Thurston PUD

Providing safe, reliable, affordable, and sustainable service.

May 19, 2022

Subject: Updated Capacity Analysis - Request for Expedited Approval of Additional Water Connections at the Timberline Village Water System #628

Jocelyne Gray, PE, WDM4, CCS
Assistant Regional Manager
Southwest Drinking Water Regional Operations
Washington State Department of Health
111 Israel Road S.E. Fifth floor
Tumwater, WA 98501

Jocelyn,

Thank you for taking the time to meet with PUD staff and I on May 18th. I would like to request your assistance and that of Regional Manager Andy Anderson P.E. In 2017, the PUD purchased the Timberline Village #628 water system from the for-profit company, H&R Waterworks. At the time Thurston PUD acquired this water system, it was over connected and we reported this to the SW Regional Engineer and a moratorium was placed on any further connections.

There was extensive water leak loss that averaged over 40 gpm in 2017. The PUD put extensive effort into reducing this leak loss to where it is **down to 5 gpm today**. These efforts have included extensive leak detection, with state of the art leak detection equipment, replacement of sections of the system's water mains, and replacement of most meters on the water system. We also installed cellular AMR meters on our critical zone areas to facilitate early warning of any water loss. This long delay from 2017 to 2022 has been very challenging and troublesome for property owners that have been waiting for water service; most are small lots so exempt wells are not an option. We feel our efforts have been successful and are requesting your assistance to approve new connections to provide service to these customers, many of whom have been on a water availability waiting list for years.

The PUD's District Engineer Doug Piehl has conducted a capacity analysis of the Timberline water system outlining our efforts and concerns and we are requesting your immediate approval of authorization to provide water service to 45 customers waiting for water service availability while we addressed these leak loss issues. We feel that our extensive efforts and the updated capacity analysis supports providing these connections now. If additional efforts and capital expenditures are needed to continue to maintain and improve the Timberline water system's infrastructure, Thurston PUD stands ready do what is necessary for the water system and its customers.

Again, I would like to request immediate approval to issue 45 new water system connections to serve customers that have no other options for service and have submitted requests for water availability from the PUD. This would bring the revised number of connections on the Timberline Village water system to 315 approved connections. Your assistance would be greatly appreciated. The PUD

Operations Team is willing to meet with you if needed. See Doug's Capacity Analysis of the Timberline #628 water system and please follow-up with him directly if there are questions at doug.piehl@thurstonpud.org. Thank you in advance for any immediate assistance you can provide the District.

If you have any questions or concerns at all, please feel free to contact me at (360) 763-5838 or email me at jweidenfeller@thurstonpud.org or Kim Gubbe, the Director of Planning and Compliance at kgubbe@thurstonpud.org.

Sincerely,

John Weidenfeller
General Manager
Thurston PUD

Attachments:
Washington State Department of Health Project Approval Application Form – Capacity Analysis of the Timberline Village #628 Water System (WSID 88388B)

Washington State Department of Health
Project Approval Application Form

Please fill in all project description information and check all boxes that apply below.

Timberline Village Capacity Analysis (project name)			**Lewis** (county)	**Pending** (DOH Project #)
Timberline Village #628 (water system name)	**88388B** PWS ID#		**Doug Piehl** (design engineer)	
Thurston PUD (system owner)			**N/A** (engineering firm)	
1230 Ruddell Rd SE (street)			(street)	
Lacey (city)	**WA** (state)	**98503** (zip code)	(city)	(st) (zip code)
(360) 357-8783 (phone number)	**(360) 357-1172** (fax number)		**(360) 890-6021** (phone number)	(fax number)
Kim Gubbe, Director of Compliance (project contact if different than above)	**(360) 763-5848** (daytime phone number)		**(360) 688-0827** (evening phone number)	
(billing contact--required if not the same as above)	(billing phone number)		(billing fax number)	
1230 Ruddell Rd SE (billing address)	**Lacey** (city)		**WA 98503** (state/zip)	

SYSTEM CLASS: [X] Group A Community [ ] Group A NTNC [ ] Group A TNC [ ] Group B

SERVICE CONNECTIONS *(for Group A systems only - # services after project completion)*

[ ] less than 100 [X] 100-500 [ ] 501-999 [ ] 1,000-9,999 [ ] 10,000 or more

PROJECT DESCRIPTION: Capacity Analysis

AREA SERVED *(for distribution projects only - name of subdivision, site address, parcel numbers, etc.)* :

TYPE OF PROJECT *(check all that apply)* :

[ ] Water system plan:
- [ ] non-complete new or updated plan
- [ ] non-minor alteration

[ ] Satellite management (SMA)
- [ ] ownership plan
- [ ] amendment
- [ ] operation plan

[ ] DWSRF Loan
Application #
Loan #

[ ] New Group B design report (Group B Workbook)

[X] Project Report: (Is water system plan required: [ ] Y [X] N If required, is it current and approved: [ ] Y [ ] N)
(Is project identified as part of capital improvement plan: [ ] Y [X] N)
- [ ] filtration or other complex treatment
- [ ] chemical addition only (ion exchange, hypochlorination, corrosion control or flouridation)
- [ ] complete new water system
- [ ] major system modification

[ ] Special reports or plans:
- [ ] corrosion control report
- [ ] corrosion control study
- [ ] plan to cover uncovered reservoir

[ ] Predesign study
- [ ] uncovered reservoir plan of operation
- [ ] tracer study plan
- [ ] surface water or GWI treatment facility operation plan
- [ ] filtration pilot study

Washington State Department of Health
Project Approval Application Form

- [ ] Existing system approval
  - [ ] non-expanding; not detailed evaluation
  - [ ] non-expanding, detailed evaluation
  - [ ] expanding, not detailed evaluation
  - [ ] expanding, detailed evaluation

- [ ] Construction documents
  - [ ] filtration or other complex treatment
  - [ ] chemical addition only
  - [ ] complete new water system
  - [ ] new source only
  - [ ] system modification
  - [ ] system modification; design standards used; PE prepared

- [ ] Waivers
  - [ ] inorganic chemical (initial)
  - [ ] organic chemical (initial)
  - [ ] use
  - [ ] area wide renewal
  - [ ] inorganic chemical (renewal)
  - [ ] organic chemical (renewal)
  - [ ] use (renewal)
  - [ ] coliform (w/ departmental inspection)
  - [ ] coliform (w/ third-party inspection)

- [ ] Other
  - [ ] well-site evaluation and approval
  - [ ] regulatory monitoring plan
  - [ ] unfiltered system annual report
  - [ ] water system compliance report (loan letter)
  - [ ] water right self-assessment (if applicable)

Other projects (describe) _____

Please return completed form to DOH regional office checked below.

[ ] NWRO Drinking Water Department of Health 20425 72nd Ave. S Ste. 310 Kent, WA 98032 (253) 395-6760	[X] SWRO Drinking Water Department of Health PO Box 47823 Olympia, WA 98504-7823 (360) 664-0768	[ ] ERO Drinking Water Department of Health 1500 W, Fourth Ave. Suite 305 Spokane, WA 99204 (509) 456-2997

For Department use only below this line:

Log-in # _____; Initial fee _____; Invoice mailed _____;

Invoice # _____; Fee received _____; # review letters _____

Approval Date: _____ Date construction report received: _____ # approved connections _____

Area Served: _____

Provisions: _____

Providing safe, reliable, affordable, and sustainable service.

Capacity Analysis
of the
Timberline Village #628 Water System
WSID: 88388B

Executive Summary

Due to excessively high leak loss the Timberline Village water system was overconnected when it was purchased by Thurston PUD. Over the past several years since the PUD purchased the system the PUD has brought leakage down from an average of 40 gpm (over 20 million gallons per year) down to a present loss of 5 gpm (2.6 million gallons per year).

There are approximately 150 parcels within the retail service area which are not currently developed; due to lot size and necessity of OSS, drilling of private wells is not generally feasible, and there are a number of property owners who have requested and been waiting for water service now for several years. In light of the fact that the PUD has pursued and resolved DSL to the best of its capability and now has excess available capacity, it is the obligation and duty of Thurston PUD per RCW 43.20.260 and Thurston PUD policy to provide water connection to these property owners on the water availability wait list. Thurston PUD herby requests approval of 45 additional connections for the Timberline Village 628 water system, bringing the revised total approved connections to 315.

Pertinent information about the water system is summarized below:

Water System Name:	Timberline Village -628
System Type:	Group A Community Water System
WSDOH ID Number:	88388-B
Location:	Lewis County, Washington
Source:	Groundwater
Type of Ownership:	Special Purpose District
Active Service Connections:	275
Current Approved Connections	270
Requested additional Con.	45
Ownership	Thurston PUD (owner/operator)
Primary Contact:	Kimberly Gubbe, Compliance Director
Owner Address:	1230 Ruddell Rd SE Lacey WA 98503
Owner Phone:	(360) 357-8783

Population and Demographics

Timberline Village is a residential community comprised of primarily part time and recreational residences, along with a small hotel, a restaurant, and a community center and swimming pool. There are very few full-time residences, and the majority of new connections being added are also part time connections. The community is located in an area which provides both abundant summertime and wintertime recreational opportunity. There are very few parcels with irrigation.

The prior water system plan was compiled in 2006. During the intervening 16 year time period the system has added an average of 3 connections per year, with an average of 1 connection per year being a full time connection. Based on this history and a survey of community members conducted earlier this year, those trends are expected to continue into the future.

Table 1: Connection Summary and Projections

Year	Total Active Connections	Full Time connections
2006	228	15
2022	275	29
2042 (projected)	335	49

In a 2022 survey conducted by Thurston PUD, a combined 16% of respondents identified as either being a fulltime resident or operating the property as a vacation rental. 84% of all respondents identified as either part time or occasional recreational use only. Very few connections have irrigation systems (only 6% of respondents report actively using an irrigation system). Based on survey response, it is likely that the current use and character of the community will continue into the foreseeable future, with a significant number of respondents reporting future plans for cabin additions, ADU's, and other development consistent with part time or recreational use, and no respondents reporting plans to build a full time residence or transition to full time occupancy.

Table 2: Survey Results

Use category	number	Percent of Total
Full Time	1	3%
Vacation rental	5	13%
Part Time	20	51%
Occasional rec use only	13	33%
Total	39	100%

ERU Analysis

For the purpose of this report, one ERU is defined as the equivalent usage of a single-family residence occupied full time. Based on average annual usage, part time connections are counted as 0.174 ERU, and

there are 15 ERU of commercial and community services (hotel, condo, restaurant, community center, pool).

