April 20, 2007

FILED

APR 19 2007

Missouri Public Service Commission

The Honorable Colleen M. Dale
Secretary/Chief Regulatory Law Judge
Missouri Public Service Commission
P. O. Box 360
Jefferson City, MO. 65102-0360

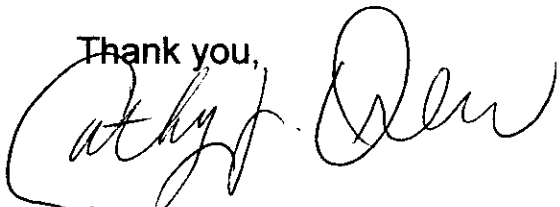
Re: Case Nos. WC-2006-0082, et al.; WO-2007-0277

The Honorable Judge Dale:

Please find enclosed, for filing, "Cathy Orler's Response to the Commission's Order Requiring Late-Filed Exhibit." Five, (5) additional copies are also included to be distributed to the appropriate Commission personnel, if you would be so kind as to bring this filing to their attention.

Please contact me, if you should have any questions regarding these filings.

Thank you,



Cathy J. Orler
3252 Big Island Drive
Roach, MO. 65787
(573)317-1490

BEFORE THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

Cathy J. Orler, Complainant,	)	
v.	)	Case No. WC-2006-0082, et al.
Folsom Ridge, LLC, (Owning and Controlling the Big Island Homeowners' Association), Respondents.	)	
In the Matter of the Application of Folsom Ridge, LLC., and Big Island Homeowners' Water and Sewer Association, Inc., for an Order Authorizing the Transfer and Assignment of Certain Water and Sewer Assets to Big Island Water Company and Big Island Sewer Company, and in Connection Therewith Certain Other Related Transactions	)	Case No. WO-2007-0277

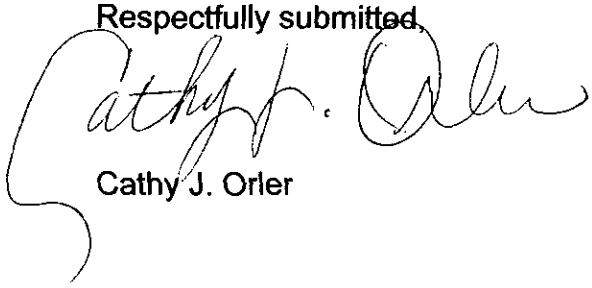
CATHY ORLER'S RESPONSE TO THE COMMISSION'S ORDER REQUIRING LATE-FILED EXHIBIT

COMES NOW, Cathy J. Orler, on her own behalf, and pursuant to the Commission's Order issued on April 13, 2007, Ms. Orler submits to the Commission, late-filed exhibit no. 110.

1. Exhibit no. 110 is being submitted in its complete and authenticated form.

Wherefore, Ms. Orler submits to the Commission, late-filed exhibit no. 110, in its complete and authenticated form, in response to the Commission's Order.

Respectfully submitted,



Cathy J. Orler

STATE OF MISSOURI)
)
COUNTY OF COLE)

AFFIDAVIT

Before me, the undersigned authority, personally appeared Ellen Harrel, who, being by me duly sworn, states as follows:

1. My name is Ellen Harrel, I am of sound mind, capable of making this affidavit, and personally acquainted with the facts herein stated.

2. I am the custodian of records for the Water Protection Program of the Missouri Department of Natural Resources (MDNR). Attached hereto are 50 pages of records from the files regarding Big Island Subdivision. These 50 pages of records are kept by MDNR in the regular course of business, and it was the regular course of business for an employee or representative of MDNR with knowledge of the act, event, condition, opinion, or diagnosis recorded to make the record or to transmit information thereof to be included in such record; and the record was made at or near the time of the act, event, condition, opinion or diagnosis. The records attached hereto are exact duplicates of the original.

Ellen Harrel

Ellen Harrel
Custodian of Records
Water Protection Program
Missouri Department of Natural Resources

In witness whereof I have hereunto subscribed my name and affixed my official seal this 13th day of April, 2007

Kay A. Johannpeter

Notary Signature

KAY A. JOHANNPETER
Notary Public - Notary Seal
STATE OF MISSOURI
Moniteau County
My Commission Expires: Aug. 4, 2007

KAY A. JOHANNPETER NOTARY PUBLIC STATE OF MISSOURI SEAL

May 10, 2004

Breck Summerford, P.E.
Section Chief
Infrastructure Permits & Engineering Section
P.O. Box 176 (65102)
101 Adams Street, 3rd Floor
Jefferson City, MO 65101

Re: Camden County
Big Island Subdivision
Permit No. MO 3031265
Settlement agreement

Dear Mr. Summerford;

Enclosed please find plans and specifications submitted in regard to the above referenced.

These plans and specifications are being submitted for a relocation and replacement project necessitated to bring the distribution system into compliance with Department regulations regarding separation of water and sewer lines. Also enclosed with this submittal is an engineering report and an Application for a Construction Permit.

You will note that our relocation routing takes advantage of the roadways that will be constructed in the inner portion of the project.

We will be submitting documents in the near future for a waterline extension and a storage facility upgrade to serve additional parcels.

If you have any questions or comments, please don't hesitate to contact me at (573) 346-5316.

Respectfully submitted,

David Krehbiel

David Krehbiel, P.E., P.L.S.

C: Mr. Reggie Golden (without plans)
Mr. Charles McElyea (without plans)
Mr. Kevin Mohammadi
Ms. Cynthia Davies

KREHBIEL ENGINEERING, INC.
63 BLAIR AVENUE POST OFFICE BOX 587 CAMDENTON MISSOURI 65020
573-346-5315 FAX 573-346-3851 info@krehbielengineering.com www.krehbielengineering.com

ENGINEERING REPORT AND TECHNICAL SPECIFICATIONS FOR WATER SYSTEM IMPROVEMENTS AT BIG ISLAND CAMDEN COUNTY, MISSOURI

May 2004

Prepared For:

Folsom Ridge, LLC
c/o Reggie Golden
P.O. Box 54
2602 Clover Basin Drive, Suite B
Longmont, CO 80501
(303) 702-0708

000008

ENGINEERING REPORT AND TECHNICAL SPECIFICATIONS FOR WATER SYSTEM IMPROVEMENTS AT BIG ISLAND CAMDEN COUNTY, MISSOURI

May 2004

Prepared For:

Folsom Ridge, LLC
c/o Reggie Golden
P.O. Box 54
2602 Clover Basin Drive, Suite B
Longmont, CO 80501
(303) 702-0708

Prepared By:

Krehbiel Engineering, Inc.
63 Blair Ave.
Camdenton, MO 65020
(573) 346-5316

Table of Contents

ENGINEERING REPORT

TECHNICAL SPECIFICATIONS

ENGINEERING REPORT
FOR
WATER LINE IMPROVEMENTS
AT BIG ISLAND
CAMDEN COUNTY, MISSOURI

Introduction

The following is an Engineering Report and Technical Specifications for the construction of water line replacement and relocation at Big Island in Camden County, Missouri. This report along with plans and specifications has been prepared for Folsom Ridge, LLC. by Krehbiel Engineering, Inc., May, 2004.

Location of Project

The proposed improvements are located in Section 1, Township 38 North, Range 18 West; Section 6, Township 38 North, Range 17 West and Section 31, Township 39 North, Range 17 West, as shown on the attached USGS Location Map. (Exhibit A)

Purpose and Scope of Report

The purpose of this report is to provide information in regard to the replacement and relocation of an existing 4" waterline with new 4" and 2" waterline in order to establish the proper horizontal and vertical separation between waterline and sewerline.

Description of Existing System

Big Island operates their own water supply, storage and distribution system. The supply capacity is from 1 deep well pumping into 4 pressure tanks and 2 ground storage reservoirs. There are no other pumping units required on the system; and, currently, no water treatment is required. The existing distribution system is comprised of 2" service lines and 4" distribution mains.

Proposed Improvements

It is proposed to relocate and construct approximately 11,268 feet of 4" PVC waterline and approximately 2448 feet of 2" PVC waterline with appurtenances.

Population to be Served

The water system will continue to serve existing customers and additional of Big Island, Camden County, Missouri. The system has been modeled on the basis of 300 residential customers.

Design Considerations

Design calculations were completed using WaterCAD software and calculations using Hazen-Wiliams formula with a C coefficient of 150. Design calculations are attached. The layout for the model is in the envelope at the back of this report and before the Technical Specifications (Exhibit B).

Water Supply

Water for the residents of Big Island will be supplied by Big Island's existing water system.

Land Use and Zoning

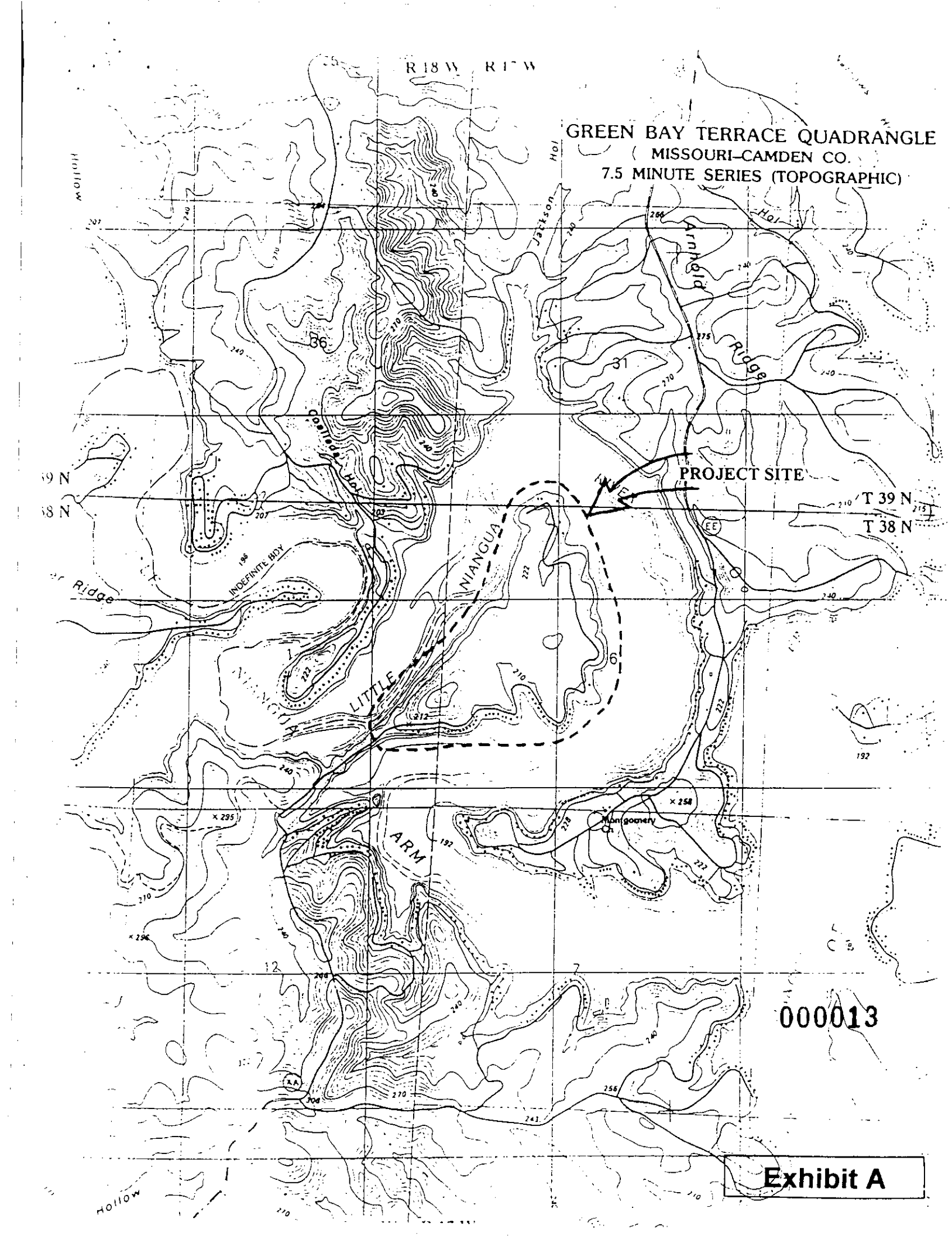
Construction will be completed in accordance with the planning and zoning regulations of Camden County, Missouri.

