City of Enumclaw

Natural Gas Utility

Natural Gas System Plan and Long-Range Investment Plan 2016 - 2035

Provided By:

JMS

JOHNSON + MAY + STEARNS

NATURAL GAS CONSULTING, LLC

www.JMSNatGasConsulting.com

Executive Summary

The City of Enumclaw's Utility Department (City) periodically validates internal planning assumptions by contracting a distribution planning study for the City's natural gas system. JMS Natural Gas Consulting (JMS) partnering with Bradley B. Bean, PE (B3PE) have completed the planning analysis and engineering to both validate the planning model and develop the proposed investment plan.

The scope of work contracted included review of growth assumptions and analysis of the adequacy of supply to Buckley, WA, which is a contractual delivery point between the City and Puget Sound Energy. The build-out through 2035, assuming maximum load delivery to the City of Buckley, was studied.

An existing GASWorkS™ model was provided by the City and updated to add customers and pipe segments to reflect current conditions. The model was reviewed and updated. A few connectivity issues were found and resolved. Approximately 60 pipe segments and 1700 customers were added to the model.

A number of different scenarios were studied. Given the load growth that is planned, and the long-range planning window (20 years), each scenario studied resulted in significant investment recommendations. All scenarios were run using two alternative assumptions; the first assumption, the Intermediate Pressure (IP) system, would remain at the current Maximum Allowable Operating Pressure (MAOP) of 40 psig, operating at 35 psig. The alternative assumption reviewed was to uprate the IP system to a higher operating pressure of 50 psig with a 60 psig MAOP. The scenarios utilizing the uprate alternative are typically lower in overall cost than the non-uprate scenarios.

The results of all scenarios studied involve significant reinforcement and potentially uprating of the IP system, as well as looping or uprating the high pressure (HP) supply pipeline. In addition, installation and rebuilding of regulator stations, increasing throughput of the existing IP system, and building ties to support the IP system are also required.

The existing system model shows that the pressures in the northeast sections of the IP system would have been expected to fall below the desired "design" pressure during recent cold

weather events; recorded field data confirmed these results. The City reported difficulty in maintaining discharge pressures at some regulator stations, further demonstrating the need for targeted reinforcement of the IP system

Uprating both the HP and the IP systems will require significant records review, documentation, planning and perhaps an exemption under WAC 480-93-230. For the HP system, identification of the pipeline material installed will need to be determined prior to authorization of the uprating. These issues are discussed in detail in Section 5, Investment Plan Components.

The selected alternative will invest over $3 million in the next 20 years to meet capacity. A proposed Investment Plan has been included with this report. It is recommended that the City validate load growth periodically and adjust the timing of capital projects as appropriate.

This report has been prepared for the City under the direction of a professional engineer utilizing information provided by the City and established engineering practices.

Pamela S. Johnson PE

Pamela S. Johnson PE

Table of Contents

Executive Summary 2
Table of Contents 4
PLANNING STUDY METHODOLOGY 5
1. MODEL DEVELOPMENT 5
2. MODEL VERIFICATION AND CALIBRATION 6
3. PLANNING BASE MODEL AND ASSUMPTIONS 11
4. MODELING RESULTS 14
5. INVESTMENT PLAN COMPONENTS 15
SYSTEM PLANNING CONSIDERATIONS 21
CONCLUSIONS 23
Appendix A – Scenario Studied -- Comparison Summary 27
Appendix B – Detailed Scenario Discussion 33
Scenario 1 ..... *33*
Scenario 2 ..... *33*
Scenario 3.1 ..... *33*
Scenario 3.2 ..... *36*
Scenario 4.1 ..... *38*
Scenario 4.2 ..... *40*
Scenario 4.3 ..... *41*
Scenario 4.4 ..... *44*
Scenario 5.1 ..... *45*
Scenario 5.2 ..... *47*
Scenario 6.1 ..... *50*
Scenario 6.2 ..... *53*
Scenario HP *55*
Appendix C – Enumclaw Investment Plan 56
Appendix D – Customers Added to Planning Model 58
Residential Customers *58*
Commercial Customers *63*

PLANNING STUDY METHODOLOGY

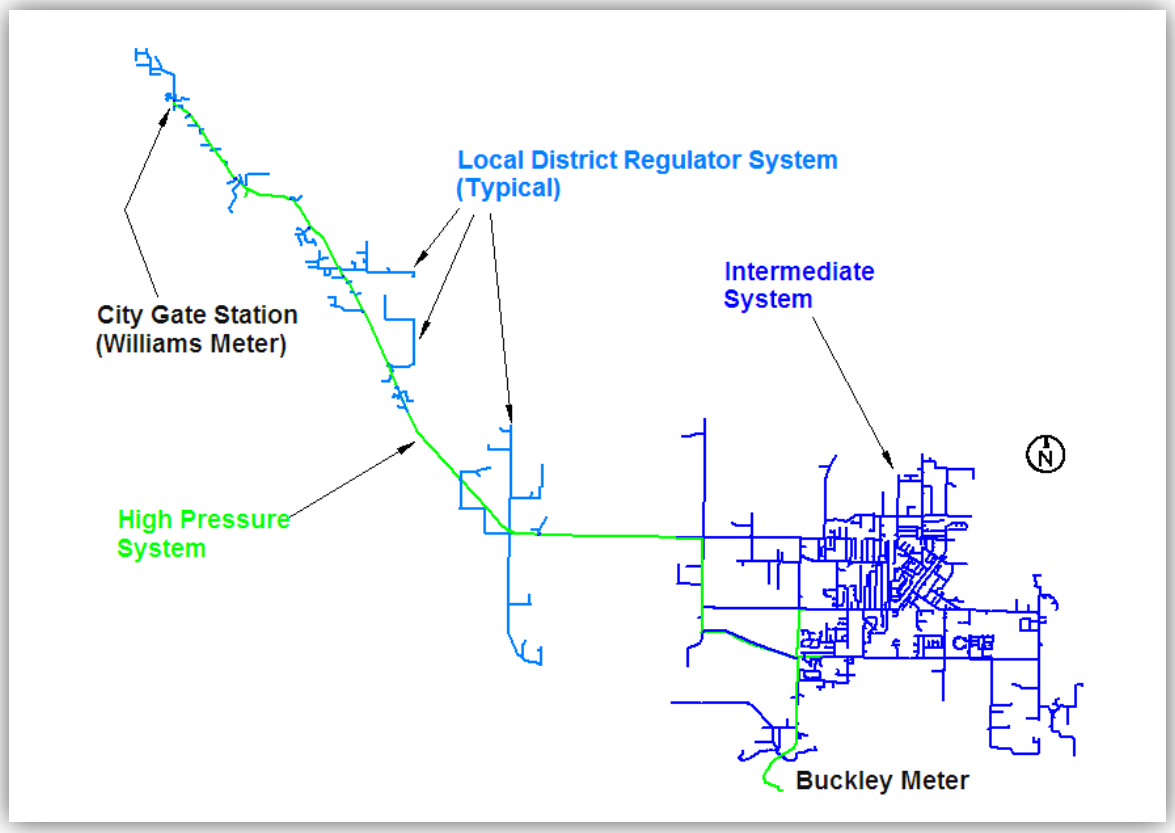
1. MODEL DEVELOPMENT

An existing GASWorkS™ model was provided by the City. The model was reviewed and updated to add customers not included in the model, and add some missing pipe segments. A few connectivity issues were found and resolved. About 60 pipe segments and about 1700 customers were added to complete the model. A few minor corrections were made to the model configuration and data values.

The initial model provided by the City used general demand values for the majority of the included customers. As part of the model development, the customer demands were assigned to more specific values using a summation of the monthly loads for December 2013 through February 2014. These loads were then adjusted using the GASWorkS™ Design Factor value, as necessary, to achieve the desired total system load.

An overview of the existing system is shown in Figure 1.

Figure 1 – Existing System



The parameter values and assumptions used in the development of the existing system model are listed below in Table 1. The model was created using the GASWorkS™ network modeling software.

Model Parameters & Assumptions	**Table 1**
Gas Specific Gravity	0.6
Gas Viscosity	0.000007 Lbm/ft-sec
Gas Flowing Temperature	40 Fahrenheit
Average Elevation Above Sea Level	760 Feet
Atmospheric Pressure	14.29 psia
Pipe Flow Equation	IGT-Improved
Pipe Hydraulic Efficiency	1.00
Base Pressure	14.73 psia
Base Temperature	60 Fahrenheit
Customer Count	4268

2. MODEL VERIFICATION AND CALIBRATION

The existing system model was calibrated to match actual operating conditions for February 6, 2014. Overall the model results matched the field results well without modification, with the exception of the following items.

A. Hydraulic Efficiency, HP Line from SE 456th to Buckley Meter

The hydraulic efficiency of this line had to be lowered from 1.0 to 0.50 to match the field values. This unusually low efficiency generally indicates a field issue, a modeling data inaccuracy, an issue with the field recorded data, or any combination of these items.

➔ Recommend installation of additional temporary pressure recorders during future peak conditions to either collaborate or discover the actual issue, and consider correction of the issue.

B. Thunder Mountain Middle School Load

1. The school has a larger capacity modulating type boiler whose consumption rate can vary from 0 cfh to 8000 cfh. It is not clear what the firing rate of the boiler might have been at the time being used for the calibration; however the field values indicate that the load was probably on the higher end of the consumption range. For the calibration analysis the load at the Thunder Mountain Middle School was set at 5500 cfh. When this load value was used, the results matched closely to the field values.
2. The pressure at the Thunder Mountain Middle School dropped below 13 psig on February 6, and to about 11 psig on February 5, both of which are less than 15 psig which is the minimum allowable main pressure used in the planning studies. The recorded pressure at the school is measured at the meter end of the service. Based on the current service size and maximum flow from the analysis results it appears that the school service line may drop as much as 6 psig from the main connection to the inlet to the meter set. At the current operating pressure, it appears that the service line to the school is undersized.

   ➔ Recommend review of connected load, service size and metering equipment to ensure service pressure is adequate to the school.

C. City Gate Station Pressure Drop

There is a large pressure drop between the Williams Pipeline Meter and the City of Enumclaw Meter. The distance between the two meters is not large enough to justify such a drop. A portion of the piping between the two meters is buried, so it is not completely known what the size and configuration of the piping actually is. The City intends to replace this piping with above-ground piping within the near future, so no further investigation was done.

A further check was run using actual field conditions recorded on February 5, 2014. The peak flow conditions for this date were only slightly lower than February 6. The values at all checked locations matched well, indicating that the exceptions noted above were also present during these operating conditions.

During the February 6, 2014 event, there were portions of the Intermediate Pressure system that would have fallen below 15 psig, the minimum allowable main pressure used in the planning studies. The areas where this occurs are in the northeast portions of the system, and are shown in the red color in Figure 2.

Increasing the supply to the northeast and planning for future growth in the City will necessitate reinforcement and installation of tie lines between higher pressure and lower pressure areas.

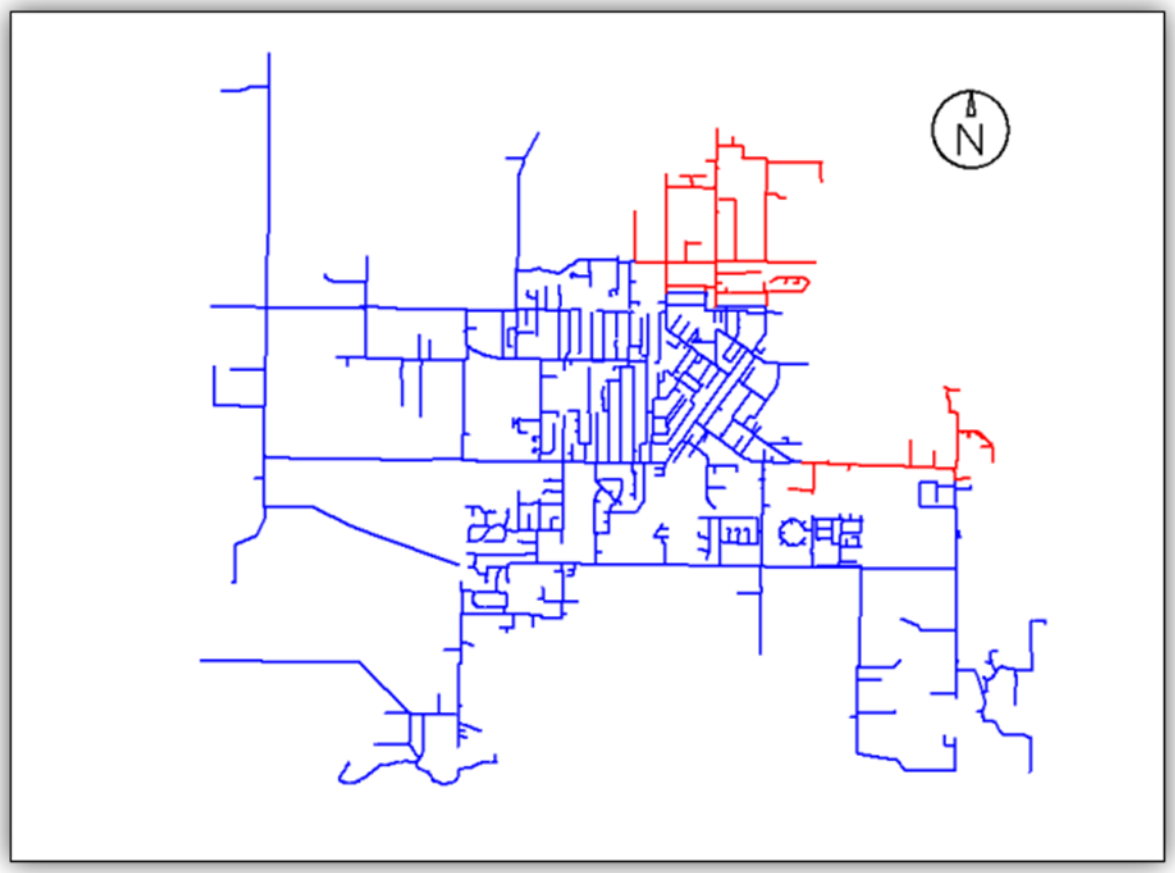


Figure 2

Model of February 6, 2014 Event System Pressures

*(Pressures lower than 15 psig shown in **red**)*

The weather on February 6, 2014 in Enumclaw had a mean temperature of 21.5°F, minimum of 18°F. The Heating Degree Day (HDD) rating for this day was 47. (Reference: Weather Underground) Wind measured at City Hall weather station was reportedly sustained at 9 mph with gusts to 25 mph for this event, although nearby

weather stations report gusts up to 45 mph. The City indicated that a 55 HDD is their preferred design criteria, so depending upon a future day's HDD and the wind, the result shown above may be more severe in a colder or windier event.

Model calibration results are shown in Table 2.

Calibration Results **Table 2**

Location	February 5, 2014, 0900			February 6, 2014, 0900		
	Field Value	Model Value	Difference	Field Value	Model Value	Difference
Williams Meter, Mcfh	322 Mcfh	322 Mcfh	0.00%	339 Mcfh	339 Mcfh	0.00%
City Shop, psig	17.9	18.8	-5.03%	19.7	20.1	-2.03%
Fairway Hills, psig	18.7	20.4	-9.09%	19.2	20.8	-8.33%
Roosevelt Regulator Inlet, psig	171.2	169.9	0.76%	164.2	161.3	1.77%
Thunder Mountain Middle School, psig	11.1	11.6	-4.50%	12.9	13.1	-1.55%
Warner Regulator Inlet, psig	173.0	173.2	-0.12%	167.1	165.9	0.72%
Buckley Meter, psig	165.1	167.2	-1.27%	158.6	159.7	-0.69%
Average			-2.75%			-1.45%

The average difference between the field results and the model results is acceptable. The average equivalent diversified residential load for the February 6 peak hour event was approximately 50 cfh. The locations of field recorded values are shown in Figure 3.

