CITY OF STAYTON, OR

AQUIFER STORAGE AND RECOVERY FEASIBILITY STUDY

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KA PROJECT NO. 220144

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1.0 INTRODUCTION

The goal of this study is to evaluate the feasibility of developing an aquifer storage and recovery (ASR) system to provide a redundant drinking water source for the City of Stayton. The City's primary drinking water source (the North Santiam River) is susceptible to drought conditions and water quality impairments (high turbidity during winter months and potential contamination upstream). While the City does have an active well, well yield is declining and the well draws from the shallow alluvial sediments adjacent to, and in direct connection with the North Santiam River. A secondary drinking water source would alleviate reliance on the declining well, reduce vulnerabilities to water quality degradation events on the North Santiam River (i.e., algal blooms and spills), increase emergency storage capacity, and supplement flow during periods of peak demand. This feasibility study is designed to determine potential water availability, evaluate hydrogeologic feasibility and potential project capacity, identify water quality issues and infrastructure needs, and lay out a pathway for implementing an ASR program.

This feasibility study used existing information and data obtained through a test well to address and evaluate potential unknowns. This study identified potential fatal flaws and evaluated key feasibility criteria that define the benefit and costs associated with developing an ASR program. These criteria include water quality, source water availability, storage aquifer parameters that define achievable storage volumes and recovery rates, permitting, and environmental impacts.

2.0 CONCEPTUAL SYSTEM CRITERIA

2.1 RECOVERY RATE

The target recovery rate is 1.5 million gallons per day (MGD) or 1,040 gallons per minute (gpm). This flow rate could meet average day demands during winter months and alleviate reliance on the declining well. It would allow the City to provide peaking capacity during the summer months.

2.2 INJECTION RATE

The proposed injection rate is 1.0 MGD or 700 gpm. This flow rate would enable the City to store approximately 420 acre-feet or approximately 137 million gallons (MG) of drinking water over the projected 5-month injection to meet the needs described above for up to three months. This flow rate is also within the capacity of the City's water treatment plant and water rights restrictions (see discussion in Section 5 below).

3.0 INFRASTRUCTURE EVALUATION

3.1 SITES CONSIDERED

Several properties located throughout the City were evaluated for potential well siting. Considerations included water management and disposal during drilling, permanent pump-to-waste facility needs, proximity and location in existing distribution network, disinfection, noise, and setback requirements. An ASR well facility could periodically generate 1,040 gpm for 60 minutes during the pump-to-waste process (approximately 62,400 gallons). This extracted water will need to be routed to stormwater infrastructure or to an appropriate outfall. For a full summary of the infrastructure evaluation and summaries of each site, see Appendix A.

3.2 COMPARING THE RESULTS

Tables 3-1 through 3-3 provide comparisons of the sites considered. Table 3-1 compares the different requirements associated with development of each site. Table 3-2 provides a summary of the advantages and disadvantages associated with each site. Table 3-3 provides a selection matrix with weighted criteria. Sites are rated on a scale of 1 (low/poor) to 5 (high/good).

Based on the comparison evaluation, the Mill Creek Park site was chosen for the test well site and for the potential permanent ASR facility. As evident in the tables below, this site provides several advantages as an offsite emergency water source and the cost estimate is the lowest of all four sites.

TABLE 3-1: COMPARISON OF REQUIREMENTS FOR EACH SITE

	COMMUNITY CENTER PARK	MILL CREEK PARK	SCHEDULE M	WTP
Cost Estimate	$4,210,000	$3,802,000	$3,854,000	$3,940,000
Requirements for Site Development				
Construction of a Detention Pond for Pump to Waste	X		X	
Improvements to the Distribution System	X	X	X	
Onsite Disinfection Treatment	X	X	X	
Land Acquisition			X	
Site Grading (Floodplain Development)				X

TABLE 3-2: ADVANTAGES AND DISADVANTAGES ASSOCIATED PER SITE

	Advantages	**Disadvantages**
COMMUNITY CENTER PARK	• Has a higher probability of reaching a thicker part of the CRBG • Redundant water source offsite of WTP	• Requires improvements to the distribution system • Reduces available public space at the park • Requires coordination with SWCD for the test well extracted water
MILL CREEK PARK	• Has a higher probability of reaching a thicker part of the CRBG • Redundant water source offsite of WTP • Does not require a detention pond for the pump-to-waste	• Requires improvements to the distribution system • Reduces available public space at the park
SCHEDULE M	• Redundant water source offsite of WTP	• Requires improvements to the distribution system • Projected to be the most expensive site to develop • Requires land acquisition • Requires coordination with SWCD for the test well extracted water
WTP	• May not require a detention pond for pump-to-waste • Disinfection facilities exist onsite • Proximity to WTP could benefit operators	• May require site grading due to floodplain development • May require coordination with SWCD for the test well extracted water

TABLE 3-3: SELECTION MATRIX

	Redundant Offsite Emergency Water Source	Higher Probability of Reaching Thicker CRBG Layer	Does Not Require a New Pump to Waste Detention Facility	Onsite Disinfection and Chemical Storage	Minimal Impacts to Public Spaces	Permitting Impacts	Cost	***Totals***
Weighting	25%	20%	10%	10%	5%	5%	25%	
Community Center Park	5	4	1	1	1	1	2	***2.9***
Mill Creek Park	5	5	5	1	4	5	5	***4.6***
Schedule M	5	4	1	1	5	1	4	***3.6***
WTP	1	3	3	5	5	3	3	***2.8***

4.0 HYDROGEOLOGIC ASSESSMENT

4.1 HYDROGEOLOGIC SETTING

4.1.1 Regional Setting

The predominant geologic units in the Stayton area, from youngest to oldest, include alluvial and fluvial deposits, basalt lava flows of the Columbia River Basalt Group (CRBG), and older marine sediments. **Figure B-1** (Appendix B) presents a map of the general geology in the Stayton area. The CRBG, which underlies the younger alluvium and fluvial deposits throughout the Stayton area, comprises an aquifer system that consists of multiple layered sequences of flood basalts. As part of the Stayton Secondary Source Alternative Study (Keller and GSI, 2019), ASR using CRBG-hosted aquifers was recommended as the most feasible and adaptable secondary source option.

Geologic mapping by the USGS (Conlon, et. al., 2005) indicates that the total section of CRBG in the Stayton area ranges in thickness from approximately 200 to 500 feet. The thickest section of the CRBG appears to run in a NE-SW trending zone to the northwest of Stayton. The CRBG thins out to the east and west of this zone. No significant faulting or folding of the CRBG has been mapped in the vicinity of Stayton; however, the immediate vicinity of Stayton has not been mapped in detail. Detailed geologic maps for the quadrangles to the north, west, and south of Stayton have identified a series of faults, which likely extend into the Stayton area.

4.1.2 Columbia River Basalt Hydrogeology

Groundwater within the CRBG aquifer system is hosted within thin permeable zones of fractured or rubbly material comprising the top of one flow and the base of the overlying flow. These zones are commonly referred to as “interflow zones” and may be highly transmissive, yielding 250 gpm to >1,000 gpm (reported at various CRBG wells throughout the Willamette Valley). The interflow zones are separated by the dense, low permeability interiors of each basalt flow that inhibit the vertical movement of groundwater, and act as a confining layer.

The high yield of CRBG interflow zones, limited recharge, and intrinsic storage characteristics (thin and confined) renders the CRBG aquifer system highly susceptible from overdraft and can be compartmentalized by geologic structures such as faults or where the basalt flows pinch out on the valley margins. Some of these same characteristics can also contribute to making the CRBG aquifers highly suitable as ASR storage aquifers. Most of the operational ASR systems in Oregon and Washington are hosted by CRBG aquifers. Areas near Stayton with CRBG thickness in excess of 500 feet may include 5 or more individual basalt flows (and corresponding water-bearing interflow zones). A thicker sequence of CRBG generally presents a greater potential for the presence of productive aquifers with suitable characteristics for ASR because of the presence of a greater number of flows.

Productive water-bearing interflow zones in the CRBG aquifer have been identified in the vicinity of Stayton, in wells used by the City of Sublimity and other irrigation wells, as shown on **Figure B-2**. While yields reported for CRBG wells in the Stayton area are generally less than 500 gpm, most wells are not rigorously tested for yield, and/or do not penetrate the entire CRBG section. Thus, some uncertainty remains regarding the upper bounds of well yields in the area. Some wells completed in the deeper CRBG units in the vicinity of Stayton produce 100 to 700 gpm, and the results of test well drilling for this project, discussed below, indicate that water-bearing zones are capable of sustaining higher yields for a full-scale ASR well.

4.2 FIELD INVESTIGATION

4.2.1 Summary of Test Well Drilling and Construction

A field investigation was performed at the previously-selected Mills Creek Park site to provide a proof of concept, building on the preliminary feasibility evaluation, and develop preliminary ASR system design parameters and cost estimates. The objectives of the test well drilling program were to (1) identify a potentially suitable storage aquifer and evaluate the hydraulic characteristics of the aquifer; (2) characterize the geochemical compatibility between injection source water, native groundwater and the aquifer. The field investigation consisted of:

- Drilling an exploratory borehole to evaluate CRBG depth and thickness
- Installing a test well and conducting hydraulic testing to evaluate storage aquifer parameters to be used in developing preliminary design storage volume, and potential injection and recovery rates
- Collecting samples of native groundwater and completing an equilibrium geochemical compatibility model to evaluate potential reactions between source water, native groundwater, and the aquifer matrix

Drilling, construction, and testing of the Stayton Test Well (MARI 70185) began on September 17, 2021 and was completed on December 16, 2021. The Test Well was drilled in the southwest corner of the Mills Creek Park site (see **Figure B-3**). Westerberg Drilling, Inc. (Westerberg) of Molalla, Oregon was contracted with GSI to complete the Test Well. An as-built diagram is presented as **Figure B-4,** and the well log is included in Appendix D. The following is a bulleted summary of drilling and construction activities.

1. Surface Casing: A 12-inch borehole was drilled and temporarily cased to a depth of 230 feet below ground surface (bgs). The purpose of this surface casing was to seal off the overburden materials (alluvial sediments) and groundwater above the CRBG. The temporary casing was removed during the installation of the production casing and final surface seal.
2. Well Borehole: An 8-inch nominal pilot borehole was drilled using direct air rotary drilling method from a depth of approximately 230 feet to 692 feet bgs. Drilling advanced approximately 20 feet into the underlying older marine sediments (clays). A productive interflow zone was identified from 382 to 420 feet bgs. The borehole was then widened to a nominal diameter of 12 inches from a depth of 230 feet to 322 feet bgs, and to a 10-inch nominal diameter from 322 feet to 324 feet bgs.
3. Production Casing: Based on results of geologic logging and down-well geophysical surveying (video survey and flow profile, conducted by Oregon Water Resources

Department [OWRD]), GSI designed the upper borehole/production casing to extend to a total depth of 324 feet bgs. 8-inch inside diameter (ID) 0.250-inch wall low carbon steel casing was installed and extends from 3 feet above ground surface (ags) to 324 feet bgs.

4. Surface Seal: Cement and bentonite were installed in the annular space between the 8-inch production casing and 12-inch borehole from ground surface to 324 feet bgs in the following order:
   - Cement seal: 4 feet to 324 feet bgs
   - Bentonite seal: ground surface to 4 feet bgs
5. Bottom Borehole Plug: The bottom of the 8-inch borehole was also backfilled with cement up to a depth of approximately 660 feet bgs to seal off any groundwater from the underlying older marine sediments.

Well Video and Flow Profile: Prior to installing 8-inch production casing, a well video was performed on October 22, 2021 in the open 8-inch borehole. This video was performed to identify potential water-bearing interflows within the CRBG. On October 25, 2021, OWRD performed an electric log (e-log) and flow profile (spinner) survey of the open borehole. Following review of the video survey and flow profile, OWRD confirmed that no significant amount of water was observed moving vertically within the borehole (i.e., there was not comingling between water-bearing zones). OWRD approved the well construction design of an 8-inch borehole open from a depth of 324 feet to 690 feet.

4.2.2 Hydrostratigraphy

Younger alluvial sediments, consisting of clay, silt, sand and gravel, were observed in the test well boring to a depth of 230 feet bgs. Basalt flows of the CRBG, consisting of alternating flow tops (brecciated and vesicular) and denser interiors, were encountered between a depth of 230 feet and 672 feet bgs. At this site, the CRBG section is interpreted to be approximately 440 feet thick and includes 7 individual flows. **Table 4-1** below summarizes the depth, thickness, water levels, and yield characteristics of the CRBG flows encountered during drilling the Test Well. Based on these data, the middle and lower water-bearing zones were targeted for the storage aquifer evaluation (from 342 to 519 feet bgs).

Older marine sediments consisting of a reddish-brown claystone, siltstone, and sandstone were encountered beneath the CRBG from 672 feet bgs to the total depth of the borehole at 692 feet bgs.

TABLE 4-1. SITE-SPECIFIC AQUIFER CHARACTERISTICS

WATER-BEARING ZONES (FEET)	ESTIMATED AIRLIFT TEST RATES (GPM)	STATIC WATER LEVEL (FEET BGS)
230-258	10-15	--
268-291	15-20	--
342-354	60-70	41.5
382-420	800-1000	43.3
457-464	800-1000	--
492-519	800-1000	49.1
660-672	800-1000	55.7

4.2.3 Aquifer Testing

Westerberg installed a submersible test pump to a depth of approximately 320 feet bgs for aquifer testing. GSI also equipped the Test Well with a LevelTROLL continuous-logging pressure transducer to automatically record and store water level measurements during testing. OWRD maintains an observation well (MARI 9135), located approximately 1 mile north of the Test Well. The observation well is equipped with a transducer that was recording water level measurements during the test period. A summary of aquifer testing observations is provided below:

- Background Monitoring: GSI monitored background water levels in the Test Well from November 24 to December 7, 2021 to identify antecedent trends and for the presence of other stresses. Groundwater levels increased from 44 to 42.5 feet bgs during the background monitoring period (**Figure B-5**). Water level fluctuations on the order of approximately 0.2 feet were observed periodically during the background period. Water levels recorded in the observation well (MARI 9135) also increased during the background monitoring period, and also fluctuated approximately 0.5 feet on a near-daily frequency. Per OWRD, these fluctuations were caused by the pumping of nearby Sublimity Well 2 (MARI 9142), which is located approximately ½-mile east of the observation well. Based on the background data, it is difficult to discern if water levels in the Test Well were also impacted by pumping of Sublimity Well 2.
- Step-Rate Testing: A step-rate pumping test was conducted on December 7, 2021 with four 60-minute steps at average rates of 128 gpm, 247 gpm, 376 gpm, and 577 gpm. Drawdown and the calculated specific capacity (SC; a measurement of production rate divided by water level drawdown) for each rate is shown in **Table 4-2** below.

TABLE 4-2. SUMMARY OF STEP-RATE PUMPING TEST

PUMPING RATE (GPM)	WATER LEVEL DRAWDOWN (FEET)	SPECIFIC CAPACITY (GPM/FEET)
128	0.35	365.7
247	1.25	197.6
376	2.55	147.5
577	5.43	106.3

- Constant-Rate Testing: A 24-hour constant-rate pumping test was conducted between December 8 and 9, 2021. The well was pumped at an average rate of 501 gpm, and the drawdown at the end of the test was 10.3 feet, corresponding to a final pumping level of 52.8 feet bgs. The SC at the end of the constant rate pumping test was approximately 48.6 gpm/feet. (**Figure B-6**).

  During testing, two distinct changes in water level drawdown slope were observed in the pumping data, indicative of the presence of flow-limiting boundaries.

4.3 Target Storage Aquifer Evaluation

Data collected during aquifer testing of the Test Well were used to estimate aquifer transmissivity, or T (i.e., the water-transmitting capacity of the aquifer expressed as gallons per day per foot, gpd/ft). The near-field transmissivity of the aquifer, calculated from early time data, was 38,000 gallons per day per foot (gpd/feet). The transmissivity calculated from later time (post-boundary) pumping and recovery data was 13,000 gpd/ft, reflective of flow-limiting boundaries. For perspective, aquifer testing data for nearby wells (Salem ASR Well 1/MARI 19624 and Mount Angel Well 6/MARI 50456) have transmissivities that fall within this range (Conlon, et. al., 2005).

Storativity, or S (which is the volume of water an aquifer releases from, or takes into, storage unit per surface area of the aquifer unit per unit change in head), is estimated be on the order of $2x10^{-4}$ and is based on aquifer testing of nearby wells (Conlon, et. al., 2005). A true storativity value for the Test Well could not be calculated using the observation well data because pumping close to the monitoring well (likely the City of Sublimity well) obscured any potential response from pumping the Test Well (see Section 4.3.2).

4.3.1 Boundaries and Compartmentalization

As noted in Section 4.2.3, potential flow-limiting boundaries of the target CRBG aquifers were observed in the drawdown data from testing. These boundary effects are characterized by increasing rates of drawdown during the constant-rate test, and may reflect thinning water-bearing interflow zones where the CRBG units pinch out to the west and east of the test well site and/or the presence of faults. The increasing rate of drawdown also potentially could be caused in part by pumping of nearby wells completed within one or more water-bearing units shared with the Test Well. Based on water level data provided by OWRD for MARI 9135, there appear to be some indications of pumping of one or more other wells (e.g., Sublimity Well 2). However, the magnitude of these influences are small relative to the drawdown during the test, and are unlikely to significantly contribute to the observed boundary effects.

Figure B-2 shows the location of nearby CRBG wells. Although it is difficult to estimate potential interference drawdowns, it appears that several wells within approximately 1-½ miles of the Test Well could be completed within one or more of the same CRBG water-bearing zones as the Test Well. While there is a potential for some water level interference, the magnitude from operation of the Sublimity well during testing was small, suggesting that interference from other individual wells may also be small. However, instrumenting the Test Well through the summer irrigation season would provide further information regarding the magnitude of potential interference drawdown at the ASR site from operation of other wells in the area.

4.3.1 Recovery Rates

The target recovery rate for a new ASR well is 1,040 gpm (1.5 MGD). The feasibility of sustaining this rate over the course of a recovery cycle was evaluated using later time data trends from the short-term (24-hour) aquifer testing and the estimated effective (late-time) transmissivity of the aquifer. The maximum sustainable recovery rate is limited by the amount of available drawdown in the well. Available drawdown is the height of the column of water in the well over the minimum allowable pumping level (maximum drawdown) under non-pumping conditions, as determined by the pump setting and pump submergence requirements. The pumping water level in a well declines over time during pumping in proportion to the transmissivity of the aquifer and the efficiency of the well. Conversely, the water level rises in a well during injection in proportion to the same factors.

The ability of the well to sustain the target recovery rate was evaluated for two ASR operational scenarios, based on the current and potential future needs of the City. A 30-day recovery scenario was modeled for short-term, emergency uses, which include temporary loss of the primary surface water source from issues related to spills and impacts from algae blooms on the Santiam River. A longer-term recovery period of 3 months was also considered, which includes the targeted demand of 420 AF. Utilizing the above aquifer parameters, an accounting for practical well construction and pumping system design, as well as a safety factor to account for potential water level declines and performance losses, the estimated water levels drawdowns are presented in **Table 4-3**. If it is assumed that the pump intake is set at a depth of 300 feet bgs, and accounting for a net positive suction head for the pump of 25 feet and a safety factor of 30 feet, and finally assuming a maximum summertime interference of 20 feet, the target recovery rate is achievable over the periods modeled with ample available drawdown to accommodate additional water level declines, interference or performance decreases.

TABLE 4-3. RECOVERY VOLUMES

RECOVERY PERIOD (DAYS)	RECOVERY RATE (GPM)	RECOVERY VOLUME (AF)	THEORETICAL WATER LEVEL DRAWDOWN (FT))	INTERFERENCE (FT)	WATER LEVEL (FT BGS)
30	1,040	138	80	20	140
91	1,040	420	90	20	150

Assumptions: Starting static water level = 40 ft bgs
Lowest allowable pumping level = 245 ft bgs based on pump setting = 300 ft bgs, NPSH = 25 ft, SF = 30 ft

4.3.2 Injection Rates

A standard practice for ASR design and operations is to limit the injection rate to a maximum of 75 percent of the pumping rate so that suspended solids present in injection water can be easily removed by back-flushing and pumping to prevent long-term clogging of the aquifer. Based on this standard of practice, the maximum design injection rate for this project would be 780 gpm; for the purposes of this evaluation, we are assuming an average injection rate of 700 gpm, or roughly 1.0 MGD.

OWRD may require, as one condition of the ASR Limited License, that a certain percentage of the volume injected each year be left in the ground as a loss factor. For the purposes of this evaluation, we utilized a 15% loss factor for calculating the minimum storage volumes to achieve recovery goals. More recent limited licenses prescribe loss factors as low as 5%, but our analysis will use the more conservative value. Thus, to recover the targeted demands of 138 AF (30-day) and 420 AF (3-months), the necessary storage (injection) volumes would be 159 AF and 483 AF, respectively. Based on observations from the short-term testing, an ASR well would need to inject water for a period of approximately 51 days and 156 days to achieve the minimum required storage volumes of 159 AF (30-day) and 483 AF (3-month), respectively.

The resulting water level rise, or “draw up” values for these two scenarios are presented in **Table 4-4**. Factors including initial well efficiency, performance losses, backflushing and operational schedules may impact the duration of injection. ASR pilot testing is necessary to refine the duration of injection necessary to achieve the target storage volumes.

TABLE 4-4. INJECTION VOLUMES

INJECTION PERIOD (DAYS)	INJECTION RATE (GPM)	INJECTION VOLUME (AF)	THEORETICAL WATER LEVEL DRAWUP (FT))	WATER LEVEL (FT BGS)
51	700	159	50	+5 (2 psi)
156 (~5 MONTHS)	700	483	60	+15 (6.5 psi)

Note: positive water level signifies the injection level is above ground surface

Based on the estimated water level draw up during injection and assumed pre-injection static water level of approximately 45 feet bgs, water levels during injection could rise above ground surface by 5 to 15 feet. Ideally, the target storage aquifer at the selected storage facility would have sufficient available draw up, or “headroom,” to achieve the minimum desired injection rate of 700 gpm with the water level in the well remaining below ground surface. However, ASR wells are commonly engineered to inject under pressure (with a water level rising above land surface). For example, the City of Cornelius ASR system is designed to inject under pressure, and the system pressure is generally 50 to 60 psi at the wellhead. A common maximum operating pressure criterion for injection is 50 pounds per square inch (psi), or approximately 115 feet above ground surface, and systems are typically designed to withstand up to 100 psi of injection pressure. Alternatively, the injection rate could be adjusted to maintain the draw up below ground surface, which would require additional time to achieve the target storage volumes.

4.4 SUMMARY

This preliminary evaluation of the CRBG aquifer at the Test Well location indicates that the target storage volume needed to meet the City’s emergency or summer peak demand needs can likely be met with a single ASR well. ASR pilot testing will be necessary to refine and improve operational understanding of injection rates, storage capacity, and interference estimates.

It is important to note that these estimated injection rates and storage volumes are based on the limited data generated during the field investigation (i.e., test well drilling and short-term testing). Full scale storage volumes, recovery rates, and injection rates will depend upon the amount of available headspace in the aquifer, which fluctuates seasonally and will be influenced by injection and recovery operations. We recommend that the City instrument the Test Well with a recording pressure transducer to monitor water levels through the summer and winter seasons if the decision is made to pursue developing an ASR system. The data will be valuable for determining the magnitude of background water level fluctuations in the aquifer, which will help refine design and operational parameters for the system.

5.0 SOURCE WATER AVAILABILITY

The rates and volumes of treated source water available to the City for ASR storage determined by the authorized capacity of its water rights, the treatment capacity and demands. Water would be injected into the ASR facility during the off-peak demand months (November through April). According to the City's 2018 Water Management and Conservation Plan, the 2017 off-peak maximum day demands ranged from 1,400 gallons per minute (gpm) to 2,600 gpm. The 2037 projected off-peak maximum day demands range from 2,000 gpm to 3,300 gpm. Injection into the facility would require the authorization to divert and the capacity to treat an additional 700 gpm during the off-peak months.

5.1 AUTHORIZED WATER USE

The City's water rights, shown in Table 5-1, are sufficient to meet the City's off-peak maximum day demands through 2037 in addition to increased demand for ASR injection. The currently authorized rate of the City's off-peak season surface water rights not subject to volume limitations or other conditions is 7,899 gpm. These water rights are highlighted in Table 5-1.

TABLE 5-1: CITY OF STAYTON WATER RIGHTS

Permit, Certificate, Claim, or Transfer	Season of Use	Priority Date	Rate (cfs)	Volume (AF)	Notes
Surface Water					
S-52447	October 1 - April 30	5/13/1991	25		Extended permit with fish persistence conditions. The City must request access to water through submittal of a Water Management and Conservation Plan before using water under this permit.
57094	Year-round	12/10/1963	7		
80346	May 1 - September 30	5/14/1909	2.78	779.5	Irrigation season only
80347	May 1 - September 30	6/24/1911	0.82	230.6	Irrigation season only
80348	Year-round	5/14/1909	0.39	78.5	Volume-limited
80349	Year-round	12/31/1907	0.6		
T-9192	Year-round	7/5/1923	10		Inchoate transfer extended through 2042
Subtotal Off-Peak Surface Water Rights without Restrictions			**17.60**		
Total Off-Peak Surface Water Rights			**42.99**		
Groundwater					
GR-145	Year-round	12/31/1930	2.674		
24587	Year-round	3/16/1956	3		

5.2 TREATMENT PLANT CAPACITY

The major water treatment process capacities are summarized in Table 5-2 below. Note that typical operation of the filters is with all three online. While each filter has the theoretical capacity of over 3,000 gpm, the filters would not be able to sustain this continuous loading rate over the span of multiple days.

TABLE 5-2: SUMMARY OF WATER TREATMENT PLANT CAPACITIES

Unit Process	Number of Units	Total Estimated Capacity
Power Canal/River Intake and Raw Water Weir Box	1	7,000 gpm
Filters	3	3,000 gpm (per filter)
Clearwell	1	500,000 gallons
Finished Water Pumps	2	4,930 gpm

The finished water pumps are the limiting treatment component at 4,930 gpm. Even with this limitation, the pumps would have capacity for injection at the upper end of the projected 2037 off-peak maximum day demand range (approximately 4,000 gpm total). The City's water treatment plant has the capacity to treat the additional flow required of an aquifer storage and recovery facility.

6.0 WATER QUALITY REVIEW

Water quality requirements for ASR are described in OAR 690-350-0010. Three state agencies regulate ASR: Oregon Water Resources Department (OWRD), Oregon Health Authority (OHA), and Department of Environmental Quality (DEQ). DEQ regulates the quality of the injection source water, and OHA regulates the quality of the water recovered from storage and distributed to customers.

6.1 INJECTION SOURCE WATER

According to state requirements, water must be treated to drinking water standards prior to injection into an aquifer for storage and recovery. Impacts of mixing injected water with the native groundwater must also be considered as the native groundwater cannot be degraded (see discussion in Section 6.2 below). The rules allow for injection of regulated chemical compounds at concentrations up to one-half the maximum contaminant level (MCL) for drinking water.

The City's water source for injection would be finished water conveyed from the treatment plant. The City's historical water treatment data and OHA drinking water data online for the last five years show that the City can consistently meet drinking water standard requirements, and that concentrations of detected analytes are less than one-half the MCL.

Additional treatment of the water prior to injection may be desired such as adding chlorine to impede bacterial growth in the well. A discussion of the native groundwater and the geochemical mixing evaluation is provided below.

6.2 NATIVE GROUNDWATER

A groundwater sample was collected from the Test Well at the end of the constant-rate test on December 8, 2021 to evaluate the quality of native groundwater as it relates to applicable maximum contaminant levels (MCLs) for drinking water, as well to assess potential geochemical reactions from mixing with surface source water. Prior to collection of the groundwater water sample, field parameters were monitored to verify that water quality was relatively stable and representative of aquifer water. The sample was submitted to Eurofins Analytical for analysis for the following constituents: geochemical and inorganic constituents (IOCs); radiologicals; synthetic organic compounds (SOCs); and volatile organic compounds (VOCs).

Analytical results show that native groundwater quality from the Test Well meets regulatory standards for all tested analytes (see Table 1 in Appendix C and the laboratory report in Appendix E). Native groundwater has favorable characteristics related to the aesthetic quality of drinking water, having a “slightly hard” classification (44 milligrams per liter, mg/L), a relatively neutral pH (8.1), and low concentrations of metals and other IOCs. Iron (75 micrograms per liter, µg/l), manganese (18 µg/l), and barium (6.6 µg/l) were detected in the groundwater sample, but at concentrations well below their respective aesthetics-based Secondary MCLs. No regulated radiological constituents, SOCs, and VOCs were detected in the groundwater sample. The Langelier Saturation Index (LSI) of -0.44 indicates that the water is slightly corrosive.

6.3 GEOCHEMICAL MIXING EVALUATION

S.S. Papadopulos & Associates, Inc (SSPA) completed a geochemical compatibility evaluation to assess the potential for mixing of surface source water with native groundwater during injection to cause geochemical reactions that could result in adverse effects such as aquifer/well clogging or degradation of recovered water quality. SSPA’s report is included in Appendix F. SSPA used laboratory analytical results from analysis of the native groundwater sample collected from the Test Well and analysis of a sample from the City’s distribution system to represent injection source water. The sample from the distribution sample was collected from a residence near the Test Well site, located at 2195 Kindle Way NE.

For this analysis, several groups of minerals were evaluated, including silica, carbonate, sulfate, iron, and manganese minerals. Based on the results of the analytical data, and as summarized below, no adverse geochemical compatibility issues are predicted, and source water-groundwater mixtures are predicted to meet drinking water criteria with no significant mineral precipitation expected to occur. A summary of the analysis of the potential for precipitation or other adverse reactions involving key compounds is provided below:

- Silica: Silica precipitation is not expected to occur because the kinetics of the reaction are very slow and the necessary minerals were not detected in solution.
- Carbonate: There is a potential for carbonate minerals to precipitate based on the equilibrium model, but the likeliness of precipitation to occur during mixing decreases with increasing source water for the ASR project.
- Sulfate: Sulfate minerals are not predicted to precipitate.

- <u>Iron:</u> There is some potential for iron oxyhydroxide precipitation based on the equilibrium model, but the amount is likely to be small based on the low concentrations of iron in the native groundwater. Based on evidence from other regional ASR systems with similar iron concentrations, well clogging is unlikely to occur.
- <u>Manganese:</u> Although some manganese precipitation is possible, the potential for well clogging is predicted to be small, and precipitation will decrease with an increasing amount of source water in the mix.
- <u>Trihalomethanes:</u> Due to the presence of residual chlorine in the City's source water, the model was performed to evaluate potential formation of trihalomethanes (a disinfection byproduct). Based on those results, concentrations of total trihalomethanes (TTHMs) are predicted to increase in injection source water, but then decay over time, and be significantly lower than the MCL of 0.08 mg/L.

6.4 RECOVERED WATER QUALITY

Sampling of the Test Well during aquifer testing for comparison with recharge source water standards under ASR rule frameworks did not identify fatal flaws for using surface source water for subsurface storage. Based on the geochemical mixing analysis, the quality of the water recovered during ASR operations is anticipated to meet the applicable drinking water standards.

7.0 CONSERVATION AND REGIONAL WATER MANAGEMENT

7.1 CONSERVATION OPPORTUNITIES

The City has implemented several measures to facilitate water conservation. These measures are described in detail in the 2018 Water Management and Conservation Plan Update (WMCP, Keller Associates) and include the following: fully meter all connections; test meters annually; replace meters annually; complete annual water audits; complete leak detection studies; replace water pipes annually; and increase public awareness of water conservation. These measures contribute to reducing water waste in the City's distribution system. The City anticipates that they will be starting a water master plan this year and will be looking to provide a status update on water conservation measures as a part of the water master plan.

7.2 REGIONAL WATER MANAGEMENT

An ASR facility in Stayton has the potential to improve resiliency in the region. The projected water demands for Stayton and the neighboring communities, Sublimity and Aumsville, are summarized below, followed by a discussion on the regional water management and planning-level costs associated with new interties.

7.2.1 Stayton Demands

The City's WMCP provides the most recent projected maximum day demands based on water production data and projected population growth. Table 7-1 is derived from the summary table provided in Section 5 of the WMCP.

TABLE 7-1: HISTORICAL AND PROJECTED MAX DAY DEMANDS FOR STAYTON BY MONTH

	Projected Max Day Demands (gpm)		
	2017*	2027 **	2037 **
Annual Population	7,770	8,833	9,567
January	1,658	2,070	2,241
February	1,423	1,886	2,042
March	1,656	2,001	2,167
April	2,638	2,999	3,248
May	1,832	2,636	2,855
June	2,305	2,990	3,238
July	4,307	5,922	6,414
August	4,570	5,196	5,627
September	4,037	5,258	5,694
October	2,315	4,406	4,772
November	1,717	2,276	2,465
December	1,769	2,190	2,372

* Values based on maximum day demands for each month in 2017

** Values based on maximum day demand for each month from 2013 to 2017

While the City has enough available water rights to support projected demands, potential low river levels, high turbidity, and water quality impairments upstream can compromise the City's primary water source. The need for a secondary water source was formally identified in the City's 2006 Water Master Plan, and several raw water options were evaluated as a part of the planning process. A two-year shallow well investigation was completed in 2014. This investigation suggested that a well with hydraulic connectivity to the North Santiam River had the potential to support a 1,000-gpm infiltration gallery. As discussed in the WMCP, the City desires to diversify its water sources to ensure an emergency water supply during times of drought or source water contamination. An ASR facility would utilize existing water rights, while enabling the City to have an emergency water source independent of the North Santiam River.

7.2.2 Neighboring Communities' Demands

Projected maximum day demands for the cities of Sublimity and Aumsville are shown in Table 7-2 below. The demands were taken from Sublimity's 2020 Water System Master Plan (4B Engineering & Consulting) and Aumsville's 2015 Water Master Plan (Keller Associates). The Sublimity planning study used a design flow of 430 gallons per capita per day (gpcd) compared to 210 gpcd in the Aumsville planning study, which results in a relatively higher maximum day water demand projection for the smaller population.

TABLE 7-2: FUTURE WATER SYSTEM DEMANDS OF SUBLIMITY AND AUMSVILLE

Future Demand Scenario	Sublimity 2035	Aumsville 2034
Population	**4,728**	**5,673**
Max Day (gpm)	1,576	928

These demands are considered below in the discussion on regional interties.

7.2.3 Interties with Neighboring Communities

Stayton has an emergency intertie with the City of Salem, which it has utilized during water shortages. This intertie is made possible in part by the proximity of Salem's point of diversion on the North Santiam River, just upstream from the City's point of diversion. The intertie is located at the City's Schedule "M" storage and booster tank facility.

Groundwater is the sole source of supply for both the Sublimity and Aumsville water systems. Sublimity's municipal wells access the Columbia River Basalt Group (CRBG) aquifer, and the wells are located within the Stayton-Sublimity Groundwater Limited Area, designated such because of declining groundwater levels. Aumsville's municipal wells access both the CRBG aquifer and shallower alluvium groundwater. The anticipated recovery rate of an ASR facility in Stayton is 1,040 gpm. In an emergency, this rate could meet the projected maximum day demand for Aumsville, and approximately 66% of the projected maximum day demand for Sublimity. A Stayton ASR facility could not only increase water resiliency in the City, but it has the potential for increasing regional resiliency and acting as an emergency source for neighboring cities.

Sublimity is the nearest neighboring City, and to connect to it, Sublimity would need approximately one mile of pipeline that would cross a canal, Mill Creek, and Highway 22. Anticipated infrastructure includes a booster station, and a flow control valve. A planning-level cost estimate is shown in Table 7-3 below. The canal and creek crossings assume a subsurface bore to install the pipe.

Capital costs developed for the estimates below are Class 4 estimates as defined by the Association for the Advancement of Cost Engineering (AACE). Actual construction costs may differ from the estimates presented, depending on specific design requirements and the economic climate when a project is bid. An AACE Class 4 estimate is normally expected to be within -50 and +100 percent of the actual construction cost. As a result, the final project costs will vary from the estimated presented in this document. The range of accuracy for a Class 4 cost estimate is broad, but these are typical accuracy levels for planning work.

TABLE 7-3: SUBLIMITY INTERTIE COST ESTIMATE

GENERAL LINE ITEM	EST. QTY	UNIT	UNIT PRICE	AMOUNT
16-inch DI Pipe - Excavation, Backfill, Fittings	5,280	LF	$ 330	$ 1,742,400
Canal Crossing	60	LF	$ 800	$ 48,000
Creek Crossing	100	LF	$ 800	$ 80,000
Full Lane Pavement Repair	5,280	LF	$ 100	$ 528,000
New Booster Station - Structural, Mechanical, Electrical, Site Work	1	LS	$ 300,000	$ 300,000
Pressure Reducing Valve and Vault	1	LS	$ 35,000	$ 35,000
Traffic Control	5,280	LF	$ 60	$ 316,800
Mobilization	1	LS	10%	$ 306,000
Contingency and Allowances	1	LS	40%	$ 1,343,000
Construction Subtotal (rounded)				***$ 4,700,000***
Engineering and CMS	1	LS	25%	$ 1,175,000
Legal, Admin, and Permitting	1	LS	2%	$ 94,000
Total Project Cost (rounded)				***$ 5,969,000***

Aumsville is the next nearest neighboring City, and an intertie with its system would require three to four miles of new pipeline and a booster station. Development of this intertie would entail crossing Mill Creek. A planning-level cost estimate is shown in Table 7-4 below. The creek crossing assumes a subsurface bore to install the pipe.

TABLE 7-4: AUMSVILLE INTERTIE COST ESTIMATE

GENERAL LINE ITEM	EST. QTY	UNIT	UNIT PRICE	AMOUNT
16-inch DI Pipe - Excavation, Backfill, Fittings	18,480	LF	$ 330	$ 6,098,400
Creek Crossing	100	LF	$ 800	$ 80,000
Full Lane Pavement Repair	18,480	LF	$ 100	$ 1,848,000
New Booster Station - Structural, Mechanical, Electrical, Site Work	1	LS	$ 300,000	$ 300,000
Traffic Control	18,480	LF	$ 60	$ 1,108,800
Mobilization	1	LS	10%	$ 944,000
Contingency and Allowances	1	LS	40%	$ 4,152,000
Construction Subtotal (rounded)				***$ 14,532,000***
Engineering and CMS	1	LS	25%	$ 3,633,000
Legal, Admin, and Permitting	1	LS	2%	$ 291,000
Total Project Cost (rounded)				***$ 18,456,000***

8.0 POTENTIAL ENVIRONMENTAL IMPACTS

Development of the Mill Creek Park site was evaluated based on potential environmental impacts. Based on published reports and data from local, federal, and state resources, this section provides information on wetlands, cultural resources, floodplain, endangered species, and wildlife habitat onsite. No environmental or cultural resource surveys were completed for this study.

8.1 WETLANDS

Three existing wetlands were identified on the Mill Creek Park Site during a 2016 park design project, as shown in the Figure G-1 in Appendix G. These wetlands are in the field north of the existing park buildings and within the 100-year floodplain. A priority identified during preliminary discussions was to avoid locating the ASR facility within the 100-year floodplain area if possible. According to the City's Local Wetland Inventory, a forested wetland exists along Mill Creek in the northeast corner of the site and in an area that was not considered acceptable for an ASR facility. Impacts to wetlands during construction of an ASR facility would require the City to obtain removal/fill permits from Oregon Department of State Lands and in-water work permits from the United States Army Corps of Engineers.