Party Responsible for System

Upon completion of construction, these improvements will remain a part of the Big Island Subdivision water system.

David Krehbiel, P.E. 11594

000012


GREEN BAY TERRACE QUADRANGLE
MISSOURI–CAMDEN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
PROJECT SITE
T 39 N
T 38 N
R 18 W
R 17 W
Arnhold Ridge
Jackson Hollow
Coalfield Hollow
INDEFINITE BDY
NIANGUA
LITTLE NIANGUA
ARM
Montgomery
000013
Exhibit A

Project Inventory

Title: 918 BIG ISLAND WATERLINE RELOCATION/REPLACEMENT
Project Engineer: DAVID KREHBIEL
Project Date: 04/30/04
Comments:

Scenario Summary	
Label	277.5
Physical Alternative	Base-Physical
Demand Alternative	Demand-Scenario 3
Initial Settings Alternative	Base-Initial Settings
Operational Alternative	Base-Operational
Age Alternative	Base-Age Alternative
Constituent Alternative	Base-Constituent
Trace Alternative	Base-Trace Alternative
Fire Flow Alternative	Base-Fire Flow
Cost Alternative	Base-Cost
User Data Alternative	Base-User Data

Liquid Characteristics			
Liquid	Water at 20C(68F)	Specific Gravity	1.00
Kinematic Viscosity	1.0804e-5 ft²/s		

Network Inventory			
Pressure Pipes	91	Number of Tanks	2
Number of Reservoirs	1	- Constant Area:	2
Number of Pressure Junctic	83	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	2	- PBV's:	0
- Standard (3 Point):	0	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	Number of Spot Elevations	0

Pressure Pipes Inventory			
2.0 in	1,614.00 ft	6.0 in	750.00 ft
4.0 in	19,333.00 ft		
Total Length	21,697.00 ft		

NOTES:
DESIGN DEMAND IS FOR 300 HOMES WITH 3.7 PEOPLE @ 75 GPD = 277.5 GPD.
DAILY PEAKS ARE IN ACCORDANCE WITH THE HOUSE STEPWISE PATTERN.
DESIGN MAXIMUM DAY'S DEMAND IS AT 150% DESIGN DAY DEMAND

000011

DESIGN AVERAGE DAY DEMAND MODEL

Exhibit B

Scenario: 277.5
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Demand (gpm)	Pattern	Demand Calculated (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-76	795.00	Zone-1	Demand	0.00	house	0.00	899.40	45.15
J-9	788.00	Zone-1	Demand	1.54	house	1.54	900.05	48.46
J-13	785.00	Zone-1	Demand	0.00	Fixed	0.00	900.03	49.74
J-63	782.00	Zone-1	Demand	2.70	house	2.70	900.04	51.04
J-25	780.00	Zone-1	Demand	0.00	Fixed	0.00	900.25	52.00
J-64	770.00	Zone-1	Demand	1.16	house	1.16	900.03	56.23
J-11	770.00	Zone-1	Demand	0.39	house	0.39	900.04	56.23
J-4	767.00	Zone-1	Demand	0.00	Fixed	0.00	899.40	57.26
J-74	764.00	Zone-1	Demand	0.58	house	0.58	899.43	58.57
J-75	762.00	Zone-1	Demand	0.58	house	0.58	899.39	59.41
J-10	762.00	Zone-1	Demand	0.00	Fixed	0.00	900.02	59.68
J-80	757.00	Zone-1	Demand	1.16	house	1.16	899.39	61.57
J-21	756.00	Zone-1	Demand	0.00	Fixed	0.00	899.35	61.99
J-73	754.00	Zone-1	Demand	0.58	house	0.58	899.45	62.90
J-5	753.00	Zone-1	Demand	0.00	Fixed	0.00	899.39	63.30
J-65	752.00	Zone-1	Demand	1.16	house	1.16	900.03	64.01
J-72	751.00	Zone-1	Demand	0.58	house	0.58	899.50	64.22
J-71	750.00	Zone-1	Demand	0.97	house	0.96	899.55	64.67
J-69	750.00	Zone-1	Demand	0.58	house	0.58	899.81	64.78
J-78	746.00	Zone-1	Demand	0.77	house	0.77	899.29	66.29
J-45	745.00	Zone-1	Demand	0.77	house	0.77	899.29	66.72
J-44	745.00	Zone-1	Demand	1.16	house	1.16	899.29	66.72
J-70	745.00	Zone-1	Demand	1.74	house	1.74	899.64	66.87
J-66	745.00	Zone-1	Demand	0.77	house	0.77	900.02	67.04
J-17	743.00	Zone-1	Demand	0.00	Fixed	0.00	900.02	67.90
J-46	742.00	Zone-1	Demand	0.77	house	0.77	899.29	68.02
J-68	742.00	Zone-1	Demand	0.77	house	0.77	900.02	68.33
J-79	741.00	Zone-1	Demand	0.77	house	0.77	899.29	68.45
J-3	740.00	Zone-1	Demand	0.00	Fixed	0.00	899.42	68.94
J-15	740.00	Zone-1	Demand	0.39	house	0.39	900.02	69.20
J-81	738.00	Zone-1	Demand	0.19	house	0.19	899.40	69.80
J-43	732.00	Zone-1	Demand	0.77	house	0.77	899.29	72.34
J-23	730.00	Zone-1	Demand	1.35	house	1.35	899.35	73.23
J-47	727.00	Zone-1	Demand	0.77	house	0.77	899.29	74.50
J-26	722.00	Zone-1	Demand	0.77	house	0.77	900.00	76.97
J-48	721.00	Zone-1	Demand	0.77	house	0.77	899.29	77.10
J-28	720.00	Zone-1	Demand	0.77	house	0.77	900.00	77.84
J-42	718.00	Zone-1	Demand	0.77	house	0.77	899.29	78.40
J-49	717.00	Zone-1	Demand	0.77	house	0.77	899.29	78.83
J-50	715.00	Zone-1	Demand	1.16	house	1.16	899.29	79.69
J-83	713.00	Zone-1	Demand	1.35	house	1.35	899.35	80.58
J-51	712.00	Zone-1	Demand	0.77	house	0.77	899.29	80.99
J-1	710.00	Zone-1	Demand	0.39	house	0.39	900.00	82.16
J-12	710.00	Zone-1	Demand	0.77	house	0.77	900.04	82.18
J-67	709.00	Zone-1	Demand	0.77	house	0.77	900.02	82.60
J-40	708.00	Zone-1	Demand	0.39	house	0.39	899.30	82.73
J-30	708.00	Zone-1	Demand	0.77	house	0.77	900.00	83.03
J-8	708.00	Zone-1	Demand	0.00	Fixed	0.00	900.02	83.03
J-14	708.00	Zone-1	Demand	0.39	house	0.39	900.03	83.04
J-53	705.00	Zone-1	Demand	1.54	house	1.54	899.29	84.02
J-39	705.00	Zone-1	Demand	0.39	house	0.39	899.32	84.03

← MINIMUM PRESSURE AT AVERAGE DAY DEMAND (DESIGN)