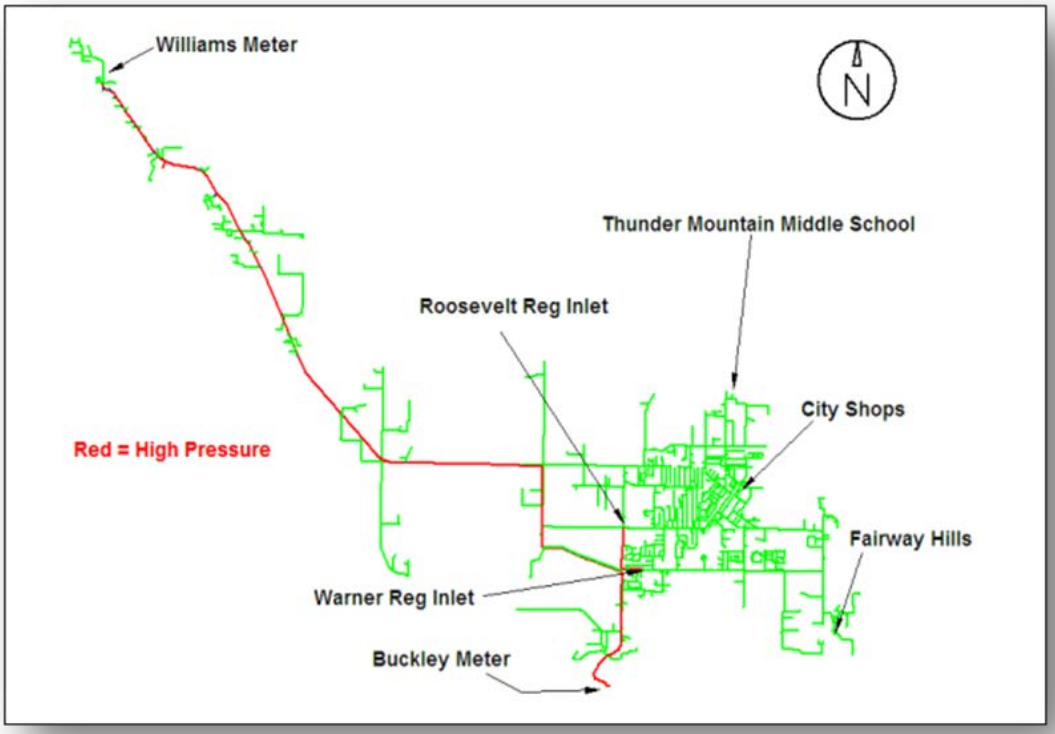


Figure 3 – Location of Field Data

D. Current System Planning Issues and Recommendations

The following recommendations are made to resolve existing pressure concerns at peak flows.

- ➔ Recommend installation of additional temporary pressure recorders on the line feeding the Buckley meter station during future peak conditions to either collaborate or discover the actual issue, and consider correction of the issue. This issue was present in 2014; however testing to attempt to duplicate the pressure drop has not been able to confirm an issue. Recommend increased monitoring during wintertime load to resolve.
- ➔ Recommend review of connected load, service size, regulation and metering equipment to ensure service pressure is adequate to the Thunder Mountain Middle School. It appears the service is currently undersized. All scenarios were run utilizing a 2-inch service to the school.
- ➔ Resolve the pressure drop between the Williams Pipeline metering system and the City of Enumclaw City Gate Station. Resolution of significant

pressure drops at the head-end of the system will provide significant benefit downstream, postponing investment needed in the remainder of the system.

3. PLANNING BASE MODEL AND ASSUMPTIONS

A planning base model was developed from the validated system model discussed in Section 2. The planning model represents the system at 2035 build-out conditions. The growth predictions were based on the City's 2035 Master Development Plan.

A. *The model was created as follows:*

1. Additional residential and commercial building locations were imported from the City's 2035 planning data. As a result, approximately 2000 new residential and 1.5 million square feet of new commercial space was added. Only locations within the City Corporate Limits were considered. No growth was provided or considered for areas outside of the City Urban Growth Area.
2. The hydraulic efficiency value of all pipe segments was set to their "normal" values (1.00 in this case). This assumes that the issues with the supply to the Buckley Meter will be resolved.
3. All regulator set pressures were set to their nominal values, for example 35 psig, for some scenarios, and set to 50 psig for scenarios involving an Intermediate Pressure (IP) system uprate. In either case it was assumed that the associated regulator stations were able to maintain the specified set pressure.
4. The load associated with the existing customers was increased by 10% above the February 6, 2014 value. This will introduce some safety factor into the analysis with respect to the existing peak system demand.
5. As directed by the City, a load of 80 cfh per customer was used for new residential customers. This load represents the increased number of gas appliances and square footage in the newer homes.

6. A load of 50 cfh per 1000 square feet was used for new commercial customers.
7. The load at the Buckley Meter was increased to the contract maximum of 124 Mcfh.
8. For modeling purposes, in most cases, the future customers were assumed to be supplied from the existing distribution main nearest their location. In most cases this is adequate for planning style modeling, however is not necessarily representative of how they would actually be served. In a few cases, a new main was extended to supply the new development.
9. For all scenarios, the operating pressure of the High Pressure System was increased to accommodate the new load requirements. The pressure value varied and is listed in the planning results.
10. The system contains a number of small independent sub-systems, referred to as "local district regulator systems". No growth was considered for the local district regulator systems.
11. The load for the Thunder Mountain Middle School was set to its maximum value of 8 Mcfh.
12. It was assumed that the required supply flow and pressure could be maintained at the outlet of the City owned meter at the Williams Meter Station location. This assumes resolution of the pressure drop between the Williams Meter Station and the City-owned meter.
13. Because of the current issues with excess pressure drop across the service to the Thunder Mountain Middle School, a 2-inch PE service was used for all planning scenarios.

As a result of the addition of the new customers, the total system load for the planning models was increased by about fifty percent (235 Mcfh) to a total of 636 Mcfh. This correlates with adding approximately 2,000 residential customers, as slightly over 4,000 services currently exist within the IP system.

B. *Actions taken to address pressure deficiencies within the planning scenarios are summarized below.*

1. Existing steel mains that were deficient within the model were replaced with polyethylene (PE) main of a larger size. This is consistent with the City's steel main replacement goal to eventually replace all existing steel mains. All other steel mains were left unchanged.
2. PE main in 2, 4, and 6-inch sizes were considered for new and replacement mains.
3. Additional support or back ties to lower pressure areas were installed as needed.
4. Installation of higher-pressure gas source within the distribution system (new regulation stations from HP to IP system.)

5. Rebuilding existing regulator stations for increased flow rates. Deactivation of regulation that is not efficiently serving customer load.
6. Uprate of the Intermediate Pressure System.
7. Looping of the High-Pressure supply line.

Combinations of the above actions are present in all scenarios studied.

C. *New Growth Added to the Model*

The new customer locations are shown in Figure 4 on the following page. The red dots represent the new commercial developments, and the green dots represent the new residential locations. A residential location may represent a single new home or could represent multiple homes. Refer to the City's 2035 Planning Study for more information on the predicted density and dwelling unit count for the specific developments.

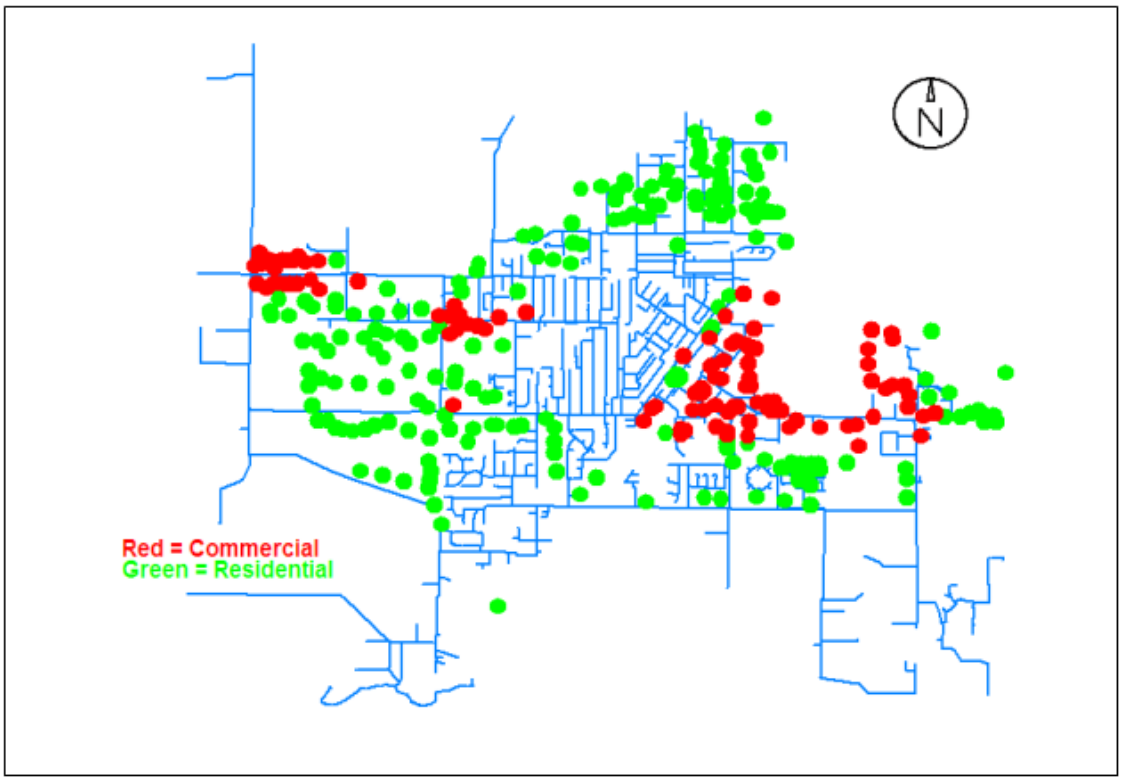


Figure 4 – New Growth Planned by 2035

Each proposed customer location was included in the model along with their Premise/ Property Identification Number (PIN). For residential customers the Per Unit Load value in the model reflects the number of proposed dwelling units for that location. For commercial customers the Per Unit Load value reflects the proposed building area, in thousands of square feet, for that location. A tabular list of proposed customers is included in Appendix D.

4. MODELING RESULTS

Scenario Results – There were a number of scenarios studied to determine the work needed by 2035 as growth projections for the Cities of Enumclaw and Buckley were realized. Significant growth is planned for the next 20 years, adding approximately 50% more residential load. The existing IP system has a number of small diameter (2") steel mains, which are not adequately sized to move the gas to the eastern side of the system without significant pressure drops. All scenarios involved a combination of remediation actions (see section 3.B.) to provide adequate pressures within the IP system while serving the contracted load to the City of Buckley.

A comparison of each scenario studied, along with project expenditures for planning and research, together with capital estimated costs, is presented as Appendix A. The scenarios are discussed in detail, together with an estimated cost for hydraulic reinforcement only, in Appendix B.

The investment plan discussed in this report is based upon adoption of Scenario 6.2, described in Appendix B. This assumes the both the IP and HP systems can be uprated to the required operating pressures. Please see Section 5 for a discussion of the HP uprating issues. Table 3, below, details the components required for installation in this scenario.

Schedule of Reinforcements – The timing of these investments is highly dependent upon the growth that actually materializes within the next few years. It is recommended that the City update the planning model periodically to analyze the growth that has occurred, and modify the project timing proposed within this report based upon actual growth.

Description	HP System Pressure	IP System Pressure	Regulator Station Work	New PE Pipe Installed	Steel Pipe Replaced with PE	Total Estimated Cost
Uprate 4-inch steel IP main in Warner Avenue between the existing Warner Regulator Station and Blake Street, adding a new regulator station near the intersection of Warner Avenue and Blake Street, a new regulator station near Auburn Enumclaw Road and 228th Avenue SE. Increase HP to 326 psig. Uprate the IP system to 50 psig.	Uprate to 326 psig 82,400 ft. Uprate existing steel IP main, 6,543 ft.	Uprate to 60 psig, operate at 50 psig. 381,000 Ft 4015 Services	New regulator stations 1. Enumclaw-Auburn Rd and 228th Ave SE. 2. Warner and Blake Rebuild Roosevelt Regulator Station.	2" – 6,666 Ft. 4" – 14,273 Ft. Relocate 16 services along Warner ($8,000)	4" – 21,023 Ft.	
	$254,210	$285,355	$225,000	$1,502,276	$1,513,656	$3,780,497

Table 3 – Scenario 6.2 Investment Planned

5. INVESTMENT PLAN COMPONENTS

The following actions are needed, based upon growth assumptions discussed in Section 3, to adequately serve the City's gas customers. These projects are based upon adoption of Scenario 6.2, summarized in Section 4 above and discussed in Appendix B. Timing of these projects has been assumed as discussed below.

1. Uprate of the IP System to 60 psig MAOP, planned operation at 50 psig. This project is proposed for completion in 2020.
    a. This action will provide additional capacity within the City's IP system to serve existing and future loads. Uprate is a very cost-effective method to meet the current and future needs. Per the City's preliminary conversations with the Washington State Utilities and Transportation Commission (UTC), this uprating will require that the IP operating pressure be temporarily increased to 90 psig to pressure test the system for an MAOP of 60 psig. The uprate will be required to be performed in four increments. A leak survey prior to the uprate must be completed, all leaks repaired, and then four 12.5 psig incremental pressure increases, with leak surveys and all leaks repaired after each pressure increase, will be required. Refer to 49 CFR 192, Subpart K and WAC 480.93.155

b. Uprating the IP system will require a written uprate plan to be developed and followed during the uprate steps. Requirements for the uprate and written plan are contained in 49 CFR §§192.553, 192.557.

c. The IP system will need to be reviewed to determine that all elements, including regulation, are adequate for the pressure (90 psig) that will be used for the uprate. All residential and commercial regulators will need to have adequate overpressure protection installed, or an internal overpressure device contained within the regulator, to protect the building served from the high pressure gas in the event of regulator failure. Sections that may have undergone previous testing to qualify for 60 psig and may be exempt from the leak survey after each incremental pressure increase (see item f below) must still be reviewed for overpressure protection adequacy during the uprate. Please refer to 49 CFR §192.197.

d. Isolation valves used to isolate a section that may be operating at a lower pressure during the uprate need to be checked to ensure they are working properly and seat tightly prior to the uprate.

e. A first step towards the uprate could be to replace all remaining steel services (without pressure test records qualifying them for 60 psig) with PE services that have been tested and qualified for 60 psig operating pressure. The cost of this action is significant, has the benefit of accelerating the replacement of steel services, and may reduce the number of leaks that will need to be repaired during the uprate. This step is not, however, a pre-requisite to the uprate, as the existing steel services can be uprated at the same time as the main and replaced at a more measured pace over future years.

f. It may be beneficial to document any large PE sections that have been pressure tested to exempt them from the uprate. A validation of previous test records to ensure these facilities are qualified for 60 psig operating pressure is required to exempt portions of the IP system from the uprate.

    1) This may be beneficial if significant cost savings are expected by eliminating these portions of the system from the uprate process, should the cost savings offset the research and documentation effort.

    2) The City indicates that all PE services have been tested to qualify for 60 psig, as have all PE main sections. These sections can be exempted from the uprate leak surveys so long as the records are verified.

    3) This due diligence search shall be documented and available for verification by the UTC if requested.

    4) Alternatively, all facilities can be uprated (as though they had not been previously tested) to qualify for the higher pressure, during the uprate. The

costs forecast for the uprate included in the investment plan anticipate 100% of the IP system, including all services, would be uprated.

g. City has not indicated the presence of any cast iron or ductile iron pipe in the IP system. No guidance has been provided for this situation, if ductile or cast iron pipe exists, please refer to 49 CFR §192.557 (d).

2. Install additional regulation and rebuild regulation stations for capacity.

   a. This alternative installs a new regulator at Enumclaw-Auburn Road and 228th Ave SE. Proposed in 2025.

   b. The Roosevelt and Warner regulator stations will need to be rebuilt in the future with larger capacity regulators to handle the increased capacity required at these locations. Proposed in 2025.

   c. Recommend undertaking the uprate of the IP system first and installing the new regulator station at a future date. The regulation work has been estimated in the Investment plan as occurring in 2025; however, it is recommended the City evaluate actual growth and capacity required prior to project planning.

3. Install new main pipe

   New pipe will be installed to both serve new loads and provide cross ties to assist in upholding system pressures. The timing of these actions is dependent upon growth, and the location of the development. It is assumed the majority of this replacement can be accommodated on a project by project basis, confirmed through the periodic update and refresh of the system planning model.

   a. The following PE main installations are estimated to be necessary within the 20 years for growth reasons. This investment will be scheduled based upon actual load growth in the City. The City should use the updated planning model for size guidance.

      1) 2-inch main – 6,666 feet

      2) 4-inch main – 14,723 feet

4. Replace undersized steel mains

   The undersized main will be replaced to provide increased capacity and continue the steel main replacement program.

   a. The following PE main is forecasted to be installed to replace undersized steel mains to increase capacity within the City's IP system. Actual locations will be determined as growth occurs within the system. According to the City, the installation cost differential between 4-inch and 6-inch main is minimal, the City may desire to increase the pipe size in some instances. These footages and diameters are a

minimum requirement.

1) 4-inch main – 21,023 feet

b. Timing of this replacement is again dependent upon growth and can be undertaken on a project by project basis.

1) It is recommended the City utilize the results of this planning study to determine minimum future pipe size for existing steel main. Larger PE main can be installed at the City's discretion.

