



March 4, 2025

City of Rochester Hills
511 E. Auburn Road
Rochester Hills, Michigan 48307

Attn: Tracey Balint, P.E., City Engineer

Re: PRV 6, 7 & 8 Improvements
Proposal for Professional Engineering Services

HRC Job No. 20240986

Dear Ms. Balint:

In accordance with your request, we are pleased to present you with a proposal and estimated budget to provide preliminary engineering and design development services for the above referenced project. We have developed a comprehensive understanding and gained valuable insights on the scope of work through prior discussions with your Department of Public Services (DPS) staff, completion of the 2019 Water System Reliability Study and from previous water system improvement projects with the City.

BACKGROUND

The City of Rochester Hills would like to relocate existing PRV 6 & PRV 7 and upgrade existing PRV 8 in accordance with the "Brookwoods and Tienken Manor Subdivision Improvement Analysis" memo (subsequently referred to as "PD #9 Redistricting Memo"), which is attached for your reference. Generally, the project will move areas of the City currently in Pressure District (PD) #6 (which has a lower average Hydraulic Grade Line (HGL)) to PD #9 (which has a higher HGL) by relocating PRV 6 and PRV 7, upgrading internal valves at PRV 8 and making other ancillary system improvements and adjustments (i.e. closing normally open valves, adding valves and adding a PRV along Allston Dr).

It is our understanding that the City of Rochester Hills will be designing a project along Tienken Rd. between Medinah Drive and Laurel Avenue and within that project will be designing the upgrade to PRV #8 and adding the PRV to Allston Dr., so only the preliminary engineering phase of that project will be included in HRC's scope.

PRELIMINARY ENGINEERING (STUDY PHASE)

HRC will review the hydraulic model analysis previously conducted and update the model based on recent water system improvements. HRC will evaluate the current sizing and configuration of PRVs 6, 7 & 8 and recommend any improvements to these existing conditions. HRC will perform a preliminary subsurface utility identification of potential locations for PRVs 6 & 7, recommend locations for the new PRV facilities and assist the City with siting these underground vaults.

HRC will summarize these recommended improvements to PRVs 6, 7 & 8 based on the City's goals and objectives for these sites and develop a Basis of Design Report to help scope the proposed projects for design development. HRC will also review with the City, the different types of underground valve vaults available, their pros and cons, costs and the available sites in which they could be built.

HRC proposes two (2) meetings during the Preliminary engineering phase; 1) a kickoff meeting to discuss the background of the sites and revisit historical operations, review the City's expectations for the projects and visit the proposed PRV site locations and 2) a Basis of Design review meeting, to assess the draft Basis of Design report prior to beginning design development.

DESIGN DEVELOPMENT SERVICES

HRC will need to obtain a topographic survey of the proposed PRV facility locations and areas of proposed water main work to find property corners and determine right-of-way constraints, existing utilities and where best the new PRV facilities would fit within the existing features of the areas. Additionally, supplementary property and boundary research will need to be done to define the limits of the right-of-way in these areas and determine if any property or easement acquisition is necessary as part of the project. HRC will also need to review Rochester Hills water system valve configurations to determine the impact of any system shutdown necessary to perform the proposed work and communicate and coordinate these impacts with affected stakeholders.

HRC proposes two (2) meetings as the design progresses. A kickoff meeting to discuss project goals and delivery timelines will be held to program the design process and develop initial design concepts. An Owner review meeting would be facilitated at approximately the 75% design stages to allow opportunity for City staff input into design details such as facility siting, equipment configuration, performance specifications, and sequence of construction. Meeting agendas, notes, attendance sheets, and other project communications would be provided by HRC.

HRC will request utility data from the companies, including municipal utilities, in the project areas and add the line work in plan and profile to the plans. HRC will include depth information provided by the respective utility companies and will schedule and attend meetings to coordinate existing information and potential conflicts. HRC assumes that municipal facilities will not require relocation and has not included the design and permitting of these facilities in this scope of work.

HRC will provide all services required to deliver a complete biddable set of construction contract documents for the improvements based on our understanding of the project and the scope of work developed in the preliminary engineering phase and discussed during the project kickoff meeting and subsequent review meeting. This effort will include any necessary field work, equipment review, preparation of permit applications, and identified draft submittals. HRC will provide assistance during the bidding process including but not limited to; developing addendum materials for City Procurement Dept. distribution, answering vendor questions and assisting the City with a pre-bid meeting if it is required.

It is recommended that any long lead time items, such as PRVs or special structures, be pre-purchased ahead of bidding so that they will be available for incorporation into the work in accordance with the desired construction schedule. It is assumed that pre-purchasing of materials or equipment from a local vendor will be coordinated through the City. However, HRC will work with the City to determine the appropriate materials and sizes of the equipment and fittings for the new PRV and associated work and review all shop drawings and purchase orders to confirm compliance with City specifications.

It is our understanding that the City will utilize their existing engineering services agreement with a geotechnical sub-contractor to evaluate the subsurface conditions of the project area and requests that HRC coordinate with this sub-contractor for the geotechnical work required. It is also assumed that the City will handle any necessary mechanical, electrical, and/or plumbing permits internally; however, it will be noted in the Contract Documents that the Contractor will need to pull any that are necessary.

ADDITIONAL SERVICES

HRC has excluded easements and/or right-of-way acquisition services from our proposal. At this time, it is unknown if additional easements or right-of-way will be required to construct the PRV facilities. Should additional property be required, HRC can provide a separate proposal for services upon request.

This proposed fee does not include construction engineering services. HRC would welcome the opportunity to provide these services which we feel are vital to the successful construction of the proposed project. We would appreciate the opportunity to discuss these services as the project gets closer to the letting date and can issue a subsequent proposal for these services under separate cover.

ANTICIPATED PROJECT SCHEDULE

Based on the City's proposed Capital Improvement Plan, the construction of the new PRV facilities is currently programmed for Spring 2028 construction. Working back from a mid-November 2027 bid date, HRC estimates that the design work and all permitting can be completed in the 2027 calendar year with a Design Development start date in mid-January 2027. Design of this project can be completed within 3 to 4 months from this projected start date. We are anticipating EGLE permitting to take 4 to 5 months to acquire due to the complexity of the operational changes this project will produce.

From the above design and construction schedule, preliminary engineering would need to be completed prior to the January 2027 design development start date. Preliminary engineering can be completed with 8 to 12 weeks and is proposed to start in mid-July to meet the design development timeline and work within gaps in the schedules of the other planned PRV improvement projects. In addition, the preliminary engineering for PRV #8 should be completed prior to the City's design schedule for the "Tienken Road between Medinah Drive and Laurel Avenue" project. Preliminary engineering for PRV's 6, 7 & 8 in the summer/Fall of 2026 would provide the time necessary to incorporate the results into the design work for that project. As such, the following schedule has been developed to help layout our milestones;

Study Phase Kickoff Meeting	July 14, 2026
PRV Location Siting Survey	July 14, 2026
Draft Basis of Design to City	August 27, 2026
Basis of Design Meeting	September 15, 2026
Finalize BOD, Begin Design Development	October 30, 2026
Topographic Survey	November 2, 2026 – November 6, 2026
Design Development Phase Kickoff Meeting	January 12, 2027
75% Plans to City	March 25, 2027
75% Owners Review Meeting	April 7, 2027
Submit for Permits (Part 399, Electrical, etc.)	April 22, 2027
Anticipated Part 399 Permit Approval	September 14, 2027
Final Contract Documents	September 30, 2027
Project Procurement	October 12, 2027 – November 16, 2027
Project Award	December 13, 2027
Project Construction	February 2028 – May 2028

OPINION OF PROBABLE CONSTRUCTION COSTS

The budgetary range of construction cost that includes two (2) new underground PRV facilities, four (4) new PRVs, ancillary isolation valves and piping, electrical service and water main improvements to connect the new facilities to the existing transmission main system is estimated at \$1,200,000 to \$1,400,000.

