ENGINEERING

PLANNING

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WATER DISTRIBUTION SYSTEM ANALYSIS
PREPARED BY: BAX ENGINEERING CO., INC.

HYLAND GREEN VILLAGES A, B, AND C – CITY OF O'FALLON
BAX PROJECT NO. 98-10293C
June 9, 2004

INTRODUCTION

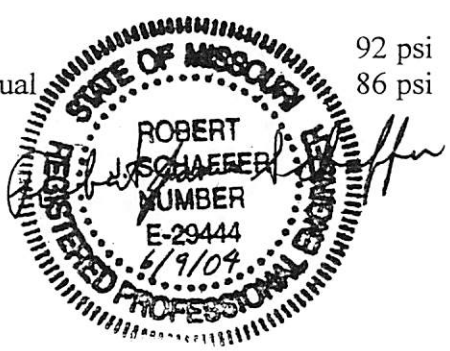
The presently undeveloped tract of land lies north of Highway P, north of the existing Dames Park development. The tract contains 90.5± acres which is to be developed into Hyland Green Villages A, B, and C, a single-family development containing 270 lots zoned R-1 P.U.D. averaging 5,000 square feet per lot. The purpose of this analysis will be to show that the proposed water distribution system will meet the requirements of a steady state analysis of both DNR's 1000 gpm @ 20 psi minimum fire flow requirement and the City's 65 psi target design pressure requirement per their April 26, 2004 comment letter.

GENERAL SITE AND FLOW TEST DATA FOR CONNECTION POINTS

The site will be connected to the City of O' Fallon's water system off of an existing 16-inch main paralleling Highway P along the site's southern most boundary. This main also serves the existing Dames Park development. The Dames Park development is served by 8" mains off of the existing 16"main. The Hyland Green development will also be served by 8" mains, these mains will be tapped off of the existing 8" mains serving Dames Park as directed by the City of O' Fallon. The flow test data used for design was obtained on June 8, 2004 by the O' Fallon fire department with the following results:

Hydrant Flow Test Data

	Pressure, psi	**Flow, gpm**
Dames Park Drive (approximately 93 feet south of the connection at Hyland Green)		
Static	85 psi	0 gpm
Residual	83 psi	1,405 gpm
Autumn Forest Drive (approximately 125 feet north of Park Ridge Drive)		
Static	92 psi	0 gpm
Residual	86 psi	1,135 gpm



BAX ENGINEERING CO., INC.
1052 South Cloverleaf Drive
St. Peters, MO 63376-6445
636-928-5552 FAX 928-1718

DESIGN SOFTWARE/METHODOLOGY USED

The analysis of the proposed water distribution system was completed using Haestad Methods WaterCAD v6.5 Water Distribution Modeling Software.

The most accurate and best approach to modeling a water distribution system is to always model the entire system back to its source. This is not usually a feasible option from an economic standpoint without an existing model of the entire public system being made available. Therefore, an accepted methodology to use when an existing model is unavailable is to use a reservoir and a pump with a three-point pump curve. The reservoir simulates the water supply to the system while the pump and pump curve simulate the pressure drops and available flow from the existing water system.

The points on the pump curve are generated from a fire flow test and the following mathematical formula. The connection pipe between the reservoir, pump, and connection junction to the system should be smooth, short and of a large diameter. Ex. C=150, length of 1 foot, and diameter of 48" are acceptable numbers.

$$Qr = Qf^{*}[(Hr/Hf)^{\wedge}.54]$$

Where:

Qr = Flow available at the desired fire flow residual pressure

Qf = Flow during test

Hr = Pressure drop to desired residual pressure (Static Pressure minus Chosen Design Pressure)

Hf = Pressure drop during fire flow test (Static Pressure minus Residual Pressure)

For this analysis 20 psi was used as the design pressure to calculate the flow available at the desired fire flow residual pressure as that is DNR's minimum.

The pressures at all nodes in the analysis were held to the 65 psi minimum target design pressure without fire flow as dictated by the City.

Demands on the system were based on DNR's 100 gpd per person, 3.7 persons per dwelling, and an 8 hour "day".

The effect of connecting the water distribution system to the water main extension proposed along relocated Koch Road was not analyzed at this time as it was not needed for the system to meet the above referenced design requirements.

SUMMARY OF RESULTS

Villages A, B, and C without fire demands or a connection at relocated Koch Road

The results of the analysis were as follows:

Pressures ranged from 100.79 psi to 86.81 psi, which is greater than the 65 psi City target pressure for the design.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Koch Road.

The results of the analysis were as follows:

Pressures ranged from 92.98 psi to 77.13 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

The results of the analysis were as follows:

Pressures ranged from 89.98 psi to 73.38 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

The results of the analysis were as follows:

Pressures ranged from 89.98 psi to 76.46 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

The above analysis shows that the proposed water distribution system will be more than adequate for the proposed development, as the system exceeds both the City's target design pressure of 65 psi, and DNR's minimum fire flow pressure of 20 psi with individual 1000 gpm fire demands at all hydrant locations furthest from the system sources.

WaterCAD v6.5
Analysis Results
Villages A, B, and C without fire demands or a connection at relocated Koch Road

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without fire demands or a connection at relocated Koch Road.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr

Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	701.98	95.22	220.07	3.85
J-2	701.98	95.97	221.81	0.00
J-3	701.44	100.35	231.94	9.24
J-4	701.36	100.35	231.94	3.08
J-5	701.36	100.67	232.67	0.00
J-6	701.36	98.82	228.41	3.08
J-7	701.36	99.02	228.86	0.00
J-8	701.37	100.35	231.95	3.08
J-9	701.37	100.03	231.21	0.00
J-10	701.42	99.12	229.09	3.08
J-11	701.42	99.10	229.05	0.00
J-12	701.98	95.21	220.05	2.31
J-13	701.98	95.18	219.99	0.00
J-14	701.42	97.88	226.24	3.08
J-15	701.42	97.82	226.09	0.00
J-16	701.98	94.21	217.74	1.54
J-17	701.36	99.21	229.30	4.62
J-18	701.81	94.97	219.52	2.31
J-19	701.81	96.11	222.14	0.00
J-20	701.98	92.42	213.60	5.39
J-21	702.16	91.57	211.64	1.54
J-22	701.99	88.12	203.68	7.70
J-23	701.44	100.04	231.22	2.31
J-24	701.42	100.03	231.19	12.32
J-25	701.37	99.53	230.05	6.16
J-26	701.36	100.79	232.96	15.40
J-27	701.37	99.02	228.86	10.78
J-28	701.81	88.59	204.77	12.32
J-29	701.44	98.09	226.73	0.00
J-30	701.98	94.45	218.29	0.00
J-31	701.43	98.24	227.06	9.24
J-32	701.49	97.32	224.93	3.08
J-33	701.44	98.38	227.40	3.08
J-34	701.98	94.04	217.35	0.00
J-35	701.98	94.04	217.35	0.00
J-36	701.98	93.04	215.05	6.16
J-37	701.98	92.99	214.92	0.00
J-38	701.92	86.81	200.64	4.62
J-39	701.92	86.81	200.65	0.00
J-40	701.81	94.24	217.81	4.62
J-41	701.81	94.23	217.79	0.00
J-42	701.66	94.13	217.56	4.62
J-43	701.66	94.12	217.55	0.00
J-44	701.47	98.23	227.04	9.24
J-45	701.47	98.23	227.04	0.00
J-46	701.44	100.07	231.29	7.70
J-47	701.44	100.07	231.29	0.00
J-48	701.43	99.33	229.58	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr

Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	701.43	99.33	229.59	0.00
J-50	701.42	99.02	228.87	3.85
J-51	701.42	99.02	228.87	0.00
J-52	701.42	98.55	227.78	1.54
J-53	701.42	98.52	227.70	0.00
J-54	701.38	99.07	228.98	0.00
J-55	701.38	99.06	228.96	0.00
J-56	701.36	101.37	234.29	4.62
J-57	701.36	101.35	234.25	0.00
J-58	701.36	99.16	229.19	21.56
J-59	701.36	99.16	229.19	0.00
J-60	701.37	100.00	231.14	3.08
J-61	701.37	99.98	231.08	0.00
J-62	701.45	98.12	226.78	0.00
J-63	701.45	98.12	226.79	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Koch Road.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Kock Road.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	675.54	83.77	193.63	3.85
J-2	675.54	84.53	195.37	0.00
J-3	682.10	91.98	212.60	9.24
J-4	682.02	91.98	212.60	3.08
J-5	682.02	92.30	213.33	0.00
J-6	682.02	90.45	209.07	3.08
J-7	682.02	90.65	209.52	0.00
J-8	682.02	91.98	212.60	3.08
J-9	682.02	91.66	211.86	0.00
J-10	682.08	90.75	209.75	3.08
J-11	682.08	90.73	209.71	0.00
J-12	668.03	80.52	186.10	2.31
J-13	668.03	80.49	186.04	0.00
J-14	682.08	89.51	206.90	3.08
J-15	682.08	89.45	206.75	0.00
J-16	675.54	82.76	191.30	1.54
J-17	682.02	90.84	209.96	4.62
J-18	682.46	86.61	200.17	2.31
J-19	682.46	87.74	202.79	0.00
J-20	668.03	77.73	179.65	5.39
J-21	687.23	85.11	196.71	1.54
J-22	682.64	79.75	184.33	7.70
J-23	682.10	91.67	211.88	2.31
J-24	682.08	91.66	211.85	12.32
J-25	682.02	91.16	210.70	6.16
J-26	682.02	92.42	213.62	15.40
J-27	682.02	90.65	209.51	10.78
J-28	682.47	80.23	185.43	12.32
J-29	682.09	89.72	207.38	0.00
J-30	666.42	79.06	182.73	0.00
J-31	682.09	89.87	207.72	9.24
J-32	682.15	88.95	205.59	3.08
J-33	682.09	90.01	208.05	3.08
J-34	666.42	78.65	181.79	0.00
J-35	662.91	77.13	178.28	1,000.00
J-36	674.61	81.20	187.68	6.16
J-37	674.61	81.14	187.55	0.00
J-38	682.58	78.44	181.30	4.62
J-39	682.58	78.44	181.31	0.00
J-40	682.46	85.87	198.46	4.62
J-41	682.46	85.86	198.44	0.00
J-42	682.31	85.76	198.21	4.62
J-43	682.31	85.75	198.20	0.00
J-44	682.12	89.86	207.69	9.24
J-45	682.12	89.86	207.69	0.00
J-46	682.10	91.70	211.95	7.70
J-47	682.10	91.70	211.95	0.00
J-48	682.08	90.96	210.23	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	682.08	90.96	210.24	0.00
J-50	682.08	90.65	209.53	3.85
J-51	682.08	90.65	209.53	0.00
J-52	682.08	90.18	208.44	1.54
J-53	682.08	90.15	208.36	0.00
J-54	682.04	90.70	209.64	0.00
J-55	682.04	90.69	209.62	0.00
J-56	682.02	93.00	214.95	4.62
J-57	682.02	92.98	214.91	0.00
J-58	682.02	90.79	209.85	21.56
J-59	682.02	90.79	209.85	0.00
J-60	682.02	91.63	211.79	3.08
J-61	682.02	91.61	211.73	0.00
J-62	682.11	89.75	207.44	0.00
J-63	682.11	89.75	207.45	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	688.13	89.22	206.22	3.85
J-2	688.13	89.98	207.96	0.00
J-3	673.05	88.07	203.55	9.24
J-4	661.64	83.17	192.22	3.08
J-5	661.64	83.48	192.95	0.00
J-6	661.64	81.64	188.69	3.08
J-7	661.64	81.83	189.14	0.00
J-8	643.40	75.27	173.98	3.08
J-9	643.40	74.95	173.24	0.00
J-10	671.99	86.38	199.66	3.08
J-11	671.99	86.37	199.62	0.00
J-12	688.13	89.21	206.20	2.31
J-13	688.13	89.19	206.14	0.00
J-14	671.99	85.15	196.81	3.08
J-15	671.99	85.09	196.66	0.00
J-16	688.13	88.21	203.89	1.54
J-17	661.64	82.02	189.58	4.62
J-18	683.68	87.13	201.39	2.31
J-19	683.68	88.27	204.01	0.00
J-20	688.13	86.42	199.75	5.39
J-21	691.47	86.94	200.95	1.54
J-22	688.14	82.13	189.83	7.70
J-23	673.21	87.82	202.99	2.31
J-24	671.99	87.29	201.76	12.32
J-25	658.94	81.17	187.62	6.16
J-26	661.64	83.61	193.24	15.40
J-27	661.65	81.83	189.14	10.78
J-28	683.69	80.75	186.65	12.32
J-29	671.63	85.20	196.92	0.00
J-30	688.13	88.45	204.44	0.00
J-31	672.00	85.51	197.63	9.24
J-32	673.88	85.37	197.32	3.08
J-33	671.36	85.37	197.32	3.08
J-34	688.13	88.05	203.50	0.00
J-35	688.13	88.05	203.50	0.00
J-36	688.13	87.05	201.20	6.16
J-37	688.13	86.99	201.07	0.00
J-38	686.40	80.09	185.12	4.62
J-39	686.40	80.10	185.13	0.00
J-40	683.68	86.39	199.68	4.62
J-41	683.68	86.39	199.66	0.00
J-42	679.04	84.34	194.94	4.62
J-43	679.04	84.34	194.93	0.00
J-44	673.53	86.14	199.10	9.24
J-45	673.53	86.14	199.10	0.00
J-46	672.85	87.70	202.70	7.70
J-47	672.85	87.70	202.70	0.00
J-48	672.00	86.59	200.15	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr

Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	672.00	86.60	200.16	0.00
J-50	671.99	86.29	199.44	3.85
J-51	671.99	86.29	199.44	0.00
J-52	671.99	85.82	198.35	1.54
J-53	671.99	85.78	198.27	0.00
J-54	663.30	82.59	190.90	0.00
J-55	663.30	82.58	190.88	0.00
J-56	661.64	84.18	194.57	4.62
J-57	661.64	84.16	194.53	0.00
J-58	661.64	81.98	189.47	21.56
J-59	661.64	81.98	189.47	0.00
J-60	643.40	74.92	173.17	3.08
J-61	639.89	73.38	169.60	1,000.00
J-62	672.20	85.46	197.53	0.00
J-63	672.20	85.47	197.54	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	688.13	89.22	206.22	3.85
J-2	688.13	89.98	207.96	0.00
J-3	673.05	88.07	203.55	9.24
J-4	647.35	76.98	177.93	3.08
J-5	647.35	77.30	178.66	0.00
J-6	660.72	81.24	187.77	3.08
J-7	660.72	81.43	188.22	0.00
J-8	661.65	83.17	192.23	3.08
J-9	661.65	82.85	191.49	0.00
J-10	671.99	86.38	199.66	3.08
J-11	671.99	86.37	199.62	0.00
J-12	688.13	89.21	206.20	2.31
J-13	688.13	89.19	206.14	0.00
J-14	671.99	85.15	196.81	3.08
J-15	671.99	85.09	196.66	0.00
J-16	688.13	88.21	203.89	1.54
J-17	660.72	81.62	188.66	4.62
J-18	683.68	87.13	201.39	2.31
J-19	683.68	88.27	204.01	0.00
J-20	688.13	86.42	199.75	5.39
J-21	691.47	86.94	200.95	1.54
J-22	688.14	82.13	189.83	7.70
J-23	673.21	87.82	202.99	2.31
J-24	671.99	87.29	201.76	12.32
J-25	661.65	82.35	190.33	6.16
J-26	658.71	82.34	190.31	15.40
J-27	661.65	81.83	189.14	10.78
J-28	683.69	80.75	186.65	12.32
J-29	671.63	85.20	196.92	0.00
J-30	688.13	88.45	204.44	0.00
J-31	672.00	85.51	197.63	9.24
J-32	673.88	85.37	197.32	3.08
J-33	671.36	85.37	197.32	3.08
J-34	688.13	88.05	203.50	0.00
J-35	688.13	88.05	203.50	0.00
J-36	688.13	87.05	201.20	6.16
J-37	688.13	86.99	201.07	0.00
J-38	686.40	80.09	185.12	4.62
J-39	686.40	80.10	185.13	0.00
J-40	683.68	86.39	199.68	4.62
J-41	683.68	86.39	199.66	0.00
J-42	679.04	84.34	194.94	4.62
J-43	679.04	84.34	194.93	0.00
J-44	673.53	86.14	199.10	9.24
J-45	673.53	86.14	199.10	0.00
J-46	672.85	87.70	202.70	7.70
J-47	672.85	87.70	202.70	0.00
J-48	672.00	86.59	200.15	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	672.00	86.60	200.16	0.00
J-50	671.99	86.29	199.44	3.85
J-51	671.99	86.29	199.44	0.00
J-52	671.99	85.82	198.35	1.54
J-53	671.99	85.78	198.27	0.00
J-54	663.30	82.59	190.90	0.00
J-55	663.30	82.58	190.88	0.00
J-56	647.35	78.00	180.28	4.62
J-57	643.84	76.46	176.73	1,000.00
J-58	660.25	81.37	188.08	21.56
J-59	660.25	81.37	188.08	0.00
J-60	661.65	82.82	191.42	3.08
J-61	661.65	82.79	191.36	0.00
J-62	672.20	85.46	197.53	0.00
J-63	672.20	85.47	197.54	0.00

ENGINEERING

PLANNING

SURVEYING

WATER DISTRIBUTION SYSTEM ANALYSIS
PREPARED BY: BAX ENGINEERING CO., INC.

HYLAND GREEN VILLAGES A, B, AND C – CITY OF O'FALLON
BAX PROJECT NO. 98-10293C
June 9, 2004

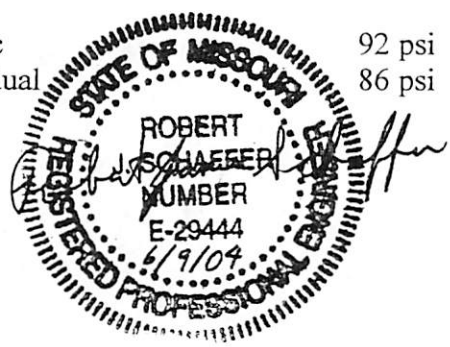
INTRODUCTION

The presently undeveloped tract of land lies north of Highway P, north of the existing Dames Park development. The tract contains 90.5± acres which is to be developed into Hyland Green Villages A, B, and C, a single-family development containing 270 lots zoned R-1 P.U.D. averaging 5,000 square feet per lot. The purpose of this analysis will be to show that the proposed water distribution system will meet the requirements of a steady state analysis of both DNR's 1000 gpm @ 20 psi minimum fire flow requirement and the City's 65 psi target design pressure requirement per their April 26, 2004 comment letter.

GENERAL SITE AND FLOW TEST DATA FOR CONNECTION POINTS

The site will be connected to the City of O' Fallon's water system off of an existing 16-inch main paralleling Highway P along the site's southern most boundary. This main also serves the existing Dames Park development. The Dames Park development is served by 8" mains off of the existing 16"main. The Hyland Green development will also be served by 8" mains, these mains will be tapped off of the existing 8" mains serving Dames Park as directed by the City of O' Fallon. The flow test data used for design was obtained on June 8, 2004 by the O' Fallon fire department with the following results:

	Hydrant Flow Test Data	
	Pressure, psi	**Flow, gpm**
Dames Park Drive (approximately 93 feet south of the connection at Hyland Green)		
Static	85 psi	0 gpm
Residual	83 psi	1,405 gpm
Autumn Forest Drive (approximately 125 feet north of Park Ridge Drive)		
Static	92 psi	0 gpm
Residual	86 psi	1,135 gpm



BAX ENGINEERING CO., INC.
1052 South Cloverleaf Drive
St. Peters, MO 63376-6445
636-928-5552 FAX 928-1718

DESIGN SOFTWARE/METHODOLOGY USED

The analysis of the proposed water distribution system was completed using Haestad Methods WaterCAD v6.5 Water Distribution Modeling Software.

The most accurate and best approach to modeling a water distribution system is to always model the entire system back to its source. This is not usually a feasible option from an economic standpoint without an existing model of the entire public system being made available. Therefore, an accepted methodology to use when an existing model is unavailable is to use a reservoir and a pump with a three-point pump curve. The reservoir simulates the water supply to the system while the pump and pump curve simulate the pressure drops and available flow from the existing water system.