8.2 CULTURAL RESOURCES

The Oregon Statewide Inventory for historic places, which includes sites listed in the Nation Register of Historic Places, was consulted to identify any known historic locations on the Mill Creek Park site. No known historic places are located on or near the site.

8.3 FLOODPLAIN

The 100-year and 500-year floodplains cut across most of the proposed site. This is evident in Figure G-2 of Appendix G. Construction within the 100-year floodplain would require floodplain development permitting and design measures to keep well electrical and fuel facilities above the floodplain elevation. As stated above, the City prefers to avoid development of the ASR facility within the 100-year floodplain.

8.4 SPECIES OF CONCERN

Threatened, endangered, and sensitive species were researched for the Mill Creek Park site. Resources included the U.S. Fish & Wildlife Service's (USFW) Information for Planning and Consultation website (https://ecos.fws.gov/ipac/), the Oregon Department of Fish & Wildlife's (ODFW) Compass mapping website (https://www.dfw.state.or.us/maps/compass/), and the Oregon Flora mapping website (https://oregonflora.org/spatial/index.php). The lists below were generated from the USFW and ODFW websites as the Oregon Flora website did not show species of concern within the vicinity of the proposed site. The following species are potentially found within the vicinity of the site.

Federally Listed Species and Status:

- Streaked Horned Lark (*Eremophila alpestris strigata*) – Threatened
- Fender's Blue Butterfly (*Icaricia icarioides fender*) – Endangered

- Bradshaw's Lomatium (*Lomatium bradshawii*) – Endangered
- Kincaid's Lupine (*Lupinus sulphureus ssp. kincaidii*) – Threatened
- Nelson's Checkermallow (*Sidalcea nelsoniana*) – Threatened
- Willamette Daisy (*Erigeron decumbens*) – Endangered

State Listed Species and Status:

- Pacific Lamprey (*Entosphenus tridentatus*) – Sensitive
- Nelson's Checkermallow (*Sidalcea nelsoniana*) – Threatened
- Oregon Vesper Sparrow (*Pooecetes gramineus affinis*) – Sensitive
- Streaked Horned Lark (*Eremophila alpestris strigata*) – Sensitive
- Western Pond Turtle (*Actinemys marmorata*) – Sensitive

8.5 WILDLIFE

ODFW's Compass website showed wildlife habitat within the vicinity of the Mill Creek Park site for sensitive species. The list of species below may have habitat on or near the site:

- Acorn Woodpecker (*Melanerpes formicivorus*)
- California Myotis (*Myotis californicus*)
- Chipping Sparrow (*Spizella passerine*)
- Common Nighthawk (*Chordeiles minor*)
- Fringed Myotis (*Myotis thysanodes*)
- Hoary Bat (*Lasiurus cinereus*)
- Northern Spotted Owl (*Strix occidentalis caurina*)
- Olive-sided Flycatcher (*Contopus cooperi*)
- Oregon Slender Salamander (*Batrachoseps wrighti*)
- Oregon Vesper Sparrow(*Pooecetes gramineus affinis*)
- Short-Eared Owl (*Asio flammeus flammeus*)
- Silver-haired Bat (*Lasionycteris noctivagans*)
- Western Bluebird (*Sialia mexicana*)
- Western Gray Squirrel (*Sciurus griseus*)
- Western Meadowlark (*Sturnella neglecta*)
- Western Painted Turtle (*Chrysemys picta bellii*)
- Western Pond Turtle (*Actinemys marmorata*)
- Purple Martin (*Progne subis arboricola*)
- Willow Flycatcher (*Empidonax traillii*)
- Yellow-Breasted Chat (*Icteria virens auricollis*)

8.6 ECOLOGICAL FLOWS

Under the terms of the City's feasibility study grant, the City must identify ecological flows and assess the impact of the storage project on those flows. The analysis must include consideration of bypass, optimum peak, and flushing flows. Following OWRD's guidance, these flows are defined as follows:

- Bypass flows are flows that a project should pass to maintain the minimum habitat needs within a river system downstream of the impoundment (Robison, 2007). Generally, bypass flows refer to flows equal to the 50 percent exceedance flow or less.
- Optimum peak flows are flows that occur less frequently, but at a greater volume than the average flow. Optimum peak flow functions can be divided up between ecological triggering flows that trigger key behaviors such as migration or spawning and geomorphic maintenance flows, which help build and maintain overall ecological habitat (Robison, 2007).
- Flushing flows are a subset of optimum peak flows that specifically address the moving of existing streambeds and gravels allowing for "cleaning" of gravels intruded with fines. They improve spawning habitat and food sources in the medium and long-term by providing higher quality macro invertebrate habitat (ODFW, 2007).

The impact of on-channel surface water storage projects on peak and flushing flows can be substantial, as there are no physical limitations on the maximum rate that water can be appropriated for storage. However, this feasibility study is for an ASR project. The maximum rate that the City of Stayton can inject for storage is limited by the capacity of the City's water treatment facility, excess water (treated water in excess of the City's demands), and injection wells. As described above, the proposed injection rate for this project is 700 gpm (1.56 cfs). A reduction in flow of 1.56 cfs from the North Santiam River at USGS Gage 14184100, located approximately 13 miles downstream of the City's diversion, is not detectable at above flows over 1,000 cfs. Gage height is measured in increments of 0.01 feet, corresponding to increments of greater than 10 cfs in estimated discharge. Flows for the North Santiam River are also reported at USGS Gage 14184100 in 10 cfs increments.

Nevertheless, consistent with the requirement to assess the impact of the storage project on ecological flows, GSI evaluated the impact of an increase in the City's diversion of 1,400 gpm (3.12 cfs), twice the proposed rate of injection, on the frequency that flow targets are met at USGS Gage 14184100 on the North Santiam River near Jefferson.

In order to document ecological flow thresholds on the North Santiam River, GSI reviewed existing information from a variety of sources, including the following:

- ODFW recommended fish persistence conditions on Permit S-52447, corresponding to bypass flows.
- Recommended Minimum Perennial Streamflows for the North Santiam River above gage 14184100 near Jefferson (from ODFW Basin Investigation Report)
- Endangered Species Act Section 7(a)(2) Consultation – Biological Opinion and Magnuson-Stevens Fishery Conservation & Management Act Essential Fish Habitat Consultation on the Willamette River Basin Flood Control Project, 2008 (Willamette Bi-Op)
- United States Army Corps of Engineers' 2018 Willamette Fish Operations Plan (Chapter 2 – North Santiam), which identifies recommended changes to flow target since the approval of the Willamette Bi-Op.
- Summary Report of Environmental Flows Workshop for the Santiam River Basin (Nature Conservancy 2013), with flow recommendations following findings of An Environmental Streamflow Assessment for the Santiam River Basin, Oregon by Risley et al., 2013.

Table 8-1 shows select bypass, optimum peak, and flushing flows identified based on a review of the above sources. The identified bypass flow is the greater of the flow identified in the 2018 Willamette Fish Operations Plan and the bypass flows recommended in Permit S-52447. Information about optimum peak flows is from the 2018 Willamette Fish Operations Plan, which identified a longer period of optimum peak flows than the original 2008 Willamette BiOp. The 2013 Nature Conservancy report is the only source that identified flushing flows. The 13,000 to 18,000 cfs range of flushing flows in the 2013 Nature Conservancy report for the Santiam River Basin is equivalent to bank full flows. USACE manages releases from Detroit Lake throughout the winter season to prevent flows in excess of bank full, making flows equivalent to bank full uncommon. Flows in excess of 13,000 cfs for 3 consecutive days or more has occurred five times since 2008.

TABLE 8-1: IDENTIFIED BYPASS, OPTIMUM PEAK, AND FLUSHING FLOWS

	Ecological Flows (cfs)				
Time Period	**Bypass Flow (greater of [a,b])**	**Optimum Peak Flows[b]**	**Purpose of Bypass and Optimum Flows**	**Flushing Flows Low[c]**	**Flushing Flows High[c]**
January	1,200		Chinook Incubation	13,000	18,000
February	1,200		Minimum	13,000	18,000
March 1 - 15	1,200		Minimum	13,000	18,000
March 16 - 30	1,500	3,000	Steelhead Spawning	13,000	18,000
April	1,500	3,000	Steelhead Spawning		
May	1,500	3,000	Steelhead Spawning		
June	1,200		Steelhead Incubation		
July 1 - 15	1,200		Steelhead Incubation		
July 16 - 31	1,000		Rearing		
August	1,000		Rearing		
September	1,500	3,000	Chinook Spawning		
October 1 - 15	1,500	3,000	Chinook Spawning		
October 16 - 31	1,500	3,000	Chinook Spawning		
November	1,500		Chinook Incubation	13,000	18,000
December	1,500		Chinook Incubation	13,000	18,000

Data sources: [a] Bypass flows identified in fish persistence conditions in Oregon Water Resources Department final order for Permit S-52447, dated April 24, 2015
[b] United States Army Corps of Engineers Willamette Fish Operations Plan - North Santiam Subbasin Fish Operations Plan 2021.
[c] Bach, L., J. Nuckols, and E. Blevins. 2013. "Summary report: environmental flows workshop for the Santiam River Basin, Oregon." The Nature Conservancy.

Tables 8-2 and 8-3 show the frequency that bypass and optimum peak flows, respectively, are met with and without the project. As described above, a reduction in flow of 3.12 cfs, equal to twice the proposed rate of injection for storage, is not detectable at USGS gage 14184100. This analysis is intended to identify when a reduction in flow of 3.12 cfs would theoretically, if not measurably, cause flow at USGS 14184100 to drop below the identified bypass flow. The impact of a reduction of 3.12 cfs on flushing flows was not evaluated, as USGS gage 14184100 estimates flows in increments of 100 cfs at flows above 10,000 cfs.

As described above, due to the low maximum rate that water can be diverted and stored, there is no impact of the proposed project on the frequency that environmental flow thresholds would be met. This is reflected in tables 8-2 and 8-3.

TABLE 8-2: FREQUENCY BYPASS FLOWS ARE MET WITH AND WITHOUT PROJECT

		Frequency Bypass Flows Are Met			
Time Period	**Median Flow of North Santiam near Jefferson, OR (USGS Gage 14184100), 2006 - 2021 Water Years**	**Bypass Flow**	**Frequency that Bypass Flow Met at Gage 141841000, 2006 - 2021 Water Years**	**Frequency that Bypass Flow Met *with project* at Gage 141841000, 2006 - 2021 Water Years**	**Change in Frequency**
November	5075	1500	97%	97%	0.0%
December	4890	1500	97%	97%	0.0%
January	4770	1200	100%	100%	0.0%
February	2970	1200	100%	100%	0.0%
March 1 - 15	2905	1200	100%	100%	0.0%
March 16 - 30	3160	1500	100%	100%	0.0%
April	3210	1500	99%	99%	0.0%

TABLE 8-3: FREQUENCY OPTIMUM PEAK FLOWS ARE MET WITH AND WITHOUT PROJECT

		Frequency Optimum Peak Flows Are Met			
Time Period	**Median Flow of North Santiam near Jefferson, OR (USGS Gage 14184100), 2006 - 2021 Water Years**	**Optimum Peak Flows**	**Frequency that Bypass Flow Met at Gage 141841000, 2006 - 2021 Water Years**	**Frequency that Bypass Flow Met *with project* at Gage 141841000, 2006 - 2021 Water Years**	**Change in Frequency**
November	5075	N/A			
December	4890	N/A			
January	4770	N/A			
February	2970	N/A			
March 1 - 15	2905	N/A			
March 16 - 30	3160	3000	53%	53%	0.0%
April	3210	3000	59%	59%	0.0%

9.0 SUMMARY AND CONCLUSIONS

The feasibility of developing an aquifer storage and recovery (ASR) system to accomplish the City's objectives for a backup supply source was studied and is documented in this report. The following is a summary of conclusions.

- The target injection and recovery rate are 1,040 gpm and 700 gpm, respectively.
- There are sufficient water rights and source capacity to deliver the target injection rates and storage volume to the ASR system during the injection period.
- Suitable sites are available, and a test well was drilled at the most likely site for development, the Mill Creek Park site.
- The hydrogeological assessment has determined there is a bounded confined aquifer with suitable storage and yield characteristics to support the development of an ASR system.
- The injection source water and the native groundwater meet water quality criteria. Additional treatment of the water prior to injection may be desired such as raising the chlorine residual in injection source water to impede bacterial growth in the well.
- The geochemical mixing evaluation showed that no adverse chemical reactions are anticipated when source water and native groundwater are mixed during injection, and the quality of the recovered water is anticipated to meet regulatory standards.
- There are regional water management opportunities to provide interties that would provide a backup water source to the neighboring communities of Sublimity and Aumsville.
- No adverse environmental impacts are anticipated including, but not limited to, wetlands, floodplain, and ecological flows.

Based on the evaluation presented herein, ASR seems to be a feasible and adaptable secondary source option for the City. ASR can be combined with the City's existing water source to provide a more robust water supply. The cost estimate in Table 9-1 includes development of the ASR well, permitting, engineering, licensing, testing, and construction of the infrastructure improvements recommended for an ASR facility for the Mill Creek Park site. Costs for routine maintenance and operation are not included.

TABLE 9-1: COST ESTIMATE FOR ASR FACILITY, TESTING, AND PERMITTING

Stayton ASR Facility at Mill Creek Park Site				
GENERAL LINE ITEM	EST. QTY	UNIT	UNIT PRICE	AMOUNT
Pipeline and Facility	1	LS	$ 2,992,500	$ 2,992,500
Pipeline and Facility Construction Subtotal (rounded)				***$ 2,993,000***
Engineering and CMS	1	LS	25%	$ 749,000
Legal, Admin, and Permitting	1	LS	2%	$ 60,000
Total Project Pipeline and Facility Cost (rounded)				***$ 3,802,000***
Well Drilling Construction	1	LS	$ 865,825	$ 865,825
Design, contractor selection support, permitting (OHA), construction oversight, testing and engineering design support	1	LS	$ 150,000	$ 150,000
ASR limited license application and supporting studies/fees	1	LS	$ 100,000	$ 100,000
Shakedown testing and first year of operational pilot testing, regulatory notifications and reporting	1	LS	$ 100,000	$ 100,000
Total Project Well Drilling Cost (rounded)				***$ 1,216,000***
Total Project Cost (rounded)				***$ 5,018,000***
AACE Class 4 Cost Estimate			**Accuracy**	**Total**
Low			**-30%**	**$ 3,512,600**
ESTIMATED PROGRAMMING COST ESTIMATE				**$ 5,018,000**
High			**+50%**	**$ 7,527,000**
The opinion of most probable cost herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.				

10.0 NEXT STEPS

Should the City decide to further explore developing an ASR system as a secondary source, the next steps would typically involve the following:

1. System Construction and Permitting

    - Apply for an ASR Limited License for pilot testing through OWRD. OWRD is the lead state agency of the three involved in ASR permitting, including OWRD, Department of Environmental Quality (DEQ) and Oregon Health Authority Drinking Water Program (OHA-DWP). ASR permitting also includes obtaining a Class V UIC permit for the ASR well.

      The ASR limited license application process includes a required pre-application conference with OWRD, DEQ and OHA-DWP staff. OWRD requires an application to include specific information including a description of the proposed project, a water quality monitoring and testing program, a system operation and wellhead facility design, and existing information about groundwater quality and source water quality (this evaluation will provide a significant amount of the supporting information for the application).

- Design, drill, and construct a full-scale ASR well. Assuming the Mill Creek Park location is selected for a full-scale ASR well, the production well can likely be sited in the southwest corner of the property. The existing test well can be used for monitoring during ASR operations and can likely be added to the Limited License and permitting through OHA-DWP to be used as a backup recovery well.
- Complete design and construction of ASR wellhead, controls, electrical, distribution, and disinfection improvements. Components of the ASR system will include, but are not limited to: a pump to waste feature, a bi-directional flow meter that can provide real-time data during injection and recovery, a turbidity meter located far enough upstream of the wellhead in order to provide sufficient time for the well to be shut down if a turbidity event occurs, and a dedicated downhole water level meter to monitor well performance.
- Complete design and construction of recommended system improvements to the City's existing distribution system. For the Mill Creek Park site, this includes new pipeline in Shaff Road.
- Complete short-duration shakedown and cycle testing to verify system performance.
- Perform pilot testing under the ASR Limited License, including full-scale injection, storage, and recovery, including delivering recovered water to customers. The pilot testing will be used to evaluate the full-scale injection and recovery rates, storage volumes, and recovered water quality. Backflushing events will take place periodically during the injection period.

2. Operations under the ASR Limited License
    - Annual reporting to OWRD (injection rates and volumes, recovery rates and volumes, water quality, etc.).
    - Well performance monitoring (tracking water levels and pumping rates).
3. Apply for ASR Permit
    - Obtain permanent ASR system permit when full system capacity is developed and tested.

11.0 REFERENCES

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Appendix A

Infrastructure Evaluation and Model Figures

APPENDIX A: INFRASTRUCTURE EVALUATION

A.1 SITES CONSIDERED

Several properties located throughout the City were evaluated for potential well siting. Considerations included water management and disposal during drilling, permanent pump-to-waste facility needs, proximity and location in existing distribution network, disinfection, noise, and setback requirements. An ASR well facility could periodically generate 1,040 gpm for 60 minutes during the pump-to-waste process (approximately 62,400 gallons). This extracted water will need to be routed to stormwater infrastructure or to an appropriate outfall.

A.1.1 Community Center Park

The Community Center Park, located in downtown Stayton adjacent to the Salem Ditch, is approximately 0.5 miles from the water treatment plant. The almost eight-acre park contains several community amenities including a community center building, tennis courts, swimming pool, playground, library, and open recreational field (see Figure A.1 below). The well site would be located within the open recreational field, which has also been identified in the City's Stormwater Master Plan as a location for a future 3.0-acre-foot regional detention pond.

FIGURE A.1. THE COMMUNITY CENTER PARK SITE.

For the well, extracted water could be discharged into the City's stormwater sewer conveyance right at the site. According to the City's GIS data, a 10-inch stormwater pipe crosses the property on the east side of the swimming pool building, conveying parking lot and swimming pool discharge directly to the Salem Ditch. The slope of the pipe is unknown. If the slope is assumed to be 0.28% (consistent with City Design Standards), the capacity of the pipe when full is 560 gpm. The City would need to coordinate with the Santiam Water Control District (SWCD, owner/operator of the Salem Ditch) regarding the potential discharge flow and volume, as well as with the swimming pool to ensure that capacity would be available in the 10-inch pipe for other dedicated flows. It is assumed that testing would occur during the dry season when there would be no demand for capacity on the existing stormwater pipe.

For a permanent ASR facility, the park site would need to be developed with a detention pond to handle the periodic pump-to-waste volume. It could be discharged into the regional stormwater detention pond that was recommended in the City's Stormwater Master Plan.

Onsite chlorine injection will likely be needed to treat recovered water prior to entering the distribution system.

A.1.2 Mill Creek Park

Mill Creek Park is on the north end of the City, partially within the floodplain of Mill Creek. It is approximately two miles from the City's water treatment plant, the farthest of all the sites considered. A portion of the site has been developed as a five-acre stormwater detention basin, with five additional acres reserved for expansion of the stormwater pond (see Figure A.2 below). The remaining eight acres is planned to be developed into a City park, and it is within this area that the well site would be located. City owned buildings currently occupy a small portion of the property.

FIGURE A.2. THE MILL CREEK PARK SITE.

Water from drilling/testing operations and during long-term operation of the well could be conveyed to the 5-acre stormwater detention basin near the site. Discharge from this pond is conveyed to an outfall on Mill Creek. Since the pond was constructed for storm events (2-year through 100-year), it is expected to be empty during the dry months (July through September) and therefore have ample capacity for well extracted water during testing and periodic wasting. Should pump-to-waste be generated during the wet months, preliminary calculations indicate that the detention pond would have capacity during a 100-year event without overtopping the facility; however, generating pump-to-waste during a large storm event would not be recommended.

Onsite chlorine injection will likely be needed to treat recovered water prior to entering the distribution system.

A.1.3 Schedule M

The Schedule M site is located south of the Power Canal, adjacent to the PNW Veg Co. property. A one-million-gallon reservoir tank, booster station, and inter-tie with the City of Salem water system are also located at this site (see Figure A.3 below). It is approximately one mile from the water treatment plant. The property that the City currently owns is less than one acre, and the City would need to obtain a variance for radius-of-control setback requirements (100-foot radius) or otherwise establish control through acquisition or a perpetual easement.

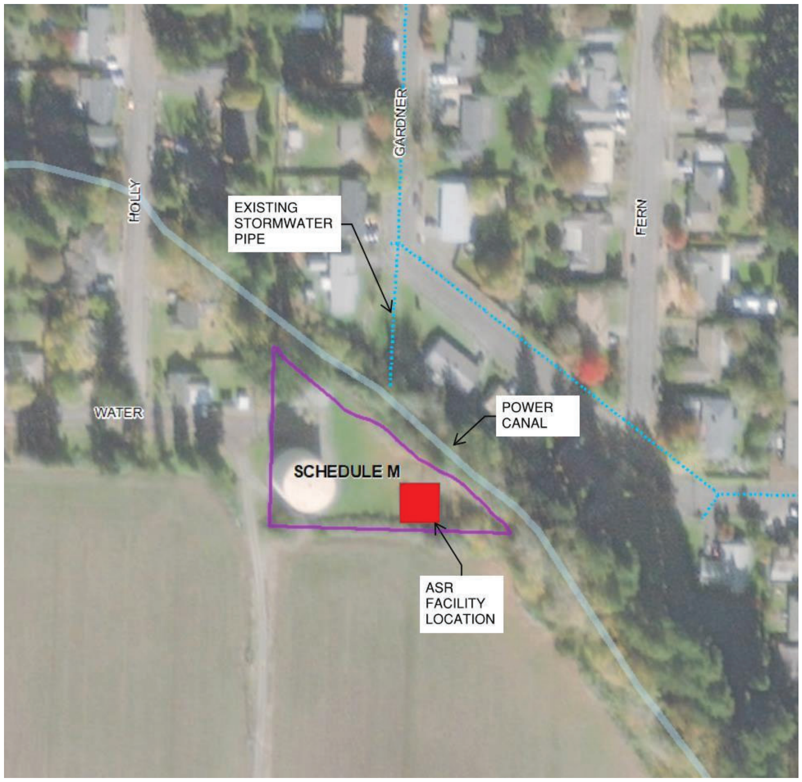


FIGURE A.3. THE SCHEDULE M SITE.

According to the City's GIS, the Schedule M site is not connected to the City's stormwater system, nor is there stormwater conveyance infrastructure serving the nearby residences south of the Power Canal. Catch basins adjacent to the Holly Avenue bridge appear to convey street runoff directly into the canal. The City would need to coordinate with the SWCD to discharge extracted water into the Power Canal generated during well operations. Additional land adjacent to the site may need to be purchased to develop a permanent well and detention pond to handle the pump-to-waste.

Onsite chlorine injection will likely be needed to treat recovered water prior to entering the distribution system.

A.1.4 Water Treatment Plant

The water treatment plant is over 30 acres in size, with space available for an ASR facility in the open field off 1st Street ("Modeled ASR Facility Location" as shown in Figure A.4 below) and in the field north of the plant clearwell ("Adjacent to WTP" as shown in Figure A.4 below). The treatment plant is located between the Power Canal and the North Santiam River. Recovered water could be conveyed to the treatment plant clearwell for disinfection, eliminating the need for separate infrastructure for disinfection of recovered water. The northern (alternate) ASR location is located within the floodplain of the North Santiam River. Development of this location would require grading to raise it out of the floodplain.

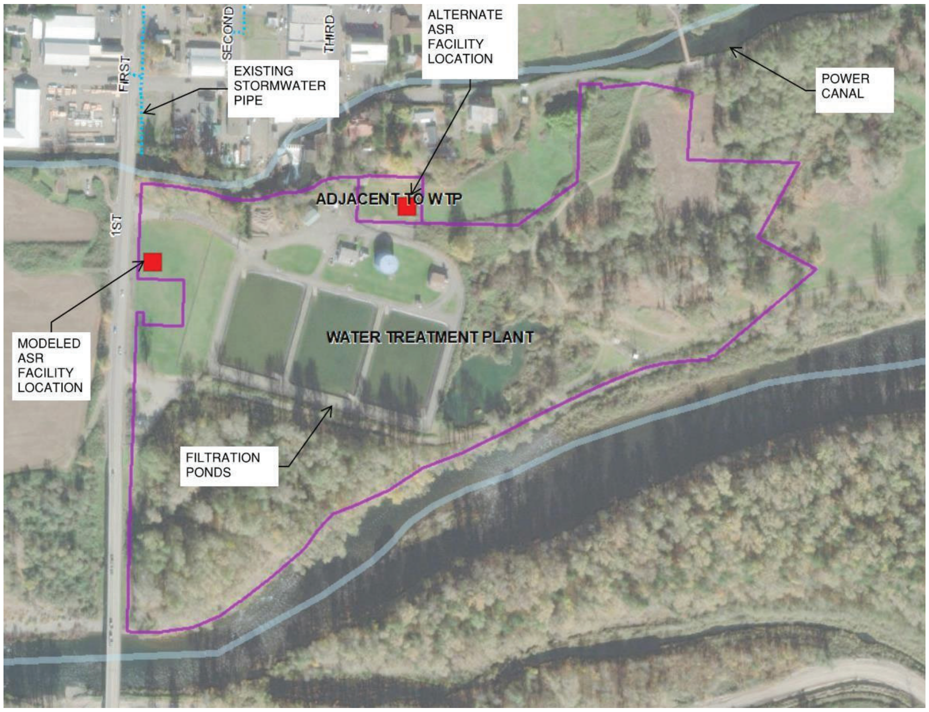


FIGURE A.4. THE WATER TREATMENT PLANT SITE.

Similar to the Schedule M site, there does not appear to be existing stormwater infrastructure south of the Power Canal onsite or adjacent to it. The City would need to coordinate directly with the SWCD to discharge extracted water generated during well operations to the Power Canal. For a permanent ASR facility, land adjacent to the site could be utilized to develop a detention pond to handle the pump-to-waste. Another option could be to convey the pump-to-waste to the slow sand filtration ponds to treat for potable consumption.

A.2 DISTRIBUTION SYSTEM EVALUATION

The 2011 calibrated version of the City's hydraulic water system model was used to evaluate distribution system capability to deliver 1 MGD of source water for injection and distribute 1.5 MGD of recovered water to the City's customers from the Mill Creek Park, Community Center Park, and Schedule M sites. WaterCAD v6.5 was utilized for the model update. The software applies the Hazen-Williams formula in an iterative manner for complex networks to determine system pressures based on various flow scenarios. The software can determine fire flows available at nodes (or pipe junctions) by systematically analyzing available flow rate per node while maintaining pressure levels above 20 psi throughout the system. Available fire flow should be between 1,000 and 1,500 gpm for residential areas and at least 2,500 gpm for commercial and industrial areas. Under normal operating conditions, public water systems typically target pressures between 60 and 80 psi, but not less than 35 psi.

The model was updated to include the Lambert Place and Wildlife Meadows subdivisions for this evaluation. For reference, existing water distribution pipe diameter and material from the current model are shown in the attached Figures A-8 and A-9. New piping to connect the well sites to the distribution system was modeled as 10-inch ductile iron pipe.

The three potential sites were evaluated based on an injection rate of 700 gpm (1 MGD) and recovery rate of 1,040 gpm (1.5 MGD). The model evaluates the effects of developing each site on the distribution system. The following scenarios were simulated for each site: available fire flow during well injection with average day demands; available fire flow during well injection with max day demands; peak hour pressures during well injection; available fire flow during well recovery with average day demands; and peak hour pressures during well recovery. Injection during max day demands with fire flows was evaluated to stress the system under extreme and unlikely operating conditions. Available fire flow during average day demands reflect a more likely scenario, although operators could shut down well injection if needed.

The attached Figures A-10 through A-12 show the existing system under these scenarios for a base line comparison. Figures A-13 through A-24 provide the results of these scenarios for the three potential sites. Figure A-25 shows the necessary distribution system improvements associated with development of specific sites. Below is a discussion of the results of the evaluation for each of the three sites, followed by a summary of the results.

A.2.1 Community Center Park

In the model, the Community Center Park site is connected to the existing 12-inch pipeline on First Avenue. For the scenario evaluation of the available fire flow during well injection with average day demands, the results indicate an increase along Virginia Street, and a decrease at the intersection of Cedar Street and Third Avenue (See Figure A-13). Injection during max day demands results in a decrease in available fire flow at the 6-inch pipe on Virginia Street (see Figure A-14), resulting in the pipeline falling below the 1,000-gpm available fire flow needed for residential areas. For the scenario evaluation of well injection during peak hour pressures, pressure reduces slightly on the southwest end of the distribution system causing four nodes to drop below normal operating pressure, as highlighted in Figure A-15.

For the scenario evaluation of available fire flow during recovery with average day demands, no changes were observed in the system (see Figure A-16). For the scenario evaluation of well recovery during peak hour pressures, an increase in pressure was observed along Holly Street and at the south end of First Street near the Water Treatment Plant, as highlighted in Figure A-17.

To address the decrease in available fire flow on Virginia Street, approximately 680 feet of 6-inch pipe should be replaced with an 8-inch pipe. Figure A.5 below and the attached Figure A-25 show this improvement. This improvement is included in the cost estimate for development of the Community Center Park site in Section 5.3. Keller recommends further analysis on this improvement as fire flows may be available by connecting to the parallel 10-inch water line on Virginia Street.

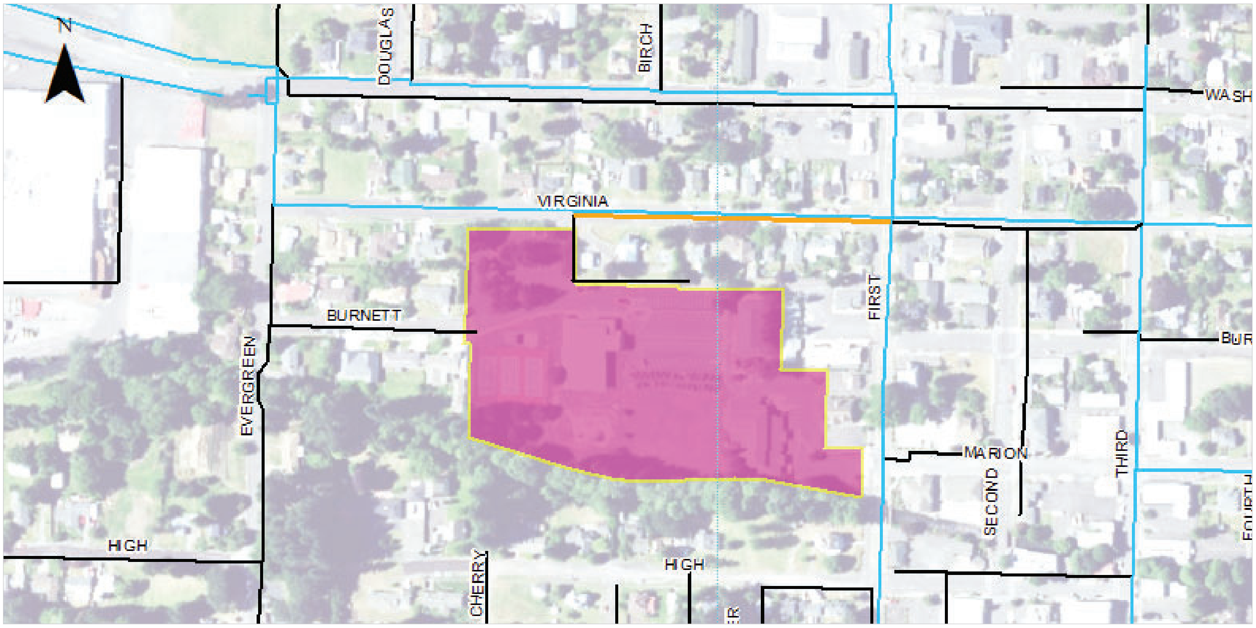


FIGURE A.5. WATER DISTRIBUTION SYSTEM IMPROVEMENTS ALONG VIRGINIA STREET (COMMUNITY CENTER PARK AND SCHEDULE M)

A.2.2 Mill Creek Park

In the model, the Mill Creek Park site was connected to the existing 10-inch main on Kindle Way SE. For the scenario evaluation of the available fire flow during well injection with max day demands, the results indicate a decrease in available fire flows along Pacific Court (see Figure A-17). Injection during max day demands results in a decrease in available fire flow at the Stayton Middle School to below 2,500 gpm. Seven nodes along the 16-inch pipeline on the south side of town increase by approximately 200-300 gpm as shown in Figure A-17. Nodes that changed in comparison to existing system conditions are highlighted in Figure A-17. For the scenario evaluation of well injection during peak hour pressures, results indicate reduced pressure on Rogue Avenue and two nodes near the intersection of Holly Street and W Ida Street from 61 psi to 59 psi, as highlighted in Figure A-18.

For the scenario evaluation of available fire flow during well recovery with average day demands, two nodes in the system near the proposed site increase available fire flows to above 2,500-gpm as highlighted in Figure A-19 For the scenario evaluation of well recovery during peak hour pressures, pressures increase near the proposed site and reduce at the southern end of the distribution system dropping from 60 to 80-psi to 40 to 60-psi, as highlighted in Figure A-20.

To address the decrease in available fire flow at the Stayton Middle School and High School, new piping will be required in Shaff Road, consistent with the Priority 1 improvements in the City's Water Master Plan. This includes the construction of new 16-inch water line along Shaff Road from the east edge of Stayton Middle School to east of Douglas Road.

FIGURE A.6. WATER DISTRIBUTION SYSTEM IMPROVEMENTS ALONG SHAFF ROAD (MILL CREEK PARK)

A.2.3 Schedule M

In the model, the Schedule M site is connected to the existing 16-inch pipeline on Holly Street just north of the pump station and tank. For the scenario evaluation of the available fire flow during well injection with average day demands, the results indicate a decrease in available fire flow along Pacific Court (see Figure A-21). Injection during max day demands results in a decrease in available fire flow to below 1,000 gpm in many nodes in the southwest portion of the distribution system. Additionally, the section of 6-inch pipeline north of the Community Center Park decreases below minimum residential fire flow demands. These deficiencies are highlighted in Figure A-21. For the scenario evaluation of well injection during peak hour pressures, several nodes fall below the targeted operating pressure on Rogue Avenue and along Maple Street as highlighted in Figure A-22.

For the scenario evaluation of available fire flow during well recovery with average day demands, results show that available fire flow increases along W Ida Street near the intersection of Holly Street and is reduced at the intersection on Sixth Street and Hollister Street, as highlighted in Figure A-23. Additionally, fire flows for a single node north of Regis High School fall from 2,685-gpm to 2,489-gpm. The node decreases below the 2,500-gpm benchmark for commercial and industrial use, although the decrease is negligible. For the scenario evaluation of well recovery with peak hour pressures, pressures increase to the targeted operating range along W Ida Street as highlighted in Figure A-24.

To address the deficiencies in available fire flow in the areas shown on Figure A-21, approximately 1,900-feet of parallel 12-inch pipe should be installed in W Water Street and N Evergreen St. Additionally, approximately 680 feet of 6-inch asbestos concrete pipe in W Virginia Street should be replaced with an 8-inch ductile iron pipe. Figures A.7 below and the attached Figure A-25 show these improvements. The cost estimate for development of the Schedule M site in Section 5.3 includes these improvements.

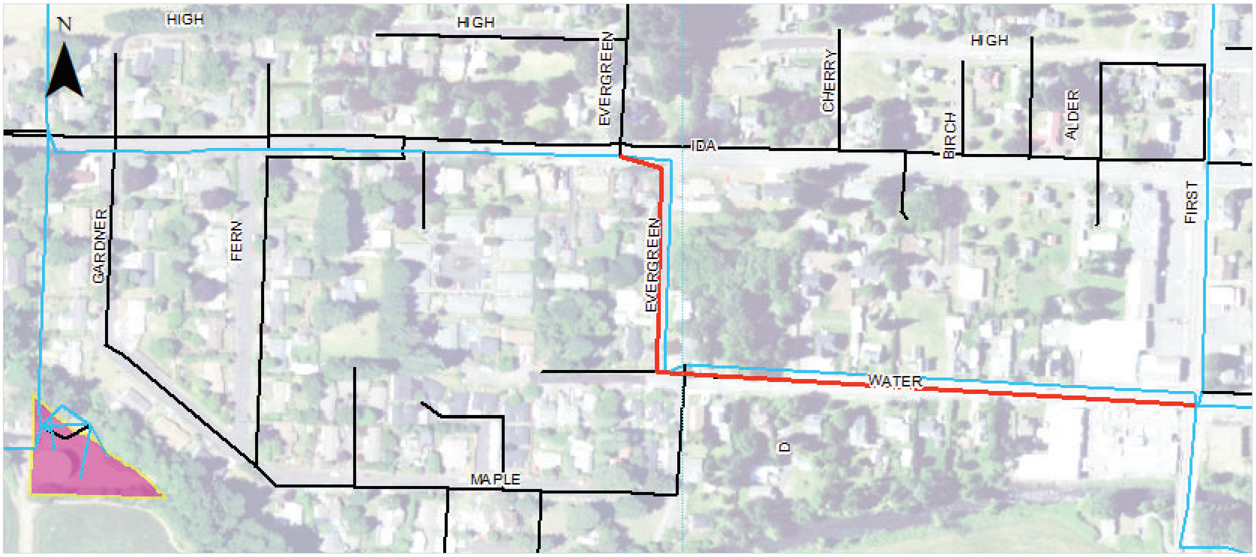


FIGURE A.7. WATER DISTRIBUTION SYSTEM IMPROVEMENTS ALONG IDA STREET (SCHEDULE M)

A.2.4 Modeling Summary

Table A-1 below provides a summary of the results from the hydraulic modeling of the Community Center Park, Mill Creek Park, and Schedule M sites.