FEE SUMMARY

Our proposed Tasks and the estimated hours and fees to complete the work have been identified in Table 1 (attached). As shown, we have budgeted 1,012 hours for a proposed not-to-exceed fee of \$136,900 (9.8%-11.5%) for our Professional Engineering Services for this project (\$40,000 Study Phase, \$96,900 Design Development Phase). As noted previously, all work would be completed under the terms and conditions of our Agreement for Professional Engineering Services.

Daniel Mitchell, P.E., President will be the Principal In-Charge. We are proposing to utilize Bradley Shepler, P.E., as the Managing Engineer. Other key team members include Beth Clarke, PE, Senior Project Engineer, Michael Roskelley, P.E. Electrical Dept. Manager, Krista Schoonveld, Structural Engineer and Ray Chartouni, Staff Engineer as specialists in water distribution system hydraulic modeling and PRV facility design and construction. All HRC staff members listed in this Proposal are familiar with this project and have extensive experience with the municipal water systems in the area. We believe you are familiar with all of these individuals but can provide detailed resumes upon request.

Once the City deems this proposal acceptable, we kindly request your signature on one copy to be promptly returned to our office, while retaining one copy for your records. We sincerely appreciate the opportunity to contribute our expertise to this vital water project and serve the City with utmost dedication.

If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.



Bradley W. Shepler, P.E., CCCA, LEED AP
Senior Associate

Attachment

pc: City of Rochester Hills; A. Hysinger, L. Luedeman, W. Rybak
HRC; D. Mitchell, B. Clarke, File

Accepted By:

Signature: _____

Written Name: _____

Title: _____

Dated: _____

**CITY OF ROCHESTER HILLS
PRVs 6, 7 & 8 IMPROVEMENTS**

**TABLE 1
ESTIMATED HOURS AND FEES**

March 4, 2025

HRC Job No. 20240986

Task Description	Rate Classification & Estimated Hours							Survey Crew (2 Person)	Total Hours
	Managing Engineer	Sr. Project Engineer	Structural Engineer	Electrical Engineer	Staff Engineer	Cadd Technician	Survey Office Supervisor		
Preliminary Engineering									
1 Review of Background Information/Scoping Confirmation	8	20	-	-	12	-	-	-	40
2 Kickoff Meeting	4	6	-	-	4	-	-	-	14
3 Hydraulic Modeling	8	32	-	-	16	-	-	-	56
4 Site Selection Selection Evaluation	12	8	12	8	8	-	-	-	48
5 Basis of Design Memorandum	8	24	-	-	16	-	-	-	48
6 Basis of Design Review Meeting	4	6	-	-	6	-	-	-	16
7 Final Study Phase Deliverables	4	16	-	-	24	-	-	-	44
Sub Total	48	112	12	8	86	0	0	0	266
Design Development									
1 Design Kickoff Meeting	4	4	-	-	4	-	-	-	12
2 Topographical Survey & Processing	-	-	-	-	4	8	16	32	60
3 Geotechnical Investigation Coordination	8	-	16	-	8	-	-	-	32
4 Schematic Design (75%)	16	8	16	16	48	98	-	-	202
5 Owner's Review Meeting	4	4	4	4	8	-	-	-	24
6 Design Development & Technical Specifications	16	8	20	12	48	80	-	-	184
7 Permitting	8	4	2	8	32	24	-	-	78
8 Final Design Phase Deliverables	12	8	8	8	40	50	-	-	126
9 Bidding & Procurement Assistance	8	-	2	2	8	8	-	-	28
Sub Total	76	36	68	50	200	268	16	32	746
PROJECT TOTALS	124	148	80	58	286	268	16	32	1,012

Notes:

1) Rates were developed considering 2026 and 2027 Calendar Year work.

ESTIMATED FEE SUMMARY

PERSONNEL	HOURS	RATE	TOTAL
Managing Engineer	124	\$ 196.00	\$ 24,300.00
Sr. Project Engineer	148	\$ 150.00	\$ 22,200.00
Structural Engineer	80	\$ 134.00	\$ 10,700.00
Electrical Engineer	58	\$ 141.50	\$ 8,200.00
Staff Engineer	286	\$ 131.00	\$ 37,500.00
Cadd Technician	268	\$ 90.00	\$ 24,100.00
Survey Office Supervisor	16	\$ 167.00	\$ 2,700.00
Survey Crew (2 Person)	32	\$ 225.00	\$ 7,200.00

TOTAL LUMP SUM NOT-TO-EXCEED \$ 136,900.00

Memorandum

To: Tracey Balint, P.E., Public Utilities Engineering Manager

From: Brad Shepler, HRC

Date: October 11, 2021

Subject: City of Rochester Hills Water Supply System
Brookwoods and Tienken Manor Subdivision Improvement Analysis &
PRV-8 Relocation/Improvement Assessment

HRC Job No. 20200462.02

Background

The City of Rochester Hills requested a review of the water system in Section 7 and Section 8 of the City including the Brookwoods Subdivision, PRV-8, Allston Drive and the Tienken Manor subdivision to assess several concerns and potential improvement options in the area including:

1. Lack of redundant supply to the Brookwood Subdivision
2. PRV-8 location and operational assessment
3. Water quality concerns due to the long dead-end water main on Allston Drive
4. Low pressures in the Tienken Manor Subdivision
5. Desire to add a booster pumping station to provide a redundant supply to Pressure Districts #7 and #8 from Pressure District #6
6. Investigate the use of an energy recovery unit to act as the primary pressure reduction device in conjunction with items 2 and 5 above

The areas within Section 7 and Section 8 of the City surrounding these issues encompass three specific pressure districts; Pressure District #6 (PD #6), Pressure District #7 (PD #7) and Pressure District #9 (PD #9). PD #6, shown in yellow in Figure 1 below, has the lowest hydraulic grade of these three noted districts with an average day hydraulic grade line between 979–992 feet and average day pressures between 35 and 105 psi. Tienken Manor Subdivision, the area with low pressure concerns, is located in PD #6 and has elevations between 858–900 feet and average day pressures of 35 to 53 psi. PD #7, shown in pink in Figure 1, has the highest hydraulic grade of these three districts with an average day hydraulic grade line between 1,122–1,123 feet and average day pressures between 55 to 107 psi. PD #9, shown in grey in Figure 1, has an average day hydraulic grade in between the other two districts in this study. The average day hydraulic grade line is between 1,049–1,057 feet and average day pressures are 43 to 110 psi. In general terms, the pressure districts have a pressure differential of about 30 psi between them (i.e., PD #9 is generally 30 psi higher than PD #6 and PD #7 is generally 30 psi higher than PD #9).