Table 3: ERU Analysis

Class	Services	ERU
Full Time Residences	29	29
Part Time / Recreational	241	42
Commercial/community	5	15
Total	275	86

Water Production and Usage

Meter Data

The community has a history of high DSL. Though current DSL is still above WUE target of less than 20%, Thurston PUD has made great strides in reducing leakage over the past several years through a combination of finding and fixing leaks and water main replacement projects. Total leakage has gone from an average of over 20 million gallons per year prior to 2018 to 5 million gallons per year in 2021, and continuing this downward trend into 2022. DSL as a percentage was 41% for 2021, and is on track to be 25% for 2022. DSL for the past 12 months represented 59 ERU based on annual consumption, and contributes a base demand of 9.9 gpm. With the resolution of further leaks, leakage for the past 3 months is even further down to 5 gpm, or about 1.25 gpm per zone. For the sake of a conservative approach average DSL of 9.9 gpm for the past 12 months is used in this capacity analysis rather than the more recent lower DSL rate.

Table 4: Summary of DSL over past 12-month period

Average Daily DSL	14,200 gpd
DSL	59 ERU
Average DSL Rate	9.9 gpm

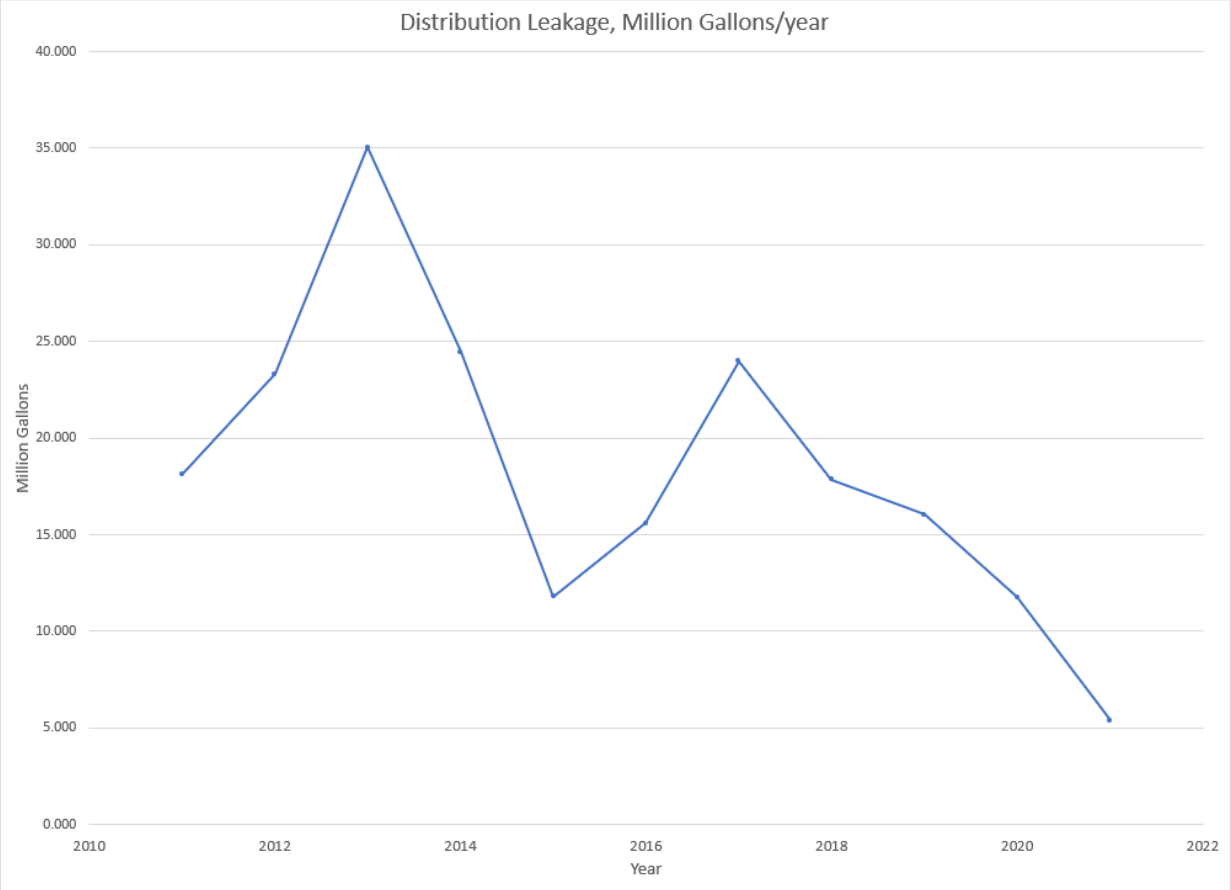

Figure 1: DSL from 2011 to 2021, MGY

System Parameters: ADD, MDD, and PHD

Based on the past year's metering data, ADD of full time connections is 241 gpd (defined as one ERU), and ADD of part time connections is 42 gpd, making part time connections 0.174 ERU. Due to the primarily part-time and seasonal nature of occupancy of the community MDD was defined as being 4 times ADD; Resulting MDD is therefore 964 gpd/ERU. A review of peak monthly metering records indicates this is a conservative assumption and likely overestimates MDD.

Due to the primarily-part time residential/recreational nature of the community Peak Hourly Demand (PHD) is calculated using Equation 3-2 of the WSDM. Based on 29 full time ERU, 15 commercial/community ERU, and 42 part time ERU, system wide MDD is

$$MDD_{system} = (29\ ERU + 15\ ERU + \ 42\ ERU) * 964 \frac{GPD}{ERU} = 82{,}904\ GPD$$

Using Equation 3-2 and Figure 3.1 of the Design Guide, PHD is calculated as

$$PHD_{exist} = \frac{MDD_{system}}{1440} * PF = \frac{82{,}904}{1440} * 2.6 = 150\ gpm$$

Table 5: Summary of Current Systems Design Parameters

Total Existing ERU	86
ADD/ERU	241 gpd
MDD/ERU	964 gpd
PHD (existing)	150 gpm
`PHD + DSL	160 gpm

Capacity Analysis

Water Rights

The system has three water rights. Water right G2-22984 provides 160 gpm and 19 acre feet per year, G2-00887 provides 160 gpm and 37 acre feet per year, and water right G2-25619 provides an additional 80 gpm, for a total combined 400 gpm and 58 acre feet per year.

The number of ERU's that may be served by the system's permitted withdrawal under MDD conditions after accounting for DSL (10 gpm) are

$$N_{wr,instant} = \frac{(400gpm - 10\ gpm) * 1{,}440\frac{min}{day}}{964\frac{gpd}{ERU}} = 583\ ERU$$

Annual water rights (minus DSL) limit the system as follows:

$$N_{wr,annual} = \frac{58\ \frac{acft}{year} * 325{,}851\frac{gallons}{acft}}{241\ \frac{gpd}{ERU} * 365} - 59\ ERU = 156\ ERU$$

Source Capacity

Well 1 (AFM952) has a capacity of 125 gpm; Well 2 (AFM953) has a capacity of 240 gpm. In general wells should not be pumped for more than 50% of the day at their peak capacity year-round; however, on peak demand days they may be pumped up to 20 hours. Well capacity with equalizing storage is:

$$N_{source} = \frac{(125gpm + 240gpm) * 20\frac{hr}{day} * 60\frac{min}{hr} - 10gpm * 1440\frac{min}{day}}{964gpd/ERU} = 439\ ERU$$

Without Equalizing Storage the wells must meet PHD and DSL, giving a more limiting well capacity of:

$$N_{source} = \frac{(125gpm + 240gpm - 10gpm) * 1440\frac{min}{day}}{2.6 * 964\ gpd/ERU} = 204\ ERU$$

Booster Pumps

The lower zone is gravity fed from the reservoir, and consists of Divisions 1,2,3 and tract 24, for a total of 248 lots. The upper zone is pressurized by four 5 hp Grundfos booster pumps and consists of Divisions 4 and 5 and Tracts 17-27 and 29, consisting of a total of 173 lots. Installed booster pumps have a combined capacity of 168 gpm while serving the upper zone. Conservatively, half of the 10 gpm DSL is assumed in the upper zone.

$$N_{booster} = \frac{(168\ gpm - 5gpm) * 1440 \frac{min}{day}}{2.6 * 964\ gpd/ERU} = 94\ ERU$$

Storage

Storage is provided by two 30,000 gallon horizontal cylindrical tanks, providing a total usable volume of approximately 48,000 gallons. Equalizing storage is not needed and fire flow storage of 15,000 gallons is nested with standby storage, therefore all available storage can be used for standby storage. With two high output wells the alternative minimum of 200 gpd/ERU is used.

$$N_{storage} = \frac{48{,}000\ gal}{200\ gal/ERU} = 240\ ERU$$

Distribution System

A distribution system hydraulic analysis was conducted by Northwest Water Systems (analysis attached). Maximum PHD that the current distribution system can support was determined to be 395 gpm. Distribution Capacity is therefore estimated to be:

$$N_{distribution} = \frac{(395gpm - 10gpm) * 1440 \frac{min}{day}}{2.6 * 964\ gpd/ERU} = 221\ ERU$$

Summary

The current systems limits are shown in Table 6.

Table 6: System Capacity Summary

Limitation	Maximum ERU
Water Rights, Instantaneous withdrawal	583
Water Rights, Annual withdrawal	156
Total Source Production	204
Upper zone booster[1]	94
Reservoirs	240
Distribution System	221

[1]Upper pressure zone only

Conclusion

Historically Timberline Village has lost extraordinarily large quantities of water to DSL. However, following a program of finding and fixing leaks and targeted main replacement DSL has been reduced from an average of 20 million gallons per year prior to 2018, to 5 million gallons in 2021, and is on target to reduce this still further in 2022. The system has the capacity for up to 156 ERU based on annual water rights, limited to 94 ERU in the upper pressure zone based on booster station capacity.

The existing 29 full time, 241 part time, and 5 commercial/community connections amount to 86 total ERU, well under the capacity of the system. Based on past trends of adding or converting one full time connection for every 2 new part time connections, 156 ERU would allow up to 51 new full-time connections and 102 new part time connections, for a total of 153 new connections (69 new ERU). At present Thurston PUD requests approval of 45 new connections (20 ERU) and will provide a revised capacity analysis based on updated metering data and demographics should further additional connections be desired in the future. We believe this is a very conservative approach and allows the PUD some connections now to fulfill its obligation to customers who have been waiting for water, with the possibility of further future connections once more metering data is available to support a further request.

Engineer:

Douglas Piehl

Doug Piehl, P.E.
District Engineer
(360) 357-8783
doug.piehl@thurstonpud.org

Engineer's Signature

Date: May 18, 2022

Washington State Department of Health
Environmental Health Programs
Division of Drinking Water

WATER FACILITIES INVENTORY (WFI) FORM

ONE FORM PER SYSTEM

RETURN TO: Southwest Regional Office POB 87423 Olympia WA 98504-7823

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
88388B	Timberline Village #628	Lewis	Group A	Comm

6. PRIMARY CONTACT NAME & MAILING ADDRESS	7. OWNER NAME & MAILING ADDRESS	8. Owner Number:
PUD No1 of Thurston County	PUD NO 1 of Thurston County	
Kimberly S. Gubbe [Compliance Director]	John G. Weidenfeller [General Manager]	
1230 Ruddell Rd SE	1230 Ruddell Rd. SE	
Lacey, WA 98503	Lacey, WA 98503	
STREET ADDRESS IF DIFFERENT FROM ABOVE	STREET ADDRESS IF DIFFERENT FROM ABOVE	
ATTN	ATTN	
ADDRESS	ADDRESS	
CITY STATE ZIP	CITY STATE ZIP	

9. 24 HOUR PRIMARY CONTACT INFORMATION		10. OWNER CONTACT INFORMATION	
Primary Contact Daytime Phone: (360) 357-8783 x 125		Owner Daytime Phone: (360) 357-8783	
Primary Contact Evening Phone: (360) 688-0827		Owner Evening Phone: (360) 791-1739	
Primary Contact Mobile/Cell Phone:		Owner Mobile/Cell Phone:	
Fax: (360) 357-1172	E-mail: kgubbe@thurstonpud.org	Fax (360) 357-1172	E-Mail:

WAC 246-290-420(()) requires that water systems provide 24-hour contact information for emergencies.