5. Uprate the High Pressure (HP) pipeline from the Williams Tap through the City Gate to Buckley Meter Station

a. This uprate will establish a new MAOP of 325 psig or greater, which will be required to ensure adequate pipeline capacity for the City and to fulfil contractual delivery requirements for the City of Buckley through 2035.

b. The timing of this work will be dependent upon the growth developed both in the City of Enumclaw and the City of Buckley. This project will likely be required in the 2030 or later timeframe. The City will need to track growth closely to refine the schedule for the uprate.

c. The HP line will need to operate at least at 307 psig, as modeled by the GASWorkS™ software program, for this scenario. It is recommended to qualify the line to an MAOP of 340 or 360 to provide operating flexibility. For the purposes of this report, a future MAOP of 326 is assumed. The City may adjust the MAOP based upon the records research and future planning study results.

1) Establishing a MAOP of 326 psig will require the test pressure to be brought up to 488 psig. City will need to perform feasibility of the uprate after the pipeline records search reveals the Specified Minimum Yield Strength (SMYS) and key characteristics of the pipe installed. The uprate may only be performed if it is deemed safe to increase the pressure. See item e) below.

2) The City has indicated it desires to operate the HP pipeline at under 20% SMYS. Six-inch pipe with 0.188" wall thickness at 350 psig would operate near 13% SMYS. Guidance for over 20% SMYS operation and uprate requirements have not been included in this report.

3) The HP pipeline must be leak surveyed in its entirety prior to the uprate. Results from a routine pipeline survey may be utilized if it has occurred within the past 12 months.

4) Uprate could be performed in 4 steps of roughly 59.5 psig. An initial leak survey is conducted prior to the uprate and any leaks found are repaired. After each pressure increase is established and held, a leak survey of the entire line is

conducted. Leaks found are repaired prior to the next incremental pressure increase.

d. A written uprate plan must be filed with the UTC at least 45 days prior to the work being performed. Regulatory requirements for the uprate and written plan are contained in 49 CFR §§192.553, 192.557, and WAC 480-93-155.

1) The Revised Code of Washington (RCW) requires (ref: RCW81-88-080) a GIS map of the pipeline for gas pipelines operating over 250 psig to facilitate the needs of first responders. This would be submitted with the uprate plan. Development of the map would require a survey and geo-referencing of the existing pipeline to the required accuracy. This information will be valuable to the City in the future should the gas facility records be converted to a GIS system.

a) It is recommended to geo-reference each segment that contains separate MAOP documentation, so the UTC can reference the records identified in item 5.e) below to the segments shown on the map.

2) From the WAC, at a minimum, the plan must include the following:

a) "A list of all affected gas pipeline facilities, including pipes, fittings, valves, and other affected equipment, with the manufacturer's specified maximum operating pressure limits, their specified minimum yield strength (SMYS) at the intended MAOP, and any other applicable specifications or limitations;

(b) Original design and construction standards;

(c) Original pressure test records;

(d) Previous operating pressures identifying the dates and lengths of time at that pressure;

(e) Records of all leaks, regardless of cause, and the dates and methods of repair;

(f) Where the pipeline is being uprated to a MAOP that produces a hoop stress of twenty percent or more of the SMYS, records of the original welding standards and welders;

(g) Maintenance records of all affected regulator stations and system relief valves for the past three years or three most recent inspections, whichever is longer; [*This applies to stations, local district regulator systems, residential regulators, etc.*

(h) Where applicable, relief valve capacities at the proposed MAOP compared to regulator flow capacities, with calculations;

(i) Cathodic protection readings of the affected gas pipeline and facilities, including rectifier readings, for the past three years or three most recent inspections, whichever is longer; and

(j) Any additional information that the commission may deem necessary to evaluate the pressure increase."

e. It does not appear that the existing records regarding the steel SMYS for the existing HP pipeline are adequate to support an uprate without significant additional research and documentation. The following activities are recommended to be performed prior to planning the uprate of the HP system.

1) Perform a thorough records search to document all material purchased and installed for the HP pipeline. Identify the SMYS of the pipe purchased through research with the material supplier or installation contractor, if possible. Often the SMYS can be verified from the Material Test Reports from the vendor, if the City can determine the vendor the pipe was purchased from.

2) Identify the material utilized in 100% of the pipeline, either from job installation records, past material testing, or vendor records.

3) Undertake a project to locate the original test records, or document a reference to the fact the pipeline was tested after installation. State regulation WAC 490-93-155 (1)(b) requires the operator to create a written plan that includes the original test records.

4) If there are gaps in pipeline verification records after performing steps 1) and 2), perform tensile tests of pipeline material in service to determine the SMYS and verify wall thickness. The tensile testing must be done pursuant to the table in 49CFR 192, Appendix B, II. Assuming the entire line would need to be verified, the number of tests required for the 15.6 miles of pipeline (82,400 feet) including HP laterals to local district regulator systems is one test per 10 lengths of pipe. This would result in 206 test locations that would remove samples of the pipeline material and submit them for testing, assuming the construction of the pipeline used double lengths of pipe (40 foot lengths). The SMYS of the pipe can then be determined from the tensile strength test results as specified in 49 CFR § 192.107. This estimated cost (over $1 million, expense) has been forecast in the investment plan; however, it is ultimately preferable to determine the pipe material from installation records, and tensile testing is usually undertaken only as a last resort, as it is a very costly effort. It is noted the cost for this option may rise to over $2 million, expense, if it cannot be concluded the pipeline was constructed with double lengths of pipe in the original construction.

f. Review of each local district regulator system fed from the HP pipeline must be

performed prior to uprate to ensure the regulation and overpressure protection is adequate for both uprate test pressure and line pressure after the uprate. This work can started at any time the City has cause to work on existing regulation stations or local district regulator systems sets. The local district regulator systems were not reviewed as a component of this project, and any local district regulator system work is not in the investment plan within this report.

6. Alternative to HP Uprate

   a. Should the uprate option discussed in item 5 above prove to be not viable, the alternative solution is to install approximately 6 miles of 6.75-inch OD X 188-inch wall thickness grade X42 pipe. This alternative is discussed briefly in Appendix B as Scenario HP. The approximate cost of this alternative is approximately $2.9 million.

   b. Given the age of the existing pipeline, and the fact that the uprate is planned for 20 years in the future, in the 2031 – 2035 timeframe, the City may wish to consider this option instead of pursuing the uprate option. The advantage of installing a new HP pipeline is the use of modern installation technology, including pig launcher and receiver planning; ability to establish a higher future MAOP through construction testing, ensuring traceable, verifiable, and complete MAOP documentation, and ensuring a reliable asset with a long life for future service to the City.

A table outlining the planned timeframe for each capital or expense investment is included as Appendix C.

SYSTEM PLANNING CONSIDERATIONS

1. Uprate of IP System:

   a. Parts of the IP system can be excluded from the uprate, if pressure test records exist for the system, are identified and available for the UTC to examine if requested, and if the excluded PE segments result in significant project cost savings. The City should evaluate the cost of the research and documentation versus the cost of uprating the entire IP system when planning the uprate.

   b. Replacement of all remaining steel services (~885) is costly (estimated at approximately $3.2 million), and is not a pre-requisite to the uprate, as the existing steel services could be uprated at the same time as the main and replaced at a more measured pace over future years. Service leak survey is estimated at $4.50 per service/leak survey, so for approximately $20,000 the existing 885 steel services can be uprated. Leak repair for

any leaks found on the services during the uprate would consist of a service replacement, and could be capitalized at the time of the uprate if desired.

c. The IP system supplied by the Mud Mountain Regulator is connected to the Intermediate Pressure System. The Mud Mountain system does not significantly contribute to the supply of the remainder of the IP system due to the size and configuration of the connection, nor does the IP system significantly contribute to the Mud Mountain system. The Mud Mountain system essentially operates as an independent system. When planning the uprate of the IP system, it may be prudent to separate the Mud Mountain system from the remainder of the IP system by way of an isolation valve to avoid the expense of uprating that portion of the system. Isolation valve(s) will need to be inspected prior to the uprate to ensure they are working properly. This has not been included in the investment plan; the assumption is the City would uprate the entire system.

2. Replacement of Steel Main

   a. Steel main has a larger internal diameter than PE mains of the same nominal size. Size-for-size replacement of steel main will over time reduce the overall capacity of the system, with all other conditions remaining the same. In some cases it may be necessary to install larger PE replacement pipe to compensate for the reduced capacity. However in cases where the replacement main only serves a localized area, the reduced capacity may still be sufficient for system requirements. Because of the increased capacity produced by the uprate IP operating pressure in the future, this affect will be reduced. It would be prudent to use the 2035 planning model to verify all proposed main replacements.

3. Cost of Main Installation and Replacement

   a. The main installation and replacement costs contained within this report are based upon the City's cost when performing the work with City crews. If contract crews are anticipated for any projects, it is recommended the installed cost be verified, as the City would incur additional costs to prepare projects for bid, and based upon market conditions, the contractor's prices may be higher or lower than the City crew prices.

4. Replacement or Rebuild of Regulator Stations

   a. Appendix B contains the required flow through and capacities of the regulator stations supplying the IP system presented in this report. Two stations, Roosevelt and Warner, have been identified as requiring modification or replacement in the future to accommodate the increased flows. If either of these stations requires significant work to be performed, the City should consider replacing the station equipment with new

regulators and piping that can meet future needs.

5. Steel Main Replacement Program

   a. The City may wish to consider implementation of a risk-based steel main replacement program rather than the current direction to replace all steel main. Main replacement is expensive if the main being replaced is not nearing the end of its useful life. The City reports that the current steel main leak rate is low indicating an effective cathodic protection program.

CONCLUSIONS

At this time, the majority of the City of Enumclaw IP system appears to be generally adequate in terms of hydraulic capacity. There are a few items that require attention at this time, and these can be corrected in the near term with relatively small investments.

The load growth planned for the long-term in Enumclaw, coupled with the contractual deliveries to the City of Buckley and the need to address capacity ties within the City do require significant investments over the planning window. The timing of these investments for main installation and replacement is dependent upon the growth developing, and where load is physically added within the system.

The investment recommendations contained within the report are to increase the Intermediate Pressure (IP) system pressure within the City's service territory and perform or plan no-regrets projects in the near term that will position the City well for planned future investments. A significant planning project and immediate need for the City is to prepare for preferred uprate of the High Pressure (HP) line from Williams Tap. Should this HP uprate project not go forward, looping of the existing HP line with approximately 6 miles of 6-inch HP pipe is the alternative.

The following recommendations are made.

1. The High Pressure (HP) system appears to be operating adequately at current demand levels. However there was a potential issue observed during the February 2014 peak periods in the section south of the Warner/Roosevelt regulator laterals supplying the Buckley Meter. The pressures recorded at the Buckley Meter were considerably less than

what was predicted by the model. The City reports that since this time the pressures have been more in line with model predictions.

➔ Recommend the pressure at the Buckley Meter continue to be monitored, particularly during peak periods, and that additional temporary pressure recorders are placed along the HP section, perhaps at the Mud Mountain Regulator Station inlet, and at least at one other location, if practical.

2. The service line to Thunder Mountain Middle School appears to be undersized. The current line size is 1.25-inch PE, and it is not clear how this service is connected to the 2-inch PE main supplying the service. Both model results and field recorded results indicate that the pressure at the end of the service is comparatively low and will get worse as new demand is added to the system.

➔ It is recommended the City replace the service to the school with a 2-inch PE service branched off of the 2-inch main with a 2-inch tee.

➔ Verification of the school's load is also recommended prior to sizing the service.

3. The Intermediate Pressure (IP) system appears to be operating at somewhat low pressure levels in the northeast portion of the system. The main pressures in this area are near the allowable pressure limit (15 psig) used for the planning design. This was predicted by the model and confirmed by recorded field pressure values.

➔ It is recommended the City begin taking steps now to plan for the uprate of the IP system from its existing MAOP of 40 psig to 60 psig, with a planned operating pressure of 50 psig. This uprate is recommended to occur within the next 5 calendar years to facilitate growth expected in this planning period. The uprate would be performed in four incremental steps and is a moderate expenditure compared to the new or replacement main expenditures necessary to obtain comparable capacity increase. See detail contained in Section 5, Investment Plan, for detail of the following recommendations.

a. Perform a records search to verify test records for systems planned to be excluded from the uprate. Specifically, all PE mains and services are reportedly tested to qualify for 60 psig MAOP. These records will need to be organized and available for UTC inspection if it is planned to exclude them from the uprate. Alternatively, uprate the entire system and document.

b. Ensure regulation and associated IP system equipment is adequate for test pressures.

c. Consider accelerated replacement of steel services if desired.

   d. Plan and prepare a written uprate plan.
   e. Perform uprate with contract leak survey assistance.

4. The HP system is proposed to be uprated to a minimum MAOP of 326 psig to supply the IP system and the City of Buckley in the future. There are a number of pipeline characteristic documentation steps that need to be performed prior to planning the uprate, currently forecast for 2025 to 2035 timeframe.

   ➔ The existing records regarding the steel SMYS for the existing HP pipeline are not adequate to support an uprate without additional research and documentation. The following recommendations are made. Further detail regarding these recommendations is contained in Section 5, Investment Plan.

      a. Document the material utilized in 100% of the pipeline, by conducting a thorough records search identifying all material purchased and installed for the HP pipeline. Identify the SMYS of the pipe utilized in the HP line by section.
      b. If there are gaps in pipeline records after performing the material records search, perform tensile tests of pipeline material in service to estimate SMYS. This step is potentially very costly and may not be desirable when compared to the looping alternative.

   ➔ Prepare and conduct HP pipeline uprate.

      a. Prepare written uprate plan and supporting documentation for submittal to the UTC.
      b. Submit plan at least 45 days prior to the planned uprate. Perform initial leak survey.
      c. Conduct uprate in 4 incremental pressure increases, leak survey and repair leaks after each pressure increase, and document work to establish new MAOP.

   ➔ City is urged to evaluate the option of HP line replacement in lieu of the HP pipeline uprate. The uprate is planned for 15 to 20 years in the future, at which time the HP pipeline will be nearing or at the end of its depreciated life. The pipeline condition would likely be a topic of some discussion during the uprate approval process. A new pipeline would be constructed to ensure all current regulation requirements are incorporated into construction, and the MAOP records would be verifiable, traceable, and complete. The new pipeline would be used and useful for likely 50 years.

5. Installation of new facilities to serve growth has been estimated within this report based upon the City's 2035 Planning Study. Actual development will occur in these areas and likely others. This investment cannot be forecast with confidence, so it has been depicted as level expenditure over the planning period.

- ➔ The City should address projects on a case by case basis, taking advantage of projects planned for construction to install portions of system ties or increased main size as planned in the 2035 model.
- ➔ Closely review development that is occurring on the northern or eastern side of the City to determine if additional reinforcement is needed prior to serving the growth. This can be performed by City maintenance and use of the gas planning model as an everyday planning tool.

6. Replacement of existing steel main (through the steel Main Replacement Program) has been a City goal. The replacement of steel main does have the advantage of reducing older main in the City while over the long term reducing ongoing maintenance associated with Cathodic Protection.
   - ➔ Follow the main sizing contained within the 2035 planning model solution as steel main is replaced.
   - ➔ Evaluate required replacement sizes for mains not included in the planning study, using an updated 2035 planning model as a basis.
7. Resolve the pressure drop between the Williams Pipeline metering system and the City of Enumclaw City Gate Station. Resolution of significant pressure drops at the head-end of the system will provide significant benefit downstream, postponing investment needed in the remainder of the system. The City has indicated this will be resolved in the near future.

The Enumclaw Investment Plan included as Appendix C proposes reasonable investment within the next five years. This includes projects 1 through 3 and 7 above. Changing economic factors may increase the pace of growth or decrease it. It is recommended that the City continue to update the gas planning model to reflect actual system conditions and to provide guidance regarding main size and system improvement projects during the future.

Appendix A – Scenario Studied -- Comparison Summary

Cost depicted within this appendix includes engineering and research costs detailed in Appendix C as well as the hydraulic reinforcement identified in Appendix B necessary to meet capacity at the future dates. Tensile testing has not been forecast as necessary for the HP system uprate. Total project costs are included in Appendix C for recommended scenario projects.