The points on the pump curve are generated from a fire flow test and the following mathematical formula. The connection pipe between the reservoir, pump, and connection junction to the system should be smooth, short and of a large diameter. Ex. C=150, length of 1 foot, and diameter of 48" are acceptable numbers.

$$Qr = Qf*[(Hr/Hf)^{.54}]$$

Where:

Qr = Flow available at the desired fire flow residual pressure

Qf = Flow during test

Hr = Pressure drop to desired residual pressure (Static Pressure minus Chosen Design Pressure)

Hf = Pressure drop during fire flow test (Static Pressure minus Residual Pressure)

For this analysis 20 psi was used as the design pressure to calculate the flow available at the desired fire flow residual pressure as that is DNR's minimum.

The pressures at all nodes in the analysis were held to the 65 psi minimum target design pressure without fire flow as dictated by the City.

Demands on the system were based on DNR's 100 gpd per person, 3.7 persons per dwelling, and an 8 hour "day".

The effect of connecting the water distribution system to the water main extension proposed along relocated Koch Road was not analyzed at this time as it was not needed for the system to meet the above referenced design requirements.

SUMMARY OF RESULTS

Villages A, B, and C without fire demands or a connection at relocated Koch Road

The results of the analysis were as follows:

Pressures ranged from 100.79 psi to 86.81 psi, which is greater than the 65 psi City target pressure for the design.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Koch Road.

The results of the analysis were as follows:

Pressures ranged from 92.98 psi to 77.13 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

The results of the analysis were as follows:

Pressures ranged from 89.98 psi to 73.38 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

The results of the analysis were as follows:

Pressures ranged from 89.98 psi to 76.46 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

The above analysis shows that the proposed water distribution system will be more than adequate for the proposed development, as the system exceeds both the City's target design pressure of 65 psi, and DNR's minimum fire flow pressure of 20 psi with individual 1000 gpm fire demands at all hydrant locations furthest from the system sources.

WaterCAD v6.5
Analysis Results
Villages A, B, and C without fire demands or a connection at relocated Koch Road

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without fire demands or a connection at relocated Koch Road.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	701.98	95.22	220.07	3.85
J-2	701.98	95.97	221.81	0.00
J-3	701.44	100.35	231.94	9.24
J-4	701.36	100.35	231.94	3.08
J-5	701.36	100.67	232.67	0.00
J-6	701.36	98.82	228.41	3.08
J-7	701.36	99.02	228.86	0.00
J-8	701.37	100.35	231.95	3.08
J-9	701.37	100.03	231.21	0.00
J-10	701.42	99.12	229.09	3.08
J-11	701.42	99.10	229.05	0.00
J-12	701.98	95.21	220.05	2.31
J-13	701.98	95.18	219.99	0.00
J-14	701.42	97.88	226.24	3.08
J-15	701.42	97.82	226.09	0.00
J-16	701.98	94.21	217.74	1.54
J-17	701.36	99.21	229.30	4.62
J-18	701.81	94.97	219.52	2.31
J-19	701.81	96.11	222.14	0.00
J-20	701.98	92.42	213.60	5.39
J-21	702.16	91.57	211.64	1.54
J-22	701.99	88.12	203.68	7.70
J-23	701.44	100.04	231.22	2.31
J-24	701.42	100.03	231.19	12.32
J-25	701.37	99.53	230.05	6.16
J-26	701.36	100.79	232.96	15.40
J-27	701.37	99.02	228.86	10.78
J-28	701.81	88.59	204.77	12.32
J-29	701.44	98.09	226.73	0.00
J-30	701.98	94.45	218.29	0.00
J-31	701.43	98.24	227.06	9.24
J-32	701.49	97.32	224.93	3.08
J-33	701.44	98.38	227.40	3.08
J-34	701.98	94.04	217.35	0.00
J-35	701.98	94.04	217.35	0.00
J-36	701.98	93.04	215.05	6.16
J-37	701.98	92.99	214.92	0.00
J-38	701.92	86.81	200.64	4.62
J-39	701.92	86.81	200.65	0.00
J-40	701.81	94.24	217.81	4.62
J-41	701.81	94.23	217.79	0.00
J-42	701.66	94.13	217.56	4.62
J-43	701.66	94.12	217.55	0.00
J-44	701.47	98.23	227.04	9.24
J-45	701.47	98.23	227.04	0.00
J-46	701.44	100.07	231.29	7.70
J-47	701.44	100.07	231.29	0.00
J-48	701.43	99.33	229.58	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	701.43	99.33	229.59	0.00
J-50	701.42	99.02	228.87	3.85
J-51	701.42	99.02	228.87	0.00
J-52	701.42	98.55	227.78	1.54
J-53	701.42	98.52	227.70	0.00
J-54	701.38	99.07	228.98	0.00
J-55	701.38	99.06	228.96	0.00
J-56	701.36	101.37	234.29	4.62
J-57	701.36	101.35	234.25	0.00
J-58	701.36	99.16	229.19	21.56
J-59	701.36	99.16	229.19	0.00
J-60	701.37	100.00	231.14	3.08
J-61	701.37	99.98	231.08	0.00
J-62	701.45	98.12	226.78	0.00
J-63	701.45	98.12	226.79	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Koch Road.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Kock Road.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	675.54	83.77	193.63	3.85
J-2	675.54	84.53	195.37	0.00
J-3	682.10	91.98	212.60	9.24
J-4	682.02	91.98	212.60	3.08
J-5	682.02	92.30	213.33	0.00
J-6	682.02	90.45	209.07	3.08
J-7	682.02	90.65	209.52	0.00
J-8	682.02	91.98	212.60	3.08
J-9	682.02	91.66	211.86	0.00
J-10	682.08	90.75	209.75	3.08
J-11	682.08	90.73	209.71	0.00
J-12	668.03	80.52	186.10	2.31
J-13	668.03	80.49	186.04	0.00
J-14	682.08	89.51	206.90	3.08
J-15	682.08	89.45	206.75	0.00
J-16	675.54	82.76	191.30	1.54
J-17	682.02	90.84	209.96	4.62
J-18	682.46	86.61	200.17	2.31
J-19	682.46	87.74	202.79	0.00
J-20	668.03	77.73	179.65	5.39
J-21	687.23	85.11	196.71	1.54
J-22	682.64	79.75	184.33	7.70
J-23	682.10	91.67	211.88	2.31
J-24	682.08	91.66	211.85	12.32
J-25	682.02	91.16	210.70	6.16
J-26	682.02	92.42	213.62	15.40
J-27	682.02	90.65	209.51	10.78
J-28	682.47	80.23	185.43	12.32
J-29	682.09	89.72	207.38	0.00
J-30	666.42	79.06	182.73	0.00
J-31	682.09	89.87	207.72	9.24
J-32	682.15	88.95	205.59	3.08
J-33	682.09	90.01	208.05	3.08
J-34	666.42	78.65	181.79	0.00
J-35	662.91	77.13	178.28	1,000.00
J-36	674.61	81.20	187.68	6.16
J-37	674.61	81.14	187.55	0.00
J-38	682.58	78.44	181.30	4.62
J-39	682.58	78.44	181.31	0.00
J-40	682.46	85.87	198.46	4.62
J-41	682.46	85.86	198.44	0.00
J-42	682.31	85.76	198.21	4.62
J-43	682.31	85.75	198.20	0.00
J-44	682.12	89.86	207.69	9.24
J-45	682.12	89.86	207.69	0.00
J-46	682.10	91.70	211.95	7.70
J-47	682.10	91.70	211.95	0.00
J-48	682.08	90.96	210.23	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr

Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	682.08	90.96	210.24	0.00
J-50	682.08	90.65	209.53	3.85
J-51	682.08	90.65	209.53	0.00
J-52	682.08	90.18	208.44	1.54
J-53	682.08	90.15	208.36	0.00
J-54	682.04	90.70	209.64	0.00
J-55	682.04	90.69	209.62	0.00
J-56	682.02	93.00	214.95	4.62
J-57	682.02	92.98	214.91	0.00
J-58	682.02	90.79	209.85	21.56
J-59	682.02	90.79	209.85	0.00
J-60	682.02	91.63	211.79	3.08
J-61	682.02	91.61	211.73	0.00
J-62	682.11	89.75	207.44	0.00
J-63	682.11	89.75	207.45	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	688.13	89.22	206.22	3.85
J-2	688.13	89.98	207.96	0.00
J-3	673.05	88.07	203.55	9.24
J-4	661.64	83.17	192.22	3.08
J-5	661.64	83.48	192.95	0.00
J-6	661.64	81.64	188.69	3.08
J-7	661.64	81.83	189.14	0.00
J-8	643.40	75.27	173.98	3.08
J-9	643.40	74.95	173.24	0.00
J-10	671.99	86.38	199.66	3.08
J-11	671.99	86.37	199.62	0.00
J-12	688.13	89.21	206.20	2.31
J-13	688.13	89.19	206.14	0.00
J-14	671.99	85.15	196.81	3.08
J-15	671.99	85.09	196.66	0.00
J-16	688.13	88.21	203.89	1.54
J-17	661.64	82.02	189.58	4.62
J-18	683.68	87.13	201.39	2.31
J-19	683.68	88.27	204.01	0.00
J-20	688.13	86.42	199.75	5.39
J-21	691.47	86.94	200.95	1.54
J-22	688.14	82.13	189.83	7.70
J-23	673.21	87.82	202.99	2.31
J-24	671.99	87.29	201.76	12.32
J-25	658.94	81.17	187.62	6.16
J-26	661.64	83.61	193.24	15.40
J-27	661.65	81.83	189.14	10.78
J-28	683.69	80.75	186.65	12.32
J-29	671.63	85.20	196.92	0.00
J-30	688.13	88.45	204.44	0.00
J-31	672.00	85.51	197.63	9.24
J-32	673.88	85.37	197.32	3.08
J-33	671.36	85.37	197.32	3.08
J-34	688.13	88.05	203.50	0.00
J-35	688.13	88.05	203.50	0.00
J-36	688.13	87.05	201.20	6.16
J-37	688.13	86.99	201.07	0.00
J-38	686.40	80.09	185.12	4.62
J-39	686.40	80.10	185.13	0.00
J-40	683.68	86.39	199.68	4.62
J-41	683.68	86.39	199.66	0.00
J-42	679.04	84.34	194.94	4.62
J-43	679.04	84.34	194.93	0.00
J-44	673.53	86.14	199.10	9.24
J-45	673.53	86.14	199.10	0.00
J-46	672.85	87.70	202.70	7.70
J-47	672.85	87.70	202.70	0.00
J-48	672.00	86.59	200.15	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	672.00	86.60	200.16	0.00
J-50	671.99	86.29	199.44	3.85
J-51	671.99	86.29	199.44	0.00
J-52	671.99	85.82	198.35	1.54
J-53	671.99	85.78	198.27	0.00
J-54	663.30	82.59	190.90	0.00
J-55	663.30	82.58	190.88	0.00
J-56	661.64	84.18	194.57	4.62
J-57	661.64	84.16	194.53	0.00
J-58	661.64	81.98	189.47	21.56
J-59	661.64	81.98	189.47	0.00
J-60	643.40	74.92	173.17	3.08
J-61	639.89	73.38	169.60	1,000.00
J-62	672.20	85.46	197.53	0.00
J-63	672.20	85.47	197.54	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr

Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	688.13	89.22	206.22	3.85
J-2	688.13	89.98	207.96	0.00
J-3	673.05	88.07	203.55	9.24
J-4	647.35	76.98	177.93	3.08
J-5	647.35	77.30	178.66	0.00
J-6	660.72	81.24	187.77	3.08
J-7	660.72	81.43	188.22	0.00
J-8	661.65	83.17	192.23	3.08
J-9	661.65	82.85	191.49	0.00
J-10	671.99	86.38	199.66	3.08
J-11	671.99	86.37	199.62	0.00
J-12	688.13	89.21	206.20	2.31
J-13	688.13	89.19	206.14	0.00
J-14	671.99	85.15	196.81	3.08
J-15	671.99	85.09	196.66	0.00
J-16	688.13	88.21	203.89	1.54
J-17	660.72	81.62	188.66	4.62
J-18	683.68	87.13	201.39	2.31
J-19	683.68	88.27	204.01	0.00
J-20	688.13	86.42	199.75	5.39
J-21	691.47	86.94	200.95	1.54
J-22	688.14	82.13	189.83	7.70
J-23	673.21	87.82	202.99	2.31
J-24	671.99	87.29	201.76	12.32
J-25	661.65	82.35	190.33	6.16
J-26	658.71	82.34	190.31	15.40
J-27	661.65	81.83	189.14	10.78
J-28	683.69	80.75	186.65	12.32
J-29	671.63	85.20	196.92	0.00
J-30	688.13	88.45	204.44	0.00
J-31	672.00	85.51	197.63	9.24
J-32	673.88	85.37	197.32	3.08
J-33	671.36	85.37	197.32	3.08
J-34	688.13	88.05	203.50	0.00
J-35	688.13	88.05	203.50	0.00
J-36	688.13	87.05	201.20	6.16
J-37	688.13	86.99	201.07	0.00
J-38	686.40	80.09	185.12	4.62
J-39	686.40	80.10	185.13	0.00
J-40	683.68	86.39	199.68	4.62
J-41	683.68	86.39	199.66	0.00
J-42	679.04	84.34	194.94	4.62
J-43	679.04	84.34	194.93	0.00
J-44	673.53	86.14	199.10	9.24
J-45	673.53	86.14	199.10	0.00
J-46	672.85	87.70	202.70	7.70
J-47	672.85	87.70	202.70	0.00
J-48	672.00	86.59	200.15	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	672.00	86.60	200.16	0.00
J-50	671.99	86.29	199.44	3.85
J-51	671.99	86.29	199.44	0.00
J-52	671.99	85.82	198.35	1.54
J-53	671.99	85.78	198.27	0.00
J-54	663.30	82.59	190.90	0.00
J-55	663.30	82.58	190.88	0.00
J-56	647.35	78.00	180.28	4.62
J-57	643.84	76.46	176.73	1,000.00
J-58	660.25	81.37	188.08	21.56
J-59	660.25	81.37	188.08	0.00
J-60	661.65	82.82	191.42	3.08
J-61	661.65	82.79	191.36	0.00
J-62	672.20	85.46	197.53	0.00
J-63	672.20	85.47	197.54	0.00