11. SATELLITE MANAGEMENT AGENCY – SMA (check only one)

- ☐ Not applicable (Skip to #12)
- ☒ Owned and Managed — SMA NAME: PUD No1 of Thurston County — SMA Number: 147
- ☐ Managed Only
- ☐ Owned Only

12. WATER SYSTEM CHARACTERISTICS (mark ALL that apply)

☐ Agricultural	☐ Hospital/Clinic	☒ Residential
☒ Commercial / Business	☐ Industrial	☐ School
☐ Day Care	☐ Licensed Residential Facility	☐ Temporary Farm Worker
☐ Food Service/Food Permit	☐ Lodging	☐ Other (church, fire station, etc.):
☐ 1,000 or more person event for 2 or more days per year	☐ Recreational / RV Park	☐ _____

13. WATER SYSTEM OWNERSHIP (mark only one)

☐ Association	☐ County	☐ Investor	☒ Special District
☐ City / Town	☐ Federal	☐ Private	☐ State

14. STORAGE CAPACITY (gallons): 60,000

15. SOURCE NUMBER	16 SOURCE NAME (LIST UTILITY'S NAME FOR SOURCE AND WELL TAG ID NUMBER. Example: WELL #1 XYZ456. IF SOURCE IS PURCHASED OR INTERTIED, LIST SELLER'S NAME Example: SEATTLE)	17. INTERTIE (INTERTIE SYSTEM ID NUMBER)	18. SOURCE CATEGORY: WELL	WELL FIELD	WELL IN A WELL FIELD	SPRING	SPRING FIELD	SPRING IN	SEA WATER	SURFACE WATER	RANNEY / INF. GALLERY	OTHER	19. USE: PERMANENT	SEASONAL	EMERGENCY	20 SOURCE METERED	21. TREATMENT: NONE	CHLORINATION	FILTRATION	FLUORIDATION	IRRADIATION (UV)	OTHER	22. DEPTH (OPEN INT (FEET))	23. CAPACITY (GALLONS PER MINUTE)	24. SOURCE LOCATION: ¼, ¼ SECTION	SECTION NUMBER	TOWNSHIP	RANGE
	Well # 1 AFM952		x										x			Y	X						89	125	SE NE	01	13N	09E
	Well # 2 AFM953		x										x			Y	X						63	240	SE NE	01	13N	09E

If this water system serves 100 OR MORE single-family residences, please enter the total number of service connections on line 25, then skip to lines 29, 35 and 36. If this water system serves LESS THAN 100 single-family residences, complete entire form.	ACTIVE SERVICE CONNECTIONS	DOH USE ONLY! CALCULATED ACTIVE CONNECTIONS	DOH USE ONLY! APPROVED CONNECTIONS
25. SINGLE FAMILY RESIDENCES (How many of the following do you have?)			
A. Full Time Single Family Residences (Occupied 180 days or more per year)	29		
B. Part Time Single Family Residences (Occupied less than 180 days per year)	241		
26. MULTI-FAMILY RESIDENTIAL BUILDINGS (How many of the following do you have?)			
A. Apartment Buildings, condos, duplexes, barracks, dorms			
B. Full Time Residential Units in Apartments, Condos, Duplexes, Dorms that are occupied more than 180 days/year			
C. Part Time Residential Units in Apartments, Condos, Duplexes, Dorms that are occupied less than 180 days/year			
27. NON-RESIDENTIAL CONNECTIONS (How many of the following do you have?)			
A. Recreational Services (Campsites, RV Sites, Spigots, etc.)			
B. Institutional, Commercial or Industrial Services	5		
28. TOTAL SERVICE CONNECTIONS	275		

29. FULL-TIME RESIDENTIAL POPULATION

A. How many residents are served by this system 180 or more days per year? 75

30. PART-TIME RESIDENTIAL POPULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many part-time residents are present each month?	193	193	193	193	193	193	193	193	193	193	193	193
B. How many days per month are they present?	8	8	8	4	4	4	4	4	4	8	8	8

31. TEMPORARY & TRANSIENT USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many visitors, attendees, travelers, campers, patients or customers have access to the water system each month?												
B. How many days per month are they present?												

32. REGULAR NON-RESIDENTIAL USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. If you have schools, daycares, or businesses connected to your water system, how many students, daycare children and/or employees are present each month?												
B. How many days per month are they present?												

33. ROUTINE COLIFORM SCHEDULE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	1	1	1	1	1	1	1	1	1	1	1	1

34. GROUP B NITRATE SCHEDULE *This will be suppressed for all Group A systems*	QUARTERLY	ANNUALLY	ONCE EVERY 3 YEARS

35. Reason for Submitting WFI: *(To be completed by system submitting form – not a Sentry feed)*

☒ **Update-Change** ☐ **Update-No Change** ☐ **Inactivate** ☐ **Re-Activate** ☐ **Name change** ☐ **New System** ☐ **Other**_____

36. I certify that the information stated on this WFI form is correct to the best of my knowledge.

SIGNATURE: Douglas Piehl **DATE:** 5/18/22

PRINT NAME: Douglas Piehl **TITLE:** District Engineer

Thurston PUD

Providing safe, reliable, affordable, and sustainable service.

January 14, 2022

Subject: Timberline Village #268 Water System Survey 2022

Dear Timberline Village residents,

This survey is part of our planning update effort for the Timberline Village water system. Responses are very important for our planning effort and will allow us to better serve you. Responses are confidential and are for planning and funding purposes only. We ask that you please take the time to complete this short survey and return it to us by February 24, 2022.

You may email, fax, or mail responses to:
Thurston PUD
Attn. Teal Reopelle
Email: treopelle@thurstonpud.org
Fax: (360) 357-1172
Mail: 1230 Ruddell Rd SE
Lacey, WA 98503

Sincerely,

Teal Reopelle

Teal Reopelle
Administrative Assistant
(360) 357-8783 x 126

Timberline Village #268 Water System Survey 2022

Please fill out or circle the below as applicable:

Lot #/Address _____

I use or reside on my property:

- Full time (primary residence)
- Part time
- Occasional recreational use only
- I use my lot primarily as a vacation rental
- I do not currently have water service
- Other _____

I have an irrigation system

- Yes
- No

Please tell us if you have intend to build on your undeveloped parcel, or to add an Accessory Dwelling Unit in the future:_____

_____

Address	Property use	Irrigation sy	Future build/ADU plans?
100 Ridge Ln	Part Time	No	In the next 5 to 10 years we intend to build another structure on an undeveloped parcel next to ours. Probably 2 bed 1.5
111 Huckleberry Ln	Occasional rec use only	No	None
107 Elkhorn Trail	Vacation rental	No	None
179 Summit Dr	Occasional rec use only	No	None
110 Cascade Dr	Part Time	No	None
124 Forest Ridge Dr	Vacation rental	No	None
113 Timber Trail	Part Time	No	None
142 Coal Creek Dr	Part Time	Yes	None
112 River Run Dr	Part Time	No	None
128 Cascade Dr	No water service	No	I have long-range plans to sell a portion of this property as a buildable parcel
107 Cottonwood Rd	No water service	No	None
105 Cedar Rd	Occasional rec use only	No	We would like to build a small 'bunkhouse'
109 Deer Park Ln	Part Time	No	None
112 Trails End Dr	Occasional rec use only	No	None
132 Grizzly Rd	Part Time	No	None
138 Coal Creek Dr	Part Time	No	Many years down the road may add ADU
126 Elkhorn Trail	Part Time	No	None
160 Timberline Dr	Part Time	No	None
138 Red Cedar Ln	Part Time	No	None
179 Timberline Dr	Occasional rec use only	No	We hope to add on in the future
106 Cascade Dr	Occasional rec use only	No	None
126 Timberline Dr W	Occasional rec use only	No	None
188 Timberline Dr	No water service	No	Hoping to build in near future, on waiting list for water
161 Coal Creek Dr	Part Time	Yes	None
121 Elkhorn Trail	Occasional rec use only	No	None
103 Hemlock Place	Occasional rec use only	No	None
108 View Place	Part Time	No	None
157 Coal Creek Rd	Occasional rec use only	No	Would like to add ADU
178 Summit Dr	Part Time	No	We plan to add on to current residence and add an ADU
193 Timberline Dr W	Part Time	No	None
107-B Ponderosa Rd	Part Time	No	None
116 Summit Dr	Part Time	No	None
196 Timberline Dr	Occasional rec use only	No	None
124 Timber Trail	Occasional rec use only	No	None
106 Timber Trail	Vacation rental	No	None
151 Forest Ridge Dr	Part Time	No	I would like to build a small cabin on adjacent lot; I have applied for water
104 Forest Ridge Dr	Vacation rental	No	No current plans, but we could develop adjacent unused lot in future
185 Timberline Dr W	Part Time	No	None

175 Timberline Dr W	Full Time	No	None
107 Red Cedar Ln	Vacation rental	Yes but unus	None
125 Timberline Dr W	Part Time	No	None
130 Forest Ridge Dr	Occasional rec use only	No	None

Use category	number	percent
Full Time	1	3%
Vacation rental	5	13%
Part Time	20	51%
Occasional rec use only	13	33%
Total	39	100%

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www.nwwatersystems.com

May 18, 2022

Doug Piehl, PE
Thurston PUD
doug.piehl@thurstonpud.org

Re: Timberline Village Water System, Hydraulic Analysis

Dear Doug Piehl,

A hydraulic analysis was completed using EPANet 2. Three scenarios were completed, full system build out, using the calculated PHD of 150 gpm from the capacity analysis, and adjusting system flow rate until the pressure dropped below 20 psi at a connection. The distribution system consists of 8-inch, 6-inch, 4-inch 3-inch, 2-inch, and 1.5-inch PVC . A coefficient of 130 was used as the friction coefficient. Pipe length, diameter, and layout were based upon the available system drawings with revisions from Thurston PUD staff who are familiar with the system layout.

A base demand was assigned to node representing service connections, and then scaled to provide the two scenarios.