Scenario	Description	HP System Pressure	IP System Pressure	Regulator Station Work	New PE Pipe Installed (Growth plus Ties)	Steel Pipe Replaced with PE	New Steel Pipe Installed	Estimated Cost
1	Increase pressure for both HP and IP. No additional regulation or main replacement. Not viable.	Increased	Increased	None	None		None	Not Viable N/A
2	Increase HP System pressure, replace steel main with 6-inch PE. Not Viable.	Increased Pressure	35 psig			Replace all steel main with 6-inch PE	None	Not Viable N/A

Scenario	Description	HP System Pressure	IP System Pressure	Regulator Station Work	New PE Pipe Installed (Growth plus Ties)	Steel Pipe Replaced with PE	New Steel Pipe Installed	Estimated Cost
3.1	Install regulator station near Enumclaw-Auburn Road and 228th Avenue SE. Uprate HP System to 309 psig, IP at 35 psig.	Uprate to 309 psig 82,400 ft.	35 psig	(1) New regulator at Enumclaw-Auburn Rd and 228th Ave SE. (2, 3) Rebuild Roosevelt and Warner Stations.	2" – 1066 Ft. 4" – 511 Ft. 6" – 16,280 Ft.	4" – 17,220 Ft. 6" – 33,036 Ft.		
		$254,210	-0-	$225,000	$1,348,692	$3,750,576	-0-	$5,578,478
3.2	Same scenario as 3.1, with HP system at 307 psig IP system qualified for 60 psig. Will operate at 50 psig.	Uprate to 307 psig 82,400 ft.	Uprate to 60 psig, operate at 50 psig. 381,000 Ft 4015 Services	Same as 3.1 scenario	2" – 1066 Ft. 4" – 6,335 Ft. 6" – 9,380 Ft.	4" – 12,635 Ft. 6" – 6,377 Ft.		
		$254,210	$282,738	$225,000	$1,243,620	$1,394,372	-0-	$3,399,940

Scenario	Description	HP System Pressure	IP System Pressure	Regulator Station Work	New PE Pipe Installed (Growth plus Ties)	Steel Pipe Replaced with PE	New Steel Pipe Installed	Estimated Cost
4.1	Install New HP Main and Regulator Station at City Park near Fredericksen St. and Kibler Ave	Uprate to 318 psig 82,400 ft.	35 psig	1 New Station. Rebuild Roosevelt Station	4” – 3,765 Ft. 6” – 4,675 Ft.	4” – 14,713 Ft. 6” – 9,266 Ft.	4” – 11,523 Ft.	
		$254,210	-0-	$150,000	$626,380	$1,763,552	$979,455	$3,773,597
4.2	Same scenario as 4.1, however the operating pressure of the HP System 316 psig, and the operating pressure of the IP System was 50 psig.	Uprate to 316 psig 82,400 Ft.	Uprate to 60 psig, operate at 50 psig. 381,000 Ft 4015 Services	1 New Station. Rebuild Roosevelt Station	2” – 996 Ft. 4” – 2,404 Ft. 6” – 4,668 Ft.	4” – 5,127 Ft.	4” – 11,523 Ft.	
		$254,210	$282,738	$150,000	$597,576	$369,144	$979,455	$2,633,122
4.3	Same scenario as 4.1, Remove Roosevelt Regulator Station and increase pressure of the HP System to 352 psig.	Uprate to 352 psig	-0-	1 New Station.	2” – 996 Ft. 4” – 9,100 Ft. 6” – 1,815 Ft.	4” – 9,502 Ft. 6” – 12,959 Ft.	4” – 11,523 Ft.	
		$254,210	$0	$75,000	$862,860	$1,669,028	$979,455	$3,840,553

Scenario	Description	HP System Pressure	IP System Pressure	Regulator Station Work	New PE Pipe Installed (Growth plus Ties)	Steel Pipe Replaced with PE	New Steel Pipe Installed	Estimated Cost
4.4	Same scenario as 4.3, with HP System uprated to 357 psig, and the IP System at operating at 50 psig.	Uprate to 357 psig 82,400 Ft.	Uprate to 60 psig, operate at 50 psig. 381,000 Ft 4015 Services	1 New Station.	2" – 551 Ft. 4" – 9429 Ft. 6" – 881 Ft.	4" – 10,905 Ft.	4" – 11,523 Ft.	
		$254,210	$282,738	$75,000	$784,414	$785,160	$979,455	$3,160,976
5.1	Extend new high pressure main down Enumclaw-Auburn Road to a City owned easement just east of 2627 Kibler, then extending north to a City owned wastewater lift station site near Florence Street and McHugh Avenue – Install new regulator station.	Uprate to 309 psig 82,400 ft.	35 psig	Install new station at Florence and McHugh. Rebuild Roosevelt and Warner Stations.	2" – 102 Ft. 4" – 7321 Ft. 6" – 283 Ft.	4" – 10,304 Ft. 6" – 23,701 Ft.	4", 0.188 w.t. - - 9,747 ft.	
		$254,210	-0-	$225,000	$555,760	$2,543,164	$828,495	$4,406,629

Scenario	Description	HP System Pressure	IP System Pressure	Regulator Station Work	New PE Pipe Installed (Growth plus Ties)	Steel Pipe Replaced with PE	New Steel Pipe Installed	Estimated Cost
5.2	Same scenario as 5.1, Removing Roosevelt Regulator Station, with the HP System at 349 psig, and of the IP System at 50 psig.	Uprate to 349 psig 82,400 Ft.	Uprate to 60 psig, operate at 50 psig. 381,000 Ft 4015 Services	Install new station at Florence and McHugh.	4" – 7,542 Ft. 6" – 1,365 Ft.	4" – 18,276 Ft. 6" – 3,415 Ft.	4", 0.188 w.t. – 11,523 ft.	
		$254,210	$282,738	$75,000	$646,764	$1,575,412	$979,455	$3,813,578
6.1	Uprate 4-inch steel IP main in Warner Avenue between the existing Warner Regulator Station and Blake Street, adding a new regulator station near the intersection of Warner Avenue and Blake Street, a new regulator station near Enumclaw-Auburn Road and 228th Avenue SE. Increase HP to 326 psig.	Uprate to 326 psig 82,400 ft. Uprate existing 4-inch steel IP main, 6,543 ft.	35 psig Upgrade 6543 ft of Warner IP Main	Install 2 new stations at: (1) Enumclaw-Auburn Rd & 228th Ave, and (2) Warner and Blake St. Rebuild Roosevelt Reg	2" – 6,666 Ft. 4" – 7,409 Ft. 6" – 7,606 Ft. Relocate 16 services along Warner ($8,000)	4" – 16,604 Ft. 6" – 7,711 Ft.		
		$254,210	$2,617	$225,000	$1,586,124	$1,781,524	$0	$3,849,475

Scenario	Description	HP System Pressure	IP System Pressure	Regulator Station Work	New PE Pipe Installed (Growth plus Ties)	Steel Pipe Replaced with PE	New Steel Pipe Installed	Estimated Cost
6.2	Same scenario as 6.1, however the operating pressure of the IP System was 50 psig.	Uprate to 326 psig 82,400 ft. Uprate existing 4-inch steel IP main, 6,543 ft.	Uprate to 60 psig, operate at 50 psig. 381,000 Ft 4015 Services Uprate 6543 ft. of Warner IP Main	Install 2 new stations at: (1) Enumclaw-Auburn Rd & 228th Ave, and (2) Warner and Blake St. Rebuild Roosevelt Reg	2" – 6,666 Ft. 4" – 14,273 Ft. Relocate 16 services along Warner ($8,000)	4" – 21,023 Ft.		
		$254,210	$285,355	$225,000	$1,502,276	$1,513,656	$0	$3,780,497
HP	Install parallel main to the existing HP system to increase capacity. Will still require IP work per scenario alternatives.						6-miles of 6", 0.188 w.t. X42 pipe. 31,680 ft.	Given the price differential, uprating was selected for all scenarios studied.
							$2,900,000 (rough est.)	

Appendix B – Detailed Scenario Discussion

Scenario 1

This model considered increasing the operating pressure of both the High Pressure and Intermediate Pressure Systems to determine if the overall system could accommodate the demand at full build-out, without further modification. The model results indicate that it is not practical to handle the increased customer loads by only increasing the operating pressure of the systems. Some system modifications would be necessary to serve the new customers.

Additional scenarios were developed to study various operating configurations that could adequately supply the full build-out customer demands.

Scenario 2

This model considered increasing the operating pressure of the High Pressure System, operating the three existing regulators serving the Intermediate Pressure System at 35 psig, and increasing pipe sizes of the existing steel mains in the Intermediate Pressure System to 6-inch plastic.

As part of the City's steel main replacement program, all of the existing steel mains in the Intermediate Pressure System have potential to be replaced. However, obviously not all would be replaced with 6-inch plastic. The purpose of this model was to determine if it was possible to serve the proposed future customers from the existing regulator stations, considering that the piping downstream of the regulators could eventually be replaced. The results of the model indicate that this was not possible. An additional supply and/or additional mains would be required to serve the new customers.

Scenario 3.1

This model considered adding a new regulator near the intersection of Enumclaw-Auburn Road and 228th Avenue SE, along with selected steel main replacement with plastic pipe, and the addition of a few new mains in critical locations.

The regulator set pressures for the Intermediate Pressure System are 35 psig. The HP supply pressure was increased to 309 psig in order to maintain the contract minimum of 100 psig at the Buckley Meter.

Certain sections of existing steel main were replaced with plastic main of the same nominal size or larger in order to satisfy the demand and design requirements.

The model results indicate that the configuration would generally work with all areas operating at or above the design pressure limits.

The new and replacement mains are summarized in Table 3.1.

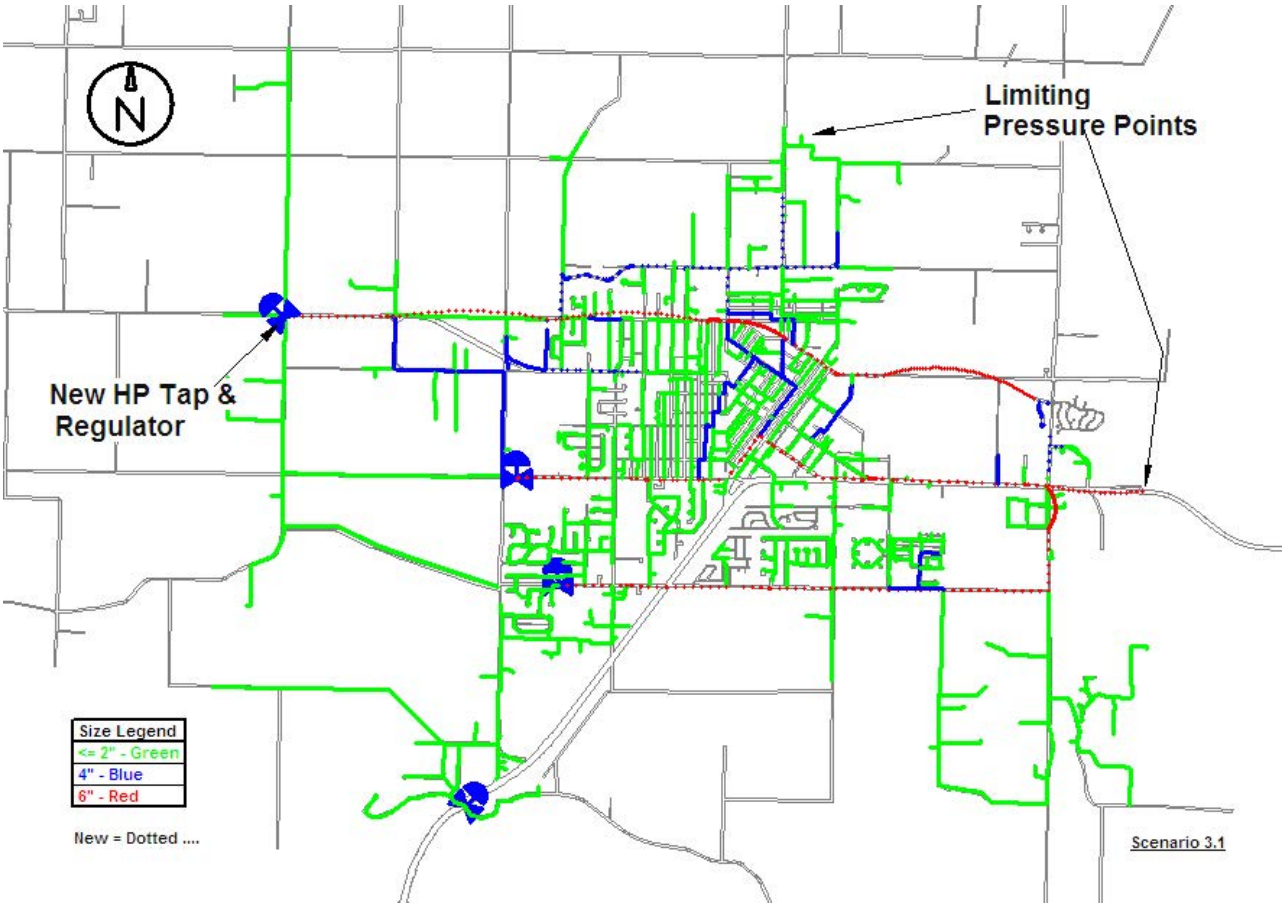
Scenario Summary		**Table 3.1**
Operating Pressures		
High Pressure	309 psig	
Intermediate Pressure	35 psig	
Steel Main Replacement		
Item	Quantity, Lf/Ea.	Cost
4-inch Polyethylene	17,220	$1,239,840
6-inch Polyethylene	33,036	$2,510,736
New Facilities		
2-inch Polyethylene	1,066	$74,620
4-inch Polyethylene	511	$36,792
6-inch Polyethylene	16,280	$1,237,280
Regulator Station - New	1	$75,000
Regulator Station - Upgrade	2	$150,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main		$0
Intermediate Pressure Services		$0
Scenario Total		**$5,578,478**

The flow distribution from the regulator stations supplying the IP System are summarized in Table 3.1a.

IP Regulator Station Flows (35 psig Set Pressure)				**Table 3.1a**
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	103	7	1%	117
Roosevelt	83	201	43%	89 ①
Warner	101	143	30%	114 ①
New	150	120	25%	N/A
Total		**471**	① Under capacity. Will require replacement.	

This scenario is depicted in Figure 3.1, including configuration and pipe sizes.

Figure 3.1
Scenario 3.1 Pipe Configuration and Sizes



Scenario 3.2

This model considered the basic configuration used in Scenario 3.1, however the regulator set pressures for the Intermediate Pressure System were increased to 50 psig. The supply pressure to the High Pressure System was set at 307 psig in order to maintain the contract minimum of 100 psig at the Buckley Meter.

The model results indicate that this configuration would work satisfactorily and would allow a reduction in the steel replacement and new main sizes compared to Scenario 3.1.

The new and replacement mains are summarized in Table 3.2.

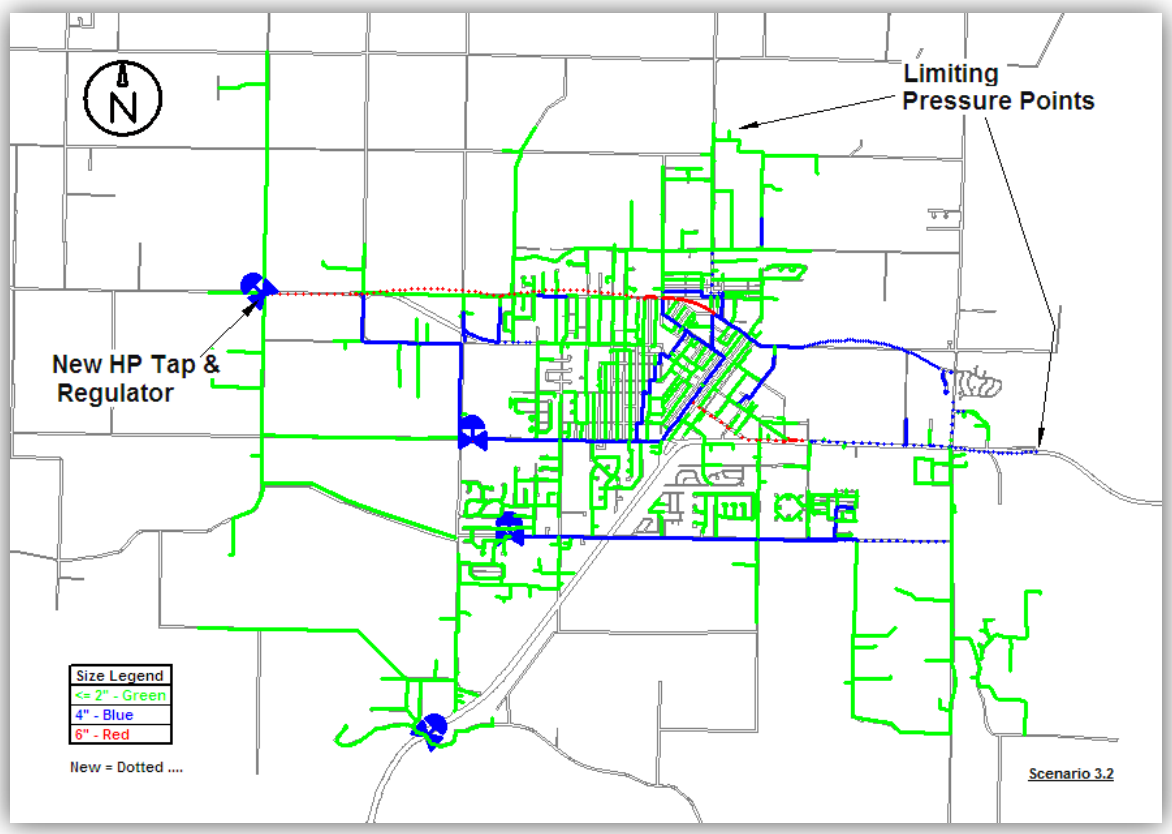
Scenario Summary		**Table 3.2**
Operating Pressures		
High Pressure	307 psig	
Intermediate Pressure	MAOP 60, Operate at 50 psig	
Steel Main Replacement		
Item	Quantity, Lf/Ea.	Cost
4-inch Polyethylene	12,635	$909,720
6-inch Polyethylene	6,377	$484,652
New Facilities		
2-inch Polyethylene	1,066	$74,620
4-inch Polyethylene	6,335	$456,120
6-inch Polyethylene	9,380	$712,880
Regulator Station - New	1	$75,000
Regulator Station - Upgrade	2	$150,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main	381,000	$192,350
Intermediate Pressure Services	4,015	$90,388
Scenario Total		**$3,399,940**

The flow distribution from the regulator stations supplying the IP System are summarized in Table 3.2a.