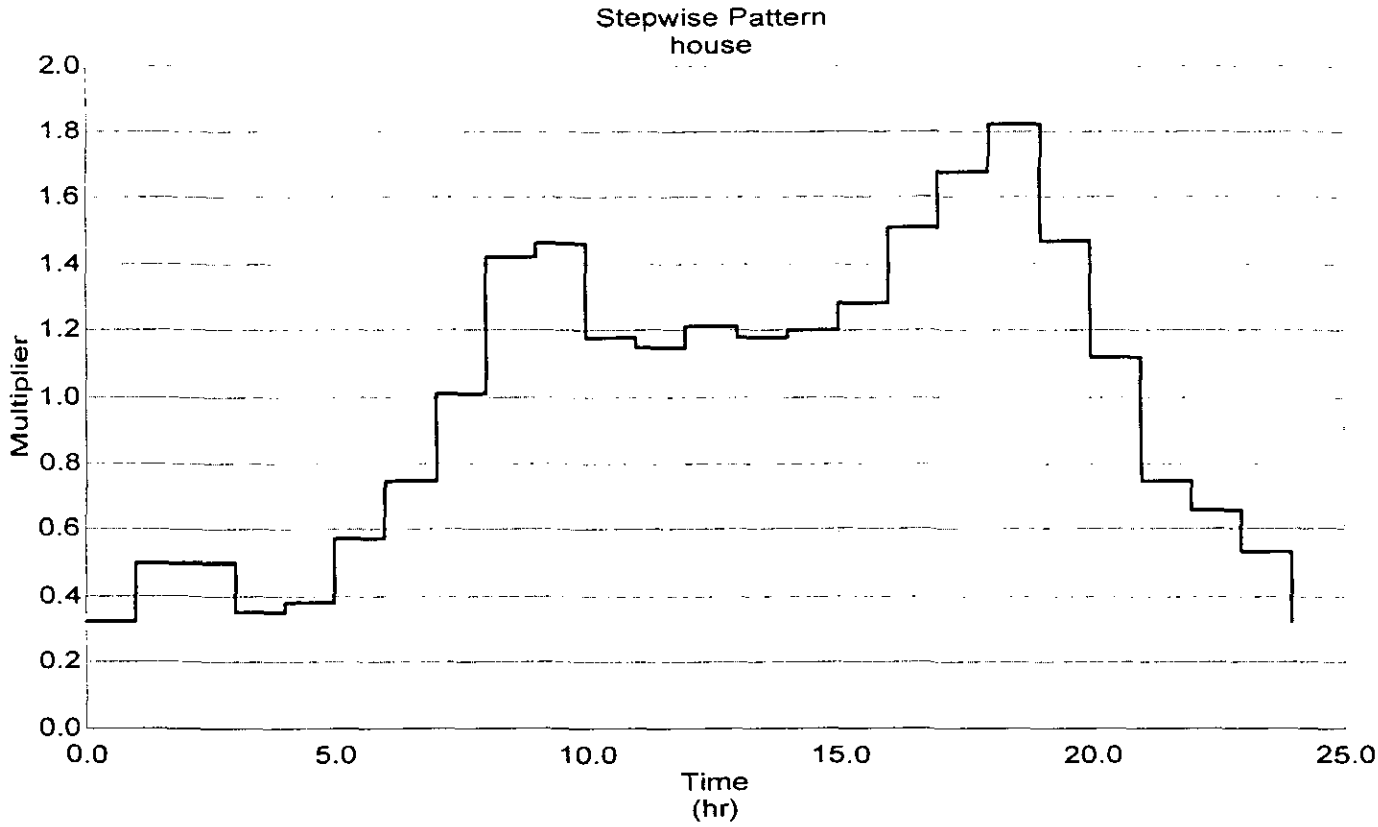
NOTE: J-76 IS AT ONE OF THE HIGHER ELEVATIONS IN THE SUBDIVISION.

000015

Scenario: 277.5
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Demand (gpm)	Pattern	Demand Calculated (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-41	704.00	Zone-1	Demand	1.54	house	1.54	899.30	84.45
J-77	704.00	Zone-1	Demand	0.00	house	0.00	899.32	84.46
J-38	703.00	Zone-1	Demand	0.58	house	0.58	899.33	84.90
J-22	702.00	Zone-1	Demand	0.00	Fixed	0.00	899.35	85.34
J-54	700.00	Zone-1	Demand	1.16	house	1.16	899.29	86.18
J-24	700.00	Zone-1	Demand	0.19	house	0.19	899.35	86.21
J-52	695.00	Zone-1	Demand	1.16	house	1.16	899.29	88.34
J-82	695.00	Zone-1	Demand	1.74	house	1.74	899.32	88.35
J-84	695.00	Zone-1	Demand	0.58	house	0.58	899.33	88.36
J-59	694.00	Zone-1	Demand	0.77	house	0.77	899.31	88.78
J-58	694.00	Zone-1	Demand	0.39	house	0.39	899.32	88.79
J-55	690.00	Zone-1	Demand	0.77	house	0.77	899.29	90.51
J-85	690.00	Zone-1	Demand	0.58	house	0.58	899.32	90.52
J-16	688.00	Zone-1	Demand	0.39	house	0.39	900.02	91.69
J-60	687.00	Zone-1	Demand	1.16	house	1.16	899.30	91.81
J-86	687.00	Zone-1	Demand	0.58	house	0.58	899.31	91.81
J-57	685.00	Zone-1	Demand	0.77	house	0.77	899.30	92.67
J-62	685.00	Zone-1	Demand	0.77	house	0.77	899.30	92.67
J-61	685.00	Zone-1	Demand	1.16	house	1.16	899.30	92.67
J-19	685.00	Zone-1	Demand	0.00	Fixed	0.00	900.02	92.98
J-32	684.00	Zone-1	Demand	0.39	house	0.39	900.01	93.41
J-56	683.00	Zone-1	Demand	1.16	house	1.16	899.29	93.53
J-6	683.00	Zone-1	Demand	0.00	Fixed	0.00	899.30	93.53
J-18	682.00	Zone-1	Demand	0.00	Fixed	0.00	900.02	94.28
J-7	680.00	Zone-1	Demand	0.39	house	0.39	900.02	95.14
J-36	673.00	Zone-1	Demand	0.77	house	0.77	900.01	98.17
J-31	671.00	Zone-1	Demand	0.39	house	0.39	900.01	99.03
J-37	671.00	Zone-1	Demand	0.77	house	0.77	900.02	99.03
J-34	670.00	Zone-1	Demand	0.39	Fixed	0.39	900.01	99.47
J-35	670.00	Zone-1	Demand	0.77	house	0.77	900.01	99.47
J-33	668.00	Zone-1	Demand	0.39	house	0.39	900.01	100.33
J-20	668.00	Zone-1	Demand	0.00	Fixed	0.00	900.02	100.33

000016


Stepwise Pattern
house
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Multiplier
0.0
5.0
10.0
15.0
20.0
25.0
Time
(hr)

000017

Scenario: 277.5
Steady State Analysis
Pipe Report

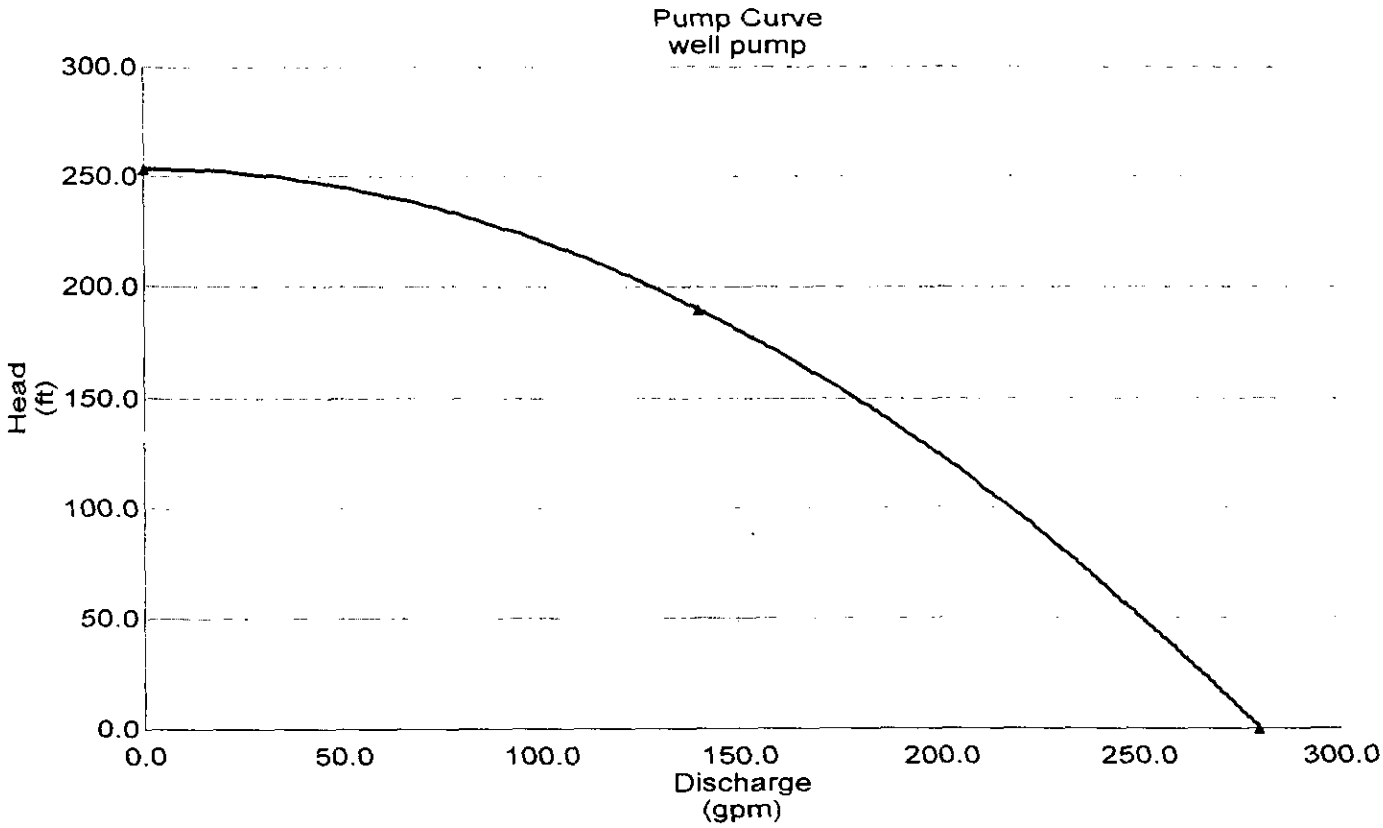
Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Minor Loss Coefficient	Control Status	Discharge (gpm)
P-32	390.00	4.0	PVC	150.0	0.00	Open	0.00
P-27	364.00	2.0	PVC	150.0	0.00	Open	0.00
P-111	236.00	2.0	PVC	150.0	0.00	Open	0.00
P-28	151.00	2.0	PVC	150.0	0.00	Open	0.00
P-11	444.00	4.0	PVC	150.0	0.00	Open	0.00
P-36	11.00	4.0	PVC	150.0	0.00	Open	4.65e-4
P-37	12.00	4.0	PVC	150.0	0.00	Open	4.65e-4
P-35	12.00	4.0	PVC	150.0	0.00	Open	9.06e-4
P-34	11.00	4.0	PVC	150.0	0.00	Open	9.06e-4
P-91	170.00	4.0	PVC	150.0	0.00	Open	0.06
P-33	210.00	4.0	PVC	150.0	0.00	Open	0.19
P-131	30.00	4.0	PVC	150.0	0.00	Open	0.20
P-41	307.00	4.0	PVC	150.0	0.00	Open	0.39
P-20	197.00	2.0	PVC	150.0	0.00	Open	0.39
P-23	275.00	2.0	PVC	150.0	0.00	Open	0.39
P-130	180.00	4.0	PVC	150.0	0.00	Open	0.57
P-110	251.00	2.0	PVC	150.0	0.00	Open	0.77
P-17	140.00	2.0	PVC	150.0	0.00	Open	0.77
P-113	430.00	4.0	PVC	150.0	0.00	Open	0.79
P-93	129.00	4.0	PVC	150.0	0.00	Open	0.83
P-73	201.00	4.0	PVC	150.0	0.00	Open	0.97
P-89	276.00	4.0	PVC	150.0	0.00	Open	1.10
P-44	228.00	4.0	PVC	150.0	0.00	Open	1.16
P-77	202.00	4.0	PVC	150.0	0.00	Open	1.35
P-31	228.00	4.0	PVC	150.0	0.00	Open	1.54
P-112	161.00	4.0	PVC	150.0	0.00	Open	1.56
P-128	105.00	4.0	PVC	150.0	0.00	Open	1.74
P-47	191.00	4.0	PVC	150.0	0.00	Open	1.93
P-95	140.00	4.0	PVC	150.0	0.00	Open	1.99
P-79	202.00	4.0	PVC	150.0	0.00	Open	2.12
P-109	127.00	4.0	PVC	150.0	0.00	Open	2.33
P-129	111.00	4.0	PVC	150.0	0.00	Open	2.51
P-87	389.00	4.0	PVC	150.0	0.00	Open	2.64
P-50	185.00	4.0	PVC	150.0	0.00	Open	2.70
P-101	77.00	4.0	PVC	150.0	0.00	Open	2.76
P-132	187.00	4.0	PVC	150.0	0.00	Open	2.79
P-81	128.00	4.0	PVC	150.0	0.00	Open	2.89
P-48	372.00	4.0	PVC	150.0	0.00	Open	3.09
P-108	334.00	4.0	PVC	150.0	0.00	Open	3.10
P-49	157.00	4.0	PVC	150.0	0.00	Open	3.47
P-100	98.00	4.0	PVC	150.0	0.00	Open	3.53
P-69	236.00	4.0	PVC	150.0	0.00	Open	3.67
P-51	211.00	4.0	PVC	150.0	0.00	Open	3.86
P-107	196.00	4.0	PVC	150.0	0.00	Open	3.87
P-133	523.00	4.0	PVC	150.0	0.00	Open	3.95
P-125	300.00	4.0	PVC	150.0	0.00	Open	3.95
P-83	50.00	4.0	PVC	150.0	0.00	Open	4.05
P-52	201.00	6.0	Ductile	130.0	0.00	Open	4.25
P-67	249.00	4.0	PVC	150.0	0.00	Open	4.44
P-99	144.00	4.0	PVC	150.0	0.00	Open	4.69
P-85	192.00	4.0	PVC	150.0	0.00	Open	4.82