An additional area of concern, as suggested from previous discussions with the City, is the low pressures observed in the Spring Hill Subdivision (which is located in PD #6 as well). This area has been added to Figure 1, below, in orange. The Water Reliability Study update completed in 2020 confirmed the presence of lower-than-average pressures in this area and potential fire flow concerns due to the low available pressure drop. Due to the proximity of this study to the Spring Hill Subdivision, this area is included for reference and for consideration of potential improvements.

Delhi Township
2101 Aurelius Rd.
Suite 2A
Holt, MI 48842
517-694-7760

Detroit
535 Griswold St.
Buhl Building, Ste 1650
Detroit, MI 48226
313-965-3330

Grand Rapids
81925 Breton Road SE
Suite 100
Grand Rapids, MI 49506
616-454-4286

Howell
105 W. Grand River
Howell, MI 48843
517-552-9199

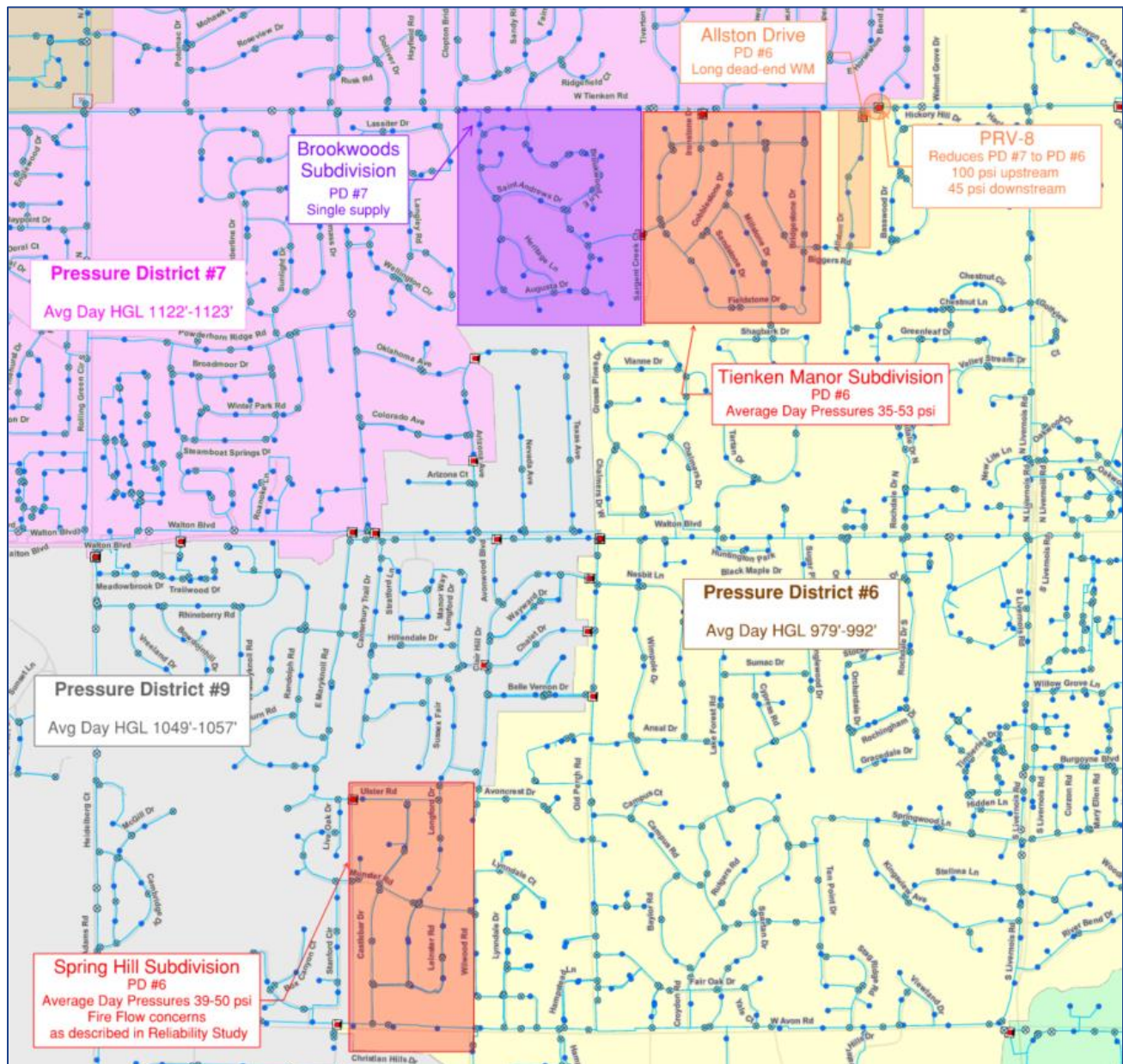
Jackson
401 S. Mechanic St.
Suite B
Jackson, MI 49201
517-292-1295

Kalamazoo
834 King Highway
Suite 107
Kalamazoo, MI 49001
269-665-2005

Lansing
215 S. Washington SQ
Suite D
Lansing, MI 48933
517-292-1488

Under all alternative scenarios, it is assumed that all existing 6-inch and 8-inch water main in the Tienken Manor subdivision are replaced with new 8-inch water main, at a minimum, as is planned for construction in 2021. In addition, the City would consider redistricting the pressure districts in the Tienken Manor area, if that addressed multiple City concerns and had minimal impact to residents unaffected by these noted areas of concerns.

Figure 1: Study Area Diagram



HRC utilized the updated hydraulic model developed for the 2020 Reliability Study to evaluate the identified concerns. Several alternative scenarios were developed and reviewed preliminarily with the City, yielding various approaches to address the City's concerns. Descriptions of the alternatives and recommendations are included as follows.

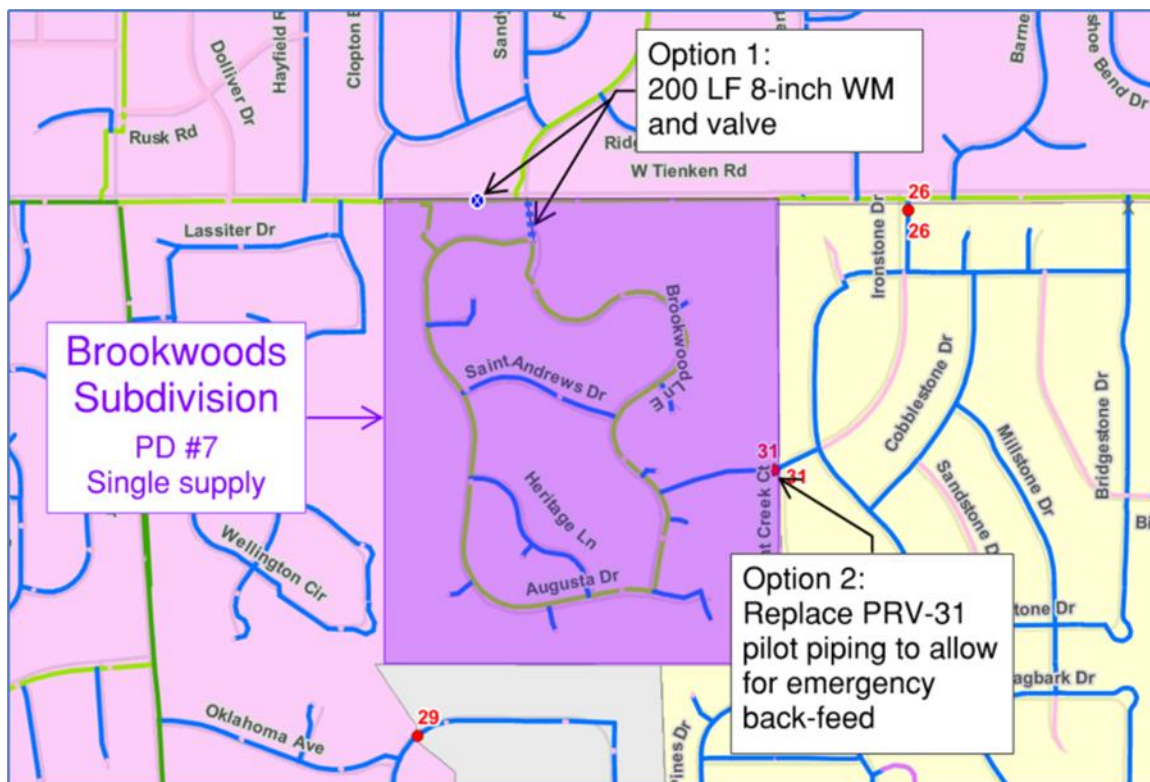
1. Brookwoods Subdivision (Redundant Connection)