TABLE A-1: SUMMARY OF DISTRIBUTION SYSTEM EVALUATION

COMMUNITY CENTER PARK		
SCENARIO	COMMENTS	IMPROVEMENTS FOR MAX DAY DEMAND SCENARIO ONLY
Well Injection with Average Day Demands	Increase in fire flow at the 6-inch pipe on Virginia Street, Decrease in fire flow at Third Avenue and Cedar Street.	Replace 6-inch pipe on Virginia Street with 8-inch ductile iron pipe (Figure A.5). Keller recommends further analysis on this improvement as fire flows may be available by connecting to the parallel 10-inch water line on Virginia Street.
Well Injection with Max Day Demands	Decrease in fire flow at the 6-inch pipe on Virginia Street, resulting in the pipeline falling below the 1,000-gpm available fire flow needed for residential areas	
Well Injection with Peak Hour Pressures	Slight decrease of pressure on southwest end of distribution system.	
Available Fire Flow during Recovery with Average Day Demands	No changes observed.	
Well Recovery during Peak Hour Pressures	Increase in pressure along Holly Street and near the water treatment plant.	
MILL CREEK PARK		
SCENARIO	COMMENTS	IMPROVEMENTS FOR MAX DAY DEMAND SCENARIO ONLY
Well Injection with Average Day Demands	Decrease in Fire Flow on Pacific Court.	To address the decrease in available fire flow at the Stayton Middle School and High School, new piping will be required in Shaff Road, consistent with the Priority 1 improvements in the City's Water Master Plan.
Well Injection with Max Day Demands	Decrease in fire flow at the Stayton Middle School to below 2,500 gpm. Seven nodes along the 16-inch pipeline on the south side of town increase from 940 gpm to 1160 gpm.	
Well Injection with Peak Hour Pressures	Decrease of 2 psi on Rogue Avenue and two nodes near the intersection of Holly Street and W Ida Street.	
Available Fire Flow during Recovery with Average Day Demands	Two nodes in the system near the proposed site increase fire flows to above 2,500-gpm.	
Well Recovery during Peak Hour Pressures	Pressures increase near the proposed site and reduce at the southern end of the distribution system.	
SCHEDULE M		
SCENARIO	COMMENTS	IMPROVEMENTS FOR MAX DAY DEMAND SCENARIO ONLY
Well Injection with Average Day Demands	No changes observed.	Approximately 1,900 feet of parallel 12-inch pipe should be installed in W Water Street and N Evergreen St. Additionally, approximately 680 feet of the 6-inch asbestos concrete pipe in W Virginia Street should be replaced with an 8-inch ductile iron pipe.
Well Injection with Max Day Demands	Decrease in fire flow to below 1,000 gpm in many nodes in the southwest portion of the distribution system. Additionally, the section of 6-inch pipeline north of the Community Center Park decreases below minimum residential fire flow demands.	
Well Injection with Peak Hour Pressures	Several nodes fall below the targeted operating pressure on Rogue Avenue and along Maple Street.	
Available Fire Flow during Recovery with Average Day Demands	Increases along W Ida Street near the intersection of Holly Street and is reduced at the intersection on Sixth Street and Hollister Street.	
Well Recovery during Peak Hour Pressures	Increase to the peak hour pressure of approximately 3 psi along W Ida Street.	

A.3 INFRASTRUCTURE COST ESTIMATES

Planning-level cost estimates were developed for each of the potential sites. Tables A-2, A-3, A-4, and A-5 provide cost estimates for each site. Table A-6 provides a summary of the cost estimates for all four sites. The costs are based on experience with similar water distribution improvement and master planning projects. The total estimated probable project costs include contractor markups and 30% contingencies. Overall project costs include total construction costs, costs for engineering design, construction management services, inspection, as well as administrative costs.

No additional infrastructure improvements are considered necessary for development of the water treatment plant site. It is assumed that the pump-to-waste pipeline could be discharged into the City's slow sand filtration ponds for treatment and drinking water use.

TABLE A-2: COST ESTIMATE FOR THE COMMUNITY CENTER PARK SITE

GENERAL LINE ITEM	EST. QTY	UNIT	UNIT PRICE	AMOUNT
10-inch DI Pipe - Excavation, Backfill, Fittings	600	LF	$ 250	$ 150,000
Full Lane Pavement Repair	500	LF	$ 100	$ 50,000
Traffic Control	500	LF	$ 15	$ 7,500
New Well - Structural, Mechanical, Electrical, Site Work	1	LS	$ 1,745,000	$ 1,745,000
Pump-to-Waste and Stormwater Detention Pond	1	LS	$ 350,000	$ 350,000
Mobilization	1	LS	10%	$ 231,000
Contingency and Allowances	1	LS	30%	$ 761,000
Construction Subtotal (rounded)				***$ 3,295,000***
Engineering and CMS	1	LS	25%	$ 824,000
Legal, Admin, and Permitting	1	LS	2%	$ 66,000
SWCD Permitting	1	LS	$ 25,000	$ 25,000
Total Project Cost (rounded)				***$ 4,210,000***

TABLE A-3: COST ESTIMATE FOR THE MILL CREEK PARK SITE

GENERAL LINE ITEM	EST. QTY	UNIT	UNIT PRICE	AMOUNT
10-inch DI Pipe - Excavation, Backfill, Fittings	110	LF	$ 250	$ 27,500
10-inch PVC Pipe - Excavation, Backfill, Fittings	1,100	LF	$ 175	$ 192,500
Full Lane Pavement Repair	1,100	LF	$ 100	$ 110,000
Traffic Control	1,100	LF	$ 15	$ 16,500
New Well - Structural, Mechanical, Electrical, Site Work	1	LS	$ 1,745,000	$ 1,745,000
Mobilization	1	LS	10%	$ 210,000
Contingency and Allowances	1	LS	30%	$ 691,000
Construction Subtotal (rounded)				***$ 2,993,000***
Engineering and CMS	1	LS	25%	$ 749,000
Legal, Admin, and Permitting	1	LS	2%	$ 60,000
Total Project Cost (rounded)				***$ 3,802,000***

TABLE A-4: COST ESTIMATE FOR THE SCHEDULE M SITE

GENERAL LINE ITEM	EST. QTY	UNIT	UNIT PRICE	AMOUNT
10-inch DI Pipe - Excavation, Backfill, Fittings	360	LF	$ 250	$ 90,000
Full Lane Pavement Repair	360	LF	$ 100	$ 36,000
Traffic Control	360	LF	$ 15	$ 5,400
New Well - Structural, Mechanical, Electrical, Site Work	1	LS	$ 1,745,000	$ 1,745,000
Pump-to-Waste Pond	1	LS	$ 200,000	$ 200,000
Land Acquisition	1	AC	$ 30,000	$ 30,000
Mobilization	1	LS	10%	$ 211,000
Contingency and Allowances	1	LS	30%	$ 696,000
Construction Subtotal (rounded)				***$ 3,014,000***
Engineering and CMS	1	LS	25%	$ 754,000
Legal, Admin, and Permitting	1	LS	2%	$ 61,000
SWCD Permitting	1	LS	$ 25,000	$ 25,000
Total Project Cost (rounded)				***$ 3,854,000***

TABLE A-5: COST ESTIMATE FOR THE WATER TREATMENT PLANT SITE

GENERAL LINE ITEM	EST. QTY	UNIT	UNIT PRICE	AMOUNT
10-inch DI Pipe - Excavation, Backfill, Fittings	1,500	LF	$ 250	$ 375,000
New Well - Structural, Mechanical, Electrical, Site Work	1	LS	$ 1,660,000	$ 1,660,000
Rough Grading	1	LS	$ 145,600	$ 145,600
Mobilization	1	LS	10%	$ 204,000
Contingency and Allowances	1	LS	30%	$ 716,000
Construction Subtotal (rounded)				***$ 3,101,000***
Engineering and CMS	1	LS	25%	$ 776,000
Legal, Admin, and Permitting	1	LS	2%	$ 63,000
Total Project Cost (rounded)				***$ 3,940,000***

TABLE A-6: SUMMARY OF COST ESTIMATES FOR ALL FOUR SITES

Potential Well Site	Cost Estimate (Rounded)
Community Center Park	$4,210,000
Mill Creek Park	$3,802,000
Schedule M	$3,854,000
Water Treatment Plant	$3,940,000

A.4 COMPARING THE RESULTS

Tables A-7 through A-9 provide comparisons of the sites considered. Table A-7 compares the different requirements associated with development of each site. Table A-8 provides a summary of the advantages and disadvantages associated with each site. Table A-9 provides a selection matrix with weighted criteria. Sites are rated on a scale of 1 (low/poor) to 5 (high/good).

Based on the comparison evaluation, the Mill Creek Park site was chosen for the potential permanent ASR facility. As evident in the tables below, this site provides several advantages as an offsite emergency water source and the cost estimate is the lowest of all four sites.

TABLE A-7: COMPARISON OF REQUIREMENTS FOR EACH SITE

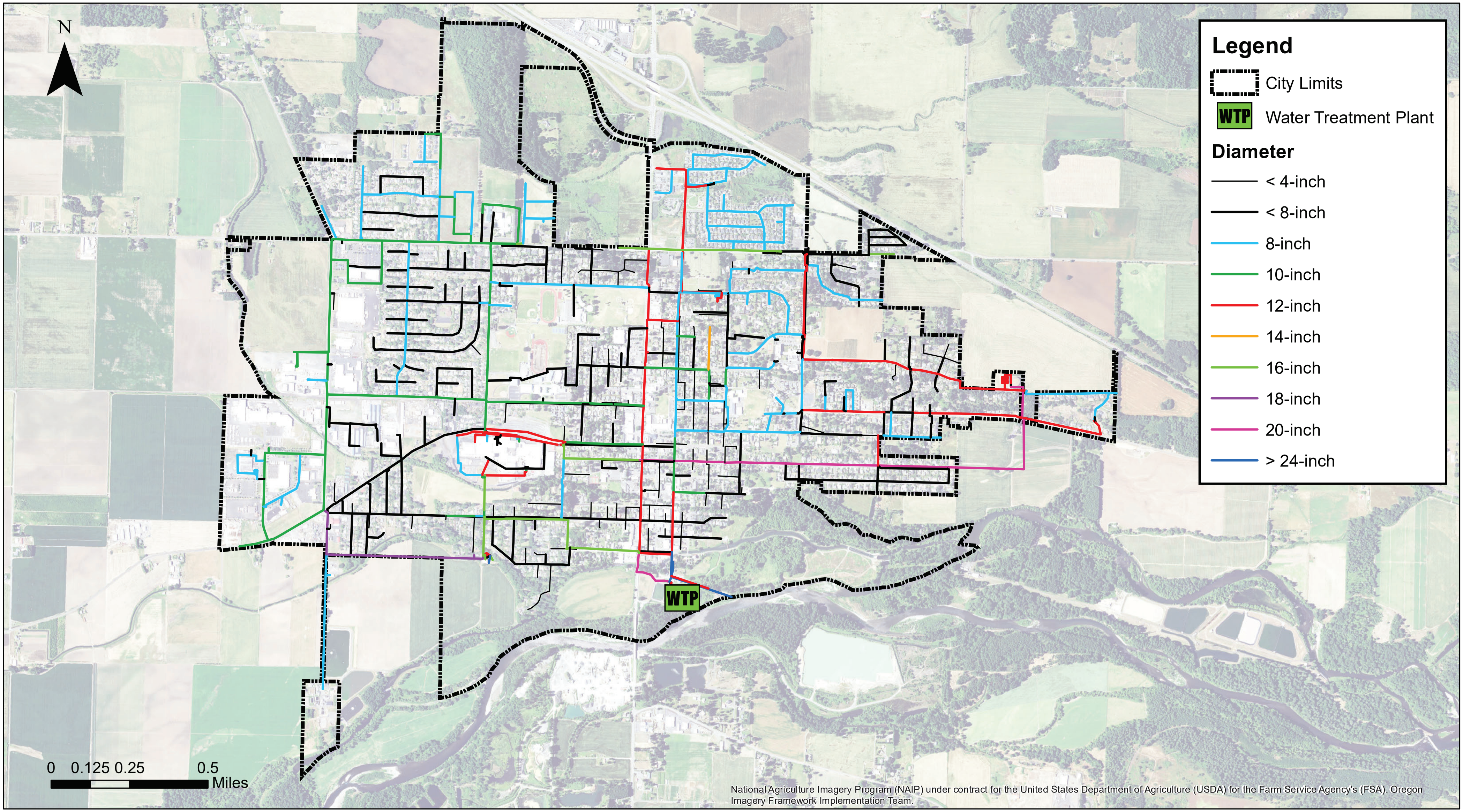
	COMMUNITY CENTER PARK	MILL CREEK PARK	SCHEDULE M	WTP
Cost Estimate	$4,210,000	$3,802,000	$3,854,000	$3,940,000
Requirements for Site Development				
Construction of a Detention Pond for Pump to Waste	X		X	
Improvements to the Distribution System	X	X	X	
Onsite Disinfection Treatment	X	X	X	
Land Acquisition			X	
Site Grading (Floodplain Development)				X

TABLE A-8: ADVANTAGES AND DISADVANTAGES ASSOCIATED PER SITE

	Advantages	**Disadvantages**
COMMUNITY CENTER PARK	• Has a higher probability of reaching a thicker part of the CRBG • Redundant water source offsite of WTP	• Requires improvements to the distribution system • Reduces available public space at the park • Requires coordination with SWCD for the well extracted water
MILL CREEK PARK	• Has a higher probability of reaching a thicker part of the CRBG • Redundant water source offsite of WTP • Does not require a detention pond for the pump-to-waste	• Requires improvements to the distribution system • Reduces available public space at the park
SCHEDULE M	• Redundant water source offsite of WTP	• Requires improvements to the distribution system • Projected to be the most expensive site to develop • Requires land acquisition • Requires coordination with SWCD for the well extracted water
WTP	• May not require a detention pond for pump-to-waste • Disinfection facilities exist onsite • Proximity to WTP could benefit operators	• May require site grading due to floodplain development • May require coordination with SWCD for the well extracted water

TABLE A-9: SELECTION MATRIX

	Redundant Offsite Emergency Water Source	Higher Probability of Reaching Thicker CRBG Layer	Does Not Require a New Pump to Waste Detention Facility	Onsite Disinfection and Chemical Storage	Minimal Impacts to Public Spaces	Permitting Impacts	Cost	***Totals***
Weighting	25%	20%	10%	10%	5%	5%	25%	
Community Center Park	5	4	1	1	1	1	2	***2.9***
Mill Creek Park	5	5	5	1	4	5	5	***4.6***
Schedule M	5	4	1	1	5	1	4	***3.6***
WTP	1	3	3	5	5	3	3	***2.8***



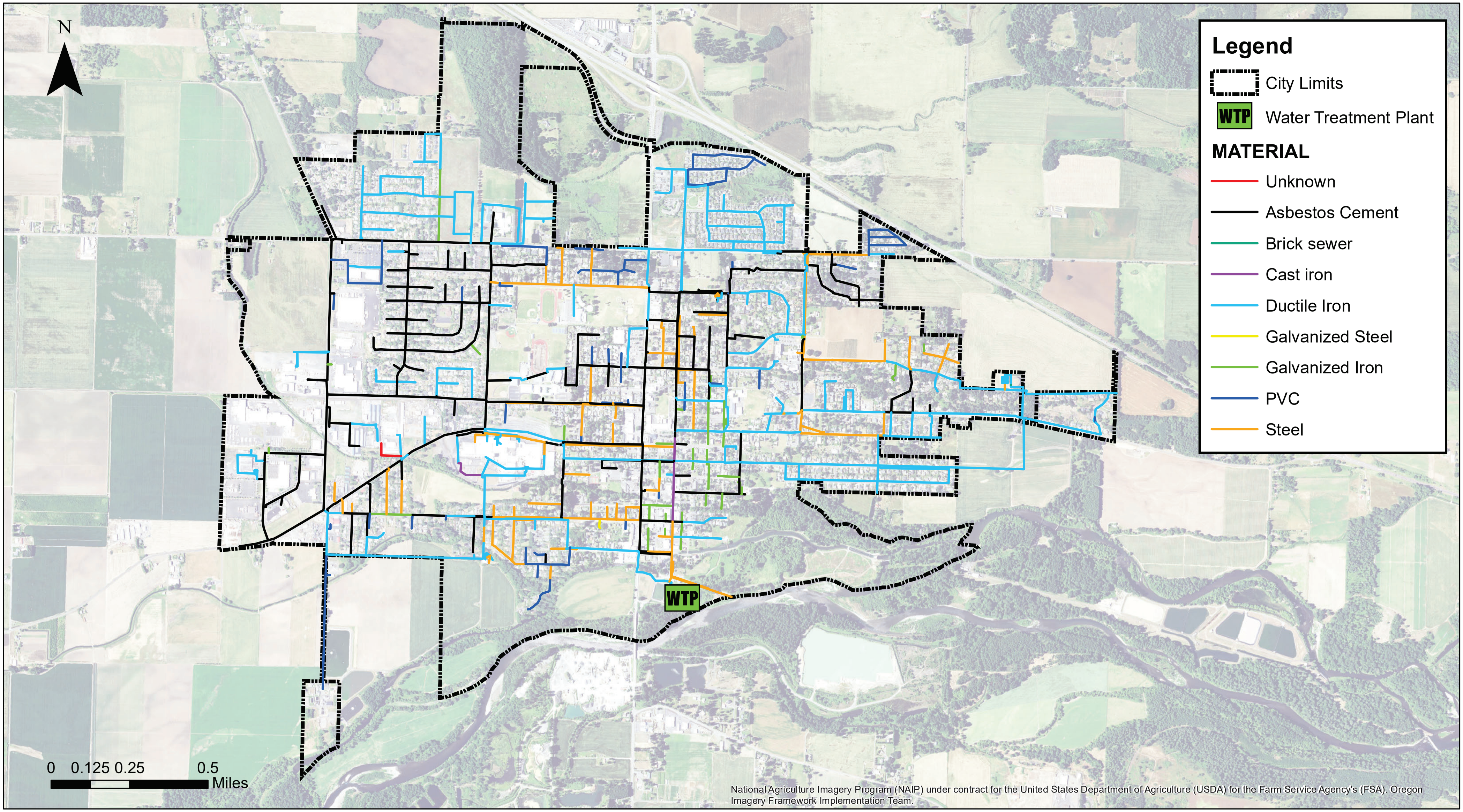
KELLER ASSOCIATES

Existing System - Pipe Diameter

Aquifer Storage and Recovery Feasibility Study

Figure A-8

City of Stayton, OR
May 2021



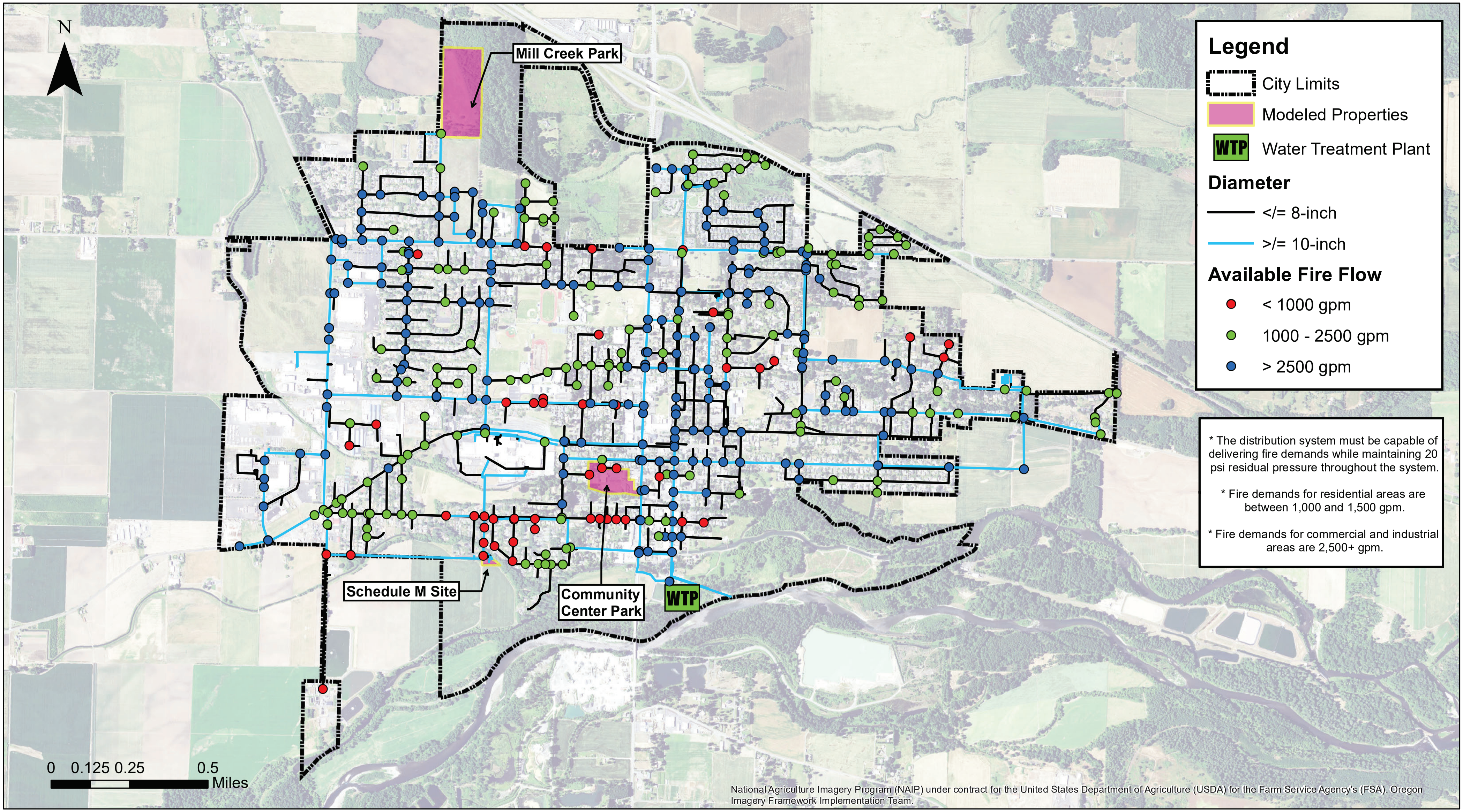
KELLER ASSOCIATES

Existing System - Pipe Material

Aquifer Storage and Recovery Feasibility Study

Figure A-9

City of Stayton, OR
May 2021



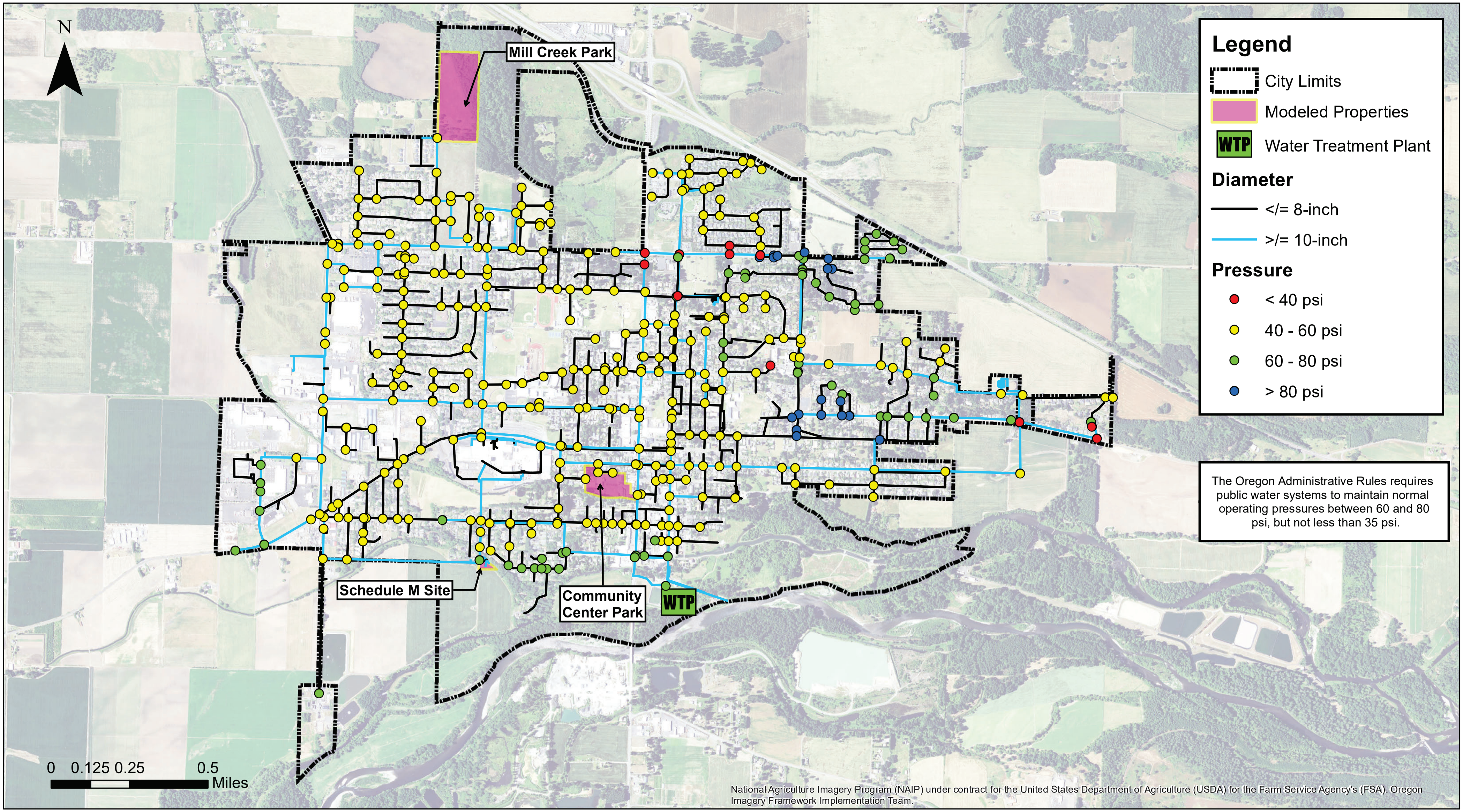
KELLER ASSOCIATES

Existing System - Max Day Available Fire Flow

Aquifer Storage and Recovery Feasibility Study

Figure A-10

City of Stayton, OR
May 2021



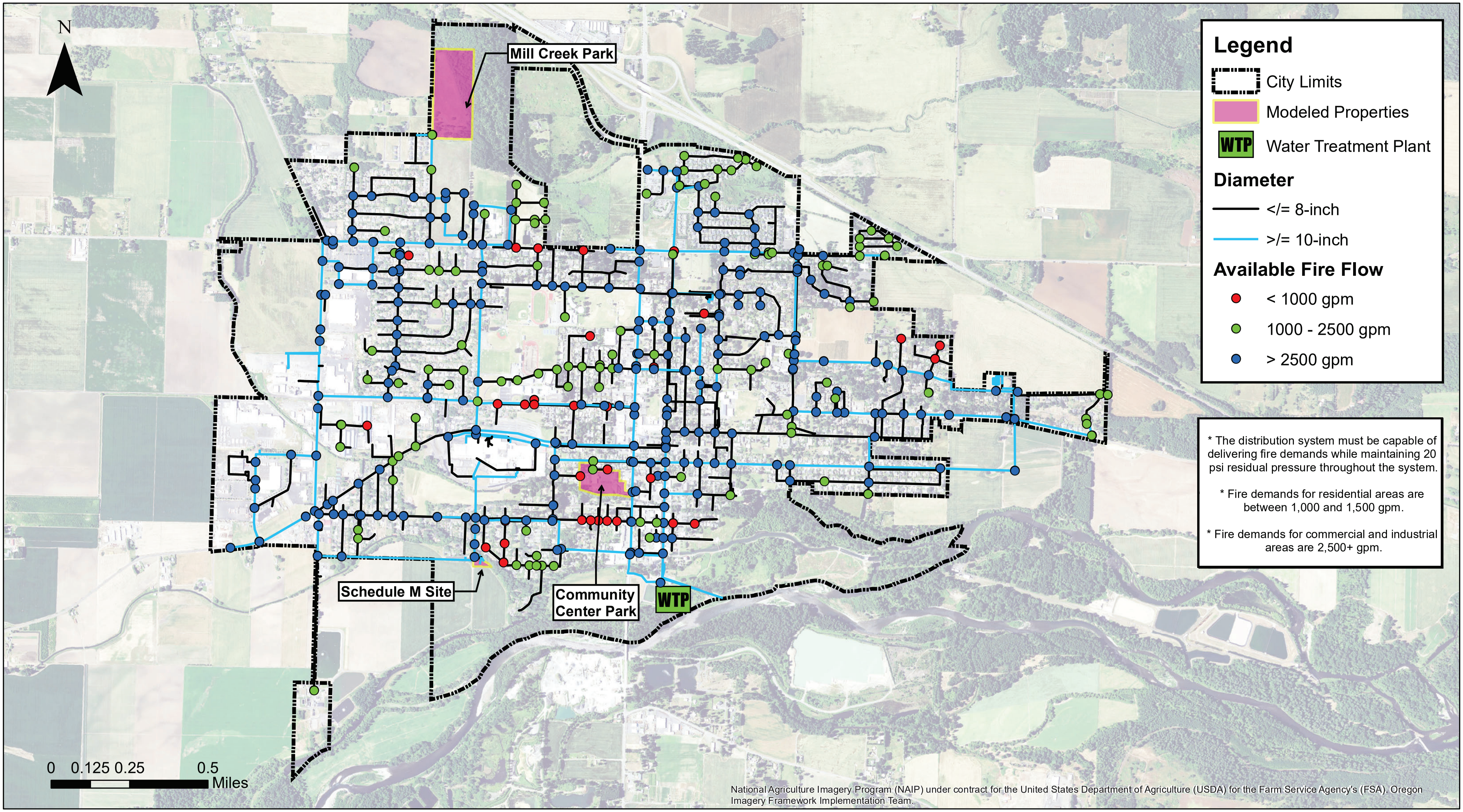
KELLER ASSOCIATES

Existing System - Peak Hour Pressure

Aquifer Storage and Recovery Feasibility Study

Figure A-11

City of Stayton, OR
May 2021



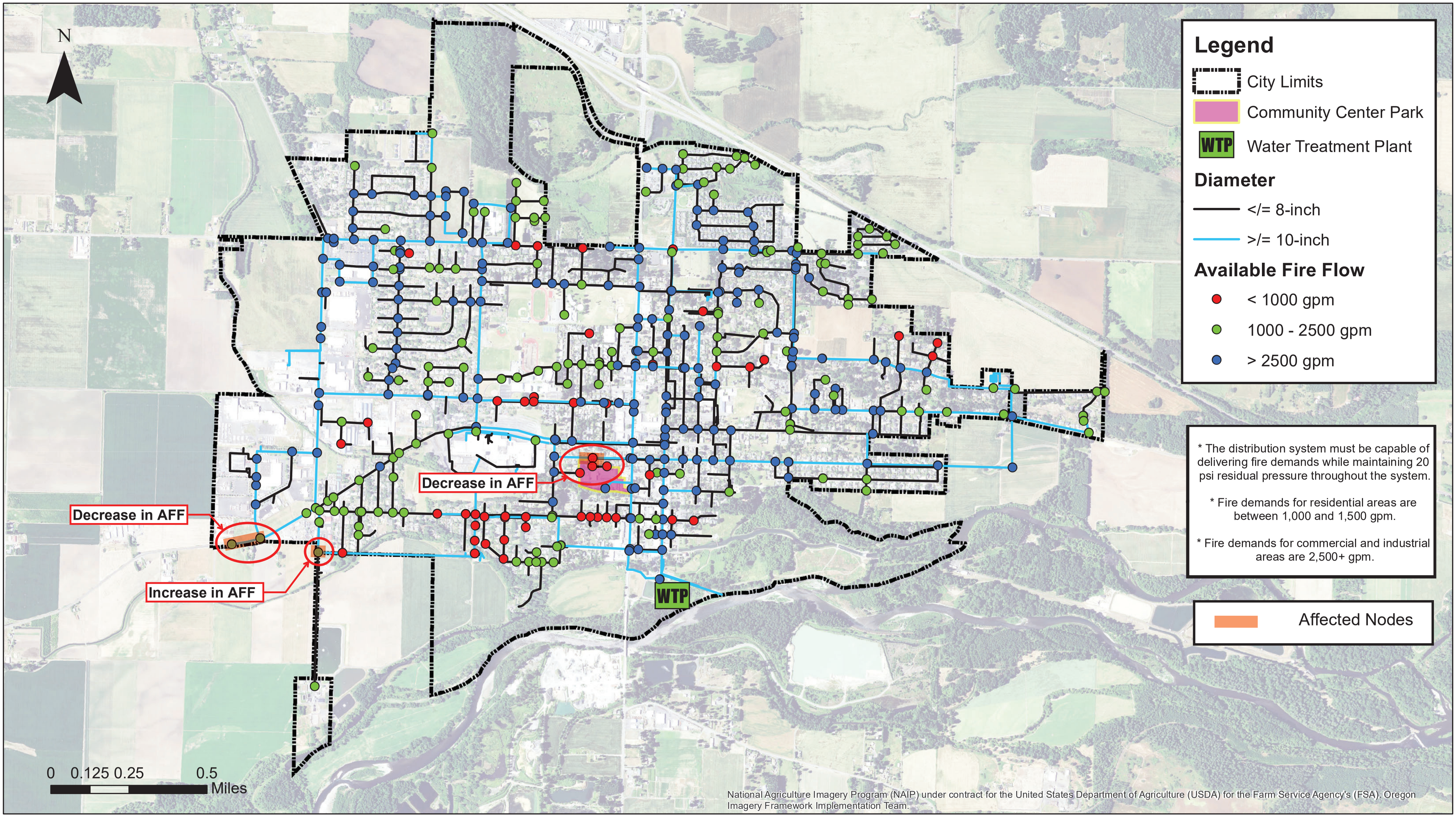
KELLER ASSOCIATES

Existing System - Average Day Available Fire Flow

Aquifer Storage and Recovery Feasibility Study

Figure A-12

City of Stayton, OR
May 2021



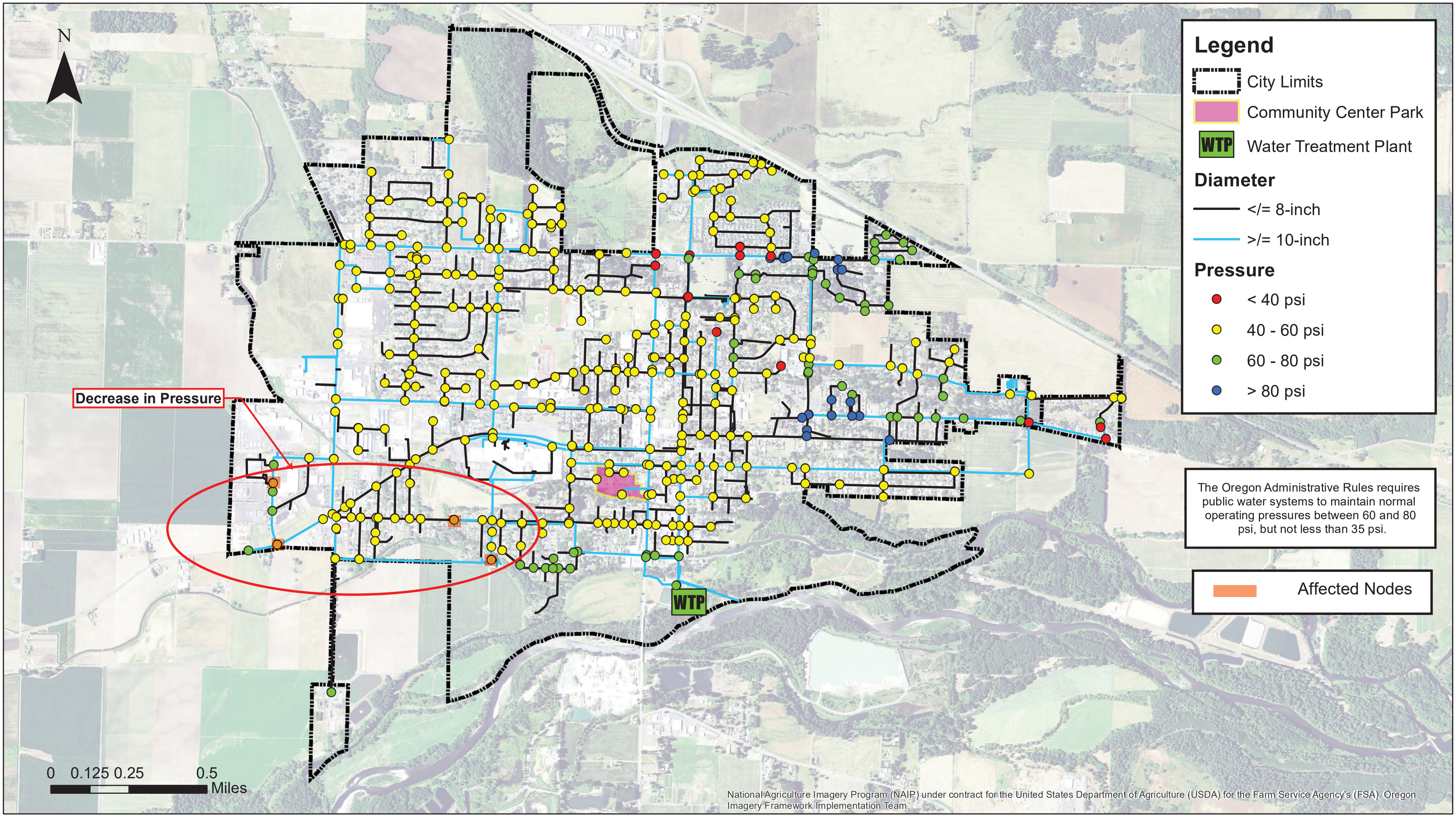
KELLER ASSOCIATES

Community Center Park Injection - Max Day Available Fire Flow

Aquifer Storage and Recovery Feasibility Study

Figure A-13

City of Stayton, OR
May 2021



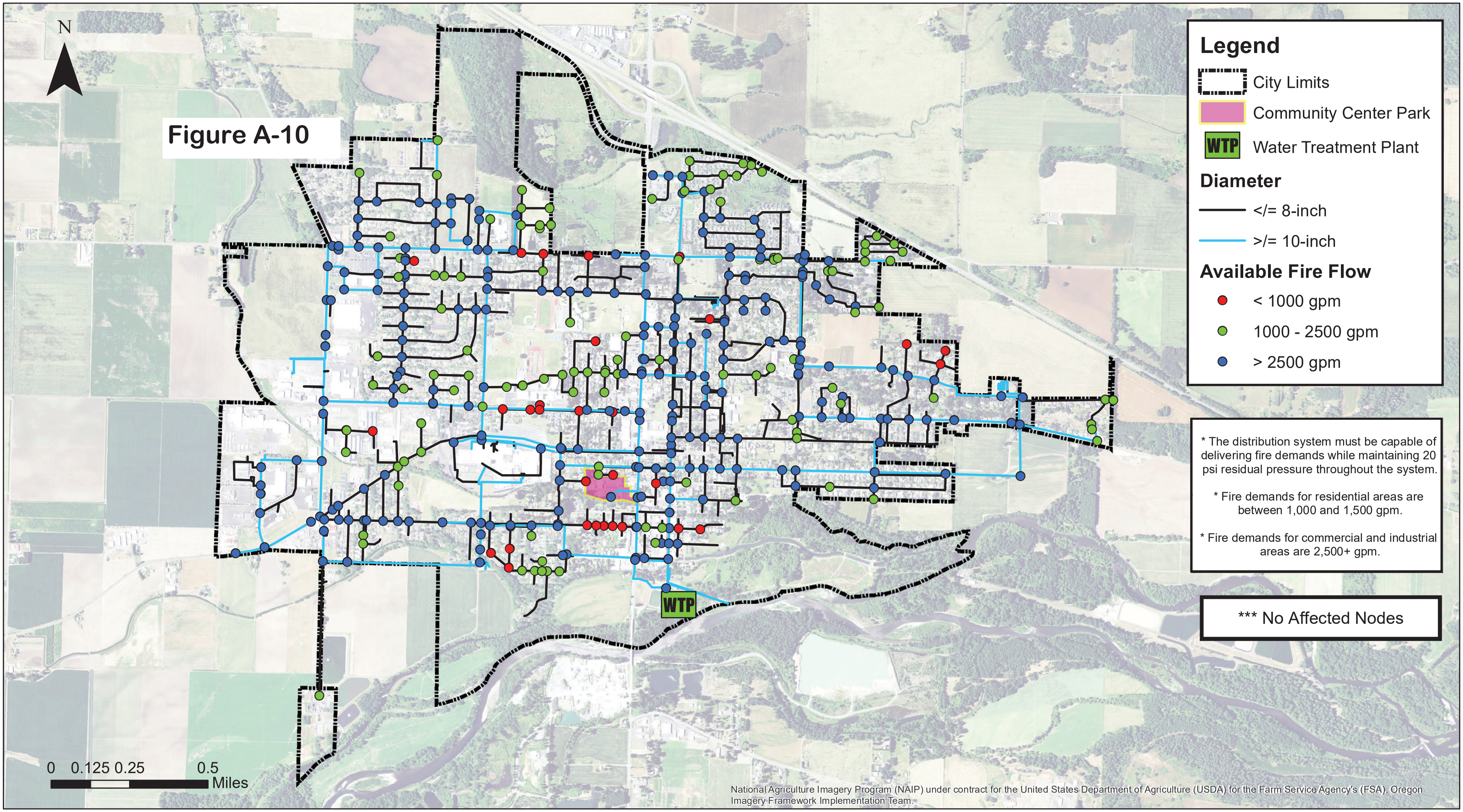
KELLER ASSOCIATES

Community Center Park Injection - Peak Hour Pressure

Aquifer Storage and Recovery Feasibility Study

Figure A-14

City of Stayton, OR
May 2021



KELLER ASSOCIATES

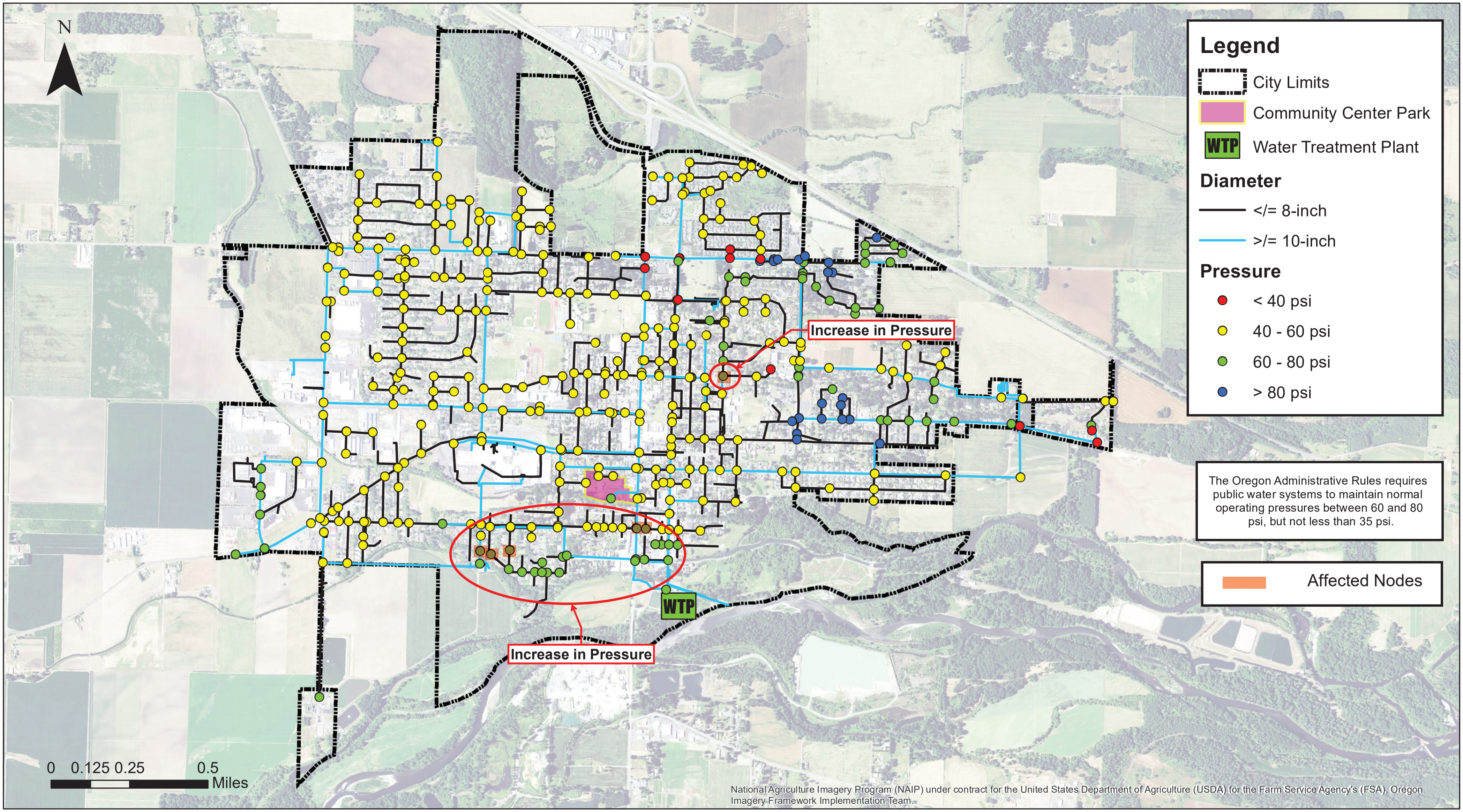
Community Center Park Recovery - Average Day Available Fire Flow