The booster pump was modeled as a reservoir with additional head to represent pressure from the booster pump. The existing booster pump can provide 62 psi (143 feet) under PHD conditions and up to 70 psi (161.7 feet) under high pressure conditions. Similarly, the well pump was modeled as a reservoir with additional head to represent pressure from the well pump. The existing well pump operates at 70 psi based on floats in the upper reservoir. This reservoir "floats" on the system and does not have a dedicated inlet and outlet. There are several services which are connected on the fill line to the reservoir. The well pump was modeled at 62 psi (143 feet) under PHD conditions. Table 1 below lists the base elevation and corresponding modeled elevations for each source of supply component.

Table 1 – Modeled Elevations

Component	Base Elevation	Pressure	Modeled Elevation
Well Elevation	1186 feet	62 psi = 143 feet	1329 feet
Reservoir	1334	0 psi = 0 feet	1334 feet
Booster Station	1330	62 psi = 143 feet	1473 feet

The first scenario used a multiplier of 1.8 gpm/node. This was based on the results of the capacity analysis which calculated a system PHD of 150 gpm and ERU of 84, or 1.8 gpm/ERU. However, this multiplier was applied assuming build-out of the distribution system, or 376 ERU, not the existing 84 ERU. This assumed the PHD was distributed evenly throughout the distribution system. The results of this scenario are shown in Figure 1 below. There are several locations which the pressure dropped below 20 psi, and in some cases below 10 psi.

The second scenario calculated a multiplier of 0.4 gpm/node in order to achieve a flow rate of 150 gpm in the distribution system. It was assumed the PHD flow of 150 gpm was distributed evenly throughout the distribution system. In this scenario, there were 6 connections which had pressure under 30 psi. Per WAC 246-290-420(2), as an existing system the minimum residual pressure under PHD conditions must be greater than 20 psi. The results are shown in Figure 2 below

The third scenario adjusted the multiplier to 1.05 gpm/node which is the maximum flow in the distribution system while maintain each connection above 20 psi. This resulted in a total flow rate of 395 gpm spread throughout the distribution system. The results are shown in Figure 3 below.

The numerical results for all three scenarios are enclosed. Junction (node) 49 and 268 consistently show low pressures, however, these are not service connections. Junction 49 is just below the upper reservoir and Junction 268 is a blow off located above the highest elevation service connection.

The results demonstrate the existing distribution system is limited to a flow rate of 395 gpm.

Sincerely,
NORTHWEST WATER SYSTEMS, INC.

Lydia Bower

Lydia Bower, PE

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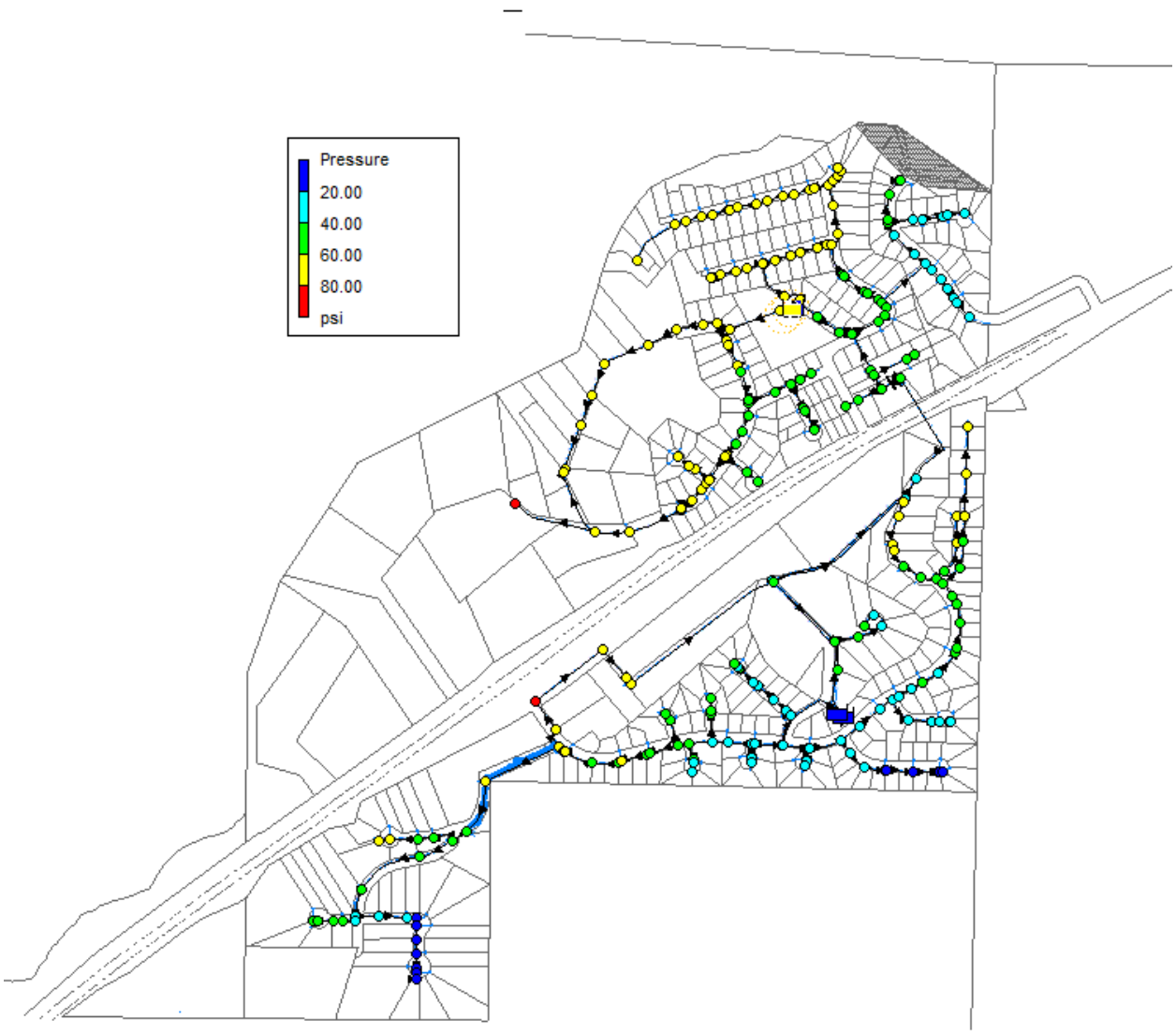

Figure 1 – Scenario 1: Multiplier of 1.8 gpm/node, full build-out

Scenario 1

Network Table - Nodes

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Resvr BoosterStation	1473.2	-331.20	1473.20	0.00
Resvr Reservoirs	1334	-135.27	1334.00	0.00
Resvr Wells	1329	-212.14	1329.00	0.00
Junc 49	1330	0.00	1333.99	1.73
Junc 268	1410	1.80	1418.89	3.85
Junc 223	1406	1.80	1418.89	5.59
Junc 222	1406	3.60	1418.89	5.59
Junc 221	1400	3.60	1418.90	8.19
Junc 220	1400	3.60	1418.91	8.19
Junc 172	1403	3.60	1422.39	8.40
Junc 170	1401	3.60	1422.42	9.28
Junc 171	1400	3.60	1422.40	9.71
Junc 169	1394	3.60	1422.90	12.52
Junc 167	1394	3.60	1424.27	13.12
Junc 168	1392	3.60	1422.92	13.40
Junc 219	1388	3.60	1418.92	13.40
Junc 218	1388	3.60	1418.94	13.41
Junc 217	1380	3.60	1418.96	16.88
Junc 166	1384	3.60	1424.33	17.48
Junc 165	1380	3.60	1426.36	20.09
Junc 216	1371	3.60	1418.96	20.78
Junc 139	1277	0.00	1332.37	23.99
Junc 164	1366	3.60	1428.72	27.18
Junc 179	1362	3.60	1424.97	27.29
Junc 177	1361	3.60	1425.18	27.81
Junc 173	1364	3.60	1429.35	28.32

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 107	1204	7.20	1269.67	28.45
Junc 180	1359	3.60	1424.97	28.58
Junc 163	1364	0.00	1430.99	29.03
Junc 178	1358	1.80	1425.07	29.06
Junc 161	1368	3.60	1435.30	29.16
Junc 159	1368	3.60	1435.40	29.20
Junc 114	1221	3.60	1289.13	29.52
Junc 106	1202	3.60	1270.29	29.59
Junc 157	1372	0.00	1441.19	29.98
Junc 156	1372	0.00	1441.29	30.02
Junc 241	1366	3.60	1436.38	30.50
Junc 105	1200	3.60	1270.75	30.66
Junc 215	1348	3.60	1418.97	30.75
Junc 160	1364	3.60	1435.36	30.92
Junc 112	1218	3.60	1289.50	30.98
Junc 176	1354	3.60	1425.77	31.10
Junc 238	1364	0.00	1437.08	31.66
Junc 239	1364	3.60	1437.47	31.84
Junc 122	1256	0.00	1330.76	32.39
Junc 113	1214	3.60	1289.33	32.64
Junc 242	1360	1.80	1436.37	33.09
Junc 104	1197	3.60	1273.56	33.17
Junc 236	1350	3.60	1428.27	33.92
Junc 240	1358	3.60	1436.43	33.98
Junc 99	1212	3.60	1290.46	34.00
Junc 184	1340	3.60	1418.68	34.09
Junc 162	1356	3.60	1435.86	34.60

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 158	1356	0.00	1436.26	34.77
Junc 103	1195	3.60	1275.31	34.80
Junc 121	1248	3.60	1330.53	35.76
Junc 182	1340	3.60	1422.64	35.81
Junc 152	1346	3.60	1428.74	35.85
Junc 98	1208	1.80	1291.87	36.34
Junc 237	1349	3.60	1434.05	36.85
Junc 174	1342	3.60	1427.69	37.13
Junc 235	1340	3.60	1428.38	38.30
Junc 267	1352	1.80	1440.48	38.34
Junc 149	1350	1.80	1438.49	38.34
Junc 151	1341	3.60	1429.61	38.39
Junc 154	1338	3.60	1427.03	38.58
Junc 181	1336	3.60	1425.28	38.69
Junc 97	1205	3.60	1294.29	38.69
Junc 233	1342	0.00	1432.25	39.11
Junc 96	1204	0.00	1294.53	39.23
Junc 101	1194	3.60	1284.76	39.33
Junc 175	1336	0.00	1426.85	39.36
Junc 150	1343	3.60	1433.90	39.39
Junc 210	1328	0.00	1418.97	39.42
Junc 209	1328	0.00	1418.97	39.42
Junc 142	1324	3.60	1415.11	39.48
Junc 141	1324	3.60	1415.11	39.48
Junc 100	1199	3.60	1290.81	39.78
Junc 102	1190	0.00	1282.35	40.02
Junc 148	1348	1.80	1440.67	40.15

