APPENDIX 3

CONCEPT DESIGN

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APPENDIX 3
CONCEPT DESIGN

INTRODUCTION

This design includes water source, treatment, conveyance and limited storage for a wholesale water system in the Lake Tenkiller area. The Phase III design extends the system developed in Phase II to include Sallisaw, Sequoyah County RWSG & SWMD #7, Muldrow, and Roland. This wholesale water system will provide a single connection point for each water district served. Each water district will retain existing distribution and storage facilities. Three alternatives for the system have been studied.

SOURCE

The water source is Lake Tenkiller. A water intake structure will be located near the water treatment plant. The main water treatment plant and intake structure will be located at the south end of the lake, near the dam. The primary consideration for locating the plant is the best water quality. Alternative 1, the second phase of Alternative 2, and Alternative 3 assume that a second treatment plant and intake station (located at the north end of the lake) would be added to serve Tahlequah and water districts north and east of Stick Ross Mountain. At the sponsor's request, the treatment plant will be sized based on current demand.

TREATMENT

The following facilities are recommended for preliminary feasibility development purposes:

Intake - Floating type with multiple levels as required by ODEQ design standards.

WTP - Conventional coagulation-sedimentation using polymer followed by multimedia gravity filters (anthracite, sand, and garnet). Facilities for pre- and post-chlorination in case taste and odor problems are experienced. Also, may want to provide facilities for adding other oxidants on an "as needed" basis for taste and odor and organic compounds produced during chlorination, such as activated carbon and permanganate. Addition of chemicals for water stability may also be required.

CONVEYANCE

The majority of the underground piping for Phase III will be ductile iron pipe conforming to AWWA C151, working pressure not less than 350 psi. Ductile iron pipe will be cement-mortar lined in accordance with AWWA C104 and encased with polyethylene in accordance with AWWA C105. A sacrificial anode cathodic protection system will be included for the ductile iron pipe.

Ductile iron pipe was selected due to higher working pressures and lower cost. High pressures, up to 200 psi, will be necessary in some parts of the system. The high pressure requirements are due to the large variation in elevation of the system. When compared with PVC pipe, ductile iron pipe in sizes larger than 8 inches in diameter, has a significantly larger inside diameter and therefore lower pressure drop. For example, 16-inch ductile iron pipe has an inside diameter of 16.8 inches. The inside diameter of 16-inch PVC pipe is 14.5 inches. A pressure reducing valve and flow control valve will be required at most connection points. See computer outputs at the back of this appendix for pressures required at each node in the system. Additional pressure reducing stations will be located in the pipeline to Gore and the pipeline to Vian in order to keep pressures below 200 psi.

Piping has been sized by hydraulic analysis using the computer program KYPIPE, developed by the University of Kentucky. Maps showing pipe numbers and node numbers are included at the end of this appendix. Computer printouts of the hydraulic analysis are also included. The piping is sized based on 24-hour operation of the treatment plant at a constant flow rate.

In addition to the three booster pump stations included in the Phase II analysis, an additional booster pump station will be required at Sallisaw. The addition of the booster pump station will allow smaller pipe sizes and result in a lower initial and life cycle cost.

Other conveyance system components will include air/vacuum valves at pipeline high points and sectional control valves to assist in repairs and limit outages.

STORAGE

Minimal finished water storage will be provided to maintain uniform pressures in the system and to provide a reserve supply during emergencies such as power outages, fires, and equipment failures. An elevated storage tank will be located near Aqua Park, another one will be located near Keys, and a third elevated storage tank will be located about 4 miles north of Muldrow. The elevated tank at Aqua Park will be unusually tall due to the high pressures required in the system. The height of the elevated tank at Keys will be 145 feet, the height of the elevated tank at Aqua Park will be 245 feet, and the height of the elevated tank at Muldrow will be 150 feet. The elevated tanks will be the fluted column type and will meet all the requirements of AWWA D100. Each storage tank will be provided with an altitude valve.

COST

For comparison of alternatives and to determine economic feasibility, a cost per 10,000 gallons of water has been calculated for each alternative. It is assumed that the Wholesale Water System will be financed entirely with revenue bonds. The Oklahoma Water Resources Board indicates that terms for the bonds will be 29 years at 5-1/2% interest. All system components were assumed to have a life of at least 29 years. All costs are in today's dollars.

The total initial cost of the system includes construction cost, engineering and construction management, and real estate. The fee for engineering and construction management is assumed to be 10% of the construction cost. The initial cost will be financed by the sale of revenue bonds, which include a 3-1/2% charge for legal fees and commissions. Using a capital

recovery factor, based on bond terms of 29 years at 5-1/2% interest, an annual capital cost is calculated.

Included in the total annual cost is the annual capital cost and costs for operations and maintenance. Included in the operations and maintenance costs are energy costs, labor, sludge disposal, and chemicals for water treatment. Costs for operations and maintenance were taken from the "Handbook of Public Water Systems" published in 1986. These costs were escalated for inflation to reflect current costs.

To obtain a cost per 10,000 gallons, the total annual cost was divided by the annual water sales. The annual water sales were based on current average daily consumption increased by a factor of 20% to account for higher summer usage.

ALTERNATIVE 1

This alternative includes all 27 water districts. This alternative assumes that the cities of Tahlequah and Sallisaw will supplement their water supply by purchasing 25% of their needs and 25% of the water that Tahlequah supplies to Cherokee RWDs #3, #7, and #8. Water for this alternative will be provided by a new 7.5-mgd plant located at the south end of Lake Tenkiller and a new treatment plant with a capacity of 3.5 mgd located at the north end of Lake Tenkiller. Finished water storage capacity will be 2,000,000 gallons. Refer to Tables 3-1, 3-2, and 3-3 for districts included, water usage, and component sizes. Figures showing conveyance lines, treatment plant locations, booster pump stations, and storage tank locations are presented in the main report as Figures 2 and 3.

Table 3-1. Tenkiller Wholesale Water System - Alternative 1
Two Water Treatment Plants – 7.5 MGD and 3.5 MGD

Water District	Node	Average Current Daily Demand (Gal Per Day)	Current Peak Daily Demand (Gal Per Day)	Current Flow to Meet Peak (Gal Per Min)	Average Future Daily Demand (Gal Per Day)	Peak Future Daily Demand (Gal Per Day)	Future Flow to Meet Peak (Gal Per Min)
Burnt Cabin	250	30,000	50,000	35	42,000	70,000	49
Cherokee City RWD #1	820	70,000	85,000	59	99,000	120,000	83
Cherokee City RWD #2	600	80,000	140,000	97	113,000	198,000	138
Cherokee City RWD #3							
Cherokee City RWD #7							
Cherokee City RWD #8							
Cherokee City RWD #13	480	70,000	140,000	97	99,000	198,000	138
City of Sallisaw	80	575,000	1,075,000	747	810,000	1,514,000	1,051
East Central OK Water	130	190,000	250,000	174	268,000	353,000	245
Fin & Feather Water	210	35,000	45,000	31	49,000	63,000	44
Lake Tenkiller Harbor	250	30,000	100,000	69	42,000	140,000	97
Lost City RWD	830	200,000	350,000	243	282,000	494,000	343
Muskogee City RWD #4	900	69,000	69,000	48	97,000	145,000	101
Muskogee City RWD #7	810	134,000	200,000	139	189,000	282,000	196
Paradise Hills	210	22,000	105,000	73	31,000	148,000	103
Sequoyah Cty Water W	400	635,000	734,000	510	895,000	1,032,000	715
Sequoyah Cty Water E	60	750,000	866,000	601	1,056,000	1,218,000	845
Sequoyah Cty #7	50	480,000	725,000	503	676,000	1,021,000	709
Stick Ross Mtn Water	650	200,000	275,000	191	282,000	388,000	269
Summit Water	510	67,000	100,000	69	94,000	140,000	97
Tahlequah Water	670	646,000	1,099,000	763	900,000	1,570,000	1,090
LRED	270			72			100
LRED	460			72			100
LRED	520	55,000	250,000	30	77,000	350,000	43
Tenkiller Aqua Park	200	10,000	37,000	26	14,000	52,000	36
Tenkiller State Park	400	18,000	120,000	83	25,000	167,000	116
Gore	140	271,000	332,000	231	382,000	468,000	325
Muldrow	55	500,000	640,000	444	705,000	902,000	626
Roland Utility Authority	45	275,000	300,000	208	387,000	422,000	293
Vian	170	180,000	180,000	125	254,000	311,000	216
Totals		4,946,000	8,267,000	5,741	7,868,000	11,766,000	8,168

Table 3-2. Tenkiller Wholesale Water System - Alternative 1 - Cost of Water

Construction Cost ($)	38,086,000
Engineering and Construction Management (10%)	3,809,000
Real Estate Cost ($)	884,000
Total Initial Cost ($)	42,779,000
Bond Legal Fees and Commissions (3-1/2%)	1,497,000
Total Bond Amount ($)	44,276,000
Capital Recovery Factor (29 years at 5-1/2%)	0.06977
Annual Capital Cost ($)	3,089,000
Annual Operation and Maintenance Cost ($)	685,000
Total Annual Cost ($)	3,774,000
Average Present Daily Usage (gallons)	4,946,000
Initial Annual Water Sales (million gallons)	2,166
Initial Cost per 10,000 Gallons ($)	17

Table 3-3. Tenkiller Wholesale Water System - Alternative 1 - Pipe Requirements

Location	Pipe Size (inches) and Length (miles)								
	6	8	10	12	14	16	18	20	24
East side of lake	4.5	10		5			5		
West side of lake		5.5	10.5	2.5					
South of lake to Gore		7							
To Vian		8							
North of lake to Hwy 62	5			5					
Hwy 62 north				1.5					
Hwy 62 west				13.5					
4 Mile Road	3.5	4							
To Cherokee Co. RWD #3									
East of Tahlequah									
To Water Tanks				1					
To Vian and Sallisaw							21.6		
Sallisaw to Sequoyah County Water Association						11.5			
Water Tank to East of Muldrow				6.2					
To Roland	2.2								
To Sequoyah County #7									
Totals	15.2	34.5	10.5	34.7	0	11.5	26.6	0	0

ALTERNATIVE 2

The first phase of Alternative 2 includes Stick Ross Mountain, Cherokee County RWD #2, and all participating water districts south of Cherokee County RWD #2 (15 districts total). A new treatment plant with a capacity of 3.5 mgd will be required for this alternative. Total finished water storage will be 1,500,000 gallons. Refer to Tables 3-4, 3-5, and 3-6 for districts included, water usage, water costs, and component sizes. A figure showing conveyance lines, treatment plant locations, booster pump stations, and storage tank locations is presented in the main report as Figure 4.

A second phase of Alternative 2 will be constructed in the year 2010 and include all 27 water districts. At the end of the second phase of construction, the system be equivalent to the system in Alternative 1. The second phase will include replacing 5 miles of 6-inch line with 12-inch line at the north end of the lake and 5 miles of 12-inch line with 18-inch line at the south end of the lake. The 3.5-mgd treatment plant located at the south end of the lake from Phase 1 will be expanded to 7.5 mgd, and a second 3.5-mgd treatment plant will be constructed at the north end of the lake. An additional 500,000 gallons of finished water storage will be included at Muldrow. Refer to Tables 3-7, 3-8, and 3-9 for districts included, water usage, water cost, and component sizes. Figures showing conveyance lines, treatment plant locations, booster pump stations, and storage tank locations are presented in the main report as Figures 2 and 3.

