (ANSI/AWWA C515 Compliant)

CFM: Totalizing Cubic feet/min 5/8" x 3/4" Water Meter (ANSI/AWWA C700 Compliant)

GPM: Totalizing Gallons/min 5/8"x 3/4" Water Meter (ANSI/AWWA C700 Compliant)

LG: Less Shutoff valves; This is NOT an APPROVED ASSEMBLY

Example Ordering Descriptions:

4" LF856-OSY-GPM - Valve Assembly fitted with OS&Y Shutoff Valves & Gallon Feet per Minute Water Meter

4" LF856-OSY-CFM - Valve Assembly fitted with OS&Y Shutoff Valves, Cubic feet per Minute Water Meter

Assembly Flow Orientation:

- Horizontal & Vertical Up (2½" – 10") - Approved by FCCCHR-USC, ASSE, cULus, FM, IAPMO

Materials

Below is a general material list of the Model LF856. All assemblies' size 2½" through 10" is similar in materials and construction. Please contact your local FEBCO Representative if you require further information.

Main Valve Body:	Ductile iron Grade 65-45-12
Coating:	Fusion epoxy coated internal and external AWWA C550
Shutoff Valves:	OS&Y resilient wedge gate valves AWWA C515 (UL/FM)
Check Seats:	Stainless Steel
Disc Holder:	Stainless Steel
Elastomer Disc	Silicone
Spring:	Stainless Steel
Clamp:	AWWA C606 (10" Only)

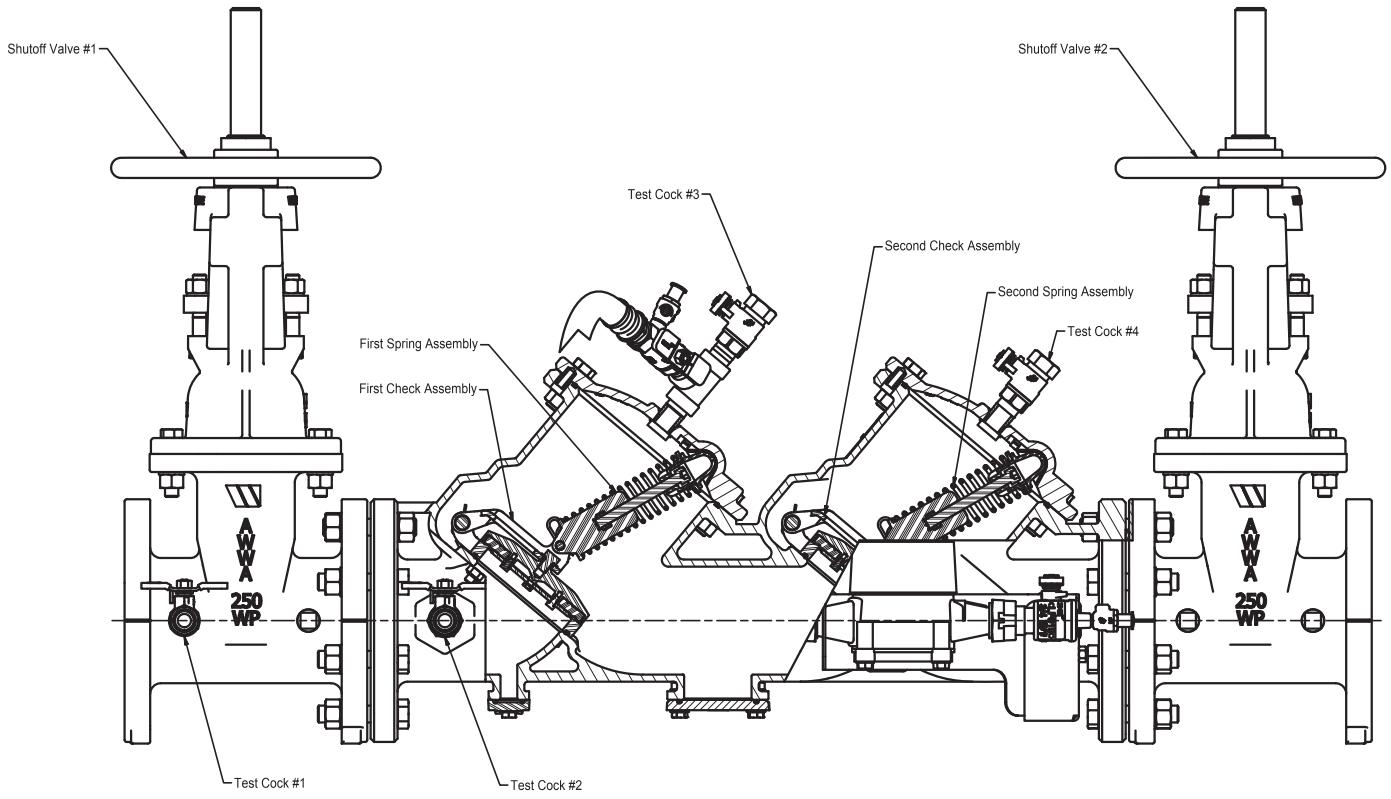
Approvals

- Approved by the Foundation for Cross-Connection Control and Hydraulic Research at The University of Southern California (FCCCHR-USC)
- ASSE 1048 Listed
- **UL Classified (US & Canada)
- **FM Approved
- IAPMO
- AWWA Standard C510 Compliant
- End Connections: Compliant to ASME B16.1 Class 125 & AWWA Class D Flange

**Assembly configured with UL/FM Approved OS&Y RW Gate Valves. Less gate valve assemblies are not UL/FM approved configurations.

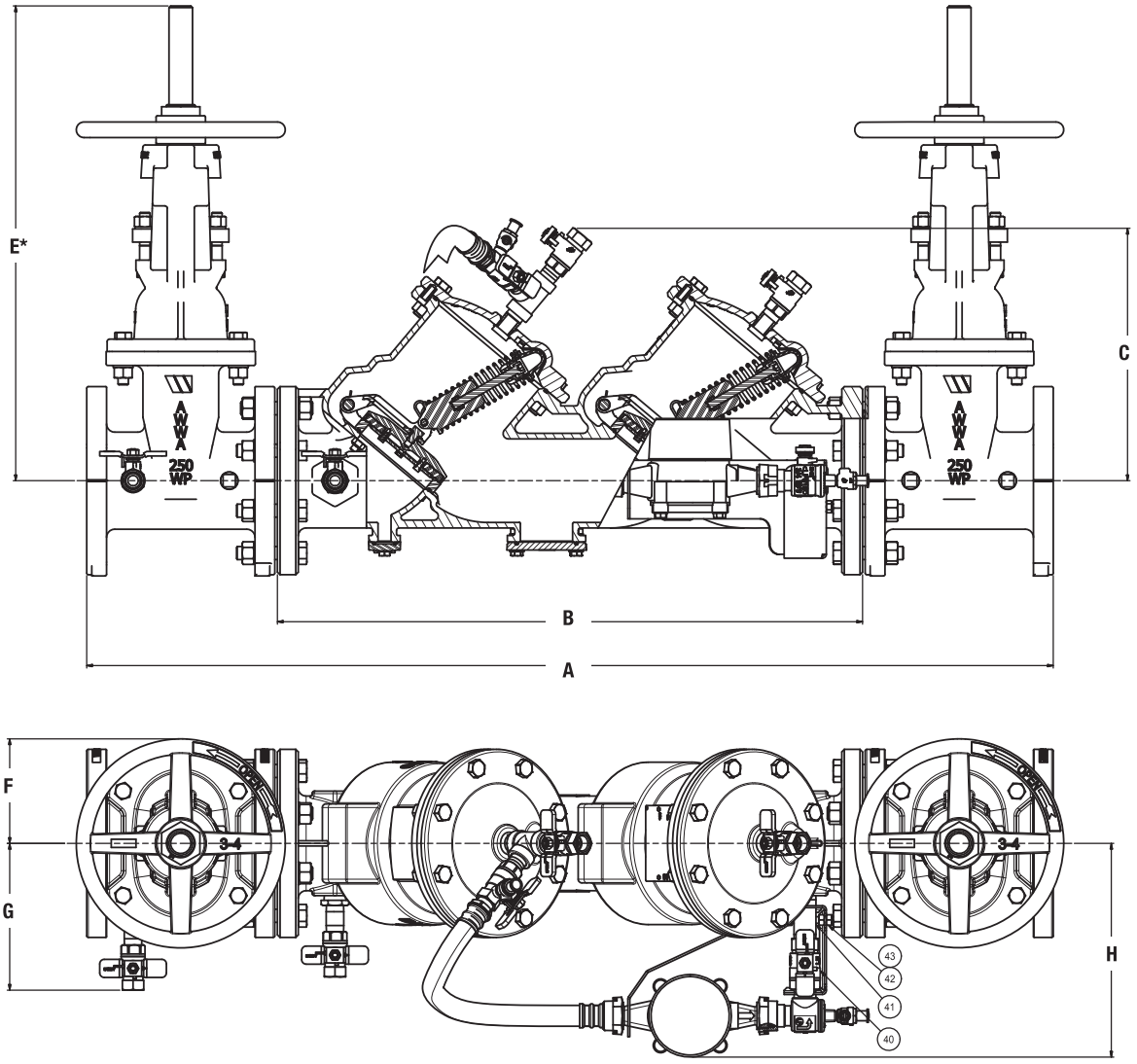
Pressure - Temperature

Max. Working Pressure:	175 psi (12.1 bar)
Min. Working Pressure:	10 psi (0.7 bar)
Hydrostatic Test Pressure:	350 psi (24.1 bar)
Hydrostatic Safety Pressure:	700 psi (48.3 bar)
Temperature Range:	33°F - 140°F (0.5°C- 60°C) Continuous



Dimensions & Weights

Below are the nominal dimensions and physical weights for the Model LF856 size 2½" through 10". Allowances must be made for normal manufacturing tolerances. Please visit our website to download a copy of this product's installation instructions, or contact your local FEBCO Representative for more information.