IP Regulator Station Flows (35 psig Set Pressure)				Table 3.2a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	103	9	2%	109
Roosevelt	83	183	39%	74 ①
Warner	102	130	28%	108 ①
New	147	149	32%	N/A
Total		**471**	① Under capacity. Will require replacement.	

The configuration and pipe sizes are shown in Figure 3.2.

Figure 3.2
Scenario 3.2 Pipe Configuration and Sizes



Scenario 4.1

This model considered extending a high pressure line from near the intersection of Enumclaw-Auburn Road and 228th Avenue SE, east along the Enumclaw-Auburn Road to a proposed regulator station at a City-owned park site near Fredericksen Street and Kibler Ave, along with steel main replacement with larger plastic pipe, and the addition of a few new mains in critical locations.

This scenario considered the regulator set pressures to be 35 psig. The supply pressure to the High Pressure System was set at 318 psig in order to maintain an adequate inlet pressure to the new regulator station.

Certain sections of existing steel main were replaced with plastic main of a larger size in order to satisfy the demand and design requirements.

The model results indicate that the configuration would generally work with all areas operating at or above the design pressure limits.

The new and replacement mains are summarized in Table 4.1.

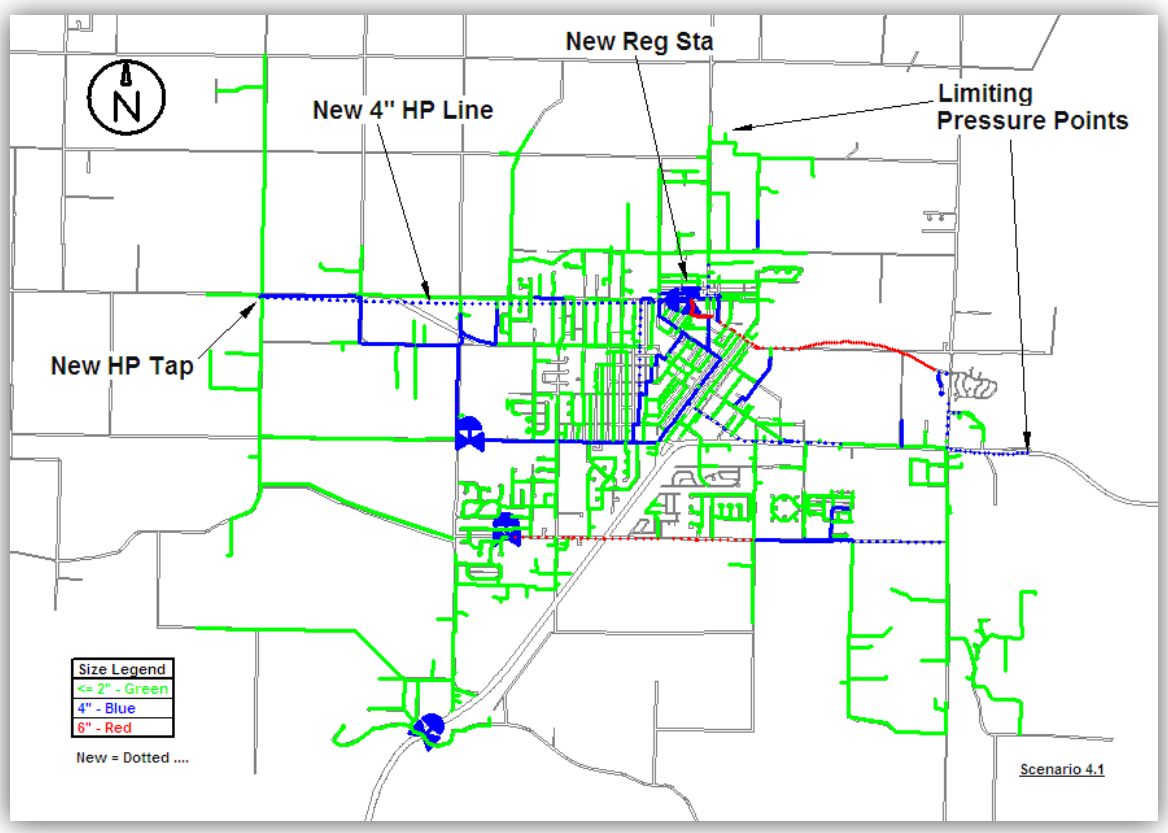
Scenario Summary		**Table 4.1**
Operating Pressures		
High Pressure	318 psig	
Intermediate Pressure	35 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea**	**Cost**
4-inch Polyethylene	14,713	$1,059,336
6-inch Polyethylene	9,266	$704,216
New Facilities		
2-inch Polyethylene		$0
4-inch Polyethylene	3,765	$271,080
6-inch Polyethylene	4,675	$355,300
4-inch, .188-inch wall thickness HP Steel	11,523	$979,455
Regulator Station - New	1	$75,000
Regulator Station - Upgrade	1	$75,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main		$0
Intermediate Pressure Services		$0
Scenario 4.1 Total		**$3,773,597**

The flow distribution from the regulator stations supplying the IP System are summarized in Table 4.1a.

IP Regulator Station Flows (35 psig Set Pressure)				Table 4.1a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	133	7	1%	151
Roosevelt	127	133	28%	144 ①
Warner	132	116	24%	149
New	68	222	46%	N/A
Total		478		
① Under capacity. Will require replacement.				

The configuration and pipe sizes are shown in Figure 4.1.

Figure 4.1
Scenario 4.1 - Consideration and Pipe Sizes



Scenario 4.2

This model considered the basic configuration used in Scenario 4.1, however the regulator set pressures for the Intermediate Pressure System were increased to 50 psig. The supply pressure to the High Pressure System was set at 315 psig in order to maintain an adequate inlet pressure to the new regulator station.

The model results indicate that this configuration would work satisfactorily and would allow a reduction in the steel replacement and new main sizes compared to Scenario 4.1.

The new and replacement mains are summarized in Table 4.2.

Scenario Summary		**Table 4.2**
Operating Pressures		
High Pressure	316 psig	
Intermediate Pressure	50 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea**	**Cost**
4-inch Polyethylene	5,127	$369,144
6-inch Polyethylene		$0
New Facilities		
2-inch Polyethylene	996	$69,720
4-inch Polyethylene	2,404	$173,088
6-inch Polyethylene	4,668	$354,768
4-inch, .188-inch wall thickness HP Steel	11,523	$979,455
Regulator Station - New	1	$75,000
Regulator Station - Upgrade	1	$75,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main	381,000	$192,350
Intermediate Pressure Services	4,015	$90,338
Scenario 4.2 Total		**$2,633,122**

The flow distribution from the regulator stations supplying the IP System are summarized in Table 4.2a.

IP Regulator Station Flows (50 psig Set Pressure)				Table 4.2a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	128	8	2%	140
Roosevelt	119	152	32%	129 ①
Warner	128	111	23%	140
New	80	206	43%	N/A
Total		477		
① Under capacity. Will require replacement.				

The configuration and pipe sizes are shown in Figure 4.2.

Figure 4.2
Scenario 4.2 - Configuration and Pipe Sizes

Scenario 4.3

This model considered the basic configuration used in Scenario 4.1, however the Roosevelt regulator station was taken out of service.

The model results indicate that this configuration would work satisfactorily and would allow a reduction in the steel replacement and new main sizes compared to Scenario 4.1. The supply pressure to the High Pressure System was set at 352 psig in order to maintain an adequate inlet pressure to the new regulator station.

The new and replacement mains are summarized in Table 4.3.

Scenario Summary		Table 4.3
Operating Pressures		
High Pressure	352 psig	
Intermediate Pressure	35 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea**	**Cost**
4-inch Polyethylene	9,502	$684,144
6-inch Polyethylene	12,959	$984,884
New Facilities		

Scenario Summary		**Table 4.3**
2-inch Polyethylene	996	$69,720
4-inch Polyethylene	9,100	$655,200
6-inch Polyethylene	1,815	$137,940
4-inch, .188-inch wall thickness HP Steel	11,523	$979,455
Regulator Station	1	$75,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main		$0
Intermediate Pressure Services		$0
Scenario 4.3 Total		**$3,840,553**

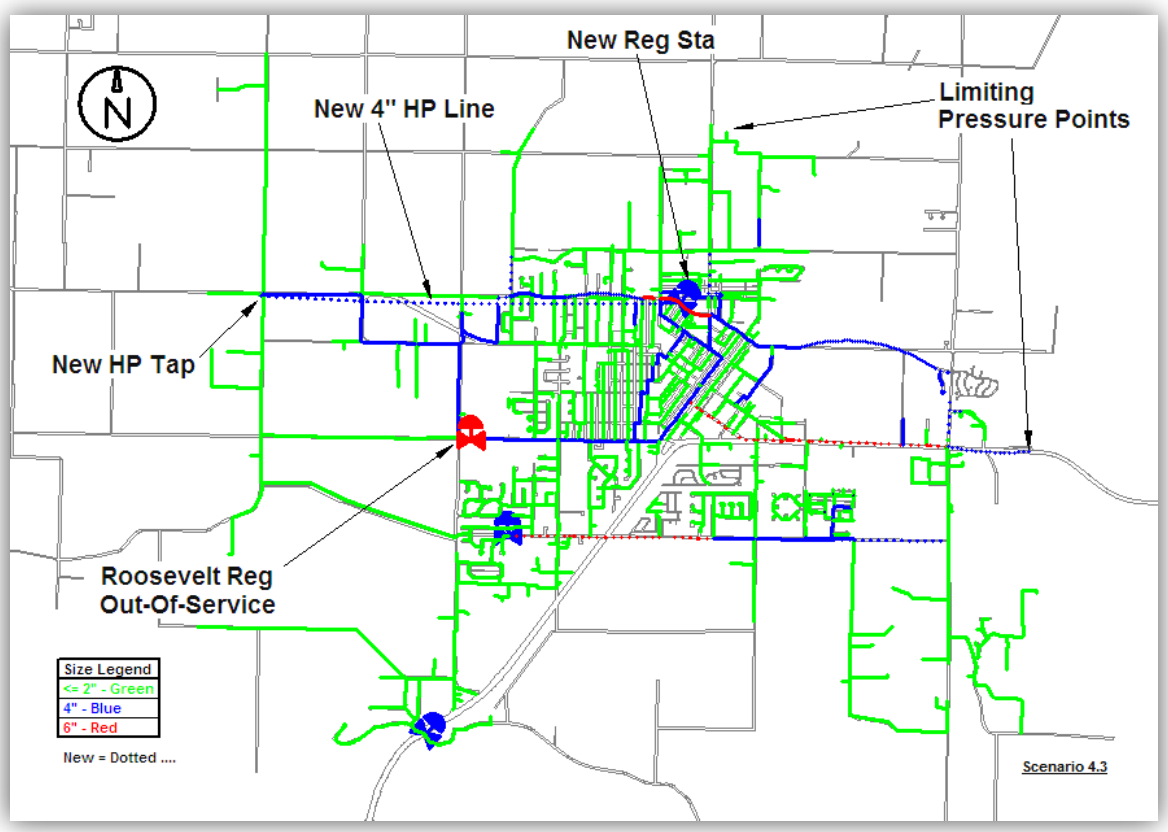
The flow distribution from the regulator stations supplying the IP System are summarized in Table 4.3a

IP Regulator Station Flows (35 psig Set Pressure)				Table 4.3a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	208	8	2%	234
Roosevelt	210	0	0%	N/A
Warner	207	142	30%	233
New	68	329	69%	N/A
Total		479		

The configuration and pipe sizes are shown Figure 4.3.

Figure 4.3

Scenario 4.3 – Configuration and Pipe Sizes



Scenario 4.4

This model considered the basic configuration used in Scenario 4.3, however the regulator set pressures for the Intermediate Pressure System were increased to 50 psig. The supply pressure to the High Pressure System was set at 357 psig in order to maintain an adequate inlet pressure to the new regulator station.

The model results indicate that this configuration would work satisfactorily and would allow a reduction in the steel replacement and new main sizes compared to Scenario 4.3.

The new and replacement mains are summarized in Table 4.4.

Scenario 4.4 Summary		**Table 4.4**
Operating Pressures		
High Pressure	357 psig	
Intermediate Pressure	50 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea**	**Cost**
4-inch Polyethylene	10,905	$785,160
6-inch Polyethylene		$0
New Facilities		
2-inch Polyethylene	551	$38,570
4-inch Polyethylene	9,429	$678,888
6-inch Polyethylene	881	$66,956
4-inch, .188-inch wall thickness HP Steel	11,523	$979,455
Regulator Station	1	$75,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main	381,000	$192,350
Intermediate Pressure Services	4,015	$90,338
Scenario 4.4 Total		**$3,160,976**

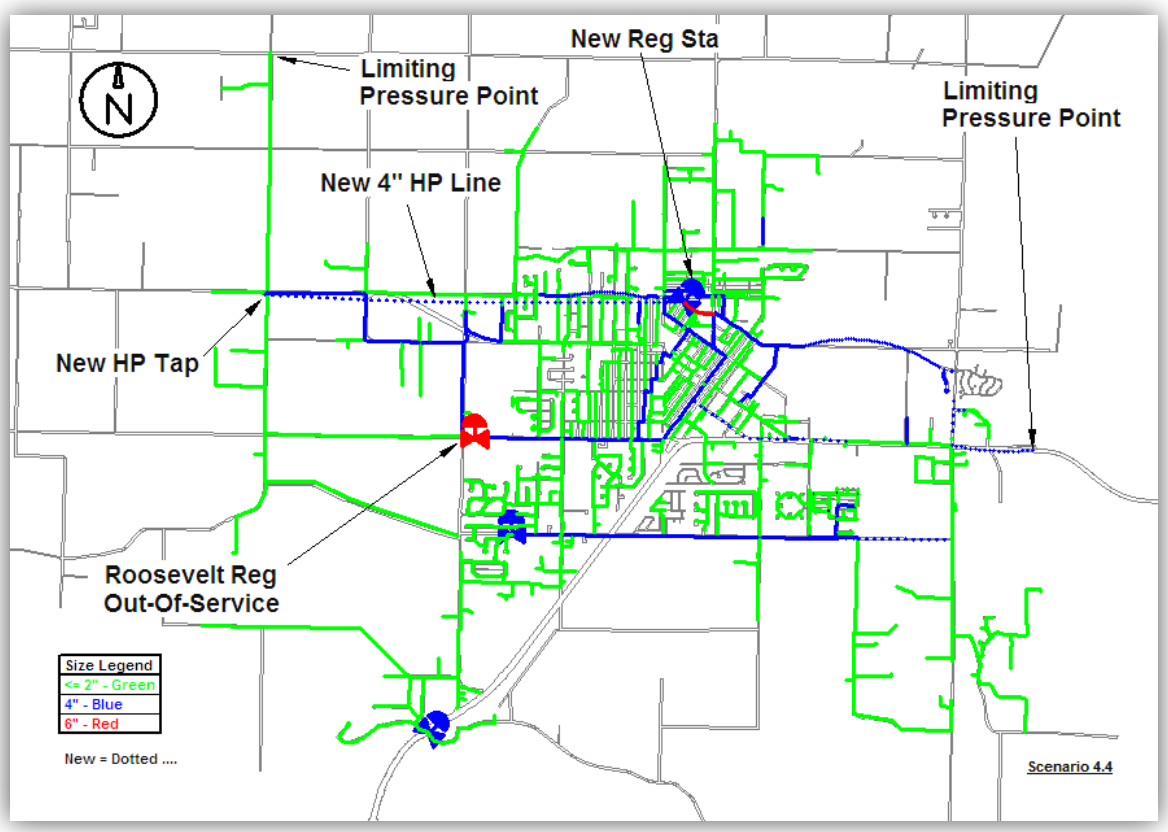
The flow distribution from the regulator stations supplying the IP System are summarized in Table 4.4a.