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 108	1189	3.60	1281.81	40.21
Junc 183	1328	3.60	1420.83	40.22
Junc 234	1334	3.60	1428.55	40.97
Junc 208	1324	3.60	1418.98	41.16
Junc 155	1332	3.60	1427.00	41.16
Junc 143	1320	0.00	1415.11	41.21
Junc 256	1320	3.60	1415.12	41.22
Junc 153	1330	3.60	1427.10	42.07
Junc 211	1321	3.60	1418.65	42.31
Junc 243	1332	3.60	1430.01	42.47
Junc 187	1314	3.60	1414.75	43.65
Junc 232	1329	0.00	1429.77	43.67
Junc 244	1328	3.60	1429.92	44.16
Junc 212	1316	3.60	1418.51	44.42
Junc 144	1312	3.60	1415.14	44.69
Junc 109	1176	3.60	1279.78	44.97
Junc 245	1326	3.60	1429.79	44.97
Junc 186	1312	3.60	1415.96	45.05
Junc 185	1310	3.60	1416.30	46.06
Junc 140	1308	0.00	1415.14	46.42
Junc 110	1172	3.60	1279.16	46.43
Junc 111	1171	3.60	1279.15	46.86
Junc 119	1221	0.00	1329.33	46.94
Junc 229	1320	0.00	1428.61	47.06
Junc 188	1302	3.60	1414.12	48.58
Junc 90	1206	1.80	1318.13	48.59
Junc 117	1216	0.00	1329.12	49.02

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 227	1312	3.60	1425.83	49.32
Junc 189	1300	3.60	1413.97	49.38
Junc 213	1304	3.60	1418.42	49.58
Junc 214	1304	1.80	1418.43	49.58
Junc 120	1214	1.80	1328.95	49.81
Junc 200	1214	0.00	1328.95	49.81
Junc 89	1202	3.60	1318.13	50.32
Junc 88	1202	3.60	1318.24	50.37
Junc 133	1294	3.60	1412.72	51.44
Junc 116	1210	0.00	1328.97	51.55
Junc 207	1300	3.60	1419.01	51.57
Junc 40	1206	3.60	1325.08	51.60
Junc 118	1210	1.80	1329.12	51.62
Junc 87	1198	3.60	1318.28	52.12
Junc 230	1306	3.60	1427.62	52.70
Junc 41	1204	3.60	1325.68	52.72
Junc 134	1292	0.00	1413.85	52.80
Junc 42	1204	3.60	1326.43	53.05
Junc 115	1206	1.80	1328.92	53.26
Junc 202	1296	0.00	1419.02	53.31
Junc 37	1200	3.60	1324.26	53.84
Junc 38	1200	1.80	1324.51	53.95
Junc 39	1200	0.00	1324.59	53.98
Junc 201	1294	1.80	1419.03	54.18
Junc 248	1204	0.00	1329.12	54.22
Junc 36	1199	3.60	1324.22	54.26
Junc 85	1194	3.60	1319.86	54.54

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 43	1202	3.60	1328.57	54.84
Junc 44	1202	3.60	1328.57	54.84
Junc 91	1192	3.60	1318.93	55.00
Junc 86	1192	0.00	1318.99	55.02
Junc 225	1296	3.60	1423.55	55.27
Junc 130	1286	1.80	1413.89	55.41
Junc 228	1298	3.60	1426.14	55.52
Junc 93	1190	1.80	1318.92	55.86
Junc 231	1298	3.60	1427.52	56.12
Junc 129	1284	0.00	1414.03	56.34
Junc 132	1281	3.60	1411.80	56.67
Junc 35	1193	3.60	1323.81	56.68
Junc 224	1290	3.60	1421.59	57.02
Junc 82	1190	3.60	1321.68	57.06
Junc 128	1282	1.80	1414.07	57.23
Junc 203	1286	1.80	1418.47	57.40
Junc 81	1188	1.80	1321.43	57.82
Junc 127	1280	1.80	1414.12	58.11
Junc 204	1284	3.60	1418.17	58.14
Junc 79	1186	1.80	1320.69	58.36
Junc 78	1186	7.20	1320.70	58.37
Junc 34	1189	3.60	1323.80	58.41
Junc 83	1187	0.00	1321.87	58.44
Junc 84	1187	3.60	1321.98	58.49
Junc 45	1193	3.60	1328.61	58.76
Junc 46	1192	3.60	1328.71	59.24
Junc 55	1186	3.60	1322.90	59.32

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 260	1277	0.00	1415.24	59.90
Junc 80	1183	3.60	1321.25	59.90
Junc 131	1275	3.60	1413.57	60.04
Junc 226	1285	3.60	1423.83	60.16
Junc 77	1181	0.00	1321.06	60.69
Junc 75	1181	1.80	1321.08	60.70
Junc 21	1183	3.60	1323.11	60.71
Junc 95	1183	0.00	1323.39	60.83
Junc 23	1183	1.80	1323.51	60.88
Junc 126	1273	3.60	1414.18	61.17
Junc 136	1270	3.60	1411.33	61.24
Junc 12	1173	3.60	1314.97	61.52
Junc 54	1181	3.60	1323.12	61.58
Junc 47	1186	3.60	1328.83	61.89
Junc 146	1330	0.00	1472.88	61.91
Junc 48	1186	0.00	1328.98	61.95
Junc 76	1186	0.00	1328.99	61.96
Junc 24	1180	3.60	1323.85	62.33
Junc 53	1180	3.60	1323.90	62.35
Junc 205	1274	3.60	1417.91	62.35
Junc 50	1184	1.80	1328.19	62.48
Junc 125	1270	1.80	1414.20	62.48
Junc 20	1178	3.60	1322.63	62.67
Junc 25	1180	3.60	1324.70	62.70
Junc 199	1274	1.80	1419.07	62.86
Junc 11	1168	3.60	1313.39	63.00
Junc 135	1268	3.60	1413.51	63.05

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 51	1183	1.80	1328.80	63.17
Junc 70	1174	1.80	1320.82	63.62
Junc 71	1174	0.00	1320.84	63.63
Junc 13	1171	3.60	1318.05	63.72
Junc 52	1177	3.60	1324.12	63.75
Junc 14	1172	1.80	1319.12	63.75
Junc 10	1164	3.60	1311.33	63.84
Junc 16	1174	3.60	1321.58	63.95
Junc 74	1172	10.80	1319.63	63.97
Junc 8	1161	3.60	1309.02	64.14
Junc 72	1172	3.60	1320.07	64.16
Junc 26	1177	3.60	1325.42	64.31
Junc 69	1172	3.60	1320.81	64.48
Junc 73	1171	1.80	1319.92	64.53
Junc 6	1159	3.60	1307.97	64.55
Junc 27	1178	3.60	1326.99	64.56
Junc 18	1172	3.60	1321.06	64.59
Junc 9	1161	3.60	1310.32	64.70
Junc 7	1159	3.60	1308.55	64.80
Junc 4	1158	3.60	1307.61	64.83
Junc 5	1158	3.60	1307.76	64.89
Junc 15	1172	3.60	1322.33	65.14
Junc 3	1157	3.60	1307.58	65.25
Junc 68	1170	3.60	1320.78	65.33
Junc 19	1170	1.80	1321.05	65.45
Junc 17	1170	3.60	1321.21	65.52
Junc 56	1172	3.60	1323.39	65.60

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 206	1266	3.60	1417.88	65.81
Junc 57	1170	3.60	1322.29	65.99
Junc 66	1168	1.80	1320.76	66.19
Junc 247	1172	0.00	1324.80	66.21
Junc 124	1261	3.60	1414.33	66.44
Junc 28	1174	3.60	1328.33	66.87
Junc 29	1174	0.00	1328.33	66.87
Junc 30	1173	3.60	1327.64	67.01
Junc 67	1166	3.60	1320.76	67.06
Junc 31	1172	3.60	1327.34	67.31
Junc 197	1264	3.60	1419.52	67.39
Junc 32	1171	3.60	1327.12	67.65
Junc 147	1164	3.60	1320.79	67.94
Junc 33	1169	3.60	1327.07	68.49
Junc 123	1256	0.00	1414.41	68.64
Junc 266	1168	1.80	1327.07	68.93
Junc 137	1250	3.60	1410.94	69.74
Junc 246	1146	0.00	1307.58	70.01
Junc 198	1256	3.60	1419.57	70.88
Junc 58	1154	3.60	1320.75	72.25
Junc 138	1244	3.60	1410.82	72.28
Junc 190	1250	0.00	1417.05	72.38
Junc 191	1250	1.80	1417.12	72.41
Junc 196	1252	3.60	1419.13	72.42
Junc 59	1150	3.60	1320.71	73.97
Junc 192	1246	0.00	1417.53	74.32
Junc 61	1148	3.60	1320.70	74.83

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 60	1148	3.60	1320.70	74.83
Junc 62	1146	3.60	1320.70	75.70
Junc 63	1146	3.60	1320.70	75.70
Junc 64	1145	0.00	1320.71	76.14
Junc 65	1145	1.80	1320.73	76.14
Junc 195	1238	3.60	1418.84	78.36
Junc 94	1136	1.80	1320.71	80.04
Junc 194	1232	0.00	1418.46	80.79