000018

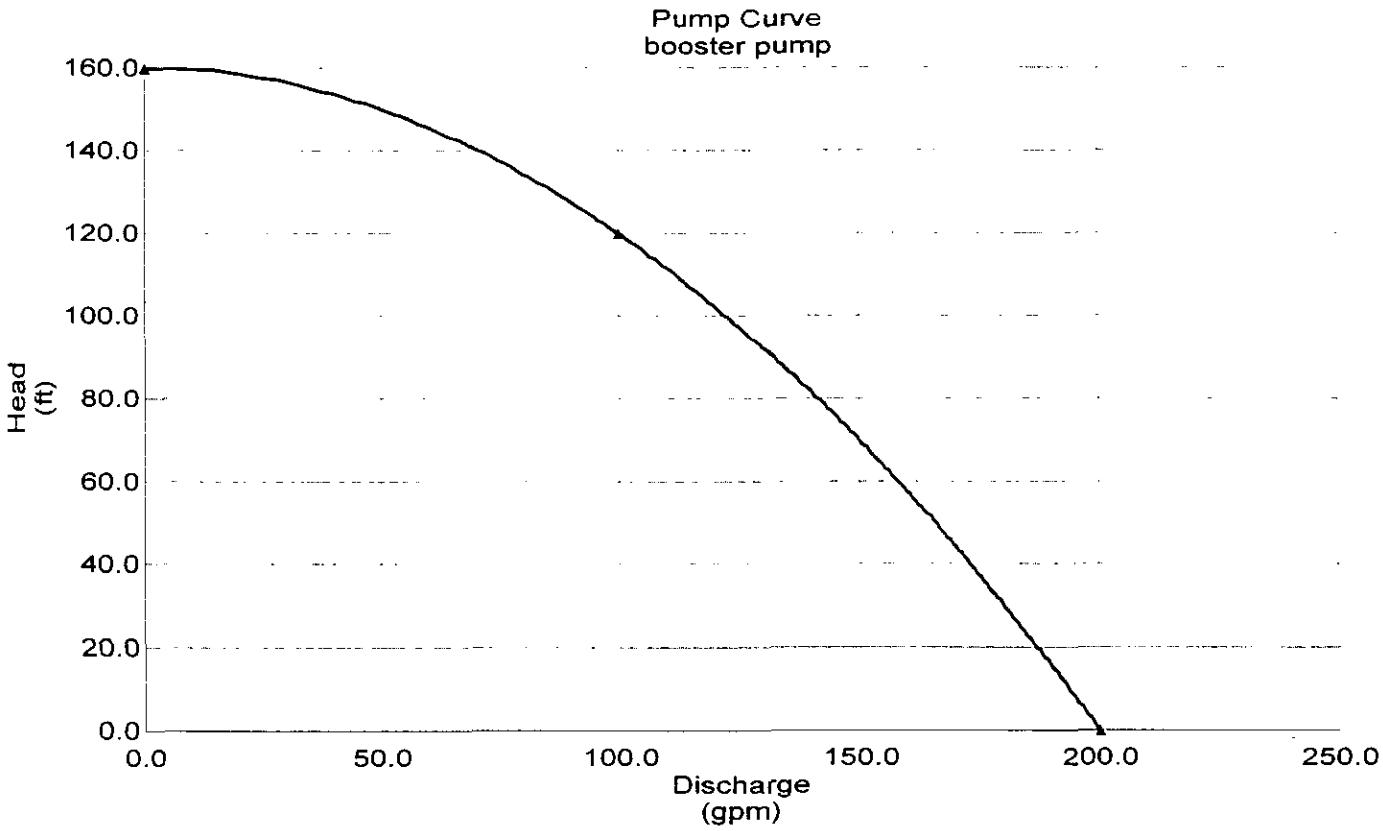
Scenario: 277.5
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Minor Loss Coefficient	Control Status	Discharge (gpm)
P-53	201.00	6.0	Ductile	130.0	0.00	Open	5.02
P-106	100.00	4.0	PVC	150.0	0.00	Open	5.03
P-65	167.00	4.0	PVC	150.0	0.00	Open	5.22
P-105	161.00	4.0	PVC	150.0	0.00	Open	5.42
P-54	194.00	6.0	Ductile	130.0	0.00	Open	5.79
P-98	260.00	4.0	PVC	150.0	0.00	Open	5.85
P-84	152.00	4.0	PVC	150.0	0.00	Open	5.98
P-55	154.00	6.0	Ductile	130.0	0.00	Open	6.56
P-104	179.00	4.0	PVC	150.0	0.00	Open	6.58
P-97	186.00	4.0	PVC	150.0	0.00	Open	6.62
P-63	155.00	4.0	PVC	150.0	0.00	Open	6.76
P-102	490.00	4.0	PVC	150.0	0.00	Open	6.95
P-137	107.00	4.0	PVC	150.0	0.00	Open	7.01
P-127	162.00	4.0	PVC	150.0	0.00	Open	7.15
P-126	264.00	4.0	PVC	150.0	0.00	Open	7.15
P-59	217.00	4.0	PVC	150.0	0.00	Open	7.53
P-15	218.00	4.0	PVC	150.0	0.00	Open	7.73
P-57	314.00	4.0	PVC	150.0	0.00	Open	8.11
P-142	122.00	4.0	PVC	150.0	0.00	Open	8.62
P-136	603.00	4.0	PVC	150.0	0.00	Open	8.74
P-135	227.00	4.0	PVC	150.0	0.00	Open	8.92
P-134	264.00	4.0	PVC	150.0	0.00	Open	9.11
P-141	224.00	4.0	PVC	150.0	0.00	Open	9.20
P-103	190.00	4.0	PVC	150.0	0.00	Open	9.65
P-122	458.00	4.0	PVC	150.0	0.00	Open	9.66
P-140	52.00	4.0	PVC	150.0	0.00	Open	9.78
P-123	182.00	4.0	PVC	150.0	0.00	Open	10.23
P-139	287.00	4.0	PVC	150.0	0.00	Open	10.36
P-138	350.00	4.0	PVC	150.0	0.00	Open	11.71
P-121	200.00	4.0	PVC	150.0	0.00	Open	14.18
P-120	117.00	4.0	PVC	150.0	0.00	Open	14.76
P-119	281.00	4.0	PVC	150.0	0.00	Open	15.34
P-118	207.00	4.0	PVC	150.0	0.00	Open	15.92
P-117	450.00	4.0	PVC	150.0	0.00	Open	16.88
P-116	916.00	4.0	PVC	150.0	0.00	Open	17.85
P-38	737.00	4.0	PVC	150.0	0.00	Open	18.93
P-39	257.00	4.0	PVC	150.0	0.00	Open	36.27
P-115	186.00	4.0	PVC	150.0	0.00	Open	36.48
P-114	226.00	4.0	PVC	150.0	0.00	Open	37.06
P-40	129.00	4.0	PVC	150.0	0.00	Open	55.19

000019


Pump Curve
well pump
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Head
(ft)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
Discharge
(gpm)

000020


Pump Curve
booster pump
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Head
(ft)
0.0
50.0
100.0
150.0
200.0
250.0
Discharge
(gpm)

000021

Scenario: 277.5

Steady State Analysis

Pump Report

Label	Elevation (ft)	Pump Power (Hp)	Shutoff Head (ft)	Shutoff Discharge (gpm)	Design Head (ft)	Design Discharge (gpm)	Maximum Operating Head (ft)	Maximum Operating Discharge (gpm)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)	Calculated Water Power (Hp)
well pump	385.00		253.33	0.00	190.00	140.00	0.00	280.00	Off	595.00	797.00	0.00	0.00	0.00
booster pum	785.00		160.00	0.00	120.00	100.00	0.00	200.00	Off	797.00	900.50	0.00	0.00	0.00

000022

Scenario: 277.5

Steady State Analysis

Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	595.00	Zone-1	9.08e-4	595.00

000023

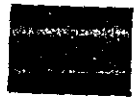
Scenario: 277.5
Steady State Analysis
Tank Report