The Brookwoods Subdivision resides in Pressure District #7 (PD #7) and typically receives pressures between 79 psi and 107 psi. The concern with the distribution system in this subdivision is that it is fed from a single 12-inch supply main connected to the 12-inch Tienken Road water main. Should this single supply main break or need to be shut down, or the Tienken Road water main in this area needs to be shut down, the entire Brookwoods Subdivision would be out of water.

To address this redundancy concern, we are proposing two (2) options shown in Figure 2 and described as follows:

- 1) Add a new connection to the Tienken Rd. water main and roughly 200 feet of 8-inch water main in Brookwood Ln.
 - a. Requires the addition of a valve on the existing Tienken Rd. water main to separate the two feeds.
- 2) Replace the pilot piping in PRV-31 to allow for back-feed during local low-pressure situations

Figure 2: Brookwoods Subdivision Redundant Connection Options



Option 1 would technically create a second supply to the Brookwoods Subdivision from the Tienken Road water main. However, it should be noted that the proposed additional connection is only approximately 500 feet from the existing connection to the subdivision and is supplied by the same 12-inch water main along Tienken Rd.

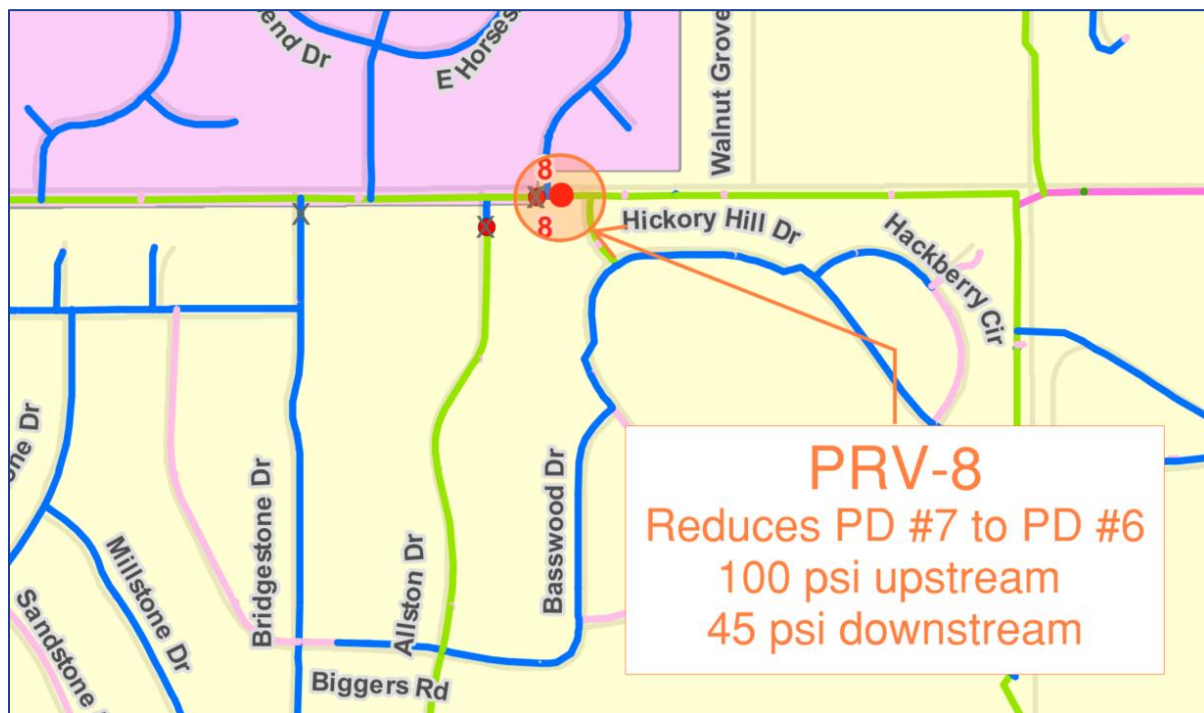
Option 2 is only a viable option if the pressure in the Tienken Manor Subdivision is increased at least 25-30 psi. Pressure modifications to the Tienken Manor Subdivision will be discussed later in this Report. Should the Tienken Manor Subdivision be incorporated in PD #7, then PRV-31 can be removed and the interconnection between the Brookwoods Subdivision and the Tienken Manor Subdivision will act as the redundant connection.

Our recommendation for Tienken Manor improvements is dependent on the other system improvements and is described further at the end of this memo in the Recommendations Summary section. In short, we recommend Option 2 if the pressure of Tienken Manor will be increased in a separate improvement. We recommend Option 1 if the pressure within the Tienken Manor Subdivision will not be increased or will not be increased for many years.

2. PRV-8 (Location/Operational Assessment)

PRV-8 separates PD #7 from PD #6 and is located on the south side of Tienken Rd. across the street from the approach to Fairview Lane, see Figure 3 below. Note that the current GIS shows the 8-inch water main connection from Fairview Ln. to the 12-inch water main on Tienken Rd. on the east side of PRV-8 when it is actually on the west side of PRV-8 and is looped in with the rest of PD #7. This is an important clarification as it confirms that the current location of PRV-8 (on Tienken Rd. between Fairview Ln. and Laurel Ct.) is the most effective location for the PD #7 to PD #6 pressure district boundary. In addition, the current PRV-8 location appears to be effective in the proposed pressure district redistricting options that will be discussed later in this Report. Therefore, we feel that the PRV-8 does not need to be relocated from a purely operational standpoint.

Figure 3: PRV-8 Location



PRV-8 is a 7 foot by 11 foot underground, cast-in-place concrete vault that houses an 8-inch Bernad PRV and a 6-inch Bernad PRV. See PRV-8 location map and vault detail, attached. Based on City staff input, the interior of the facility appears to be in fair to good condition. However, the facility piping and valving is nearing 35 years old and in poor to fair condition and the PRVs, also nearing 35 years old, have exceeded their expected useful life.