IP Regulator Station Flows (50 psig Set Pressure)				Table 4.4a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	220	9	2%	244
Roosevelt	222	0	0%	N/A
Warner	219	130	27%	243
New	81	339	71%	N/A
Total		478		

The configuration and pipe sizes are shown in Figure 4.4.

Figure 4.4

Scenario 4.4 – Configuration and Pipe Sizes



Scenario 5.1

This model considered extending a high pressure main from near the intersection of Enumclaw-

Auburn Road and 228th Avenue SE, east along the Enumclaw-Auburn Road to a City-owned easement just east of 2627 Kibler Avenue, north to a proposed regulator station at a City-owned wastewater lift station site near Florence Street and McHugh Avenue, along with steel main replacement with larger plastic pipe, and the addition of a few new mains in critical locations.

This scenario considered the regulator set pressures to be 35 psig. The supply pressure to the High Pressure System was set at 309 psig in order to maintain an adequate inlet pressure to the Buckley Meter station.

Certain sections of existing steel main were replaced with plastic main of the same nominal size or larger in order to satisfy the demand and design requirements.

The model results indicate that this configuration would work satisfactorily.

The new and replacement mains are summarized in Table 5.1.

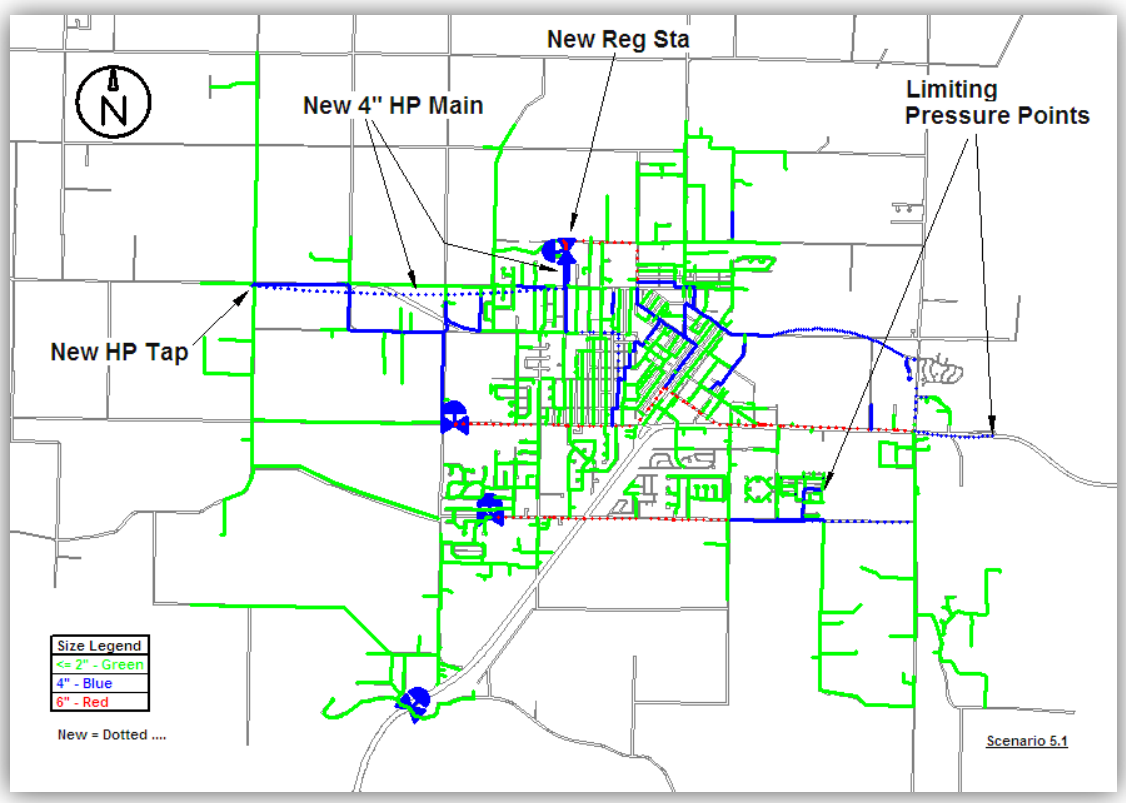
Scenario Summary		**Table 5.1**
Operating Pressures		
High Pressure	309 psig	
Intermediate Pressure	35 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea**	**Cost**
4 -inch Polyethylene	10,304	$741,888
6 -inch Polyethylene	23,701	$1,801,276
New Facilities		
2 -inch Polyethylene	102	$7,140
4 -inch Polyethylene	7,321	$527,112
6 -inch Polyethylene	283	$21,508
4 -inch, .188 -inch wall thickness HP Steel	9,747	$828,495
Regulator Station - New	1	$75,000
Regulator Station - Upgrade	2	$150,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main		$0
Intermediate Pressure Services		$0
Scenario 5.1 Total		**$4,406,629**

The flow distribution from the regulator stations supplying the IP System are summarized in

Table 5.1a.

IP Regulator Station Flows (35 psig Set Pressure)				Table 5.1a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	105	7	1%	119
Roosevelt	90	177	37%	101 ①
Warner	104	121	25%	118 ①
New	96	172	36%	N/A
Total		477		
				① Under capacity. Will require replacement.

The configuration and pipe sizes are shown in Figure 5.1.



Scenario 5.2

This model considered the basic configuration used in Scenario 5.1, however the regulator set pressures for the Intermediate Pressure System were increased to 50 psig. The supply pressure

to the High Pressure System was set at 349 psig in order to maintain an adequate inlet pressure to the new regulator station.

The model results indicate that this configuration would work satisfactorily and would allow a reduction in the steel replacement and new main sizes compared to Scenario 5.1.

The new and replacement mains are summarized in Table 5.2.

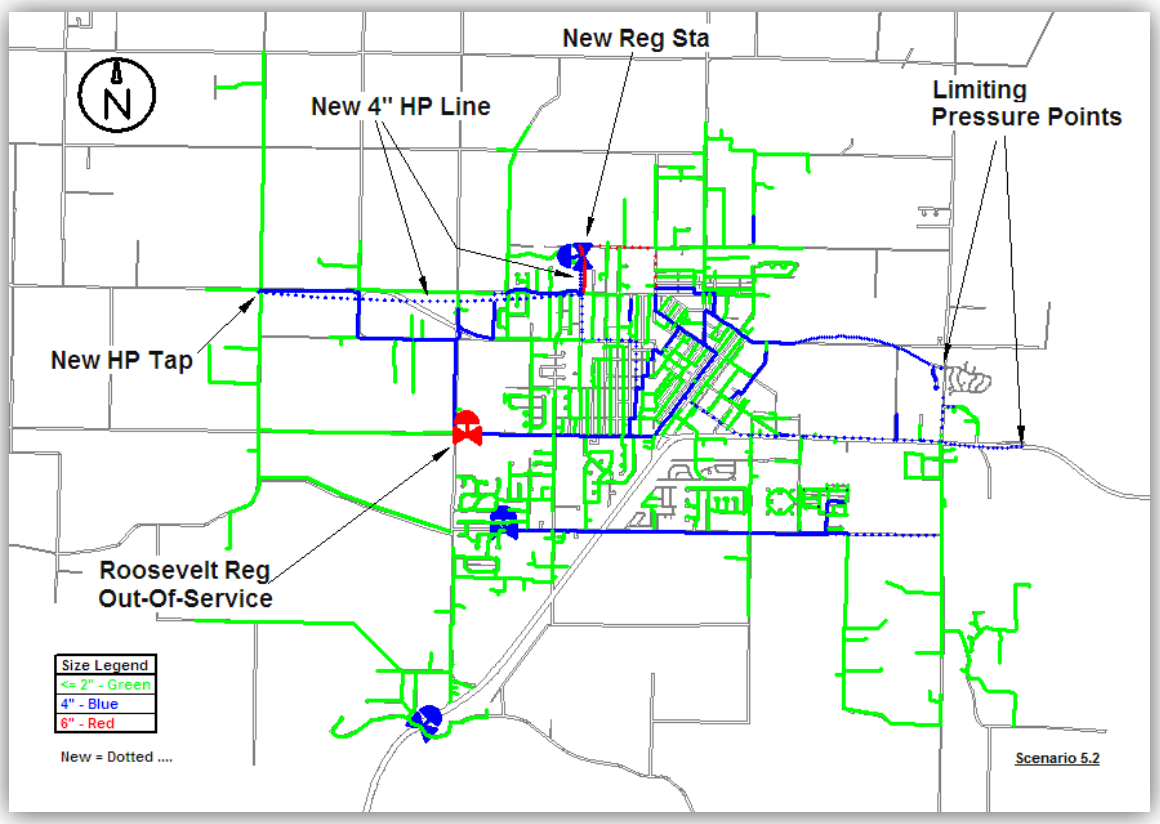
Scenario Summary		**Table 5.2**
Operating Pressures		
High Pressure	349 psig	
Intermediate Pressure	50 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea.**	**Cost**
4 -inch Polyethylene	18,276	$1,315,872
6 -inch Polyethylene	3,415	$259,540
New Facilities		
2 -inch Polyethylene		$0
4 -inch Polyethylene	7,542	$543,024
6 -inch Polyethylene	1,365	$103,740
4 -inch, .188 -inch wall thickness HP Steel	9747	$979,455
Regulator Station	1	$75,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main	381,000	$192,350
Intermediate Pressure Services	4,015	$90,388
Scenario 5.2 Total		**$3,813,578**

The flow distribution from the regulator stations supplying the IP System are summarized in Table 5.2a:

IP Regulator Station Flows (50 psig Set Pressure)				Table 5.2a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	204	9	2%	226
Roosevelt	203	0	0%	N/A
Warner	203	132	28%	225
New	82	338	71%	N/A
Total		479		

The configuration and pipe sizes are shown in Figure 5.2.

Figure 5.2
Scenario 5.2 – Configuration and Pipe Sizes



Scenario 6.1

This model considered uprating the existing 4-inch steel line in Warner Avenue from near the location of the current Warner Regulator Station east along Warner Avenue to the intersection of Warner Avenue and Blake Street. The scenario considered that a new regulator would be installed near that intersection, that a new regulator would be placed near Enumclaw-Auburn Road and 228th Avenue SE (similar to Scenario 3), and that the existing Warner Regulator Station would be taken out of service.

For modeling purposes, a new 4-inch high pressure main was shown along Warner Avenue to simulate the uprated existing 4-inch main, and the existing 4-inch main was turned off.

This scenario required that new mains be placed along Warner to supply several services currently supplied by the 4-inch main to be uprated.

This scenario considered the regulator set pressures to be 35 psig. The supply pressure to the High Pressure System was set at 326 psig in order to maintain an adequate inlet pressure to the new regulator station at Warner Avenue and Blake Street.

Certain sections of existing steel main were replaced with plastic main of the same nominal size or larger in order to satisfy the demand and design requirements.

The model results indicate that this configuration would work satisfactorily.

The new and replacement mains are summarized in Table 6.1.

Scenario 6.1 Summary		**Table 6.1**
Operating Pressures		
High Pressure	326 psig	
Intermediate Pressure	35 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea**	**Cost**
4 -inch Polyethylene	16,604	$1,195,488
6 -inch Polyethylene	7,711	$586,036
New Facilities		
2 -inch Polyethylene	6,666	$466,620
4 -inch Polyethylene	7,409	$533,448
6 -inch Polyethylene	7,606	$578,056

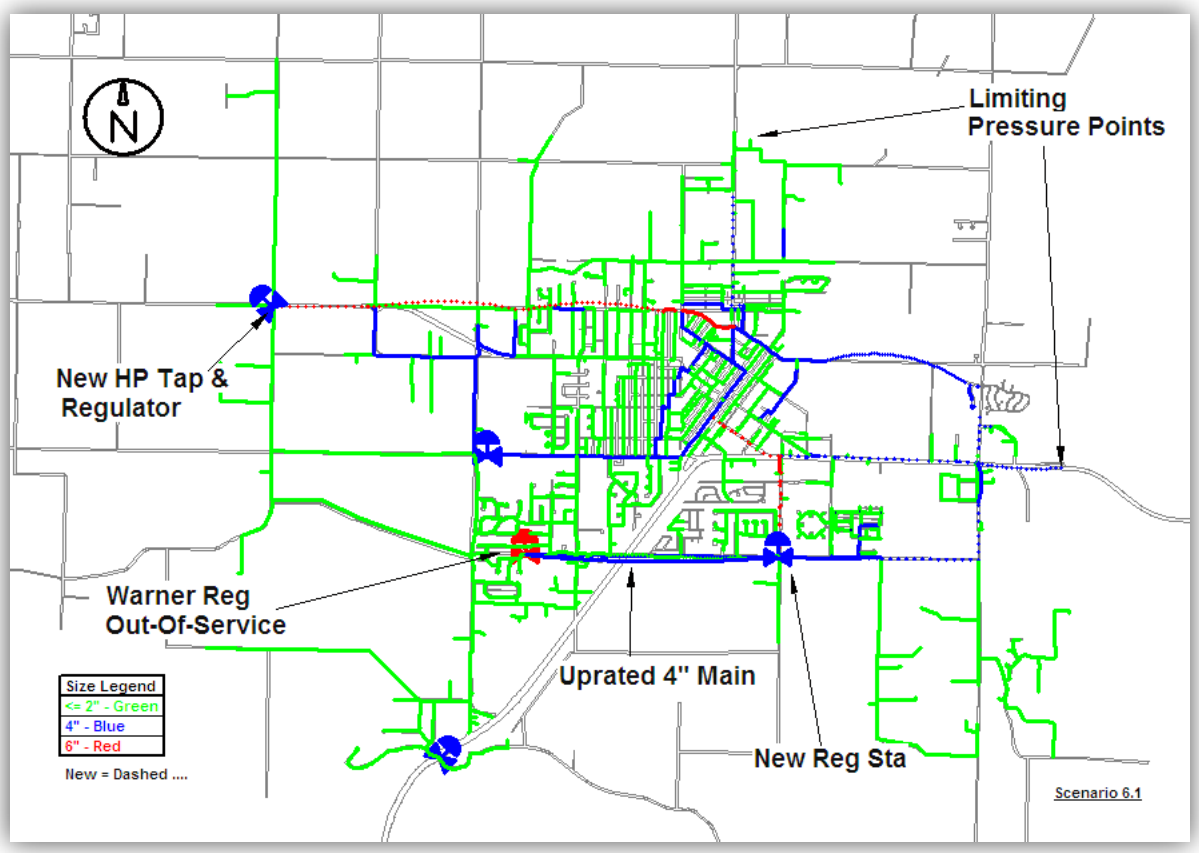
4 -inch, .188 -inch wall thickness HP Steel		$0
Regulator Station – New	2	$150,000
Regulator Station - Upgrade	1	$75,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main (Warner)	6,543	$2,617
Intermediate Pressure Main		$0
Intermediate Pressure Services		$0
Relocate Services (along Warner)	16	$8,000
Scenario 6.1 Total		**$3,849,475**

The flow distribution from the regulator stations supplying the IP System are summarized in Table 6.1a.

IP Regulator Station Flows (35 psig Set Pressure)				**Table 6.1a**
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	136	11	2%	154
Roosevelt	129	138	29%	146 ①
Warner	128	0	0%	N/A
New (Enumclaw-Auburn)	177	105	22%	N/A
New (Blake)	66	224	47%	N/A
Total		478		
① Under capacity. Will require replacement.				

The configuration and pipe sizes are shown in Figure 6.1.

Figure 6.1



Scenario 6.1 – Configuration and Pipe Sizes

Scenario 6.2

This model considered the basic configuration used in Scenario 6.1, however the regulator set pressures for the Intermediate Pressure System were increased to 50 psig. The supply pressure to the High Pressure System was set at 326 psig in order to maintain an adequate inlet pressure to the new regulator station at Warner Avenue and Blake Street.

The model results indicate that this configuration would work satisfactorily and would allow a reduction in the steel replacement and new main sizes compared to Scenario 6.1.

The new and replacement mains are summarized in Table 6.2.

Scenario Summary		**Table 6.2**
Operating Pressures		
High Pressure	326 psig	
Intermediate Pressure	50 psig	
Steel Main Replacement		
Item	**Quantity, Lf/Ea**	**Cost**
4 -inch Polyethylene	21,023	$1,513,656
6 -inch Polyethylene		$0
New Facilities		
2 -inch Polyethylene	6,666	$466,620
4 -inch Polyethylene	14,273	$1,027,656
6 -inch Polyethylene		$0
4 -inch, .188 -inch wall thickness HP Steel		$0
Regulator Station - New	2	$150,000
Regulator Station - Upgrade	1	$75,000
Uprated Facilities		
High Pressure Main	82,400	$254,210
Intermediate Pressure Main (Warner)	6,543	$2,617
Intermediate Pressure Main	381,000	$192,350
Intermediate Pressure Services	4,015	$90,388
Relocate Services (along Warner)	16	$8,000
Scenario 6.2 Total		**$3,780,497**

The flow distribution from the regulator stations supplying the IP System are summarized in Table 6.2a.