Table 3-4. Tenkiller Wholesale Water System - Alternative 2
(First Phase) New Water Treatment Plant – 3.5 MGD

Water District	Node	Average Current Daily Demand (Gal Per Day)	Current Peak Daily Demand (Gal Per Day)	Current Flow to Meet Peak (Gal Per Min)	Average Future Daily Demand (Gal Per Day)	Peak Future Daily Demand (Gal Per Day)	Future Flow to Meet Peak (Gal Per Min)
Burnt Cabin	250	30,000	50,000	35	42,000	70,000	49
Cherokee City RWD #1	820						
Cherokee City RWD #2	600	80,000	140,000	97	113,000	198,000	138
Cherokee City RWD #3							
Cherokee City RWD #7							
Cherokee City RWD #8							
Cherokee City RWD #13	480	70,000	140,000	97	99,000	198,000	138
City of Sallisaw	80						
East Central OK Water	130	190,000	250,000	174	268,000	353,000	245
Fin & Feather Water	210	35,000	45,000	31	49,000	63,000	44
Lake Tenkiller Harbor	250	30,000	100,000	69	42,000	140,000	97
Lost City RWD	830						
Muskogee City RWD #4	900						
Muskogee City RWD #7	810						
Paradise Hills	210	22,000	105,000	73	31,000	148,000	103
Sequoyah Cty Water W	400	635,000	734,000	510	895,000	1,032,000	715
Sequoyah Cty Water E	60						
Sequoyah Cty #7	50						
Stick Ross Mtn Water	650	200,000	275,000	191	282,000	388,000	269
Summit Water	510	67,000	100,000	69	94,000	140,000	97
Tahlequah Water	670						
LRED	270			72			100
LRED	460			72			100
LRED	520	55,000	250,000	30	77,000	350,000	43
Tenkiller Aqua Park	200	10,000	37,000	26	14,000	52,000	36
Tenkiller State Park	400	18,000	120,000	83	25,000	167,000	116
Gore	140	271,000	332,000	231	382,000	468,000	325
Muldrow	55						
Roland Utility Authority	45						
Vian	170	180,000	180,000	125	254,000	311,000	216
Totals		1,893,000	2,858,000	1,985	2,667,000	4,078,000	2,831

Table 3-5. Tenkiller Wholesale Water System - Alternative 2 - Cost of Water
(First Phase)

Construction Cost ($)	13,199,000
Engineering and Construction Management (10%)	1,320,000
Real Estate Cost ($)	510,000
Total Initial Cost ($)	15,029,000
Bond Legal Fees and Commissions (3-1/2%)	526,000
Total Bond Amount ($)	15,555,000
Capital Recovery Factor (29 years at 5-1/2%)	0.06977
Annual Capital Cost ($)	1,085,000
Annual Operation and Maintenance Cost ($)	262,000
Total Annual Cost ($)	1,347,000
Average Present Daily Usage (gallons)	1,893,000
Initial Annual Water Sales (million gallons)	829
Initial Cost per 10,000 Gallons ($)	16

Table 3-6. Tenkiller Wholesale Water System - Alternative 2 - Pipe Requirements
(First Phase)

Location	Pipe Size (inches) and Length (miles)							
	6	**8**	**10**	**12**	**14**	**18**	**20**	**24**
East side of lake	9.5	10		5				
West side of lake		5.5	10.5	2.5				
South of lake to Gore		7						
To Vian		8						
North of lake to Hwy 62	5							
Hwy 62 north								
Hwy 62 west								
4 Mile Road								
To Cherokee Co. RWD #3								
East of Tahlequah								
To Water Tanks				1				
Totals	14.5	30.5	10.5	8.5	0	0	0	0

**Table 3-7. Tenkiller Wholesale Water System - Alternative 2
(Second Phase) Two Water Treatment Plants – 7.5 MGD and 3.5 MGD**

Water District	Node	Average 2010 Daily Demand (Gal Per Day)	2010 Peak Daily Demand (Gal Per Day)	2010 Flow to Meet Peak (Gal Per Min)	Average Future Daily Demand (Gal Per Day)	Peak Future Daily Demand (Gal Per Day)	Future Flow to Meet Peak (Gal Per Min)
Burnt Cabin	250	36,000	60,000	42	42,000	70,000	49
Cherokee City RWD #1	820	84,000	102,000	71	99,000	120,000	83
Cherokee City RWD #2	600	95,000	166,000	115	113,000	198,000	138
Cherokee City RWD #3							
Cherokee City RWD #7							
Cherokee City RWD #8							
Cherokee City RWD #13	480	84,000	168,000	117	99,000	198,000	138
City of Sallisaw	80	686,000	1,283,000	891	810,000	1,514,000	1,051
East Central OK Water	130	227,000	299,000	208	268,000	353,000	245
Fin & Feather Water	210	42,000	54,000	38	49,000	63,000	44
Lake Tenkiller Harbor	250	36,000	120,000	83	42,000	140,000	97
Lost City RWD	830	239,000	419,000	291	282,000	494,000	343
Muskogee City RWD #4	900	82,000	123,000	85	97,000	145,000	101
Muskogee City RWD #7	810	160,000	239,000	166	189,000	282,000	196
Paradise Hills	210	26,000	124,000	86	31,000	148,000	103
Sequoyah Cty Water W	400	758,000	874,000	607	895,000	1,032,000	715
Sequoyah Cty Water E	60	895,000	1,032,000	717	1,056,000	1,218,000	845
Sequoyah Cty #7	50	573,000	865,000	601	676,000	1,021,000	709
Stick Ross Mtn Water	650	239,000	329,000	228	282,000	388,000	269
Summit Water	510	80,000	119,000	83	94,000	140,000	97
Tahlequah Water	670	734,000	1,280,000	889	900,000	1,570,000	1,090
LRED	270			72			100
LRED	460			72			100
LRED	520	66,000	300,000	30	77,000	350,000	43
Tenkiller Aqua Park	200	12,000	45,000	31	14,000	52,000	36
Tenkiller State Park	400	21,000	140,000	97	25,000	167,000	116
Gore	140	323,000	396,000	275	382,000	468,000	325
Muldrow	55	597,000	764,000	531	705,000	902,000	626
Roland Utility Authority	45	328,000	358,000	249	387,000	422,000	293
Vian	170	215,000	263,000	183	254,000	311,000	216
Totals		5,904,000	9,922,000	6,856	7,868,000	11,766,000	8,168

Table 3-8. Tenkiller Wholesale Water System - Alternative 2 - Cost of Water
(Second Phase)

Construction Cost For Expansion($)	26,519,000
Engineering and Construction Management (10%)	2,652,000
Real Estate Cost ($)	374,000
Total Initial Cost For Expansion ($)	29,545,000
Bond Legal Fees and Commissions (3-1/2%)	1,034,000
Total Bond Amount For Expansion ($)	30,579,000
Capital Recovery Factor (29 years at 5-1/2%)	0.06977
Annual Capital Cost For Expansion ($)	2,133,000
Annual Operation and Maintenance Cost For Expansion ($)	423,000
Total Annual Cost For Expansion ($)	2,556,000
Average Daily Usage in Year 2010 (gallons)	5,904,000
Annual Water Sales in Year 2010 (million gallons)	2,586
Cost per 10,000 Gallons For Expansion ($)	10
Total Cost per 10,000 Gallons in 2010 ($)	15

Table 3-9. Tenkiller Wholesale Water System - Alternative 2 - Pipe Requirements
(Second Phase)

Location	Pipe Size (inches) and Length (miles)								
	6	8	10	12	14	16	18	20	24
East side of lake				5			5		
West side of lake									
South of lake to Gore									
To Vian									
North of lake to Hwy 62				5					
Hwy 62 north				1.5					
Hwy 62 west				13.5					
4 Mile Road	3.5	4							
To Cherokee Co. RWD #3									
East of Tahlequah									
To Water Tanks									
To Vian and Sallisaw							21.6		
Sallisaw to Sequoyah County Water Association						11.5			
Water Tank to East of Muldrow				6.2					
To Roland	2.2								
To Sequoyah County #7									
Totals	5.7	4	0	31.2	0	11.5	26.6	0	0

ALTERNATIVE 3

This alternative is the same as Alternative 1 except an additional demand of 7,000 gpm (the capacity of a 24-inch pipe flowing at about 5 feet per second) has been added at Roland. Water for this alternative will be provided by a new 19.5-mgd plant located at the south end of Lake Tenkiller and a new treatment plant with a capacity of 3.5 mgd located at the north end of Lake Tenkiller. Finished water storage capacity will be 2,000,000 gallons. Refer to Tables 3-10, 3-11, and 3-12 for districts included, water usage, water costs, and component sizes. Figures showing conveyance lines, treatment plant locations, booster pump stations, and storage tank locations are presented in the main report as Figures 5 and 6.

Table 3-10 Tenkiller Wholesale Water System - Alternative 3
Two Water Treatment Plants – 19.5 MGD and 3.5 MGD

Water District	Node	Average Current Daily Demand (Gal Per Day)	Current Peak Daily Demand (Gal Per Day)	Current Flow to Meet Peak (Gal Per Min)	Average Future Daily Demand (Gal Per Day)	Peak Future Daily Demand (Gal Per Day)	Future Flow to Meet Peak (Gal Per Min)
Burnt Cabin	250	30,000	50,000	35	42,000	70,000	49
Cherokee City RWD #1	820	70,000	85,000	59	99,000	120,000	83
Cherokee City RWD #2	600	80,000	140,000	97	113,000	198,000	138
Cherokee City RWD #3							
Cherokee City RWD #7							
Cherokee City RWD #8							
Cherokee City RWD #13	480	70,000	140,000	97	99,000	198,000	138
City of Sallisaw	80	575,000	1,075,000	747	810,000	1,514,000	1,051
East Central OK Water	130	190,000	250,000	174	268,000	353,000	245
Fin & Feather Water	210	35,000	45,000	31	49,000	63,000	44
Lake Tenkiller Harbor	250	30,000	100,000	69	42,000	140,000	97
Lost City RWD	830	200,000	350,000	243	282,000	494,000	343
Muskogee City RWD #4	900	69,000	69,000	48	97,000	145,000	101
Muskogee City RWD #7	810	134,000	200,000	139	189,000	282,000	196
Paradise Hills	210	22,000	105,000	73	31,000	148,000	103
Sequoyah Cty Water W	400	635,000	734,000	510	895,000	1,032,000	715
Sequoyah Cty Water E	60	750,000	866,000	601	1,056,000	1,218,000	845
Sequoyah Cty #7	50	480,000	725,000	503	676,000	1,021,000	709
Stick Ross Mtn Water	650	200,000	275,000	191	282,000	388,000	269
Summit Water	510	67,000	100,000	69	94,000	140,000	97
Tahlequah Water	670	646,000	1,099,000	763	900,000	1,570,000	1,090
LRED	270			72			100
LRED	460			72			100
LRED	520	55,000	250,000	30	77,000	350,000	43
Tenkiller Aqua Park	200	10,000	37,000	26	14,000	52,000	36
Tenkiller State Park	400	18,000	120,000	83	25,000	167,000	116
Gore	140	271,000	332,000	231	382,000	468,000	325
Muldrow	55	500,000	640,000	444	705,000	902,000	626
Roland Utility Authority	45	275,000	300,000	208	387,000	422,000	293
Vian	170	180,000	180,000	125	254,000	311,000	216
24" Pipe at Roland	45	10,080,000	10,080,000	7,000	10,080,000	10,080,000	7,000
Totals		15,026,000	18,347,000	12,741	17,948,000	21,846,000	15,168

Table 3-11. Tenkiller Wholesale Water System - Alternative 3 - Cost of Water

Construction Cost ($)	55,920,000
Engineering and Construction Management (10%)	5,592,000
Real Estate Cost ($)	884,000
Total Initial Cost ($)	62,396,000
Bond Legal Fees and Commissions (3-1/2%)	2,184,000
Total Bond Amount ($)	64,580,000
Capital Recovery Factor (29 years at 5-1/2%)	0.06977
Annual Capital Cost ($)	4,506,000
Annual Operation and Maintenance Cost ($)	1,438,000
Total Annual Cost ($)	5,944,000
Average Present Daily Usage (gallons)	15,026,000
Initial Annual Water Sales (million gallons)	5,484
Initial Cost per 10,000 Gallons ($)	11

Table 3-12. Tenkiller Wholesale Water System - Alternative 3 - Pipe Requirements

Location	Pipe Size (inches) and Length (miles)									
	6	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**
East side of lake	4.5	10		5			5			5
West side of lake		5.5	10.5	2.5						
South of lake to Gore		7								
To Vian		8								
North of lake to Hwy 62	5			5						
Hwy 62 north				1.5						
Hwy 62 west				13.5						
4 Mile Road	3.5	4								
To Cherokee Co. RWD #3										
East of Tahlequah										
To Water Tanks				1						
To Vian and Sallisaw										21.6
Sallisaw to Sequoyah County Water Association									11.5	
Water Tank to East of Muldrow									6.2	
To Roland									2.2	
To Sequoyah County #7										
Totals	13	34.5	10.5	28.5	0	0	0	0	19.9	26.6

HYDRAULIC ANALYSIS

Computer Analysis

The hydraulic analysis for sizing the piping was performed with the KYPIPE computer program developed by the University of Kentucky. The figures on the following pages show the pipe and node numbers, node elevations, and pipe lengths. Computer input and output for the three alternatives follow the figures. Piping was sized based on the 24-hour average flow required to meet the projected peak daily demand in the year 2050.