Based on the preliminary assessment of PRV-8, its location, facility and internal piping and valves, we recommend that the existing facility remain in its current location and that the internal piping and valves be replaced and the interior of the facility rehabilitated. It is also proposed that formal condition assessment, inventory and survey of the facility, piping and equipment be completed to verify the proposed improvements. Our recommendation is described further in an overall plan at the end of this memo in the Recommendations Summary section.

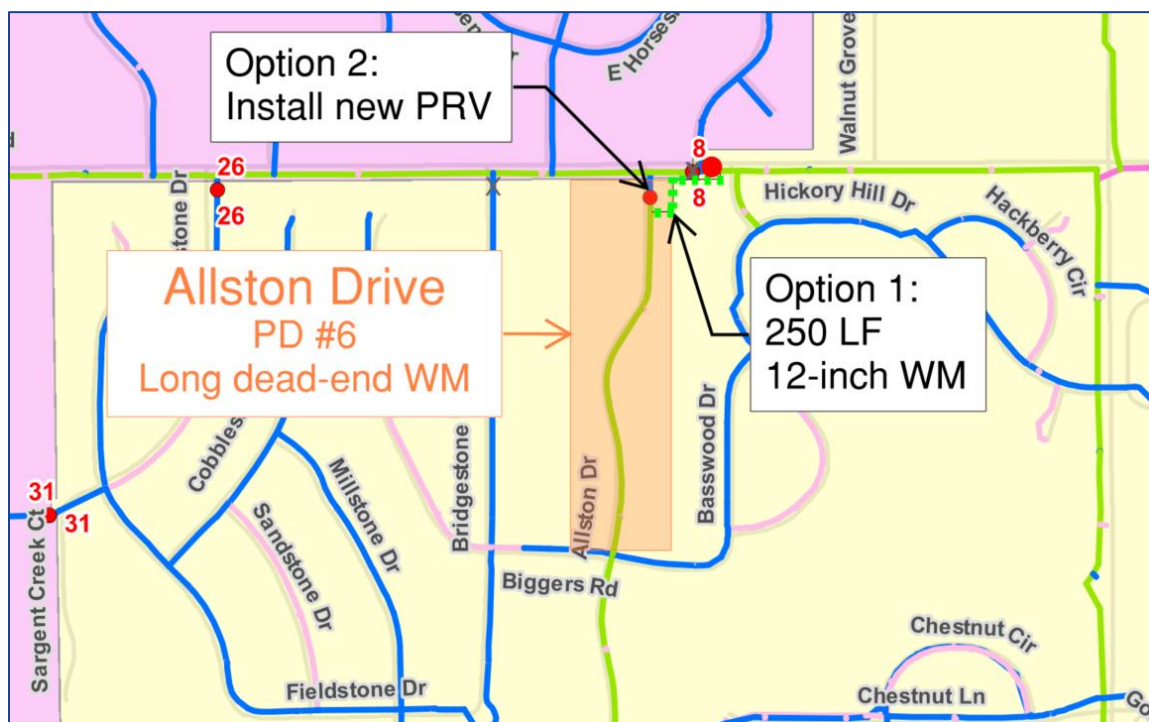
3. Allston Drive (Dead-End Water Main)

Allston Drive, north of Biggers Lane, resides in Pressure District #6 (PD #6) and typically receives pressures between 43 psi and 51 psi. The concern with this area is that it is serviced by a 12-inch dead-end water main that supplies approximately 24 residences. A dead-end main of that size with the little usage demand of only 24 residences has an increased potential for water quality issues, unless the dead-end main is frequently flushed.

To address the potential water quality concerns, we considered two (2) options shown in Figure 4 and described as follows:

- 1) Extend roughly 250 LF of new 12-inch main from the downstream side of PRV-8 to Allston Drive
- 2) Install a new PRV around the normally closed valve on Allston Drive just south of Tienken Rd.

Figure 4: Allston Drive Dead-End Water Main Options



Option 1 would create a looped distribution system within PD #6, removing the dead-end.

Option 2 would provide the potential for a controlled, looped system based on system pressures by interconnecting PD #7 with PD #6 through a control valve.

Option 1 is the more cost-effective option; however, Allston Drive will need to remain in PD #6 for this option to be viable. If the City is considering redistricting and including Allston Drive, north of Biggers Ln., into a pressure district other than PD #6, Option 2 should be the selected improvement as it provides the most flexibility for future water system development. Installing a PRV at Allston and Tienken will allow the City to set the delivery pressure to the water main on Allston, which permits the City to redistrict this area if and when desired. In addition, the PRV can deliver supplemental flow to the long run of water main on Allston Drive between Tienken and Biggers Rd., in the meantime, to address water quality concerns.

Construction of either option would be logistically challenging, as the right-of-way on Allston Drive is narrow and the existing water main on Allston Drive is already located in the east side greenbelt. Easements may be necessary to construct either improvement, so property acquisition conversations should begin early in the design process. Our recommendation is described further in an overall plan at the end of this memo in the Recommendations Summary section.

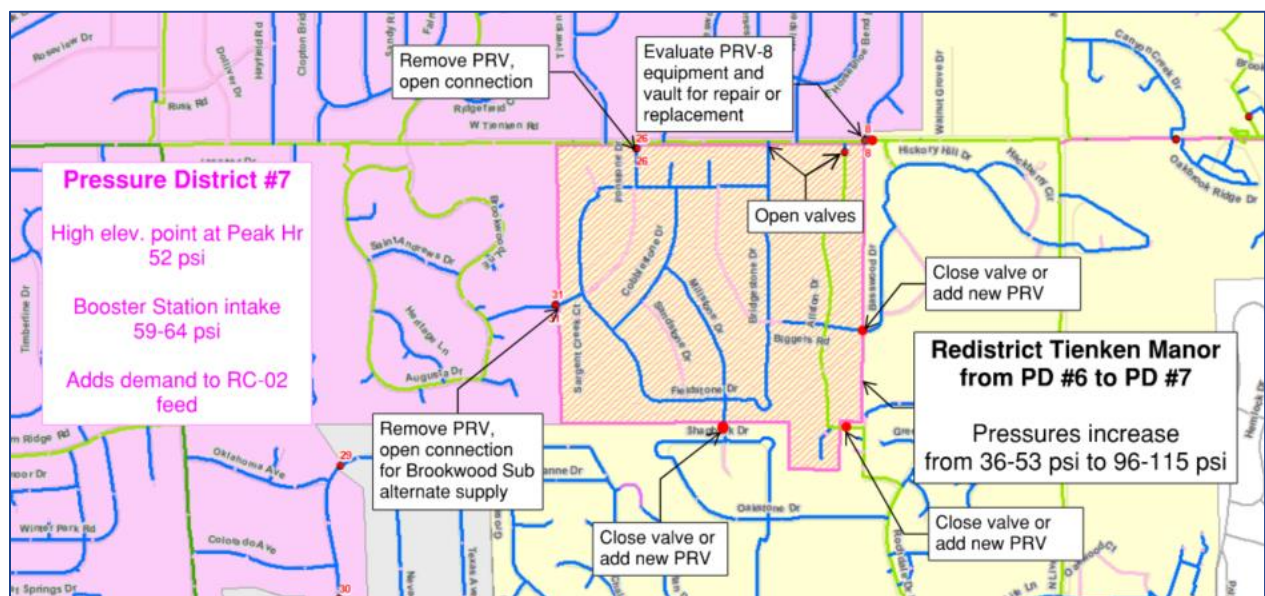
4. Tienken Manor Subdivision (Low Pressure)

As noted previously, the Tienken Manor Subdivision is currently located Pressure District #6 (PD #6) and is consistently delivered pressures between 35 psi and 53 psi. The pressure districts adjacent to PD #6 in this area (PD #7 and PD #9) have average pressure nearly 60 psi and 30 psi higher than PD #6, respectively. The following alternatives describe the nuances, extents and work scope plus advantages and disadvantages of redistricting the Tienken Manor Subdivision into PD #7 (Alternative #1) or into PD #9 (Alternative #2).