Aquifer Storage and Recovery Feasibility Study

CITY OF STAYTON

Figure A-15

City of Stayton, OR
May 2021



KELLER ASSOCIATES

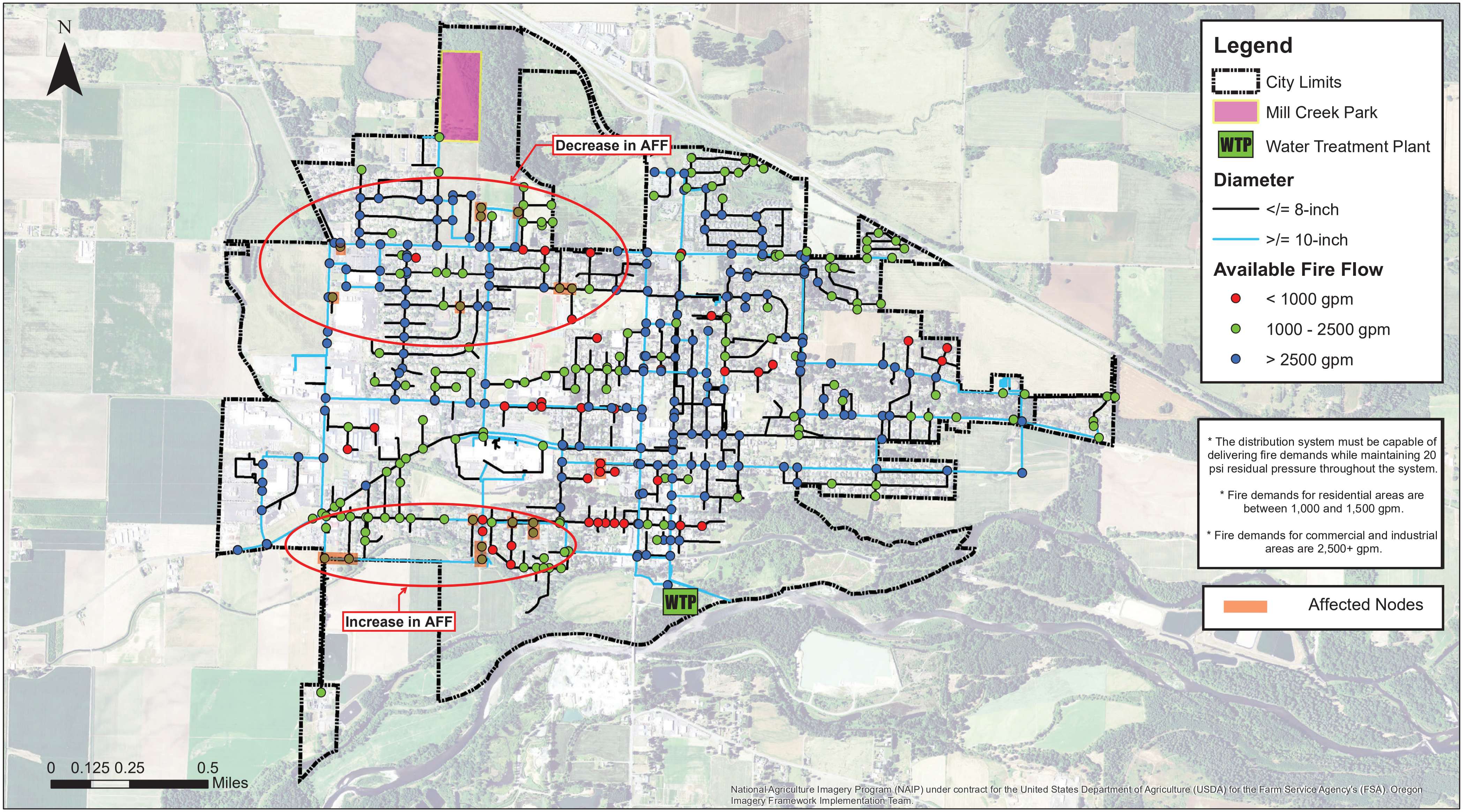
Community Center Park Recovery - Peak Hour Pressure

Aquifer Storage and Recovery Feasibility Study

CITY OF STAYTON

Figure A-16

City of Stayton, OR
May 2021



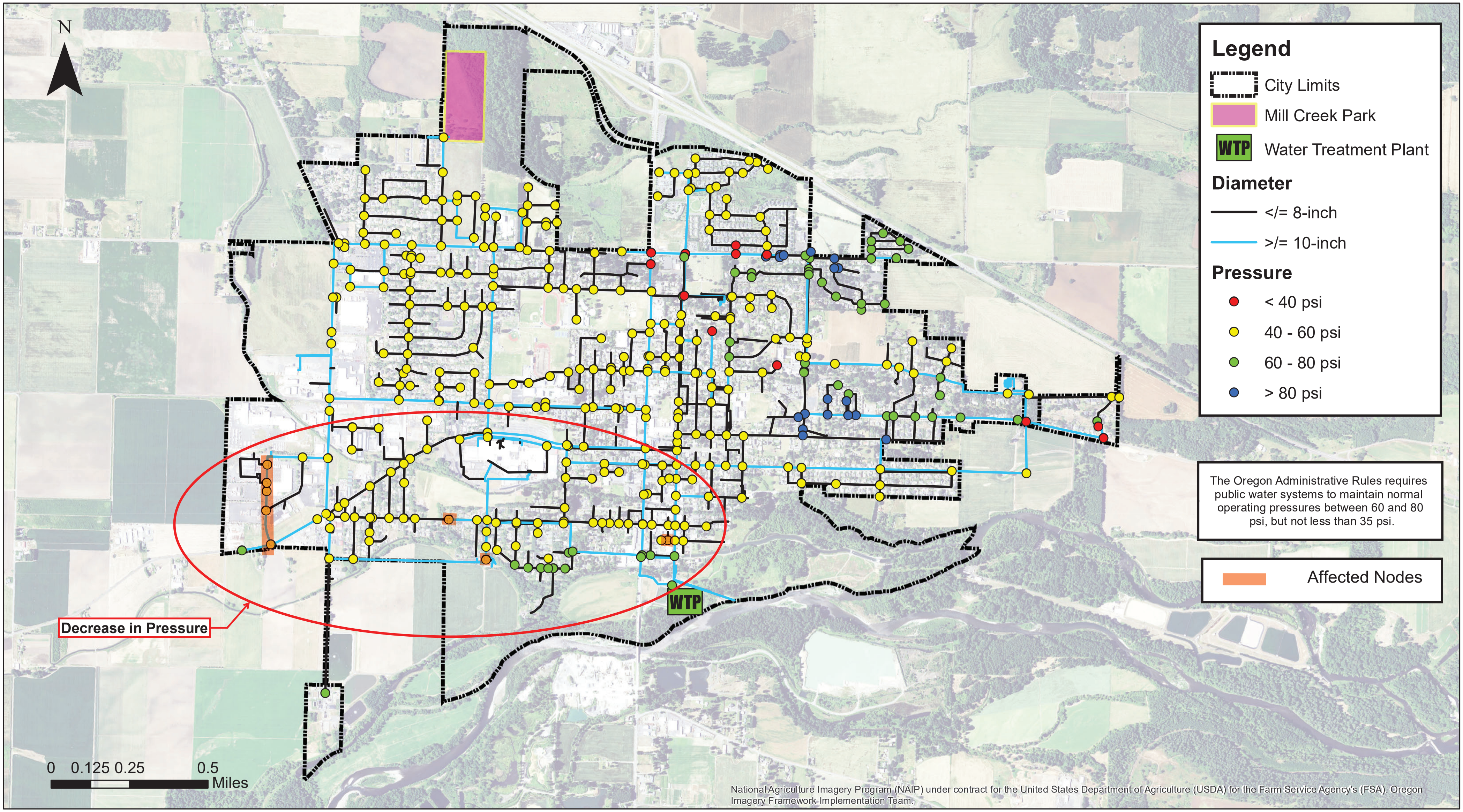
KELLER ASSOCIATES

Mill Creek Park Injection - Max Day Available Fire Flow

Aquifer Storage and Recovery Feasibility Study

Figure A-17

City of Stayton, OR
May 2021



KELLER ASSOCIATES

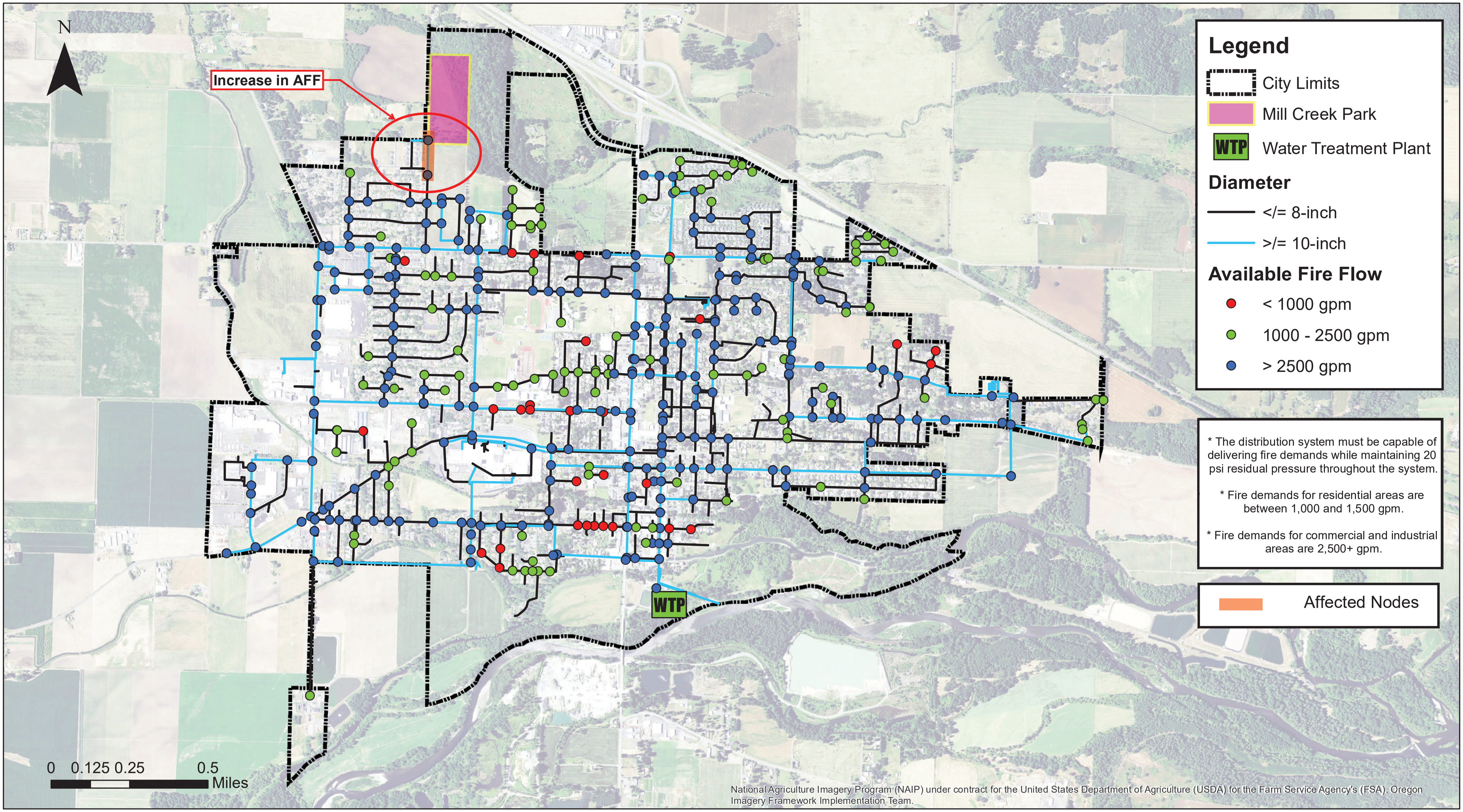
Mill Creek Park Injection - Peak Hour Pressure

Aquifer Storage and Recovery Feasibility Study

CITY OF STAYTON

Figure A-18

City of Stayton, OR
May 2021



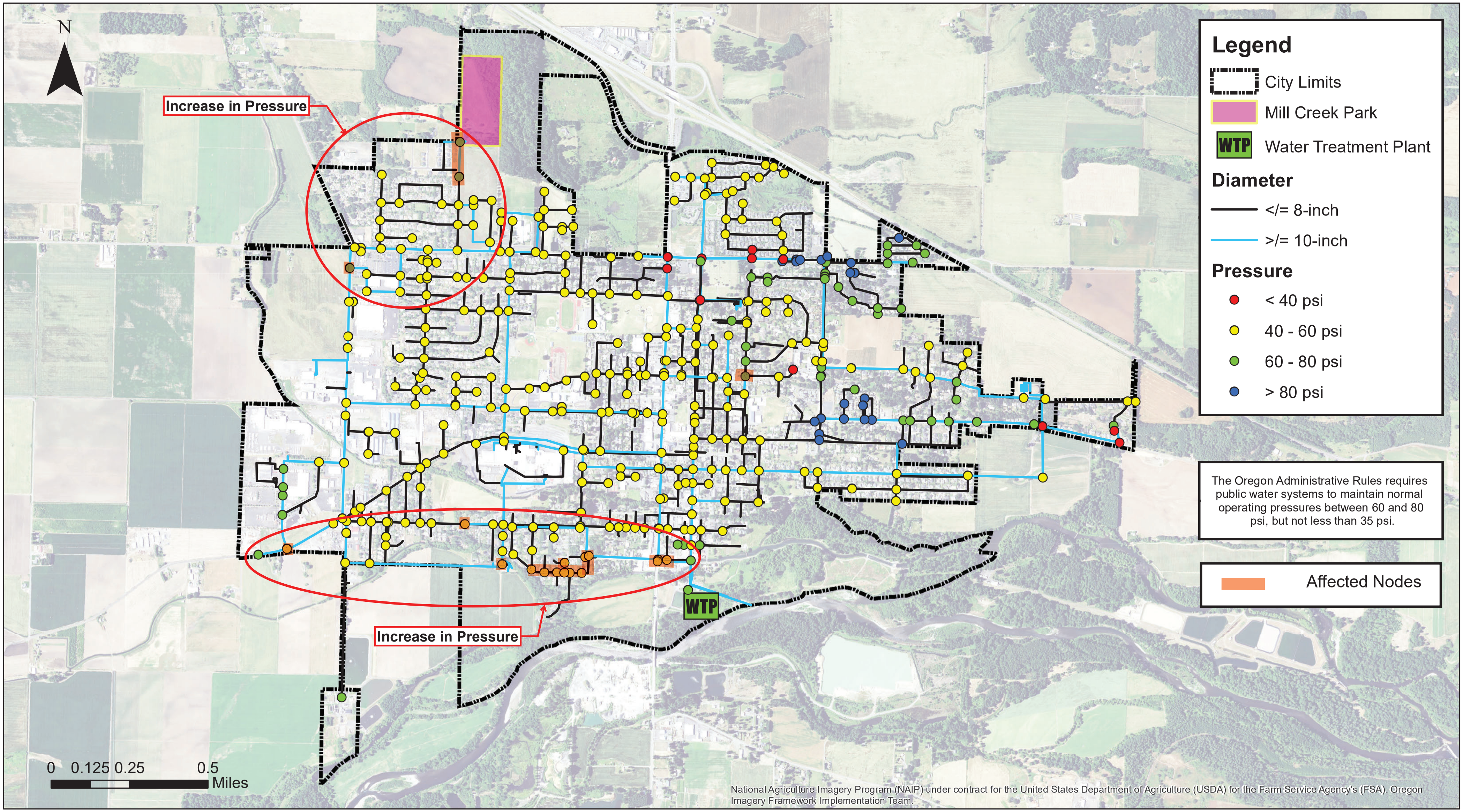
KELLER ASSOCIATES

Mill Creek Park Recovery - Average Day Fire Flow Available

Aquifer Storage and Recovery Feasibility Study

Figure A-19

City of Stayton, OR
May 2021



KELLER ASSOCIATES

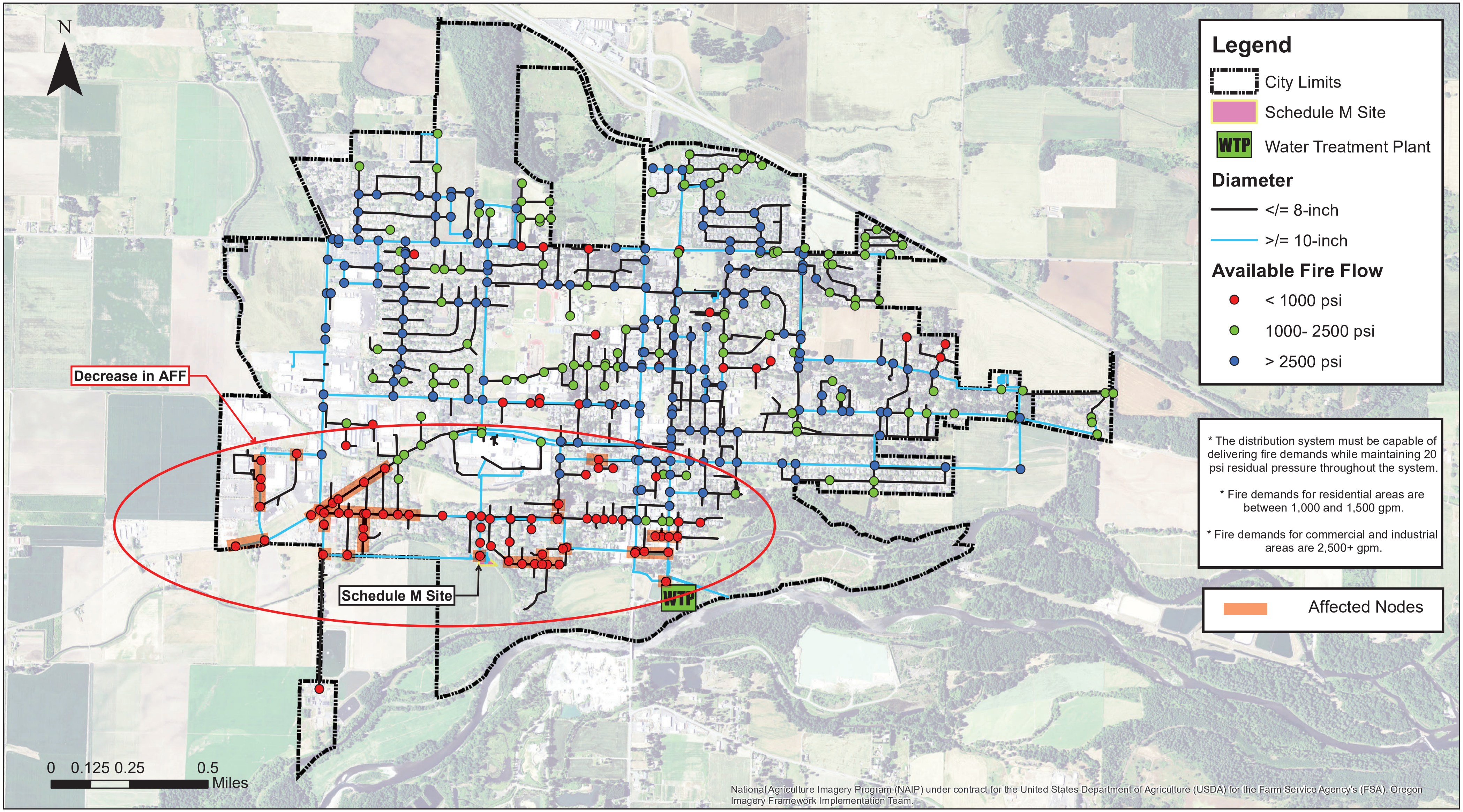
Mill Creek Park Recovery - Peak Hour Pressure

Aquifer Storage and Recovery Feasibility Study

CITY OF STAYTON

Figure A-20

City of Stayton, OR
May 2021



KELLER ASSOCIATES

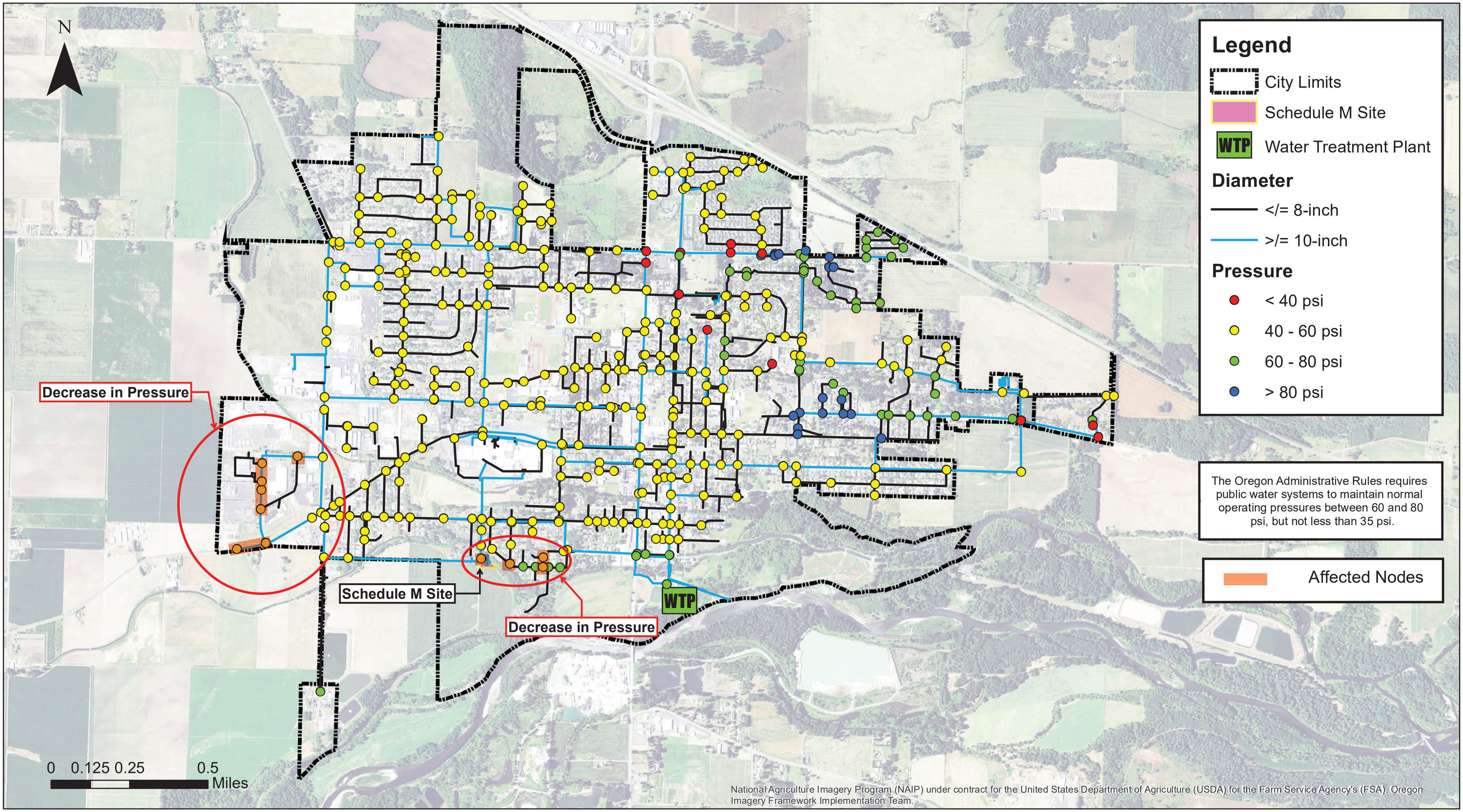
Schedule M Injection - Max Day Available Fire Flow

Aquifer Storage and Recovery Feasibility Study

CITY OF STAYTON

Figure A-21

City of Stayton, OR
May 2021



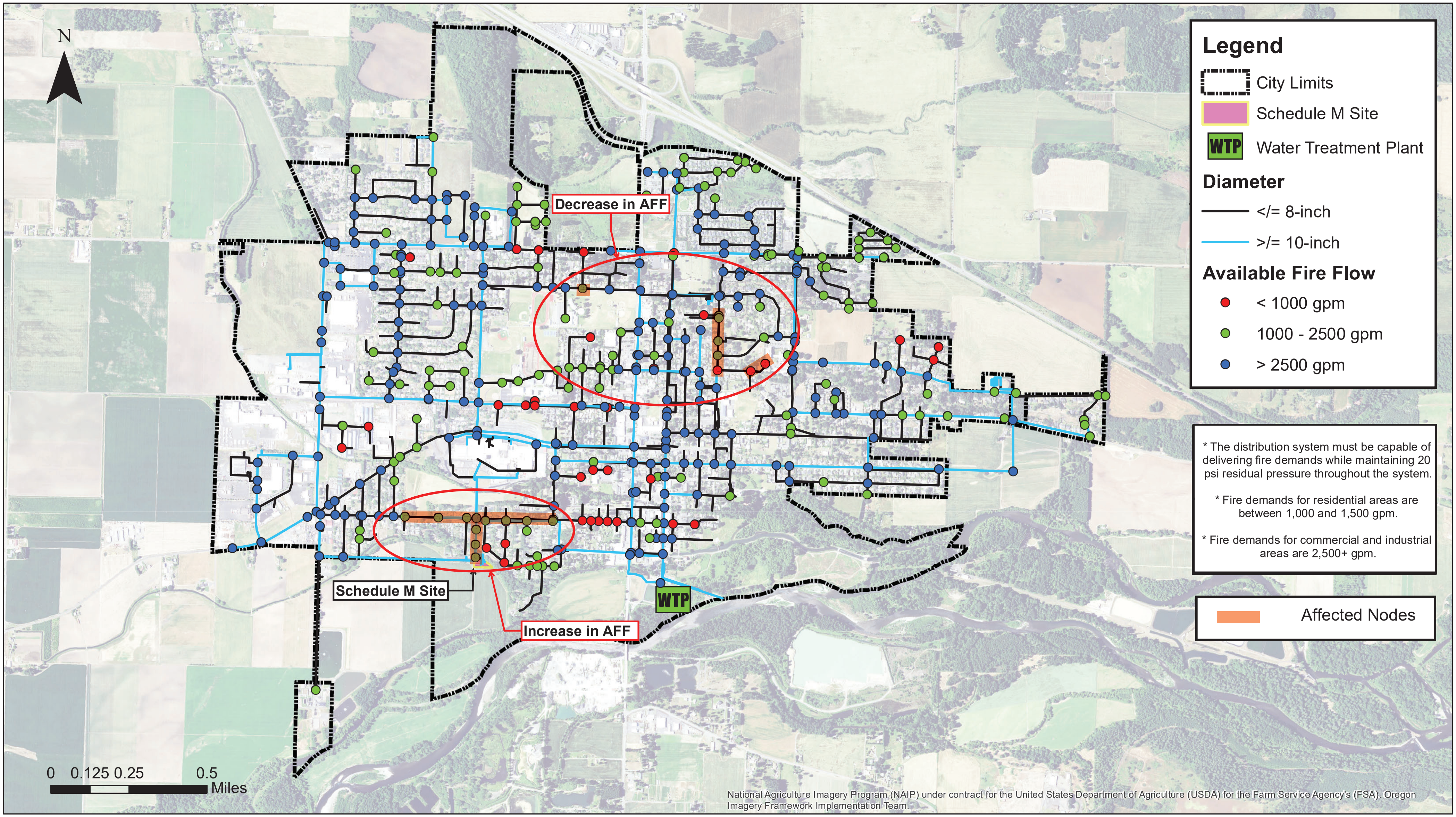
KELLER ASSOCIATES

Schedule M Injection - Peak Hour Pressure

Aquifer Storage and Recovery Feasibility Study

Figure A-22

City of Stayton, OR
May 2021



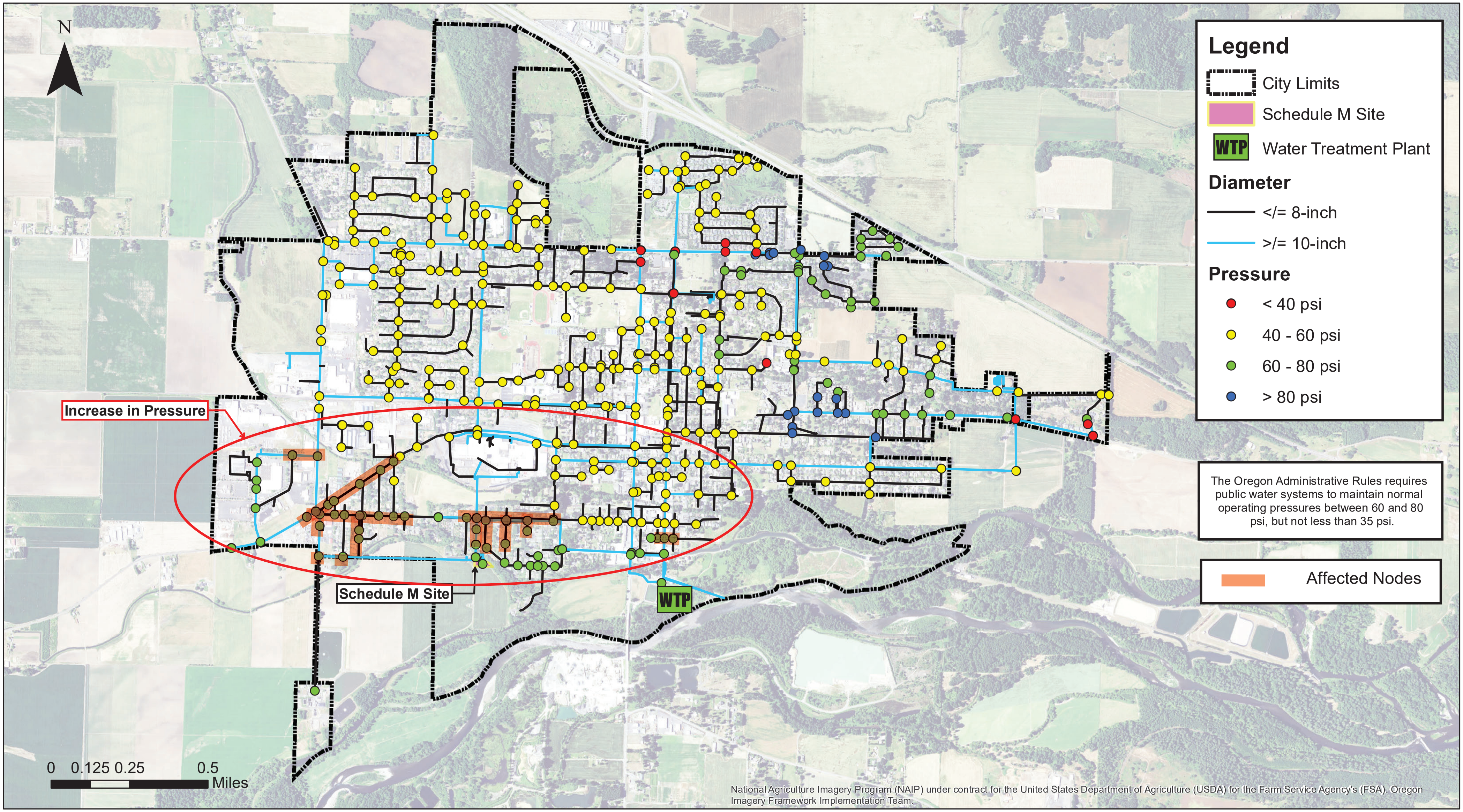
KELLER ASSOCIATES

Schedule M Recovery - Average Day Available Fire Flow

Aquifer Storage and Recovery Feasibility Study

Figure A-23

City of Stayton, OR
May 2021



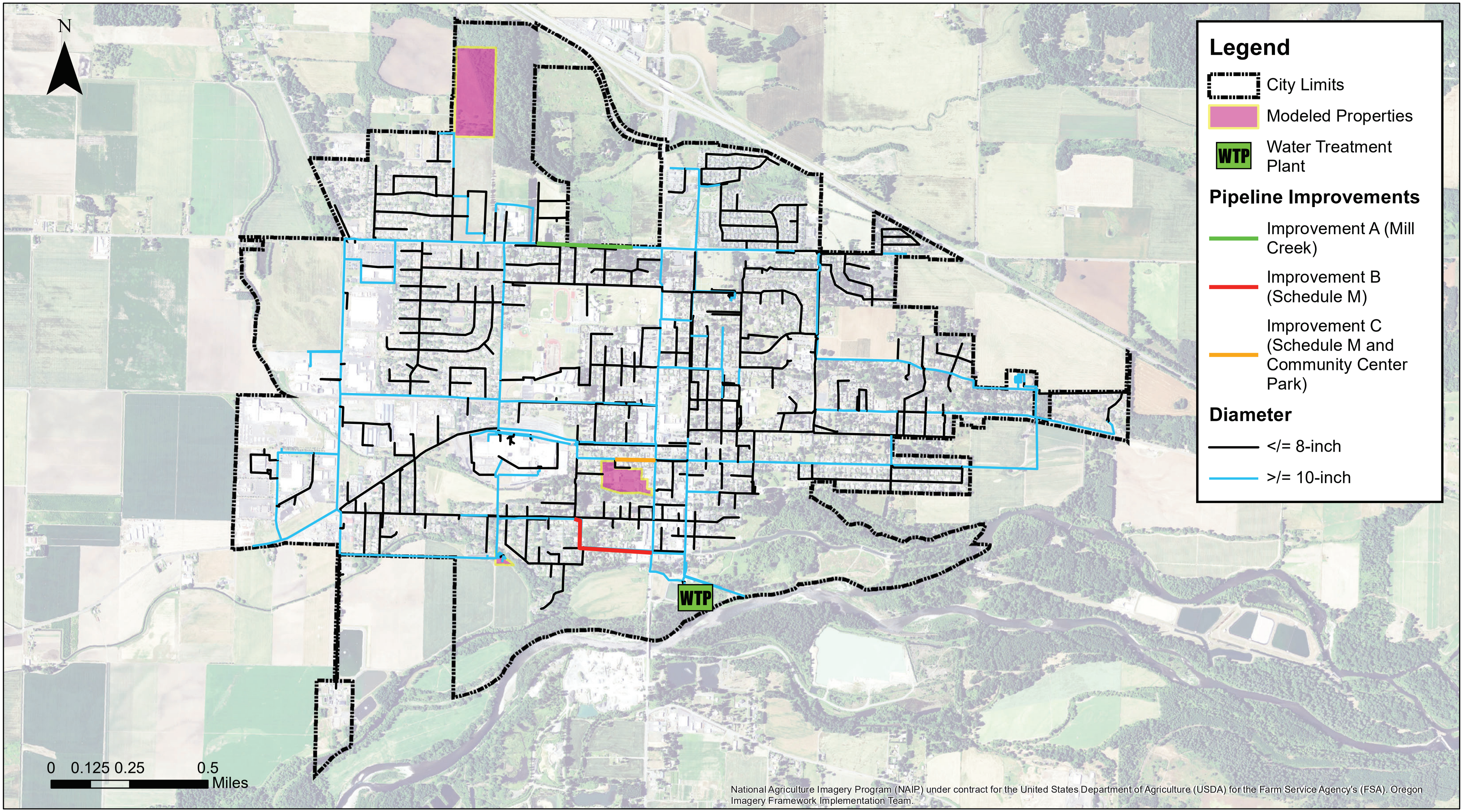
KELLER ASSOCIATES

Schedule M Recovery - Peak Hour Pressure

Aquifer Storage and Recovery Feasibility Study

Figure A-24

City of Stayton, OR
May 2021



KELLER ASSOCIATES

Distribution System Improvements

Aquifer Storage and Recovery Feasibility Study

CITY OF STAYTON

Figure A-25

City of Stayton, OR
May 2021

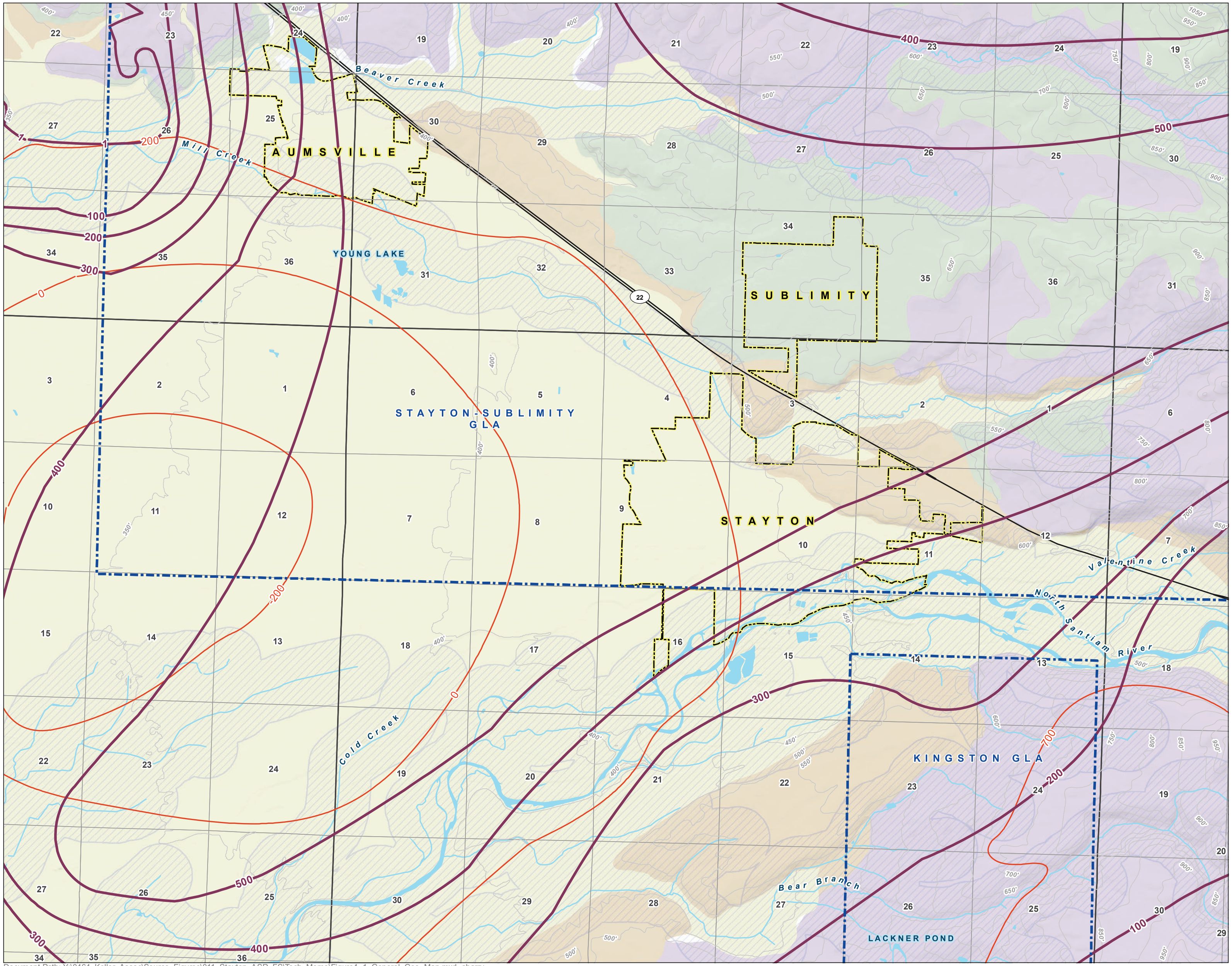
APPENDIX B

Figures

FIGURE B-1

General Geology Map

Stayton, Oregon



LEGEND

- Approximate Thickness in feet of Columbia River Basalt Group
- Altitude in feet of the Top of Columbia River Basalt Group[1]
- Surface Contour (feet)
- Groundwater Limited Area
- Surface Water Buffer (1/4 mile)

Generalized Geology

- Alluvium
- Fluvial Sediments
- Columbia River Basalt Group (CRBG)
- Older Rocks

All Other Features

- City Boundary
- Major Road
- Watercourse
- Waterbody

NOTE

1. Isopach lines adapted from a 2005 USGS-OWRD report, Figure 9.

N

0 2,000 4,000 6,000
Feet

Date: February 1, 2022
Data Sources: BLM, ESRI, ODOT, USGS, DOGAMI

GSI Water Solutions, Inc.