Water Plant

Sequoyah Cty
Water Assn West

400
405
410

110

400

410

160
162
165
170

160
162
165
170
Vian

90

90

85
85

Sallisaw
80
80

75
75

77
77

70
70

75

65
60
65

Sequoyah Co
Water Assn East
60

55
Muldrow
55

50
50

45
45
Roland

Sequoyah Cty #7

Scale:
0 1 2 3 4 5 — 10 miles
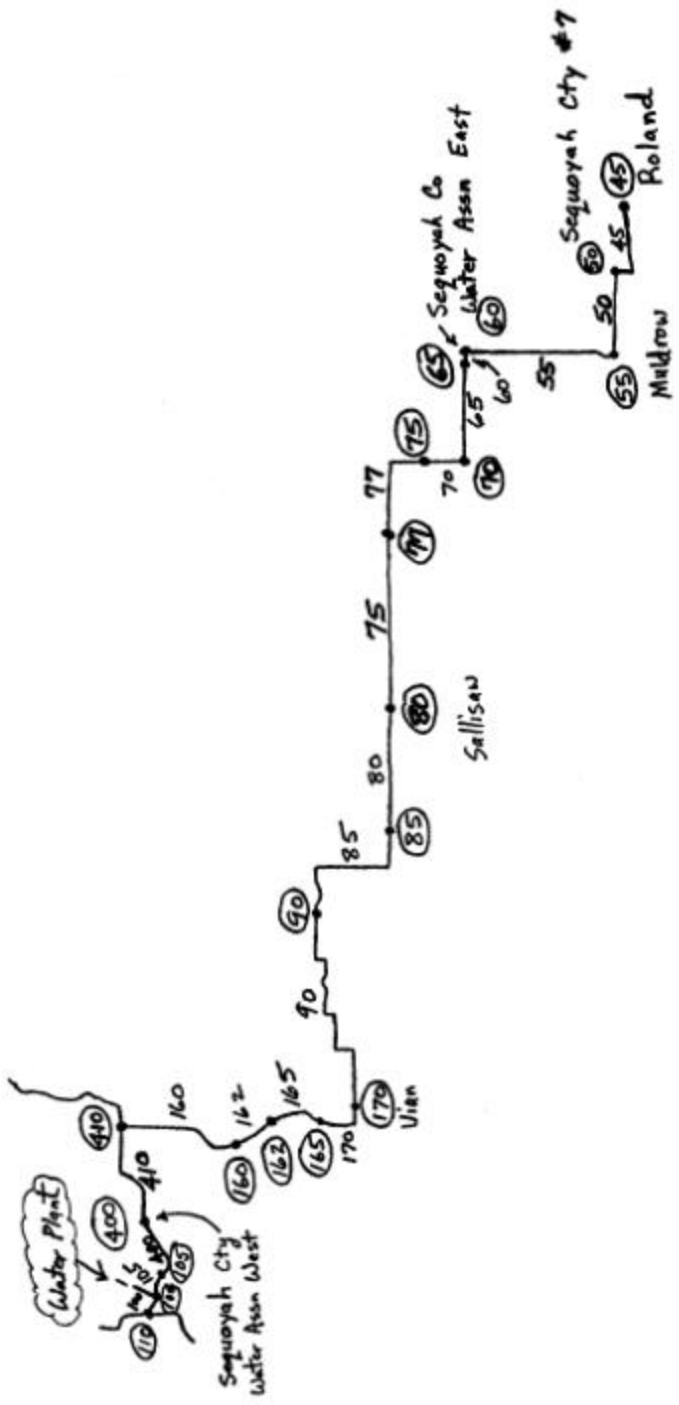
Nodes (xx)
Pipes xx
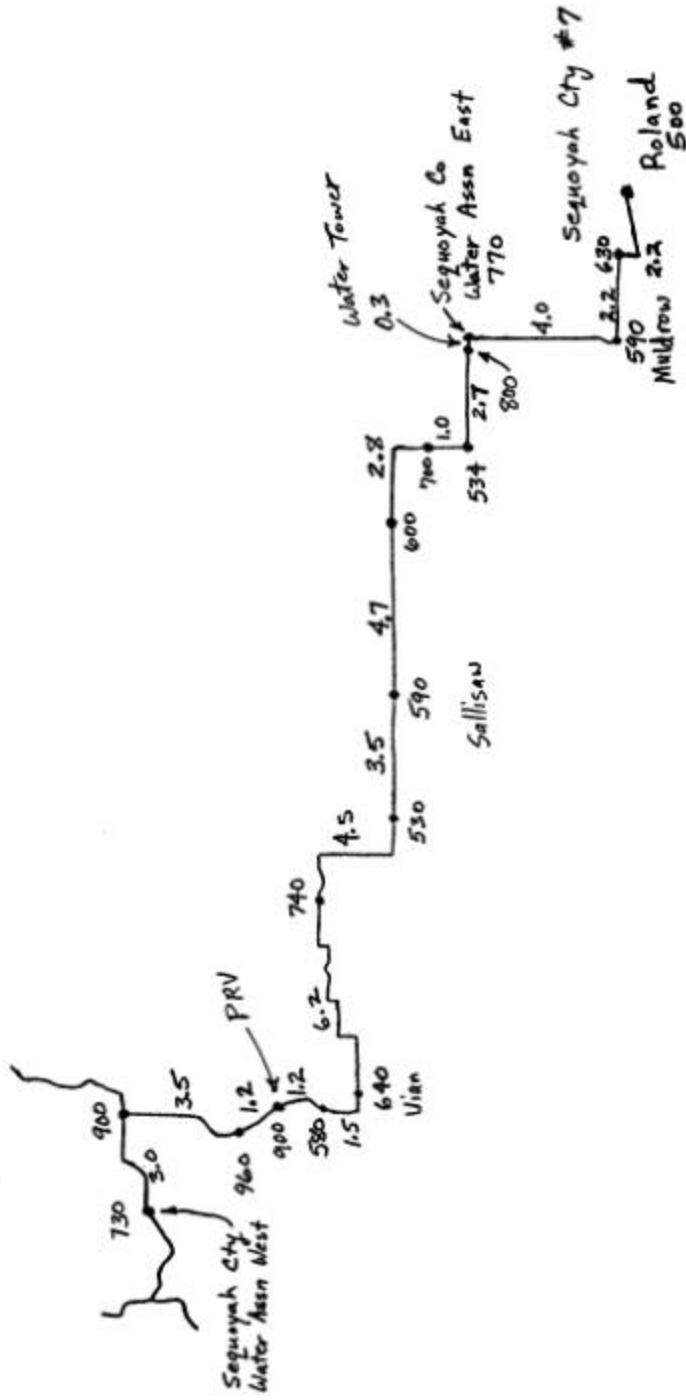
Node elevation (Feet)
Pipe length (miles)

Sequoyah City Water Assn West

730

3.0

900

3.5

960

900

580

1.2

1.2

PRV

1.5

640
Vian

740

6.2

4.5

530

3.5

590
Sallisaw

4.7

600

740

2.8

534

1.0

800

2.7

Water Tower
0.3

Sequoyah Co
Water Assn East
770

4.0

590
Muldrow

3.2

630

2.2

Sequoyah City #7

Roland
500

Scale:
0 1 2 3 4 5   10 miles

FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

THERE IS A PRV AT JUNCTION 162 FOR LINE 165 SET AT A GRADE OF 950.00
THERE IS A PRV AT JUNCTION 110 FOR LINE 110 SET AT A GRADE OF 845.00

PIPE NO.	NODE NOS.		LENGTH (FEET)	DIAMETER (INCHES)	ROUGHNESS	MINOR LOSS K	FIXED GRADE
1	0	100	1.0	18.8	140.0	.00	1146.00
2	0	670	1.0	12.4	140.0	.00	1000.00
LINE 2 IS CLOSED							
3	0	510	2640.0	12.4	140.0	.00	1100.00
45	50	45	11600.0	12.4	140.0	.00	
50	55	50	11600.0	12.4	140.0	.00	
55	60	55	21120.0	12.4	140.0	.00	
60	65	60	1320.0	16.6	140.0	.00	
65	70	65	14520.0	16.6	140.0	.00	
70	75	70	5280.0	16.6	140.0	.00	
75	80	77	25080.0	16.6	140.0	.00	
LINE 75 PUMP DATA (HEAD-FLOW):			416.0	.0	370.0	2500.0	358.0 3000.0
77	77	75	14520.0	16.6	140.0	.00	
80	85	80	18480.0	18.7	140.0	.00	
85	90	85	23760.0	18.7	140.0	.00	
90	170	90	33000.0	18.7	140.0	.00	
100	100	110	2640.0	12.4	140.0	.00	
105	105	100	2640.0	18.7	140.0	.00	
110	110	120	5280.0	8.4	140.0	.00	
120	120	130	7920.0	8.4	140.0	.00	
130	130	140	23760.0	8.4	140.0	.00	
160	410	160	18480.0	18.7	140.0	.00	
162	160	162	6600.0	18.7	140.0	.00	
165	162	165	6600.0	18.7	140.0	.00	
170	165	170	7920.0	18.7	140.0	.00	
200	110	200	7920.0	12.4	140.0	.00	
210	200	210	2640.0	12.4	140.0	.00	
220	210	220	7920.0	10.4	140.0	.00	
230	220	230	15840.0	10.4	140.0	.00	
240	230	240	13200.0	10.4	140.0	.00	
250	240	250	2640.0	10.4	140.0	.00	
260	250	260	15840.0	10.4	140.0	.00	
270	260	270	7920.0	10.4	140.0	.00	
280	270	280	2640.0	10.4	140.0	.00	

290	280	290	5280.0	10.4	140.0		.00		
300	290	300	7920.0	10.4	140.0		.00		
310	300	310	2640.0	10.4	140.0		.00		
320	310	600	10560.0	10.4	140.0		.00		
LINE 320 PUMP DATA (HEAD-FLOW):			145.0	.0	137.0	500.0	114.0	800.0	
400	105	400	10560.0	18.7	140.0		.00		
410	400	410	15840.0	18.7	140.0		.00		
420	410	420	10560.0	8.4	140.0		.00		
430	420	430	5280.0	8.4	140.0		.00		
440	430	440	2640.0	8.4	140.0		.00		
450	440	450	7920.0	8.4	140.0		.00		
460	450	460	5280.0	8.4	140.0		.00		
470	460	470	5280.0	8.4	140.0		.00		
480	470	480	15840.0	8.4	140.0		.00		
490	480	490	7920.0	6.3	140.0		.00		
500	490	500	10560.0	6.3	140.0		.00		
510	500	510	2640.0	6.3	140.0		.00		
520	510	520	10560.0	12.4	140.0		.00		
530	520	530	10560.0	12.4	140.0		.00		
LINE 530 PUMP DATA (HEAD-FLOW):			275.0	.0	233.0	2000.0	160.0	3000.0	
540	530	600	7920.0	12.4	140.0		.00		
600	600	650	26400.0	12.4	140.0		.00		
650	650	660	7920.0	12.4	140.0		.00		
660	660	665	7920.0	12.4	140.0		.00		
665	665	670	13200.0	12.4	140.0		.00		
670	670	675	2640.0	10.4	140.0		.00		
675	675	680	15840.0	8.4	140.0		.00		
700	675	700	7920.0	8.4	140.0		.00		
800	650	800	31680.0	12.4	140.0		.00		
810	800	810	39600.0	12.4	140.0		.00		
820	810	820	21120.0	8.4	140.0		.00		
LINE 820 PUMP DATA (HEAD-FLOW):			268.0	.0	235.0	500.0	140.0	800.0	
830	820	830	18480.0	6.3	140.0		.00		
900	810	900	15840.0	6.3	140.0		.00		

JUNCTION NUMBER	DEMAND	ELEVATION	CONNECTING PIPES		
45	293.00	487.00	45		
50	709.00	640.00	45	50	
55	626.00	590.00	50	55	
60	845.00	770.00	55	60	
65	.00	800.00	60	65	
70	.00	534.00	65	70	
75	.00	700.00	70	77	
77	.00	600.00	75	77	
80	1051.00	590.00	75	80	
85	.00	530.00	80	85	
90	.00	740.00	85	90	
100	.00	800.00	1	100	105
105	.00	670.00	105	400	
110	.00	815.00	100	110	200