Alternative #1 – Redistrict Tienken Manor into PD #7

Alternative #1 involves redistricting Tienken Manor subdivision from PD #6 into PD #7, see Figure 5. This option presents some issues because PD #7 has a hydraulic grade line (HGL) that is, on average, 138 feet higher than the HGL in PD #6 (1,122' in PD #7 versus 984' in PD #6). Therefore, the pressures within the Tienken Manor Subdivision would increase by roughly 60 psi. The model predicted average day pressures within the Tienken Manor Subdivision, which currently range from 35 psi to 53 psi, would be increased to 96 psi to 115 psi. These elevated pressures may cause problems to the older homes and plumbing in the area; however, there are some subdivisions within the City that successfully operate with higher pressures similar to this proposed range, such as Brookwood Golf Club (87-107 psi), Fairview Farms (98-103 psi) and Chichester (88-104 psi).

Figure 5: Tienken Manor Alternative #1a

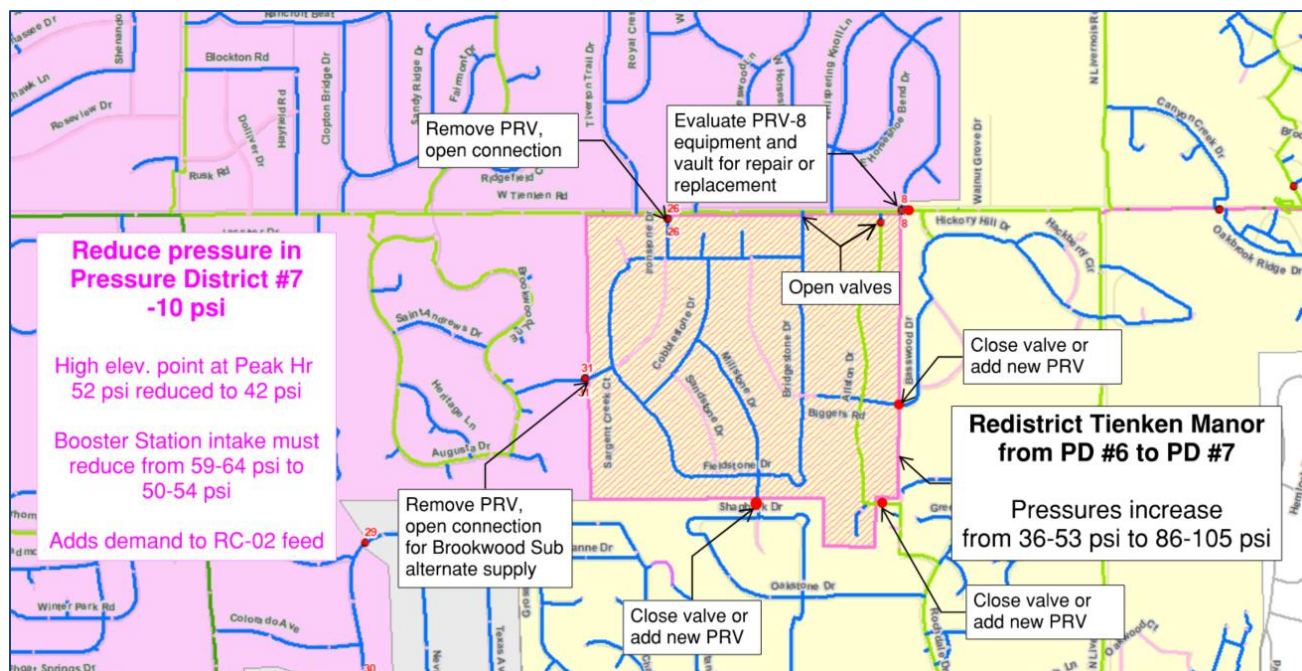


This Alternative is presented because it resolves the low-pressure issues in the Tienken Manor Subdivision as well as the redundant supply concern to the Brookwoods Subdivision and the dead-end water main on Allston with minimal complexity and reduced cost. The secondary supply to the Brookwoods Subdivision can be accomplished by removing PRV-31 and opening the connection, and the dead-end on Allston can be removed by opening up the normally closed valve and moving Allston Drive into PD #7. Alternatively, the City could consider not including Allston Drive in the redistricting, instead keeping it in PD #6 and adding the new water main and connection as described previously as Allston Option 1.

However, if the resulting pressures in the Tienken Manor Subdivision are considered too high, there is a secondary option to improve on Alternative #1, shown in Figure 6. If the HGL in PD #7 was lowered by 23 feet (or 10 psi) and operated around 1,099', the proposed pressure range within the Tienken Manor Subdivision would be lowered to 86 psi to 105 psi, which may be more manageable. However, lowering the HGL in PD #7 has subsequent ramifications:

- First, all customers currently within PD #7 would see a 10 psi drop in pressure. This pressure drop is not a huge concern in most of the area currently serviced by PD #7 as over 70% of these customers currently see pressures above 70 psi. However, some areas of higher elevation in the Brookdale Woods Subdivision would see their pressures, on average, fall from 55 psi to 45 psi (and 52 psi to 42 psi during peak hour).
- Secondly, the PRVs along the border of PD #7 and PD #9 may need to be adjusted as the pressure drop through these PRVs would be reduced.
- Thirdly, and most impactful, the booster pumping station at Adams and Tienken (BPS #2) was specifically designed for incoming pressures between 50 psi and 60 psi. If the incoming pressure to BPS #2 is lowered, the capabilities of the pump station are reduced. Preliminary indications are that the duty pump would need to be replaced but the other pumps may only require impeller upgrades should the incoming pressure be lowered as suggested. The electrical and programming upgrades that would be necessary have not been evaluated at this time.