Model LF856 Assemblies

SIZE	DIMENSIONS														WEIGHT***	
	A		B		C		E**		F		G		H		OSY	
in.	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kg.*
2½	40¾	1035	25½	648	10	254	16⅜	416	4½	114	7⅛	181	13⅜	340	245	111
3	41⅞	1064	25⅝	651	10	254	22⅙	565	4½	114	7⅜	187	13⅜	340	271	123
4	46¼	1175	28	711	10⅛	257	23¼	591	5½	140	8⅛	206	14	356	338	153
6	56	1422	34¾	883	12¾	324	30⅛	765	6½	165	9⅞	251	15	381	515	234
8	65	1651	41¾	1061	15⅝	397	37¾	959	7	178	11⅛	283	15¾	400	826	375
10	72⅝	1845	46⅜	1178	15⅝	397	48	1219	9	229	12⅜	314	15¾	400	1234	560

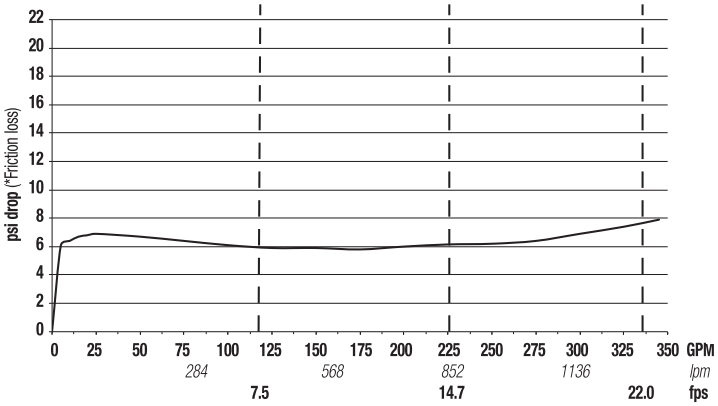
** Indicates nominal dimensions with OSY Gate Valves (Full Open Position)
*** Indicates weight of complete Backflow Assemblies with specified Gate Valves

Performance

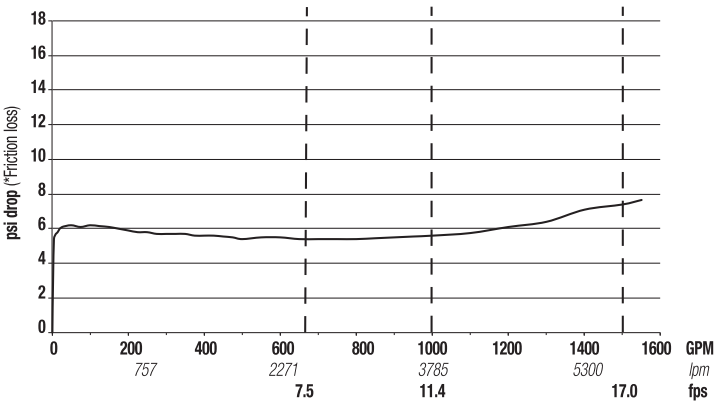
Flow capacity chart identifies valve performance based upon rated water Velocity up to 20fps.

- Maximum service flow rate is determined by maximum rated Velocity of 7.5fps.
- AWWA Manual M-22 (Appendix C) recommends that the maximum water Velocity in the services be not more than 10fps.
- UL flow rate is determined by typically rated Velocity of 15 feet/sec.

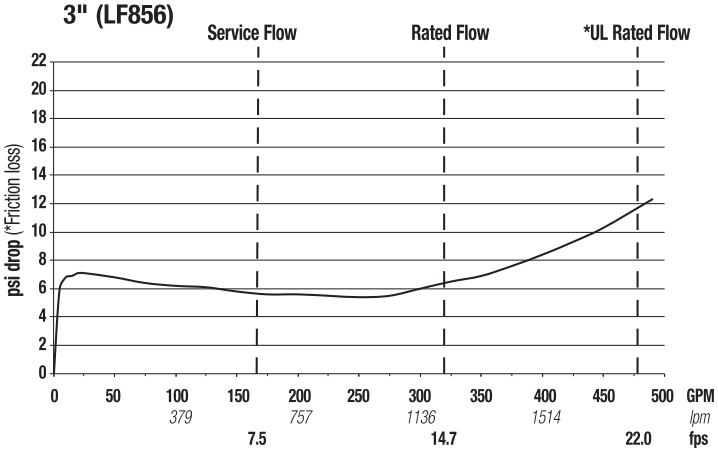
2½" (LF856)



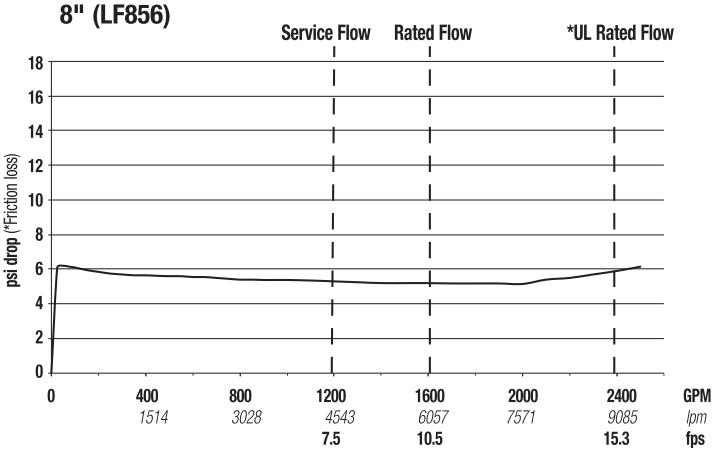
6" (LF856)



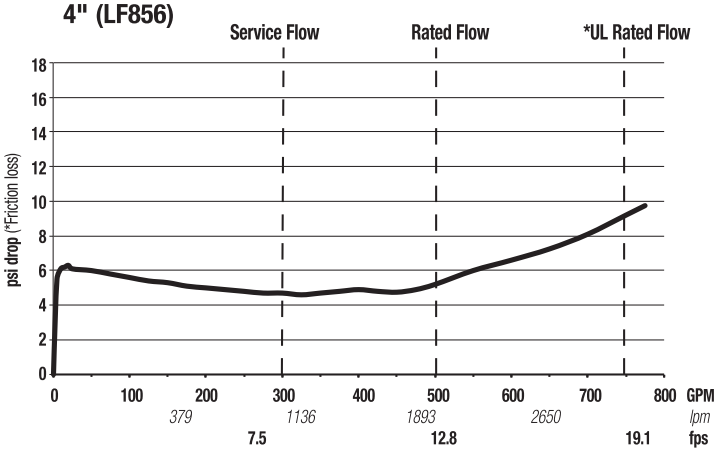
3" (LF856)



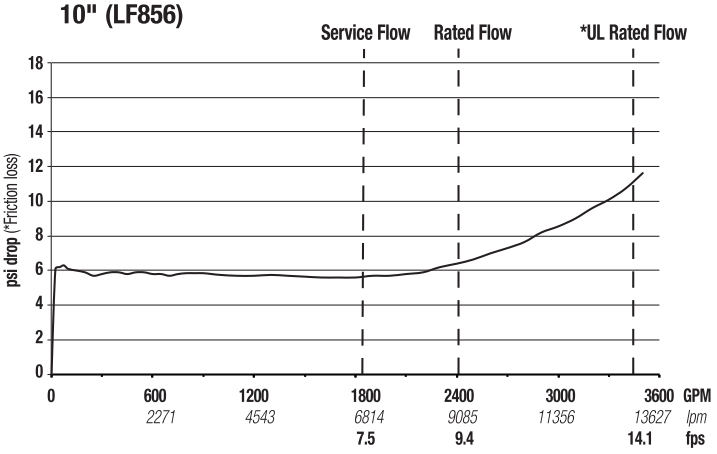
8" (LF856)



4" (LF856)



10" (LF856)



FEBCO®

A Watts Water Technologies Company

MASTER series®

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Latin America: (52) 81-1001-8600 • Fax: (52) 81-8000-7091 • FEBCOonline.com

APPENDIX C

COMPUTER MODELING RESULTS

WATER SYSTEM ANALYSIS

COMPUTER RUNS

NODE AND PIPE DIAGRAM

Exhibit A

DEMAND CONDITIONS MODELED:

1. Average Day
2. Maximum Day
3. Peak Hour
4. Max. Day plus 4,000 gpm Fire Flow split between Nodes 35 and 39
5. Max. Day plus 4,000 gpm Fire Flow split between Nodes 41 and 43
6. Max. Day plus 4,000 gpm Fire Flow split between Nodes 45 and 47
7. Max. Day plus 3,000 gpm Fire Flow split between Nodes 11 and 13
8. Max. Day plus 3,000 gpm Fire Flow split between Nodes 17 and 19
9. Max. Day plus 3,000 gpm Fire Flow split between Nodes 69 and 71

```
* * * * * * * * * * * * 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:  Classic                                      *
*  Licensed for Pipe2018                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

Date & Time: Mon Dec 21 10:45:10 2020

Master File : \\artic\eng\921003\kypipe\2020-12-21\921003a1.KYP\921003a1.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.
2	R1	1	4800.00	30.00	120.0000	1.75
4	1	3	820.00	18.00	120.0000	0.30
6	3	5	195.00	12.00	120.0000	0.30
8	5	7	385.00	12.00	120.0000	0.65
10	7	9	200.00	12.00	120.0000	3.47
12	9	11	200.00	12.00	120.0000	2.72
14	11	13	335.00	12.00	120.0000	5.32
16	13	15	135.00	12.00	120.0000	2.72
18	15	17	465.00	12.00	120.0000	3.47
20	17	19	330.00	12.00	120.0000	2.72
22	19	21	330.00	12.00	120.0000	1.10
24	23	7	152.00	12.00	120.0000	0.00
26	25	23	10.00	12.00	120.0000	0.30
28	27	25	248.00	12.00	120.0000	0.30
30	21	27	129.00	12.00	120.0000	0.65

32	25	I-BP1	20.00	10.00	120.0000	4.09
34	O-BP1	29	545.00	10.00	120.0000	3.12
36	29	31	75.00	8.00	120.0000	0.00
38	29	33	255.00	10.00	120.0000	1.05
40	33	35	145.00	8.00	120.0000	2.42
42	33	37	585.00	10.00	120.0000	3.07
44	37	39	56.00	8.00	120.0000	2.42
46	37	41	510.00	10.00	120.0000	3.42
48	41	43	300.00	10.00	120.0000	3.82
50	43	45	167.00	10.00	120.0000	2.72
52	45	47	583.00	10.00	120.0000	3.82
54	47	O-BP2	100.00	10.00	120.0000	3.17
56	I-BP2	49	20.00	10.00	120.0000	0.00
58	51	63	880.00	12.00	120.0000	0.30
60	51	53	355.00	12.00	120.0000	2.42
62	55	53	200.00	12.00	120.0000	0.94
64	55	57	350.00	12.00	120.0000	0.30
66	57	59	165.00	8.00	120.0000	3.17
68	57	61	160.00	12.00	120.0000	0.65
70	61	21	155.00	12.00	120.0000	0.30
72	49	63	450.00	12.00	120.0000	1.05
74	51	65	900.00	12.00	120.0000	0.30
76	65	67	200.00	12.00	120.0000	3.17
78	67	69	293.00	12.00	120.0000	2.72
80	69	71	585.00	12.00	120.0000	3.07
82	71	73	780.00	12.00	120.0000	4.97
84	73	75	527.00	8.00	120.0000	3.07
86	75	77	527.00	8.00	120.0000	2.72
88	77	79	527.00	8.00	120.0000	2.72
90	65	79	520.00	12.00	120.0000	0.30
92	79	81	2600.00	12.00	120.0000	2.50
94	81	R2	3800.00	24.00	120.0000	0.30

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

THERE IS A DEVICE AT NODE BP1 DESCRIBED BY THE FOLLOWING DATA: (ID= 1)

HEAD (ft)	FLOWRATE (gpm)	EFFICIENCY (%)	
-13.85	0.00	75.00	(Default)
-13.87	1800.00	75.00	(Default)
-18.46	2900.00	75.00	(Default)
-26.54	3500.00	75.00	(Default)

THERE IS A DEVICE AT NODE BP2 .....> (ID= 1)

N O D E D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
1		0.00	43.00	
3		6.60	45.00	
5		0.00	43.50	
7		0.00	44.00	
9		11.10	45.00	
11		11.10	45.00	
13		11.10	45.00	
15		11.10	45.00	
17		11.10	45.00	
19		0.00	45.00	
21		0.00	46.00	
23		0.00	46.00	
25		0.00	46.00	
27		0.00	49.00	
29		0.00	43.50	
31		0.00	43.50	
33		0.00	43.50	
35		0.00	43.50	
37		0.00	41.50	
39		0.00	41.50	
41		0.00	40.00	
43		0.00	40.00	
45		0.00	40.00	
47		0.00	41.00	
49		6.60	41.00	
51		0.00	47.00	
53		17.40	48.00	
55		0.00	48.00	
57		0.00	48.00	
59		0.00	48.00	
61		25.00	47.00	
63		0.00	38.00	
65		0.00	42.00	
67		13.90	46.00	
69		13.90	50.00	
71		13.90	44.00	
73		0.00	40.00	
75		0.00	33.00	
77		0.00	37.00	
79		0.00	43.00	
81		0.00	56.00	
I-BP1		0.00	46.00	
I-BP2		0.00	41.00	
R1		----	290.00	305.00
R2		----	290.00	305.00
O-BP1		0.00	46.00	
O-BP2		0.00	41.00	

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

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

NUMBER OF PIPES .....(P) =	47
NUMBER OF END NODES .....(J) =	43
NUMBER OF PRIMARY LOOPS .....(L) =	3
NUMBER OF SUPPLY NODES .....(F) =	2
NUMBER OF SUPPLY ZONES .....(Z) =	1

==========

CASE 1: AVERAGE DAY DEMAND

RESULTS OBTAINED AFTER 20 TRIALS: ACCURACY = 0.26832E-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
2	R1	1	101.60	0.00	0.00	0.05	0.00	0.00
4	1	3	101.60	0.00	0.00	0.13	0.01	0.01
6	3	5	95.00	0.01	0.00	0.27	0.04	0.04
8	5	7	95.00	0.01	0.00	0.27	0.04	0.04
10	7	9	47.06	0.00	0.00	0.13	0.02	0.01
12	9	11	35.96	0.00	0.00	0.10	0.01	0.01
14	11	13	24.86	0.00	0.00	0.07	0.00	0.00
16	13	15	13.76	0.00	0.00	0.04	0.00	0.00
18	15	17	2.66	0.00	0.00	0.01	0.00	0.00
20	17	19	-8.44	0.00	0.00	0.02	0.00	0.00
22	19	21	-8.44	0.00	0.00	0.02	0.00	0.00
24	23	7	-47.95	0.00	0.00	0.14	0.01	0.01
26	25	23	-47.95	0.00	0.00	0.14	0.02	0.01
28	27	25	-47.95	0.00	0.00	0.14	0.01	0.01
30	21	27	-47.95	0.00	0.00	0.14	0.01	0.01
32	25	I-BP1	0.00	0.00	0.00	0.00	0.00	0.00
34	O-BP1	29	0.00	0.00	0.00	0.00	0.00	0.00
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	0.00	0.00	0.00	0.00	0.00	0.00
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	0.00	0.00	0.00	0.00	0.00	0.00
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	0.00	0.00	0.00	0.00	0.00	0.00
48	41	43	0.00	0.00	0.00	0.00	0.00	0.00
50	43	45	0.00	0.00	0.00	0.00	0.00	0.00
52	45	47	0.00	0.00	0.00	0.00	0.00	0.00
54	47	O-BP2	0.00	0.00	0.00	0.00	0.00	0.00
56	I-BP2	49	0.00	0.00	0.00	0.00	0.00	0.00
58	51	63	6.60	0.00	0.00	0.02	0.00	0.00
60	51	53	2.90	0.00	0.00	0.01	0.00	0.00
62	55	53	14.50	0.00	0.00	0.04	0.00	0.00
64	55	57	-14.50	0.00	0.00	0.04	0.00	0.00
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	-14.50	0.00	0.00	0.04	0.00	0.00
70	61	21	-39.50	0.00	0.00	0.11	0.01	0.01
72	49	63	-6.60	0.00	0.00	0.02	0.00	0.00
74	51	65	-9.50	0.00	0.00	0.03	0.00	0.00
76	65	67	32.50	0.00	0.00	0.09	0.01	0.01
78	67	69	18.60	0.00	0.00	0.05	0.00	0.00
80	69	71	4.70	0.00	0.00	0.01	0.00	0.00
82	71	73	-9.20	0.00	0.00	0.03	0.00	0.00
84	73	75	-9.20	0.00	0.00	0.06	0.00	0.00
86	75	77	-9.20	0.00	0.00	0.06	0.00	0.00

88	77	79	-9.20	0.00	0.00	0.06	0.00	0.00
90	65	79	-41.99	0.00	0.00	0.12	0.01	0.01
92	79	81	-51.20	0.03	0.00	0.15	0.01	0.01
94	81	R2	-51.20	0.00	0.00	0.04	0.00	0.00

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC- ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	0.00	258.97	245.12	-13.8	75.00	0.	0.0	0.0	292.2
BP2	0.00	263.96	250.12	0.0	75.00	0.	0.0	0.	297.2

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
1		0.00	305.00	43.00	262.00	113.53
3		6.60	304.99	45.00	259.99	112.66
5		0.00	304.99	43.50	261.49	113.31
7		0.00	304.97	44.00	260.97	113.09
9		11.10	304.97	45.00	259.97	112.65
11		11.10	304.97	45.00	259.97	112.65
13		11.10	304.96	45.00	259.96	112.65
15		11.10	304.96	45.00	259.96	112.65
17		11.10	304.96	45.00	259.96	112.65
19		0.00	304.96	45.00	259.96	112.65
21		0.00	304.96	46.00	258.96	112.22
23		0.00	304.97	46.00	258.97	112.22
25		0.00	304.97	46.00	258.97	112.22
27		0.00	304.97	49.00	255.97	110.92
29		0.00	291.12	43.50	247.62	107.30
31		0.00	291.12	43.50	247.62	107.30
33		0.00	291.12	43.50	247.62	107.30
35		0.00	291.12	43.50	247.62	107.30
37		0.00	291.12	41.50	249.62	108.17
39		0.00	291.12	41.50	249.62	108.17
41		0.00	291.12	40.00	251.12	108.82
43		0.00	291.12	40.00	251.12	108.82
45		0.00	291.12	40.00	251.12	108.82
47		0.00	291.12	41.00	250.12	108.39
49		6.60	304.96	41.00	263.96	114.38
51		0.00	304.96	47.00	257.96	111.78
53		17.40	304.96	48.00	256.96	111.35
55		0.00	304.96	48.00	256.96	111.35
57		0.00	304.96	48.00	256.96	111.35
59		0.00	304.96	48.00	256.96	111.35
61		25.00	304.96	47.00	257.96	111.78
63		0.00	304.96	38.00	266.96	115.68
65		0.00	304.96	42.00	262.96	113.95
67		13.90	304.96	46.00	258.96	112.22
69		13.90	304.96	50.00	254.96	110.48

71	13.90	304.96	44.00	260.96	113.08
73	0.00	304.96	40.00	264.96	114.82
75	0.00	304.96	33.00	271.96	117.85
77	0.00	304.96	37.00	267.96	116.12