Document Path: Y:\0464_Keller_Assoc\Source_Figures\011_Stayton_ASR_FS\Tech_Memo\Figure4_1_General_Geo_Map.mxd, abarry

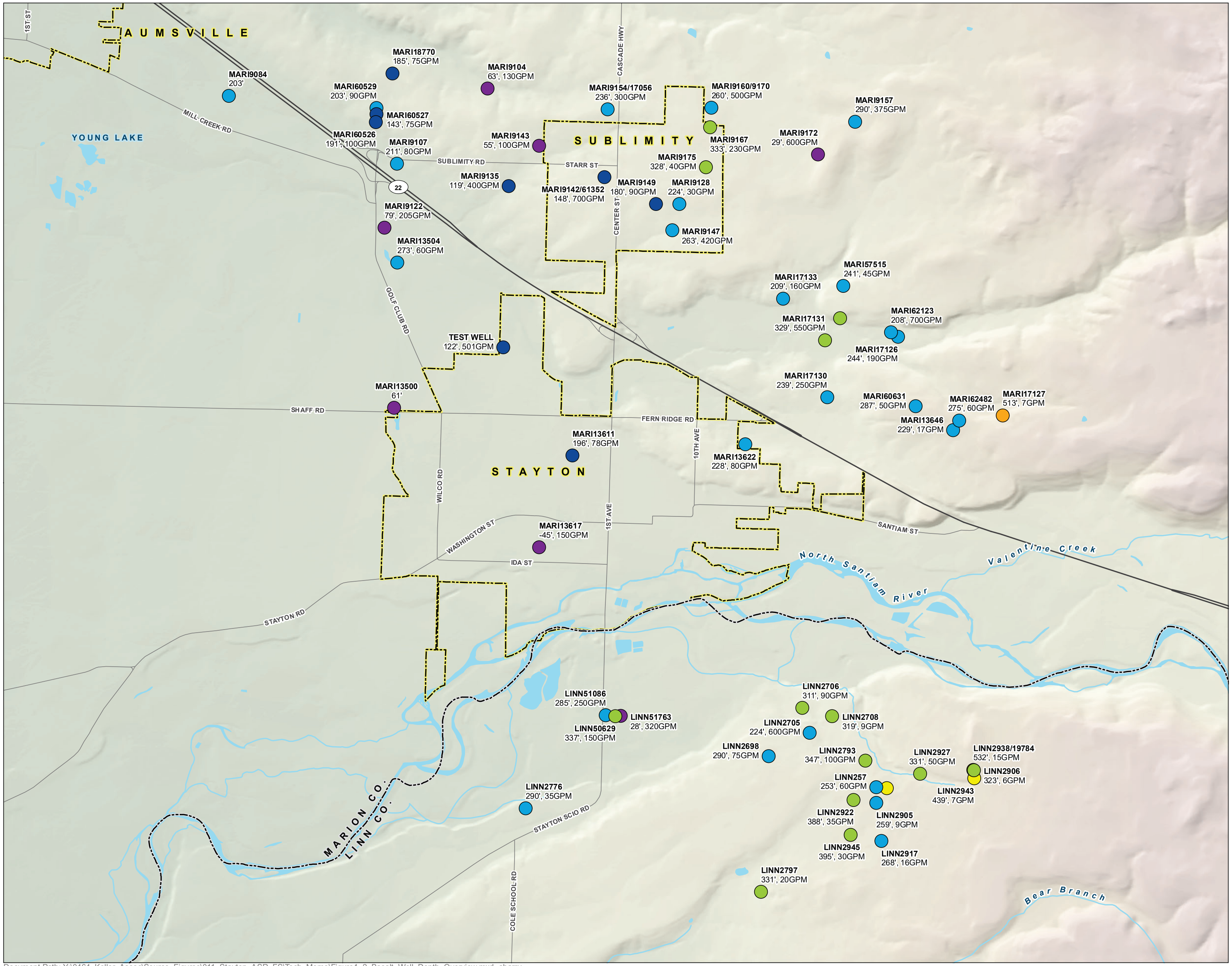


FIGURE B-2

Basalt (CRBG)
Well Depth Overview

Stayton, Oregon

LEGEND

- Basalt Well

Well Depth Elevation, ft amsl

- 0 - 100
- >100 - 200
- >200 - 400
- >300 - 400
- >400 - 500
- >500 - 600

All Other Features

- City Boundary
- County Boundary
- Major Road
- Watercourse
- Waterbody

NOTES

1. Well depth elevations in ft above mean sea level.
2. Reported well yields from OWRD well logs.

amsl: above mean sea level
GPM: gallons per minute

Date: February 1, 2022
Data Sources: BLM, ESRI, ODOT, USGS

Document Path: Y:\0464_Keller_Assoc\Source_Figures\011_Stayton_ASR_FS\Tech_Memo\Figure4_2_Basalt_Well_Depth_Overview.mxd, abarry

FIGURE B-3

Site Map
ASR Test Well
Stayton, Oregon

LEGEND

- Existing Domestic Well
- Test Well
- Tax Lot
- Watercourse

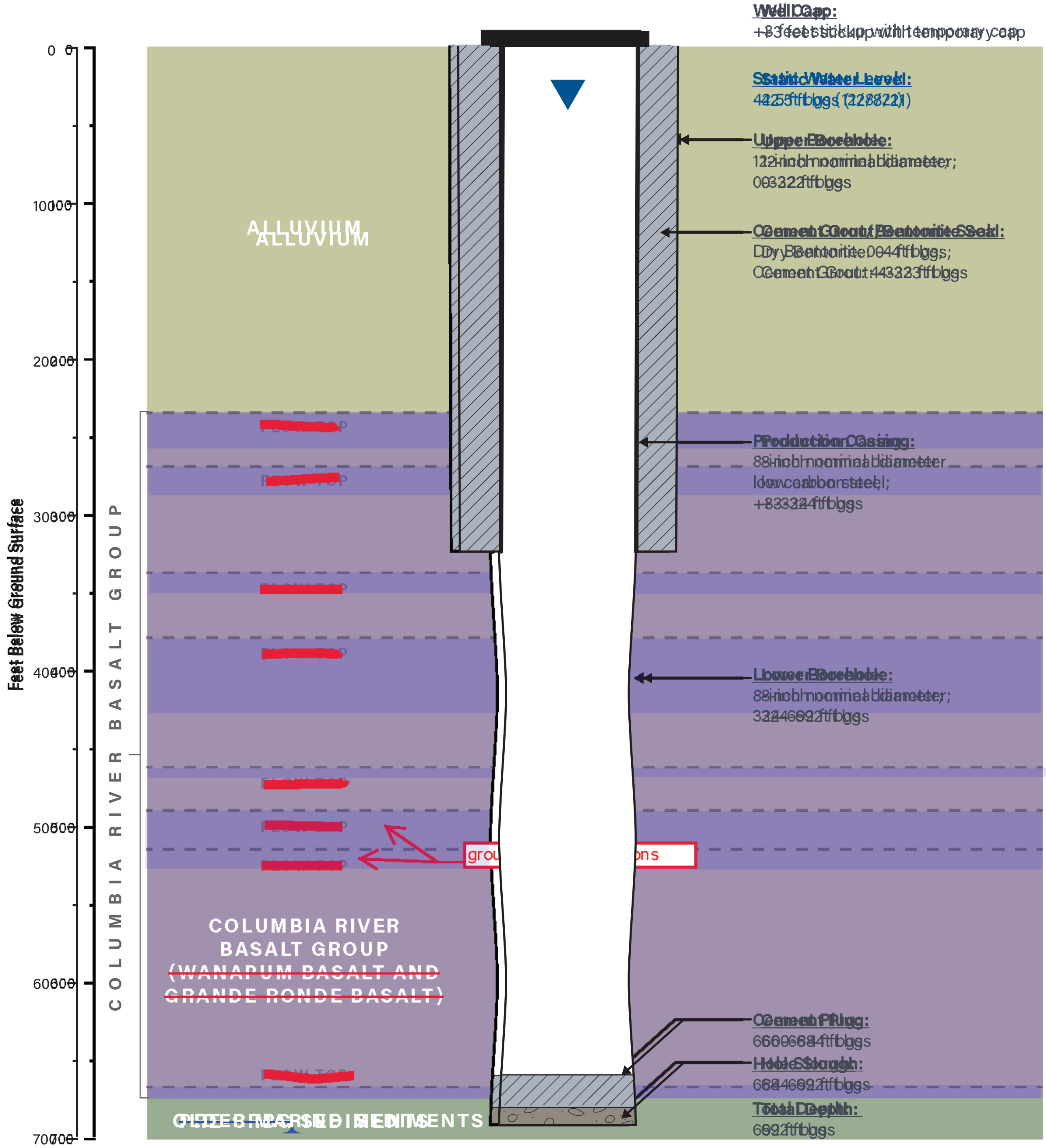
N

0 75 150 225
Feet

Date: February 1, 2022
Data Sources: City of Stayton, BLM, ESRI, ODOT, USGS, Maxar Imagery (2021)

GSI Water Solutions, Inc.

Document Path: Y:\0464_Keller_Assoc\Source_Figures\011_Stayton_ASR_FS\Tech_Memo\Figure4_3_Site_Map_ASR_Test_Well.mxd, abarry



NOTES
1. The borehole was drilled using the direct air rotary drilling method
2. All depths are feet below ground surface (bgs)

Likely Water-Bearing Zone (breccia/vesicular)

Low-Permeable Zone (dense interior)

FIGURE X
As-Built Well Construction Diagram
ASR Test Well
City of Stayton

GSI Water Solutions, Inc.

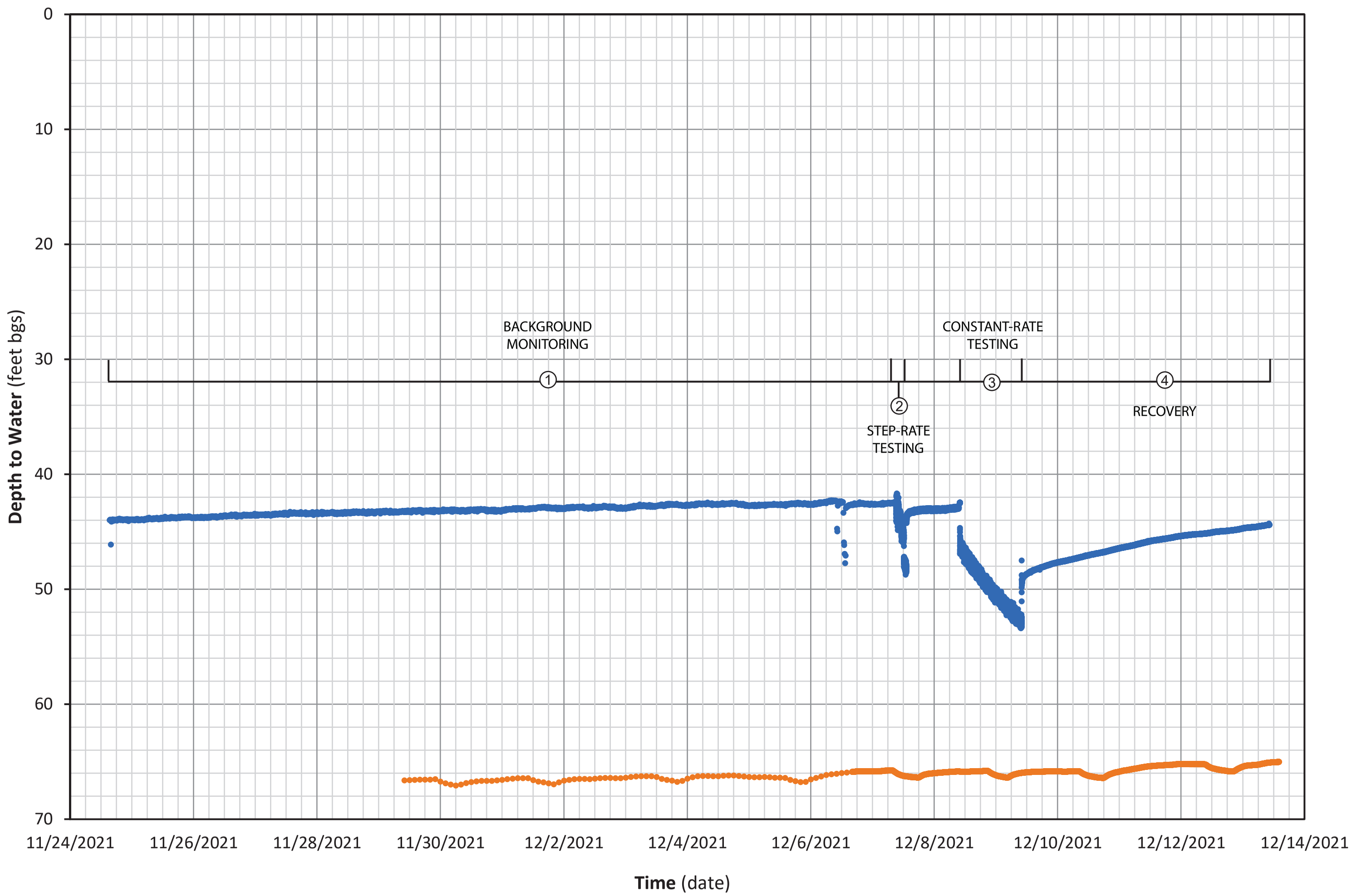


FIGURE B-5

ASR Test Well: Aquifer Testing Hydrograph

City of Stayton

LEGEND

- Test Well Transducer Level
- OWRD Observation Well (MARI 9135) Transducer Level

NOTE

bgs: below ground surface

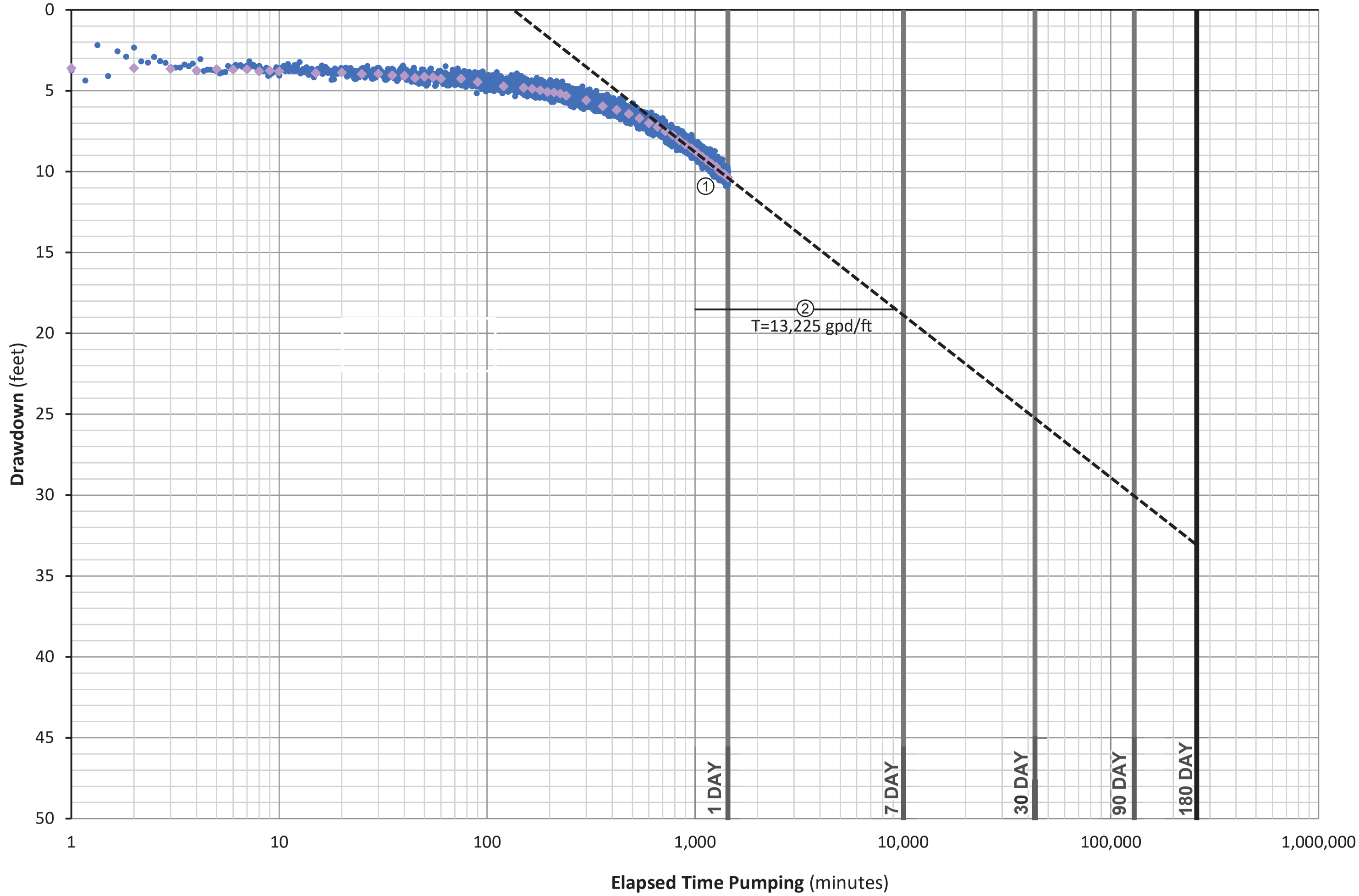
GSI Water Solutions, Inc.

Y:\0464_Keller_Assoc\Source_Figures\011_Stayton_ASR_FS\Tech_Memo

FIGURE B-6

ASR Test Well: Constant Rate Drawdown Hydrograph

City of Stayton



LEGEND

- Test Well Transducer Level
- Hand Level

NOTES

Constant-Rate Testing Information:

Start: 10:00 AM, December 8, 2021
End: 10:00 AM, December 9, 2021
Pre-Test Static Water Level = 42.5 ft bgs
Average Pumping Rate (Q) = 501 gpm

Notes/Data Analysis:

① Basline Specific Capacity (24-Hours)
Observed Drawdown (s) = 10.3 ft
Specific Capacity (SC) = Q/s = 48.6 gpm/ft

② Estimated Late-Time Transmissivity
1-Log Cycle Drawdown (s) = 10 ft
Transmissivity (T) = (264xQ)/Δs' = 13,225 gpd/ft

bgs: below ground surface
gpd/ft: gallons per day per foot
gpm: gallons per minute

GSI Water Solutions, Inc.

Appendix C

Water Quality Results

Appendix C, Table 1: Water Quality Results

ASR Test Well, Stayton, OR

Parameter	Units	Drinking Water Standard[1]	Standard Type	ASR Test Well (Native GW) 12/9/2021	Source Water (Surface Water) 12/21/2021
Geochemical and Inorganic Constituents (IOCs)					
AGRESSIVENESS INDEX (CALCULATED)	None	-	-	11.5	10.3
ALKALINITY (AS CACO3)	mg/L	-	-	68	26
ALUMINUM (TOTAL)	ug/L	50	SMCL	ND <20	ND <20
ANTIMONY (TOTAL)	ug/L	6	MCL	ND <1	ND <1
APPARENT COLOR	ACU	15	SMCL	ND <3	ND <3
ARSENIC (TOTAL)	ug/L	10	MCL	ND <1	ND <1
BARIUM (TOTAL)	ug/L	2000	MCL	6.6	2.6
BERYLLIUM (TOTAL)	ug/L	4	MCL	ND <1	ND <1
BICARBONATE ALKALINITY (AS HCO3)	mg/L	-	-	82	31
CADMIUM (TOTAL)	ug/L	5	MCL	ND <0.5	ND <0.5
CALCIUM (TOTAL)	mg/L	-	-	10	6
CARBONATE (AS CO3, CALCULATED)	mg/L	-	-	ND <2	ND <2
CHLORIDE	mg/L	250	SMCL	3.6	2.4
CHROMIUM (TOTAL)	ug/L	100	MCL	ND <1	ND <1
COPPER (TOTAL)	ug/L	1300	AL	3.8	6.3
CYANIDE	mg/L	0.2	MCL	ND <0.025	ND <0.025
FLUORIDE	mg/L	4	MCL	0.19	ND <0.05
IRON (DISSOLVED)	mg/L	-	-	0.068	0.051
IRON (TOTAL)	mg/L	0.3	SMCL	0.075	0.058
LANGELIER INDEX (25 DEGREES C)	None	-	-	-0.44	-1.5
LANGELIER INDEX (60 DEGREES C)	None	-	-	-0.016	-1.1
LEAD (TOTAL)	ug/L	15	AL	ND <0.5	ND <0.5
MAGNESIUM (TOTAL)	mg/L	-	-	4.5	1.2
MANGANESE (DISSOLVED)	ug/L	-	-	17	ND <2
MANGANESE (TOTAL)	ug/L	50	SMCL	18	ND <2
MERCURY	ug/L	2	MCL	ND <0.2	ND <0.2
NICKEL (TOTAL)	ug/L	-	-	ND <5	ND <5
NITRATE (AS NITROGEN)	mg/L	10	MCL	ND <0.05	0.39
NITRATE (AS NO3, CALCULATED)	mg/L	-	-	ND <0.22	1.7
NITRITE (AS NITROGEN)	mg/L	1	MCL	ND <0.05	ND <0.05
ODOR (TON)	TON	3	SMCL	ND <1	ND <1
PH	None	6.5-8.5	SMCL	8.1	7.6
POTASSIUM (TOTAL)	mg/L	-	-	1.3	ND <1
SELENIUM (TOTAL)	ug/L	50	MCL	ND <5	ND <5
SILICA	mg/L	-	-	46	14
SILVER (TOTAL)	ug/L	100	SMCL	ND <0.5	ND <0.5
SODIUM (TOTAL)	mg/L	-	-	16	5.6
SULFATE	mg/L	250	SMCL	2.9	0.94
THALLIUM (TOTAL)	ug/L	2	MCL	ND <1	ND <1
TOTAL DISSOLVED SOLIDS (TDS)	mg/L	500	SMCL	110	48
TOTAL HARDNESS (AS CACO3)	mg/L	250	SMCL	44	20
TOTAL ORGANIC CARBON (TOC)	mg/L	-	-	0.22	0.74
TOTAL SUSPENDED SOLIDS (TSS)	mg/L	-	-	ND <10	ND <10
ZINC (TOTAL)	ug/L	5000	SMCL	ND <20	ND <20
Other					
FREE CHLORINE	mg/L	4	MRDL	-	ND <0.1
TOTAL RESIDUAL CHLORINE	mg/L	4	MRDL	-	ND <0.1
Disinfecton Byproducts (DBPs)					
BROMATE	ug/L	10	MCL	-	ND <1
CHLORITE	ug/L	1000	MCL	-	ND <0.01
CHLOROFORM	ug/L	70	MCLG	ND <0.5	25
BROMOFORM	ug/L	-		ND <0.5	ND <0.5
DIBROMOCHLOROMETHANE	ug/L	-		ND <0.5	ND <0.5
BROMODICHLOROMETHANE	ug/L	-		ND <0.5	2.1
TOTAL TRIHALOMETHANE (TTHM)	ug/L	80	MCL	ND <0.5	27
DIBROMOACETIC ACID	ug/L	-		ND <1	-
DICHLOROACETIC ACID	ug/L	-		-	4
MONOBROMOACETIC ACID	ug/L	-		-	ND <1
MONOCHLOROACETIC ACID	ug/L	-		-	ND <2
TRICHLOROACETIC ACID	ug/L	-		-	14
TOTAL HALOACETIC ACIDS (HAA5)	ug/L	60	MCL	-	18

Appendix C, Table 1: Water Quality Results

ASR Test Well, Stayton, OR

Parameter	Units	Drinking Water Standard[1]	Standard Type	ASR Test Well (Native GW) 12/9/2021	Source Water (Surface Water) 12/21/2021
Radiologicals (RADs)					
ALPHA, GROSS	pCi/L	15	MCL	ND <3	-
BETA, GROSS	pCi/L	-	-	ND <3	-
RADIUM 226	pCi/L	-	-	ND <1	-
RADIUM 226, 228 COMBINED	pCi/L	5	MCL	ND <2	-
RADIUM 228	pCi/L	-	-	ND <1	-
URANIUM BY ICPMS AS PCI/L	pCi/L	-	-	ND <0.70	-
URANIUM ICAP/MS	ug/L	30	MCL	ND <1	ND <1
Synthetic Organic Compounds (SOCs)					
2,4,5-TP (SILVEX)	ug/L	50	MCL	ND <0.2	-
2,4-D	ug/L	70	MCL	ND <0.1	-
ALACHLOR (ALANEX)	ug/L	2	MCL	ND <0.1	-
ATRAZINE	ug/L	3	MCL	ND <0.05	-
BENZO(A)PYRENE	ug/L	0.2	MCL	ND <0.02	-
CARBOFURAN (FURADAN)	ug/L	40	MCL	ND <0.5	-
CHLORDANE	ug/L	2	MCL	ND <0.1	-
DALAPON	ug/L	200	MCL	ND <1	-
DI-(2-ETHYLHEXYL)ADIPATE	ug/L	400	MCL	ND <0.6	-
DI(2-ETHYLHEXYL)PHTHALATE	ug/L	6	MCL	ND <0.6	-
DIBROMOCHLOROPROPANE (DBCP)	ug/L	0.2	MCL	ND <0.01	-
DINOSEB	ug/L	7	MCL	ND <0.2	-
DIQUAT	ug/L	20	MCL	ND <0.4	-
ENDOTHALL	ug/L	100	MCL	ND <5	-
ENDRIN	ug/L	2	MCL	ND <0.01	-
GLYPHOSATE	ug/L	700	MCL	ND <6	-
HEPTACHLOR	ug/L	0.4	MCL	ND <0.01	-
HEPTACHLOR EPOXIDE	ug/L	0.2	MCL	ND <0.01	-
HEXACHLOROBENZENE	ug/L	1	MCL	ND <0.05	-
HEXACHLOROCYCLOPENTADIENE	ug/L	50	MCL	ND <0.05	-
LINDANE (GAMMA-BHC)	ug/L	0.2	MCL	ND <0.01	-
METHOXYCHLOR	ug/L	40	MCL	ND <0.05	-
OXAMYL (VYDATE)	ug/L	200	MCL	ND <0.5	-
PCB 1221 AROCLOR	ug/L	0.5	MCL	ND <0.1	-
PCB 1232 AROCLOR	ug/L	0.5	MCL	ND <0.1	-
PCB 1242 AROCLOR	ug/L	0.5	MCL	ND <0.1	-
PCB 1248 AROCLOR	ug/L	0.5	MCL	ND <0.1	-
PCB 1254 AROCLOR	ug/L	0.5	MCL	ND <.01	-
PCB 1260 AROCLOR	ug/L	0.5	MCL	ND <0.1	-
PENTACHLOROPHENOL	ug/L	1	MCL	ND <0.04	-
PICLORAM	ug/L	500	MCL	ND <0.1	-
SIMAZINE	ug/L	4	MCL	ND <0.05	-
TOTAL PCBS	ug/L	0.5	MCL	ND <0.1	-
TOXAPHENE	ug/L	3	MCL	ND <0.5	-

Appendix C, Table 1: Water Quality Results

ASR Test Well, Stayton, OR

Parameter	Units	Drinking Water Standard[1]	Standard Type	ASR Test Well (Native GW) 12/9/2021	Source Water (Surface Water) 12/21/2021
Volatile Organic Compounds (VOCs)					
1,1,1-TRICHLOROETHANE	ug/L	200	MCL	ND <0.5	-
1,1,2-TRICHLOROETHANE	ug/L	5	MCL	ND <0.5	-
1,1-DICHLOROETHYLENE	ug/L	7	MCL	ND <0.5	-
1,2,4-TRICHLOROBENZENE	ug/L	70	MCL	ND <0.5	-
1,2-DICHLOROETHANE	ug/L	5	MCL	ND <0.5	-
1,2-DICHLOROPROPANE	ug/L	5	MCL	ND <0.5	-
BENZENE	ug/L	5	MCL	ND <0.5	-
BROMODICHLOROMETHANE	ug/L	-	-	ND <0.5	**2.1**
CARBON TETRACHLORIDE	ug/L	5	MCL	ND <0.5	-
CHLOROFORM (TRICHLOROMETHANE)	ug/L	-	-	ND <0.5	**25**
CIS-1,2-DICHLOROETHYLENE	ug/L	70	MCL	ND <0.5	-
DICHLOROMETHANE	ug/L	5	MCL	ND <0.5	-
ETHYL BENZENE	ug/L	700	MCL	ND <0.5	-
O-DICHLOROBENZENE (1,2-DCB)	ug/L	600	MCL	ND <0.5	-
P-DICHLOROBENZENE (1,4-DCB)	ug/L	75	MCL	ND <0.5	-
STYRENE	ug/L	100	MCL	ND <0.5	-
TETRACHLOROETHYLENE (PCE)	ug/L	5	MCL	ND <0.5	-
TOLUENE	ug/L	1000	MCL	ND <0.5	-
TOTAL TRIHALOMETHANE (TTHM)	ug/L	80	MCL	ND <0.5	**27**
TOTAL XYLENES	ug/L	10000	MCL	ND <0.5	-
TRANS-1,2-DICHLOROETHYLENE	ug/L	100	MCL	ND <0.5	-
TRICHLOROETHYLENE (TCE)	ug/L	5	MCL	ND <0.5	-
VINYL CHLORIDE (VC)	ug/L	2	MCL	ND <0.5	-

NOTES:

Acronyms / Superscripts:

[1] See Oregon Administrative Rules (OAR) 333-061-0030; 0031 for drinking water MCLs and SMCLs for public water systems

AL = Action Level

MCL = Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

MRDL = Maximum Residual Disinfectant Level

Analytical Results:

- = no analytical result or applicable MCL/SMCL available

ND = Parameter not detected at/above the analytical method detection limit; method detection limit not available

ND< = Parameter not detected at/above the indicated analytical method detection limit

Bold = Parameter detected above method detection limit

(shaded) = Parameter detected above drinking water standard (MCL/SMCL)

APPENDIX D

Test Well Log

MARI 70185

WESTERBERG DRILLING INC.
PO BOX 1228
MOLALLA, OR 97038

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

WELL I.D. LABEL# L 141561
START CARD # 218464
ORIGINAL LOG #

(1) LAND OWNER
Owner Well I.D.
First Name Last Name
Company City of Stayton
Address 362 N. Third St.
City Stayton State OR Zip 97383

(2) TYPE OF WORK
[X] New Well [ ] Deepening [ ] Conversion
[ ] Alteration (complete 2a & 10) [ ] Abandonment(complete 5a)

(2a) PRE-ALTERATION
Casing: Dia + From To Gauge Stl Plstc Wld Thrd
Seal: Material From To Amt sacks/lbs

(3) DRILL METHOD
[X] Rotary Air [ ] Rotary Mud [ ] Cable [ ] Auger [ ] Cable Mud
[ ] Reverse Rotary [ ] Other

(4) PROPOSED USE
[ ] Domestic [ ] Irrigation [ ] Community
[ ] Industrial/ Commercial [ ] Livestock [ ] Dewatering
[ ] Thermal [ ] Injection [X] Other ASR Test Hole

(5) BORE HOLE CONSTRUCTION
Special Standard [ ] (Attach copy)
Depth of Completed Well 660 ft.