120	.00	500.00	110	120	
130	245.00	550.00	120	130	
140	325.00	500.00	130		
160	.00	960.00	160	162	
162	.00	900.00	162	165	
165	.00	580.00	165	170	
170	216.00	540.00	90	170	
200	36.00	760.00	200	210	
210	147.00	900.00	210	220	
220	.00	640.00	220	230	
230	.00	790.00	230	240	
240	.00	630.00	240	250	
250	146.00	680.00	250	260	
260	.00	820.00	260	270	
270	100.00	700.00	270	280	
280	.00	660.00	280	290	
290	.00	770.00	290	300	
300	.00	660.00	300	310	
310	.00	710.00	310	320	
400	831.00	730.00	400	410	
410	.00	900.00	160	410	420
420	.00	1000.00	420	430	
430	.00	630.00	430	440	
440	.00	680.00	440	450	
450	.00	930.00	450	460	
460	100.00	830.00	460	470	
470	.00	660.00	470	480	
480	138.00	920.00	480	490	
490	.00	660.00	490	500	
500	.00	800.00	500	510	
510	97.00	660.00	3	510	520
520	43.00	900.00	520	530	
530	.00	740.00	530	540	
600	138.00	1000.00	320	540	600
650	269.00	740.00	600	650	800
660	1090.00	800.00	650	660	
665	.00	740.00	660	665	
670	.00	900.00	2	665	670
675	.00	880.00	670	675	700
680	.00	900.00	675		
700	.00	680.00	700		
800	.00	840.00	800	810	
810	196.00	560.00	810	820	900
820	83.00	1000.00	820	830	
830	343.00	800.00	830		
900	101.00	580.00	900		

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD

THIS SYSTEM HAS 63 PIPES WITH 60 JUNCTIONS , -1 LOOPS AND   5 FGNS

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00181

Tenkiller Wholesale Water System, Phase 3
Alternative 1 - All Systems

PIPE NO.	NODE	NOS.	FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	100	6008.82	.01	.00	.00	6.94	6.88
LINE	2 IS CLOSED							
3	0	510	2159.18	20.70	.00	.00	5.74	7.84
45	50	45	293.00	2.25	.00	.00	.78	.19
50	55	50	1002.00	21.94	.00	.00	2.66	1.89
55	60	55	1628.00	98.14	.00	.00	4.32	4.65
60	65	60	2473.00	3.21	.00	.00	3.67	2.43
65	70	65	2473.00	35.35	.00	.00	3.67	2.43
70	75	70	2473.00	12.86	.00	.00	3.67	2.43
75	80	77	2473.00	61.06	370.63	.00	3.67	2.43
77	77	75	2473.00	35.35	.00	.00	3.67	2.43
80	85	80	3524.00	48.54	.00	.00	4.12	2.63
85	90	85	3524.00	62.41	.00	.00	4.12	2.63
90	170	90	3524.00	86.67	.00	.00	4.12	2.63
100	100	110	1371.44	8.93	.00	.00	3.64	3.38
105	105	100	-4637.37	-11.53	.00	.00	-5.42	-4.37
110	0	120	570.00	23.41	.00	.00	3.30	4.43
120	120	130	570.00	35.12	.00	.00	3.30	4.43
130	130	140	325.00	37.22	.00	.00	1.88	1.57
160	410	160	3740.00	54.19	.00	.00	4.37	2.93
162	160	162	3740.00	19.35	.00	.00	4.37	2.93
165	0	165	3740.00	19.35	.00	.00	4.37	2.93
170	165	170	3740.00	23.22	.00	.00	4.37	2.93
200	110	200	801.44	9.91	.00	.00	2.13	1.25
210	200	210	765.44	3.03	.00	.00	2.03	1.15
220	210	220	618.44	14.43	.00	.00	2.34	1.82
230	220	230	618.44	28.87	.00	.00	2.34	1.82
240	230	240	618.44	24.06	.00	.00	2.34	1.82
250	240	250	618.44	4.81	.00	.00	2.34	1.82
260	250	260	472.44	17.53	.00	.00	1.78	1.11
270	260	270	472.44	8.77	.00	.00	1.78	1.11
280	270	280	372.44	1.88	.00	.00	1.41	.71
290	280	290	372.44	3.76	.00	.00	1.41	.71
300	290	300	372.44	5.64	.00	.00	1.41	.71
310	300	310	372.44	1.88	.00	.00	1.41	.71
320	310	600	372.44	7.52	141.58	.00	1.41	.71
400	105	400	4637.37	46.12	.00	.00	5.42	4.37
410	400	410	3806.37	47.99	.00	.00	4.45	3.03

420	410	420	66.37	.87	.00	.00	.38	.08
430	420	430	66.37	.44	.00	.00	.38	.08
440	430	440	66.37	.22	.00	.00	.38	.08
450	440	450	66.37	.65	.00	.00	.38	.08
460	450	460	66.37	.44	.00	.00	.38	.08
470	460	470	-33.63	-.12	.00	.00	-.19	-.02
480	470	480	-33.63	-.37	.00	.00	-.19	-.02
490	480	490	-171.63	-15.44	.00	.00	-1.77	-1.95
500	490	500	-171.63	-20.58	.00	.00	-1.77	-1.95
510	500	510	-171.63	-5.15	.00	.00	-1.77	-1.95
520	510	520	1890.56	64.73	.00	.00	5.02	6.13
530	520	530	1847.56	62.03	240.51	.00	4.91	5.87
540	530	600	1847.56	46.52	.00	.00	4.91	5.87
600	600	650	2082.00	193.46	.00	.00	5.53	7.33
650	650	660	1090.00	17.51	.00	.00	2.90	2.21
660	660	665	.00	.00	.00	.00	.00	.00
665	665	670	.00	.00	.00	.00	.00	.00
670	670	675	.00	.00	.00	.00	.00	.00
675	675	680	.00	.00	.00	.00	.00	.00
700	675	700	.00	.00	.00	.00	.00	.00
800	650	800	723.00	32.74	.00	.00	1.92	1.03
810	800	810	723.00	40.93	.00	.00	1.92	1.03
820	810	820	426.00	54.61	247.21	.00	2.47	2.59
830	820	830	343.00	129.84	.00	.00	3.53	7.03
900	810	900	101.00	11.56	.00	.00	1.04	.73

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
45	293.00	810.26	487.00	140.08
50	709.00	812.51	640.00	74.76
55	626.00	834.45	590.00	105.93
60	845.00	932.59	770.00	70.46
65	.00	935.81	800.00	58.85
70	.00	971.16	534.00	189.44
75	.00	984.02	700.00	123.07
77	.00	1019.37	600.00	181.73
80	1051.00	709.80	590.00	51.91
85	.00	758.34	530.00	98.95
90	.00	820.75	740.00	34.99
100	.00	1145.99	800.00	149.93
105	.00	1134.46	670.00	201.27
110	.00	1137.06	815.00	139.56
120	.00	821.59	500.00	139.36
130	245.00	786.47	550.00	102.47
140	325.00	749.26	500.00	108.01
160	.00	986.17	960.00	11.34
162	.00	966.81	900.00	28.95
165	.00	930.65	580.00	151.95
170	216.00	907.42	540.00	159.22
200	36.00	1127.16	760.00	159.10
210	147.00	1124.13	900.00	97.12

220	.00	1109.69	640.00	203.53
230	.00	1080.82	790.00	126.02
240	.00	1056.77	630.00	184.93
250	146.00	1051.95	680.00	161.18
260	.00	1034.42	820.00	92.92
270	100.00	1025.66	700.00	141.12
280	.00	1023.77	660.00	157.64
290	.00	1020.01	770.00	108.34
300	.00	1014.37	660.00	153.56
310	.00	1012.49	710.00	131.08
400	831.00	1088.35	730.00	155.28
410	.00	1040.36	900.00	60.82
420	.00	1039.49	1000.00	17.11
430	.00	1039.05	630.00	177.25
440	.00	1038.83	680.00	155.49
450	.00	1038.08	930.00	46.84
460	100.00	1037.65	830.00	89.98
470	.00	1037.77	660.00	163.70
480	138.00	1038.14	920.00	51.20
490	.00	1053.58	660.00	170.55
500	.00	1074.16	800.00	118.80
510	97.00	1079.30	660.00	181.70
520	43.00	1014.58	900.00	49.65
530	.00	1193.06	740.00	196.33
600	138.00	1146.54	1000.00	63.50
650	269.00	953.08	740.00	92.33
660	1090.00	935.57	800.00	58.75
665	.00	935.57	740.00	84.75
670	.00	935.57	900.00	15.41
675	.00	935.57	880.00	24.08
680	.00	935.57	900.00	15.41
700	.00	935.57	680.00	110.75
800	.00	920.34	840.00	34.81
810	196.00	879.41	560.00	138.41
820	83.00	1072.01	1000.00	31.20
830	343.00	942.17	800.00	61.61
900	101.00	867.85	580.00	124.73

THE NET SYSTEM DEMAND =   8168.00

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

PIPE NUMBER	FLOWRATE
1	6008.82
3	2159.18

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES =   8168.00
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES =   .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR =   .00
LINE   3 IS CLOSED

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

PIPE NO.	NODE NOS.		LENGTH	DIAMETER	ROUGHNESS	MINOR LOSS K	FIXED GRADE
75	80	77	39600.0	16.6	140.0	.00	.00
320	310	600	10560.0	10.4	140.0	.00	.00
530	520	530	10560.0	12.4	140.0	.00	.00
820	810	820	21120.0	8.4	140.0	.00	.00

THE RESULTS ARE OBTAINED AFTER 9 TRIALS WITH AN ACCURACY = .00136

Static Condition
Global Demand Factor is .001
Delete all pumps and close line 3

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	100	8.17	.00	.00	.00	.01	.00
LINE	2 IS CLOSED							
LINE	3 IS CLOSED							
45	50	45	.29	.00	.00	.00	.00	.00
50	55	50	1.00	.00	.00	.00	.00	.00
55	60	55	1.63	.00	.00	.00	.00	.00
60	65	60	2.47	.00	.00	.00	.00	.00
65	70	65	2.47	.00	.00	.00	.00	.00
70	75	70	2.47	.00	.00	.00	.00	.00
75	80	77	2.47	.00	.00	.00	.00	.00
77	77	75	2.47	.00	.00	.00	.00	.00
80	85	80	3.52	.00	.00	.00	.00	.00
85	90	85	3.52	.00	.00	.00	.00	.00
90	170	90	3.52	.00	.00	.00	.00	.00
100	100	110	2.65	.00	.00	.00	.01	.00
105	105	100	-5.52	.00	.00	.00	-.01	.00
110	0	120	.57	.00	.00	.00	.00	.00
120	120	130	.57	.00	.00	.00	.00	.00
130	130	140	.33	.00	.00	.00	.00	.00
160	410	160	3.74	.00	.00	.00	.00	.00
162	160	162	3.74	.00	.00	.00	.00	.00
165	0	165	3.74	.00	.00	.00	.00	.00
170	165	170	3.74	.00	.00	.00	.00	.00
200	110	200	2.08	.00	.00	.00	.01	.00
210	200	210	2.04	.00	.00	.00	.01	.00
220	210	220	1.89	.00	.00	.00	.01	.00

230	220	230	1.89	.00	.00	.00	.01	.00
240	230	240	1.89	.00	.00	.00	.01	.00
250	240	250	1.89	.00	.00	.00	.01	.00
260	250	260	1.75	.00	.00	.00	.01	.00
270	260	270	1.75	.00	.00	.00	.01	.00
280	270	280	1.65	.00	.00	.00	.01	.00
290	280	290	1.65	.00	.00	.00	.01	.00
300	290	300	1.65	.00	.00	.00	.01	.00
310	300	310	1.65	.00	.00	.00	.01	.00
320	310	600	1.65	.00	.00	.00	.01	.00
400	105	400	5.52	.00	.00	.00	.01	.00
410	400	410	4.69	.00	.00	.00	.01	.00
420	410	420	.95	.00	.00	.00	.01	.00
430	420	430	.95	.00	.00	.00	.01	.00
440	430	440	.95	.00	.00	.00	.01	.00
450	440	450	.95	.00	.00	.00	.01	.00
460	450	460	.95	.00	.00	.00	.01	.00
470	460	470	.85	.00	.00	.00	.00	.00
480	470	480	.85	.00	.00	.00	.00	.00
490	480	490	.71	.00	.00	.00	.01	.00
500	490	500	.71	.00	.00	.00	.01	.00
510	500	510	.71	.00	.00	.00	.01	.00
520	510	520	.61	.00	.00	.00	.00	.00
530	520	530	.57	.00	.00	.00	.00	.00
540	530	600	.57	.00	.00	.00	.00	.00
600	600	650	2.08	.00	.00	.00	.01	.00
650	650	660	1.09	.00	.00	.00	.00	.00
660	660	665	.00	.00	.00	.00	.00	.00
665	665	670	.00	.00	.00	.00	.00	.00
670	670	675	.00	.00	.00	.00	.00	.00
675	675	680	.00	.00	.00	.00	.00	.00
700	675	700	.00	.00	.00	.00	.00	.00
800	650	800	.72	.00	.00	.00	.00	.00
810	800	810	.72	.00	.00	.00	.00	.00
820	810	820	.43	.00	.00	.00	.00	.00
830	820	830	.34	.00	.00	.00	.00	.00
900	810	900	.10	.00	.00	.00	.00	.00