79	0.00	304.97	43.00	261.97	113.52
81	0.00	305.00	56.00	249.00	107.90
I-BP1	0.00	304.97	46.00	258.97	112.22
I-BP2	0.00	304.96	41.00	263.96	114.38
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	291.12	46.00	245.12	106.22
O-BP2	0.00	291.12	41.00	250.12	108.39

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
75	117.85	R1	6.50
77	116.12	R2	6.50
63	115.68	O-BP1	106.22
73	114.82	29	107.30
49	114.38	31	107.30

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
6	0.27	18	0.01
8	0.27	60	0.01
92	0.15	80	0.01
24	0.14	58	0.02
26	0.14	72	0.02

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
R1	101.60	
R2	51.20	

NET SYSTEM INFLOW = 152.80
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 152.80

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CASE 2: MAXIMUM DAY DEMANDS

RESULTS OBTAINED AFTER 3 TRIALS: ACCURACY = 0.31956E-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
2	R1	1	203.09	0.01	0.00	0.09	0.00	0.00
4	1	3	203.09	0.02	0.00	0.26	0.02	0.02
6	3	5	189.89	0.03	0.00	0.54	0.14	0.14
8	5	7	189.89	0.05	0.00	0.54	0.14	0.14
10	7	9	93.61	0.01	0.00	0.27	0.06	0.04
12	9	11	71.41	0.00	0.00	0.20	0.03	0.02
14	11	13	49.21	0.00	0.00	0.14	0.02	0.01
16	13	15	27.01	0.00	0.00	0.08	0.01	0.00
18	15	17	4.81	0.00	0.00	0.01	0.00	0.00
20	17	19	-17.39	0.00	0.00	0.05	0.00	0.00
22	19	21	-17.39	0.00	0.00	0.05	0.00	0.00
24	23	7	-96.28	0.01	0.00	0.27	0.04	0.04
26	25	23	-96.28	0.00	0.00	0.27	0.07	0.04
28	27	25	-96.28	0.01	0.00	0.27	0.04	0.04
30	21	27	-96.28	0.00	0.00	0.27	0.04	0.04
32	25	I-BP1	0.00	0.00	0.00	0.00	0.00	0.00
34	O-BP1	29	0.00	0.00	0.00	0.00	0.00	0.00
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	0.00	0.00	0.00	0.00	0.00	0.00
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	0.00	0.00	0.00	0.00	0.00	0.00
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	0.00	0.00	0.00	0.00	0.00	0.00
48	41	43	0.00	0.00	0.00	0.00	0.00	0.00
50	43	45	0.00	0.00	0.00	0.00	0.00	0.00
52	45	47	0.00	0.00	0.00	0.00	0.00	0.00
54	47	O-BP2	0.00	0.00	0.00	0.00	0.00	0.00
56	I-BP2	49	0.00	0.00	0.00	0.00	0.00	0.00
58	51	63	13.20	0.00	0.00	0.04	0.00	0.00
60	51	53	5.91	0.00	0.00	0.02	0.00	0.00
62	55	53	28.89	0.00	0.00	0.08	0.00	0.00
64	55	57	-28.89	0.00	0.00	0.08	0.00	0.00
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	-28.89	0.00	0.00	0.08	0.00	0.00
70	61	21	-78.89	0.00	0.00	0.22	0.03	0.03
72	49	63	-13.20	0.00	0.00	0.04	0.00	0.00
74	51	65	-19.11	0.00	0.00	0.05	0.00	0.00
76	65	67	64.97	0.00	0.00	0.18	0.03	0.02
78	67	69	37.17	0.00	0.00	0.11	0.01	0.01
80	69	71	9.37	0.00	0.00	0.03	0.00	0.00
82	71	73	-18.43	0.00	0.00	0.05	0.00	0.00
84	73	75	-18.43	0.01	0.00	0.12	0.01	0.01
86	75	77	-18.43	0.01	0.00	0.12	0.01	0.01

88	77	79	-18.43	0.01	0.00	0.12	0.01	0.01
90	65	79	-84.08	0.02	0.00	0.24	0.03	0.03
92	79	81	-102.51	0.11	0.00	0.29	0.04	0.04
94	81	R2	-102.51	0.01	0.00	0.07	0.00	0.00

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC-ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	0.00	258.88	245.0	-13.8	75.00	0.	0.0	0.0	292.1
BP2	0.00	263.86	250.04	0.0	75.00	0.	0.0	0.0	297.1

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
1		0.00	304.99	43.00	261.99	113.53
3		13.20(2.00)	304.97	45.00	259.97	112.66
5		0.00	304.95	43.50	261.45	113.29
7		0.00	304.89	44.00	260.89	113.05
9		22.20(2.00)	304.88	45.00	259.88	112.61
11		22.20(2.00)	304.87	45.00	259.87	112.61
13		22.20(2.00)	304.87	45.00	259.87	112.61
15		22.20(2.00)	304.87	45.00	259.87	112.61
17		22.20(2.00)	304.87	45.00	259.87	112.61
19		0.00	304.87	45.00	259.87	112.61
21		0.00	304.87	46.00	258.87	112.18
23		0.00	304.88	46.00	258.88	112.18
25		0.00	304.88	46.00	258.88	112.18
27		0.00	304.87	49.00	255.87	110.88
29		0.00	291.04	43.50	247.54	107.27
31		0.00	291.04	43.50	247.54	107.27
33		0.00	291.04	43.50	247.54	107.27
35		0.00	291.04	43.50	247.54	107.27
37		0.00	291.04	41.50	249.54	108.13
39		0.00	291.04	41.50	249.54	108.13
41		0.00	291.04	40.00	251.04	108.78
43		0.00	291.04	40.00	251.04	108.78
45		0.00	291.04	40.00	251.04	108.78
47		0.00	291.04	41.00	250.04	108.35
49		13.20(2.00)	304.86	41.00	263.86	114.34
51		0.00	304.86	47.00	257.86	111.74
53		34.80(2.00)	304.86	48.00	256.86	111.31
55		0.00	304.86	48.00	256.86	111.31
57		0.00	304.86	48.00	256.86	111.31
59		0.00	304.86	48.00	256.86	111.31
61		50.00(2.00)	304.86	47.00	257.86	111.74
63		0.00	304.86	38.00	266.86	115.64
65		0.00	304.86	42.00	262.86	113.91
67		27.80(2.00)	304.86	46.00	258.86	112.17
69		27.80(2.00)	304.85	50.00	254.85	110.44

71	27.80(2.00)	304.85	44.00	260.85	113.04
73	0.00	304.86	40.00	264.86	114.77
75	0.00	304.86	33.00	271.86	117.81
77	0.00	304.87	37.00	267.87	116.08
79	0.00	304.88	43.00	261.88	113.48
81	0.00	304.99	56.00	248.99	107.90
I-BP1	0.00	304.88	46.00	258.88	112.18
I-BP2	0.00	304.86	41.00	263.86	114.34
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	291.04	46.00	245.04	106.18
O-BP2	0.00	291.04	41.00	250.04	108.35

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
75	117.81	R1	6.50
77	116.08	R2	6.50
63	115.64	O-BP1	106.18
73	114.77	29	107.27
49	114.34	31	107.27

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
6	0.54	18	0.01
8	0.54	60	0.02
92	0.29	80	0.03
24	0.27	58	0.04
26	0.27	72	0.04

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
R1	203.09	
R2	102.51	

NET SYSTEM INFLOW = 305.60
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 305.60

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CASE 3: PEAK HOUR DEMANDS

RESULTS OBTAINED AFTER 3 TRIALS: ACCURACY = 0.12690E-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
2	R1	1	304.53	0.02	0.00	0.14	0.00	0.00
4	1	3	304.53	0.04	0.00	0.38	0.05	0.05
6	3	5	284.73	0.06	0.00	0.81	0.30	0.29
8	5	7	284.73	0.11	0.01	0.81	0.30	0.29
10	7	9	139.95	0.02	0.01	0.40	0.12	0.08
12	9	11	106.65	0.01	0.00	0.30	0.07	0.05
14	11	13	73.35	0.01	0.00	0.21	0.03	0.02
16	13	15	40.05	0.00	0.00	0.11	0.01	0.01
18	15	17	6.75	0.00	0.00	0.02	0.00	0.00
20	17	19	-26.55	0.00	0.00	0.08	0.00	0.00
22	19	21	-26.55	0.00	0.00	0.08	0.00	0.00
24	23	7	-144.78	0.01	0.00	0.41	0.08	0.08
26	25	23	-144.78	0.00	0.00	0.41	0.16	0.08
28	27	25	-144.78	0.02	0.00	0.41	0.09	0.08
30	21	27	-144.78	0.01	0.00	0.41	0.10	0.08
32	25	I-BP1	0.00	0.00	0.00	0.00	0.00	0.00
34	O-BP1	29	0.00	0.00	0.00	0.00	0.00	0.00
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	0.00	0.00	0.00	0.00	0.00	0.00
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	0.00	0.00	0.00	0.00	0.00	0.00
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	0.00	0.00	0.00	0.00	0.00	0.00
48	41	43	0.00	0.00	0.00	0.00	0.00	0.00
50	43	45	0.00	0.00	0.00	0.00	0.00	0.00
52	45	47	0.00	0.00	0.00	0.00	0.00	0.00
54	47	O-BP2	0.00	0.00	0.00	0.00	0.00	0.00
56	I-BP2	49	0.00	0.00	0.00	0.00	0.00	0.00
58	51	63	19.80	0.00	0.00	0.06	0.00	0.00
60	51	53	8.97	0.00	0.00	0.03	0.00	0.00
62	55	53	43.23	0.00	0.00	0.12	0.01	0.01
64	55	57	-43.23	0.00	0.00	0.12	0.01	0.01
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	-43.23	0.00	0.00	0.12	0.01	0.01
70	61	21	-118.23	0.01	0.00	0.34	0.06	0.06
72	49	63	-19.80	0.00	0.00	0.06	0.00	0.00
74	51	65	-28.77	0.00	0.00	0.08	0.00	0.00
76	65	67	97.43	0.01	0.00	0.28	0.06	0.04
78	67	69	55.73	0.00	0.00	0.16	0.02	0.01
80	69	71	14.03	0.00	0.00	0.04	0.00	0.00
82	71	73	-27.67	0.00	0.00	0.08	0.00	0.00
84	73	75	-27.67	0.01	0.00	0.18	0.03	0.03
86	75	77	-27.67	0.01	0.00	0.18	0.03	0.03

88	77	79	-27.67	0.01	0.00	0.18	0.03	0.03
90	65	79	-126.20	0.03	0.00	0.36	0.06	0.06
92	79	81	-153.87	0.24	0.01	0.44	0.09	0.09
94	81	R2	-153.87	0.01	0.00	0.11	0.00	0.00

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC- ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	0.00	258.75	244.91	-13.8	75.00	0.	0.0	0.0	292.0
BP2	0.00	263.70	249.91	0.0	75.00	0.	0.0	0.0	296.9

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
1		0.00	304.98	43.00	261.98	113.53
3		19.80(3.00)	304.94	45.00	259.94	112.64