BORE HOLE Dia	From	To	SEAL Material	From	To	Amt	sacks/lbs
12	0	322	Bentonite	0	4	2	S
10	322	324			Calculated		
8	324	692	Cement	4	323	382	S
					Calculated	115	

How was seal placed: Method [ ] A [ ] B [X] C [ ] D [ ] E
[X] Other bent placed dry
Backfill placed from 323 ft. to 324 ft. Material fine sand
Filter pack from ft. to ft. Material Size
Explosives used: [ ] Yes Type Amount

(5a) ABANDONMENT USING UNHYDRATED BENTONITE
Proposed Amount Pounds Actual Amount Pounds

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
(•)	( )	8	[X]	3	324	250	(•)	( )	[X]	[ ]

Shoe [ ] Inside [X] Outside [ ] Other Location of shoe(s) 324
Temp casing [X] Yes Dia 12 From + [ ] 0 To 230

(7) PERFORATIONS/SCREENS
Perforations Method none
Screens Type Material

Perf/Screen	Casing/Liner	Screen Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/pipe size

RECEIVED
DEC 30 2021
OWRD

(8) WELL TESTS: Minimum testing time is 1 hour
(•) Pump ( ) Bailer ( ) Air ( ) Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
500	10.36		24

Temperature 55 °F Lab analysis [ ] Yes By
Water quality concerns? [ ] Yes (describe below) TDS amount 88 ppm

From	To	Description	Amount	Units

(9) LOCATION OF WELL (legal description)
County MARION Twp 9 S N/S Range 1 W E/W WM
Sec 4D NE 1/4 of the SE 1/4 Tax Lot 200
Tax Map Number Lot
Lat ° ' " or DMS or DD
Long ° ' " or DMS or DD
(•) Street address of well ( ) Nearest address
2800 Kindle Way

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Pre-Alteration				
Completed Well	12-08-2021			42.75

Flowing Artesian? [ ] Dry Hole? [ ]

WATER BEARING ZONES Depth water was first found 12

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
10-08-2021	230	375				41.5
10-11-2021	375	425				43.3
10-13-2021	425	455				43.10
10-15-2021	455	575				49.15
10-21-2021	575	692				55.75

(11) WELL LOG
Ground Elevation

Material	From	To
soil	0	1
river gravel with binder	1	33
gravel with brown clay	33	45
blue clay with gravel	45	58
gravel loose blue grey	58	73
clay blue sticky	73	80
clay grey sticky	80	108
clay blue	108	110
clay grey	110	118
clay blue grey	118	120
clay grey	120	130
clay grey with some brown	130	170
clay grey with green	170	180
clay grey with brown	180	196
cemented gravel	196	200
clay blue with gravel	200	215
silt grey with wood	215	230
basalt grey with fractures	230	245
basalt grey medium hard with green	245	259

Date Started 09-17-2021 Completed 12-16-2021

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
License Number 1352 Date 12-22-2021
Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
License Number 688 Date 12-22-2021
Signed
Contact Info (optional)

MARI 70185

Pg 2 of 2

WATER SUPPLY WELL REPORT - continuation page

WESTERBERG DRILLING INC.
PO BOX 1228
MOLALLA, OR 97038

WELL I.D. LABEL# L 141561
START CARD # 218464
ORIGINAL LOG #

(2a) PRE-ALTERATION

Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

Material	From	To	Amt	sacks/lbs

Water Quality Concerns

From	To	Description	Amount	Units

(5) BORE HOLE CONSTRUCTION

BORE HOLE

Dia	From	To

SEAL

Material	From	To	Amt	sacks/lbs
		Calculated		
		Calculated		
		Calculated		
		Calculated		

FILTER PACK

From	To	Material	Size

(10) STATIC WATER LEVEL

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

(11) WELL LOG

Material	From	To
clay green & white	259	261
basalt grey medium with green claystone lenses	261	275
basalt grey medium	275	285
basalt grey hard	285	333
basalt hard with some fractures	333	343
basalt more fractures	343	350
basalt grey with fractures	350	375
basalt grey hard	375	382
basalt grey with red fractures/faster drilling	382	390
basalt grey hard with fractures	390	405
basalt grey with red fractured & visic	405	410
basalt grey hard	410	443
basalt grey less hard	443	445
basalt grey hard	445	470
basalt grey fractured & had to redrill some	470	484
basalt grey hard	484	490
basalt medium hard	490	500
basalt grey hard	500	525
basalt grey hard with occiasional fractures	525	575
basalt grey hard	575	580
basalt grey fractured	580	584
basalt grey hard with fractures	584	643
basalt grey hard	643	652
basalt light grey very hard	652	671
basalt grey less hard	671	672
soft drilling red crumbly siltstone	672	679
red clay sticky	679	689
siltstone softer drilling	689	692

(7) PERFORATIONS/SCREENS

Perf/Screen	Casing/Liner	Screen Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/pipe size

(8) WELL TESTS: Minimum testing time is 1 hour

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Comments/Remarks

8" hole sloughed from 692' up to 684'
Cement grout plug from 660'-684' 10.5 sacks

Appendix E

Laboratory Results

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (866) 988-3757
1 800 566 LABS (1 800 566 5227)

ACCREDITED
CERTIFICATE #'s 5890.01 & 5890.02

Laboratory Report

for

GSI Water Solutions
55SW Yamhill Street, Suite 400
Portland, 97204
Attention: Robyn Cook
Fax: (503) 239-8940

REPORT REVISED,
replaces the original report.

Date of Issue
02/04/2022
Vanessa Berry
EUROFINS EATON ANALYTICAL, LLC

Utah ELCP CA00006

Report: 976823
Project: STAYTON
Group: City of Stayton Test Well - IOCs DBPs

ZIA8: Vanessa Berry

Project Manager

* Accredited in accordance with TNI 2016 and ISO/IEC 17025:2017.
* Laboratory certifies that the test results meet all **TNI 2016 and ISO/IEC 17025:2017** requirements unless noted under the individual analysis.
* As applicable, this report consists of the cover page, State Certification List, ISO 17025 Accredited Method List, Acknowledgement of Samples Received, Comments, Hits Report, Data Report, QC Summary, QC Report and Regulatory Forms.
* Test results relate only to the sample(s) tested.
* Test results apply to the sample(s) as received, unless otherwise noted in the comments report (ISO/IEC 17025:2017).
* This report shall not be reproduced except in full, without the written approval of the laboratory.
* This report includes ISO/IEC 17025 and non-ISO 17025 accredited methods.

STATE CERTIFICATION LIST

State	Certification Number	State	Certification Number
Alabama	41060	Montana	Cert 0035
Arizona	AZ0778	Nebraska	NE-OS-21-13
Arkansas	CA00006	Nevada	CA00006
California	2813	New Hampshire *	2959
Colorado	CA00006	New Jersey *	CA 008
Connecticut	PH-0107	New Mexico	CA00006
Delaware	CA 006	New York *	11320
Florida *	E871024	North Carolina	06701
Georgia	947	North Dakota	R-009
Guam	21-008R	Ohio - 537.1	87786
Hawaii	CA00006	Oregon *	4034
Idaho	CA00006	Pennsylvania *	68-00565
Illinois	200033	Puerto Rico	CA00006
Indiana	C-CA-01	Rhode Island	LAO00326
Iowa – Asbestos	413	South Carolina	87016
Kansas *	E-10268	South Dakota	CA11320
Kentucky	90107	Tennessee	TN02839
Louisiana *	LA008	Texas *	T104704230-20-18
Maine	CA00006	Utah (Primary AB) *	CA00006
Maryland	224	Vermont	VT0114
Marianas Islands	MP0004	Virginia *	460260
Massachusetts	M-CA006	Washington	C838
Michigan	9906	EPA Region 5	CA00006
Mississippi	CA00006	Los Angeles County Sanitation Districts	10264

* NELAP/TNI Recognized Accreditation Bodies

Eurofins Eaton Analytical, LLC
750 Royal Oaks Drive, Suite 100
Monrovia, CA 91016-3629
T | 626-386-1100
F | 866-988-3757
www.EurofinsUS.com/Eaton

ISO/IEC 17025:2917 Accredited Method List
The test listed below are accredited and met the requirements of ISO/IEC 17025 as verify by A2LA.
Refer to our certificates and scope of accreditations (no. 5890-1 and 5890-2) found at:
https://www.eurofinsus.com/Eaton

Test(s)	Method(s)	Potable Water *	Waste Water
Enterococci	Enterolert	x	x
Escherichia coli (Enumeration)	SM 9221 B.1 SM 9221 F	x	
Fecal Coliform (P/A and Enumeration)	SM 9221 C (MTF/EC), SM 9221 E (MTF/EC)	x	x
Fecal Streptococci and Enterococci	SM 9230 B	x	x
Heterotrophic Bacteria	SM 9215 B	x	
Legionella	Legiolert®	x	
Pseudomonas aeruginosa	Idexx Pseudalert	x	
Total Coliform (P/A and Enumeration)	SM 9221A, SM 9221B, SM 9221 C	x	x
Total Coliform, Total Coliform with Chlorine Present	SM 9221 B	x	x
Total Coliform/E. coli (P/A and Enumeration, Idexx Colilert, Idexx Colilert 18, Colisure)	SM 9223	x	
Total Microcystins and Nodularins	EPA 546	X	
Yeast and Mold	SM 9610	x	
1,2,3-Trichloropropane (TCP) at 5 PPT	CA SRL 524M-TCP	x	
1,4-Dioxane	EPA 522	x	
2,3,7,8-TCDD	Modified EPA 1613 B	x	
Acrylamide	+LCMS 2440)	x	
Algal Toxins/Microcystin	+ LCMS 3570	x	
Alkalinity	SM 2320B	x	x
Ammonia	EPA 350.1, SM 4500-NH3 H		x
Asbestos	EPA 100.2	x	x
Bicarbonate Alkalinity as HCO3	SM 2330 B	x	x
BOD/CBOD	SM 5210 B		x
Bromate	+LCMS- 2447	x	
Carbonate as CO3	SM 2330 B	x	x
Carbonyls	EPA 556	x	x
Chemical Oxygen Demand	EPA 410.4, SM 5220D		x
Chlorinated Acids	EPA 515.4	x	
Chlorine Dioxide	Palin Test Chlordio X Plus, SM 4500-CLO2 D	x	
Chlorine, Free, Combined, Total Residual, Chloramines	SM 4500-Cl G	x	
Color	SM2120B	x	
Conductivity	EPA 120.1, SM 2510B	x	x
Corrosivity (Langelier Index), Carbonate as CO3, Hydroxide as OH Calculated	SM 2330 B	x	
Cyanide (Amenable)	SM 4500-CN G	x	x
Cyanide (Free)	SM 4500CN F	x	x
Cyanide (Total)	EPA 335.4	x	x
Cyanogen Chloride (Screen)	+335 Mod (WC-24467)	x	
Diquat and Paraquat	EPA 549.2	x	
DBP and HAA	SM 6251 B	x	
Dissolved Organic Carbon	SM 5310 C	x	
Dissolved Oxygen	SM 4500-O G		x
EDB/DCBP/TCP	EPA 504.1	x	
EDB/DBCP and Disinfection Byproducts	EPA 551.1	x	
EDTA and NTA	+ WC-2454	x	
Endothall	EPA 548.1, +(LCMS-2445)	x	
Fluoride	SM 4500F C	x	x
Glyphosate	EPA 547	x	
Glyphosate and AMPA	+LCMS-3618	x	
Gross Alpha and Gross Beta	EPA 900.0	x	x

Test(s)	Method(s)	Potable Water *	Waste Water
Gross Alpha coprecipitation	SM 7110 C	x	x
Hardness	SM 2340 B	x	x
Hexavalent Chromium	EPA 218.6,	x	x
Hexavalent Chromium	EPA 218.7,	x	
Hexavalent Chromium	SM 3500-Cr B		x
Inorganic Anions and DBPs	EPA 300.0	x	x
Norganic Anions and DBPs	EPA 300.1	x	
Kjeldahl Nitrogen	EPA 351.2		x
Metals	EPA 200.7, EPA200.8	x	x
Nitrosamines	EEA-Agilent 521.1 (GCMS-24250)	x	
Nitrate/Nitrite Nitrogen	EPA 353.2	x	x
Odor	SM2150B	x	
Organohalide Pesticides and PCB	EPA 505	x	
Ortho Phosphate	SM 4500P E	x	
Oxyhalides Disinfection Byproducts	EPA 317.0	x	
Perchlorate	EPA 331.0	x	
Perchlorate (Low and High Levels)	EPA 314.0	x	
Perfluorinated Alkyl Acids	EPA 533, EPA 537, EPA 537.1	x	
PPCP and EDC	+LCMS-2443	x	
pH	EPA 150.1 SM 4500-H+ B	x	x
Phenolics – Low Level	+WC 2493 (EPA 420.2 and EPA 420.4 MOD)	x	x
Phenylurea Pesticides/Herbicides	+LCMS-2448	x	
Radium-226, Radium-228	GA Tech (Rad-2374)	x	
Radon-222	SM 7500RN	x	
Residue (Filterable)	SM 2540C	x	x
Residue (Non-Filterable)	SM 2540D		x
Residue (Total)	SM 2540B		x
Residue (Volatile)	EPA 160.4		x
Semi-Volatile Compounds	EPA 525.2	x	
Silica	SM 4500-SiO2 C	x	x
Sulfide	SM 4500-S D		x
Sulfite	SM 4500-SO3 B	x	x
Surfactants	SM 5540C	x	x
Taste and Odor	SM 6040 E	x	
Total Organic Carbon	SM 5310 C	x	x
Total Phenols	EPA 420.1		x
Total Phenols	EPA 420.4	x	x
Triazine Pesticides and their Degradates	+LCMS-3617	x	
Turbidity	EPA 180.1	x	x
Uranium by ICP/MS	EPA 200.8	x	
UV 254 Organic Constituents	SM 5910B	x	
VOCs	EPA 524.2	x	
VOCs	+ (GCMS 2412) by EPA 524.2 modified	x	

(*) includes: Bottled Water, Drinking Water and Water as Component of Food & Beverage.
(+) In-House Method

Eurofins Eaton Analytical

Acknowledgement of Samples Received

Addr: **GSI Water Solutions**
55SW Yamhill Street, Suite 400
Portland97204

Attn: Robyn Cook
Phone: (503) 239-8799

Client ID: GWS-LEATON
Folder #: 976823
Project: STAYTON
Sample Group: City of Stayton Test Well - IOCs DBPs

Project Manager: Vanessa Berry
Phone: 503-310-3905

The following samples were received from you on **December 22, 2021** at **1444**. They have been scheduled for the tests listed below each sample. If this information is incorrect, please contact your service representative. Thank you for using Eurofins Eaton Analytical, LLC.

Sample #	Sample ID	Sample Date
202112220582	Stayton Source Water	12/21/2021 1500

Anion Sum - Calculated	Cation Sum - Calculated	Cation/Anion Difference
Apparent Color	Odor at 60 C (TON)	Agressiveness Index-Calculated
Langelier Index - 25 degree	Langlier Index at 60 degrees C	PH (H3=past HT not compliant)
pH of CaCO3 saturation(25C)	pH of CaCO3 saturation(60C)	@ANIONS48
@HAA5	@THM524	Alkalinity in CaCO3 units
Aluminum Total ICAP/MS	Antimony Total ICAP/MS	Arsenic Total ICAP/MS
Barium Total ICAP/MS	Beryllium Total ICAP/MS	Bicarb.Alkalinity as HCO3,calc
Bromate by UV/VIS	Cadmium Total ICAP/MS	Calcium Total ICAP
Carbonate as CO3, Calculated	Chloride	Chlorite
Chromium Total ICAP/MS	Copper Total ICAP/MS	Cyanide
Fluoride	Free Chlorine Residual	Iron Dissolved ICAP
Iron Total ICAP	Lead Total ICAP/MS	Magnesium Total ICAP
Manganese dissolved ICAP/MS	Manganese Total ICAP/MS	Mercury ICPMS
Nickel Total ICAP/MS	PH (H3=past HT not compliant)	Potassium Total ICAP
Selenium Total ICAP/MS	Silica	Silver Total ICAP/MS
Sodium Total ICAP	Sulfate	Surfactants
Thallium Total ICAP/MS	Total Chlorine Residual	Total Dissolved Solid (TDS)
Total Hardness as CaCO3 by ICP	Total Organic Carbon	Total Suspended Solids (TSS)
Uranium by ICPMS as pCi/L	Uranium ICAP/MS	Zinc Total ICAP/MS

Test Description

@ANIONS48 -- Nitrate, Nitrite by EPA 300.0

@HAA5 -- Haloacetic Acids

@THM524 -- Volatile Organics by GCMS

750 Royal Oaks Drive, Suite 100, Monrovia, CA 91016 Tel (626) 386-1100 Fax (866) 988-3757 www.EurofinsUS.com/Eaton

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CHAIN OF CUSTODY RECORD

750 Royal Oaks Drive, Suite 100
Monrovia, CA 91016-3629

Phone: 626 386 1100
Fax: 626 386 1101

800 566 LABS (800 566 5227)

Website: www.EatonAnalytical.com

EUROFINS EATON ANALYTICAL USE ONLY: 976823

LOGIN COMMENTS: ______

SAMPLES CHECKED AGAINST COC BY: JJ

SAMPLES LOGGED IN BY: Sm

SAMPLE TEMP RECEIVED AT:

SAMPLES REC'D DAY OF COLLECTION? ☐ (check for yes)

☐ ______ (Other) IR Gun ID = ______ (Observation= ______ °C) (Corr.Factor ______ °C) (Final = ______ °C)

☑ Monrovia IR Gun ID = 631A (Observation= 2.5 °C) (Corr.Factor -0.2 °C) (Final = 2.3 °C)

Compliance Acceptance Criteria: (Chemistry: 4 ± 2 °C) (Microbiology: < 10°C)

TYPE OF ICE: Real ✓ Synthetic ___ No Ice ___ **CONDITION OF ICE:** Frozen ___ Partially Frozen ___ Thawed ___ N/A ___

METHOD OF SHIPMENT: Pick-Up / Walk-In / (FedEx) / UPS / DHL / Area Fast / Top Line / Other: ______

TO BE COMPLETED BY SAMPLER:

COMPANY/AGENCY NAME: GSI Water Solutions Inc.

PROJECT CODE: Stayton

EEA CLIENT CODE:

COC ID:

SAMPLE GROUP:

COMPLIANCE SAMPLES ☐ (check for yes)
- Requires state forms ☐

NON-COMPLIANCE SAMPLES ☒ (check for yes)

REGULATION INVOLVED: ______ (eg. SDWA, NPDES, etc.)

Type of samples (circle one): (ROUTINE) SPECIAL CONFIRMATION

SEE ATTACHED KIT ORDER FOR ANALYSES ☒ (check for yes), ***OR***

List ALL ANALYSES REQUIRED (enter number of bottles sent for each test for each sample)

TAT requested: rush by adv notice only STD X 1 wk ___ 3 day ___ 2 day ___ 1 day ___

SAMPLE DATE	SAMPLE TIME	SAMPLE ID	CLIENT LAB ID	MATRIX *	FIELD DATA	FIELD DATA															SAMPLER COMMENTS
12/21/21	1500	Stayton Test well Source Water		RSW																	* see Kit # 308244 for analysis

*** MATRIX TYPES: RSW** = Raw Surface Water **RGW** = Raw Ground Water **CFW** = Chlor(am)inated Finished Water **FW** = Other Finished Water **SEAW** = Sea Water **WW** = Waste Water **BW** = Bottled Water **SW** = Storm Water **SO** = Soil **SL** = Sludge **O** = Other - Please Identify

	SIGNATURE	PRINT NAME	COMPANY/TITLE	DATE	TIME
SAMPLED BY:	[signature]	Chris Wick	GSI Water Solutions Inc.	12/21/21	15:45
RELINQUISHED BY:	[signature]	Chris Wick	GSI Water Solutions Inc.	12/21/21	15:45
RECEIVED BY:	[signature]	Joe Sanchez	EEA	12/22/21	1441
RELINQUISHED BY:					
RECEIVED BY:					

QA FO 0029.2 (Version 2) (08/28/2014)

PAGE ____ OF ____

eurofins | Eaton Analytical

Kit Order for Groundwater Solutions, Inc,

Vanessa Berry is your Eurofins Eaton Analytical, LLC Service Manager

Created Date & Time: 12/16/2021 4:47:32PM

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
(626) 386-1100 FAX (866) 988-3757

Note: Sampler Please return this paper with your samples

Kit #: 308244

Created By: Vanessa Berry - [ZIA8]
Deliver By: 12/20/2021
STG: Bottle Orders
Ice Type: W

Client ID: GWS-LEATON
Project Code: STAYTON Bottle Orders
Group Name: City of Stayton Test Well - IOCs DBPs
PO#/JOB#:
Description: RUSH KO

Ship Sample Kits to
Groundwater Solutions, Inc,
5181 NE Wistaria Dr
Portland, OR 97213

Attn: Chris Wick - Shipping
Phone: 323.610.3792

Send Report to
GSI Water Solutions
55SW Yamhill Street, Suite 400
Portland, 97204

Attn: Robyn Cook
Phone: (503) 239-8799
Fax: (503) 239-8940

Billing Address
GSI Water Solutions
55SW Yamhill Street, Suite 400
Portland, 97204

Attn: Robyn Cook
Phone: (503) 239-8799
Fax: (503) 239-8940

# of Sample	Tests	Bottle Qty - Type [preservative information]	Total	UN DOT #
1	Total Organic Carbon	1 - 125ml amber glass [0.5 ml H2SO4 (50%)]	1	UN1830
1	@ANIONS48, Chloride, Fluoride, Iron Dissolved ICAP, Manganese dissolved ICAP/MS, PH (H3=past HT not compliant), Sulfate	1 - 125ml poly [no preservative]	1	
1	Apparent Color, Odor at 60 C (TON)	1 - 1L amber glass [no preservative]	1	
1	Cyanide	1 - 250 ml poly [2 ml NaOH (30%)+6 scoops AA]	1	
1	PH (H3=past HT not compliant), Alkalinity in CaCO3 units	1 - 250ml poly [no preservative]	1	
1	@THM524	3 - 40ml amber glass vial [0.25 ml Thio (8%)]	3	
1	@HAA5	3 - 40ml amber glass vial [65 mg NH4Cl]	3	
1	Aluminum Total ICAP/MS, Antimony Total ICAP/MS, Arsenic Total ICAP/MS, Barium Total ICAP/MS, Beryllium Total ICAP/MS, Cadmium Total ICAP/MS, Calcium Total ICAP, Chromium Total ICAP/MS, Copper Total ICAP/MS, Iron Total ICAP, Lead Total ICAP/MS, Magnesium Total ICAP, Manganese Total ICAP/MS, Mercury by ICAP/MS, Nickel Total ICAP/MS, Potassium Total ICAP, Selenium Total ICAP/MS, Silica, Silver Total ICAP/MS, Sodium Total ICAP, Thallium Total ICAP/MS, Uranium by ICPMS as pCi/L, Uranium ICAP/MS, Zinc Total ICA	1 - 500ml acid poly [2ml HNO3 (18%)]	1	UN2031
1	Surfactants	1 - 500ml poly [no preservative]	1	
1	Total Dissolved Solid (TDS), Total Suspended Solids (TSS)	1 - 500ml poly [no preservative]	1	

Sum Tests: 10

Sum Bottles: 14

Comments

ship out wiht UPS

include return shipping labels
COCs
sampling instructions

Code	Status	Date Shipped	Via	Tracking #	# of Coolers	Prepared By

Eurofins Eaton Analytical

Tel: (626) 386-1100
Fax: (866) 988-3757
1 800 566 LABS (1 800 566 5227)

Laboratory Comments

Report: 976823
Project: STAYTON
Group: City of Stayton Test Well - IOCs DBPs

GSI Water Solutions
Robyn Cook
55SW Yamhill Street, Suite 400
Portland, 97204

Folder Comments

Revised Report: Client requested results for free chlorine, total chlorine, chlorite and bromate. VHB 1.24.22

Flags Legend:

B4 - Target analyte detected in blank at or above method acceptance criteria.

H3 - Sample was received and/ or analysis requested past holding time.

Q4 - Sample received and analyzed without chemical preservation.

Result Comments

Odor at 60 C (TON)

202112220582: none

The Comments Report may be blank if there are no comments for this report.

eurofins
Eaton Analytical

Tel: (626) 386-1100
Fax: (866) 988-3757
1 800 566 LABS (1 800 566 5227)

Laboratory Hits

Report: 976823
Project: STAYTON
Group: City of Stayton Test Well - IOCs DBPs

GSI Water Solutions
Robyn Cook
55SW Yamhill Street, Suite 400
Portland, 97204

Samples Received on:
12/22/2021 1444

Analyzed	Analyte	Sample ID	Result	Federal MCL	Units	MRL
	202112220582	**Stayton Source Water**				
12/28/2021 17:43	Agressiveness Index-Calculated		10.3		None	0.100
12/28/2021 04:55	Alkalinity in CaCO3 units		26		mg/L	2.0
12/28/2021 13:51	Anion Sum - Calculated		0.63		meq/L	0.0010
01/13/2022 20:00	Barium Total ICAP/MS		2.6	2000	ug/L	2.0
12/28/2021 14:22	Bicarb.Alkalinity as HCO3calc		31		mg/L	2.0
01/04/2022 06:08	Bromodichloromethane		2.1		ug/L	0.50
01/04/2022 20:52	Calcium Total ICAP		6.0		mg/L	1.0
12/28/2021 17:43	Cation Sum - Calculated		0.64		meq/L	0.0010
12/22/2021 17:43	Chloride		2.4	250	mg/L	0.50
01/04/2022 06:08	Chloroform (Trichloromethane)		25		ug/L	0.50
01/13/2022 20:00	Copper Total ICAP/MS		6.3	1300	ug/L	2.0
01/04/2022 15:43	Dichloroacetic acid		4.0		ug/L	1.0
01/11/2022 13:21	Iron Dissolved ICAP		0.051		mg/L	0.010
12/28/2021 13:46	Iron Total ICAP		0.058	0.3	mg/L	0.010
12/28/2021 14:22	Langelier Index - 25 degree		-1.5		None	-14
12/28/2021 22:34	Langelier Index at 60 degrees C		-1.1		None	-14
12/28/2021 13:46	Magnesium Total ICAP		1.2		mg/L	0.10
12/22/2021 17:43	Nitrate as Nitrogen by IC		0.39	10	mg/L	0.050
12/22/2021 17:43	Nitrate as NO3 (calc)		1.7	45	mg/L	0.22
12/28/2021 04:55	PH (H3=past HT not compliant)		7.6		Units	0.10
12/28/2021 17:43	pH of CaCO3 saturation(25C)		9.2		Units	0.10
12/28/2021 13:51	pH of CaCO3 saturation(60C)		8.7		Units	0.10
12/28/2021 13:46	Silica		14		mg/L	0.50
12/28/2021 13:46	Sodium Total ICAP		5.6		mg/L	1.0
12/22/2021 17:43	Sulfate		0.94	250	mg/L	0.50
12/28/2021 23:15	Total Dissolved Solids (TDS)		48	500	mg/L	10
01/04/2022 15:43	Total Haloacetic Acids (HAA5)		18	60	ug/L	2.0
12/28/2021 17:43	Total Hardness as CaCO3 by ICP (calc)		20		mg/L	3.0
12/22/2021 17:43	Total Nitrate, Nitrite-N, CALC		0.39		mg/L	0.050
01/07/2022 04:09	Total Organic Carbon		0.74		mg/L	0.20
01/04/2022 06:08	Total THM		27	80	ug/L	0.50
01/04/2022 15:43	Trichloroacetic acid		14		ug/L	1.0

SUMMARY OF POSITIVE DATA ONLY

eurofins Eaton Analytical

Laboratory Data

Tel: (626) 386-1100
Fax: (866) 988-3757
1 800 566 LABS (1 800 566 5227)

Report: 976823
Project: STAYTON
Group: City of Stayton Test Well - IOCs DBPs

GSI Water Solutions
Robyn Cook
55SW Yamhill Street, Suite 400
Portland, 97204

Samples Received on:
12/22/2021 1444

Prepped	Analyzed	Prep Batch	Analytical Batch	Method	Analyte	Result	Units	MRL	Dilution
Stayton Source Water (202112220582)						**Sampled on 12/21/2021 1500**			
		EPA 200.8 - ICPMS Metals							
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Aluminum Total ICAP/MS	ND	ug/L	20	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Antimony Total ICAP/MS	ND	ug/L	1.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Arsenic Total ICAP/MS	ND	ug/L	1.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Barium Total ICAP/MS	2.6	ug/L	2.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Beryllium Total ICAP/MS	ND	ug/L	1.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Cadmium Total ICAP/MS	ND	ug/L	0.50	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Chromium Total ICAP/MS	ND	ug/L	1.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Copper Total ICAP/MS	6.3	ug/L	2.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Lead Total ICAP/MS	ND	ug/L	0.50	1
12/27/21	01/03/22 19:24	1375908	1377119	(EPA 200.8)	Manganese dissolved ICAP/MS	ND	ug/L	2.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Manganese Total ICAP/MS	ND	ug/L	2.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Nickel Total ICAP/MS	ND	ug/L	5.0	1
12/27/21	01/17/22 17:58	1375908	1379786	(EPA 200.8)	Selenium Total ICAP/MS	ND	ug/L	5.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Silver Total ICAP/MS	ND	ug/L	0.50	1
12/27/21	01/17/22 17:58	1375908	1379786	(EPA 200.8)	Thallium Total ICAP/MS	ND	ug/L	1.0	1
12/27/21	01/17/22 17:58	1375908	1379786	(EPA 200.8)	Uranium ICAP/MS	ND	ug/L	1.0	1
12/27/21	01/13/22 20:00	1375908	1378798	(EPA 200.8)	Zinc Total ICAP/MS	ND	ug/L	20	1
		EPA 200.7 - ICP Metals							
12/27/21	01/04/22 20:52	1375908	1377405	(EPA 200.7)	Calcium Total ICAP	6.0	mg/L	1.0	1
12/27/21	01/11/22 13:21	1375908	1378628	(EPA 200.7)	Iron Dissolved ICAP	0.051	mg/L	0.010	1
12/27/21	12/28/21 13:46	1375908	1376057	(EPA 200.7)	Iron Total ICAP	0.058	mg/L	0.010	1
12/27/21	12/28/21 13:46	1375908	1376057	(EPA 200.7)	Magnesium Total ICAP	1.2	mg/L	0.10	1
12/27/21	12/28/21 13:46	1375908	1376057	(EPA 200.7)	Potassium Total ICAP	ND	mg/L	1.0	1
12/27/21	12/28/21 13:46	1375908	1376057	(EPA 200.7)	Sodium Total ICAP	5.6	mg/L	1.0	1
		EPA 200.7 - ICP Metals							
12/27/21	12/28/21 13:46	1375908	1376123	(EPA 200.7)	Silica	14	mg/L	0.50	1
		EPA 200.8 - Mercury ICPMS							
12/27/21	01/17/22 16:43	1375908	1380026	(EPA 200.8)	Mercury ICPMS	ND	ug/L	0.20	1
		SM 5310C - Total Organic Carbon							
	01/07/22 04:09		1377850	(SM 5310C)	Total Organic Carbon	0.74	mg/L	0.20	1
		SM 2330B - pH of CaCO3 saturation(60C)							
	12/28/21 13:51			(SM 2330B)	pH of CaCO3 saturation(60C)	8.7 (c)	Units	0.10	1
		EPA 200.8 - Uranium by ICPMS as pCi/L							
	01/14/22 16:23			(EPA 200.8)	Uranium by ICPMS as pCi/L	ND (c)	pCi/L	0.70	1
		SM 2330B - Langelier Index - 25 degree							

Rounding on totals after summation.
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Samples Received on:
12/22/2021 1444

Prepped	Analyzed	Prep Batch	Analytical Batch	Method	Analyte	Result	Units	MRL	Dilution
	12/28/21 14:22			(SM 2330B)	Langelier Index - 25 degree	-1.5 (c)	None	-14	1
		SM2330B - Carbonate as CO3, Calculated							
	12/28/21 22:34			(SM2330B)	Carbonate as CO3, Calculated	ND (c)	mg/L	2.0	1
		SM 2340B - Total Hardness as CaCO3 by ICP							
	12/28/21 17:43			(SM 2340B)	Total Hardness as CaCO3 by ICP (calc)	20 (c)	mg/L	3.0	1
		SM 1030E - Anion Sum - Calculated							
	12/28/21 13:51			(SM 1030E)	Anion Sum - Calculated	0.63 (c)	meq/L	0.0010	1
		SM 1030E - Cation Sum - Calculated							
	12/28/21 17:43			(SM 1030E)	Cation Sum - Calculated	0.64 (c)	meq/L	0.0010	1
		SM 2330B - pH of CaCO3 saturation(25C)							
	12/28/21 17:43			(SM 2330B)	pH of CaCO3 saturation(25C)	9.2 (c)	Units	0.10	1
		SM2330B - Bicarb.Alkalinity as HCO3,calc							
	12/28/21 14:22			(SM2330B)	Bicarb.Alkalinity as HCO3calc	31 (c)	mg/L	2.0	1
		SM 2330 - Agressiveness Index-Calculated							
	12/28/21 17:43			(SM 2330)	Agressiveness Index-Calculated	10.3 (c)	None	0.100	1
		SM 2330B - Langlier Index at 60 degrees C							
	12/28/21 22:34			(SM 2330B)	Langelier Index at 60 degrees C	-1.1 (c)	None	-14	1
		SM 1030E - Cation/Anion Difference							
	01/06/22 22:32			(SM 1030E)	Cation/Anion Difference	1.3 (c)	%		1
		SM 6251B - Haloacetic Acids							
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	Dibromoacetic acid	ND	ug/L	1.0	1
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	Dichloroacetic acid	4.0	ug/L	1.0	1
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	Monobromoacetic acid	ND	ug/L	1.0	1
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	Monochloroacetic acid	ND	ug/L	2.0	1
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	Total Haloacetic Acids (HAA5)	18	ug/L	2.0	1
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	Trichloroacetic acid	14	ug/L	1.0	1
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	1,2,3-Trichloropropane	104	%		1
01/03/22	01/04/22 15:43	1376995	1377145	(SM 6251B)	2,3-Dibromopropionic acid	125	%		1
		EPA 317 - Bromate by UV/VIS 317							
	01/26/22 14:17		1382324	(EPA 317)	Bromate by UV/VIS	ND (H3)	ug/L	1.0	1
		EPA 300.0 - Nitrate, Nitrite by EPA 300.0							
	12/22/21 17:43		1375662	(EPA 300.0)	Nitrate as Nitrogen by IC	0.39	mg/L	0.050	1
	12/22/21 17:43		1375662	(EPA 300.0)	Nitrate as NO3 (calc)	1.7	mg/L	0.22	1
	12/22/21 17:43		1375662	(EPA 300.0)	Nitrite Nitrogen by IC	ND	mg/L	0.050	1
	12/22/21 17:43		1375662	(EPA 300.0)	Total Nitrate, Nitrite-N, CALC	0.39	mg/L	0.050	1
		EPA 300.0 - Chlorite by 300.0							
	01/26/22 23:00		1382462	(EPA 300.0)	Chlorite by IC	ND (H3,Q4)	mg/L	0.010	1

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12/22/2021 1444

Prepped	Analyzed	Prep Batch	Analytical Batch	Method	Analyte	Result	Units	MRL	Dilution
		EPA 300.0 - Chloride, Sulfate by EPA 300.0							
	12/22/21 17:43		1375665	(EPA 300.0)	Chloride	2.4	mg/L	0.50	1
	12/22/21 17:43		1375665	(EPA 300.0)	Sulfate	0.94 (B4)	mg/L	0.50	1
		EPA 524.2 - Volatile Organics by GCMS							
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	Bromodichloromethane	2.1	ug/L	0.50	1
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	Bromoform	ND	ug/L	0.50	1
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	Chlorodibromomethane	ND	ug/L	0.50	1
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	Chloroform (Trichloromethane)	25	ug/L	0.50	1
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	Total THM	27	ug/L	0.50	1
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	1,2-Dichloroethane-d4	105	%		1
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	4-Bromofluorobenzene	95	%		1
01/04/22	01/04/22 06:08	1377182	1377185	(EPA 524.2)	Toluene-d8	100	%		1
		SM4500CN-F - Cyanide							
	12/30/21 09:13		1376336	(SM4500CN-F)	Cyanide	ND	mg/L	0.025	1
		SM 2150B - Odor at 60 C (TON)							
	12/22/21 14:57		1375939	(SM 2150B)	Odor at 60 C (TON)	ND	TON	1.0	1
		SM 4500F-C - Fluoride							
	12/30/21 18:11		1376246	(SM 4500F-C)	Fluoride	ND	mg/L	0.050	1
		SM 2320B - Alkalinity in CaCO3 units							
	12/28/21 04:55		1376113	(SM 2320B)	Alkalinity in CaCO3 units	26	mg/L	2.0	1
		E160.1/SM2540C - Total Dissolved Solids (TDS)							
12/28/21	12/28/21 23:15	1376317	1376319	(E160.1/SM2540C)	Total Dissolved Solids (TDS)	48	mg/L	10	1
		SM4500-HB - PH (H3=past HT not compliant)							
	12/28/21 04:55		1376117	(SM4500-HB)	PH (H3=past HT not compliant)	7.6	Units	0.10	1
		SM 2540D - Total Suspended Solids (TSS)							
	12/28/21 16:32		1376018	(SM 2540D)	Total Suspended Solids (TSS)	ND	mg/L	10	1
		SM 5540C/EPA 425.1 - Surfactants							
	12/22/21 15:52		1375564	(SM 5540C/EPA 425.1)	Surfactants	ND	mg/L	0.10	1
		SM 2120B - Apparent Color							
	12/22/21 16:55		1375620	(SM 2120B)	Apparent Color	ND	ACU	3.0	1
		SM 4500-CL G - Total Chlorine Residual (H3=past HT not compliant)							
	02/01/22 15:18		1383491	(SM 4500-CL G)	Total Chlorine Residual (H3=past HT not compliant)	ND	mg/L	0.10	1
		SM 4500CL-G/HACH - Free Chlorine Residual (H3=past HT not compliant)							
	02/01/22 15:18		1383490	(SM 4500CL-G/HACH)	Free Chlorine Residual (H3=past HT not compliant)	ND	mg/L	0.10	1

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Laboratory QC Summary

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GSI Water Solutions

Surfactants

Analytical Batch: 1375564 — **Analysis Date: 12/22/2021**

202112220582 Stayton Source Water — Analyzed by: PK4Q

Apparent Color

Analytical Batch: 1375620 — **Analysis Date: 12/22/2021**

202112220582 Stayton Source Water — Analyzed by: ZYV7

Nitrate, Nitrite by EPA 300.0

Analytical Batch: 1375662 — **Analysis Date: 12/22/2021**

202112220582 Stayton Source Water — Analyzed by: LUPE

Chloride, Sulfate by EPA 300.0

Analytical Batch: 1375665 — **Analysis Date: 12/22/2021**

202112220582 Stayton Source Water — Analyzed by: LUPE

Odor at 60 C (TON)

Analytical Batch: 1375939 — **Analysis Date: 12/22/2021**

202112220582 Stayton Source Water — Analyzed by: LK6J

Total Suspended Solids (TSS)

Analytical Batch: 1376018 — **Analysis Date: 12/28/2021**

202112220582 Stayton Source Water — Analyzed by: TJ52

ICP Metals

Prep Batch: 1375908 Analytical Batch: 1376057 — **Analysis Date: 12/28/2021**

202112220582 Stayton Source Water — Analyzed by: NINA

Alkalinity in CaCO3 units

Analytical Batch: 1376113 — **Analysis Date: 12/28/2021**

202112220582 Stayton Source Water — Analyzed by: D5MQ

PH (H3=past HT not compliant)

Analytical Batch: 1376117 — **Analysis Date: 12/28/2021**

202112220582 Stayton Source Water — Analyzed by: D5MQ

ICP Metals

Prep Batch: 1375908 Analytical Batch: 1376123 — **Analysis Date: 12/28/2021**

202112220582 Stayton Source Water — Analyzed by: NINA

Fluoride

Analytical Batch: 1376246 — **Analysis Date: 12/30/2021**

202112220582 Stayton Source Water — Analyzed by: D5MQ

Total Dissolved Solids (TDS)

Prep Batch: 1376317 Analytical Batch: 1376319 — **Analysis Date: 12/28/2021**

202112220582 Stayton Source Water — Analyzed by: TJ52

Cyanide

Analytical Batch: 1376336 — **Analysis Date: 12/30/2021**

202112220582 Stayton Source Water — Analyzed by: AV4L

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GSI Water Solutions

ICPMS Metals

Prep Batch: 1375908 Analytical Batch: 1377119 — **Analysis Date: 01/03/2022**

202112220582 Stayton Source Water — Analyzed by: DHX7

Haloacetic Acids

Prep Batch: 1376995 Analytical Batch: 1377145 — **Analysis Date: 01/04/2022**

202112220582 Stayton Source Water — Analyzed by: H5VG

Volatile Organics by GCMS

Prep Batch: 1377182 Analytical Batch: 1377185 — **Analysis Date: 01/04/2022**

202112220582 Stayton Source Water — Analyzed by: KCP

ICP Metals

Prep Batch: 1375908 Analytical Batch: 1377405 — **Analysis Date: 01/04/2022**

202112220582 Stayton Source Water — Analyzed by: Y7TT

Total Organic Carbon

Analytical Batch: 1377850 — **Analysis Date: 01/07/2022**

202112220582 Stayton Source Water — Analyzed by: TT9M

ICP Metals

Prep Batch: 1375908 Analytical Batch: 1378628 — **Analysis Date: 01/11/2022**

202112220582 Stayton Source Water — Analyzed by: NINA

ICPMS Metals

Prep Batch: 1375908 Analytical Batch: 1378798 — **Analysis Date: 01/13/2022**

202112220582 Stayton Source Water — Analyzed by: AZS

ICPMS Metals

Prep Batch: 1375908 Analytical Batch: 1379786 — **Analysis Date: 01/17/2022**

202112220582 Stayton Source Water — Analyzed by: AZS

Mercury ICPMS

Prep Batch: 1375908 Analytical Batch: 1380026 — **Analysis Date: 01/17/2022**

202112220582 Stayton Source Water — Analyzed by: AZS

Bromate by UV/VIS 317

Analytical Batch: 1382324 — **Analysis Date: 01/26/2022**

202112220582 Stayton Source Water — Analyzed by: TLH

Chlorite by 300.0

Analytical Batch: 1382462 — **Analysis Date: 01/26/2022**

202112220582 Stayton Source Water — Analyzed by: NJR

Free Chlorine Residual (H3=past HT not complia

Analytical Batch: 1383490 — **Analysis Date: 02/01/2022**

202112220582 Stayton Source Water — Analyzed by: YHP7

Total Chlorine Residual (H3=past HT not compli

Analytical Batch: 1383491 — **Analysis Date: 02/01/2022**

202112220582 Stayton Source Water — Analyzed by: YHP7

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GSI Water Solutions

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
cj rGa: taf tn by cs AAl i CD1 e2 l / A0B									
2 f alyt3 ah5 at: 6RB4NAA, l						**2 f alyn3n 7 atuRB/ D/ Di / B**			
LCS1	Surfactants		0.2	0.203	mg/L	101	(90-110)		
LCS2	Surfactants		0.2	0.208	mg/L	104	(90-110)	20	2.4
MBLK	Surfactants			<0.05	mg/L				
MRL_CHK	Surfactants		0.1	0.104	mg/L	104	(75-125)		
MS_202112220582	Surfactants	ND	0.2	0.199	mg/L	91	(80-120)		
MSD_202112220582	Surfactants	ND	0.2	0.206	mg/L	94	(80-120)	20	3.5
2 mmaruf t Color by cs / B/ i 5									
2 f alyt3 ah5 at: 6RB4NA, / i						**2 f alyn3n 7 atuRB/ D/ Di / B**			
DUP1_202112210875	Apparent Color	ND		ND	ACU		(0-20)		
DUP2_202112220617	Apparent Color	ND		ND	ACU		(0-20)		
MBLK	Apparent Color			<0.5	ACU				
E3ratu. E3r3u by 1 e2 4i i 0 by 1 e2 4i i 0									
2 f alyt3 ah5 at: 6RB4NA, , /						**2 f alyn3n 7 atuRB/ D/ Di / B**			
LCS1	Nitrate as Nitrogen by IC		2.5	2.38	mg/L	95	(90-110)		
LCS2	Nitrate as Nitrogen by IC		2.5	2.40	mg/L	96	(90-110)	20	0.84
MBLK	Nitrate as Nitrogen by IC			<0.0042	mg/L				
MRL_CHK	Nitrate as Nitrogen by IC		0.05	0.0649	mg/L	130	(50-150)		
MRLLW	Nitrate as Nitrogen by IC		0.013	0.0118	mg/L	94	(50-150)		
MS_202112220389	Nitrate as Nitrogen by IC	ND	1.3	1.31	mg/L	102	(80-120)		
MS_202112220623	Nitrate as Nitrogen by IC	8.8	1.3	15.5	mg/L	108	(80-120)		
MSD_202112220389	Nitrate as Nitrogen by IC	ND	1.3	1.31	mg/L	102	(80-120)	20	0.21
MSD_202112220623	Nitrate as Nitrogen by IC	8.8	1.3	15.5	mg/L	107	(80-120)	20	0.23
LCS1	Nitrite Nitrogen by IC		1	0.921	mg/L	92	(90-110)		
LCS2	Nitrite Nitrogen by IC		1	0.931	mg/L	93	(90-110)	20	1.1
MBLK	Nitrite Nitrogen by IC			<0.0050	mg/L				
MRL_CHK	Nitrite Nitrogen by IC		0.05	0.0463	mg/L	93	(50-150)		
MRLLW	Nitrite Nitrogen by IC		0.013	0.0112	mg/L	90	(50-150)		
MS_202112220389	Nitrite Nitrogen by IC	ND	0.5	0.491	mg/L	98	(80-120)		
MS_202112220623	Nitrite Nitrogen by IC	ND	0.5	2.36	mg/L	94	(80-120)		
MSD_202112220389	Nitrite Nitrogen by IC	ND	0.5	0.488	mg/L	98	(80-120)	20	0.65
MSD_202112220623	Nitrite Nitrogen by IC	ND	0.5	2.34	mg/L	94	(80-120)	20	0.86
C6hor3du. cj hGatu by 1 e2 4i i 0 by 1 e2 4i i 0									
2 f alyt3 ah5 at: 6RB4NA, , A						**2 f alyn3n 7 atuRB/ D/ Di / B**			

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
(S) - Indicates surrogate compound.
(I) - Indicates internal standard compound.