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
45	.29	950.00	487.00	200.63
50	.71	950.00	640.00	134.33
55	.63	950.00	590.00	156.00
60	.85	950.00	770.00	78.00
65	.00	950.00	800.00	65.00
70	.00	950.00	534.00	180.27
75	.00	950.00	700.00	108.33
77	.00	950.00	600.00	151.67
80	1.05	950.00	590.00	156.00
85	.00	950.00	530.00	182.00
90	.00	950.00	740.00	91.00

100	.00	1146.00	800.00	149.93
105	.00	1146.00	670.00	206.27
110	.00	1146.00	815.00	143.43
120	.00	845.00	500.00	149.50
130	.25	845.00	550.00	127.83
140	.33	845.00	500.00	149.50
160	.00	1146.00	960.00	80.60
162	.00	1146.00	900.00	106.60
165	.00	950.00	580.00	160.33
170	.22	950.00	540.00	177.67
200	.04	1146.00	760.00	167.27
210	.15	1146.00	900.00	106.60
220	.00	1146.00	640.00	219.27
230	.00	1146.00	790.00	154.27
240	.00	1146.00	630.00	223.60
250	.15	1146.00	680.00	201.93
260	.00	1146.00	820.00	141.27
270	.10	1146.00	700.00	193.27
280	.00	1146.00	660.00	210.60
290	.00	1146.00	770.00	162.93
300	.00	1146.00	660.00	210.60
310	.00	1146.00	710.00	188.93
400	.83	1146.00	730.00	180.27
410	.00	1146.00	900.00	106.60
420	.00	1146.00	1000.00	63.27
430	.00	1146.00	630.00	223.60
440	.00	1146.00	680.00	201.93
450	.00	1146.00	930.00	93.60
460	.10	1146.00	830.00	136.93
470	.00	1146.00	660.00	210.60
480	.14	1146.00	920.00	97.93
490	.00	1146.00	660.00	210.60
500	.00	1146.00	800.00	149.93
510	.10	1146.00	660.00	210.60
520	.04	1146.00	900.00	106.60
530	.00	1146.00	740.00	175.93
600	.14	1146.00	1000.00	63.27
650	.27	1146.00	740.00	175.93
660	1.09	1146.00	800.00	149.93
665	.00	1146.00	740.00	175.93
670	.00	1146.00	900.00	106.60
675	.00	1146.00	880.00	115.26
680	.00	1146.00	900.00	106.60
700	.00	1146.00	680.00	201.93
800	.00	1146.00	840.00	132.60
810	.20	1146.00	560.00	253.93
820	.08	1146.00	1000.00	63.26
830	.34	1146.00	800.00	149.93
900	.10	1146.00	580.00	245.26

THE NET SYSTEM DEMAND =   8.17

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

```
   PIPE NUMBER      FLOWRATE
        1              8.17
```

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES =   8.17
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES =   .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR =   .70
LINE   3 IS OPEN

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

FOR PIPE NUMBER 165 THE VALUE OF THE FIXED GRADE IS CHANGED TO 1050.0

```
   PIPE NO. NODE NOS. LENGTH  DIAMETER  ROUGHNESS  MINOR LOSS K  FIXED GRADE
      75      80   77  39600.0   16.6      140.0        .00          .00
     320     310  600  10560.0   10.4      140.0        .00          .00
LINE 320 PUMP DATA (HEAD-FLOW):   145.0     .0   137.0   500.0   114.0   800.0
     530     520  530  10560.0   12.4      140.0        .00          .00
LINE 530 PUMP DATA (HEAD-FLOW):   275.0     .0   233.0  2000.0   160.0  3000.0
     820     810  820  21120.0    8.4      140.0        .00          .00
LINE 820 PUMP DATA (HEAD-FLOW):   268.0     .0   235.0   500.0   140.0   800.0
```

THE RESULTS ARE OBTAINED AFTER 9 TRIALS WITH AN ACCURACY = .00148

Global Demand Factor is 0.70
Delete pump in line 75 and open line 3
Change setting of PRV in line 165

```
  PIPE NO. NODE NOS.  FLOWRATE  HEAD LOSS PUMP HEAD MINOR LOSS VELOCITY HL/1000
     1       0  100   4173.75     .00       .00       .00       4.82    3.50
LINE    2 IS CLOSED
     3       0  510   1543.84   11.12       .00       .00       4.10    4.21
    45      50   45    205.10    1.16       .00       .00        .54     .10
    50      55   50    701.40   11.33       .00       .00       1.86     .98
    55      60   55   1139.60   50.70       .00       .00       3.03    2.40
    60      65   60   1731.10    1.66       .00       .00       2.57    1.26
    65      70   65   1731.10   18.26       .00       .00       2.57    1.26
    70      75   70   1731.10    6.64       .00       .00       2.57    1.26
    75      80   77   1731.10   49.81       .00       .00       2.57    1.26
```

77	77	75	1731.10	18.26	.00	.00	2.57	1.26
80	85	80	2466.80	25.07	.00	.00	2.88	1.36
85	90	85	2466.80	32.24	.00	.00	2.88	1.36
90	170	90	2466.80	44.77	.00	.00	2.88	1.36
100	100	110	868.98	3.84	.00	.00	2.31	1.45
105	105	100	-3304.78	-6.16	.00	.00	-3.86	-2.33
110	0	120	399.00	12.09	.00	.00	2.31	2.29
120	120	130	399.00	18.14	.00	.00	2.31	2.29
130	130	140	227.50	19.23	.00	.00	1.32	.81
160	410	160	2618.00	27.99	.00	.00	3.06	1.51
162	160	162	2618.00	10.00	.00	.00	3.06	1.51
165	0	165	2618.00	10.00	.00	.00	3.06	1.51
170	165	170	2618.00	12.00	.00	.00	3.06	1.51
200	110	200	469.98	3.69	.00	.00	1.25	.47
210	200	210	444.78	1.11	.00	.00	1.18	.42
220	210	220	341.88	4.82	.00	.00	1.29	.61
230	220	230	341.88	9.63	.00	.00	1.29	.61
240	230	240	341.88	8.03	.00	.00	1.29	.61
250	240	250	341.88	1.61	.00	.00	1.29	.61
260	250	260	239.68	4.99	.00	.00	.91	.31
270	260	270	239.68	2.49	.00	.00	.91	.31
280	270	280	169.68	.44	.00	.00	.64	.17
290	280	290	169.68	.88	.00	.00	.64	.17
300	290	300	169.68	1.32	.00	.00	.64	.17
310	300	310	169.68	.44	.00	.00	.64	.17
320	310	600	169.68	1.75	144.64	.00	.64	.17
400	105	400	3304.78	24.63	.00	.00	3.86	2.33
410	400	410	2723.08	25.81	.00	.00	3.18	1.63
420	410	420	105.08	2.04	.00	.00	.61	.19
430	420	430	105.08	1.02	.00	.00	.61	.19
440	430	440	105.08	.51	.00	.00	.61	.19
450	440	450	105.08	1.53	.00	.00	.61	.19
460	450	460	105.08	1.02	.00	.00	.61	.19
470	460	470	35.08	.13	.00	.00	.20	.03
480	470	480	35.08	.40	.00	.00	.20	.03
490	480	490	-61.52	-2.31	.00	.00	-.63	-.29
500	490	500	-61.52	-3.08	.00	.00	-.63	-.29
510	500	510	-61.52	-.77	.00	.00	-.63	-.29
520	510	520	1414.42	37.82	.00	.00	3.76	3.58
530	520	530	1384.32	36.34	258.16	.00	3.68	3.44
540	530	600	1384.32	27.26	.00	.00	3.68	3.44
600	600	650	1457.40	99.94	.00	.00	3.87	3.79
650	650	660	763.00	9.04	.00	.00	2.03	1.14
660	660	665	.00	.00	.00	.00	.00	.00
665	665	670	.00	.00	.00	.00	.00	.00
670	670	675	.00	.00	.00	.00	.00	.00
675	675	680	.00	.00	.00	.00	.00	.00
700	675	700	.00	.00	.00	.00	.00	.00
800	650	800	506.10	16.91	.00	.00	1.34	.53
810	800	810	506.10	21.14	.00	.00	1.34	.53
820	810	820	298.20	28.21	260.57	.00	1.73	1.34

| 830 | 820 | 830 | 240.10 | 67.07 | .00 | .00 | 2.47 | 3.63 |
| 900 | 810 | 900 | 70.70 | 5.97 | .00 | .00 | .73 | .38 |

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
45	205.10	768.10	487.00	121.81
50	496.30	769.26	640.00	56.01
55	438.20	780.60	590.00	82.59
60	591.50	831.29	770.00	26.56
65	.00	832.95	800.00	14.28
70	.00	851.22	534.00	137.46
75	.00	857.86	700.00	68.40
77	.00	876.12	600.00	119.65
80	735.70	925.92	590.00	145.57
85	.00	951.00	530.00	182.43
90	.00	983.23	740.00	105.40
100	.00	1146.00	800.00	149.93
105	.00	1139.84	670.00	203.60
110	.00	1142.16	815.00	141.77
120	.00	832.91	500.00	144.26
130	171.50	814.77	550.00	114.73
140	227.50	795.54	500.00	128.07
160	.00	1061.41	960.00	43.95
162	.00	1051.42	900.00	65.61
165	.00	1040.00	580.00	199.33
170	151.20	1028.01	540.00	211.47
200	25.20	1138.47	760.00	164.01
210	102.90	1137.37	900.00	102.86
220	.00	1132.55	640.00	213.44
230	.00	1122.92	790.00	144.26
240	.00	1114.89	630.00	210.12
250	102.20	1113.29	680.00	187.76
260	.00	1108.30	820.00	124.93
270	70.00	1105.80	700.00	175.85
280	.00	1105.37	660.00	192.99
290	.00	1104.49	770.00	144.95
300	.00	1103.17	660.00	192.04
310	.00	1102.73	710.00	170.19
400	581.70	1115.21	730.00	166.93
410	.00	1089.41	900.00	82.08
420	.00	1087.36	1000.00	37.86
430	.00	1086.34	630.00	197.75
440	.00	1085.83	680.00	175.86
450	.00	1084.28	930.00	66.86
460	70.00	1083.26	830.00	109.75
470	.00	1083.13	660.00	183.35
480	96.60	1082.72	920.00	70.51
490	.00	1085.03	660.00	184.18
500	.00	1088.11	800.00	124.85
510	67.90	1088.88	660.00	185.85
520	30.10	1051.06	900.00	65.46

530	.00	1272.88	740.00	230.92
600	96.60	1245.63	1000.00	106.44
650	188.30	1145.69	740.00	175.80
660	763.00	1136.65	800.00	145.88
665	.00	1136.65	740.00	171.88
670	.00	1136.65	900.00	102.55
675	.00	1136.65	880.00	111.21
680	.00	1136.65	900.00	102.55
700	.00	1136.65	680.00	197.88
800	.00	1128.78	840.00	125.14
810	137.20	1107.64	560.00	237.31
820	58.10	1340.00	1000.00	147.33
830	240.10	1272.92	800.00	204.93
900	70.70	1101.66	580.00	226.05

THE NET SYSTEM DEMAND =   5717.60

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

PIPE NUMBER	FLOWRATE
1	4173.75
3	1543.84

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES =   5717.60
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES =   .00

FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

PIPE NO.	NODE NOS.		LENGTH (FEET)	DIAMETER (INCHES)	ROUGHNESS	MINOR LOSS K	FIXED GRADE
1	0	100	1.0	12.4	140.0	.00	1146.00
100	100	110	2640.0	12.4	140.0	.00	
105	105	100	2640.0	12.4	140.0	.00	
110	110	120	5280.0	8.4	140.0	.00	
120	120	130	7920.0	8.4	140.0	.00	
130	130	140	23760.0	8.4	140.0	.00	
160	410	160	18480.0	8.4	140.0	.00	
170	160	170	23760.0	8.4	140.0	.00	
200	110	200	7920.0	12.4	140.0	.00	
210	200	210	2640.0	12.4	140.0	.00	
220	210	220	7920.0	10.4	140.0	.00	
230	220	230	15840.0	10.4	140.0	.00	
240	230	240	10560.0	10.4	140.0	.00	
250	240	250	2640.0	10.4	140.0	.00	
260	250	260	10560.0	10.4	140.0	.00	
270	260	270	7920.0	10.4	140.0	.00	
280	270	280	2640.0	10.4	140.0	.00	
290	280	290	5280.0	10.4	140.0	.00	
300	290	300	7920.0	10.4	140.0	.00	
310	300	310	2640.0	10.4	140.0	.00	
320	310	600	10560.0	10.4	140.0	.00	
LINE 320	PUMP DATA (HEAD-FLOW):		334.0	.0	290.0	500.0	209.0 800.0
400	105	400	7920.0	12.4	140.0	.00	
410	400	410	15840.0	12.4	140.0	.00	
420	410	420	10560.0	8.4	140.0	.00	
430	420	430	5280.0	8.4	140.0	.00	
440	430	440	2640.0	8.4	140.0	.00	
450	440	450	7920.0	8.4	140.0	.00	
460	450	460	5280.0	8.4	140.0	.00	
470	460	470	5280.0	8.4	140.0	.00	
480	470	480	15840.0	8.4	140.0	.00	
490	480	490	10560.0	6.3	140.0	.00	
500	490	500	10560.0	6.3	140.0	.00	
510	500	510	2640.0	6.3	140.0	.00	
520	510	520	10560.0	6.3	140.0	.00	
530	520	530	7920.0	6.3	140.0	.00	

| 540 | 530 | 600 | 7920.0 | 6.3 | 140.0 | .00 |
| 600 | 600 | 650 | 26400.0 | 6.3 | 140.0 | .00 |

JUNCTION NUMBER	DEMAND	ELEVATION	CONNECTING PIPES		
100	.00	800.00	1	100	105
105	.00	670.00	105	400	
110	.00	815.00	100	110	200
120	.00	500.00	110	120	
130	245.00	550.00	120	130	
140	325.00	500.00	130		
160	.00	960.00	160	170	
170	216.00	540.00	170		
200	36.00	760.00	200	210	
210	147.00	900.00	210	220	
220	.00	640.00	220	230	
230	.00	790.00	230	240	
240	.00	630.00	240	250	
250	146.00	680.00	250	260	
260	.00	820.00	260	270	
270	100.00	700.00	270	280	
280	.00	660.00	280	290	
290	.00	770.00	290	300	
300	.00	660.00	300	310	
310	.00	710.00	310	320	
400	831.00	730.00	400	410	
410	.00	900.00	160	410	420
420	.00	1000.00	420	430	
430	.00	630.00	430	440	
440	.00	680.00	440	450	
450	.00	930.00	450	460	
460	100.00	830.00	460	470	
470	.00	660.00	470	480	
480	138.00	920.00	480	490	
490	.00	660.00	490	500	
500	.00	800.00	500	510	
510	97.00	660.00	510	520	
520	43.00	900.00	520	530	
530	.00	740.00	530	540	
600	138.00	1000.00	320	540	600
650	269.00	740.00	600		

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD

THIS SYSTEM HAS 37 PIPES WITH 36 JUNCTIONS , 1 LOOPS AND 1 FGNS

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00005

Tenkiller Wholesale Water System, Phase 3
Alternative 2, initial construction, Stick Ross Mtn & all systems south to Vian

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	100	2831.00	.01	.00	.00	7.52	12.95
100	100	110	1608.52	12.00	.00	.00	4.27	4.54
105	105	100	-1222.48	-7.22	.00	.00	-3.25	-2.73
110	110	120	570.00	23.41	.00	.00	3.30	4.43
120	120	130	570.00	35.12	.00	.00	3.30	4.43
130	130	140	325.00	37.22	.00	.00	1.88	1.57
160	410	160	216.00	13.58	.00	.00	1.25	.74
170	160	170	216.00	17.46	.00	.00	1.25	.74
200	110	200	1038.52	16.01	.00	.00	2.76	2.02
210	200	210	1002.52	5.00	.00	.00	2.66	1.89
220	210	220	855.52	26.33	.00	.00	3.23	3.32
230	220	230	855.52	52.65	.00	.00	3.23	3.32
240	230	240	855.52	35.10	.00	.00	3.23	3.32
250	240	250	855.52	8.78	.00	.00	3.23	3.32
260	250	260	709.52	24.82	.00	.00	2.68	2.35
270	260	270	709.52	18.62	.00	.00	2.68	2.35
280	270	280	609.52	4.68	.00	.00	2.30	1.77
290	280	290	609.52	9.37	.00	.00	2.30	1.77
300	290	300	609.52	14.05	.00	.00	2.30	1.77
310	300	310	609.52	4.68	.00	.00	2.30	1.77
320	310	600	609.52	18.73	265.68	.00	2.30	1.77
400	105	400	1222.48	21.65	.00	.00	3.25	2.73
410	400	410	391.48	5.26	.00	.00	1.04	.33
420	410	420	175.48	5.28	.00	.00	1.02	.50
430	420	430	175.48	2.64	.00	.00	1.02	.50
440	430	440	175.48	1.32	.00	.00	1.02	.50
450	440	450	175.48	3.96	.00	.00	1.02	.50
460	450	460	175.48	2.64	.00	.00	1.02	.50
470	460	470	75.48	.55	.00	.00	.44	.10
480	470	480	75.48	1.66	.00	.00	.44	.10
490	480	490	-62.52	-3.17	.00	.00	-.64	-.30
500	490	500	-62.52	-3.17	.00	.00	-.64	-.30
510	500	510	-62.52	-.79	.00	.00	-.64	-.30
520	510	520	-159.52	-17.97	.00	.00	-1.64	-1.70
530	520	530	-202.52	-20.97	.00	.00	-2.08	-2.65
540	530	600	-202.52	-20.97	.00	.00	-2.08	-2.65
600	600	650	269.00	118.26	.00	.00	2.77	4.48

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
100	.00	1145.99	800.00	149.93
105	.00	1138.77	670.00	203.13
110	.00	1133.99	815.00	138.23

120	.00	1110.58	500.00	264.58
130	245.00	1075.46	550.00	227.70
140	325.00	1038.25	500.00	233.24
160	.00	1098.28	960.00	59.92
170	216.00	1080.82	540.00	234.35
200	36.00	1117.98	760.00	155.13
210	147.00	1112.99	900.00	92.29
220	.00	1086.66	640.00	193.55
230	.00	1034.01	790.00	105.74
240	.00	998.90	630.00	159.86
250	146.00	990.13	680.00	134.39
260	.00	965.31	820.00	62.97
270	100.00	946.69	700.00	106.90
280	.00	942.01	660.00	122.20
290	.00	932.64	770.00	70.48
300	.00	918.59	660.00	112.05
310	.00	913.90	710.00	88.36
400	831.00	1117.12	730.00	167.75
410	.00	1111.86	900.00	91.81
420	.00	1106.58	1000.00	46.19
430	.00	1103.94	630.00	205.37
440	.00	1102.62	680.00	183.13
450	.00	1098.66	930.00	73.08
460	100.00	1096.01	830.00	115.27
470	.00	1095.46	660.00	188.70
480	138.00	1093.80	920.00	75.31
490	.00	1096.97	660.00	189.35
500	.00	1100.14	800.00	130.06
510	97.00	1100.93	660.00	191.07
520	43.00	1118.91	900.00	94.86
530	.00	1139.88	740.00	173.28
600	138.00	1160.85	1000.00	69.70
650	269.00	1042.59	740.00	131.12

THE NET SYSTEM DEMAND = 2831.00

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

```
    PIPE NUMBER    FLOWRATE
         1         2831.00
```

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES =   2831.00
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES =   .00

FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

THERE IS A PRV AT JUNCTION 162 FOR LINE 165 SET AT A GRADE OF 950.00
THERE IS A PRV AT JUNCTION 110 FOR LINE 110 SET AT A GRADE OF 845.00

PIPE NO.	NODE NOS.		LENGTH (FEET)	DIAMETER (INCHES)	ROUGHNESS	MINOR LOSS K	FIXED GRADE
1	0	100	1.0	31.0	140.0	.00	1146.00
2	0	670	1.0	12.4	140.0	.00	1000.00
LINE 2 IS CLOSED							
3	0	510	2640.0	12.4	140.0	.00	1100.00
45	50	45	11600.0	24.9	140.0	.00	
50	55	50	11600.0	24.9	140.0	.00	
55	60	55	21120.0	24.9	140.0	.00	
60	65	60	1320.0	24.9	140.0	.00	
65	70	65	14520.0	24.9	140.0	.00	
70	75	70	5280.0	24.9	140.0	.00	
75	80	77	25080.0	24.9	140.0	.00	
LINE 75 PUMP DATA (HEAD-FLOW):			416.0	.0	370.0 10000.0	358.0 12000.0	
77	77	75	14520.0	24.9	140.0	.00	
80	85	80	18480.0	31.0	140.0	.00	
85	90	85	23760.0	31.0	140.0	.00	
90	170	90	33000.0	31.0	140.0	.00	
100	100	110	2640.0	12.4	140.0	.00	
105	105	100	2640.0	31.0	140.0	.00	
110	110	120	5280.0	8.4	140.0	.00	
120	120	130	7920.0	8.4	140.0	.00	
130	130	140	23760.0	8.4	140.0	.00	
160	410	160	18480.0	31.0	140.0	.00	
162	160	162	6600.0	31.0	140.0	.00	
165	162	165	6600.0	31.0	140.0	.00	
170	165	170	7920.0	31.0	140.0	.00	
200	110	200	7920.0	12.4	140.0	.00	
210	200	210	2640.0	12.4	140.0	.00	
220	210	220	7920.0	10.4	140.0	.00	
230	220	230	15840.0	10.4	140.0	.00	
240	230	240	13200.0	10.4	140.0	.00	
250	240	250	2640.0	10.4	140.0	.00	
260	250	260	15840.0	10.4	140.0	.00	
270	260	270	7920.0	10.4	140.0	.00	
280	270	280	2640.0	10.4	140.0	.00	

290	280	290	5280.0	10.4	140.0	.00				
300	290	300	7920.0	10.4	140.0	.00				
310	300	310	2640.0	10.4	140.0	.00				
320	310	600	10560.0	10.4	140.0	.00				
LINE 320 PUMP DATA (HEAD-FLOW):			145.0	.0	137.0	500.0	114.0	800.0		
400	105	400	10560.0	31.0	140.0	.00				
410	400	410	15840.0	31.0	140.0	.00				
420	410	420	10560.0	8.4	140.0	.00				
430	420	430	5280.0	8.4	140.0	.00				
440	430	440	2640.0	8.4	140.0	.00				
450	440	450	7920.0	8.4	140.0	.00				
460	450	460	5280.0	8.4	140.0	.00				
470	460	470	5280.0	8.4	140.0	.00				
480	470	480	15840.0	8.4	140.0	.00				
490	480	490	7920.0	6.3	140.0	.00				
500	490	500	10560.0	6.3	140.0	.00				
510	500	510	2640.0	6.3	140.0	.00				
520	510	520	10560.0	12.4	140.0	.00				
530	520	530	10560.0	12.4	140.0	.00				
LINE 530 PUMP DATA (HEAD-FLOW):			275.0	.0	233.0	2000.0	160.0	3000.0		
540	530	600	7920.0	12.4	140.0	.00				
600	600	650	26400.0	12.4	140.0	.00				
650	650	660	7920.0	12.4	140.0	.00				
660	660	665	7920.0	12.4	140.0	.00				
665	665	670	13200.0	12.4	140.0	.00				
670	670	675	2640.0	10.4	140.0	.00				
675	675	680	15840.0	8.4	140.0	.00				
700	675	700	7920.0	8.4	140.0	.00				
800	650	800	31680.0	12.4	140.0	.00				
810	800	810	39600.0	12.4	140.0	.00				
820	810	820	21120.0	8.4	140.0	.00				
LINE 820 PUMP DATA (HEAD-FLOW):			268.0	.0	235.0	500.0	140.0	800.0		
830	820	830	18480.0	6.3	140.0	.00				
900	810	900	15840.0	6.3	140.0	.00				