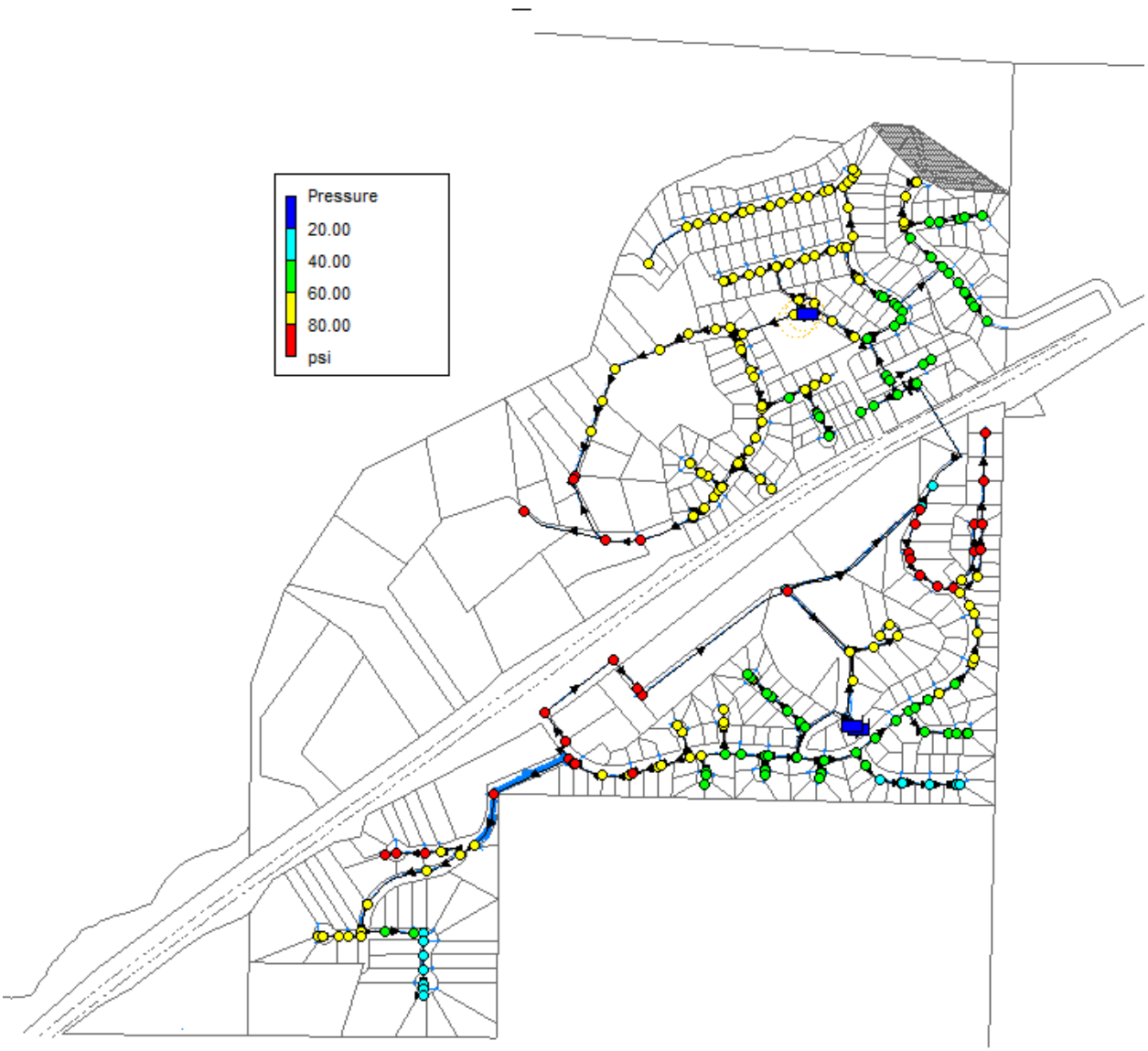

Figure 2 – Scenario 2: Multiplier of 0.4 gpm/node, 150 gpm distributed evenly across all nodes

Scenario 2

Network Table - Nodes

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Resvr BoosterStation	1473.2	-73.60	1473.20	0.00
Resvr Wells	1329	0.00	1329.00	0.00
Resvr Reservoirs	1334	-77.20	1334.00	0.00
Junc 49	1330	0.00	1334.00	1.73
Junc 139	1277	0.00	1333.42	24.45
Junc 268	1410	0.40	1469.85	25.93
Junc 223	1406	0.40	1469.85	27.67
Junc 222	1406	0.80	1469.85	27.67
Junc 172	1403	0.80	1470.07	29.06
Junc 170	1401	0.80	1470.07	29.93
Junc 221	1400	0.80	1469.85	30.27
Junc 220	1400	0.80	1469.85	30.27
Junc 171	1400	0.80	1470.07	30.36
Junc 169	1394	0.80	1470.10	32.97
Junc 167	1394	0.80	1470.18	33.01
Junc 122	1256	0.00	1332.85	33.30
Junc 168	1392	0.80	1470.10	33.84
Junc 219	1388	0.80	1469.85	35.47
Junc 218	1388	0.80	1469.85	35.47
Junc 121	1248	0.80	1332.77	36.73
Junc 166	1384	0.80	1470.19	37.34
Junc 217	1380	0.80	1469.85	38.93
Junc 165	1380	0.80	1470.31	39.13
Junc 216	1371	0.80	1469.85	42.83
Junc 157	1372	0.00	1471.22	42.99
Junc 156	1372	0.00	1471.23	43.00

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 161	1368	0.80	1470.86	44.57
Junc 159	1368	0.80	1470.87	44.57
Junc 164	1366	0.80	1470.46	45.26
Junc 241	1366	0.80	1470.93	45.47
Junc 173	1364	0.80	1470.49	46.14
Junc 163	1364	0.00	1470.60	46.19
Junc 160	1364	0.80	1470.87	46.30
Junc 238	1364	0.00	1470.97	46.35
Junc 239	1364	0.80	1471.00	46.36
Junc 179	1362	0.80	1470.22	46.89
Junc 114	1221	0.80	1329.52	47.02
Junc 177	1361	0.80	1470.24	47.33
Junc 242	1360	0.40	1470.93	48.07
Junc 180	1359	0.80	1470.22	48.19
Junc 119	1221	0.00	1332.34	48.24
Junc 112	1218	0.80	1329.54	48.33
Junc 178	1358	0.40	1470.23	48.63
Junc 240	1358	0.80	1470.93	48.93
Junc 162	1356	0.80	1470.90	49.78
Junc 158	1356	0.00	1470.92	49.80
Junc 113	1214	0.80	1329.53	50.06
Junc 117	1216	0.00	1332.26	50.37
Junc 176	1354	0.80	1470.27	50.38
Junc 99	1212	0.80	1329.60	50.96
Junc 120	1214	0.40	1332.20	51.22
Junc 200	1214	0.00	1332.20	51.22
Junc 267	1352	0.40	1471.18	51.64

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 236	1350	0.80	1470.43	52.18
Junc 149	1350	0.40	1471.06	52.45
Junc 98	1208	0.40	1329.68	52.73
Junc 237	1349	0.80	1470.78	52.77
Junc 215	1348	0.80	1469.85	52.80
Junc 116	1210	0.00	1332.20	52.95
Junc 118	1210	0.40	1332.26	52.97
Junc 148	1348	0.40	1471.19	53.38
Junc 107	1204	1.60	1328.32	53.87
Junc 152	1346	0.80	1470.46	53.93
Junc 97	1205	0.80	1329.83	54.09
Junc 90	1206	0.40	1330.84	54.09
Junc 40	1206	0.80	1331.75	54.49
Junc 96	1204	0.00	1329.85	54.53
Junc 115	1206	0.40	1332.18	54.68
Junc 106	1202	0.80	1328.35	54.75
Junc 150	1343	0.80	1470.78	55.37
Junc 41	1204	0.80	1331.80	55.38
Junc 42	1204	0.80	1331.86	55.40
Junc 248	1204	0.00	1332.26	55.57
Junc 105	1200	0.80	1328.38	55.63
Junc 174	1342	0.80	1470.39	55.63
Junc 233	1342	0.00	1470.67	55.75
Junc 89	1202	0.80	1330.84	55.82
Junc 88	1202	0.80	1330.84	55.83
Junc 151	1341	0.80	1470.51	56.12
Junc 184	1340	0.80	1469.84	56.26

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 44	1202	0.80	1332.04	56.35
Junc 43	1202	0.80	1332.05	56.35
Junc 182	1340	0.80	1470.08	56.36
Junc 235	1340	0.80	1470.44	56.52
Junc 100	1199	0.80	1329.62	56.60
Junc 104	1197	0.80	1328.56	57.00
Junc 37	1200	0.80	1331.66	57.05
Junc 38	1200	0.40	1331.69	57.06
Junc 39	1200	0.00	1331.70	57.07
Junc 154	1338	0.80	1470.35	57.35
Junc 36	1199	0.80	1331.66	57.48
Junc 87	1198	0.80	1330.84	57.56
Junc 103	1195	0.80	1328.66	57.92
Junc 181	1336	0.80	1470.24	58.17
Junc 175	1336	0.00	1470.34	58.21
Junc 101	1194	0.80	1329.25	58.60
Junc 234	1334	0.80	1470.45	59.12
Junc 85	1194	0.80	1330.94	59.34
Junc 155	1332	0.80	1470.35	59.95
Junc 243	1332	0.80	1470.54	60.03
Junc 35	1193	0.80	1331.61	60.06
Junc 91	1192	0.80	1330.88	60.18
Junc 86	1192	0.00	1330.89	60.18
Junc 45	1193	0.80	1331.95	60.21
Junc 102	1190	0.00	1329.10	60.27
Junc 46	1192	0.80	1331.80	60.57
Junc 108	1189	0.80	1329.06	60.69

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 153	1330	0.80	1470.36	60.82
Junc 93	1190	0.40	1330.88	61.05
Junc 82	1190	0.80	1331.05	61.12
Junc 232	1329	0.00	1470.52	61.32
Junc 210	1328	0.00	1469.85	61.47
Junc 209	1328	0.00	1469.85	61.47
Junc 183	1328	0.80	1469.97	61.52
Junc 244	1328	0.80	1470.53	61.76
Junc 34	1189	0.80	1331.61	61.79
Junc 81	1188	0.40	1331.04	61.98
Junc 146	1330	0.00	1473.18	62.04
Junc 83	1187	0.00	1331.07	62.42
Junc 84	1187	0.80	1331.07	62.43
Junc 245	1326	0.80	1470.52	62.62
Junc 79	1186	0.40	1330.99	62.83
Junc 78	1186	1.60	1330.99	62.83
Junc 55	1186	0.80	1331.13	62.88
Junc 76	1186	0.00	1331.50	63.05
Junc 48	1186	0.00	1331.50	63.05
Junc 142	1324	0.80	1469.62	63.10
Junc 141	1324	0.80	1469.62	63.10
Junc 47	1186	0.80	1331.65	63.11
Junc 208	1324	0.80	1469.85	63.20
Junc 50	1184	0.40	1331.46	63.89
Junc 80	1183	0.80	1331.03	64.14
Junc 51	1183	0.40	1331.50	64.35
Junc 21	1183	0.80	1331.53	64.36

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 23	1183	0.40	1331.54	64.36
Junc 95	1183	0.00	1331.55	64.37
Junc 211	1321	0.80	1469.83	64.49
Junc 143	1320	0.00	1469.62	64.83
Junc 256	1320	0.80	1469.62	64.83
Junc 77	1181	0.00	1331.02	65.00
Junc 75	1181	0.40	1331.02	65.00
Junc 54	1181	0.80	1331.14	65.06
Junc 229	1320	0.00	1470.45	65.19
Junc 53	1180	0.80	1331.19	65.51
Junc 25	1180	0.80	1331.50	65.65
Junc 24	1180	0.80	1331.52	65.65
Junc 109	1176	0.80	1328.94	66.27
Junc 27	1178	0.80	1331.50	66.51
Junc 20	1178	0.80	1331.50	66.51
Junc 212	1316	0.80	1469.83	66.65
Junc 52	1177	0.80	1331.20	66.82
Junc 26	1177	0.80	1331.50	66.94
Junc 187	1314	0.80	1469.59	67.42
Junc 110	1172	0.80	1328.90	67.98
Junc 70	1174	0.40	1331.00	68.03
Junc 71	1174	0.00	1331.00	68.03
Junc 16	1174	0.80	1331.44	68.22
Junc 28	1174	0.80	1331.50	68.24
Junc 29	1174	0.00	1331.50	68.24
Junc 144	1312	0.80	1469.62	68.30
Junc 186	1312	0.80	1469.67	68.32