5		0.00	304.88	43.50	261.38	113.27
7		0.00	304.77	44.00	260.77	113.00
9		33.30(3.00)	304.74	45.00	259.74	112.56
11		33.30(3.00)	304.73	45.00	259.73	112.55
13		33.30(3.00)	304.72	45.00	259.72	112.54
15		33.30(3.00)	304.72	45.00	259.72	112.54
17		33.30(3.00)	304.72	45.00	259.72	112.54
19		0.00	304.72	45.00	259.72	112.54
21		0.00	304.72	46.00	258.72	112.11
23		0.00	304.76	46.00	258.76	112.13
25		0.00	304.75	46.00	258.75	112.13
27		0.00	304.73	49.00	255.73	110.82
29		0.00	290.91	43.50	247.41	107.21
31		0.00	290.91	43.50	247.41	107.21
33		0.00	290.91	43.50	247.41	107.21
35		0.00	290.91	43.50	247.41	107.21
37		0.00	290.91	41.50	249.41	108.08
39		0.00	290.91	41.50	249.41	108.08
41		0.00	290.91	40.00	250.91	108.73
43		0.00	290.91	40.00	250.91	108.73
45		0.00	290.91	40.00	250.91	108.73
47		0.00	290.91	41.00	249.91	108.29
49		19.80(3.00)	304.70	41.00	263.70	114.27
51		0.00	304.70	47.00	257.70	111.67
53		52.20(3.00)	304.70	48.00	256.70	111.24
55		0.00	304.71	48.00	256.71	111.24
57		0.00	304.71	48.00	256.71	111.24
59		0.00	304.71	48.00	256.71	111.24
61		75.00(3.00)	304.71	47.00	257.71	111.67
63		0.00	304.70	38.00	266.70	115.57
65		0.00	304.71	42.00	262.71	113.84
67		41.70(3.00)	304.70	46.00	258.70	112.10
69		41.70(3.00)	304.69	50.00	254.69	110.37

71	41.70(3.00)	304.69	44.00	260.69	112.97
73	0.00	304.69	40.00	264.69	114.70
75	0.00	304.71	33.00	271.71	117.74
77	0.00	304.73	37.00	267.73	116.01
79	0.00	304.74	43.00	261.74	113.42
81	0.00	304.99	56.00	248.99	107.89
I-BP1	0.00	304.75	46.00	258.75	112.13
I-BP2	0.00	304.70	41.00	263.70	114.27
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	290.91	46.00	244.91	106.13
O-BP2	0.00	290.91	41.00	249.91	108.29

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
75	117.74	R1	6.50
77	116.01	R2	6.50
63	115.57	O-BP1	106.13
73	114.70	29	107.21
49	114.27	31	107.21

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
6	0.81	18	0.02
8	0.81	60	0.03
92	0.44	80	0.04
24	0.41	58	0.06
26	0.41	72	0.06

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
R1	304.53	
R2	153.87	

NET SYSTEM INFLOW = 458.40
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 458.40

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CASE 4: 4,000 GPM FIRE FLOW SPLIT BETWEEN NODES 35 AND 29

RESULTS OBTAINED AFTER 10 TRIALS: ACCURACY = 0.78724E-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
2	R1	1	2963.71	1.22	0.05	1.35	0.26	0.25
4	1	3	2963.71	2.50	0.07	3.74	3.13	3.05
6	3	5	2950.51	4.25	0.33	8.37	23.49	21.82
8	5	7	2950.51	8.40	0.71	8.37	23.65	21.82
10	7	9	591.24	0.22	0.15	1.68	1.87	1.11
12	9	11	569.04	0.21	0.11	1.61	1.59	1.04
14	11	13	546.84	0.32	0.20	1.55	1.55	0.96
16	13	15	524.64	0.12	0.09	1.49	1.58	0.89
18	15	17	502.44	0.38	0.11	1.43	1.06	0.82
20	17	19	480.24	0.25	0.08	1.36	0.99	0.76
22	19	21	480.24	0.25	0.03	1.36	0.85	0.76
24	23	7	-2359.27	2.19	0.00	6.69	14.42	14.42
26	25	23	-2359.27	0.14	0.21	6.69	35.28	14.42
28	27	25	103.63	0.01	0.00	0.29	0.05	0.04
30	21	27	103.63	0.01	0.00	0.29	0.05	0.04
32	25	I-BP1	2462.90	0.76	6.43	10.06	359.28	37.94
34	O-BP1	29	2462.90	20.68	4.90	10.06	46.93	37.94
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	2462.90	9.67	1.65	10.06	44.41	37.94
40	33	35	2000.00	11.09	6.12	12.76	118.71	76.49
42	33	37	462.90	1.00	0.17	1.89	2.01	1.72
44	37	39	2000.00	4.28	6.12	12.76	185.81	76.49
46	37	41	-1537.10	8.08	2.09	6.28	19.95	15.85
48	41	43	-1537.10	4.75	2.34	6.28	23.64	15.85
50	43	45	-1537.10	2.65	1.66	6.28	25.81	15.85
52	45	47	-1537.10	9.24	2.34	6.28	19.86	15.85
54	47	O-BP2	-1537.10	1.58	1.94	6.28	35.25	15.85
56	I-BP2	49	-1537.10	0.32	0.00	6.28	15.85	15.85
58	51	63	1550.30	5.83	0.09	4.40	6.73	6.62
60	51	53	-291.81	0.11	0.03	0.83	0.37	0.30
62	55	53	326.61	0.07	0.01	0.93	0.43	0.37
64	55	57	-326.61	0.13	0.00	0.93	0.38	0.37
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	-326.61	0.06	0.01	0.93	0.42	0.37
70	61	21	-376.61	0.07	0.01	1.07	0.52	0.48
72	49	63	-1550.30	2.98	0.32	4.40	7.33	6.62
74	51	65	-1258.49	4.05	0.06	3.57	4.57	4.50
76	65	67	-109.10	0.01	0.00	0.31	0.07	0.05
78	67	69	-136.90	0.02	0.01	0.39	0.10	0.07
80	69	71	-164.70	0.06	0.01	0.47	0.12	0.10
82	71	73	-192.50	0.11	0.02	0.55	0.17	0.14
84	73	75	-192.50	0.53	0.07	1.23	1.14	1.00
86	75	77	-192.50	0.53	0.06	1.23	1.12	1.00
88	77	79	-192.50	0.53	0.06	1.23	1.12	1.00

90	65	79	-1149.40	1.98	0.05	3.26	3.90	3.81
92	79	81	-1341.89	13.18	0.56	3.81	5.29	5.07
94	81	R2	-1341.89	0.66	0.00	0.95	0.17	0.17

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC-ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	2462.90	231.75	216.47	-15.3	75.00	-10.	-0.5	-0.5	263.4
BP2	1537.10	233.92	220.07	-13.9	75.00	-5.	-0.3	-0.3	266.5

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
1		0.00	303.73	43.00	260.73	112.98
3		13.20(2.00)	301.16	45.00	256.16	111.00
5		0.00	296.58	43.50	253.08	109.67
7		0.00	287.48	44.00	243.48	105.51
9		22.20(2.00)	287.10	45.00	242.10	104.91
11		22.20(2.00)	286.79	45.00	241.79	104.77
13		22.20(2.00)	286.27	45.00	241.27	104.55
15		22.20(2.00)	286.05	45.00	241.05	104.46
17		22.20(2.00)	285.56	45.00	240.56	104.24
19		0.00	285.23	45.00	240.23	104.10
21		0.00	284.95	46.00	238.95	103.55
23		0.00	285.29	46.00	239.29	103.69
25		0.00	284.93	46.00	238.93	103.54
27		0.00	284.95	49.00	235.95	102.24
29		0.00	236.89	43.50	193.39	83.80
31		0.00	236.89	43.50	193.39	83.80
33		0.00	225.57	43.50	182.07	78.90
35		2000.00	208.35	43.50	164.85	71.44
37		0.00	224.39	41.50	182.89	79.25
39		2000.00	213.99	41.50	172.49	74.74
41		0.00	234.57	40.00	194.57	84.31
43		0.00	241.66	40.00	201.66	87.38
45		0.00	245.97	40.00	205.97	89.25
47		0.00	257.54	41.00	216.54	93.84
49		13.20(2.00)	275.24	41.00	234.24	101.50
51		0.00	284.45	47.00	237.45	102.90
53		34.80(2.00)	284.58	48.00	236.58	102.52
55		0.00	284.67	48.00	236.67	102.56
57		0.00	284.80	48.00	236.80	102.62
59		0.00	284.80	48.00	236.80	102.62
61		50.00(2.00)	284.87	47.00	237.87	103.08
63		0.00	278.53	38.00	240.53	104.23
65		0.00	288.56	42.00	246.56	106.84
67		27.80(2.00)	288.58	46.00	242.58	105.12
69		27.80(2.00)	288.61	50.00	238.61	103.40
71		27.80(2.00)	288.68	44.00	244.68	106.03

73	0.00	288.81	40.00	248.81	107.82
75	0.00	289.41	33.00	256.41	111.11
77	0.00	290.00	37.00	253.00	109.63
79	0.00	290.59	43.00	247.59	107.29
81	0.00	304.34	56.00	248.34	107.61
I-BP1	0.00	277.75	46.00	231.75	100.42
I-BP2	0.00	274.92	41.00	233.92	101.36
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	262.47	46.00	216.47	93.80
O-BP2	0.00	261.07	41.00	220.07	95.36

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
1	112.98	R1	6.50
75	111.11	R2	6.50
3	111.00	35	71.44
5	109.67	39	74.74
77	109.63	33	78.90

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
40	12.76	28	0.29
44	12.76	30	0.29
32	10.06	76	0.31
34	10.06	78	0.39
38	10.06	80	0.47

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
R1	2963.71	
R2	1341.89	

NET SYSTEM INFLOW = 4305.60
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 4305.60

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CASE 5: 4,000 GPM FIRE FLOW SPLIT BETWEEN NODES 41 AND 43

RESULTS OBTAINED AFTER 5 TRIALS: ACCURACY = 0.14561E-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
2	R1	1	2897.71	1.17	0.05	1.32	0.25	0.24
4	1	3	2897.71	2.40	0.06	3.65	3.00	2.93
6	3	5	2884.51	4.08	0.31	8.18	22.52	20.92
8	5	7	2884.51	8.05	0.68	8.18	22.67	20.92
10	7	9	602.23	0.23	0.16	1.71	1.94	1.15
12	9	11	580.03	0.21	0.11	1.65	1.64	1.07
14	11	13	557.83	0.33	0.21	1.58	1.62	1.00
16	13	15	535.63	0.12	0.10	1.52	1.65	0.93
18	15	17	513.43	0.40	0.11	1.46	1.10	0.86
20	17	19	491.23	0.26	0.08	1.39	1.04	0.79
22	19	21	491.23	0.26	0.03	1.39	0.89	0.79
24	23	7	-2282.28	2.06	0.00	6.47	13.56	13.56
26	25	23	-2282.28	0.14	0.20	6.47	33.08	13.56
28	27	25	-412.72	0.14	0.01	1.17	0.60	0.57
30	21	27	-412.72	0.07	0.01	1.17	0.68	0.57
32	25	I-BP1	1869.56	0.46	3.70	7.64	207.94	22.77