JUNCTION NUMBER	DEMAND	ELEVATION	CONNECTING PIPES		
45	7293.00	487.00	45		
50	709.00	640.00	45	50	
55	626.00	590.00	50	55	
60	845.00	770.00	55	60	
65	.00	800.00	60	65	
70	.00	534.00	65	70	
75	.00	700.00	70	77	
77	.00	600.00	75	77	
80	1051.00	590.00	75	80	
85	.00	530.00	80	85	
90	.00	740.00	85	90	
100	.00	800.00	1	100	105
105	.00	670.00	105	400	
110	.00	815.00	100	110	200

120	.00	500.00	110	120	
130	245.00	550.00	120	130	
140	325.00	500.00	130		
160	.00	960.00	160	162	
162	.00	900.00	162	165	
165	.00	580.00	165	170	
170	216.00	540.00	90	170	
200	36.00	760.00	200	210	
210	147.00	900.00	210	220	
220	.00	640.00	220	230	
230	.00	790.00	230	240	
240	.00	630.00	240	250	
250	146.00	680.00	250	260	
260	.00	820.00	260	270	
270	100.00	700.00	270	280	
280	.00	660.00	280	290	
290	.00	770.00	290	300	
300	.00	660.00	300	310	
310	.00	710.00	310	320	
400	831.00	730.00	400	410	
410	.00	900.00	160	410	420
420	.00	1000.00	420	430	
430	.00	630.00	430	440	
440	.00	680.00	440	450	
450	.00	930.00	450	460	
460	100.00	830.00	460	470	
470	.00	660.00	470	480	
480	138.00	920.00	480	490	
490	.00	660.00	490	500	
500	.00	800.00	500	510	
510	97.00	660.00	3	510	520
520	43.00	900.00	520	530	
530	.00	740.00	530	540	
600	138.00	1000.00	320	540	600
650	269.00	740.00	600	650	800
660	1090.00	800.00	650	660	
665	.00	740.00	660	665	
670	.00	900.00	2	665	670
675	.00	880.00	670	675	700
680	.00	900.00	675		
700	.00	680.00	700		
800	.00	840.00	800	810	
810	196.00	560.00	810	820	900
820	83.00	1000.00	820	830	
830	343.00	800.00	830		
900	101.00	580.00	900		

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD

THIS SYSTEM HAS 63 PIPES WITH 60 JUNCTIONS , -1 LOOPS AND   5 FGNS

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00012

Tenkiller Wholesale Water System, Phase 3
Alternative 3, All Systems & 24" Pipe at Roland

PIPE NO.	NODE	NOS.	FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	100	13108.26	.00	.00	.00	5.57	2.55
LINE	2 IS CLOSED							
3	0	510	2059.74	18.97	.00	.00	5.47	7.18
45	50	45	7293.00	29.05	.00	.00	4.80	2.50
50	55	50	8002.00	34.50	.00	.00	5.27	2.97
55	60	55	8628.00	72.22	.00	.00	5.68	3.42
60	65	60	9473.00	5.37	.00	.00	6.24	4.07
65	70	65	9473.00	59.03	.00	.00	6.24	4.07
70	75	70	9473.00	21.47	.00	.00	6.24	4.07
75	80	77	9473.00	101.96	373.06	.00	6.24	4.07
77	77	75	9473.00	59.03	.00	.00	6.24	4.07
80	85	80	10524.00	31.40	.00	.00	4.47	1.70
85	90	85	10524.00	40.38	.00	.00	4.47	1.70
90	170	90	10524.00	56.08	.00	.00	4.47	1.70
100	100	110	1369.01	8.90	.00	.00	3.64	3.37
105	105	100	-11739.25	-5.49	.00	.00	-4.99	-2.08
110	0	120	570.00	23.41	.00	.00	3.30	4.43
120	120	130	570.00	35.12	.00	.00	3.30	4.43
130	130	140	325.00	37.22	.00	.00	1.88	1.57
160	410	160	10740.00	32.61	.00	.00	4.57	1.76
162	160	162	10740.00	11.65	.00	.00	4.57	1.76
165	0	165	10740.00	11.65	.00	.00	4.57	1.76
170	165	170	10740.00	13.97	.00	.00	4.57	1.76
200	110	200	799.01	9.85	.00	.00	2.12	1.24
210	200	210	763.01	3.01	.00	.00	2.03	1.14
220	210	220	616.01	14.33	.00	.00	2.33	1.81
230	220	230	616.01	28.66	.00	.00	2.33	1.81
240	230	240	616.01	23.88	.00	.00	2.33	1.81
250	240	250	616.01	4.78	.00	.00	2.33	1.81
260	250	260	470.01	17.37	.00	.00	1.78	1.10
270	260	270	470.01	8.68	.00	.00	1.78	1.10
280	270	280	370.01	1.86	.00	.00	1.40	.70
290	280	290	370.01	3.72	.00	.00	1.40	.70
300	290	300	370.01	5.57	.00	.00	1.40	.70
310	300	310	370.01	1.86	.00	.00	1.40	.70
320	310	600	370.01	7.43	141.64	.00	1.40	.70
400	105	400	11739.25	21.97	.00	.00	4.99	2.08
410	400	410	10908.25	28.77	.00	.00	4.64	1.82

420	410	420	168.25	4.89	.00	.00	.97	.46
430	420	430	168.25	2.44	.00	.00	.97	.46
440	430	440	168.25	1.22	.00	.00	.97	.46
450	440	450	168.25	3.67	.00	.00	.97	.46
460	450	460	168.25	2.44	.00	.00	.97	.46
470	460	470	68.25	.46	.00	.00	.40	.09
480	470	480	68.25	1.38	.00	.00	.40	.09
490	480	490	-69.75	-2.91	.00	.00	-.72	-.37
500	490	500	-69.75	-3.88	.00	.00	-.72	-.37
510	500	510	-69.75	-.97	.00	.00	-.72	-.37
520	510	520	1892.99	64.88	.00	.00	5.03	6.14
530	520	530	1849.99	62.18	240.40	.00	4.91	5.89
540	530	600	1849.99	46.63	.00	.00	4.91	5.89
600	600	650	2082.00	193.46	.00	.00	5.53	7.33
650	650	660	1090.00	17.51	.00	.00	2.90	2.21
660	660	665	.00	.00	.00	.00	.00	.00
665	665	670	.00	.00	.00	.00	.00	.00
670	670	675	.00	.00	.00	.00	.00	.00
675	675	680	.00	.00	.00	.00	.00	.00
700	675	700	.00	.00	.00	.00	.00	.00
800	650	800	723.00	32.74	.00	.00	1.92	1.03
810	800	810	723.00	40.93	.00	.00	1.92	1.03
820	810	820	426.00	54.61	247.21	.00	2.47	2.59
830	820	830	343.00	129.84	.00	.00	3.53	7.03
900	810	900	101.00	11.56	.00	.00	1.04	.73

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
45	7293.00	786.96	487.00	129.98
50	709.00	816.01	640.00	76.27
55	626.00	850.51	590.00	112.89
60	845.00	922.73	770.00	66.18
65	.00	928.10	800.00	55.51
70	.00	987.13	534.00	196.35
75	.00	1008.59	700.00	133.72
77	.00	1067.62	600.00	202.64
80	1051.00	796.52	590.00	89.49
85	.00	827.92	530.00	129.10
90	.00	868.30	740.00	55.60
100	.00	1146.00	800.00	149.93
105	.00	1140.50	670.00	203.89
110	.00	1137.10	815.00	139.58
120	.00	821.59	500.00	139.36
130	245.00	786.47	550.00	102.47
140	325.00	749.26	500.00	108.01
160	.00	1057.16	960.00	42.10
162	.00	1045.51	900.00	63.06
165	.00	938.35	580.00	155.29
170	216.00	924.38	540.00	166.56
200	36.00	1127.25	760.00	159.14
210	147.00	1124.23	900.00	97.17

220	.00	1109.90	640.00	203.62
230	.00	1081.25	790.00	126.21
240	.00	1057.36	630.00	185.19
250	146.00	1052.59	680.00	161.45
260	.00	1035.22	820.00	93.26
270	100.00	1026.54	700.00	141.50
280	.00	1024.68	660.00	158.03
290	.00	1020.96	770.00	108.75
300	.00	1015.39	660.00	154.00
310	.00	1013.53	710.00	131.53
400	831.00	1118.53	730.00	168.36
410	.00	1089.77	900.00	82.23
420	.00	1084.88	1000.00	36.78
430	.00	1082.44	630.00	196.06
440	.00	1081.22	680.00	173.86
450	.00	1077.55	930.00	63.94
460	100.00	1075.11	830.00	106.21
470	.00	1074.65	660.00	179.68
480	138.00	1073.27	920.00	66.42
490	.00	1076.18	660.00	180.34
500	.00	1080.06	800.00	121.36
510	97.00	1081.03	660.00	182.45
520	43.00	1016.15	900.00	50.33
530	.00	1194.37	740.00	196.89
600	138.00	1147.74	1000.00	64.02
650	269.00	954.27	740.00	92.85
660	1090.00	936.77	800.00	59.27
665	.00	936.77	740.00	85.27
670	.00	936.77	900.00	15.93
675	.00	936.77	880.00	24.60
680	.00	936.77	900.00	15.93
700	.00	936.77	680.00	111.27
800	.00	921.53	840.00	35.33
810	196.00	880.61	560.00	138.93
820	83.00	1073.21	1000.00	31.72
830	343.00	943.37	800.00	62.13
900	101.00	869.04	580.00	125.25

THE NET SYSTEM DEMAND = 15168.00

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

PIPE NUMBER	FLOWRATE
1	13108.26
3	2059.74

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 15168.00
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR =   .00
LINE   3 IS CLOSED

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

PIPE NO.	NODE NOS.		LENGTH	DIAMETER	ROUGHNESS	MINOR LOSS K	FIXED GRADE
75	80	77	25080.0	24.9	140.0	.00	.00
320	310	600	10560.0	10.4	140.0	.00	.00
530	520	530	10560.0	12.4	140.0	.00	.00
820	810	820	21120.0	8.4	140.0	.00	.00

THE RESULTS ARE OBTAINED AFTER 9 TRIALS WITH AN ACCURACY = .00125

Static Condition
Global Demand Factor is .001
Delete All Pumps and Close Line 3

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	100	15.17	.00	.00	.00	.01	.00
LINE	2 IS CLOSED							
LINE	3 IS CLOSED							
45	50	45	7.29	.00	.00	.00	.00	.00
50	55	50	8.00	.00	.00	.00	.01	.00
55	60	55	8.63	.00	.00	.00	.01	.00
60	65	60	9.47	.00	.00	.00	.01	.00
65	70	65	9.47	.00	.00	.00	.01	.00
70	75	70	9.47	.00	.00	.00	.01	.00
75	80	77	9.47	.00	.00	.00	.01	.00
77	77	75	9.47	.00	.00	.00	.01	.00
80	85	80	10.52	.00	.00	.00	.00	.00
85	90	85	10.52	.00	.00	.00	.00	.00
90	170	90	10.52	.00	.00	.00	.00	.00
100	100	110	2.63	.00	.00	.00	.01	.00
105	105	100	-12.54	.00	.00	.00	-.01	.00
110	0	120	.57	.00	.00	.00	.00	.00
120	120	130	.57	.00	.00	.00	.00	.00
130	130	140	.33	.00	.00	.00	.00	.00
160	410	160	10.74	.00	.00	.00	.00	.00
162	160	162	10.74	.00	.00	.00	.00	.00
165	0	165	10.74	.00	.00	.00	.00	.00
170	165	170	10.74	.00	.00	.00	.00	.00
200	110	200	2.06	.00	.00	.00	.01	.00
210	200	210	2.02	.00	.00	.00	.01	.00
220	210	220	1.87	.00	.00	.00	.01	.00