ENGINEERING

PLANNING

SURVEYING

WATER DISTRIBUTION SYSTEM ANALYSIS
PREPARED BY: BAX ENGINEERING CO., INC.

HYLAND GREEN VILLAGES A, B, AND C – CITY OF O'FALLON
BAX PROJECT NO. 98-10293C
June 9, 2004

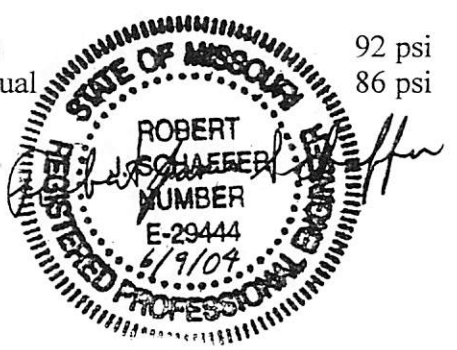
INTRODUCTION

The presently undeveloped tract of land lies north of Highway P, north of the existing Dames Park development. The tract contains 90.5± acres which is to be developed into Hyland Green Villages A, B, and C, a single-family development containing 270 lots zoned R-1 P.U.D. averaging 5,000 square feet per lot. The purpose of this analysis will be to show that the proposed water distribution system will meet the requirements of a steady state analysis of both DNR's 1000 gpm @ 20 psi minimum fire flow requirement and the City's 65 psi target design pressure requirement per their April 26, 2004 comment letter.

GENERAL SITE AND FLOW TEST DATA FOR CONNECTION POINTS

The site will be connected to the City of O' Fallon's water system off of an existing 16-inch main paralleling Highway P along the site's southern most boundary. This main also serves the existing Dames Park development. The Dames Park development is served by 8" mains off of the existing 16"main. The Hyland Green development will also be served by 8" mains, these mains will be tapped off of the existing 8" mains serving Dames Park as directed by the City of O' Fallon. The flow test data used for design was obtained on June 8, 2004 by the O' Fallon fire department with the following results:

	Hydrant Flow Test Data	
	Pressure, psi	**Flow, gpm**
Dames Park Drive (approximately 93 feet south of the connection at Hyland Green)		
Static	85 psi	0 gpm
Residual	83 psi	1,405 gpm
Autumn Forest Drive (approximately 125 feet north of Park Ridge Drive)		
Static	92 psi	0 gpm
Residual	86 psi	1,135 gpm



BAX ENGINEERING CO., INC.
1052 South Cloverleaf Drive
St. Peters, MO 63376-6445
636-928-5552 FAX 928-1718

DESIGN SOFTWARE/METHODOLOGY USED

The analysis of the proposed water distribution system was completed using Haestad Methods WaterCAD v6.5 Water Distribution Modeling Software.

The most accurate and best approach to modeling a water distribution system is to always model the entire system back to its source. This is not usually a feasible option from an economic standpoint without an existing model of the entire public system being made available. Therefore, an accepted methodology to use when an existing model is unavailable is to use a reservoir and a pump with a three-point pump curve. The reservoir simulates the water supply to the system while the pump and pump curve simulate the pressure drops and available flow from the existing water system.

The points on the pump curve are generated from a fire flow test and the following mathematical formula. The connection pipe between the reservoir, pump, and connection junction to the system should be smooth, short and of a large diameter. Ex. C=150, length of 1 foot, and diameter of 48" are acceptable numbers.

$$Qr = Qf^{*}[(Hr/Hf)^{\wedge}.54]$$

Where: Qr = Flow available at the desired fire flow residual pressure

Qf = Flow during test

Hr = Pressure drop to desired residual pressure (Static Pressure minus Chosen Design Pressure)

Hf = Pressure drop during fire flow test (Static Pressure minus Residual Pressure)

For this analysis 20 psi was used as the design pressure to calculate the flow available at the desired fire flow residual pressure as that is DNR's minimum.

The pressures at all nodes in the analysis were held to the 65 psi minimum target design pressure without fire flow as dictated by the City.

Demands on the system were based on DNR's 100 gpd per person, 3.7 persons per dwelling, and an 8 hour "day".

The effect of connecting the water distribution system to the water main extension proposed along relocated Koch Road was not analyzed at this time as it was not needed for the system to meet the above referenced design requirements.

SUMMARY OF RESULTS

Villages A, B, and C without fire demands or a connection at relocated Koch Road

The results of the analysis were as follows:

Pressures ranged from 100.79 psi to 86.81 psi, which is greater than the 65 psi City target pressure for the design.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Koch Road.

The results of the analysis were as follows:

Pressures ranged from 92.98 psi to 77.13 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

The results of the analysis were as follows:

Pressures ranged from 89.98 psi to 73.38 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

The results of the analysis were as follows:

Pressures ranged from 89.98 psi to 76.46 psi, which is greater than both the 65 psi City target pressure and DNR's 20 psi minimum for fire flow.

The above analysis shows that the proposed water distribution system will be more than adequate for the proposed development, as the system exceeds both the City's target design pressure of 65 psi, and DNR's minimum fire flow pressure of 20 psi with individual 1000 gpm fire demands at all hydrant locations furthest from the system sources.