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 111	1171	0.80	1328.90	68.42
Junc 12	1173	0.80	1331.03	68.47
Junc 227	1312	0.80	1470.28	68.58
Junc 30	1173	0.80	1331.45	68.66
Junc 74	1172	2.40	1330.93	68.86
Junc 72	1172	0.80	1330.95	68.88
Junc 69	1172	0.80	1331.00	68.89
Junc 56	1172	0.80	1331.16	68.96
Junc 247	1172	0.00	1331.25	69.00
Junc 14	1172	0.40	1331.29	69.02
Junc 18	1172	0.80	1331.41	69.07
Junc 31	1172	0.80	1331.43	69.08
Junc 15	1172	0.80	1331.49	69.11
Junc 185	1310	0.80	1469.69	69.19
Junc 73	1171	0.40	1330.95	69.30
Junc 13	1171	0.80	1331.22	69.42
Junc 32	1171	0.80	1331.42	69.51
Junc 68	1170	0.80	1331.00	69.76
Junc 57	1170	0.80	1331.09	69.80
Junc 19	1170	0.40	1331.41	69.94
Junc 17	1170	0.80	1331.42	69.94
Junc 140	1308	0.00	1469.62	70.03
Junc 33	1169	0.80	1331.42	70.38
Junc 11	1168	0.80	1330.93	70.60
Junc 66	1168	0.40	1331.00	70.63
Junc 266	1168	0.40	1331.42	70.81
Junc 230	1306	0.80	1470.39	71.23

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 67	1166	0.80	1331.00	71.49
Junc 213	1304	0.80	1469.82	71.85
Junc 214	1304	0.40	1469.82	71.85
Junc 10	1164	0.80	1330.81	72.28
Junc 147	1164	0.80	1331.00	72.36
Junc 188	1302	0.80	1469.56	72.60
Junc 189	1300	0.80	1469.55	73.46
Junc 8	1161	0.80	1330.66	73.52
Junc 9	1161	0.80	1330.74	73.55
Junc 207	1300	0.80	1469.86	73.60
Junc 6	1159	0.80	1330.60	74.35
Junc 7	1159	0.80	1330.63	74.37
Junc 228	1298	0.80	1470.30	74.66
Junc 231	1298	0.80	1470.38	74.69
Junc 4	1158	0.80	1330.58	74.78
Junc 5	1158	0.80	1330.59	74.78
Junc 3	1157	0.80	1330.58	75.21
Junc 202	1296	0.00	1469.86	75.33
Junc 225	1296	0.80	1470.14	75.45
Junc 133	1294	0.80	1469.47	76.03
Junc 201	1294	0.40	1469.86	76.20
Junc 58	1154	0.80	1331.00	76.69
Junc 134	1292	0.00	1469.54	76.93
Junc 224	1290	0.80	1470.02	78.00
Junc 59	1150	0.80	1330.99	78.42
Junc 61	1148	0.80	1330.99	79.29
Junc 60	1148	0.80	1330.99	79.29

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 130	1286	0.40	1469.54	79.53
Junc 203	1286	0.40	1469.82	79.65
Junc 246	1146	0.00	1330.58	79.98
Junc 63	1146	0.80	1330.99	80.16
Junc 62	1146	0.80	1330.99	80.16
Junc 226	1285	0.80	1470.15	80.23
Junc 129	1284	0.00	1469.55	80.40
Junc 204	1284	0.80	1469.80	80.51
Junc 64	1145	0.00	1330.99	80.59
Junc 65	1145	0.40	1331.00	80.59
Junc 128	1282	0.40	1469.55	81.27
Junc 132	1281	0.80	1469.41	81.64
Junc 127	1280	0.40	1469.56	82.13
Junc 260	1277	0.00	1469.62	83.46
Junc 131	1275	0.80	1469.52	84.29
Junc 94	1136	0.40	1330.99	84.49
Junc 205	1274	0.80	1469.79	84.84
Junc 199	1274	0.40	1469.86	84.87
Junc 126	1273	0.80	1469.56	85.17
Junc 136	1270	0.80	1469.38	86.39
Junc 125	1270	0.40	1469.56	86.47
Junc 135	1268	0.80	1469.52	87.32
Junc 206	1266	0.80	1469.79	88.30
Junc 197	1264	0.80	1469.89	89.21
Junc 124	1261	0.80	1469.57	90.37
Junc 123	1256	0.00	1469.57	92.54
Junc 198	1256	0.80	1469.89	92.68

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 196	1252	0.80	1469.86	94.40
Junc 137	1250	0.80	1469.36	95.05
Junc 190	1250	0.00	1469.74	95.21
Junc 191	1250	0.40	1469.74	95.21
Junc 192	1246	0.00	1469.77	96.96
Junc 138	1244	0.80	1469.35	97.64
Junc 195	1238	0.80	1469.85	100.46
Junc 194	1232	0.00	1469.82	103.05

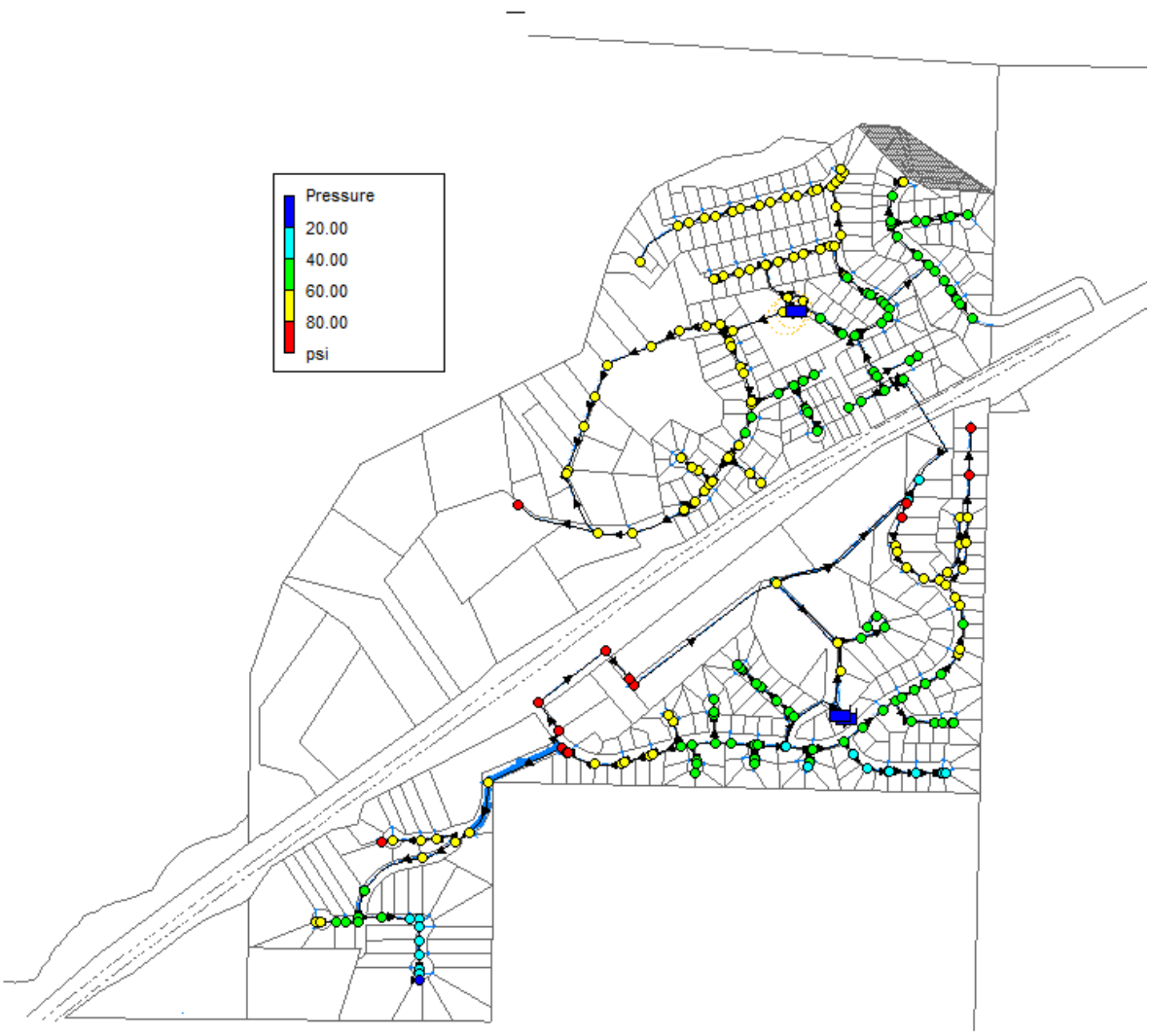

Figure 3 – Scenario 3: Multiplier 1.05 gpm/node, pressure at all connections >20 psi

Scenario 3

Network Table - Nodes

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Resvr BoosterStation	1473.2	-193.20	1473.20	0.00
Resvr Reservoirs	1334	-124.01	1334.00	0.00
Resvr Wells	1329	-78.64	1329.00	0.00
Junc 49	1330	0.00	1333.99	1.73
Junc 268	1410	1.05	1453.19	18.71
Junc 223	1406	1.05	1453.19	20.45
Junc 222	1406	2.10	1453.19	20.45
Junc 172	1403	2.10	1454.48	22.30
Junc 221	1400	2.10	1453.19	23.05
Junc 220	1400	2.10	1453.19	23.05
Junc 170	1401	2.10	1454.48	23.17
Junc 171	1400	2.10	1454.48	23.61
Junc 139	1277	0.00	1332.61	24.10
Junc 169	1394	2.10	1454.66	26.29
Junc 167	1394	2.10	1455.17	26.50
Junc 168	1392	2.10	1454.67	27.15
Junc 219	1388	2.10	1453.20	28.25
Junc 218	1388	2.10	1453.20	28.25
Junc 166	1384	2.10	1455.19	30.85
Junc 217	1380	2.10	1453.21	31.72
Junc 122	1256	0.00	1331.24	32.60
Junc 165	1380	2.10	1455.94	32.90
Junc 216	1371	2.10	1453.21	35.62
Junc 121	1248	2.10	1331.04	35.98
Junc 157	1372	0.00	1461.40	38.74
Junc 156	1372	0.00	1461.44	38.75

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 164	1366	2.10	1456.81	39.35
Junc 161	1368	2.10	1459.23	39.53
Junc 159	1368	2.10	1459.27	39.55
Junc 173	1364	2.10	1457.04	40.31
Junc 179	1362	2.10	1455.43	40.48
Junc 241	1366	2.10	1459.63	40.57
Junc 163	1364	0.00	1457.64	40.58
Junc 114	1221	2.10	1314.75	40.62
Junc 177	1361	2.10	1455.50	40.95
Junc 160	1364	2.10	1459.25	41.27
Junc 238	1364	0.00	1459.89	41.55
Junc 239	1364	2.10	1460.03	41.61
Junc 180	1359	2.10	1455.43	41.78
Junc 112	1218	2.10	1314.89	41.98
Junc 178	1358	1.05	1455.46	42.23
Junc 242	1360	1.05	1459.63	43.17
Junc 113	1214	2.10	1314.82	43.69
Junc 240	1358	2.10	1459.65	44.04
Junc 176	1354	2.10	1455.72	44.07
Junc 99	1212	2.10	1315.24	44.73
Junc 162	1356	2.10	1459.44	44.82
Junc 107	1204	4.20	1307.58	44.88
Junc 158	1356	0.00	1459.58	44.88
Junc 215	1348	2.10	1453.21	45.59
Junc 106	1202	2.10	1307.81	45.85
Junc 236	1350	2.10	1456.64	46.21
Junc 98	1208	1.05	1315.76	46.69