IP Regulator Station Flows (50 psig Set Pressure)				Table 6.2a
Station Location	**Inlet Pressure, psig**	**Flow, Mcfh**	**Percent IP Total**	**Estimated Capacity, Mcfh**
Mud Mountain	129	17	4%	141
Roosevelt	113	204	43%	122 ①
Warner	125	0	0%	N/A
New (Enumclaw-Auburn)	177	68	14%	N/A
New (Blake)	81	190	40%	N/A
Total		479		
				① Under capacity. Will require replacement.

The configuration and pipe sizes are shown in Figure 6.2.

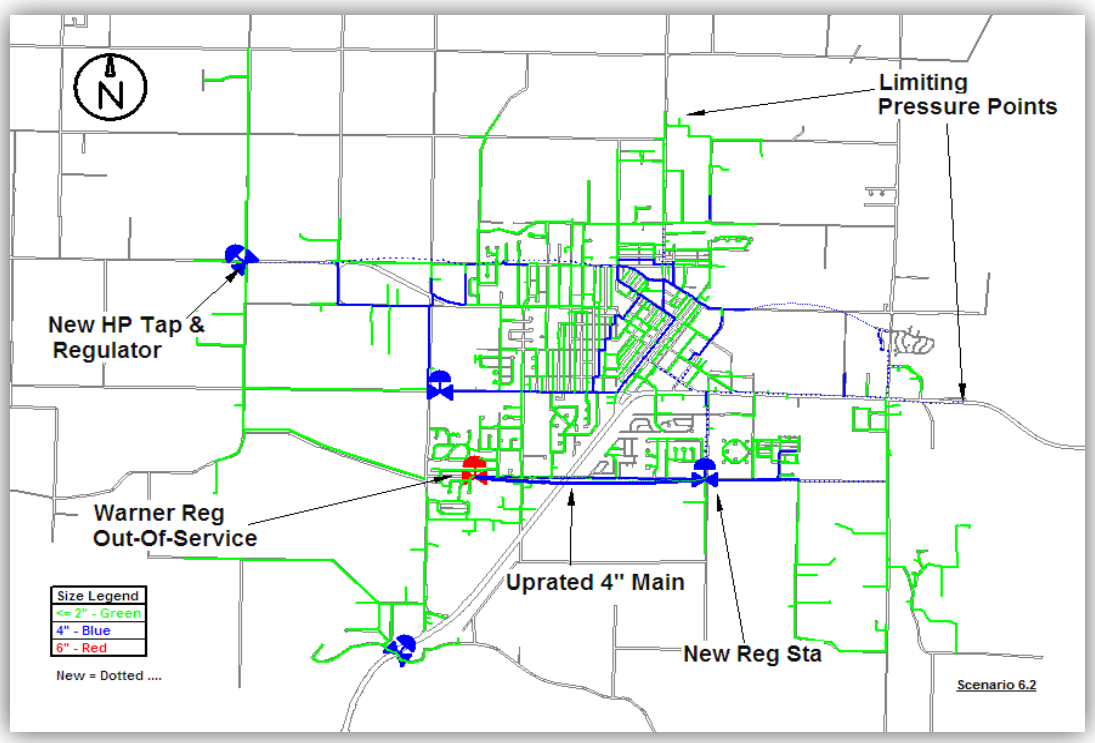


Figure 6.2
Scenario 6.2 – Configuration and Pipe Sizes

Scenario HP

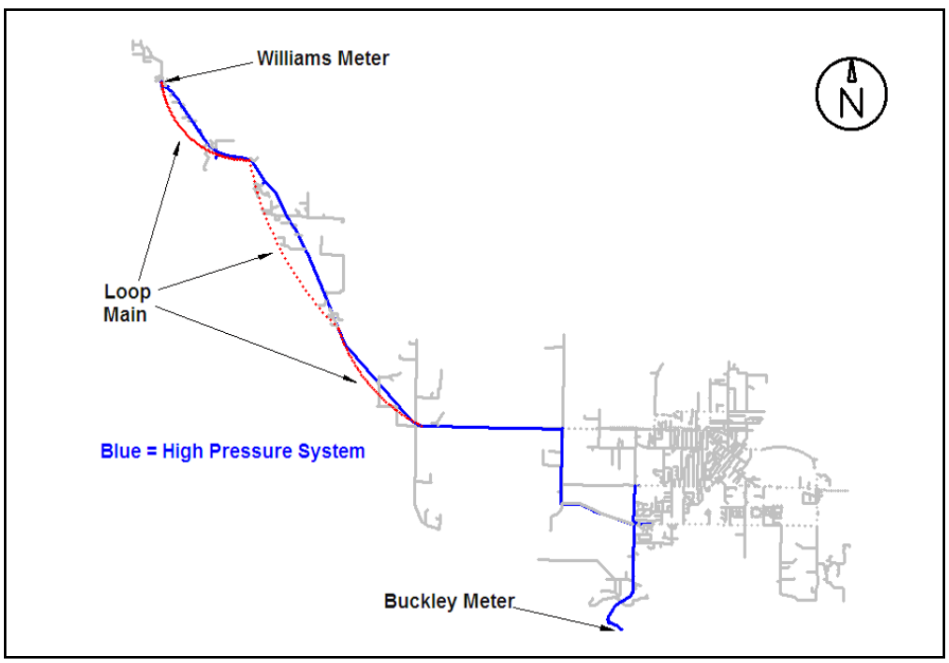
This model was developed to determine if it would be practical to increase the capacity of the HP system by installing additional main parallel to the existing main, this is commonly referred to as looping. This alternative does not include an uprate, and would maintain the existing 250psig MAOP, however the new pipeline could be tested to qualify for a higher MAOP.

The pressure requirements from Scenario 3.1 provided the most stringent operating conditions for the HP line, so this scenario was utilized as a basis for the pressure requirements. Scenario HP may be substituted in any scenario to replace the HP system uprate portion of the scenario. The looping started at the Williams Meter and continued along the Enumclaw-Auburn Highway until the downstream HP operating pressures were acceptable. About 6 miles of loop main was required to satisfy the pressure requirements. The loop main was assumed to be 6 -inch, 0.188 -inch wall thickness, X42 grade pipe. This is estimated at approximately $2.9 million.

The model results indicate that this configuration would work satisfactorily. No judgement was made as to whether this solution would be practical or not. However, it was decided that for the purposes of the planning study, only uprating of the HP system would be considered for the various scenarios.

The configuration is shown in Figure HP.

Figure HP



Appendix C – Enumclaw Investment Plan

The following table of expenditures is provided as a budgetary planning tool fulfilling the projects discussed within this report. The plan is detailed for the upcoming 5 budgetary years, and has 5-year windows for the future expenditures through the entire 20 year planning window.

5-year Capital Improvement Plan (based upon Scenario 6.2)

All amounts are in 2015 constant dollars. Shown in $1,000's of dollars.

Project Description	2016		2017		2018		2019		2020	
	Capital	Expense	Capital	Expense	Capital	Expense	Capital	Expense	Capital	Expense
A. Replace Service at Thunder Mnt. MS			**15**							
B. Investigate Buckley Meter Station				**1.5**						
C. Replace UG piping at City Gate Station to above ground					**30**					
D. Develop IP Upgrade Plan*						25*				
E. Perform IP Uprate										**243**
F. IP System Leak Repair									**7.5**◊	**7.5**◊
Growth and Replacement installation (Estimated)	**75**		**75**		**75**		**175**		**75**	
Steel Service Replacement (optional)	**637.2**		**637.2**		**637.2**		**637.2**		**637.2**	

* Estimated as being performed with city personnel. If contracted, revise estimated amount.

◊ Total leak repairs estimated at $15k. Half of leak repair assumed to be expense work, and half capital repair.

Long-Range Capital Improvement Estimates (based upon Scenario 6.2)

All financial amounts are in 2015 constant dollars. Shown in $1,000's of dollars

Project Description	2021-2025		2026 - 2030		2031 - 2035	
	Capital	Expense	Capital	Expense	Capital	Expense
Install Regulator at Enumclaw-Auburn Rd and 228th Ave SE	**75**					
Rebuild Roosevelt Regulator Station	**75**					
Rebuild Warner Regulator station	**75**					
Uprate HP supply line						
1. Research and complete MAOP documentation		**95**				
2. Tensile Testing (if/as needed)▽				**1,030**▽		
3. Develop Uprate Plan						**25**
4. Perform Uprate and Leak Repair					**100**⌂	**34**
Estimated Growth and Steel Main Replacement (Estimated)	**659.5**		**659.5**		**659.5**	

▽ Assumes 206 locations will need to have pipe sections removed (entire pipeline.) Estimated at $5k per location. This also assumes the original construction of the HP pipeline was with 40 foot lengths of pipe. If the pipeline was constructed with 20 foot lengths of pipe, this cost will at least double to $2.06 Million. While shown in chart, has not been included in alternative cost (Appendix A, Appendix B) due to uncertainty of need.

⌂ Assumes all leak repairs will be capital on the HP pipeline system.

Appendix D – Customers Added to Planning Model

Residential Customers

PIN	RESIDENCE ADDRESS	DU BASE	DU 2035	DU DELTA	UNIT LOAD, CFH	2035 LOAD, MCFH
1420069024	25902 SE 432ND ST	1.00	5.433	4.433	80.00	0.355
1420069026		0.00	6.209	6.209	80.00	0.497
2320069108	2462 MCHUGH AVE	1.00	3.045	2.045	80.00	0.164
2320069112	2811 MCHUGH AVE	0.00	1.304	1.304	80.00	0.104
1420069015		0.00	11.578	11.578	80.00	0.926
1420069019	42812 257TH PL SE	1.00	2.462	1.462	80.00	0.117
1420069040		0.00	1.415	1.415	80.00	0.113
1420069043	42725 260TH AVE SE	1.00	2.163	1.163	80.00	0.093
1420069044		0.00	1.454	1.454	80.00	0.116
1420069109	42715 260TH AVE SE	1.00	2.486	1.486	80.00	0.119
1420069135		0.00	4.842	4.842	80.00	0.387
1420069136	2435 MCHUGH AVE	1.00	24.060	23.060	80.00	1.845
2030100160		0.00	2.814	2.814	80.00	0.225
2030100170		0.00	2.807	2.807	80.00	0.225
2030100180		0.00	2.886	2.886	80.00	0.231
2030100451		0.00	20.360	20.360	80.00	1.629
2220069006	24216 SE 440TH ST	1.00	4.133	3.133	80.00	0.251
2220069007	23934 SE 440TH ST	1.00	4.880	3.880	80.00	0.310
2220069012	23229 SE 440TH ST	1.00	11.997	10.997	80.00	0.880
2220069016		0.00	36.833	36.833	80.00	2.947
2220069017	23711 SE 440TH ST	1.00	22.518	21.518	80.00	1.721
2220069021	43815 236TH AVE SE	1.00	3.657	2.657	80.00	0.213
2220069038	24018 SE 440TH ST	1.00	2.312	1.312	80.00	0.105
2220069052		0.00	1.204	1.204	80.00	0.096
2220069059	23527 SE 440TH ST	1.00	12.029	11.029	80.00	0.882
2220069062	23327 SE 440TH ST	1.00	12.315	11.315	80.00	0.905
2220069065	43906 228TH AVE SE	1.00	6.208	5.208	80.00	0.417
2220069086	43405 236TH AVE SE	1.00	6.429	5.429	80.00	0.434
2220069088		0.00	1.006	1.006	80.00	0.080
2220069114	23630 SE 440TH ST	1.00	11.037	10.037	80.00	0.803
2220069121	44326 239TH AVE SE	1.00	6.262	5.262	80.00	0.421
2220069123		0.00	10.770	10.770	80.00	0.862
2220069127	23322 SE 440TH ST	1.00	8.260	7.260	80.00	0.581
2220069129	22919 SE 438TH ST	1.00	9.005	8.005	80.00	0.640
2220069133		0.00	3.953	3.953	80.00	0.316
2220069150	43825 236TH AVE SE	1.00	2.562	1.562	80.00	0.125
2220069156	44205 234TH PL SE	1.00	6.116	5.116	80.00	0.409
2220069159		0.00	3.013	3.013	80.00	0.241
2220069173	44027 239TH AVE SE	1.00	4.432	3.432	80.00	0.275
2220069186	44110 239TH AVE SE	1.00	7.568	6.568	80.00	0.525
2220069188	44215 239TH AVE SE	1.00	3.031	2.031	80.00	0.162

PIN	RESIDENCE ADDRESS	DU BASE	DU 2035	DU DELTA	UNIT LOAD, CFH	2035 LOAD, MCFH
2220069209		1.00	2.340	1.340	80.00	0.107
2220069214	24117 SE 440TH ST	1.00	3.039	2.039	80.00	0.163
2309700190		0.00	1.000	1.000	80.00	0.080
2309700320		0.00	1.000	1.000	80.00	0.080
2309700380	419 BRUHN LN N	0.00	1.000	1.000	80.00	0.080
2309700390	407 BRUHN LN N	0.00	1.000	1.000	80.00	0.080
2309700400	385 BRUHN LN N	0.00	1.000	1.000	80.00	0.080
2309700420	351 BRUHN LN N	0.00	1.000	1.000	80.00	0.080
2320069011	2951 MCHUGH AVE	1.00	2.546	1.546	80.00	0.124
2320069014	43610 244TH AVE SE	1.00	5.473	4.473	80.00	0.358
2320069020	24729 SE 440TH ST	0.00	61.000	61.000	80.00	4.880
2320069078	24628 SE 436TH ST	1.00	2.527	1.527	80.00	0.122
2320069091	2512 MCHUGH AVE	0.00	3.264	3.264	80.00	0.261
2320069181	1641 FARRELLY ST	0.00	23.565	23.565	80.00	1.885
2320069225		0.00	5.655	5.655	80.00	0.452
2320069245	24439 SE 437TH PL	1.00	2.565	1.565	80.00	0.125
2320069268	3041 GOSSARD PL	0.00	1.272	1.272	80.00	0.102
2320069298	43429 248TH AVE SE	1.00	10.958	9.958	80.00	0.797
2320069327		0.00	7.253	7.253	80.00	0.580
2320069330		0.00	4.612	4.612	80.00	0.369
2420069028	2352 COLE ST	0.00	23.878	23.878	80.00	1.910
2420069562		0.00	15.392	15.392	80.00	1.231
2520069004		0.00	13.371	13.371	80.00	1.070
2520069007	209 WARNER AVE	1.00	4.778	3.778	80.00	0.302
2520069084	1153 WARNER AVE	0.00	2.517	2.517	80.00	0.201
2520069106	703 WARNER AVE	1.00	3.467	2.467	80.00	0.197
2520069119		0.00	6.990	6.990	80.00	0.559
2520069137		0.00	10.418	10.418	80.00	0.833
2520069144		0.00	1.113	1.113	80.00	0.089
3966900125		0.00	1.878	1.878	80.00	0.150
3966900140	1951 COLE ST	0.00	2.492	2.492	80.00	0.199
8141300050	428 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
8141300060	436 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
8141300080	462 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
8141300090	470 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
8141300100	478 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
8141300150	475 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
8141300180	429 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
8141300220	361 BONDGARD AVE E	0.00	1.000	1.000	80.00	0.080
1320069012	42415 268TH AVE SE	1.00	7.482	6.482	80.00	0.519
1320069018		0.00	3.119	3.119	80.00	0.250
1320069019	42828 264TH AVE SE	1.00	2.921	1.921	80.00	0.154
1320069022	42424 268TH AVE SE	0.00	4.865	4.865	80.00	0.389
1320069024	42832 268TH AVE SE	1.00	3.449	2.449	80.00	0.196
1320069032	42514 264TH AVE SE	1.00	2.946	1.946	80.00	0.156
1320069033	26020 SE 432ND ST	1.00	6.136	5.136	80.00	0.411