Label	Zone	Base Elevation (ft)	Minimum Elevation (ft)	Initial HGL (ft)	Maximum Elevation (ft)	Inactive Volume (ft^3)	Tank Diameter (ft)	Inflow (gpm)	Current Status	Calculated Hydraulic Grade (ft)	Calculated Percent Full (%)
ground storag	Zone-1	785.00	785.00	797.00	797.00	0.00	15.75	0.00	Full	797.00	100.0
pressure tank	Zone-1	785.00	785.00	900.50	900.50	0.00	2.43	-55.20	Draining	900.50	100.0

000024

Scenario: 277.5*150%
Steady State Analysis
Junction Report

150% DESIGN DAY DEMAND



Label	Elevation (ft)	Zone	Type	Demand (gpm)	Pattern	Demand Calculated (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-76	795.00	Zone-1	Demand	0.00	house	0.00	898.17	44.61
J-9	788.00	Zone-1	Demand	2.32	Fixed	2.32	899.55	48.24
J-13	785.00	Zone-1	Demand	0.00	Fixed	0.00	899.50	49.52
J-63	782.00	Zone-1	Demand	4.05	house	4.05	899.52	50.82
J-25	780.00	Zone-1	Demand	0.00	Fixed	0.00	899.97	51.88
J-64	770.00	Zone-1	Demand	1.74	house	1.74	899.51	56.01
J-11	770.00	Zone-1	Demand	0.58	house	0.58	899.53	56.01
J-4	767.00	Zone-1	Demand	0.00	Fixed	0.00	898.18	56.73
J-74	764.00	Zone-1	Demand	0.87	house	0.87	898.24	58.05
J-75	762.00	Zone-1	Demand	0.87	house	0.87	898.14	58.87
J-10	762.00	Zone-1	Demand	0.00	Fixed	0.00	899.48	59.45
J-80	757.00	Zone-1	Demand	1.74	house	1.74	898.15	61.04
J-21	756.00	Zone-1	Demand	0.00	Fixed	0.00	898.07	61.44
J-73	754.00	Zone-1	Demand	0.87	house	0.87	898.28	62.39
J-5	753.00	Zone-1	Demand	0.00	Fixed	0.00	898.15	62.77
J-72	751.00	Zone-1	Demand	0.87	house	0.87	898.39	63.74
J-65	752.00	Zone-1	Demand	1.74	house	1.74	899.50	63.78
J-71	750.00	Zone-1	Demand	1.45	house	1.45	898.48	64.21
J-69	750.00	Zone-1	Demand	0.87	house	0.87	899.04	64.45
J-78	746.00	Zone-1	Demand	1.16	house	1.16	897.93	65.70
J-45	745.00	Zone-1	Demand	1.16	house	1.16	897.93	66.13
J-44	745.00	Zone-1	Demand	1.74	house	1.74	897.93	66.13
J-70	745.00	Zone-1	Demand	2.61	Fixed	2.61	898.68	66.46
J-66	745.00	Zone-1	Demand	1.16	house	1.16	899.49	66.81
J-46	742.00	Zone-1	Demand	1.16	house	1.16	897.93	67.43
J-17	743.00	Zone-1	Demand	0.00	Fixed	0.00	899.49	67.67
J-79	741.00	Zone-1	Demand	1.16	house	1.16	897.93	67.86
J-68	742.00	Zone-1	Demand	1.16	house	1.16	899.49	68.10
J-3	740.00	Zone-1	Demand	0.00	Fixed	0.00	898.22	68.42
J-15	740.00	Zone-1	Demand	0.58	house	0.58	899.49	68.97
J-81	738.00	Zone-1	Demand	0.29	house	0.29	898.18	69.27
J-43	732.00	Zone-1	Demand	1.16	house	1.16	897.94	71.76
J-23	730.00	Zone-1	Demand	2.03	house	2.03	898.07	72.68
J-47	727.00	Zone-1	Demand	1.16	house	1.16	897.93	73.92
J-48	721.00	Zone-1	Demand	1.16	house	1.16	897.93	76.51
J-26	722.00	Zone-1	Demand	1.16	house	1.16	899.45	76.73
J-28	720.00	Zone-1	Demand	1.16	house	1.16	899.45	77.60
J-42	718.00	Zone-1	Demand	1.16	house	1.16	897.95	77.82
J-49	717.00	Zone-1	Demand	1.16	house	1.16	897.93	78.24
J-50	715.00	Zone-1	Demand	1.74	house	1.74	897.93	79.11
J-83	713.00	Zone-1	Demand	2.03	house	2.03	898.07	80.03
J-51	712.00	Zone-1	Demand	1.16	house	1.16	897.94	80.40
J-1	710.00	Zone-1	Demand	0.58	house	0.58	899.45	81.92
J-12	710.00	Zone-1	Demand	1.16	house	1.16	899.52	81.96
J-40	708.00	Zone-1	Demand	0.58	house	0.58	897.97	82.15
J-67	709.00	Zone-1	Demand	1.16	house	1.16	899.47	82.37
J-30	708.00	Zone-1	Demand	1.16	house	1.16	899.45	82.79
J-8	708.00	Zone-1	Demand	0.00	Fixed	0.00	899.48	82.80
J-14	708.00	Zone-1	Demand	0.58	house	0.58	899.50	82.81
J-53	705.00	Zone-1	Demand	2.32	house	2.32	897.95	83.44
J-39	705.00	Zone-1	Demand	0.58	house	0.58	898.01	83.46

000025

DESIGN MAXIMUM DAY'S DEMAND MODEL

Scenario: 277.5*150%
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Demand (gpm)	Pattern	Demand Calculated (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-41	704.00	Zone-1	Demand	2.32	house	2.32	897.96	83.87
J-77	704.00	Zone-1	Demand	0.00	house	0.00	897.99	83.89
J-38	703.00	Zone-1	Demand	0.87	house	0.87	898.03	84.34
J-22	702.00	Zone-1	Demand	0.00	Fixed	0.00	898.07	84.79
J-54	700.00	Zone-1	Demand	1.74	house	1.74	897.95	85.60
J-24	700.00	Zone-1	Demand	0.29	house	0.29	898.07	85.65
J-52	695.00	Zone-1	Demand	1.74	house	1.74	897.94	87.76
J-82	695.00	Zone-1	Demand	2.61	house	2.61	898.00	87.78
J-84	695.00	Zone-1	Demand	0.87	house	0.87	898.01	87.79
J-59	694.00	Zone-1	Demand	1.16	house	1.16	897.98	88.21
J-58	694.00	Zone-1	Demand	0.58	house	0.58	897.99	88.21
J-55	690.00	Zone-1	Demand	1.16	house	1.16	897.95	89.92
J-85	690.00	Zone-1	Demand	0.87	house	0.87	898.00	89.95
J-60	687.00	Zone-1	Demand	1.74	house	1.74	897.96	91.23
J-86	687.00	Zone-1	Demand	0.87	house	0.87	897.97	91.23
J-16	688.00	Zone-1	Demand	0.58	house	0.58	899.49	91.46
J-57	685.00	Zone-1	Demand	1.16	house	1.16	897.95	92.09
J-62	685.00	Zone-1	Demand	1.16	house	1.16	897.95	92.09
J-61	685.00	Zone-1	Demand	1.74	house	1.74	897.95	92.09
J-19	685.00	Zone-1	Demand	0.00	Fixed	0.00	899.47	92.75
J-56	683.00	Zone-1	Demand	1.74	house	1.74	897.95	92.95
J-6	683.00	Zone-1	Demand	0.00	Fixed	0.00	897.95	92.95
J-32	684.00	Zone-1	Demand	0.58	house	0.58	899.45	93.17
J-18	682.00	Zone-1	Demand	0.00	Fixed	0.00	899.47	94.04
J-7	680.00	Zone-1	Demand	0.58	house	0.58	899.48	94.91
J-36	673.00	Zone-1	Demand	1.16	house	1.16	899.47	97.93
J-31	671.00	Zone-1	Demand	0.58	house	0.58	899.46	98.79
J-37	671.00	Zone-1	Demand	1.16	house	1.16	899.48	98.80
J-34	670.00	Zone-1	Demand	0.58	Fixed	0.58	899.47	99.23
J-35	670.00	Zone-1	Demand	1.16	house	1.16	899.47	99.23
J-33	668.00	Zone-1	Demand	0.58	house	0.58	899.46	100.09
J-20	668.00	Zone-1	Demand	0.00	Fixed	0.00	899.47	100.10

000026

Scenario: 277.5*150%

Steady State Analysis

Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Minor Loss Coefficient	Control Status	Discharge (gpm)
P-32	390.00	4.0	PVC	150.0	0.00	Open	0.00
P-27	364.00	2.0	PVC	150.0	0.00	Open	0.00
P-111	236.00	2.0	PVC	150.0	0.00	Open	0.00
P-28	151.00	2.0	PVC	150.0	0.00	Open	0.00
P-11	444.00	4.0	PVC	150.0	0.00	Open	0.00
P-36	11.00	4.0	PVC	150.0	0.00	Open	4.65e-4
P-37	12.00	4.0	PVC	150.0	0.00	Open	4.65e-4
P-35	12.00	4.0	PVC	150.0	0.00	Open	9.04e-4
P-34	11.00	4.0	PVC	150.0	0.00	Open	9.08e-4
P-91	170.00	4.0	PVC	150.0	0.00	Open	0.09
P-33	210.00	4.0	PVC	150.0	0.00	Open	0.29
P-131	30.00	4.0	PVC	150.0	0.00	Open	0.30
P-41	307.00	4.0	PVC	150.0	0.00	Open	0.58
P-20	197.00	2.0	PVC	150.0	0.00	Open	0.58
P-23	275.00	2.0	PVC	150.0	0.00	Open	0.58
P-130	180.00	4.0	PVC	150.0	0.00	Open	0.86
P-110	251.00	2.0	PVC	150.0	0.00	Open	1.16
P-17	140.00	2.0	PVC	150.0	0.00	Open	1.16
P-113	430.00	4.0	PVC	150.0	0.00	Open	1.18
P-93	129.00	4.0	PVC	150.0	0.00	Open	1.24
P-73	201.00	4.0	PVC	150.0	0.00	Open	1.46
P-89	276.00	4.0	PVC	150.0	0.00	Open	1.65
P-44	228.00	4.0	PVC	150.0	0.00	Open	1.74
P-77	202.00	4.0	PVC	150.0	0.00	Open	2.02
P-31	228.00	4.0	PVC	150.0	0.00	Open	2.32
P-112	161.00	4.0	PVC	150.0	0.00	Open	2.34
P-128	105.00	4.0	PVC	150.0	0.00	Open	2.61
P-47	191.00	4.0	PVC	150.0	0.00	Open	2.89
P-95	140.00	4.0	PVC	150.0	0.00	Open	2.98
P-79	202.00	4.0	PVC	150.0	0.00	Open	3.18
P-109	127.00	4.0	PVC	150.0	0.00	Open	3.49
P-129	111.00	4.0	PVC	150.0	0.00	Open	3.77
P-87	389.00	4.0	PVC	150.0	0.00	Open	3.97
P-50	185.00	4.0	PVC	150.0	0.00	Open	4.05
P-101	77.00	4.0	PVC	150.0	0.00	Open	4.14
P-132	187.00	4.0	PVC	150.0	0.00	Open	4.19
P-81	128.00	4.0	PVC	150.0	0.00	Open	4.33
P-48	372.00	4.0	PVC	150.0	0.00	Open	4.63
P-108	334.00	4.0	PVC	150.0	0.00	Open	4.65
P-49	157.00	4.0	PVC	150.0	0.00	Open	5.21
P-100	98.00	4.0	PVC	150.0	0.00	Open	5.30
P-69	236.00	4.0	PVC	150.0	0.00	Open	5.51
P-51	211.00	4.0	PVC	150.0	0.00	Open	5.79
P-107	196.00	4.0	PVC	150.0	0.00	Open	5.81
P-133	523.00	4.0	PVC	150.0	0.00	Open	5.92
P-125	300.00	4.0	PVC	150.0	0.00	Open	5.92
P-83	50.00	4.0	PVC	150.0	0.00	Open	6.07
P-52	201.00	6.0	Ductile	130.0	0.00	Open	6.37
P-67	249.00	4.0	PVC	150.0	0.00	Open	6.67
P-99	144.00	4.0	PVC	150.0	0.00	Open	7.03
P-85	192.00	4.0	PVC	150.0	0.00	Open	7.23