230	220	230	1.87	.00	.00	.00	.01	.00
240	230	240	1.87	.00	.00	.00	.01	.00
250	240	250	1.87	.00	.00	.00	.01	.00
260	250	260	1.73	.00	.00	.00	.01	.00
270	260	270	1.73	.00	.00	.00	.01	.00
280	270	280	1.63	.00	.00	.00	.01	.00
290	280	290	1.63	.00	.00	.00	.01	.00
300	290	300	1.63	.00	.00	.00	.01	.00
310	300	310	1.63	.00	.00	.00	.01	.00
320	310	600	1.63	.00	.00	.00	.01	.00
400	105	400	12.54	.00	.00	.00	.01	.00
410	400	410	11.71	.00	.00	.00	.00	.00
420	410	420	.97	.00	.00	.00	.01	.00
430	420	430	.97	.00	.00	.00	.01	.00
440	430	440	.97	.00	.00	.00	.01	.00
450	440	450	.97	.00	.00	.00	.01	.00
460	450	460	.97	.00	.00	.00	.01	.00
470	460	470	.87	.00	.00	.00	.01	.00
480	470	480	.87	.00	.00	.00	.01	.00
490	480	490	.73	.00	.00	.00	.01	.00
500	490	500	.73	.00	.00	.00	.01	.00
510	500	510	.73	.00	.00	.00	.01	.00
520	510	520	.64	.00	.00	.00	.00	.00
530	520	530	.59	.00	.00	.00	.00	.00
540	530	600	.59	.00	.00	.00	.00	.00
600	600	650	2.08	.00	.00	.00	.01	.00
650	650	660	1.09	.00	.00	.00	.00	.00
660	660	665	.00	.00	.00	.00	.00	.00
665	665	670	.00	.00	.00	.00	.00	.00
670	670	675	.00	.00	.00	.00	.00	.00
675	675	680	.00	.00	.00	.00	.00	.00
700	675	700	.00	.00	.00	.00	.00	.00
800	650	800	.72	.00	.00	.00	.00	.00
810	800	810	.72	.00	.00	.00	.00	.00
820	810	820	.43	.00	.00	.00	.00	.00
830	820	830	.34	.00	.00	.00	.00	.00
900	810	900	.10	.00	.00	.00	.00	.00

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
45	7.29	950.00	487.00	200.63
50	.71	950.00	640.00	134.33
55	.63	950.00	590.00	156.00
60	.85	950.00	770.00	78.00
65	.00	950.00	800.00	65.00
70	.00	950.00	534.00	180.27
75	.00	950.00	700.00	108.33
77	.00	950.00	600.00	151.67
80	1.05	950.00	590.00	156.00
85	.00	950.00	530.00	182.00
90	.00	950.00	740.00	91.00

100	.00	1146.00	800.00	149.93
105	.00	1146.00	670.00	206.27
110	.00	1146.00	815.00	143.43
120	.00	845.00	500.00	149.50
130	.25	845.00	550.00	127.83
140	.33	845.00	500.00	149.50
160	.00	1146.00	960.00	80.60
162	.00	1146.00	900.00	106.60
165	.00	950.00	580.00	160.33
170	.22	950.00	540.00	177.67
200	.04	1146.00	760.00	167.27
210	.15	1146.00	900.00	106.60
220	.00	1146.00	640.00	219.27
230	.00	1146.00	790.00	154.27
240	.00	1146.00	630.00	223.60
250	.15	1146.00	680.00	201.93
260	.00	1146.00	820.00	141.27
270	.10	1146.00	700.00	193.27
280	.00	1146.00	660.00	210.60
290	.00	1146.00	770.00	162.93
300	.00	1146.00	660.00	210.60
310	.00	1146.00	710.00	188.93
400	.83	1146.00	730.00	180.27
410	.00	1146.00	900.00	106.60
420	.00	1146.00	1000.00	63.27
430	.00	1146.00	630.00	223.60
440	.00	1146.00	680.00	201.93
450	.00	1146.00	930.00	93.60
460	.10	1146.00	830.00	136.93
470	.00	1146.00	660.00	210.60
480	.14	1146.00	920.00	97.93
490	.00	1146.00	660.00	210.60
500	.00	1146.00	800.00	149.93
510	.10	1146.00	660.00	210.60
520	.04	1146.00	900.00	106.60
530	.00	1146.00	740.00	175.93
600	.14	1146.00	1000.00	63.27
650	.27	1146.00	740.00	175.93
660	1.09	1146.00	800.00	149.93
665	.00	1146.00	740.00	175.93
670	.00	1146.00	900.00	106.60
675	.00	1146.00	880.00	115.26
680	.00	1146.00	900.00	106.60
700	.00	1146.00	680.00	201.93
800	.00	1146.00	840.00	132.60
810	.20	1146.00	560.00	253.93
820	.08	1146.00	1000.00	63.26
830	.34	1146.00	800.00	149.93
900	.10	1146.00	580.00	245.26

THE NET SYSTEM DEMAND =   15.17

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

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PIPE NUMBER    FLOWRATE
     1           15.17
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THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES =   15.17
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES =   .00

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR =   .70
LINE   3 IS OPEN

THE FOLLOWING CHANGES IN PIPE DATA ARE SPECIFIED

FOR PIPE NUMBER 165 THE VALUE OF THE FIXED GRADE IS CHANGED TO 1050.0

PIPE NO.	NODE NOS.		LENGTH	DIAMETER	ROUGHNESS	MINOR LOSS K	FIXED GRADE	
75	80	77	25080.0	24.9	140.0	.00	.00	
320	310	600	10560.0	10.4	140.0	.00	.00	
LINE 320 PUMP DATA (HEAD-FLOW):			145.0	.0	137.0	500.0	114.0	800.0
530	520	530	10560.0	12.4	140.0	.00	.00	
LINE 530 PUMP DATA (HEAD-FLOW):			275.0	.0	233.0	2000.0	160.0	3000.0
820	810	820	21120.0	8.4	140.0	.00	.00	
LINE 820 PUMP DATA (HEAD-FLOW):			268.0	.0	235.0	500.0	140.0	800.0

THE RESULTS ARE OBTAINED AFTER 8 TRIALS WITH AN ACCURACY = .00262

Global Demand Factor is 0.70
Delete Pump in Line 75 and Open Line 3
Change setting of PRV in Line 165

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	0	100	9164.48	.00	.00	.00	3.90	1.32
LINE	2 IS CLOSED							
3	0	510	1453.12	9.94	.00	.00	3.86	3.76
45	50	45	5105.10	15.01	.00	.00	3.36	1.29
50	55	50	5601.40	17.82	.00	.00	3.69	1.54
55	60	55	6039.60	37.30	.00	.00	3.98	1.77
60	65	60	6631.10	2.77	.00	.00	4.37	2.10
65	70	65	6631.10	30.49	.00	.00	4.37	2.10
70	75	70	6631.10	11.09	.00	.00	4.37	2.10
75	80	77	6631.10	52.67	.00	.00	4.37	2.10

77	77	75	6631.10	30.49	.00	.00	4.37	2.10
80	85	80	7366.80	16.22	.00	.00	3.13	.88
85	90	85	7366.80	20.86	.00	.00	3.13	.88
90	170	90	7366.80	28.97	.00	.00	3.13	.88
100	100	110	866.28	3.81	.00	.00	2.30	1.44
105	105	100	-8298.19	-2.89	.00	.00	-3.53	-1.09
110	0	120	399.00	12.09	.00	.00	2.31	2.29
120	120	130	399.00	18.14	.00	.00	2.31	2.29
130	130	140	227.50	19.23	.00	.00	1.32	.81
160	410	160	7518.00	16.84	.00	.00	3.20	.91
162	160	162	7518.00	6.02	.00	.00	3.20	.91
165	0	165	7518.00	6.02	.00	.00	3.20	.91
170	165	170	7518.00	7.22	.00	.00	3.20	.91
200	110	200	467.28	3.65	.00	.00	1.24	.46
210	200	210	442.08	1.10	.00	.00	1.17	.42
220	210	220	339.18	4.75	.00	.00	1.28	.60
230	220	230	339.18	9.49	.00	.00	1.28	.60
240	230	240	339.18	7.91	.00	.00	1.28	.60
250	240	250	339.18	1.58	.00	.00	1.28	.60
260	250	260	236.98	4.89	.00	.00	.89	.31
270	260	270	236.98	2.44	.00	.00	.89	.31
280	270	280	166.98	.43	.00	.00	.63	.16
290	280	290	166.98	.85	.00	.00	.63	.16
300	290	300	166.98	1.28	.00	.00	.63	.16
310	300	310	166.98	.43	.00	.00	.63	.16
320	310	600	166.98	1.70	144.66	.00	.63	.16
400	105	400	8298.19	11.56	.00	.00	3.53	1.09
410	400	410	7716.49	15.15	.00	.00	3.28	.96
420	410	420	198.50	6.64	.00	.00	1.15	.63
430	420	430	198.50	3.32	.00	.00	1.15	.63
440	430	440	198.50	1.66	.00	.00	1.15	.63
450	440	450	198.50	4.98	.00	.00	1.15	.63
460	450	460	198.50	3.32	.00	.00	1.15	.63
470	460	470	128.50	1.48	.00	.00	.74	.28
480	470	480	128.50	4.45	.00	.00	.74	.28
490	480	490	31.90	.68	.00	.00	.33	.09
500	490	500	31.90	.91	.00	.00	.33	.09
510	500	510	31.90	.23	.00	.00	.33	.09
520	510	520	1417.12	37.95	.00	.00	3.76	3.59
530	520	530	1387.02	36.47	258.08	.00	3.68	3.45
540	530	600	1387.02	27.35	.00	.00	3.68	3.45
600	600	650	1457.40	99.94	.00	.00	3.87	3.79
650	650	660	763.00	9.04	.00	.00	2.03	1.14
660	660	665	.00	.00	.00	.00	.00	.00
665	665	670	.00	.00	.00	.00	.00	.00
670	670	675	.00	.00	.00	.00	.00	.00
675	675	680	.00	.00	.00	.00	.00	.00
700	675	700	.00	.00	.00	.00	.00	.00
800	650	800	506.10	16.91	.00	.00	1.34	.53
810	800	810	506.10	21.14	.00	.00	1.34	.53
820	810	820	298.20	28.21	260.57	.00	1.73	1.34

| 830 | 820 | 830 | 240.10 | 67.07 | .00 | .00 | 2.47 | 3.63 |
| 900 | 810 | 900 | 70.70 | 5.97 | .00 | .00 | .73 | .38 |

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
45	5105.10	773.07	487.00	123.96
50	496.30	788.08	640.00	64.17
55	438.20	805.90	590.00	93.56
60	591.50	843.21	770.00	31.72
65	.00	845.98	800.00	19.92
70	.00	876.47	534.00	148.40
75	.00	887.56	700.00	81.28
77	.00	918.05	600.00	137.82
80	735.70	970.72	590.00	164.98
85	.00	986.94	530.00	198.01
90	.00	1007.80	740.00	116.05
100	.00	1146.00	800.00	149.93
105	.00	1143.11	670.00	205.01
110	.00	1142.19	815.00	141.78
120	.00	832.91	500.00	144.26
130	171.50	814.77	550.00	114.73
140	227.50	795.54	500.00	128.07
160	.00	1099.56	960.00	60.47
162	.00	1093.54	900.00	83.87
165	.00	1043.98	580.00	201.06
170	151.20	1036.77	540.00	215.26
200	25.20	1138.54	760.00	164.03
210	102.90	1137.44	900.00	102.89
220	.00	1132.70	640.00	213.50
230	.00	1123.20	790.00	144.39
240	.00	1115.30	630.00	210.29
250	102.20	1113.71	680.00	187.94
260	.00	1108.83	820.00	125.16
270	70.00	1106.38	700.00	176.10
280	.00	1105.96	660.00	193.25
290	.00	1105.11	770.00	145.21
300	.00	1103.83	660.00	192.33
310	.00	1103.40	710.00	170.47
400	581.70	1131.55	730.00	174.01
410	.00	1116.40	900.00	93.77
420	.00	1109.76	1000.00	47.56
430	.00	1106.45	630.00	206.46
440	.00	1104.79	680.00	184.07
450	.00	1101.14	930.00	74.16
460	70.00	1097.82	830.00	116.05
470	.00	1096.33	660.00	189.08
480	96.60	1091.88	920.00	74.48
490	.00	1091.20	660.00	186.85
500	.00	1090.29	800.00	125.79
510	67.90	1090.06	660.00	186.36
520	30.10	1052.11	900.00	65.91

530	.00	1273.72	740.00	231.28
600	96.60	1246.36	1000.00	106.76
650	188.30	1146.43	740.00	176.12
660	763.00	1137.38	800.00	146.20
665	.00	1137.38	740.00	172.20
670	.00	1137.38	900.00	102.87
675	.00	1137.38	880.00	111.53
680	.00	1137.38	900.00	102.87
700	.00	1137.38	680.00	198.20
800	.00	1129.51	840.00	125.46
810	137.20	1108.37	560.00	237.63
820	58.10	1340.73	1000.00	147.65
830	240.10	1273.66	800.00	205.25
900	70.70	1102.40	580.00	226.37

THE NET SYSTEM DEMAND = 10617.60

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

PIPE NUMBER	FLOWRATE
1	9164.48
3	1453.12

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 10617.60
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES =   .00