WaterCAD v6.5
Analysis Results
Villages A, B, and C without fire demands or a connection at relocated Koch Road

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without fire demands or a connection at relocated Koch Road.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	701.98	95.22	220.07	3.85
J-2	701.98	95.97	221.81	0.00
J-3	701.44	100.35	231.94	9.24
J-4	701.36	100.35	231.94	3.08
J-5	701.36	100.67	232.67	0.00
J-6	701.36	98.82	228.41	3.08
J-7	701.36	99.02	228.86	0.00
J-8	701.37	100.35	231.95	3.08
J-9	701.37	100.03	231.21	0.00
J-10	701.42	99.12	229.09	3.08
J-11	701.42	99.10	229.05	0.00
J-12	701.98	95.21	220.05	2.31
J-13	701.98	95.18	219.99	0.00
J-14	701.42	97.88	226.24	3.08
J-15	701.42	97.82	226.09	0.00
J-16	701.98	94.21	217.74	1.54
J-17	701.36	99.21	229.30	4.62
J-18	701.81	94.97	219.52	2.31
J-19	701.81	96.11	222.14	0.00
J-20	701.98	92.42	213.60	5.39
J-21	702.16	91.57	211.64	1.54
J-22	701.99	88.12	203.68	7.70
J-23	701.44	100.04	231.22	2.31
J-24	701.42	100.03	231.19	12.32
J-25	701.37	99.53	230.05	6.16
J-26	701.36	100.79	232.96	15.40
J-27	701.37	99.02	228.86	10.78
J-28	701.81	88.59	204.77	12.32
J-29	701.44	98.09	226.73	0.00
J-30	701.98	94.45	218.29	0.00
J-31	701.43	98.24	227.06	9.24
J-32	701.49	97.32	224.93	3.08
J-33	701.44	98.38	227.40	3.08
J-34	701.98	94.04	217.35	0.00
J-35	701.98	94.04	217.35	0.00
J-36	701.98	93.04	215.05	6.16
J-37	701.98	92.99	214.92	0.00
J-38	701.92	86.81	200.64	4.62
J-39	701.92	86.81	200.65	0.00
J-40	701.81	94.24	217.81	4.62
J-41	701.81	94.23	217.79	0.00
J-42	701.66	94.13	217.56	4.62
J-43	701.66	94.12	217.55	0.00
J-44	701.47	98.23	227.04	9.24
J-45	701.47	98.23	227.04	0.00
J-46	701.44	100.07	231.29	7.70
J-47	701.44	100.07	231.29	0.00
J-48	701.43	99.33	229.58	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	701.43	99.33	229.59	0.00
J-50	701.42	99.02	228.87	3.85
J-51	701.42	99.02	228.87	0.00
J-52	701.42	98.55	227.78	1.54
J-53	701.42	98.52	227.70	0.00
J-54	701.38	99.07	228.98	0.00
J-55	701.38	99.06	228.96	0.00
J-56	701.36	101.37	234.29	4.62
J-57	701.36	101.35	234.25	0.00
J-58	701.36	99.16	229.19	21.56
J-59	701.36	99.16	229.19	0.00
J-60	701.37	100.00	231.14	3.08
J-61	701.37	99.98	231.08	0.00
J-62	701.45	98.12	226.78	0.00
J-63	701.45	98.12	226.79	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Koch Road.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at Roxbury Drive and Relocated Kock Road.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	675.54	83.77	193.63	3.85
J-2	675.54	84.53	195.37	0.00
J-3	682.10	91.98	212.60	9.24
J-4	682.02	91.98	212.60	3.08
J-5	682.02	92.30	213.33	0.00
J-6	682.02	90.45	209.07	3.08
J-7	682.02	90.65	209.52	0.00
J-8	682.02	91.98	212.60	3.08
J-9	682.02	91.66	211.86	0.00
J-10	682.08	90.75	209.75	3.08
J-11	682.08	90.73	209.71	0.00
J-12	668.03	80.52	186.10	2.31
J-13	668.03	80.49	186.04	0.00
J-14	682.08	89.51	206.90	3.08
J-15	682.08	89.45	206.75	0.00
J-16	675.54	82.76	191.30	1.54
J-17	682.02	90.84	209.96	4.62
J-18	682.46	86.61	200.17	2.31
J-19	682.46	87.74	202.79	0.00
J-20	668.03	77.73	179.65	5.39
J-21	687.23	85.11	196.71	1.54
J-22	682.64	79.75	184.33	7.70
J-23	682.10	91.67	211.88	2.31
J-24	682.08	91.66	211.85	12.32
J-25	682.02	91.16	210.70	6.16
J-26	682.02	92.42	213.62	15.40
J-27	682.02	90.65	209.51	10.78
J-28	682.47	80.23	185.43	12.32
J-29	682.09	89.72	207.38	0.00
J-30	666.42	79.06	182.73	0.00
J-31	682.09	89.87	207.72	9.24
J-32	682.15	88.95	205.59	3.08
J-33	682.09	90.01	208.05	3.08
J-34	666.42	78.65	181.79	0.00
J-35	662.91	77.13	178.28	1,000.00
J-36	674.61	81.20	187.68	6.16
J-37	674.61	81.14	187.55	0.00
J-38	682.58	78.44	181.30	4.62
J-39	682.58	78.44	181.31	0.00
J-40	682.46	85.87	198.46	4.62
J-41	682.46	85.86	198.44	0.00
J-42	682.31	85.76	198.21	4.62
J-43	682.31	85.75	198.20	0.00
J-44	682.12	89.86	207.69	9.24
J-45	682.12	89.86	207.69	0.00
J-46	682.10	91.70	211.95	7.70
J-47	682.10	91.70	211.95	0.00
J-48	682.08	90.96	210.23	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	682.08	90.96	210.24	0.00
J-50	682.08	90.65	209.53	3.85
J-51	682.08	90.65	209.53	0.00
J-52	682.08	90.18	208.44	1.54
J-53	682.08	90.15	208.36	0.00
J-54	682.04	90.70	209.64	0.00
J-55	682.04	90.69	209.62	0.00
J-56	682.02	93.00	214.95	4.62
J-57	682.02	92.98	214.91	0.00
J-58	682.02	90.79	209.85	21.56
J-59	682.02	90.79	209.85	0.00
J-60	682.02	91.63	211.79	3.08
J-61	682.02	91.61	211.73	0.00
J-62	682.11	89.75	207.44	0.00
J-63	682.11	89.75	207.45	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

Analysis Results
Scenario: Base
Steady State Analysis

Title:	Hyland Green 10293C
Project Engineer:	Robert Schaffer
Project Date:	06/02/04 01:38:53 PM
Comments:	Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive north of Roxbury Drive.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr

Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	688.13	89.22	206.22	3.85
J-2	688.13	89.98	207.96	0.00
J-3	673.05	88.07	203.55	9.24
J-4	661.64	83.17	192.22	3.08
J-5	661.64	83.48	192.95	0.00
J-6	661.64	81.64	188.69	3.08
J-7	661.64	81.83	189.14	0.00
J-8	643.40	75.27	173.98	3.08
J-9	643.40	74.95	173.24	0.00
J-10	671.99	86.38	199.66	3.08
J-11	671.99	86.37	199.62	0.00
J-12	688.13	89.21	206.20	2.31
J-13	688.13	89.19	206.14	0.00
J-14	671.99	85.15	196.81	3.08
J-15	671.99	85.09	196.66	0.00
J-16	688.13	88.21	203.89	1.54
J-17	661.64	82.02	189.58	4.62
J-18	683.68	87.13	201.39	2.31
J-19	683.68	88.27	204.01	0.00
J-20	688.13	86.42	199.75	5.39
J-21	691.47	86.94	200.95	1.54
J-22	688.14	82.13	189.83	7.70
J-23	673.21	87.82	202.99	2.31
J-24	671.99	87.29	201.76	12.32
J-25	658.94	81.17	187.62	6.16
J-26	661.64	83.61	193.24	15.40
J-27	661.65	81.83	189.14	10.78
J-28	683.69	80.75	186.65	12.32
J-29	671.63	85.20	196.92	0.00
J-30	688.13	88.45	204.44	0.00
J-31	672.00	85.51	197.63	9.24
J-32	673.88	85.37	197.32	3.08
J-33	671.36	85.37	197.32	3.08
J-34	688.13	88.05	203.50	0.00
J-35	688.13	88.05	203.50	0.00
J-36	688.13	87.05	201.20	6.16
J-37	688.13	86.99	201.07	0.00
J-38	686.40	80.09	185.12	4.62
J-39	686.40	80.10	185.13	0.00
J-40	683.68	86.39	199.68	4.62
J-41	683.68	86.39	199.66	0.00
J-42	679.04	84.34	194.94	4.62
J-43	679.04	84.34	194.93	0.00
J-44	673.53	86.14	199.10	9.24
J-45	673.53	86.14	199.10	0.00
J-46	672.85	87.70	202.70	7.70
J-47	672.85	87.70	202.70	0.00
J-48	672.00	86.59	200.15	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	672.00	86.60	200.16	0.00
J-50	671.99	86.29	199.44	3.85
J-51	671.99	86.29	199.44	0.00
J-52	671.99	85.82	198.35	1.54
J-53	671.99	85.78	198.27	0.00
J-54	663.30	82.59	190.90	0.00
J-55	663.30	82.58	190.88	0.00
J-56	661.64	84.18	194.57	4.62
J-57	661.64	84.16	194.53	0.00
J-58	661.64	81.98	189.47	21.56
J-59	661.64	81.98	189.47	0.00
J-60	643.40	74.92	173.17	3.08
J-61	639.89	73.38	169.60	1,000.00
J-62	672.20	85.46	197.53	0.00
J-63	672.20	85.47	197.54	0.00

WaterCAD v6.5
Analysis Results
Villages A, B, and C without connection at relocated Koch Road.
1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

Analysis Results
Scenario: Base
Steady State Analysis

Title: Hyland Green 10293C
Project Engineer: Robert Schaffer
Project Date: 06/02/04 01:38:53 PM
Comments: Villages A, B, and C without connection at relocated Koch Road. 1000 gpm fire demand at hydrant at cul-de-sac on Wayland Drive south of Roxbury Drive.

Scenario Summary	
Scenario	Base
Active Topology Alternative	Base-Active Topology
Physical Alternative	Base-Physical
Demand Alternative	Base-Demand
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
Capital Cost Alternative	Base-Capital Cost
Energy Cost Alternative	Base-Energy 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	68	Number of Tanks	0
Number of Reservoirs	2	- Constant Area:	0
Number of Pressure Junctions	63	- Variable Area:	0
Number of Pumps	2	Number of Valves	0
- Constant Power:	0	- FCV's:	0
- One Point (Design Point):	0	- PBV's:	0
- Standard (3 Point):	2	- PRV's:	0
- Standard Extended:	0	- PSV's:	0
- Custom Extended:	0	- TCV's:	0
- Multiple Point:	0	- GPV's:	0
Number of Spot Elevations	0		

Pressure Pipes Inventory			
2.0 in	857.00 ft	8.0 in	7,214.00 ft
6.0 in	2,625.00 ft	48.0 in	4.00 ft
Total Length	10,700.00 ft		

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr

Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-1	688.13	89.22	206.22	3.85
J-2	688.13	89.98	207.96	0.00
J-3	673.05	88.07	203.55	9.24
J-4	647.35	76.98	177.93	3.08
J-5	647.35	77.30	178.66	0.00
J-6	660.72	81.24	187.77	3.08
J-7	660.72	81.43	188.22	0.00
J-8	661.65	83.17	192.23	3.08
J-9	661.65	82.85	191.49	0.00
J-10	671.99	86.38	199.66	3.08
J-11	671.99	86.37	199.62	0.00
J-12	688.13	89.21	206.20	2.31
J-13	688.13	89.19	206.14	0.00
J-14	671.99	85.15	196.81	3.08
J-15	671.99	85.09	196.66	0.00
J-16	688.13	88.21	203.89	1.54
J-17	660.72	81.62	188.66	4.62
J-18	683.68	87.13	201.39	2.31
J-19	683.68	88.27	204.01	0.00
J-20	688.13	86.42	199.75	5.39
J-21	691.47	86.94	200.95	1.54
J-22	688.14	82.13	189.83	7.70
J-23	673.21	87.82	202.99	2.31
J-24	671.99	87.29	201.76	12.32
J-25	661.65	82.35	190.33	6.16
J-26	658.71	82.34	190.31	15.40
J-27	661.65	81.83	189.14	10.78
J-28	683.69	80.75	186.65	12.32
J-29	671.63	85.20	196.92	0.00
J-30	688.13	88.45	204.44	0.00
J-31	672.00	85.51	197.63	9.24
J-32	673.88	85.37	197.32	3.08
J-33	671.36	85.37	197.32	3.08
J-34	688.13	88.05	203.50	0.00
J-35	688.13	88.05	203.50	0.00
J-36	688.13	87.05	201.20	6.16
J-37	688.13	86.99	201.07	0.00
J-38	686.40	80.09	185.12	4.62
J-39	686.40	80.10	185.13	0.00
J-40	683.68	86.39	199.68	4.62
J-41	683.68	86.39	199.66	0.00
J-42	679.04	84.34	194.94	4.62
J-43	679.04	84.34	194.93	0.00
J-44	673.53	86.14	199.10	9.24
J-45	673.53	86.14	199.10	0.00
J-46	672.85	87.70	202.70	7.70
J-47	672.85	87.70	202.70	0.00
J-48	672.00	86.59	200.15	7.77

Analysis Results
Scenario: Base
Steady State Analysis

Pressure Junctions @ 0.00 hr				
Label	Calculated Hydraulic Grade (ft)	Pressure (psi)	Pressure Head (ft)	Demand (Calculated) (gpm)
J-49	672.00	86.60	200.16	0.00
J-50	671.99	86.29	199.44	3.85
J-51	671.99	86.29	199.44	0.00
J-52	671.99	85.82	198.35	1.54
J-53	671.99	85.78	198.27	0.00
J-54	663.30	82.59	190.90	0.00
J-55	663.30	82.58	190.88	0.00
J-56	647.35	78.00	180.28	4.62
J-57	643.84	76.46	176.73	1,000.00
J-58	660.25	81.37	188.08	21.56
J-59	660.25	81.37	188.08	0.00
J-60	661.65	82.82	191.42	3.08
J-61	661.65	82.79	191.36	0.00
J-62	672.20	85.46	197.53	0.00
J-63	672.20	85.47	197.54	0.00