000027

Scenario: 277.5*150%
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Minor Loss Coefficient	Control Status	Discharge (gpm)
P-53	201.00	6.0	Ductile	130.0	0.00	Open	7.53
P-106	100.00	4.0	PVC	150.0	0.00	Open	7.55
P-65	167.00	4.0	PVC	150.0	0.00	Open	7.82
P-105	161.00	4.0	PVC	150.0	0.00	Open	8.13
P-54	194.00	6.0	Ductile	130.0	0.00	Open	8.69
P-98	260.00	4.0	PVC	150.0	0.00	Open	8.77
P-84	152.00	4.0	PVC	150.0	0.00	Open	8.97
P-55	154.00	6.0	Ductile	130.0	0.00	Open	9.84
P-104	179.00	4.0	PVC	150.0	0.00	Open	9.86
P-97	186.00	4.0	PVC	150.0	0.00	Open	9.93
P-63	155.00	4.0	PVC	150.0	0.00	Open	10.14
P-102	490.00	4.0	PVC	150.0	0.00	Open	10.42
P-137	107.00	4.0	PVC	150.0	0.00	Open	10.51
P-127	162.00	4.0	PVC	150.0	0.00	Open	10.72
P-126	264.00	4.0	PVC	150.0	0.00	Open	10.72
P-59	217.00	4.0	PVC	150.0	0.00	Open	11.30
P-15	218.00	4.0	PVC	150.0	0.00	Open	11.60
P-57	314.00	4.0	PVC	150.0	0.00	Open	12.17
P-142	122.00	4.0	PVC	150.0	0.00	Open	12.93
P-136	803.00	4.0	PVC	150.0	0.00	Open	13.11
P-135	227.00	4.0	PVC	150.0	0.00	Open	13.38
P-134	264.00	4.0	PVC	150.0	0.00	Open	13.67
P-141	224.00	4.0	PVC	150.0	0.00	Open	13.80
P-103	190.00	4.0	PVC	150.0	0.00	Open	14.47
P-122	458.00	4.0	PVC	150.0	0.00	Open	14.48
P-140	52.00	4.0	PVC	150.0	0.00	Open	14.67
P-123	182.00	4.0	PVC	150.0	0.00	Open	15.35
P-139	287.00	4.0	PVC	150.0	0.00	Open	15.54
P-138	350.00	4.0	PVC	150.0	0.00	Open	17.57
P-121	200.00	4.0	PVC	150.0	0.00	Open	21.27
P-120	117.00	4.0	PVC	150.0	0.00	Open	22.14
P-119	281.00	4.0	PVC	150.0	0.00	Open	23.01
P-118	207.00	4.0	PVC	150.0	0.00	Open	23.88
P-117	450.00	4.0	PVC	150.0	0.00	Open	25.33
P-116	916.00	4.0	PVC	150.0	0.00	Open	26.78
P-38	737.00	4.0	PVC	150.0	0.00	Open	28.39
P-39	257.00	4.0	PVC	150.0	0.00	Open	54.41
P-115	186.00	4.0	PVC	150.0	0.00	Open	54.72
P-114	226.00	4.0	PVC	150.0	0.00	Open	55.58
P-40	129.00	4.0	PVC	150.0	0.00	Open	82.80

000028

Scenario: 277.5*150%
Steady State Analysis
Pump Report

Label	Elevation (ft)	Pump Power (Hp)	Shutoff Head (ft)	Shutoff Discharge (gpm)	Design Head (ft)	Design Discharge (gpm)	Maximum Operating Head (ft)	Maximum Operating Discharge (gpm)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)	Calculated Water Power (Hp)
well pump	365.00		253.33	0.00	190.00	140.00	0.00	280.00	Off	595.00	797.00	0.00	0.00	0.00
booster pum	785.00		160.00	0.00	120.00	100.00	0.00	200.00	Off	797.00	900.50	0.00	0.00	0.00

000029

Scenario: 277.5*150%
Steady State Analysis
Reservoir Report

Label	Elevation (ft)	Zone	Inflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	595.00	Zone-1	3.08e-4	595.00

000030

Scenario: 277.5*150%
Steady State Analysis
Tank Report

Label	Zone	Base Elevation (ft)	Minimum Elevation (ft)	Initial HGL (ft)	Maximum Elevation (ft)	Inactive Volume (ft^3)	Tank Diameter (ft)	Inflow (gpm)	Current Status	Calculated Hydraulic Grade (ft)	Calculated Percent Full (%)
ground storag	Zone-1	785.00	785.00	797.00	797.00	0.00	15.75	0.00	Full	797.00	100.0
pressure tank	Zone-1	785.00	785.00	900.50	900.50	0.00	2.43	-82.80	Draining	900.50	100.0

000031


P= PIPE
J= JUNCTION
THE JUNCTIONS REPRESENT A POINT WHERE PIPES ARE CONNECTED OR WHERE THEY CHANGE SIZE. DEMANDS WERE PLACED AT THE JUNCTIONS TO REPRESENT THE SERVICE CONNECTIONS. ONE JUNCTION MAY REPRESENT MORE THAN ONE SERVICE CONNECTION. JUNCTIONS J-63 AND J-70 ARE FOR POTENTIAL EXPANSIONS TO THE SYSTEM.
R= RESERVOIR
R-1 REPRESENTS THE AQUIFER SUPPLYING THE WELL PUMP.

000032

10 MAY 04

BIG ISLAND
WATERLINE IMPROVEMENTS

KREHBIEL ENGINEERING, INC.
CONSULTING ENGINEERS
CAMDENTON, MISSOURI

REVISIONS	BY	DATE

SCALE 1" = 300'
DATE 05/11/04
DR'N. LS CKD.
APVD.
ACCOUNT NO.
PROJECT NO. 918

TITLE HYDRAULIC MODELING

NO. 1 OF 1

000033

TECHNICAL SPECIFICATIONS

SECTION 1.0

EXCAVATION OF TRENCHES

1.0-1. **Description**

The work in this section consists of furnishing all equipment, labor, and tools necessary for the excavation of trenches as required by the plans and specifications.

Trenches shall be constructed to the lines and grades shown on the plans or as directed by Krehbiel Engineering, Inc. The Contractor shall furnish all batter boards and labor for setting them. The use of a laser for establishing grade of trench bottom, bedding material and pipe inverts is also approved. The Contractor shall be careful to preserve stakes and survey marks from damage or dislocation.

1.0-2. **Material**

The Contractor shall be responsible for the acceptability and storage of all material furnished by him and shall assume responsibility for the replacement of all such material found damaged or defective in manufacture. This shall include the furnishing of all material and labor required for the replacement of installed material discovered to be defective prior to the final acceptance of the work.

1.0-3. **Construction Procedures**

A. Trench Excavation and Backfill - All excavation and backfill work shall be done in accordance with pipe manufacturers and industry recommendations, standards and practices.

1. Clearing and Care of Surface Materials. The Contractor shall furnish all the labor, materials and equipment necessary to complete all clearing of brush, trees, or other obstructions required to complete all work under this heading.

Where existing roads are cut or disturbed by the excavation of the trenches, or otherwise damaged by the Contractor's equipment, the roads and streets shall be replaced and repaired with surface materials matching the existing paving materials in such a manner satisfactory to Krehbiel Engineering, Inc. Fences, power poles, and other property shall be protected by the Contractor, unless their removal is authorized. All property shall be satisfactorily restored by the Contractor at his expense to the approval of Krehbiel Engineering, Inc.

000034

2. Protection of Trees and Shrubs. All trees and shrubs adjacent to the proposed property shall be adequately protected by the Contractor. No excavation material shall be placed so as to injure trees or shrubs. Trees and shrubs damaged or destroyed by the Contractor shall be replaced by him with new stocks of a similar size and age, and at the proper season, and at the sole expense of the Contractor.

3. Alignment Grade and Trench Preparation. Trenches shall be located as shown on the drawings, or as directed by Krehbiel Engineering, Inc.

Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, Krehbiel Engineering, Inc. shall have the authority to change the plans and order a deviation from the line or grade, or arrange with the Owners of the structures for the removal, relocation, or reconstruction of the obstructions. If the change of plans results in a change in the amount of work by the Contractor, such altered work shall be done on the basis of payment to the Contractor for extra work, or credit to the Owner for less work.

The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of the underground structures, both known and unknown, may be determined, and he shall be responsible for the repair of such structures when broken, or otherwise damaged because of carelessness on his part.

4. Trenching and Excavating. Excavation of trenches may be either by hand, or machinery. Contractor shall overdig such that excavating shall extend below the finished grade. Select backfill as directed by Krehbiel Engineering, Inc. thoroughly compacted to the shape and grade required, shall be placed before the placement of the pipe. Backfill material may be earth, sand, gravel, or concrete as approved by Krehbiel Engineering, Inc.