34	O-BP1	29	1869.56	12.41	2.83	7.64	27.95	22.77
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	1869.56	5.81	0.95	7.64	26.50	22.77
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	1869.56	13.32	2.78	7.64	27.52	22.77
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	1869.56	11.61	3.10	7.64	28.84	22.77
48	41	43	-130.44	0.05	0.02	0.53	0.22	0.16
50	43	45	-2130.44	4.84	3.20	8.70	48.15	29.00
52	45	47	-2130.44	16.91	4.49	8.70	36.71	29.00
54	47	O-BP2	-2130.44	2.90	3.73	8.70	66.28	29.00
56	I-BP2	49	-2130.44	0.58	0.00	8.70	29.00	29.00
58	51	63	2143.64	10.62	0.17	6.08	12.27	12.07
60	51	53	-819.15	0.72	0.20	2.32	2.60	2.03
62	55	53	853.95	0.44	0.09	2.42	2.62	2.20
64	55	57	-853.95	0.77	0.03	2.42	2.27	2.20
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	-853.95	0.35	0.06	2.42	2.57	2.20
70	61	21	-903.95	0.38	0.03	2.56	2.64	2.44
72	49	63	-2143.64	5.43	0.60	6.08	13.41	12.07
74	51	65	-1324.49	4.45	0.07	3.76	5.02	4.95
76	65	67	-118.36	0.01	0.01	0.34	0.08	0.06
78	67	69	-146.16	0.02	0.01	0.41	0.11	0.08
80	69	71	-173.96	0.07	0.01	0.49	0.14	0.12
82	71	73	-201.76	0.12	0.03	0.57	0.18	0.15
84	73	75	-201.76	0.58	0.08	1.29	1.24	1.09
86	75	77	-201.76	0.58	0.07	1.29	1.23	1.09

88	77	79	-201.76	0.58	0.07	1.29	1.23	1.09
90	65	79	-1206.12	2.16	0.05	3.42	4.27	4.16
92	79	81	-1407.89	14.41	0.62	3.99	5.78	5.54
94	81	R2	-1407.89	0.72	0.00	1.00	0.19	0.19

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC- ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	1869.56	235.65	221.77	-13.9	75.00	-7.	-0.5	-0.9	267.9
BP2	2130.44	224.10	210.10	-14.0	75.00	-8.	-0.3	-0.5	256.1

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
1		0.00	303.78	43.00	260.78	113.01
3		13.20(2.00)	301.32	45.00	256.32	111.07
5		0.00	296.93	43.50	253.43	109.82
7		0.00	288.20	44.00	244.20	105.82
9		22.20(2.00)	287.81	45.00	242.81	105.22
11		22.20(2.00)	287.48	45.00	242.48	105.08
13		22.20(2.00)	286.94	45.00	241.94	104.84
15		22.20(2.00)	286.72	45.00	241.72	104.75
17		22.20(2.00)	286.21	45.00	241.21	104.52
19		0.00	285.87	45.00	240.87	104.38
21		0.00	285.57	46.00	239.57	103.81
23		0.00	286.14	46.00	240.14	104.06
25		0.00	285.81	46.00	239.81	103.92
27		0.00	285.66	49.00	236.66	102.55
29		0.00	252.53	43.50	209.03	90.58
31		0.00	252.53	43.50	209.03	90.58
33		0.00	245.78	43.50	202.28	87.65
35		0.00	245.78	43.50	202.28	87.65
37		0.00	229.68	41.50	188.18	81.54
39		0.00	229.68	41.50	188.18	81.54
41		2000.00	214.97	40.00	174.97	75.82
43		2000.00	215.03	40.00	175.03	75.85
45		0.00	223.07	40.00	183.07	79.33
47		0.00	244.47	41.00	203.47	88.17
49		13.20(2.00)	265.68	41.00	224.68	97.36
51		0.00	282.51	47.00	235.51	102.05
53		34.80(2.00)	283.43	48.00	235.43	102.02
55		0.00	283.96	48.00	235.96	102.25
57		0.00	284.75	48.00	236.75	102.59
59		0.00	284.75	48.00	236.75	102.59
61		50.00(2.00)	285.16	47.00	238.16	103.20
63		0.00	271.71	38.00	233.71	101.28
65		0.00	287.03	42.00	245.03	106.18
67		27.80(2.00)	287.05	46.00	241.05	104.45
69		27.80(2.00)	287.08	50.00	237.08	102.73

71	27.80(2.00)	287.16	44.00	243.16	105.37
73	0.00	287.30	40.00	247.30	107.16
75	0.00	287.96	33.00	254.96	110.48
77	0.00	288.60	37.00	251.60	109.03
79	0.00	289.25	43.00	246.25	106.71
81	0.00	304.28	56.00	248.28	107.59
I-BP1	0.00	281.65	46.00	235.65	102.11
I-BP2	0.00	265.10	41.00	224.10	97.11
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	267.77	46.00	221.77	96.10
O-BP2	0.00	251.10	41.00	210.10	91.04

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
1	113.01	R1	6.50
3	111.07	R2	6.50
75	110.48	41	75.82
5	109.82	43	75.85
77	109.03	45	79.33

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
50	8.70	76	0.34
52	8.70	78	0.41
54	8.70	80	0.49
56	8.70	48	0.53
6	8.18	82	0.57

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
R1	2897.71	
R2	1407.89	

NET SYSTEM INFLOW = 4305.60
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 4305.60

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CASE 6: 4,000 GPM FIRE FLOW SPLIT BETWEEN NODES 45 AND 47

RESULTS OBTAINED AFTER 5 TRIALS: ACCURACY = 0.37895E-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
2	R1	1	2821.78	1.11	0.04	1.28	0.24	0.23
4	1	3	2821.78	2.29	0.06	3.56	2.86	2.79
6	3	5	2808.58	3.88	0.30	7.97	21.43	19.91
8	5	7	2808.58	7.67	0.64	7.97	21.58	19.91
10	7	9	630.87	0.25	0.17	1.79	2.12	1.25
12	9	11	608.67	0.23	0.13	1.73	1.80	1.17
14	11	13	586.47	0.37	0.23	1.66	1.78	1.09
16	13	15	564.27	0.14	0.11	1.60	1.82	1.02
18	15	17	542.07	0.44	0.13	1.54	1.22	0.95
20	17	19	519.87	0.29	0.09	1.47	1.15	0.88
22	19	21	519.87	0.29	0.04	1.47	0.99	0.88
24	23	7	-2177.71	1.89	0.00	6.18	12.43	12.43
26	25	23	-2177.71	0.12	0.18	6.18	30.20	12.43
28	27	25	-744.32	0.42	0.02	2.11	1.79	1.70
30	21	27	-744.32	0.22	0.04	2.11	2.05	1.70
32	25	I-BP1	1433.39	0.28	2.18	5.85	122.77	13.92
34	O-BP1	29	1433.39	7.59	1.66	5.85	16.97	13.92
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	1433.39	3.55	0.56	5.85	16.11	13.92
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	1433.39	8.14	1.63	5.85	16.72	13.92
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	1433.39	7.10	1.82	5.85	17.49	13.92
48	41	43	1433.39	4.18	2.03	5.85	20.70	13.92
50	43	45	1433.39	2.32	1.45	5.85	22.59	13.92
52	45	47	-566.61	1.46	0.32	2.31	3.04	2.50
54	47	O-BP2	-2566.61	4.10	5.41	10.48	95.05	40.95
56	I-BP2	49	-2566.61	0.82	0.00	10.48	40.95	40.95
58	51	63	2579.81	14.97	0.25	7.32	17.30	17.01
60	51	53	-1179.39	1.42	0.42	3.35	5.18	3.99
62	55	53	1214.19	0.84	0.17	3.44	5.08	4.21
64	55	57	-1214.19	1.47	0.06	3.44	4.37	4.21
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	-1214.19	0.67	0.12	3.44	4.96	4.21
70	61	21	-1264.19	0.70	0.06	3.59	4.93	4.54
72	49	63	-2579.81	7.66	0.87	7.32	18.95	17.01
74	51	65	-1400.42	4.94	0.07	3.97	5.57	5.49
76	65	67	-129.02	0.01	0.01	0.37	0.10	0.07
78	67	69	-156.82	0.03	0.01	0.44	0.12	0.10
80	69	71	-184.62	0.08	0.01	0.52	0.15	0.13
82	71	73	-212.42	0.13	0.03	0.60	0.20	0.17
84	73	75	-212.42	0.63	0.09	1.36	1.37	1.20
86	75	77	-212.42	0.63	0.08	1.36	1.35	1.20

88	77	79	-212.42	0.63	0.08	1.36	1.35	1.20
90	65	79	-1271.41	2.39	0.06	3.61	4.70	4.59
92	79	81	-1483.82	15.88	0.69	4.21	6.37	6.11
94	81	R2	-1483.82	0.79	0.01	1.05	0.21	0.21

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC- ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	1433.39	238.37	224.52	-13.8	75.00	-5.	-0.3	-1.3	271.0
BP2	2566.61	214.61	198.76	-15.8	75.00	-10.	-0.4	-0.9	246.1

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
1		0.00	303.84	43.00	260.84	113.03
3		13.20(2.00)	301.50	45.00	256.50	111.15
5		0.00	297.32	43.50	253.82	109.99
7		0.00	289.01	44.00	245.01	106.17
9		22.20(2.00)	288.59	45.00	243.59	105.56
11		22.20(2.00)	288.23	45.00	243.23	105.40
13		22.20(2.00)	287.63	45.00	242.63	105.14
15		22.20(2.00)	287.39	45.00	242.39	105.04
17		22.20(2.00)	286.82	45.00	241.82	104.79
19		0.00	286.44	45.00	241.44	104.6
21		0.00	286.11	46.00	240.11	104.05
23		0.00	287.12	46.00	241.12	104.49
25		0.00	286.82	46.00	240.82	104.36
27		0.00	286.38	49.00	237.38	102.86
29		0.00	261.27	43.50	217.77	94.37
31		0.00	261.27	43.50	217.77	94.37
33		0.00	257.16	43.50	213.66	92.59
35		0.00	257.16	43.50	213.66	92.59
37		0.00	247.38	41.50	205.88	89.22
39		0.00	247.38	41.50	205.88	89.22
41		0.00	238.46	40.00	198.46	86.00
43		0.00	232.25	40.00	192.25	83.31
45		2000.00	228.48	40.00	188.48	81.67
47		2000.00	230.25	41.00	189.25	82.01
49		13.20(2.00)	256.42	41.00	215.42	93.35
51		0.00	280.17	47.00	233.17	101.04
53		34.80(2.00)	282.01	48.00	234.01	101.40
55		0.00	283.03	48.00	235.03	101.85
57		0.00	284.56	48.00	236.56	102.51
59		0.00	284.56	48.00	236.56	102.51
61		50.00(2.00)	285.35	47.00	238.35	103.29
63		0.00	264.95	38.00	226.95	98.35
65		0.00	285.19	42.00	243.19	105.38
67		27.80(2.00)	285.21	46.00	239.21	103.66
69		27.80(2.00)	285.24	50.00	235.24	101.94

71	27.80(2.00)	285.33	44.00	241.33	104.58