PIN	RESIDENCE ADDRESS	DU BASE	DU 2035	DU DELTA	UNIT LOAD, CFH	2035 LOAD, MCFH
1320069034		0.00	4.451	4.451	80.00	0.356
1320069036	3530 PORTER ST	1.00	3.074	2.074	80.00	0.166
1320069039	42501 268TH AVE SE	1.00	5.871	4.871	80.00	0.390
1320069040	42602 268TH AVE SE	1.00	2.930	1.930	80.00	0.154
1320069041	42420 264TH AVE SE	1.00	2.947	1.947	80.00	0.156
1320069045	3636 PORTER ST	1.00	2.902	1.902	80.00	0.152
1320069056	3780 PORTER ST	1.00	7.199	6.199	80.00	0.496
1320069059		0.00	3.099	3.099	80.00	0.248
1320069061	42926 268TH AVE SE	1.00	3.067	2.067	80.00	0.165
1320069063	42316 264TH AVE SE	1.00	6.047	5.047	80.00	0.404
1320069071	27128 SE 432ND ST	1.00	7.162	6.162	80.00	0.493
1320069073	3650 PORTER ST	1.00	5.867	4.867	80.00	0.389
1320069078	42520 264TH AVE SE	1.00	2.915	1.915	80.00	0.153
1320069080	42410 264TH AVE SE	1.00	4.440	3.440	80.00	0.275
1320069096	27010 SE 424TH ST	1.00	12.335	11.335	80.00	0.907
1320069099		0.00	2.078	2.078	80.00	0.166
1320069102		0.00	2.071	2.071	80.00	0.166
1320069110		0.00	4.767	4.767	80.00	0.381
1320069112		0.00	3.205	3.205	80.00	0.256
1320069118	26444 SE 427TH ST	1.00	2.483	1.483	80.00	0.119
1320069123		0.00	4.005	4.005	80.00	0.320
1320069125		0.00	4.763	4.763	80.00	0.381
1320069127		0.00	3.111	3.111	80.00	0.249
1320069148	1301 MCHUGH AVE	1.00	5.854	4.854	80.00	0.388
1320069168		1.00	5.036	4.036	80.00	0.323
1320069186		0.00	2.214	2.214	80.00	0.177
1320069191	42707 268TH AVE SE	1.00	2.752	1.752	80.00	0.140
1320069192	42801 268TH AVE SE	1.00	2.401	1.401	80.00	0.112
1320069195	42727 268TH AVE SE	1.00	2.674	1.674	80.00	0.134
1320069197		0.00	4.764	4.764	80.00	0.381
1320069198	3424 MCHUGH PL	1.00	3.824	2.824	80.00	0.226
1320069223	3615 DIVISION ST	1.00	2.984	1.984	80.00	0.159
1320069226	3420 COLE ST	0.00	2.382	2.382	80.00	0.191
1320069240	42618 268TH AVE SE	1.00	3.717	2.717	80.00	0.217
1320069242		0.00	2.604	2.604	80.00	0.208
1320069275	42806 268TH AVE SE	0.00	2.345	2.345	80.00	0.188
2420069433	SE 432ND ST	0.00	3.878	3.878	80.00	0.310
2420069003	26929 SE 432ND ST	1.00	2.297	1.297	80.00	0.104
2420069569		0.00	1.061	1.061	80.00	0.085
0193000010		0.00	1.002	1.002	80.00	0.080
2220069015	23206 SE 448TH ST	1.00	2.993	1.993	80.00	0.159
2220069018	23912 SE 448TH ST	1.00	11.642	10.642	80.00	0.851
2220069019	44709 244TH AVE SE	1.00	15.458	14.458	80.00	1.157
2220069028		0.00	11.401	11.401	80.00	0.912
2220069029	23420 SE 448TH ST	1.00	4.190	3.190	80.00	0.255
2220069090	44521 244TH AVE SE	1.00	4.991	3.991	80.00	0.319

PIN	RESIDENCE ADDRESS	DU BASE	DU 2035	DU DELTA	UNIT LOAD, CFH	2035 LOAD, MCFH
2220069149	44405 240TH PL SE	1.00	18.753	17.753	80.00	1.420
2220069206	23316 SE 448TH ST	1.00	2.793	1.793	80.00	0.143
2220069212		0.00	15.518	15.518	80.00	1.241
2220069218		0.00	3.960	3.960	80.00	0.317
2320069022	44520 244TH AVE SE	0.00	8.005	8.005	80.00	0.640
2320069039	24622 SE 448TH ST	0.00	13.249	13.249	80.00	1.060
2320069048	24828 SE 448TH ST	1.00	4.863	3.863	80.00	0.309
2320069072	44408 244TH AVE SE	1.00	4.952	3.952	80.00	0.316
2320069162		0.00	9.761	9.761	80.00	0.781
2620069006	657 SEMANSKI ST	0.00	18.000	18.000	80.00	1.440
2620069007	445 SEMANSKI ST	0.00	48.000	48.000	80.00	3.840
2620069041		0.00	28.108	28.108	80.00	2.249
2620069053	24805 SE 448TH ST	1.00	2.427	1.427	80.00	0.114
2620069080	2732 ROOSEVELT AVE	1.00	2.611	1.611	80.00	0.129
2620069082		0.00	8.160	8.160	80.00	0.653
2620069083	801 SEMANSKI ST	0.00	19.000	19.000	80.00	1.520
2620069086	45730 244TH AVE SE	1.00	3.358	2.358	80.00	0.189
2620069089	24921 SE 448TH ST	1.00	4.911	3.911	80.00	0.313
2620069100	24823 SE 448TH ST	1.00	2.411	1.411	80.00	0.113
2620069117	2501 WARNER AVE	0.00	33.991	33.991	80.00	2.719
2620069134		0.00	1.624	1.624	80.00	0.130
2620069176		0.00	12.000	12.000	80.00	0.960
2620069177		0.00	9.011	9.011	80.00	0.721
2620069178		0.00	26.000	26.000	80.00	2.080
2720069001	45015 244TH AVE SE	1.00	4.753	3.753	80.00	0.300
2720069002	23715 SE 448TH ST	1.00	5.859	4.859	80.00	0.389
2720069003	23627 SE 448TH ST	1.00	5.891	4.891	80.00	0.391
2720069004	23722 SE 456TH WAY	1.00	6.996	5.996	80.00	0.480
2720069005	45317 244TH AVE SE	1.00	2.309	1.309	80.00	0.105
2720069006	23415 SE 448TH ST	0.00	3.860	3.860	80.00	0.309
2720069024	24006 SE 456TH WAY	1.00	8.799	7.799	80.00	0.624
2720069027	23815 SE 448TH ST	1.00	2.298	1.298	80.00	0.104
2720069028	45203 244TH AVE SE	1.00	2.873	1.873	80.00	0.150
2720069029		0.00	2.010	2.010	80.00	0.161
2720069030	23911 SE 448TH ST	1.00	2.875	1.875	80.00	0.150
2720069032	45527 244TH AVE SE	1.00	3.656	2.656	80.00	0.212
2720069033	45407 244TH AVE SE	1.00	2.307	1.307	80.00	0.105
2720069035		0.00	1.950	1.950	80.00	0.156
2720069036	23525 SE 448TH ST	1.00	3.014	2.014	80.00	0.161
2720069037	44807 244TH AVE SE	1.00	30.685	29.685	80.00	2.375
2720069060	23509 SE 448TH ST	1.00	2.917	1.917	80.00	0.153
2720069073		0.00	9.661	9.661	80.00	0.773
3520069009	46623 ENUMCLAW-BUCKLEY RD SE	1.00	9.860	8.860	80.00	0.709
1920079020	1707 ROOSEVELT AVE E	0.00	51.282	51.282	80.00	4.103
1920079024	1803 ROOSEVELT AVE E	0.00	24.321	24.321	80.00	1.946

PIN	RESIDENCE ADDRESS	DU BASE	DU 2035	DU DELTA	UNIT LOAD, CFH	2035 LOAD, MCFH
1920079047		0.00	16.142	16.142	80.00	1.291
1920079051		0.00	12.079	12.079	80.00	0.966
1920079079		0.00	103.428	103.428	80.00	8.274
1920079118	2155 FARMAN ST N	0.00	9.464	9.464	80.00	0.757
1920079119		0.00	36.664	36.664	80.00	2.933
1920079120		0.00	37.256	37.256	80.00	2.980
1920079121		0.00	5.370	5.370	80.00	0.430
1920079136	2005 FARMAN ST N	0.00	31.250	31.250	80.00	2.500
1920079152	1525 ROOSEVELT AVE E	0.00	14.285	14.285	80.00	1.143
2309700430		0.00	12.000	12.000	80.00	0.960
2520069002		0.00	15.501	15.501	80.00	1.240
3020079001		0.00	1.936	1.936	80.00	0.155
3020079012		0.00	400.000	400.000	80.00	32.000
3020079028	45425 284TH AVE SE	1.00	10.799	9.799	80.00	0.784
3020079035	45309 284TH AVE SE	1.00	5.549	4.549	80.00	0.364
3020079053		0.00	2.013	2.013	80.00	0.161
3020079067	45201 284TH AVE SE	1.00	4.456	3.456	80.00	0.276
8141310230		0.00	24.000	24.000	80.00	1.920
8141310240		0.00	24.000	24.000	80.00	1.920
2420069062	1158 INITIAL AVE	0.00	5.000	5.000	80.00	0.400
2420069063		0.00	5.000	5.000	80.00	0.400
2420069064	1421 COLE ST	0.00	5.000	5.000	80.00	0.400
2420069305		0.00	5.000	5.000	80.00	0.400
2420069326		0.00	5.000	5.000	80.00	0.400
2620069176		0.00	12.000	12.000	80.00	0.960

Commercial Customers

Additional customers planned for 2035 gas service.

PIN	COMMERCIAL ADDRESS	2035 SF	2035 1000SF	UNIT LOAD, CFH/1000SF	2035 LOAD, MCFH
2030100020	810 BLAKE ST	1658.613	1.659	50	0.0829307
2030100030		2321.900	2.322	50	0.116095
2030100055		2115.136	2.115	50	0.1057568
2030100110		6467.531	6.468	50	0.3233766
2030100120		3008.143	3.008	50	0.1504072
2030100130		2988.818	2.989	50	0.1494409
2220069003	23818 SE 440TH ST	73926.105	73.926	50	3.6963053
2220069022	43728 228TH AVE SE	3751.609	3.752	50	0.1875805
2220069026	43731 236TH AVE SE	10243.783	10.244	50	0.5121892
2220069040	23013 SE 436TH ST	1466.237	1.466	50	0.0733119
2220069044	23003 SE 436TH ST	1044.139	1.044	50	0.052207
2220069045	23127 SE 436TH ST	2499.997	2.500	50	0.1249999
2220069046	23109 SE 436TH ST	2474.108	2.474	50	0.1237054
2220069051	22929 SE 436TH ST	1554.439	1.554	50	0.077722
2220069053	24328 SE 440TH ST	9147.025	9.147	50	0.4573513
2220069071	23112 SE 436TH ST	2948.385	2.948	50	0.1474193
2220069073	22920 SE 436TH ST	2651.152	2.651	50	0.1325576
2220069079	23004 SE 436TH ST	4439.873	4.440	50	0.2219937
2220069080	22824 SE 436TH ST	1782.745	1.783	50	0.0891373
2220069087	23023 SE 436TH ST	1963.841	1.964	50	0.0981921
2220069101	22908 SE 436TH ST	2055.929	2.056	50	0.1027965
2220069102	43406 228TH AVE SE	1160.062	1.160	50	0.0580031
2220069107	22930 SE 436TH ST	283.975	0.284	50	0.0141988
2220069109		1286.481	1.286	50	0.0643241
2220069110	43422 228TH AVE SE	689.779	0.690	50	0.034489
2220069122		2128.783	2.129	50	0.1064392
2220069142		900.383	0.900	50	0.0450192
2220069148	23300 SE 436TH ST	3758.008	3.758	50	0.1879004
2220069171		4381.550	4.382	50	0.2190775
2220069193		26672.863	26.673	50	1.3336432
2220069208		1834.345	1.834	50	0.0917173
2320069041		52608.171	52.608	50	2.6304086
2320069156	24515 SE 440TH ST	20540.553	20.541	50	1.0270277
2320069177	24530 SE 436TH WAY	14958.403	14.958	50	0.7479202
2320069186		8317.451	8.317	50	0.4158726
2320069188	24711 SE 440TH ST	28866.028	28.866	50	1.4433014
2320069189	43824 244TH AVE SE	22079.779	22.080	50	1.103989
2320069213	24631 SE 440TH ST	14518.722	14.519	50	0.7259361
2320069229	2917 GRIFFIN AVE	11834.551	11.835	50	0.5917276
2320069276		21602.772	21.603	50	1.0801386
2320069315		19236.566	19.237	50	0.9618283

PIN	COMMERCIAL ADDRESS	2035 SF	2035 1000SF	UNIT LOAD, CFH/1000SF	2035 LOAD, MCFH
2361800325		8013.530	8.014	50	0.4006765
2420069101	294 RAINIER AVE	4068.018	4.068	50	0.2034009
2420069123		6829.777	6.830	50	0.3414889
2420069137		894.746	0.895	50	0.0447373
2420069294	1049 COLE ST	2038.477	2.038	50	0.1019239
2420069296	1115 COLE ST	2020.464	2.020	50	0.1010232
2420069315		1411.272	1.411	50	0.0705636
2420069352	901 STEVENSON AVE	5092.977	5.093	50	0.2546489
2420069391		3061.794	3.062	50	0.1530897
2420069394		2871.867	2.872	50	0.1435934
2420069524		1232.980	1.233	50	0.061649
2420069545		2249.425	2.249	50	0.1124713
2420069571		4027.422	4.027	50	0.2013711
2420069596		3170.613	3.171	50	0.1585307
2520069104	907 COLE ST	1523.101	1.523	50	0.0761551
2520069135		5854.456	5.854	50	0.2927228
2520069136		8359.308	8.359	50	0.4179654
3966900005		3246.433	3.246	50	0.1623217
7127300140		682.722	0.683	50	0.0341361
7127300190		2806.900	2.807	50	0.140345
8006100008	501 ROOSEVELT AVE	1276.852	1.277	50	0.0638426
8006100030		2967.352	2.967	50	0.1483676
8006100185		2648.021	2.648	50	0.1324011
8006100195		449.327	0.449	50	0.0224664
8006100196	1460 GARRETT ST	2461.074	2.461	50	0.1230537
2420069007		32874.231	32.874	50	1.6437116
2420069603	COLE ST	3089.330	3.089	50	0.1544665
2320069042	24506 SE 448TH ST	23308.000	23.308	50	1.1654
	ROOSEVELT AVE E	9281.141	0.000	50	0
0012500035	915 FARMAN ST N	3903.023	3.903	50	0.1951512
1920079013		66000.225	66.000	50	3.3000113
1920079019	1499 FARMAN ST N	15808.474	15.808	50	0.7904237
1920079070	1439 ROOSEVELT AVE E	19108.971	19.109	50	0.9554486
1920079083		67518.000	67.518	50	3.3759
1920079086		4181.890	4.182	50	0.2090945
1920079089		53020.633	53.021	50	2.6510317
1920079090		50323.058	50.323	50	2.5161529
1920079098	1145 ROOSEVELT AVE E	20169.716	20.170	50	1.0084858
1920079123		29633.066	29.633	50	1.4816533
1920079126		36171.633	36.172	50	1.8085817
1920079133		31162.545	31.163	50	1.5581273
1920079144		31507.641	31.508	50	1.5753821
1920079145		31810.110	31.810	50	1.5905055
1920079146		31200.149	31.200	50	1.5600075
2361000020		20105.421	20.105	50	1.0052711

PIN	COMMERCIAL ADDRESS	2035 SF	2035 1000SF	UNIT LOAD, CFH/1000SF	2035 LOAD, MCFH
2361000030		15646.328	15.646	50	0.7823164
2361000050	1804 GARRETT ST	31739.788	31.740	50	1.5869894
2361000090	2001 GARRETT ST	28532.758	28.533	50	1.4266379
2361000110	2099 GARRETT ST	15183.219	15.183	50	0.759161
2361000150		15438.317	15.438	50	0.7719159
2361000160	300 WASHINGTON AVE	15374.331	15.374	50	0.7687166
2361000180		1512.160	1.512	50	0.075608
2361000190	2109 GARRETT ST	2879.785	2.880	50	0.1439893
2420069398	313 RAINIER AVE	9728.470	9.728	50	0.4864235
2420069414	355 RAINIER AVE	16285.809	16.286	50	0.8142905
2420069450		2997.215	2.997	50	0.1498608
2420069593	115 BATTERSBY AVE	128666.038	128.666	50	6.4333019
2520069001		5223.541	5.224	50	0.2611771
2520069107	230 ROOSEVELT AVE E	3739.272	3.739	50	0.1869636
2520069116	202 ROOSEVELT AVE E	24434.131	24.434	50	1.2217066
3020079011	27925 SE 448TH ST	100000.000	100.000	50	5
3020079111		50000.000	50.000	50	2.5
2420069062	1158 INITIAL AVE	10052.338	10.052	50	0.5026169
2420069063		10088.954	10.089	50	0.5044477
2420069064	1421 COLE ST	4983.735	4.984	50	0.2491868
2420069305		10186.941	10.187	50	0.5093471
2420069326		3357.920	3.358	50	0.167896
3020079011	27925 SE 448TH ST	100000.000	100.000	50	5
2620069176		15000.000	15.000	50	0.75