The sides of all trenches shall be as nearly as possible vertical. Excessive width of trenches will not be allowed. From a point six inches above the finished grade to the finished grade line, the excavation shall conform as nearly as possible to the size and shape of the pipe so that the pipe may rest on undisturbed soil.

Materials excavated from the trenches shall be deposited

along the sides and beyond the reach of possible slides with the banks trimmed so that as little as possible inconvenience to public travel or tenants occupying adjoining property will ensue. The bottom of the trench shall provide continuous uniform bearing for the pipe.

In the event it is necessary to place the excavated materials on any sidewalk, the Contractor shall keep the excavated materials a minimum of four feet from the front of all buildings and from the inner portion of the sidewalk.

All sidewalks are to be cleaned thoroughly and open to pedestrian traffic when work is not in progress. Barricades and portable flashing beacons shall be provided at each end, and at such other locations as required by Krehbiel Engineering, Inc. to provide safety for the general public. Where the excavated material has been deposited on green grass plots, the Contractor shall remove the excavated material carefully when backfilling so as not to destroy the grass.

5. Sheeting, Shoring and Bracing. Where necessary to prevent caving, trench excavation in sand, gravel, sandy soils or other unsuitable materials shall be adequately sheeted and braced. Where sheeting and bracing are used, the clear trench width shall not be less than that specified for unsheeted trenches. As back-fill is placed, the sheeting shall be withdrawn in sections for proper compaction of the fill materials.

Excavation surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workmen, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. The Contractor shall furnish, place and subsequently remove such supporting installations.

6. Pipe Clearance in Rock. A minimum clearance to rock of at least six (6) inches shall be provided below and on each side of any and all pipe. All rock, boulders, ledge rock and other large stones shall be removed to provide a minimum of six inches clearance.

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This minimum specified clearance is a minimum clear distance, which will be permitted between any part of the pipe being laid to a point of projection of such rock, boulder, or stone. Before the pipe is installed, all irregularities of the rock shall be filled with earth, or sand that has been well rammed

into place and the bottom of the trench brought to the proper grade and shape.

7. Rock Excavation. Trench Excavation is unclassified, and no extra compensation will be allowed for rock excavation.

8. Blasting. The use of dynamite or other blasting materials will be permitted upon the approval of Krehbiel Engineering, Inc. and then only after adequate safety precautions have been taken. The hours of blasting shall be fixed by Krehbiel Engineering, Inc. Any damage resulting from the necessary blasting shall be paid for by the Contractor at his own expense. The Contractor's methods and procedures for blasting shall conform to all local and State Ordinances.

9. Dewatering Trenches. Adequate provisions shall be made by the Contractor for the removal and disposal of all water entering the excavation and for the maintenance of the same in a dry condition until the pipe lines and other parts of the work have been satisfactorily installed.

   When large quantities of ground water are encountered, crushed stone or gravel may be used as a subdrain to facilitate drainage to trench or sump pumps. A dam shall be provided in the subdrain to minimize the possibility of undercutting the trench foundation from excessive ground water flows. Ground water will be pumped away from the trenches and area that will be excavated.

   When dewatering of a section is completed and the dewatering process is terminated, the termination will be done in such a manner to allow the pressures to increase gradually.

10. Traffic Control. Where traffic must cross open trenches the Contractor shall provide suitable bridges, or bypass as required for the proper handling of traffic. Barricades and portable flashing beacons shall be provided at such locations and as required by Krehbiel Engineering, Inc. to provide safety for the general public.

B. Backfilling

1. Backfilling the Trench. The pipe will be covered and tamped by hand, or approved mechanical methods, with selected backfill.

   a. For backfilling under rigid or non-rigid surfacing the crushed limestone shall be placed to the bottom of the surfacing. All replacement surfacing shall be Type - C

asphalt or concrete as applicable, to provide replacement surfacing of the same type as existing surfacing.

2. Backfilling and Cleanup. The bottom of the trench shall be backfilled with material as specified above, and shall be deposited in the trench simultaneously on both sides of the pipe and to a distance above the top of the pipe as specified on plans. This backfill shall be tamped in even layers solid bearing and backing.

The upper portion of the trench shall be backfilled with materials as specified above and shall be compacted by hand tamping, wheel compaction, or other mechanical method, approved by Krehbiel Engineering, Inc.

Upon completing the backfill of the trenches, the trench shall be maintained in a safe condition relative to transportation. The ditches shall be maintained for a period of twelve (12) months in such manner that no standing water will occur over the trenches. All excess excavation materials shall be moved from the alignment of the trench and disposed of at the direction of the Owner and Krehbiel Engineering, Inc. If extra trench fill is needed, approved material shall be provided by the Contractor at no additional cost to the Owner.

3. Backfill in Unsuitable Material. Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders refuse, vegetable or other organic material that in the judgment of Krehbiel Engineering, Inc. should be removed, the Contractor shall excavate any such unsuitable material to the width and depth ordered by Krehbiel Engineering, Inc. Before the pipe is laid, the subgrade shall be made by backfilling with an approved material in six (6) inch layers. These layers shall be thoroughly tamped to provide uniform and continuous bearing for the pipe.

Where the bottom of the trench at subgrade is found to consist of material that is unstable to such a degree that, in the opinion of Krehbiel Engineering, Inc., it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling, timbers, or other materials, in accordance with plans prepared by Krehbiel Engineering, Inc.

000038

4 .Restoration of Original Surfaces. All surplus materials, excavated and not required for backfill in the excavations, shall

be removed from the area by the Contractor and deposited and graded at accessible points as directed by the Owner. The cost of hauling, deposit, and grading of the waste materials shall be done at the expense of the Contractor. Upon completing the backfill of the trenches, the trench shall be maintained in a safe condition relative to transportation and maintenance.

If extra trench fill is needed, approved material shall be provided by the Contractor at no additional cost to the Owner. The ditches shall be maintained for a period of twelve (12) months in such a manner that no standing water will occur over the trenches.

SECTION 2.0

WATER LINES AND APPURTENANCES

2.0-1. **Description**

This work shall consist of the furnishing of all equipment, materials, skill, tools, and labor necessary for the installation of all waterlines and appurtenances as shown on the plans or herein specified for a complete working water distribution system.

2.0-2. **Materials**

The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by Krehbiel Engineering, Inc. Such inspection may be made at the place of manufacture or on the work site after delivery, or at both places, and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture.

Krehbiel Engineering, Inc. shall have the right to cut cores from such pieces of the finished pipe as desired for such inspection and tests as deemed necessary. If Krehbiel Engineering, Inc. has a core cut from a finished pipe and that core is found not to be in compliance with the specifications, such pipe shall be replaced by, and at the expense of, the manufacturer of the pipe. If the pipe is found to be in compliance with the specifications, the Owner will pay for the replacement.

Any pipe, which has been damaged after delivery, will be rejected and if such pipe is already laid in the conduit line, it shall be acceptably repaired, if permitted, or removed and replaced, or made good solely at the Contractor's expense.

A. Integral Bell PVC Pressure Pipe - Only PVC pipe jointed by elastomeric ring seal joint shall be used in the distribution system. PVC pipe pressure rating is to be based on ASTM Standards. The pipe is to bear the seal of NSF.

PVC pipe and fittings with elastomeric ring seal joints shall meet the requirements of ASTM D-3139. The elastomeric ring seal joints shall have been tested and approved by the National Sanitation Foundation (NSF) and certification of said approval shall be submitted.

000040

1. General. This specification designates the general requirements and installation of Polyvinyl Chloride (PVC) pipe and fittings used for conveying potable water under pressure.

2. Pipe. All plastic pipe shall meet the requirements of the National Sanitation Foundation. Each length of pipe must also show the diameter and the commercial standard, which is applicable to the type of pipe specified. Plastic pipe shall be polyvinyl chloride ASTM type 1, grade 1 (normal impact), conforming to the commercial standard, which is, applicable to the type of pipe specified. Plastic pipe shall conform to ASTM D2241, latest edition. Class 200 PVC pipe, shall have a maximum design stress of 2000 pounds per square inch.

3. Certification Requirements. The Contractor shall furnish three copies of a pipe manufacturer's certification that the pipe furnished is in full compliance with the commercial standards applicable to the pipe specified. The Contractor shall furnish Krehbiel Engineering, Inc. three copies of date showing the physical properties of the pipe furnished. Properties should include normal bursting pressure, manufacturer's maximum working pressure, physical dimensions, and tolerances. Pipe shall not be purchased until approved by Krehbiel Engineering, Inc.

   The Contractor shall have the manufacturer provide a factory representative skilled in the installation of the type of pipe purchased to instruct the Contractor's personnel in the proper procedures for connecting and laying the pipe.

4. Fittings. All fittings, couplings and adapters shall be manufactured out of materials conforming to the same standards as the pipe and having a design strength equal or better than the adjacent pipe.

5. Mechanical Joint Adapters. It is contemplated that valves two inches and larger may be specified mechanical joint, AWWA, and in such event PVC Mechanical Joint Adapters shall be furnished. They are to be made of Schedule 80 PVC at least twelve (12) inches long. One end shall be built up to an O.D. equal to that required by the MJ fitting.

   Male adapters shall be of the heavy duty type, be made of Schedule 80 pipe and have socket depth equal to the coupling. All threads shall be iron pipe size and be sized for a tight fit. Extra heavy-duty adapters shall be used wherever possible. Schedule 80 PVC pipe shall meet all requirements of SDR pipe and shall conform in all respects to the commercial standards CS-207-60.

000041

Contractor's Guarantee - Pipe furnished by Contractor shall be

guaranteed against rot, electrolytic corrosion, and production defects.

Contractor shall maintain the pipe lines for a period of one year from date of acceptance by Krehbiel Engineering, Inc. Such remedial measures as required to correct leaks and similar troubles will be done by the Contractor at his own expense.

B. Gate Valves - Gate valves shall be iron-body, resilient-seated, tight closure gate valves with nonrising stems, "0" ring type packing, and complying with AWWA C509. The waterway of the valve in the fully open position shall be unobstructed. All exposed gate valves shall have flanged ends conforming to ANSI B16.1, Class 125. All buried gate valves shall be specifically designed for buried use and shall be equipped with mechanical joint ends. The gate valve wedge shall have Buna "N" or SBR rubber bond to both sides to form a double seal when the valve is closed. The operator shall be of the hand wheel type for exposed valves. Buried gate valves shall be equipped with a 2-inch square operating nut. All valves shall open in a counterclockwise direction. The valve interior and exterior shall be coated with epoxy paint standard with the valve manufacturer.