73	0.00	285.49	40.00	245.49	106.38
75	0.00	286.21	33.00	253.21	109.72
77	0.00	286.92	37.00	249.92	108.30
79	0.00	287.63	43.00	244.63	106.01
81	0.00	304.20	56.00	248.20	107.55
I-BP1	0.00	284.37	46.00	238.37	103.29
I-BP2	0.00	255.61	41.00	214.61	93.00
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	270.52	46.00	224.52	97.29
O-BP2	0.00	239.76	41.00	198.76	86.13

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
1	113.03	R1	6.50
3	111.15	R2	6.50
5	109.99	45	81.67
75	109.72	47	82.01
77	108.30	43	83.31

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
54	10.48	76	0.37
56	10.48	78	0.44
6	7.97	80	0.52
8	7.97	82	0.60
58	7.32	94	1.05

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
R1	2821.78	
R2	1483.82	

NET SYSTEM INFLOW = 4305.60
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 4305.60

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CASE 7: 3,000 GPM FIRE FLOW SPLIT BETWEEN NODES 11 AND 13

RESULTS OBTAINED AFTER 20 TRIALS: ACCURACY = 0.48902E-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
2	R1	1	2404.79	0.83	0.03	1.09	0.18	0.17
4	1	3	2404.79	1.70	0.04	3.03	2.13	2.07
6	3	5	2391.59	2.88	0.21	6.78	15.88	14.79
8	5	7	2391.59	5.69	0.46	6.78	15.99	14.79
10	7	9	1929.40	1.99	1.61	5.47	18.00	9.93
12	9	11	1907.20	1.94	1.24	5.41	15.90	9.72
14	11	13	385.00	0.17	0.10	1.09	0.80	0.50
16	13	15	-1137.20	0.50	0.44	3.23	6.99	3.73
18	15	17	-1159.40	1.80	0.58	3.29	5.12	3.87
20	17	19	-1181.60	1.32	0.47	3.35	5.44	4.01
22	19	21	-1181.60	1.32	0.19	3.35	4.59	4.01
24	23	7	-462.19	0.11	0.00	1.31	0.70	0.70
26	25	23	-462.19	0.01	0.01	1.31	1.50	0.70
28	27	25	-462.19	0.17	0.01	1.31	0.74	0.70
30	21	27	-462.19	0.09	0.02	1.31	0.84	0.70
32	25	I-BP1	0.00	0.00	0.00	0.00	0.00	0.00
34	O-BP1	29	0.00	0.00	0.00	0.00	0.00	0.00
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	0.00	0.00	0.00	0.00	0.00	0.00
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	0.00	0.00	0.00	0.00	0.00	0.00
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	0.00	0.00	0.00	0.00	0.00	0.00
48	41	43	0.00	0.00	0.00	0.00	0.00	0.00
50	43	45	0.00	0.00	0.00	0.00	0.00	0.00
52	45	47	0.00	0.00	0.00	0.00	0.00	0.00
54	47	O-BP2	0.00	0.00	0.00	0.00	0.00	0.00
56	I-BP2	49	0.00	0.00	0.00	0.00	0.00	0.00
58	51	63	13.20	0.00	0.00	0.04	0.00	0.00
60	51	53	804.21	0.70	0.20	2.28	2.52	1.96
62	55	53	-769.41	0.36	0.07	2.18	2.16	1.81
64	55	57	769.41	0.63	0.02	2.18	1.87	1.81
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	769.41	0.29	0.05	2.18	2.11	1.81
70	61	21	719.41	0.25	0.02	2.04	1.72	1.60
72	49	63	-13.20	0.00	0.00	0.04	0.00	0.00
74	51	65	-817.41	1.82	0.03	2.32	2.05	2.02
76	65	67	-46.97	0.00	0.00	0.13	0.01	0.01
78	67	69	-74.77	0.01	0.00	0.21	0.03	0.02
80	69	71	-102.57	0.03	0.00	0.29	0.05	0.04
82	71	73	-130.37	0.05	0.01	0.37	0.08	0.07
84	73	75	-130.37	0.26	0.03	0.83	0.55	0.49
86	75	77	-130.37	0.26	0.03	0.83	0.54	0.49

88	77	79	-130.37	0.26	0.03	0.83	0.54	0.49
90	65	79	-770.43	0.94	0.02	2.19	1.86	1.81
92	79	81	-900.81	6.30	0.25	2.56	2.52	2.42
94	81	R2	-900.81	0.31	0.00	0.64	0.08	0.08

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC-ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	0.00	247.02	235.47	0.0	75.00	0.	-0.2	-1.	280.2
BP2	0.00	254.31	240.47	-13.8	75.00	0.	-0.5	-1.4	287.5

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
1		0.00	304.14	43.00	261.14	113.16
3		13.20(2.00)	302.40	45.00	257.40	111.54
5		0.00	299.30	43.50	255.80	110.85
7		0.00	293.14	44.00	249.14	107.96
9		22.20(2.00)	289.54	45.00	244.54	105.97
11		1522.20(**)	286.36	45.00	241.36	104.59
13		1522.20(**)	286.10	45.00	241.10	104.47
15		22.20(2.00)	287.04	45.00	242.04	104.88
17		22.20(2.00)	289.42	45.00	244.42	105.92
19		0.00	291.22	45.00	246.22	106.69
21		0.00	292.73	46.00	246.73	106.92
23		0.00	293.04	46.00	247.04	107.05
25		0.00	293.02	46.00	247.02	107.04
27		0.00	292.84	49.00	243.84	105.66
29		0.00	281.47	43.50	237.97	103.12
31		0.00	281.47	43.50	237.97	103.12
33		0.00	281.47	43.50	237.97	103.12
35		0.00	281.47	43.50	237.97	103.12
37		0.00	281.47	41.50	239.97	103.99
39		0.00	281.47	41.50	239.97	103.99
41		0.00	281.47	40.00	241.47	104.64
43		0.00	281.47	40.00	241.47	104.64
45		0.00	281.47	40.00	241.47	104.64
47		0.00	281.47	41.00	240.47	104.20
49		13.20(2.00)	295.31	41.00	254.31	110.20
51		0.00	295.32	47.00	248.32	107.60
53		34.80(2.00)	294.42	48.00	246.42	106.78
55		0.00	293.99	48.00	245.99	106.60
57		0.00	293.33	48.00	245.33	106.31
59		0.00	293.33	48.00	245.33	106.31
61		50.00(2.00)	293.00	47.00	246.00	106.60
63		0.00	295.31	38.00	257.31	111.50
65		0.00	297.16	42.00	255.16	110.57
67		27.80(2.00)	297.17	46.00	251.17	108.84
69		27.80(2.00)	297.17	50.00	247.17	107.11

71	27.80(2.00)	297.20	44.00	253.20	109.72
73	0.00	297.27	40.00	257.27	111.48
75	0.00	297.56	33.00	264.56	114.64
77	0.00	297.84	37.00	260.84	113.03
79	0.00	298.13	43.00	255.13	110.56
81	0.00	304.68	56.00	248.68	107.76
I-BP1	0.00	293.02	46.00	247.02	107.04
I-BP2	0.00	295.31	41.00	254.31	110.20
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	281.47	46.00	235.47	102.04
O-BP2	0.00	281.47	41.00	240.47	104.20

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
75	114.64	R1	6.50
1	113.16	R2	6.50
77	113.03	O-BP1	102.04
3	111.54	29	103.12
63	111.50	31	103.12

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
6	6.78	58	0.04
8	6.78	72	0.04
10	5.47	76	0.13
12	5.41	78	0.21
20	3.35	80	0.29

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
R1	2404.79	
R2	900.81	

NET SYSTEM INFLOW = 3305.60
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 3305.60

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CASE 8: 3,000 GPM FIRE FLOS SPLIT BETWEEN NODES 17 AND 19

RESULTS OBTAINED AFTER 4 TRIALS: ACCURACY = 0.51784E-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
2	R1	1	2346.94	0.79	0.03	1.07	0.17	0.16
4	1	3	2346.94	1.63	0.04	2.96	2.03	1.98
6	3	5	2333.74	2.76	0.20	6.62	15.18	14.13
8	5	7	2333.74	5.44	0.44	6.62	15.28	14.13
10	7	9	1113.59	0.72	0.54	3.16	6.28	3.59
12	9	11	1091.39	0.69	0.40	3.10	5.48	3.46
14	11	13	1069.19	1.12	0.76	3.03	5.60	3.33
16	13	15	1046.99	0.43	0.37	2.97	5.96	3.20
18	15	17	1024.79	1.43	0.46	2.91	4.06	3.08
20	17	19	-497.41	0.27	0.08	1.41	1.06	0.81
22	19	21	-1997.41	3.50	0.55	5.67	12.25	10.59
24	23	7	-1220.15	0.65	0.00	3.46	4.25	4.25
26	25	23	-1220.15	0.04	0.06	3.46	9.83	4.25
28	27	25	-1220.15	1.05	0.06	3.46	4.48	4.25
30	21	27	-1220.15	0.55	0.12	3.46	5.19	4.25
32	25	I-BP1	0.00	0.00	0.00	0.00	0.00	0.00
34	O-BP1	29	0.00	0.00	0.00	0.00	0.00	0.00
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	0.00	0.00	0.00	0.00	0.00	0.00
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	0.00	0.00	0.00	0.00	0.00	0.00
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	0.00	0.00	0.00	0.00	0.00	0.00
48	41	43	0.00	0.00	0.00	0.00	0.00	0.00
50	43	45	0.00	0.00	0.00	0.00	0.00	0.00
52	45	47	0.00	0.00	0.00	0.00	0.00	0.00
54	47	O-BP2	0.00	0.00	0.00	0.00	0.00	0.00
56	I-BP2	49	0.00	0.00	0.00	0.00	0.00	0.00
58	51	63	13.20	0.00	0.00	0.04	0.00	0.00
60	51	53	862.06	0.79	0.22	2.45	2.87	2.23
62	55	53	-827.26	0.41	0.08	2.35	2.47	2.07
64	55	57	827.26	0.72	0.03	2.35	2.14	2.07
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	827.26	0.33	0.06	2.35	2.42	2.07
70	61	21	777.26	0.29	0.02	2.20	1.99	1.84
72	49	63	-13.20	0.00	0.00	0.04	0.00	0.00
74	51	65	-875.26	2.07	0.03	2.48	2.33	2.30
76	65	67	-55.15	0.00	0.00	0.16	0.02	0.01
78	67	69	-82.95	0.01	0.00	0.24	0.04	0.03
80	69	71	-110.75	0.03	0.00	0.31	0.06	0.05
82	71	73	-138.55	0.06	0.01	0.39	0.09	0.08
84	73	75	-138.55	0.29	0.04	0.88	0.62	0.54
86	75	77	-138.55	0.29	0.03	0.88	0.61	0.54

88	77	79	-138.55	0.29	0.03	0.88	0.61	0.54
90	65	79	-820.11	1.06	0.03	2.33	2.09	2.04
92	79	81	-958.66	7.07	0.29	2.72	2.83	2.72
94	81	R2	-958.66	0.35	0.00	0.68	0.09	0.09