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 105	1200	2.10	1307.98	46.79
Junc 119	1221	0.00	1330.01	47.23
Junc 267	1352	1.05	1461.14	47.29
Junc 237	1349	2.10	1458.77	47.56
Junc 149	1350	1.05	1460.41	47.84
Junc 152	1346	2.10	1456.81	48.02
Junc 97	1205	2.10	1316.65	48.38
Junc 104	1197	2.10	1309.01	48.53
Junc 96	1204	0.00	1316.74	48.85
Junc 184	1340	2.10	1453.11	49.01
Junc 148	1348	1.05	1461.21	49.05
Junc 117	1216	0.00	1329.82	49.32
Junc 174	1342	2.10	1456.43	49.58
Junc 182	1340	2.10	1454.56	49.64
Junc 103	1195	2.10	1309.66	49.68
Junc 200	1214	0.00	1329.69	50.13
Junc 120	1214	1.05	1329.69	50.13
Junc 150	1343	2.10	1458.72	50.14
Junc 233	1342	0.00	1458.11	50.31
Junc 151	1341	2.10	1457.13	50.32
Junc 100	1199	2.10	1315.37	50.42
Junc 235	1340	2.10	1456.68	50.56
Junc 154	1338	2.10	1456.18	51.21
Junc 90	1206	1.05	1325.00	51.56
Junc 101	1194	2.10	1313.14	51.62
Junc 181	1336	2.10	1455.54	51.80
Junc 116	1210	0.00	1329.70	51.86

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 118	1210	1.05	1329.82	51.92
Junc 175	1336	0.00	1456.12	52.05
Junc 40	1206	2.10	1328.01	52.87
Junc 102	1190	0.00	1312.25	52.97
Junc 234	1334	2.10	1456.74	53.18
Junc 89	1202	2.10	1325.00	53.30
Junc 88	1202	2.10	1325.04	53.31
Junc 108	1189	2.10	1312.05	53.32
Junc 115	1206	1.05	1329.65	53.58
Junc 155	1332	2.10	1456.17	53.80
Junc 41	1204	2.10	1328.23	53.83
Junc 42	1204	2.10	1328.52	53.95
Junc 209	1328	0.00	1453.21	54.26
Junc 210	1328	0.00	1453.21	54.26
Junc 243	1332	2.10	1457.28	54.29
Junc 248	1204	0.00	1329.82	54.52
Junc 183	1328	2.10	1453.90	54.55
Junc 153	1330	2.10	1456.21	54.69
Junc 87	1198	2.10	1325.05	55.05
Junc 44	1202	2.10	1329.33	55.17
Junc 43	1202	2.10	1329.34	55.17
Junc 37	1200	2.10	1327.69	55.33
Junc 38	1200	1.05	1327.78	55.37
Junc 142	1324	2.10	1451.79	55.37
Junc 141	1324	2.10	1451.79	55.37
Junc 39	1200	0.00	1327.82	55.38
Junc 232	1329	0.00	1457.20	55.55

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 36	1199	2.10	1327.67	55.75
Junc 208	1324	2.10	1453.22	55.99
Junc 244	1328	2.10	1457.25	56.00
Junc 245	1326	2.10	1457.20	56.85
Junc 85	1194	2.10	1325.64	57.04
Junc 143	1320	0.00	1451.79	57.11
Junc 256	1320	2.10	1451.80	57.11
Junc 211	1321	2.10	1453.10	57.24
Junc 91	1192	2.10	1325.30	57.76
Junc 86	1192	0.00	1325.31	57.77
Junc 35	1193	2.10	1327.51	58.28
Junc 93	1190	1.05	1325.29	58.62
Junc 109	1176	2.10	1311.30	58.63
Junc 45	1193	2.10	1329.27	59.04
Junc 82	1190	2.10	1326.31	59.06
Junc 229	1320	0.00	1456.77	59.26
Junc 212	1316	2.10	1453.04	59.38
Junc 46	1192	2.10	1329.16	59.43
Junc 187	1314	2.10	1451.66	59.65
Junc 81	1188	1.05	1326.22	59.89
Junc 34	1189	2.10	1327.50	60.01
Junc 110	1172	2.10	1311.07	60.26
Junc 83	1187	0.00	1326.38	60.39
Junc 84	1187	2.10	1326.42	60.41
Junc 144	1312	2.10	1451.80	60.58
Junc 79	1186	1.05	1325.94	60.64
Junc 78	1186	4.20	1325.95	60.64

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 111	1171	2.10	1311.07	60.69
Junc 186	1312	2.10	1452.10	60.71
Junc 55	1186	2.10	1326.76	60.99
Junc 185	1310	2.10	1452.23	61.63
Junc 48	1186	0.00	1329.00	61.96
Junc 76	1186	0.00	1329.00	61.96
Junc 47	1186	2.10	1329.07	61.99
Junc 146	1330	0.00	1473.08	62.00
Junc 80	1183	2.10	1326.15	62.03
Junc 227	1312	2.10	1455.74	62.28
Junc 140	1308	0.00	1451.80	62.31
Junc 21	1183	2.10	1327.23	62.50
Junc 95	1183	0.00	1327.34	62.54
Junc 23	1183	1.05	1327.37	62.55
Junc 50	1184	1.05	1328.71	62.70
Junc 77	1181	0.00	1326.08	62.86
Junc 75	1181	1.05	1326.09	62.87
Junc 54	1181	2.10	1326.84	63.19
Junc 51	1183	1.05	1328.94	63.23
Junc 53	1180	2.10	1327.13	63.75
Junc 24	1180	2.10	1327.45	63.89
Junc 25	1180	2.10	1327.69	63.99
Junc 213	1304	2.10	1453.01	64.57
Junc 214	1304	1.05	1453.01	64.57
Junc 20	1178	2.10	1327.06	64.59
Junc 188	1302	2.10	1451.43	64.75
Junc 52	1177	2.10	1327.21	65.08

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 27	1178	2.10	1328.37	65.15
Junc 230	1306	2.10	1456.40	65.17
Junc 26	1177	2.10	1327.90	65.38
Junc 12	1173	2.10	1324.24	65.53
Junc 189	1300	2.10	1451.37	65.59
Junc 70	1174	1.05	1325.99	65.86
Junc 71	1174	0.00	1326.00	65.86
Junc 16	1174	2.10	1326.67	66.15
Junc 207	1300	2.10	1453.23	66.39
Junc 74	1172	6.30	1325.55	66.53
Junc 72	1172	2.10	1325.71	66.60
Junc 14	1172	1.05	1325.77	66.63
Junc 69	1172	2.10	1325.99	66.72
Junc 13	1171	2.10	1325.37	66.89
Junc 18	1172	2.10	1326.48	66.94
Junc 73	1171	1.05	1325.66	67.01
Junc 28	1174	2.10	1328.78	67.07
Junc 29	1174	0.00	1328.78	67.07
Junc 56	1172	2.10	1326.94	67.13
Junc 15	1172	2.10	1326.95	67.14
Junc 247	1172	0.00	1327.46	67.36
Junc 30	1173	2.10	1328.53	67.39
Junc 11	1168	2.10	1323.65	67.44
Junc 68	1170	2.10	1325.97	67.58
Junc 31	1172	2.10	1328.42	67.77
Junc 19	1170	1.05	1326.48	67.80
Junc 57	1170	2.10	1326.53	67.82

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 17	1170	2.10	1326.53	67.83
Junc 133	1294	2.10	1450.91	67.99
Junc 202	1296	0.00	1453.23	68.13
Junc 32	1171	2.10	1328.33	68.17
Junc 228	1298	2.10	1455.86	68.40
Junc 66	1168	1.05	1325.97	68.45
Junc 231	1298	2.10	1456.37	68.62
Junc 10	1164	2.10	1322.89	68.85
Junc 225	1296	2.10	1454.90	68.85
Junc 201	1294	1.05	1453.24	69.00
Junc 33	1169	2.10	1328.32	69.03
Junc 134	1292	0.00	1451.33	69.04
Junc 67	1166	2.10	1325.97	69.31
Junc 266	1168	1.05	1328.32	69.47
Junc 8	1161	2.10	1322.04	69.78
Junc 9	1161	2.10	1322.52	69.99
Junc 147	1164	2.10	1325.98	70.19
Junc 6	1159	2.10	1321.66	70.48
Junc 7	1159	2.10	1321.87	70.57
Junc 4	1158	2.10	1321.52	70.85
Junc 5	1158	2.10	1321.58	70.88
Junc 224	1290	2.10	1454.18	71.14
Junc 3	1157	2.10	1321.51	71.28
Junc 130	1286	1.05	1451.34	71.64
Junc 203	1286	1.05	1453.03	72.37
Junc 129	1284	0.00	1451.39	72.53
Junc 204	1284	2.10	1452.92	73.19

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 128	1282	1.05	1451.41	73.40
Junc 132	1281	2.10	1450.57	73.47
Junc 226	1285	2.10	1455.01	73.66
Junc 127	1280	1.05	1451.43	74.28
Junc 58	1154	2.10	1325.97	74.51
Junc 260	1277	0.00	1451.84	75.76
Junc 246	1146	0.00	1321.51	76.05
Junc 59	1150	2.10	1325.95	76.24
Junc 131	1275	2.10	1451.23	76.36
Junc 61	1148	2.10	1325.95	77.10
Junc 60	1148	2.10	1325.95	77.10
Junc 126	1273	2.10	1451.45	77.32
Junc 205	1274	2.10	1452.82	77.48
Junc 199	1274	1.05	1453.25	77.67
Junc 62	1146	2.10	1325.94	77.97
Junc 63	1146	2.10	1325.95	77.97
Junc 136	1270	2.10	1450.40	78.17
Junc 64	1145	0.00	1325.95	78.41
Junc 65	1145	1.05	1325.96	78.41
Junc 125	1270	1.05	1451.46	78.63
Junc 135	1268	2.10	1451.20	79.38
Junc 206	1266	2.10	1452.81	80.95
Junc 197	1264	2.10	1453.42	82.07
Junc 94	1136	1.05	1325.95	82.31
Junc 124	1261	2.10	1451.50	82.55
Junc 123	1256	0.00	1451.53	84.72
Junc 198	1256	2.10	1453.44	85.55

Node ID	Elevation ft	Demand GPM	Head ft	Pressure psi
Junc 137	1250	2.10	1450.26	86.77
Junc 196	1252	2.10	1453.27	87.21
Junc 190	1250	0.00	1452.50	87.75
Junc 191	1250	1.05	1452.53	87.76
Junc 138	1244	2.10	1450.21	89.35
Junc 192	1246	0.00	1452.68	89.56
Junc 195	1238	2.10	1453.17	93.23
Junc 194	1232	0.00	1453.02	95.77