C. Gate valves Two and One-half Inches and Smaller – Unless otherwise specified, gate valves two and one-half inches smaller in size shall be standard, bronze, solid-wedge, rising stem type gate valves with screwed ends, suitable for 125 pound working stem pressure and conforming to Federal Specification WW-V-54, Amendment 1, Class B, for Valves, Bronze, Gate 125 and 150 pound Screwed and Flanged (for land use).

D. Service Connections –Service connection shall be ½" Copper pipe shall be rigid cold drawn type. Copper shall be completely deoxidized and conform to Federal Specifications ASTM B88, latest edition, Type K or ¾ ", SDR 9, 200 psi, PE-3408 Eagle Pure-Core Blue HDPE Tubing.

E. Valve Boxes - Valve boxes shall be provided for all gate valves on the system. Boxes shall be tough, white, high-strength PVC plastic molded in a ribbed configuration having rolled edges. They shall have suitable bases to fit around the valve bodies without bearing on them. Barrels shall be made telescopic for adjustment and shall have a minimum inside diameter of five inches. They shall be designed for the depth of trench specified. Top section shall have a flange for holding it in position. Covers shall be recessed flush with top, and marked "Water" in raised letters.

000042

F. Data - For valves, gates and appurtenances the Contractor shall

furnish for approval, illustrations, descriptive matter and complete manufacturer's specifications of the equipment he proposes to furnish. Such material shall be sufficiently detailed to enable Krehbiel Engineering, Inc. to determine that the proposed equipment will conform to the specifications.

2.0-3. **Construction Procedures**

A. Excavation of Trenches - All excavation of trenches shall be done in accordance with Section 1.0, Excavation of Trenches, and as shown on the plans.

B. Pipe Line Installation -

1. Water Main Laying. All pipes, special castings, valves, and other appurtenances shall be carefully examined for defects, and no pipe, or other fittings shall be installed which is known to be defective. In the event such pipe, or other appurtenances shall be discovered to be defective after being installed, they shall be removed and replaced with sound material at the Contractor's expense.

   Every pipe shall be cleared of all debris, dirt, etc., before being laid. Care shall be taken to preserve a good alignment and to give the pipe a firm bearing throughout its entire length. Pipe shall be laid in a satisfactory manner, true to line and depth. Pipes shall not be laid in water.

   The methods of laying pipe shall be in accordance with the recommendations of the manufacturer and as approved by Krehbiel Engineering, Inc. Each pipe shall be aligned with that already in place, forced home completely with as nearly an axial movement as possible, and held securely in position.

   Joints shall not be pulled or cramped more than the manufacturer's recommendation to secure changes in alignment. Special care shall be taken to avoid damage to the rubber-sealing gasket and each joint shall be inspected and checked with an approved device to ensure that the rubber gasket is in place.

2. Temporary Plugs and Trench Water. When pipelaying is not in progress the open ends of installed pipe shall be closed to prevent entrance of trench water into the line. The open ends of the pipe shall be closed by temporary watertight plugs, or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed. Enough backfill shall be

placed on the pipe to prevent floatation. Any pipe that has floated shall be relaid as directed by Krehbiel Engineering, Inc.

3. Thrust Blocks. Thrust blocks shall be provided for all bends, tees, wyes, caps, plugs, and valves as directed by Krehbiel Engineering, Inc., or as shown on the plans. Backing shall be of concrete, as specified, and shall be placed between solid ground and the fittings to be anchored. The backing shall be placed so that the pipe and fittings will be accessible for repairs unless otherwise directed by Krehbiel Engineering, Inc.

C. Appurtenances Installation - Care shall be taken to prevent damage or injury to valves and appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out of valve openings, etc., all operating mechanisms operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment, which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.

All bends, tees, caps, plugs, etc., shall be provided with thrust blocks. Valves and valve boxes shall be firmly set on a foundation or footing of concrete. The volume of the concrete base shall be not less than one (1) cubic foot. The height shall conform to the height of the connecting pipe.

Valve boxes shall be given two shop coats of asphaltum varnish or coal-tar coating.

Tees for service lines or laterals must be assembled so that no strain is placed on the pipe during, or after the backfill operation. The plastic pipe must be handled with reasonable care so that it is not crimped, scratched, or damaged when in the trench.

All finished parts shall be coated with grease to prevent corrosion during shipment and installation.

D. Valve Markers – Contractor shall furnish and install a four foot painted metal fence post at each gate valve location.

E. Horizontal Separation of Water Mains and Sewer Lines - Sewer lines shall be laid a minimum of ten-foot (10') horizontally from any existing or proposed water lines. The distance must be measured edge-to-edge

000044

F. Vertical Separation of Water and Sewer Lines - There shall be a minimum vertical separation of eighteen inches (18") between the outside of the water main and the outside of the sanitary sewer where

water mains cross sanitary sewer mains. At crossings, one (1) full length of water pipe must be located so both joints will be as far from the sanitary sewer line as possible.

G. Separation of Water Mains and Sewer Manholes – No water pipe shall pass through, or come into contact with, any part of a sewer manhole.

000045

SECTION 3.0

PRESSURE AND LEAKAGE TESTS

3.0-1. **Description**

The work to be performed under this section of the Specifications shall include the furnishing of all labor, materials and equipment necessary for the completion of pressure and leakage tests of all pressure sewer lines and water lines that are to be installed as shown on the plans and/or as herein specified.

3.0-2. **Materials**

The Contractor shall furnish all the necessary materials to make the pressure and leakage tests and to perform any work incidental hereto. The Contractor shall also provide a pump to raise the pressure to the required amount above the normal operating pressures. In addition to a suitable pump, the Contractor shall provide pressure gauges, water meters and other appliances necessary for measuring the amount of water pumped in the mains that are being tested.

3.0-3. **Construction Procedures**

A. Test Pressure - Pressure tests shall be conducted between valves in sections as long as possible up to 5,000 feet and as directed by Krehbiel Engineering, Inc. All laid pipe shall be subjected to a hydrostatic pressure of 100 percent above normal operating pressure, but shall not exceed manufacturer's rating. The normal operating pressure shall be defined as a total hydrostatic pressure caused by the static head between the existing water reservoir and the lowest point in the new lines. The pressure shall be maintained for a period of not less than two hours for uncovered pipe joints. Where the pipe has been completely backfilled before the tests are conducted the pressure shall remain on these pipes for no more than twenty-four hours.

B. Leakage Tests - Care shall be taken to expel all air from the water and sewer lines as they are being filled with water to make the necessary pressure tests. The quantity of water forced into the mains during the time of the pressure tests shall be determined through a water meter, and this amount shall be taken as a basis to compute the leakage for a twenty-four hour period.

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C. Permissible Overall Leakage - No pipe or installation shall be accepted unless, or until the leakage, determined under the test pressure, is less than ten gallons per inch of pipe diameter per mile of pipe per twenty-four hours. Test pressure shall not exceed the rating

working pressure of pipe, as so stamped.

D. Correction of Leakage Defects - All pipe, fittings, valves, hydrants and joints shall be carefully examined for leakage defects. Leaking joints shall be remade and re-tested. The Contractor shall, at his own expense, continue to locate and repair the defective joints until the leakage is within the permitted allowance.

000047

SECTION 4.0

WATERLINE DISINFECTION

4.0-1. **Description**

The work to be performed under this section shall include the furnishing of all labor, materials, and equipment necessary for the complete sterilization of the water distribution system. Each unit of the water distribution system shall be sterilized in accordance with AWWA Standard C 651-99, latest edition, with chlorine or chlorine-bearing compounds as directed by Krehbiel Engineering, Inc., before acceptance for domestic operation.

4.0-2. **Materials**

A. Liquid chlorine shall conform to AWWA Standard B 301, latest edition.

B. Hypochlorite shall conform to AWWA Standard B 300, latest edition.

4.0-3. **Construction Procedures**

A. Laying Pipe - Every precaution shall be used to protect pipe against the entrance of foreign material before the pipe is placed in the new line. At the close of the day's work, or whenever the workmen are absent from the job, the end of the last laid section of pipe shall be plugged, capped or other wise tightly closed to prevent the entry of foreign material of any nature.

If the Contractor, or pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, Krehbiel Engineering, Inc., may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until connection is to be made to the adjacent pipe.

B. Preventing Trench Water from Entering Pipe - At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Krehbiel Engineering, Inc. If water is in the trench, the seal shall remain in place until the trench is pumped dry.

000048 C. Flushing Completed Pipelines - The main shall be flushed, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. If no hydrant is installed at

the end of the main, a tap should be provided large enough to develop a velocity in the main of at least 2.5 feet per second.

D. Requirement of Chlorination - Before being placed in service, all new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than ten ppm remains in the water after twenty-four hours standing in the pipe.

E. Liquid Chlorine - A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device, or if approved by Krehbiel Engineering, Inc., the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing backflow of water into the chlorine cylinder.

F. Point of Application and Retention Period - The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension, or any valved section of it and through a corporation stop (except in new distribution systems) in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. In a new system, application of chlorine may be made at the pumping station, the elevated water storage tank the standpipe or the reservoir.

Water from the existing distribution system or other source of supply shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. The rate of chlorine mixture flow shall be such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least 10 ppm after twenty-four hours standing. This may be expected with an application of 25 ppm, although some conditions may require more. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves may be used, if desired.

Treated water shall be retained in the pipe long enough to destroy all nonspore-forming bacteria. This period should be at least twenty-four hours and should produce no less than 10 ppm at the extreme end of the line at the end of retention period.

NOTE: If the circumstances are such that a shorter retention period must be used, the chlorine concentration shall be increased accordingly. For instance, for a contact period of one hour, a 100-ppm chlorine concentration is required. Under these conditions, special care should be taken to avoid attack on

pipes, valves, hydrants, and other appurtenances.

In the process of chlorinating newly laid pipe, all valves, or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

G. Final Flushing and Test - Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities until the replacement water throughout its length shall, upon test, be proved comparable in quality to the water served the public from the existing water supply system and approved by the regional office of the Clean Water Commission, Department of Natural Resources. This satisfactory quality of water delivered by the new main should continue for a period of at least two full days as demonstrated by laboratory examination of samples taken from a tap located and installed in such a way as to prevent outside contamination.

If the test samples show unsatisfactory quality of water, the process of sterilization shall be repeated until satisfactory samples are obtained. The Contractor shall pay for all tests.