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SumortR 976823
e ropu: tR STAYTON
Proj mR City of Stayton Test Well - IOCs DBPs

GSI Water Solutions

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Chloride		25	24.4	mg/L	98	(90-110)		
LCS2	Chloride		25	24.6	mg/L	98	(90-110)	20	0.82
MBLK	Chloride			<0.1397	mg/L				
MRL_CHK	Chloride		0.5	0.435	mg/L	87	(50-150)		
MS_202112220389	Chloride	7.4	13	21.8	mg/L	115	(80-120)		
MS_202112220623	Chloride	120	13	186	mg/L	107	(80-120)		
MSD_202112220389	Chloride	7.4	13	21.8	mg/L	115	(80-120)	20	0.23
MSD_202112220623	Chloride	120	13	185	mg/L	106	(80-120)	20	0.50
LCS1	Sulfate		50	49.0	mg/L	98	(90-110)		
LCS2	Sulfate		50	49.4	mg/L	99	(90-110)	20	0.81
MBLK	Sulfate			<0.0614	mg/L				
MRL_CHK	Sulfate		1	0.928	mg/L	93	(50-150)		
MRLLW	Sulfate		0.25	0.241	mg/L	96	(50-150)		
MS_202112220389	Sulfate	1.7	25	28.5	mg/L	107	(80-120)		
MS_202112220623	Sulfate	240	25	376	mg/L	108	(80-120)		
MSD_202112220389	Sulfate	1.7	25	28.4	mg/L	107	(80-120)	20	0.088
MSD_202112220623	Sulfate	240	25	374	mg/L	107	(80-120)	20	0.44

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2 f alyt3 ah5 at: 6RB4NAT4T **2 f alyn3n 7 atuRB/ D/ Di / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
DUP1_202112220582	Odor at 60 C (TON)	ND		ND	TON		(0-20)		
MBLK	Odor at 60 C (TON)			<1	TON				

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2 f alyt3 ah5 at: 6RB4N, i BM **2 f alyn3n 7 atuRB/ DMDi / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
DUP_202111170003	Total Suspended Solids (TSS)	290		262	mg/L		(0-10)	10	8.8
DUP_202111170050	Total Suspended Solids (TSS)	200		194	mg/L		(0-10)	10	1.0
LCS1	Total Suspended Solids (TSS)		175	168	mg/L	96	(71-107)		
LCS2	Total Suspended Solids (TSS)		175	174	mg/L	99	(71-107)	20	3.5
MBLK	Total Suspended Solids (TSS)			<10	mg/L				
MRL_CHK	Total Suspended Solids (TSS)		10	9.00	mg/L	90	(50-150)		

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2 f alyt3 ah5 at: 6RB4N, i AN **2 f alyn3n 7 atuRB/ DMDi / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Iron Dissolved ICAP		5	5.02	mg/L	101	(85-115)		
LCS2	Iron Dissolved ICAP		5	5.04	mg/L	101	(85-115)	20	0.40
MBLK	Iron Dissolved ICAP			<0.004850	mg/L				
MRL_CHK	Iron Dissolved ICAP		0.01	0.0109	mg/L	109	(50-150)		
MS_202112200055	Iron Dissolved ICAP	ND	5	5.35	mg/L	107	(70-130)		

Spike recovery is already corrected for native results.
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GSI Water Solutions

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MS2_202112210323	Iron Dissolved ICAP	ND	5	5.36	mg/L	107	(70-130)		
MSD_202112200055	Iron Dissolved ICAP	ND	5	5.43	mg/L	109	(70-130)	20	1.5
MSD2_202112210323	Iron Dissolved ICAP	ND	5	5.41	mg/L	108	(70-130)	20	0.87
LCS1	Iron Total ICAP		5	5.02	mg/L	101	(85-115)		
LCS2	Iron Total ICAP		5	5.04	mg/L	101	(85-115)	20	0.40
MBLK	Iron Total ICAP			<0.004850	mg/L				
MRL_CHK	Iron Total ICAP		0.01	0.0109	mg/L	109	(50-150)		
MS_202112200055	Iron Total ICAP	ND	5	5.35	mg/L	107	(70-130)		
MS2_202112210323	Iron Total ICAP	ND	5	5.36	mg/L	107	(70-130)		
MSD_202112200055	Iron Total ICAP	ND	5	5.43	mg/L	109	(70-130)	20	1.5
MSD2_202112210323	Iron Total ICAP	ND	5	5.41	mg/L	108	(70-130)	20	0.87
LCS1	Magnesium Total ICAP		20	19.7	mg/L	99	(85-115)		
LCS2	Magnesium Total ICAP		20	19.8	mg/L	99	(85-115)	20	0.51
MBLK	Magnesium Total ICAP			<0.009606	mg/L				
MRL_CHK	Magnesium Total ICAP		0.1	0.0975	mg/L	98	(50-150)		
MS_202112200055	Magnesium Total ICAP	3.4	20	24.6	mg/L	106	(70-130)		
MS2_202112210323	Magnesium Total ICAP	28	20	48.1	mg/L	101	(70-130)		
MSD_202112200055	Magnesium Total ICAP	3.4	20	24.8	mg/L	107	(70-130)	20	0.82
MSD2_202112210323	Magnesium Total ICAP	28	20	48.5	mg/L	103	(70-130)	20	0.90
LCS1	Potassium Total ICAP		20	19.8	mg/L	99	(85-115)		
LCS2	Potassium Total ICAP		20	20.0	mg/L	100	(85-115)	20	1.0
MBLK	Potassium Total ICAP			<0.233312	mg/L				
MRL_CHK	Potassium Total ICAP		1	0.694	mg/L	69	(50-150)		
MS_202112200055	Potassium Total ICAP	3.0	20	24.6	mg/L	108	(70-130)		
MS2_202112210323	Potassium Total ICAP	4.4	20	27.1	mg/L	113	(70-130)		
MSD_202112200055	Potassium Total ICAP	3.0	20	25.0	mg/L	110	(70-130)	20	1.8
MSD2_202112210323	Potassium Total ICAP	4.4	20	27.4	mg/L	115	(70-130)	20	1.3
LCS1	Sodium Total ICAP		50	49.8	mg/L	100	(85-115)		
LCS2	Sodium Total ICAP		50	49.4	mg/L	99	(85-115)	20	0.81
MBLK	Sodium Total ICAP			<0.4255	mg/L				
MRL_CHK	Sodium Total ICAP		1	1.15	mg/L	115	(50-150)		
MS_202112200055	Sodium Total ICAP	4.3	50	56.4	mg/L	104	(70-130)		
MS2_202112210323	Sodium Total ICAP	78	50	124	mg/L	91	(70-130)		
MSD_202112200055	Sodium Total ICAP	4.3	50	57.4	mg/L	106	(70-130)	20	1.6
MSD2_202112210323	Sodium Total ICAP	78	50	125	mg/L	94	(70-130)	20	0.80

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2 f alyt3 ah5 at: 6RB4N, BB4 **2 f alyn3n 7 atuRB/ D MD i / B**

Spike recovery is already corrected for native results.
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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Alkalinity in CaCO3 units		100	96.8	mg/L	97	(90-110)		
LCS2	Alkalinity in CaCO3 units		100	97.5	mg/L	98	(90-110)	20	0.72
MBLK	Alkalinity in CaCO3 units			<1	mg/L				
MRL_CHK	Alkalinity in CaCO3 units		2	2.28	mg/L	114	(50-150)		
MS_202112210279	Alkalinity in CaCO3 units	130	100	224	mg/L	94	(80-120)		
MS_202112210374	Alkalinity in CaCO3 units	8.2	100	108	mg/L	100	(80-120)		
MSD_202112210279	Alkalinity in CaCO3 units	130	100	227	mg/L	97	(80-120)	20	1.4
MSD_202112210374	Alkalinity in CaCO3 units	8.2	100	107	mg/L	99	(80-120)	20	0.89

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2 f alyt3 ah5 at: 6RB4N, BBN — **2 f alyn3n 7 atuRB/ D MD i / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
DUP_202112210374	PH (H3=past HT not compliant)	6.5		6.49	Units		(0-20)	20	0.46
LCS1	PH (H3=past HT not compliant)		6	5.93	Units	99	(98-102)		
LCS2	PH (H3=past HT not compliant)		6	5.93	Units	99	(98-102)	20	0.0

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2 f alyt3 ah5 at: 6RB4N, B/ 4 — **2 f alyn3n 7 atuRB/ D MD i / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Silica		21	20.0	mg/L	93	(85-115)		
LCS2	Silica		21	20.1	mg/L	94	(85-115)	20	0.50
MBLK	Silica			<0.035638	mg/L				
MRL_CHK	Silica		0.43	0.420	mg/L	98	(50-150)		
MS_202201030472	Silica	0.61	21	21.9	mg/L	99	(70-130)		
MSD_202201030472	Silica	0.61	21	22.1	mg/L	100	(70-130)	20	1.1

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2 f alyt3 ah5 at: 6RB4N, / I , — **2 f alyn3n 7 atuRB/ D4i D i / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Fluoride		1	0.990	mg/L	99	(90-110)		
LCS2	Fluoride		1	0.998	mg/L	100	(90-110)	20	0.81
MBLK	Fluoride			<0.025	mg/L				
MRL_CHK	Fluoride		0.05	0.0492	mg/L	98	(50-150)		
MS_202112220402	Fluoride	ND	1	1.00	mg/L	99	(80-120)		
MS_202112280960	Fluoride	ND	1	0.979	mg/L	97	(80-120)		
MSD_202112220402	Fluoride	ND	1	1.01	mg/L	99	(80-120)	20	0.89
MSD_202112280960	Fluoride	ND	1	0.974	mg/L	97	(80-120)	20	0.51

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2 f alyt3 ah5 at: 6RB4N, 4BT — **2 f alyn3n 7 atuRB/ D MD i / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
DUP_202112210624	Total Dissolved Solid (TDS)	230		226	mg/L		(0-10)	10	0.88
DUP_202112220680	Total Dissolved Solid (TDS)	940		954	mg/L		(0-10)	10	1.5

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Total Dissolved Solid (TDS)		175	178	mg/L	102	(80-114)		
LCS2	Total Dissolved Solid (TDS)		700	682	mg/L	97	(80-114)		
MBLK	Total Dissolved Solid (TDS)			<5	mg/L				
MRL_CHK	Total Dissolved Solid (TDS)		10	9.00	mg/L	90	(50-150)		

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2 f alyt3 ah5 at: 6RB4N, 44, **2 f alyn3n 7 atuRB/ D4i D i / B**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Cyanide		0.1	0.103	mg/L	103	(90-110)		
LCS2	Cyanide		0.1	0.0937	mg/L	94	(90-110)	20	9.5
MBLK	Cyanide			<0.025	mg/L				
MRL_CHK	Cyanide		0.025	0.0322	mg/L	129	(50-150)		
MS_202112220389	Cyanide	ND	0.1	0.103	mg/L	93	(80-120)		
MS_202112280934	Cyanide	ND	0.1	0.0534	mg/L	<u>**4N**</u>	(80-120)		
MSD_202112220389	Cyanide	ND	0.1	0.0973	mg/L	87	(80-120)	20	5.7
MSD_202112280934	Cyanide	ND	0.1	0.0603	mg/L	<u>**I I**</u>	(80-120)	20	12

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2 f alyt3 ah5 at: 6RB4NNBBT **2 f alyn3n 7 atuRi BD 4D i / /**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Aluminum Total ICAP/MS		100	105	ug/L	105	(85-115)		
LCS2	Aluminum Total ICAP/MS		100	106	ug/L	106	(85-115)	20	0.95
MBLK	Aluminum Total ICAP/MS			<10.93	ug/L				
MRL_CHK	Aluminum Total ICAP/MS		20	16.2	ug/L	81	(50-150)		
MS_202112300347	Aluminum Total ICAP/MS	60	100	170	ug/L	110	(70-130)		
MS2_202112300556	Aluminum Total ICAP/MS	ND	100	104	ug/L	104	(70-130)		
MSD_202112300347	Aluminum Total ICAP/MS	60	100	169	ug/L	108	(70-130)	20	0.66
MSD2_202112300556	Aluminum Total ICAP/MS	ND	100	105	ug/L	105	(70-130)	20	1.1
LCS1	Copper Total ICAP/MS		50	55.7	ug/L	111	(85-115)		
LCS2	Copper Total ICAP/MS		50	56.4	ug/L	113	(85-115)	20	1.3
MRL_CHK	Copper Total ICAP/MS		2	1.95	ug/L	98	(50-150)		
MS_202112300347	Copper Total ICAP/MS	ND	50	55.7	ug/L	111	(70-130)		
MS2_202112300556	Copper Total ICAP/MS	ND	50	52.5	ug/L	104	(70-130)		
MSD_202112300347	Copper Total ICAP/MS	ND	50	53.5	ug/L	106	(70-130)	20	4.1
MSD2_202112300556	Copper Total ICAP/MS	ND	50	52.3	ug/L	104	(70-130)	20	0.36
LCS1	Manganese dissolved ICAP/MS		100	106	ug/L	106	(85-115)		
LCS2	Manganese dissolved ICAP/MS		100	107	ug/L	107	(85-115)	20	0.94
MBLK	Manganese dissolved ICAP/MS			<0.4606	ug/L				
MRL_CHK	Manganese dissolved ICAP/MS		2	1.93	ug/L	97	(50-150)		
MS_202112300347	Manganese dissolved ICAP/MS	4.6	100	109	ug/L	104	(70-130)		
MS2_202112300556	Manganese dissolved ICAP/MS	180	100	276	ug/L	97	(70-130)		

Spike recovery is already corrected for native results.
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RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MSD_202112300347	Manganese dissolved ICAP/MS	4.6	100	107	ug/L	103	(70-130)	20	1.6
MSD2_202112300556	Manganese dissolved ICAP/MS	180	100	280	ug/L	101	(70-130)	20	1.4
LCS1	Manganese Total ICAP/MS		100	106	ug/L	106	(85-115)		
LCS2	Manganese Total ICAP/MS		100	107	ug/L	107	(85-115)	20	0.94
MBLK	Manganese Total ICAP/MS			<0.4606	ug/L				
MRL_CHK	Manganese Total ICAP/MS		2	1.93	ug/L	97	(50-150)		
MS_202112300347	Manganese Total ICAP/MS	4.6	100	109	ug/L	104	(70-130)		
MS2_202112300556	Manganese Total ICAP/MS	180	100	276	ug/L	97	(70-130)		
MSD_202112300347	Manganese Total ICAP/MS	4.6	100	107	ug/L	103	(70-130)	20	1.6
MSD2_202112300556	Manganese Total ICAP/MS	180	100	280	ug/L	101	(70-130)	20	1.4

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
CCCH	1,2,3-Trichloropropane (I)		100	100	%	100	(80-120)		
CCCM	1,2,3-Trichloropropane (I)		100	101	%	101	(80-130)		
DUP1_202112200052	1,2,3-Trichloropropane (I)			103	%	103	(80-120)		
DUP2_202112220160	1,2,3-Trichloropropane (I)			102	%	102	(80-120)		
LCS3	1,2,3-Trichloropropane (I)		100	100	%	100	(80-120)		
MBLK	1,2,3-Trichloropropane (I)			103	%	103	(80-120)		
MRL_CHK	1,2,3-Trichloropropane (I)		100	102	%	102	(80-120)		
MS1_202112210422	1,2,3-Trichloropropane (I)		100	99.0	%	99	(80-120)		
MS2_202112220141	1,2,3-Trichloropropane (I)			100	%	100	(80-120)		
CCCH	2,3-Dibromopropionic acid (S)		100	117	%	117	(70-130)		
CCCM	2,3-Dibromopropionic acid (S)		100	109	%	109	(70-130)		
DUP1_202112200052	2,3-Dibromopropionic acid (S)			116	%	116	(70-130)		
DUP2_202112220160	2,3-Dibromopropionic acid (S)			108	%	108	(70-130)		
LCS3	2,3-Dibromopropionic acid (S)		100	97.0	%	97	(70-130)		
MBLK	2,3-Dibromopropionic acid (S)			113	%	113	(70-130)		
MRL_CHK	2,3-Dibromopropionic acid (S)		100	116	%	116	(70-130)		
MS1_202112210422	2,3-Dibromopropionic acid (S)		100	121	%	121	(70-130)		
MS2_202112220141	2,3-Dibromopropionic acid (S)			112	%	112	(70-130)		
CCCH	D/DBP Haloacetic Acids (HAA5)		160	171	ug/L	107	(85-115)		
CCCM	D/DBP Haloacetic Acids (HAA5)		100	ND	ug/L	115	(85-115)		
DUP1_202112200052	D/DBP Haloacetic Acids (HAA5)	ND		ND	ug/L		(0-20)		
DUP2_202112220160	D/DBP Haloacetic Acids (HAA5)	ND		ND	ug/L		(0-20)		
LCS3	D/DBP Haloacetic Acids (HAA5)			40.8	ug/L		(80-120)		
MBLK	D/DBP Haloacetic Acids (HAA5)			<1	ug/L				
MRL_CHK	D/DBP Haloacetic Acids (HAA5)		6	6.49	ug/L	108	(50-150)		

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RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MS1_202112210422	D/DBP Haloacetic Acids (HAA5)	3.6	100	113	ug/L	109	(70-130)		
MS2_202112220141	D/DBP Haloacetic Acids (HAA5)	ND	160	170	ug/L	106	(70-130)		
CCCH	Dibromoacetic acid		32	35.0	ug/L	109	(85-115)		
CCCM	Dibromoacetic acid		20	21.0	ug/L	105	(85-115)		
DUP1_202112200052	Dibromoacetic acid	ND		ND	ug/L		(0-20)		
DUP2_202112220160	Dibromoacetic acid	ND		ND	ug/L		(0-20)		
LCS3	Dibromoacetic acid		8	7.56	ug/L	95	(80-120)		
MBLK	Dibromoacetic acid			<0.5	ug/L				
MRL_CHK	Dibromoacetic acid		1	1.05	ug/L	105	(50-150)		
MS1_202112210422	Dibromoacetic acid	2.1	20	25.0	ug/L	115	(84-122)		
MS2_202112220141	Dibromoacetic acid	ND	32	34.5	ug/L	108	(84-122)		
CCCH	Dichloroacetic acid		32	33.2	ug/L	104	(85-115)		
CCCM	Dichloroacetic acid		20	20.2	ug/L	101	(85-115)		
DUP1_202112200052	Dichloroacetic acid	ND		ND	ug/L		(0-20)		
DUP2_202112220160	Dichloroacetic acid	ND		ND	ug/L		(0-20)		
LCS3	Dichloroacetic acid		8	8.00	ug/L	100	(80-120)		
MBLK	Dichloroacetic acid			<0.5	ug/L				
MRL_CHK	Dichloroacetic acid		1	1.22	ug/L	122	(50-150)		
MS1_202112210422	Dichloroacetic acid	1.5	20	22.3	ug/L	104	(79-123)		
MS2_202112220141	Dichloroacetic acid	ND	32	33.2	ug/L	103	(79-123)		
CCCH	Monobromoacetic acid		32	34.3	ug/L	107	(85-115)		
CCCM	Monobromoacetic acid		20	20.6	ug/L	103	(85-115)		
DUP1_202112200052	Monobromoacetic acid	ND		ND	ug/L		(0-20)		
DUP2_202112220160	Monobromoacetic acid	ND		ND	ug/L		(0-20)		
LCS3	Monobromoacetic acid		8	8.08	ug/L	101	(80-120)		
MBLK	Monobromoacetic acid			<0.5	ug/L				
MRL_CHK	Monobromoacetic acid		1	1.23	ug/L	123	(50-150)		
MS1_202112210422	Monobromoacetic acid	ND	20	18.9	ug/L	95	(81-122)		
MS2_202112220141	Monobromoacetic acid	ND	32	34.0	ug/L	106	(81-122)		
CCCH	Monochloroacetic acid		32	34.0	ug/L	106	(85-115)		
CCCM	Monochloroacetic acid		20	20.8	ug/L	104	(85-115)		
DUP1_202112200052	Monochloroacetic acid	ND		ND	ug/L		(0-20)		
DUP2_202112220160	Monochloroacetic acid	ND		ND	ug/L		(0-20)		
LCS3	Monochloroacetic acid		8	8.25	ug/L	103	(80-120)		
MBLK	Monochloroacetic acid			<1	ug/L				
MRL_CHK	Monochloroacetic acid		2	1.82	ug/L	91	(50-150)		
MS1_202112210422	Monochloroacetic acid	ND	20	24.6	ug/L	123	(72-126)		
MS2_202112220141	Monochloroacetic acid	ND	32	34.4	ug/L	108	(72-126)		

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RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
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Laboratory QC

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Proj mR City of Stayton Test Well - IOCs DBPs

GSI Water Solutions

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
CCCH	Trichloroacetic acid		32	34.4	ug/L	108	(85-115)		
CCCM	Trichloroacetic acid		20	20.7	ug/L	103	(85-115)		
DUP1_202112200052	Trichloroacetic acid	ND		ND	ug/L		(0-20)		
DUP2_202112220160	Trichloroacetic acid	ND		ND	ug/L		(0-20)		
LCS3	Trichloroacetic acid		8	8.96	ug/L	112	(80-120)		
MBLK	Trichloroacetic acid			<0.5	ug/L				
MRL_CHK	Trichloroacetic acid		1	1.17	ug/L	117	(50-150)		
MS1_202112210422	Trichloroacetic acid	ND	20	22.1	ug/L	106	(82-124)		
MS2_202112220141	Trichloroacetic acid	ND	32	34.1	ug/L	105	(82-124)		

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2 f alyt3 ah5 at: 6RB4NNBMA **2 f alyn3n 7 atuRi BD 4D i / /**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	1,2-Dichloroethane-d4 (S)		5	104	%	104	(70-130)		
LCS2	1,2-Dichloroethane-d4 (S)		5	103	%	103	(70-130)		
MBLK	1,2-Dichloroethane-d4 (S)			97.0	%	97	(70-130)		
MRL_CHK	1,2-Dichloroethane-d4 (S)		5	104	%	104	(70-130)		
LCS1	4-Bromofluorobenzene (S)		5	94.2	%	94	(70-130)		
LCS2	4-Bromofluorobenzene (S)		5	96.6	%	97	(70-130)		
MBLK	4-Bromofluorobenzene (S)			97.6	%	98	(70-130)		
MRL_CHK	4-Bromofluorobenzene (S)		5	97.6	%	98	(70-130)		
LCS1	Bromodichloromethane		5	4.83	ug/L	97	(70-130)		
LCS2	Bromodichloromethane		5	4.53	ug/L	91	(70-130)	20	6.4
MBLK	Bromodichloromethane			<0.5	ug/L				
MRL_CHK	Bromodichloromethane		0.5	0.580	ug/L	116	(50-150)		
LCS1	Bromoform		5	4.51	ug/L	90	(70-130)		
LCS2	Bromoform		5	4.54	ug/L	91	(70-130)	20	0.66
MBLK	Bromoform			<0.5	ug/L				
MRL_CHK	Bromoform		0.5	0.530	ug/L	106	(50-150)		
LCS1	Chlorodibromomethane		5	5.27	ug/L	105	(70-130)		
LCS2	Chlorodibromomethane		5	4.89	ug/L	98	(70-130)	20	7.5
MBLK	Chlorodibromomethane			<0.5	ug/L				
MRL_CHK	Chlorodibromomethane		0.5	0.590	ug/L	118	(50-150)		
LCS1	Chloroform (Trichloromethane)		5	5.51	ug/L	110	(70-130)		
LCS2	Chloroform (Trichloromethane)		5	5.13	ug/L	103	(70-130)	20	7.1
MBLK	Chloroform (Trichloromethane)			<0.5	ug/L				
MRL_CHK	Chloroform (Trichloromethane)		0.5	0.660	ug/L	132	(50-150)		
LCS1	Toluene-d8 (S)		5	106	%	106	(70-130)		
LCS2	Toluene-d8 (S)		5	102	%	102	(70-130)		

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MBLK	Toluene-d8 (S)			102	%	102	(70-130)		
MRL_CHK	Toluene-d8 (S)		5	105	%	105	(70-130)		

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2f alyt3 ah5 at: 6RB4NNI i A — **2f alyn3n 7 atuRi BDI IDi / /**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Calcium Total ICAP		50	49.8	mg/L	100	(85-115)		
LCS2	Calcium Total ICAP		50	49.5	mg/L	99	(85-115)	20	0.60
MBLK	Calcium Total ICAP			<0.043087	mg/L				
MRL_CHK	Calcium Total ICAP		1	0.971	mg/L	97	(50-150)		
MS_202112220582	Calcium Total ICAP	6.0	50	55.0	mg/L	98	(70-130)		
MS2_202111100514	Calcium Total ICAP	24	50	72.7	mg/L	97	(70-130)		
MSD_202112220582	Calcium Total ICAP	6.0	50	55.2	mg/L	98	(70-130)	20	0.33
MSD2_202111100514	Calcium Total ICAP	24	50	73.0	mg/L	98	(70-130)	20	0.57

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2f alyt3 ah5 at: 6RB4NNMAi — **2f alyn3n 7 atuRi BDNDi / /**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Total Organic Carbon		5	4.91	mg/L	98	(90-110)		
LCS2	Total Organic Carbon		5	4.90	mg/L	98	(90-110)	20	0.20
MBLK	Total Organic Carbon			<0.10	mg/L				
MRL_CHK	Total Organic Carbon		0.2	0.271	mg/L	136	(50-150)		
MS_202112210279	Total Organic Carbon	3.1	4	6.62	mg/L	88	(80-120)		
MS2_202112210284	Total Organic Carbon	2.6	2	4.42	mg/L	92	(80-120)		
MSD_202112210279	Total Organic Carbon	3.1	4	6.63	mg/L	89	(80-120)	20	0.23
MSD2_202112210284	Total Organic Carbon	2.6	2	4.31	mg/L	86	(80-120)	20	2.5

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2f alyt3 ah5 at: 6RB4NM/ M — **2f alyn3n 7 atuRi BDBDi / /**

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Calcium Total ICAP		50	50.4	mg/L	101	(85-115)		
LCS2	Calcium Total ICAP		50	52.9	mg/L	106	(85-115)	20	4.8
MBLK	Calcium Total ICAP			<0.043087	mg/L				
MRL_CHK	Calcium Total ICAP		1	0.980	mg/L	98	(50-150)		
MS_202201060078	Calcium Total ICAP	44	50	93.2	mg/L	98	(70-130)		
MS2_202201070368	Calcium Total ICAP	18	50	68.1	mg/L	101	(70-130)		
MSD_202201060078	Calcium Total ICAP	44	50	92.2	mg/L	96	(70-130)	20	1.0
MSD2_202201070368	Calcium Total ICAP	18	50	67.0	mg/L	99	(70-130)	20	1.6
LCS1	Iron Dissolved ICAP		5	5.04	mg/L	101	(85-115)		
LCS2	Iron Dissolved ICAP		5	5.27	mg/L	105	(85-115)	20	4.5
MBLK	Iron Dissolved ICAP			<0.004850	mg/L				
MRL_CHK	Iron Dissolved ICAP		0.01	0.0103	mg/L	103	(50-150)		

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RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MS_202201060078	Iron Dissolved ICAP	ND	5	5.20	mg/L	104	(70-130)		
MS2_202201070368	Iron Dissolved ICAP	0.1	5	5.28	mg/L	104	(70-130)		
MSD_202201060078	Iron Dissolved ICAP	ND	5	5.16	mg/L	103	(70-130)	20	0.60
MSD2_202201070368	Iron Dissolved ICAP	0.1	5	5.37	mg/L	105	(70-130)	20	1.6
LCS1	Iron Total ICAP		5	5.04	mg/L	101	(85-115)		
LCS2	Iron Total ICAP		5	5.27	mg/L	105	(85-115)	20	4.5
MBLK	Iron Total ICAP			<0.004850	mg/L				
MRL_CHK	Iron Total ICAP		0.01	0.0103	mg/L	103	(50-150)		
MS_202201060078	Iron Total ICAP	ND	5	5.20	mg/L	104	(70-130)		
MS2_202201070368	Iron Total ICAP	0.10	5	5.28	mg/L	104	(70-130)		
MSD_202201060078	Iron Total ICAP	ND	5	5.16	mg/L	103	(70-130)	20	0.60
MSD2_202201070368	Iron Total ICAP	0.10	5	5.37	mg/L	105	(70-130)	20	1.6
LCS1	Magnesium Total ICAP		20	19.8	mg/L	99	(85-115)		
LCS2	Magnesium Total ICAP		20	20.6	mg/L	103	(85-115)	20	4.0
MBLK	Magnesium Total ICAP			<0.009606	mg/L				
MRL_CHK	Magnesium Total ICAP		0.1	0.0937	mg/L	94	(50-150)		
MS_202201060078	Magnesium Total ICAP	21	20	41.1	mg/L	101	(70-130)		
MS2_202201070368	Magnesium Total ICAP	2.4	20	22.9	mg/L	103	(70-130)		
MSD_202201060078	Magnesium Total ICAP	21	20	40.9	mg/L	100	(70-130)	20	0.41
MSD2_202201070368	Magnesium Total ICAP	2.4	20	22.4	mg/L	100	(70-130)	20	1.8
LCS1	Potassium Total ICAP		20	20.2	mg/L	101	(85-115)		
LCS2	Potassium Total ICAP		20	20.9	mg/L	105	(85-115)	20	3.4
MBLK	Potassium Total ICAP			<0.233312	mg/L				
MRL_CHK	Potassium Total ICAP		1	0.752	mg/L	75	(50-150)		
MS_202201060078	Potassium Total ICAP	3.8	20	26.2	mg/L	112	(70-130)		
MS2_202201070368	Potassium Total ICAP	1.2	20	22.8	mg/L	108	(70-130)		
MSD_202201060078	Potassium Total ICAP	3.8	20	26.1	mg/L	111	(70-130)	20	0.44
MSD2_202201070368	Potassium Total ICAP	1.2	20	22.4	mg/L	106	(70-130)	20	1.9
LCS1	Sodium Total ICAP		50	50.4	mg/L	101	(85-115)		
LCS2	Sodium Total ICAP		50	52.4	mg/L	105	(85-115)	20	3.9
MBLK	Sodium Total ICAP			<0.4255	mg/L				
MRL_CHK	Sodium Total ICAP		1	1.10	mg/L	110	(50-150)		
MS_202201060078	Sodium Total ICAP	85	50	130	mg/L	89	(70-130)		
MS2_202201070368	Sodium Total ICAP	19	50	69.4	mg/L	100	(70-130)		
MSD_202201060078	Sodium Total ICAP	85	50	128	mg/L	86	(70-130)	20	1.3
MSD2_202201070368	Sodium Total ICAP	19	50	68.3	mg/L	98	(70-130)	20	1.6

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
ICes c s utalm by 1 e 2 / i i 0M									
2 f alyt3 ah5 at: 6RB4NMNTM						**2 f alyn3n 7 atuRi BDB4D i / /**			
LCS1	Aluminum Total ICAP/MS		100	94.1	ug/L	94	(85-115)		
LCS2	Aluminum Total ICAP/MS		100	96.3	ug/L	96	(85-115)	20	2.3
MBLK	Aluminum Total ICAP/MS			<10.93	ug/L				
MRL_CHK	Aluminum Total ICAP/MS		20	18.5	ug/L	93	(50-150)		
MS_202112220405	Aluminum Total ICAP/MS	ND	100	97.6	ug/L	98	(70-130)		
MS2_202112270184	Aluminum Total ICAP/MS	ND	100	95.8	ug/L	93	(70-130)		
MSD_202112220405	Aluminum Total ICAP/MS	ND	100	96.0	ug/L	96	(70-130)	20	1.7
MSD2_202112270184	Aluminum Total ICAP/MS	ND	100	97.2	ug/L	95	(70-130)	20	1.5
LCS1	Antimony Total ICAP/MS		50	46.0	ug/L	92	(85-115)		
LCS2	Antimony Total ICAP/MS		50	46.2	ug/L	93	(85-115)	20	0.65
MBLK	Antimony Total ICAP/MS			<0.2437	ug/L				
MRL_CHK	Antimony Total ICAP/MS		1	1.01	ug/L	101	(50-150)		
MS_202112220405	Antimony Total ICAP/MS	ND	50	47.3	ug/L	95	(70-130)		
MS2_202112270184	Antimony Total ICAP/MS	ND	50	47.4	ug/L	95	(70-130)		
MSD_202112220405	Antimony Total ICAP/MS	ND	50	46.6	ug/L	93	(70-130)	20	1.5
MSD2_202112270184	Antimony Total ICAP/MS	ND	50	48.5	ug/L	97	(70-130)	20	2.2
LCS1	Arsenic Total ICAP/MS		50	48.0	ug/L	96	(85-115)		
LCS2	Arsenic Total ICAP/MS		50	48.4	ug/L	97	(85-115)	20	0.83
MBLK	Arsenic Total ICAP/MS			<0.4134	ug/L				
MRL_CHK	Arsenic Total ICAP/MS		1	0.788	ug/L	79	(50-150)		
MS_202112220405	Arsenic Total ICAP/MS	ND	50	48.5	ug/L	97	(70-130)		
MS2_202112270184	Arsenic Total ICAP/MS	ND	50	49.0	ug/L	98	(70-130)		
MSD_202112220405	Arsenic Total ICAP/MS	ND	50	47.8	ug/L	96	(70-130)	20	1.4
MSD2_202112270184	Arsenic Total ICAP/MS	ND	50	49.1	ug/L	98	(70-130)	20	0.12
LCS1	Barium Total ICAP/MS		50	48.3	ug/L	97	(85-115)		
LCS2	Barium Total ICAP/MS		50	48.9	ug/L	98	(85-115)	20	1.2
MBLK	Barium Total ICAP/MS			<0.1886	ug/L				
MRL_CHK	Barium Total ICAP/MS		2	1.93	ug/L	97	(50-150)		
MS2_202112270184	Barium Total ICAP/MS	72	50	119	ug/L	95	(70-130)		
MSD2_202112270184	Barium Total ICAP/MS	72	50	122	ug/L	101	(70-130)	20	2.5
LCS1	Beryllium Total ICAP/MS		25	23.3	ug/L	93	(85-115)		
LCS2	Beryllium Total ICAP/MS		25	23.6	ug/L	95	(85-115)	20	1.3
MBLK	Beryllium Total ICAP/MS			<0.1106	ug/L				
MRL_CHK	Beryllium Total ICAP/MS		1	0.932	ug/L	93	(50-150)		
MS_202112220405	Beryllium Total ICAP/MS	ND	25	24.5	ug/L	98	(70-130)		