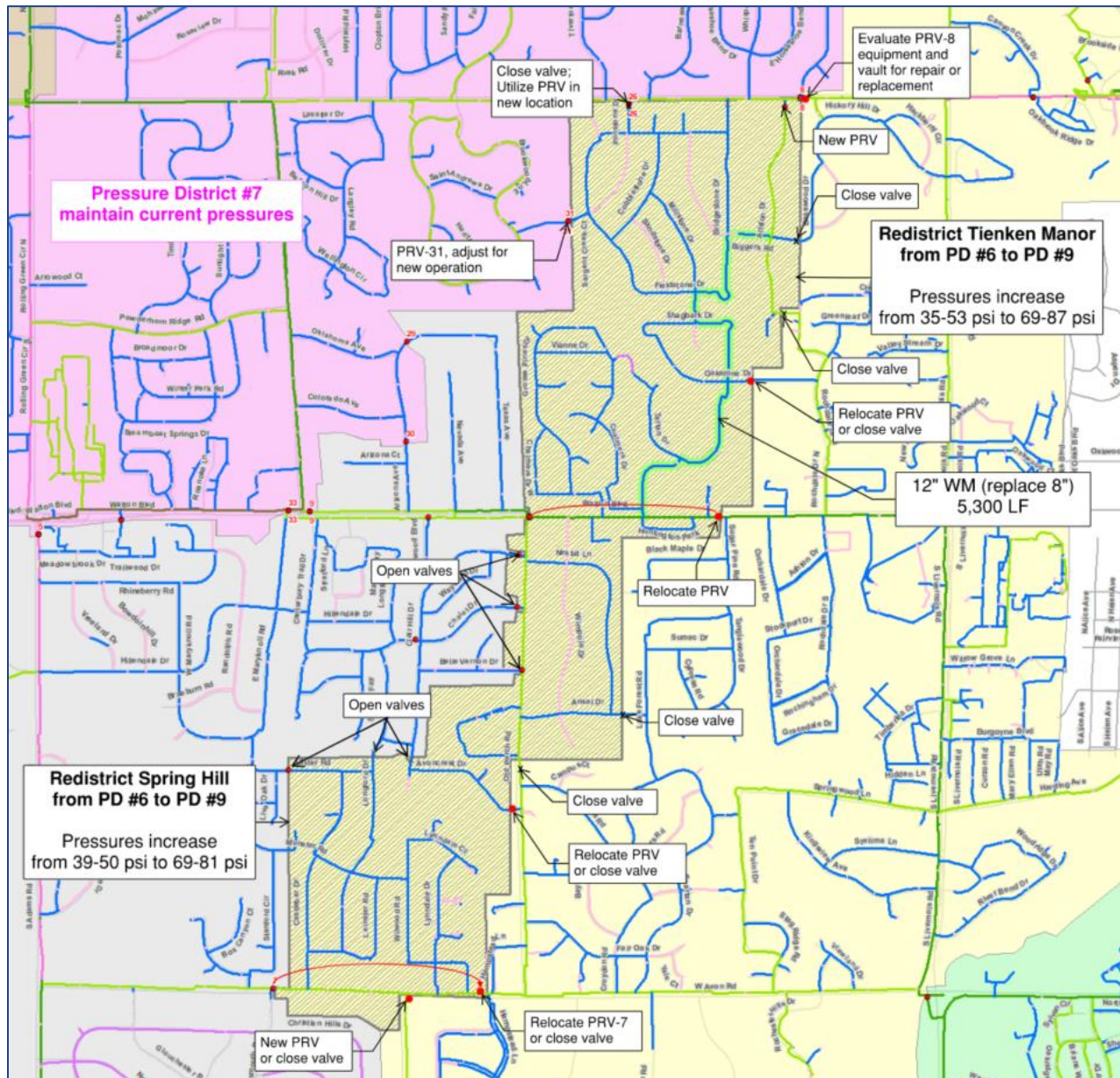
Figure 6: Tienken Manor Alternative #1b - Reduce Pressure in PD #7



Alternative #2 – Redistrict Tienken Manor into PD #9

Alternative #2 is a proposal to move the Tienken Manor subdivision into Pressure District #9 (PD #9), which would provide a more reasonable pressure increase (plus 25 psi) than Alternative #1. However, this also necessitates a larger redistricting project which moves the western portion of PD #6 (north of Avon Rd.) into PD #9. The redistricted area, shown below in Figure 7 in yellow with gray hatching, includes both the Tienken Manor Subdivision and Allston Drive as well as the Spring Hill Subdivision (as was previously mentioned as a reported area with low pressures). This will increase the pressures in both Tienken Manor and Spring Hill Subdivisions from approximately 45 psi to 75 psi and add demand to the usual operation of PD #9. The redistricting will move approximately 605 acres of land from PD #6 to PD #9 and require at least four (4) new or relocated PRVs as shown below. This Alternative will have the added benefit of not increasing the demand on the RC-02 connection (as Tienken Manor Alternative #1 does) and maintaining the existing pressure gradient in PD #7. Lastly, this Alternative should lower the demand through PRV-13 while still operating similarly to existing conditions (i.e., primarily through RC-03 with supplemental assistance through internal PRVs fed from RC-02).

Figure 7: Tienken Manor Alternative #2



This Alternative includes increasing the 8-inch water main along Biggers Rd., Bridgestone Dr., and Millstone Dr. in the Tienken Manor subdivision to 12-inch main as highlighted in Figure 6 below. This will provide a 12-inch backbone in the newly redistricted area. It is noted that all other water main in Tienken Manor was modeled as improved to new 8-inch as planned for the 2021 replacement program.

A redundant supply to the Brookwoods subdivision would be accomplished by modifying the pilot piping of PRV-31 so that valve can flow in both directions. With the higher pressure in the Tienken Manor Subdivision as a result of this Alternative, the Tienken Manor Subdivision could feed into the Brookwoods Subdivision during periods of local low pressure or fire protection needs. Based on the model predictions, this upgrade would meet the need for a secondary supply to the Brookwoods subdivision, and the proposed additional connection to the Tienken Rd. water main at Brookwoods Ln. would not be necessary.

Water quality issues on Allston Drive north of Biggers Ln. would be addressed by installing a new PRV at Allston Drive and Tienken Rd. This new PRV, combined with the 12-inch water main back bone described above, would serve as the primary supplemental feed from PD #7 to PD #9 in this proposed northern section of District to address local pressure drops and fire protection needs.

We recommend implementing Alternative #2 and moving Tienken Manor into PD #9. A summary comparison of Tienken Manor improvement Alternatives #1a, #1b and #2 are shown in Table 1 in the Recommendations Summary section at the end of this memo. Our recommendation for Alternative #2 is described further in an overall plan also in the Recommendations Summary section.

5 Emergency Booster Pumping Station

The City also desires to add a booster pumping station (BPS) in the vicinity of PRV-8 to provide emergency supply from Pressure District #6 (PD #6) up to PD #7 and PD #8 (and potentially PD #9, if possible). This redundant supply proposal is supported from the recent Risk and Resilience Assessment and the 2020 Water Reliability Study update for resiliency and alternate supply. Additional considerations to evaluate are utilizing a backwards rotating pump (or pump as turbine, PAT) as a PRV and/or hydrokinetic in-line energy recovery turbine generator.

Preliminary model analysis predicts that an emergency BPS in the vicinity of PRV-8 would be able to supply average day demands to PD #7 and PD #8. However, if the City had the desire to supply PD #9 as well or wishes to be able to service higher demands in PD #7 and PD #8 during emergency periods, system improvements such as installation of a larger or additional water main along Tienken would likely need to be provided. Our preliminary assessment may be able to be adjusted by expanding the Study scope and reviewing alternative site locations and emergency response operations.

It is the opinion of this office that the addition of an emergency BPS to provide a redundant supply to PD #7 and PD #8 is prudent and forward-thinking capital improvement planning. Programming for this BPS should begin as soon as possible as easements or property acquisition may be necessary to build this facility.