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC-ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	0.00	246.93	234.26	0.0	75.00	0.	0.0	-1.5	280.1
BP2	0.00	253.10	239.26	-13.8	75.00	0.	0.0	-1.	286.3

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
1		0.00	304.18	43.00	261.18	113.18
3		13.20(2.00)	302.51	45.00	257.51	111.59
5		0.00	299.55	43.50	256.05	110.96
7		0.00	293.67	44.00	249.67	108.19
9		22.20(2.00)	292.42	45.00	247.42	107.21
11		22.20(2.00)	291.32	45.00	246.32	106.74
13		22.20(2.00)	289.44	45.00	244.44	105.93
15		22.20(2.00)	288.64	45.00	243.64	105.58
17		1522.20(**)	286.75	45.00	241.75	104.76
19		1500.00	287.10	45.00	242.10	104.91
21		0.00	291.15	46.00	245.15	106.23
23		0.00	293.02	46.00	247.02	107.04
25		0.00	292.93	46.00	246.93	107.00
27		0.00	291.82	49.00	242.82	105.22
29		0.00	280.26	43.50	236.76	102.59
31		0.00	280.26	43.50	236.76	102.59
33		0.00	280.26	43.50	236.76	102.59
35		0.00	280.26	43.50	236.76	102.59
37		0.00	280.26	41.50	238.76	103.46
39		0.00	280.26	41.50	238.76	103.46
41		0.00	280.26	40.00	240.26	104.11
43		0.00	280.26	40.00	240.26	104.11
45		0.00	280.26	40.00	240.26	104.11
47		0.00	280.26	41.00	239.26	103.68
49		13.20(2.00)	294.10	41.00	253.10	109.68
51		0.00	294.10	47.00	247.10	107.08
53		34.80(2.00)	293.09	48.00	245.09	106.20
55		0.00	292.59	48.00	244.59	105.99
57		0.00	291.84	48.00	243.84	105.66
59		0.00	291.84	48.00	243.84	105.66
61		50.00(2.00)	291.46	47.00	244.46	105.93
63		0.00	294.10	38.00	256.10	110.98
65		0.00	296.20	42.00	254.20	110.15
67		27.80(2.00)	296.21	46.00	250.21	108.42
69		27.80(2.00)	296.22	50.00	246.22	106.69

71	27.80(2.00)	296.25	44.00	252.25	109.31
73	0.00	296.32	40.00	256.32	111.07
75	0.00	296.65	33.00	263.65	114.25
77	0.00	296.97	37.00	259.97	112.65
79	0.00	297.29	43.00	254.29	110.19
81	0.00	304.64	56.00	248.64	107.75
I-BP1	0.00	292.93	46.00	246.93	107.00
I-BP2	0.00	294.10	41.00	253.10	109.68
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	280.26	46.00	234.26	101.51
O-BP2	0.00	280.26	41.00	239.26	103.68

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

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
75	114.25	R1	6.50
1	113.18	R2	6.50
77	112.65	O-BP1	101.51
3	111.59	29	102.59
73	111.07	31	102.59

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
6	6.62	58	0.04
8	6.62	72	0.04
22	5.67	76	0.16
24	3.46	78	0.24
26	3.46	80	0.31

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
R1	2346.94	
R2	958.66	

NET SYSTEM INFLOW = 3305.60
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 3305.60
==========

CASE 9: 3,000 GPM FIRE FLOW SPLIT BETWEEN NODES 69 AND 71

RESULTS OBTAINED AFTER 20 TRIALS: ACCURACY = 0.29773E-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
2	R1	1	1674.84	0.42	0.02	0.76	0.09	0.09
4	1	3	1674.84	0.87	0.02	2.11	1.09	1.06
6	3	5	1661.64	1.47	0.10	4.71	8.06	7.53
8	5	7	1661.64	2.90	0.22	4.71	8.11	7.53
10	7	9	546.41	0.19	0.13	1.55	1.61	0.96
12	9	11	524.21	0.18	0.09	1.49	1.36	0.89
14	11	13	502.01	0.27	0.17	1.42	1.32	0.82
16	13	15	479.81	0.10	0.08	1.36	1.33	0.75
18	15	17	457.61	0.32	0.09	1.30	0.89	0.69
20	17	19	435.41	0.21	0.06	1.24	0.83	0.63
22	19	21	435.41	0.21	0.03	1.24	0.71	0.63
24	23	7	-1115.23	0.55	0.00	3.16	3.60	3.60
26	25	23	-1115.23	0.04	0.05	3.16	8.26	3.60
28	27	25	-1115.23	0.89	0.05	3.16	3.79	3.60
30	21	27	-1115.23	0.46	0.10	3.16	4.38	3.60
32	25	I-BP1	0.00	0.00	0.00	0.00	0.00	0.00
34	O-BP1	29	0.00	0.00	0.00	0.00	0.00	0.00
36	29	31	0.00	0.00	0.00	0.00	0.00	0.00
38	29	33	0.00	0.00	0.00	0.00	0.00	0.00
40	33	35	0.00	0.00	0.00	0.00	0.00	0.00
42	33	37	0.00	0.00	0.00	0.00	0.00	0.00
44	37	39	0.00	0.00	0.00	0.00	0.00	0.00
46	37	41	0.00	0.00	0.00	0.00	0.00	0.00
48	41	43	0.00	0.00	0.00	0.00	0.00	0.00
50	43	45	0.00	0.00	0.00	0.00	0.00	0.00
52	45	47	0.00	0.00	0.00	0.00	0.00	0.00
54	47	O-BP2	0.00	0.00	0.00	0.00	0.00	0.00
56	I-BP2	49	0.00	0.00	0.00	0.00	0.00	0.00
58	51	63	13.20	0.00	0.00	0.04	0.00	0.00
60	51	53	-1465.84	2.12	0.65	4.16	7.80	5.97
62	55	53	1500.64	1.25	0.26	4.26	7.56	6.24
64	55	57	-1500.64	2.18	0.08	4.26	6.48	6.24
66	57	59	0.00	0.00	0.00	0.00	0.00	0.00
68	57	61	-1500.64	1.00	0.18	4.26	7.38	6.24
70	61	21	-1550.64	1.03	0.09	4.40	7.21	6.63
72	49	63	-13.20	0.00	0.00	0.04	0.00	0.00
74	51	65	1452.64	5.29	0.08	4.12	5.96	5.87
76	65	67	2488.87	3.18	2.45	7.06	28.18	15.92
78	67	69	2461.07	4.57	2.06	6.98	22.62	15.59
80	69	71	933.27	1.51	0.33	2.65	3.16	2.59
82	71	73	-594.53	0.88	0.22	1.69	1.40	1.12
84	73	75	-594.53	4.26	0.69	3.79	9.39	8.09
86	75	77	-594.53	4.26	0.61	3.79	9.24	8.09
88	77	79	-594.53	4.26	0.61	3.79	9.24	8.09

90	65	79	-1036.22	1.63	0.04	2.94	3.22	3.14
92	79	81	-1630.76	18.92	0.83	4.63	7.59	7.28
94	81	R2	-1630.76	0.95	0.01	1.16	0.25	0.25

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC-ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	NPSH Avail. ft
BP1	0.00	252.34	238.50	-13.8	75.00	0.	0.0	-1.5	285.5
BP2	0.00	246.99	243.50	0.0	75.00	0.	0.0	-1.	280.2

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
1		0.00	304.56	43.00	261.56	113.34
3		13.20(2.00)	303.67	45.00	258.67	112.09
5		0.00	302.10	43.50	258.60	112.06
7		0.00	298.97	44.00	254.97	110.49
9		22.20(2.00)	298.65	45.00	253.65	109.92
11		22.20(2.00)	298.38	45.00	253.38	109.80
13		22.20(2.00)	297.94	45.00	252.94	109.61
15		22.20(2.00)	297.76	45.00	252.76	109.53
17		22.20(2.00)	297.35	45.00	252.35	109.35
19		0.00	297.07	45.00	252.07	109.23
21		0.00	296.84	46.00	250.84	108.70
23		0.00	298.43	46.00	252.43	109.38
25		0.00	298.34	46.00	252.34	109.35
27		0.00	297.40	49.00	248.40	107.64
29		0.00	284.50	43.50	241.00	104.43
31		0.00	284.50	43.50	241.00	104.43
33		0.00	284.50	43.50	241.00	104.43
35		0.00	284.50	43.50	241.00	104.43
37		0.00	284.50	41.50	243.00	105.30
39		0.00	284.50	41.50	243.00	105.30
41		0.00	284.50	40.00	244.50	105.95
43		0.00	284.50	40.00	244.50	105.95
45		0.00	284.50	40.00	244.50	105.95
47		0.00	284.50	41.00	243.50	105.52
49		13.20(2.00)	287.99	41.00	246.99	107.03
51		0.00	287.99	47.00	240.99	104.43
53		34.80(2.00)	290.76	48.00	242.76	105.20
55		0.00	292.27	48.00	244.27	105.85
57		0.00	294.54	48.00	246.54	106.83
59		0.00	294.54	48.00	246.54	106.83
61		50.00(2.00)	295.72	47.00	248.72	107.78
63		0.00	287.99	38.00	249.99	108.33
65		0.00	282.63	42.00	240.63	104.27
67		27.80(2.00)	276.99	46.00	230.99	100.10
69		1527.80(**)	270.36	50.00	220.36	95.49
71		1527.80(**)	268.52	44.00	224.52	97.29

73	0.00	269.61	40.00	229.61	99.50
75	0.00	274.56	33.00	241.56	104.68
77	0.00	279.43	37.00	242.43	105.05
79	0.00	284.30	43.00	241.30	104.56
81	0.00	304.05	56.00	248.05	107.49
I-BP1	0.00	298.34	46.00	252.34	109.35
I-BP2	0.00	287.99	41.00	246.99	107.03
R1	----	305.00	290.00	15.00	6.50
R2	----	305.00	290.00	15.00	6.50
O-BP1	0.00	284.50	46.00	238.50	103.35
O-BP2	0.00	284.50	41.00	243.50	105.52

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
1	113.34	R1	6.50
3	112.09	R2	6.50
5	112.06	69	95.49
7	110.49	71	97.29
9	109.92	73	99.50

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
76	7.06	58	0.04
78	6.98	72	0.04
6	4.71	2	0.76
8	4.71	94	1.16
92	4.63	20	1.24

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
R1	1674.84	
R2	1630.76	

NET SYSTEM INFLOW = 3305.60
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 3305.60

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

EXHIBIT A

NODE AND PIPE DIAGRAM

LEGEND

EXISTING PUBLIC WATER SYSTEM

PROPOSED PUBLIC WATER SYSTEM

PROPOSED PRIVATE FIRE PROTECTION SYST

PROPOSED PRIVATE FIRE HYDRANT

1 COMPUTER MODEL NODE NUMBER

4 COMPUTER MODEL PIPE NUMBER

LOT 1

LOT 2

LOT 3

LOT 4

LOT 5

LOT 6

LOT 7

LOT 8

LOT 9

LOT A

LOT B

LOT C

LOT D

LOT E

LOT F

LOT G

SAN LUIS REY RIVER

SAN LUIS REY RIVER

FOUSSAT RD

FOUSSAT RD

HERITAGE ST

FIRESIDE ST

MISSION AVE

HIGHWAY 76

HIGHWAY 76

N

0 300 FEET

EXHIBIT A

NODE AND PIPE DIAGRAM

OCEAN KAMP

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