6. Emergency BPS as PRV & Hydrokinetic Energy Recovery Unit

Additional evaluation was requested to review utilizing the proposed Emergency BPS as a hydrokinetic in-line energy recovery turbine generator by operating the pump(s) backwards as a pump as turbine (or PAT) and using it as a PRV (essentially replacing PRV-8). HRC performed a cursory review of utilizing a PAT to function as a pressure reducing device, thereby using a single station to function as both a BPS in emergency conditions (to pump from PD #6 to PD #7) and a PRV facility under regular, daily use conditions. It is noted that a combined PRV-8 and emergency BPS would function predominantly in the flow direction for pressure reducing.

The tolerances in the City's water system operations require precise operation for pressure reducing devices at the perimeter of the pressure districts. Currently, it is unclear if the equipment available to perform pressure reducing, pressure boosting, and energy recovery would have the capabilities to function within the tolerances needed to effectively operate (specifically from a pressure reducing capacity) within the City's system. The concern is that if this unit was installed, it would never be used in the pressure reducing function because the ancillary internal PRVs that feed PD #6 would be more efficient and responsive and provide more control. Therefore, the unit would function as a closed valve most of the time, reduce operational flexibility in the system, rarely act as an in-line turbine to recover energy, and would act predominantly as an emergency booster station.

Additionally, based on our cursory review, the cost of constructing a single station to perform both regular pressure reducing and emergency booster pumping would not be significantly more cost effective than the cost of constructing separate PRV and BPS facilities (especially since the existing PRV-8 facility only appears to need rehabilitation and piping/valve improvements).

Lastly, while the pressure drop through PRV-8 is significant (+/- 60 psi), the model predicted flow through this location is not consistent. PRV-8 is not the lead supply to PD #6 and acts as a supplemental supply (or “lag” supply). Flow through PRV-8 is typically only registered during peak demand times or during periods of increased local demand (i.e., hydrant flushing, fire protection, irrigation, etc.). Therefore, the amount of time in which a proposed PAT would be in energy recovery mode at this location (again, even if it can operate within the tolerances of the system as described above) would be limited and would therefore limit the potential for energy recovery.

It is recommended that a separate BPS facility be constructed that is dedicated to being an emergency BPS only and not a combined BPS/PRV/hydrokinetic in-line energy recovery turbine generator. The following reasons lead us to this recommendation:

- 1) Impacts to system operation
 - a. The inability to ensure that a PAT device could provide the City with the precision it needs to maintain its successful system operation.
- 2) Construction cost effectiveness
 - a. The construction cost of a facility necessary to house a proposed PAT device and ancillary valving and piping would be comparable to the construction of two (2) smaller sized facilities.
 - b. It appears that the existing PRV-8 facility can be rehabilitated in-place and function appropriately in proposed future system operations, which would further reduce the capital costs for two separate facilities for pressure reducing and emergency pressure boosting.
- 3) Siting feasibility
 - a. The footprint of a proposed facility to house a PAT device and ancillary valving and piping may be substantially larger than separate facilities. There is limited available right-of-way in the anticipated location of these facilities, therefore siting a larger, single location may be problematic.
- 4) Minimal energy recovery potential
 - a. Due to the anticipated limited usage period for energy recovery through this location, the amount of recoverable energy would not be significant enough to justify the cost, logistical issues and operational inefficiencies described above.

In summary, we do not recommend pursuing a combined BPS/PRV facility in this location with the intent to provide energy recovery contributions. It is our opinion that the facility would provide minimal energy recovery, negatively impact the operational control of the water system, and not provide any significant cost savings over constructing a separate emergency BPS facility and rehabilitating the existing PRV-8 facility.

Recommendations Summary

The scenarios described previously address the key criteria separately. The larger scenario, for Tienken Manor, combines several measures for other key criteria. Table 1, below, describes each Tienken Manor alternative and how it could combine with other scenarios.

Table 1: Alternatives Summary Table

Criteria	Existing Conditions	Tienken Manor Alternative #1a	Tienken Manor Alternative #1b	Tienken Manor Alternative #2
1. New supply to Brookwood	No	Yes, open connection at existing PRV-31 because both in PD #7	Yes, open connection at existing PRV-31 because both in PD #7	Adjust PRV-31 for new operation (Brookwoods Option 2)
2. PRV-8 location and operational	No	Rehabilitation of pipe, valve and vault	Rehabilitation of pipe, valve and vault	Rehabilitation of pipe, valve and vault
3. Remove Allston dead-end	No	Open valve, moved into PD #7	Open valve, moved into PD #7	Add new PRV (Allston Drive Option 2)
4. Increase Tienken Manor pressures	No	Yes, redistrict into PD #7	Yes, redistrict into PD #7 (and lower PD #7 pressure by 10 psi)	Yes, redistrict into PD #9
<i>Avg pressure range in Tienken Manor:</i>	<i>35-53 psi</i>	<i>96-115 psi</i>	<i>86-105 psi</i>	<i>69-87 psi</i>
<i>Avg pressure at PD #7 high point*:</i>	<i>55 psi</i>	<i>55 psi</i>	<i>45 psi</i>	<i>55 psi</i>
<i>Peak Hr pressure at PD #7 high point*:</i>	<i>52 psi</i>	<i>52 psi</i>	<i>42 psi</i>	<i>51 psi</i>
5. BPS for redundant supply to west	No	Yes, pursue planning	Yes, pursue planning	Yes, pursue planning
6. Energy recovery unit	No	Not recommended	Not recommended	Not recommended

Based on the provided benefits as shown in the summary table above and preliminary discussions with the City, we recommend Tienken Manor Alternative #2 as described to best address the existing system deficiencies. Preliminary cost estimates can be provided upon request for the City to evaluate the alternative scenarios.

A component of the overall recommendation is repairing and rehabilitating PRV-8 (based on the results of the facility assessment) and pursuing a feasibility study for constructing a new emergency booster station in a separate vault to operate independently from the PRV-8. We conclude to not operate a combined PRV and booster station facility, and options are available for sequencing the implementation of improvements and for construction of separate facilities. It is recommended that a detailed feasibility study be prepared to coordinate, model, locate and size the proposed emergency booster station and develop an implementation program for its design and construction.

A recommended phased approach for implementation is as follows:

1. Authorize a comprehensive operational and condition assessment of the PRV-8 facility and valving/piping.
 - a. If PRV-8 vault is in a condition adequate for continued use and sized appropriately, authorize a rehabilitation project to extend the facility's useful life.
 - b. If PRV-8 vault is not recommended for continued use, add to scope in Step 2 below.
2. Authorize a comprehensive Feasibility Study of an emergency Booster Pumping Station to begin proposed siting analysis and property acquisition discussions.
3. If the City needs to immediately address Brookwoods concerns, make improvements described as Brookwoods Option 1. Otherwise, the completed phased approach as described herein will address the Brookwoods supply issue later through implementation of Brookwoods Option 2 in conjunction with other improvements.

4. Increase 8-inch watermain along Biggers Rd., Bridgestone Dr. and Millstone Dr. in the Tienken Manor subdivision to 12-inch main.
5. Install a new PRV at Allston around the existing closed valve.
6. Develop a phased plan for redistricting improvements shown for Tienken Manor Alternative #2.
 - a. Add valves delineating new district limits (where existing valves don't exist currently).
 - b. Make water main improvements beneficial to the redistricting plan.
 - c. Add or relocate PRVs.
7. Replace the pilot tubing in PRV-31 to provide redundant supply to Brookwoods Subdivision.

We trust this addresses your concerns and we are available to discuss the recommendations in this memo in more detail with City staff.