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GSI Water Solutions

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MS2_202112270184	Beryllium Total ICAP/MS	ND	25	23.7	ug/L	95	(70-130)		
MSD_202112220405	Beryllium Total ICAP/MS	ND	25	24.0	ug/L	96	(70-130)	20	1.9
MSD2_202112270184	Beryllium Total ICAP/MS	ND	25	24.0	ug/L	96	(70-130)	20	1.3
LCS1	Cadmium Total ICAP/MS		25	24.4	ug/L	98	(85-115)		
LCS2	Cadmium Total ICAP/MS		25	24.6	ug/L	98	(85-115)	20	0.82
MBLK	Cadmium Total ICAP/MS			<0.0546	ug/L				
MRL_CHK	Cadmium Total ICAP/MS		0.5	0.480	ug/L	96	(50-150)		
MS_202112220405	Cadmium Total ICAP/MS	ND	25	24.3	ug/L	97	(70-130)		
MS2_202112270184	Cadmium Total ICAP/MS	ND	25	23.8	ug/L	95	(70-130)		
MSD_202112220405	Cadmium Total ICAP/MS	ND	25	24.0	ug/L	96	(70-130)	20	1.4
MSD2_202112270184	Cadmium Total ICAP/MS	ND	25	24.3	ug/L	97	(70-130)	20	2.0
LCS1	Chromium Total ICAP/MS		50	45.0	ug/L	90	(85-115)		
LCS2	Chromium Total ICAP/MS		50	45.3	ug/L	91	(85-115)	20	0.66
MBLK	Chromium Total ICAP/MS			<0.580	ug/L				
MRL_CHK	Chromium Total ICAP/MS		1	0.831	ug/L	83	(50-150)		
MS_202112220405	Chromium Total ICAP/MS	ND	50	45.7	ug/L	91	(70-130)		
MS2_202112270184	Chromium Total ICAP/MS	4.6	50	49.7	ug/L	90	(70-130)		
MSD_202112220405	Chromium Total ICAP/MS	ND	50	45.4	ug/L	91	(70-130)	20	0.70
MSD2_202112270184	Chromium Total ICAP/MS	4.6	50	50.6	ug/L	92	(70-130)	20	1.8
LCS1	Copper Total ICAP/MS		50	47.5	ug/L	95	(85-115)		
LCS2	Copper Total ICAP/MS		50	48.2	ug/L	96	(85-115)	20	1.5
MBLK	Copper Total ICAP/MS			<1.343	ug/L				
MRL_CHK	Copper Total ICAP/MS		2	1.89	ug/L	95	(50-150)		
MS_202112220405	Copper Total ICAP/MS	4.6	50	47.1	ug/L	94	(70-130)		
MS2_202112270184	Copper Total ICAP/MS	ND	50	45.3	ug/L	90	(70-130)		
MSD_202112220405	Copper Total ICAP/MS	4.6	50	46.6	ug/L	93	(70-130)	20	1.0
MSD2_202112270184	Copper Total ICAP/MS	ND	50	46.2	ug/L	92	(70-130)	20	1.9
LCS1	Lead Total ICAP/MS		50	45.0	ug/L	90	(85-115)		
LCS2	Lead Total ICAP/MS		50	45.6	ug/L	91	(85-115)	20	1.3
MBLK	Lead Total ICAP/MS			<0.0608	ug/L				
MRL_CHK	Lead Total ICAP/MS		0.5	0.454	ug/L	91	(50-150)		
MS_202112220405	Lead Total ICAP/MS	ND	50	45.9	ug/L	92	(70-130)		
MS2_202112270184	Lead Total ICAP/MS	ND	50	44.1	ug/L	88	(70-130)		
MSD_202112220405	Lead Total ICAP/MS	ND	50	44.6	ug/L	89	(70-130)	20	2.8
MSD2_202112270184	Lead Total ICAP/MS	ND	50	44.4	ug/L	89	(70-130)	20	0.74
LCS1	Manganese Total ICAP/MS		100	94.1	ug/L	94	(85-115)		
LCS2	Manganese Total ICAP/MS		100	95.0	ug/L	95	(85-115)	20	0.95
MBLK	Manganese Total ICAP/MS			<0.4606	ug/L				

Spike recovery is already corrected for native results.
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Laboratory QC

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GSI Water Solutions

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MRL_CHK	Manganese Total ICAP/MS		2	1.80	ug/L	90	(50-150)		
MS_202112220405	Manganese Total ICAP/MS	ND	100	96.6	ug/L	97	(70-130)		
MS2_202112270184	Manganese Total ICAP/MS	ND	100	93.5	ug/L	93	(70-130)		
MSD_202112220405	Manganese Total ICAP/MS	ND	100	94.3	ug/L	94	(70-130)	20	2.4
MSD2_202112270184	Manganese Total ICAP/MS	ND	100	96.3	ug/L	96	(70-130)	20	3.0
LCS1	Nickel Total ICAP/MS		50	46.6	ug/L	93	(85-115)		
LCS2	Nickel Total ICAP/MS		50	46.9	ug/L	94	(85-115)	20	0.43
MBLK	Nickel Total ICAP/MS			<0.4959	ug/L				
MRL_CHK	Nickel Total ICAP/MS		5	4.63	ug/L	93	(50-150)		
MS_202112220405	Nickel Total ICAP/MS	ND	50	46.9	ug/L	94	(70-130)		
MS2_202112270184	Nickel Total ICAP/MS	ND	50	45.4	ug/L	90	(70-130)		
MSD_202112220405	Nickel Total ICAP/MS	ND	50	46.4	ug/L	93	(70-130)	20	1.1
MSD2_202112270184	Nickel Total ICAP/MS	ND	50	46.1	ug/L	91	(70-130)	20	1.5
LCS1	Selenium Total ICAP/MS		50	48.5	ug/L	97	(85-115)		
LCS2	Selenium Total ICAP/MS		50	50.0	ug/L	100	(85-115)	20	3.0
MRL_CHK	Selenium Total ICAP/MS		5	5.16	ug/L	103	(50-150)		
MS_202112220405	Selenium Total ICAP/MS	ND	50	51.3	ug/L	103	(70-130)		
MS2_202112270184	Selenium Total ICAP/MS	ND	50	50.0	ug/L	94	(70-130)		
MSD_202112220405	Selenium Total ICAP/MS	ND	50	48.5	ug/L	97	(70-130)	20	5.6
MSD2_202112270184	Selenium Total ICAP/MS	ND	50	50.4	ug/L	95	(70-130)	20	0.78
LCS1	Silver Total ICAP/MS		25	22.2	ug/L	89	(85-115)		
LCS2	Silver Total ICAP/MS		25	22.3	ug/L	89	(85-115)	20	0.45
MBLK	Silver Total ICAP/MS			<0.1929	ug/L				
MRL_CHK	Silver Total ICAP/MS		0.5	0.471	ug/L	94	(50-150)		
MS_202112220405	Silver Total ICAP/MS	ND	25	22.4	ug/L	89	(70-130)		
MS2_202112270184	Silver Total ICAP/MS	ND	25	21.6	ug/L	86	(70-130)		
MSD_202112220405	Silver Total ICAP/MS	ND	25	21.9	ug/L	88	(70-130)	20	2.1
MSD2_202112270184	Silver Total ICAP/MS	ND	25	22.1	ug/L	88	(70-130)	20	2.1
MBLK	Thallium Total ICAP/MS			<0.1449	ug/L				
MRL_CHK	Thallium Total ICAP/MS		1	0.782	ug/L	78	(50-150)		
MS_202112220405	Thallium Total ICAP/MS	ND	50	40.9	ug/L	82	(70-130)		
MS2_202112270184	Thallium Total ICAP/MS	ND	50	39.0	ug/L	78	(70-130)		
MSD_202112220405	Thallium Total ICAP/MS	ND	50	40.1	ug/L	80	(70-130)	20	1.9
MSD2_202112270184	Thallium Total ICAP/MS	ND	50	39.9	ug/L	79	(70-130)	20	2.3
LCS1	Uranium ICAP/MS		50	42.9	ug/L	86	(85-115)		
LCS2	Uranium ICAP/MS		50	43.8	ug/L	88	(85-115)	20	2.1
MBLK	Uranium ICAP/MS			<0.0872	ug/L				
MRL_CHK	Uranium ICAP/MS		1	0.865	ug/L	87	(50-150)		

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Laboratory QC

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GSI Water Solutions

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MS_202112220405	Uranium ICAP/MS	ND	50	45.0	ug/L	90	(70-130)		
MS2_202112270184	Uranium ICAP/MS	7.5	50	53.0	ug/L	91	(70-130)		
MSD_202112220405	Uranium ICAP/MS	ND	50	44.5	ug/L	89	(70-130)	20	1.2
MSD2_202112270184	Uranium ICAP/MS	7.5	50	53.9	ug/L	93	(70-130)	20	1.6
LCS1	Zinc Total ICAP/MS		50	48.1	ug/L	96	(85-115)		
LCS2	Zinc Total ICAP/MS		50	48.3	ug/L	97	(85-115)	20	0.42
MBLK	Zinc Total ICAP/MS			<10.62	ug/L				
MRL_CHK	Zinc Total ICAP/MS		20	18.8	ug/L	94	(50-150)		
MS_202112220405	Zinc Total ICAP/MS	ND	50	48.5	ug/L	97	(70-130)		
MS2_202112270184	Zinc Total ICAP/MS	ND	50	47.7	ug/L	92	(70-130)		
MSD_202112220405	Zinc Total ICAP/MS	ND	50	47.8	ug/L	96	(70-130)	20	1.4
MSD2_202112270184	Zinc Total ICAP/MS	ND	50	48.9	ug/L	94	(70-130)	20	2.5

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Aluminum Total ICAP/MS		100	108	ug/L	108	(85-115)		
LCS2	Aluminum Total ICAP/MS		100	108	ug/L	108	(85-115)	20	0.0
MBLK	Aluminum Total ICAP/MS			<10.93	ug/L				
MRL_CHK	Aluminum Total ICAP/MS		20	20.4	ug/L	102	(50-150)		
MS_202112220582	Aluminum Total ICAP/MS	ND	100	121	ug/L	121	(70-130)		
MS2_202112300356	Aluminum Total ICAP/MS	ND	100	123	ug/L	123	(70-130)		
MSD_202112220582	Aluminum Total ICAP/MS	ND	100	114	ug/L	114	(70-130)	20	6.0
MSD2_202112300356	Aluminum Total ICAP/MS	ND	100	115	ug/L	115	(70-130)	20	6.9
LCS1	Antimony Total ICAP/MS		50	48.2	ug/L	96	(85-115)		
LCS2	Antimony Total ICAP/MS		50	49.1	ug/L	98	(85-115)	20	1.9
MBLK	Antimony Total ICAP/MS			<0.2437	ug/L				
MRL_CHK	Antimony Total ICAP/MS		1	0.951	ug/L	95	(50-150)		
MS_202112220582	Antimony Total ICAP/MS	ND	50	50.4	ug/L	101	(70-130)		
MS2_202112300356	Antimony Total ICAP/MS	ND	50	51.0	ug/L	102	(70-130)		
MSD_202112220582	Antimony Total ICAP/MS	ND	50	47.0	ug/L	94	(70-130)	20	7.0
MSD2_202112300356	Antimony Total ICAP/MS	ND	50	48.8	ug/L	98	(70-130)	20	4.5
LCS1	Arsenic Total ICAP/MS		50	51.2	ug/L	102	(85-115)		
LCS2	Arsenic Total ICAP/MS		50	51.7	ug/L	103	(85-115)	20	0.97
MBLK	Arsenic Total ICAP/MS			<0.4134	ug/L				
MS_202112220582	Arsenic Total ICAP/MS	ND	50	55.1	ug/L	110	(70-130)		
MS2_202112300356	Arsenic Total ICAP/MS	ND	50	57.0	ug/L	114	(70-130)		
MSD_202112220582	Arsenic Total ICAP/MS	ND	50	52.4	ug/L	105	(70-130)	20	5.0
MSD2_202112300356	Arsenic Total ICAP/MS	ND	50	54.6	ug/L	109	(70-130)	20	4.2

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Barium Total ICAP/MS		50	52.2	ug/L	104	(85-115)		
LCS2	Barium Total ICAP/MS		50	52.7	ug/L	105	(85-115)	20	0.95
MBLK	Barium Total ICAP/MS			<0.1886	ug/L				
MRL_CHK	Barium Total ICAP/MS		2	1.95	ug/L	98	(50-150)		
MS_202112220582	Barium Total ICAP/MS	2.6	50	57.6	ug/L	115	(70-130)		
MS2_202112300356	Barium Total ICAP/MS	ND	50	55.6	ug/L	111	(70-130)		
MSD_202112220582	Barium Total ICAP/MS	2.6	50	53.5	ug/L	107	(70-130)	20	7.4
MSD2_202112300356	Barium Total ICAP/MS	ND	50	52.8	ug/L	106	(70-130)	20	5.1
LCS1	Beryllium Total ICAP/MS		25	25.0	ug/L	100	(85-115)		
LCS2	Beryllium Total ICAP/MS		25	25.2	ug/L	101	(85-115)	20	0.80
MBLK	Beryllium Total ICAP/MS			<0.1106	ug/L				
MRL_CHK	Beryllium Total ICAP/MS		1	0.969	ug/L	97	(50-150)		
MS_202112220582	Beryllium Total ICAP/MS	ND	25	26.6	ug/L	106	(70-130)		
MS2_202112300356	Beryllium Total ICAP/MS	ND	25	27.9	ug/L	112	(70-130)		
MSD_202112220582	Beryllium Total ICAP/MS	ND	25	25.2	ug/L	101	(70-130)	20	5.1
MSD2_202112300356	Beryllium Total ICAP/MS	ND	25	26.3	ug/L	105	(70-130)	20	5.8
LCS1	Cadmium Total ICAP/MS		25	25.6	ug/L	103	(85-115)		
LCS2	Cadmium Total ICAP/MS		25	25.8	ug/L	103	(85-115)	20	0.78
MBLK	Cadmium Total ICAP/MS			<0.0546	ug/L				
MRL_CHK	Cadmium Total ICAP/MS		0.5	0.488	ug/L	98	(50-150)		
MS_202112220582	Cadmium Total ICAP/MS	ND	25	27.2	ug/L	109	(70-130)		
MS2_202112300356	Cadmium Total ICAP/MS	ND	25	28.2	ug/L	113	(70-130)		
MSD_202112220582	Cadmium Total ICAP/MS	ND	25	25.5	ug/L	102	(70-130)	20	6.5
MSD2_202112300356	Cadmium Total ICAP/MS	ND	25	27.0	ug/L	108	(70-130)	20	4.3
LCS1	Chromium Total ICAP/MS		50	49.7	ug/L	99	(85-115)		
LCS2	Chromium Total ICAP/MS		50	49.8	ug/L	100	(85-115)	20	0.20
MBLK	Chromium Total ICAP/MS			<0.580	ug/L				
MRL_CHK	Chromium Total ICAP/MS		1	1.02	ug/L	102	(50-150)		
MS_202112220582	Chromium Total ICAP/MS	ND	50	52.0	ug/L	104	(70-130)		
MS2_202112300356	Chromium Total ICAP/MS	ND	50	54.3	ug/L	109	(70-130)		
MSD_202112220582	Chromium Total ICAP/MS	ND	50	49.5	ug/L	99	(70-130)	20	5.0
MSD2_202112300356	Chromium Total ICAP/MS	ND	50	51.6	ug/L	103	(70-130)	20	4.8
LCS1	Copper Total ICAP/MS		50	51.3	ug/L	103	(85-115)		
LCS2	Copper Total ICAP/MS		50	51.6	ug/L	103	(85-115)	20	0.58
MBLK	Copper Total ICAP/MS			<1.343	ug/L				
MRL_CHK	Copper Total ICAP/MS		2	1.00	ug/L	50	(50-150)		
MS_202112220582	Copper Total ICAP/MS	6.3	50	61.0	ug/L	122	(70-130)		
MS2_202112300356	Copper Total ICAP/MS	ND	50	56.2	ug/L	112	(70-130)		

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MSD_202112220582	Copper Total ICAP/MS	6.3	50	58.5	ug/L	117	(70-130)	20	4.2
MSD2_202112300356	Copper Total ICAP/MS	ND	50	53.4	ug/L	107	(70-130)	20	5.1
LCS1	Lead Total ICAP/MS		50	48.4	ug/L	97	(85-115)		
LCS2	Lead Total ICAP/MS		50	48.8	ug/L	98	(85-115)	20	0.82
MBLK	Lead Total ICAP/MS			<0.0608	ug/L				
MRL_CHK	Lead Total ICAP/MS		0.5	0.462	ug/L	92	(50-150)		
MS_202112220582	Lead Total ICAP/MS	ND	50	51.1	ug/L	102	(70-130)		
MS2_202112300356	Lead Total ICAP/MS	ND	50	52.6	ug/L	105	(70-130)		
MSD_202112220582	Lead Total ICAP/MS	ND	50	47.7	ug/L	95	(70-130)	20	6.8
MSD2_202112300356	Lead Total ICAP/MS	ND	50	49.4	ug/L	99	(70-130)	20	6.2
LCS1	Manganese Total ICAP/MS		100	102	ug/L	102	(85-115)		
LCS2	Manganese Total ICAP/MS		100	103	ug/L	103	(85-115)	20	0.98
MBLK	Manganese Total ICAP/MS			<0.4606	ug/L				
MRL_CHK	Manganese Total ICAP/MS		2	1.94	ug/L	97	(50-150)		
MS_202112220582	Manganese Total ICAP/MS	ND	100	108	ug/L	108	(70-130)		
MS2_202112300356	Manganese Total ICAP/MS	ND	100	113	ug/L	113	(70-130)		
MSD_202112220582	Manganese Total ICAP/MS	ND	100	104	ug/L	104	(70-130)	20	4.1
MSD2_202112300356	Manganese Total ICAP/MS	ND	100	106	ug/L	106	(70-130)	20	6.5
LCS1	Nickel Total ICAP/MS		50	50.7	ug/L	101	(85-115)		
LCS2	Nickel Total ICAP/MS		50	51.2	ug/L	102	(85-115)	20	0.98
MBLK	Nickel Total ICAP/MS			<0.4959	ug/L				
MRL_CHK	Nickel Total ICAP/MS		5	4.86	ug/L	97	(50-150)		
MS_202112220582	Nickel Total ICAP/MS	ND	50	53.6	ug/L	107	(70-130)		
MS2_202112300356	Nickel Total ICAP/MS	ND	50	56.3	ug/L	113	(70-130)		
MSD_202112220582	Nickel Total ICAP/MS	ND	50	51.1	ug/L	102	(70-130)	20	4.8
MSD2_202112300356	Nickel Total ICAP/MS	ND	50	53.4	ug/L	107	(70-130)	20	5.3
LCS1	Selenium Total ICAP/MS		50	51.7	ug/L	103	(85-115)		
LCS2	Selenium Total ICAP/MS		50	52.4	ug/L	105	(85-115)	20	1.3
MBLK	Selenium Total ICAP/MS			<0.6224	ug/L				
MRL_CHK	Selenium Total ICAP/MS		5	5.01	ug/L	100	(50-150)		
MS_202112220582	Selenium Total ICAP/MS	ND	50	57.2	ug/L	114	(70-130)		
MS2_202112300356	Selenium Total ICAP/MS	ND	50	59.3	ug/L	119	(70-130)		
MSD_202112220582	Selenium Total ICAP/MS	ND	50	55.6	ug/L	111	(70-130)	20	2.8
MSD2_202112300356	Selenium Total ICAP/MS	ND	50	56.9	ug/L	114	(70-130)	20	4.2
LCS1	Silver Total ICAP/MS		25	25.1	ug/L	101	(85-115)		
LCS2	Silver Total ICAP/MS		25	25.3	ug/L	101	(85-115)	20	0.79
MBLK	Silver Total ICAP/MS			<0.1929	ug/L				
MRL_CHK	Silver Total ICAP/MS		0.5	0.487	ug/L	97	(50-150)		

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MS_202112220582	Silver Total ICAP/MS	ND	25	25.9	ug/L	104	(70-130)		
MS2_202112300356	Silver Total ICAP/MS	ND	25	26.7	ug/L	107	(70-130)		
MSD_202112220582	Silver Total ICAP/MS	ND	25	24.3	ug/L	97	(70-130)	20	6.5
MSD2_202112300356	Silver Total ICAP/MS	ND	25	25.6	ug/L	102	(70-130)	20	4.1
LCS1	Thallium Total ICAP/MS		50	48.0	ug/L	96	(85-115)		
LCS2	Thallium Total ICAP/MS		50	48.4	ug/L	97	(85-115)	20	0.83
MBLK	Thallium Total ICAP/MS			<0.1449	ug/L				
MRL_CHK	Thallium Total ICAP/MS		1	0.861	ug/L	86	(50-150)		
MS_202112220582	Thallium Total ICAP/MS	ND	50	50.6	ug/L	101	(70-130)		
MS2_202112300356	Thallium Total ICAP/MS	ND	50	52.0	ug/L	104	(70-130)		
MSD_202112220582	Thallium Total ICAP/MS	ND	50	47.0	ug/L	94	(70-130)	20	7.3
MSD2_202112300356	Thallium Total ICAP/MS	ND	50	49.1	ug/L	98	(70-130)	20	5.8
LCS1	Uranium ICAP/MS		50	47.8	ug/L	96	(85-115)		
LCS2	Uranium ICAP/MS		50	49.8	ug/L	100	(85-115)	20	4.1
MBLK	Uranium ICAP/MS			<0.0872	ug/L				
MRL_CHK	Uranium ICAP/MS		1	0.914	ug/L	91	(50-150)		
MS_202112220582	Uranium ICAP/MS	ND	50	52.9	ug/L	106	(70-130)		
MS2_202112300356	Uranium ICAP/MS	ND	50	57.6	ug/L	115	(70-130)		
MSD_202112220582	Uranium ICAP/MS	ND	50	47.3	ug/L	95	(70-130)	20	11
MSD2_202112300356	Uranium ICAP/MS	ND	50	53.4	ug/L	107	(70-130)	20	7.5
LCS1	Zinc Total ICAP/MS		50	48.7	ug/L	97	(85-115)		
LCS2	Zinc Total ICAP/MS		50	48.4	ug/L	97	(85-115)	20	0.62
MBLK	Zinc Total ICAP/MS			<10.62	ug/L				
MRL_CHK	Zinc Total ICAP/MS		20	17.2	ug/L	86	(50-150)		
MS_202112220582	Zinc Total ICAP/MS	ND	50	60.2	ug/L	120	(70-130)		
MS2_202112300356	Zinc Total ICAP/MS	ND	50	56.7	ug/L	113	(70-130)		
MSD_202112220582	Zinc Total ICAP/MS	ND	50	56.7	ug/L	113	(70-130)	20	6.0
MSD2_202112300356	Zinc Total ICAP/MS	ND	50	52.8	ug/L	106	(70-130)	20	7.2

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Mercury ICPMS		0.75	0.825	ug/L	110	(85-115)		
LCS2	Mercury ICPMS		0.75	0.724	ug/L	97	(85-115)	20	13
MBLK	Mercury ICPMS			<0.1	ug/L				
MRL_CHK	Mercury ICPMS		0.2	0.228	ug/L	114	(50-150)		
MS_202112220582	Mercury ICPMS	ND	0.75	0.784	ug/L	105	(70-130)		
MS2_202201030282	Mercury ICPMS	ND	0.75	0.757	ug/L	99	(70-130)		
MSD_202112220582	Mercury ICPMS	ND	0.75	0.749	ug/L	100	(70-130)	20	4.6

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
(S) - Indicates surrogate compound.
(I) - Indicates internal standard compound.

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MSD2_202201030282	Mercury ICPMS	ND	0.75	0.768	ug/L	101	(70-130)	20	1.4

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Bromate by UV/VIS		10	10.1	ug/L	101	(90-110)		
LCS2	Bromate by UV/VIS		10	9.84	ug/L	98	(90-110)	20	2.6
MBLK	Bromate by UV/VIS			<0.5	ug/L				
MRL_CHK	Bromate by UV/VIS		1	0.846	ug/L	85	(75-125)		
MS_202201180186	Bromate by UV/VIS	1.3	5	6.19	ug/L	98	(75-125)		
MS_202201250494	Bromate by UV/VIS	1.8	5	6.64	ug/L	98	(75-125)		
MSD_202201180186	Bromate by UV/VIS	1.3	5	6.19	ug/L	98	(75-125)	15	0.053
MSD_202201250494	Bromate by UV/VIS	1.8	5	7.18	ug/L	109	(75-125)	15	7.9

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
LCS1	Chlorite by IC		0.2	0.200	mg/L	100	(90-110)		
LCS2	Chlorite by IC		0.2	0.200	mg/L	100	(90-110)	10	0.0
MBLK	Chlorite by IC			<0.0033	mg/L				
MRL_CHK	Chlorite by IC		0.01	0.0111	mg/L	111	(75-125)		
MS_202201200613	Chlorite by IC	ND	0.1	0.0989	mg/L	99	(80-120)		
MS_202201210065	Chlorite by IC	ND	0.1	0.0977	mg/L	98	(80-120)		
MSD_202201200613	Chlorite by IC	ND	0.1	0.100	mg/L	100	(80-120)	15	1.1
MSD_202201210065	Chlorite by IC	ND	0.1	0.0990	mg/L	99	(80-120)	15	1.3

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
DUP_202201260335	Free Chlorine Residual	ND		ND	mg/L		(0-20)		
DUP_202201270085	Free Chlorine Residual	ND		ND	mg/L		(0-20)		
LCS1	Free Chlorine Residual		1	0.920	mg/L	92	(85-115)		
LCS2	Free Chlorine Residual		1	0.850	mg/L	85	(85-115)	20	7.9
MBLK	Free Chlorine Residual			<0.1	mg/L				
MRL_CHK	Free Chlorine Residual		0.1	0.100	mg/L	100	(50-150)		

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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
DUP_202201260335	Total Chlorine Residual	ND		ND	mg/L		(0-20)		
DUP_202201270085	Total Chlorine Residual	ND		ND	mg/L		(0-20)		
LCS1	Total Chlorine Residual		1	0.990	mg/L	99	(85-115)		
LCS2	Total Chlorine Residual		1	0.990	mg/L	99	(85-115)	20	0.0

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
(S) - Indicates surrogate compound.
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QC Type	Analyte	Native	Spiked	Recovered	Units	Yield(%)	Limits (%)	RPD Limit(%)	RPD%
MBLK	Total Chlorine Residual			<0.1	mg/L				
MRL_CHK	Total Chlorine Residual		0.1	0.100	mg/L	100	(50-150)		

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
(S) - Indicates surrogate compound.
(I) - Indicates internal standard compound.

Appendix F

Geochemical Mixing Analysis

S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

Memorandum

Date: February 11, 2022

From: Brad Bessinger

To: Robyn Cook, GSI Water Solutions, Inc.

Project: City of Stayton ASR Feasibility Study Project

Subject: **ASR Geochemical Compatibility Evaluation**

This memorandum presents results of a geochemical evaluation in support of the City of Stayton's Aquifer Storage and Recovery (ASR) Feasibility Study Project. The objective of the evaluation was to identify potential adverse interactions between ASR source water (consisting of treated municipal water from the Santiam River) and the proposed City of Stayton's ASR aquifer.

Geochemical modeling was performed using reported source and groundwater chemistry and modeling results were used to evaluate the following potential compatibility issues:

1) Potential changes in water quality caused by mixing of native groundwater with the injected source water; and,
2) Potential mineral precipitation and clogging in the ASR aquifer caused by mixing of native groundwater with the injected source water.

No adverse geochemical compatibility issues are predicted. Source water-groundwater mixtures are predicted to meet drinking water quality criteria, and no significant mineral precipitation is predicted to occur.

Methodology

Water chemistry data was provided in spreadsheet format by GSI Water Solutions (GSI) for the following: 1) native groundwater from the Columbia River Basalt Group; and 2) source water (consisting of City of Stayton treated municipal water from the Santiam River) being proposed for injection into the aquifer. As shown in Table 1, there are no exceedances of primary or secondary maximum contaminant levels (MCLs) for any of the constituents in either water.

The USGS-supported geochemical model PHREEQC (Parkhurst and Appelo 1999) was used to calculate the effect of water mixing on (1) the concentrations of dissolved constituents in source water-groundwater mixtures, and (2) mineral saturation indices[1] (SI). Model results were reported

[1] As concentrations of dissolved aqueous species that comprise a particular mineral increase, the tendency for that mineral to precipitate out of groundwater is enhanced. This tendency is defined mathematically by a value called the saturation index (SI), which is expressed on a logarithmic scale as the ratio of the concentration of ions in solution to the concentration required for mineral precipitation to occur. SI values greater than or equal to zero represent groundwater that is saturated or supersaturated (under these conditions, there is a thermodynamic driving force for mineral precipitation to occur). Conversely, values less than zero imply that a mineral is unstable, and if present in aquifer soils, will dissolve into groundwater.

as a function of the percentage of City of Stayton source water contained in the mixture (from 0 to 100%).

Predicted Water Quality

Table 2 compares model-predicted constituent concentrations in source water-native groundwater mixtures to primary and secondary MCLs. The mixing of native groundwater with injected source water is predicted to result in no exceedances of primary or secondary MCLs.

Residual chlorine is reported to occur at concentrations less than the reporting limit in source water (<0.1 mg/L; Table 1). As a conservative assumption, the potential for trihalomethane formation during ASR operations (due to reactions between residual chlorine and organic carbon) was evaluated using an additional model simulation that assumed residual chlorine is present in source water at the same concentration as the reporting limit (0.1 mg/L). The initial trihalomethane concentration used in the simulation was 0.027 mg/L and the reactive organic carbon was set to the maximum-reported concentration in Table 2 (0.74 mg/L). The trihalomethanes formation rates used were based on Clark et al. (1998a and 1998b) and degradation rates on Pavelic et al. (2005). As shown in Figure 1, there is predicted to be no significant total trihalomethanes (TTHMs) formation; in fact, the initial concentration of 0.027 mg/L decreases over time. Most-importantly, concentrations of TTHMs are predicted to be significantly less than the MCL of 0.08 mg/L.

Predicted Mineral Saturation Indices

Table 3 reports model predicted saturation indices (SI) for source water-native groundwater mixtures. SI values greater than or equal to zero indicate a mineral is saturated or supersaturated, respectively, which means there is a potential for mineral precipitation and/or clogging to occur.

Although some minerals are predicted to be saturated or supersaturated in Table 3, it is important to understand that mineral saturation indices greater than zero (SI>0) are common in nature without mineral precipitation actually occurring. This is because some minerals require SI values significantly greater than zero for crystal precipitation to initiate; other minerals only form slowly over time following the precipitation and ripening of more amorphous (precursor) minerals. The precipitation/clogging potential for each mineral type reported in Table 3 includes the following:

- **Silica (SiO_2):** Source water-groundwater mixtures are close to equilibrium with several silica polymorphs, including quartz, chalcedony, and SiO_2(am) (SI values ± 1.0). Although quartz has the most-positive SI value, it is unlikely to precipitate. This is because quartz precipitation kinetics are extremely slow, and its precursor mineral is SiO_2(am), which has negative SI values. In summary, silica minerals are not predicted to precipitate.

- **Carbonate Minerals:** Some source water-groundwater mixtures with predominantly native groundwater are saturated or supersaturated with respect to witherite ($BaCO_3$) (SI>0 for mixtures with less than 30% source water). Although this result could be interpreted to indicate carbonate scale formation is possible, precipitation of witherite is inhibited by the large nucleation energy required to form new minerals. For example, SI values required for carbonate nucleation and crystal growth have been reported range from 1.3 to 2.5 (Morse et al., 2007; Lebron and Suarez, 1996), which are higher than the SI values predicted by the model in Table 3. Also, the tendency for precipitation to occur decreases with increasing source water, which means the potential for precipitation to occur would be less due to the proposed ASR project than under natural conditions.
- **Sulfate Minerals:** No sulfate minerals are predicted to precipitate.
- **Iron Minerals:** Iron oxyhydroxide, $Fe(OH)_3$(am), is a very insoluble mineral that is known to precipitate in ASR and injection well systems (due to the oxidation/conversion of ferrous iron to ferric iron). There is a potential for mineral precipitation and/or biofouling by Fe-related bacteria in the proposed ASR system based on (1) the occurrence of dissolved iron in mixtures (Table 2), and (2) positive saturation indices predicted for $Fe(OH)_3$(am) during mixing (Table 3).

  Although some iron oxyhydroxide precipitation is possible, the amount that could occur is likely to be small, based on low concentrations of ferrous iron in native groundwater[2]. Therefore, it is unlikely that clogging will occur. Supporting evidence for a lack of clogging is provided in Table 4, which summarizes water quality for other regional ASR systems with similar (or higher) iron concentrations, and no reported issues associated with clogging.
- **Manganese Minerals:** Several manganese oxide minerals are predicted to have SI>0, which indicates some mineral precipitation is possible. As with iron, the potential for clogging related to mineral precipitation is predicted to be small. First, manganese concentrations are less than iron. Second, the precipitation potential decreases with increasing amounts of source water in the mixture. Finally, water quality for other regional ASR systems with similar (or higher) manganese concentrations have not reported issues associated with clogging (Table 4).

[2] In view of the predicted potential for iron precipitation, it is of interest to estimate the possible volume of precipitates that could form to evaluate whether this could pose a concern for clogging. The measured iron concentration of approximately 0.068 mg/L was used to evaluate a worst-case scenario. If all the iron present in 1 liter of groundwater were to be precipitated as amorphous $Fe(OH)_3$ (density = 3.13 g/cm^3), it would occupy a total volume of less than 0.0002% of the pore volume occupied by the groundwater. This suggests that the level of iron present in groundwater has a low potential for aquifer clogging.

Conclusions and Recommendations

No detrimental water quality changes are predicted from operation of an ASR system by the City of Stayton. Although there is a potential for minor amounts of iron and manganese mineral precipitation to occur, the amount that could precipitate is not predicted to be significant and no clogging should occur.

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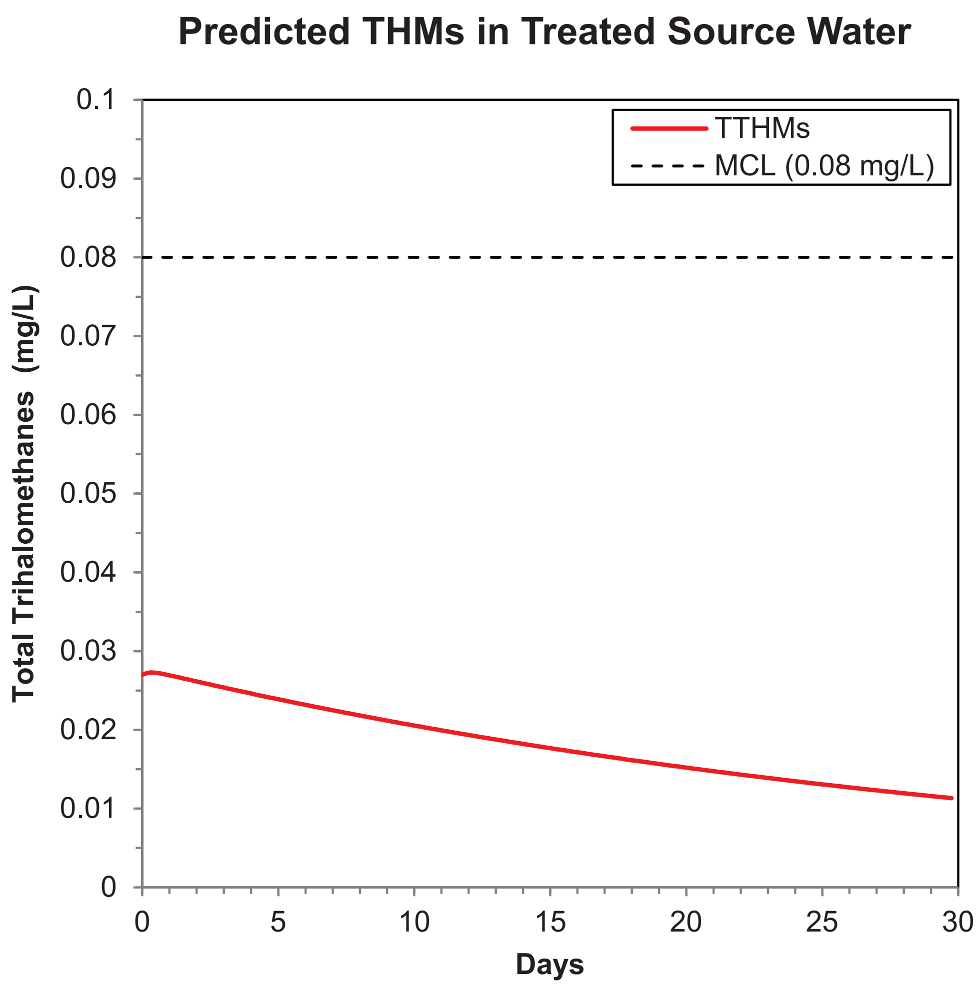


Figure 1. Predicted total trihalomethane (THM) concentrations in source water (treated municipal water from the Santiam River) as a function of time due to reactions with organic carbon in source water and natural degradation.

Table 1. Summary of Water Quality of Waters Used in Mixing Analysis

Type	Parameter	Units	Primary MCL	Secondary MCL	Native Groundwater (Test Well)	City of Stayton Source Water
General	Conductivity	us/cm			121	91
	Dissolved Oxygen	mg/L			0.16	8.99
	ORP	mV			2	612
	pH	unitless		6.5-8.5	7.66	6.46
	Temperature	degC			13	11
	Total Dissolved Solids	mg/L		500	110	48
Cations	Calcium	mg/L			10	6
	Magnesium	mg/L			4.5	1.2
	Potassium	mg/L			1.3	<1
	Sodium	mg/L			16	5.6
Anions	Alkalinity, Total as CaCO3	mg/L			68	26
	Bicarbonate	mg/L			82	31
	Carbonate	mg/L			<2	<2
	Chloride	mg/L		250	3.6	2.4
	Sulfate	mg/L		250	2.9	0.94
Redox Species	Iron, Dissolved	mg/L		0.3	0.068	0.051
	Iron, Total	mg/L		0.3	0.075	0.058
	Manganese, Dissolved	mg/L		0.05	0.017	<0.002
	Manganese, Total	mg/L		0.05	0.018	<0.002
	Nitrate + Nitrite	mg/L			<0.050	0.39
	Nitrate as N	mg/L	10		<0.050	0.39
	Nitrite as N	mg/L	1		<0.050	<0.050
Metals	Aluminum	mg/L		0.05 to 2	<0.020	<0.020
	Antimony	mg/L	0.006		<0.001	<0.001
	Arsenic	mg/L	0.01		<0.001	<0.001
	Barium	mg/L	2		0.007	0.003
	Beryllium	mg/L	0.004		<0.001	<0.001
	Cadmium	mg/L	0.005		<0.0005	<0.0005
	Chromium	mg/L	0.1		<0.001	<0.001
	Copper	mg/L	1.3	1	0.0038	0.0063
	Lead	mg/L	0.015		<.0005	<0.0005
	Mercury	mg/L	0.002		<0.0002	<0.0002
	Nickel	mg/L			<0.005	<0.005
	Selenium	mg/L	0.05		<0.005	<0.005
	Silver	mg/L		0.1	<0.0005	<0.0005
	Thallium	mg/L	0.002		<0.001	<0.001
	Zinc	mg/L		5	<0.020	<0.020
Other Parameters	Color	c.u.		15	<3	<3
	Corrosivity	--		NC	-0.44	-1.5
	Cyanide	mg/L	0.2		<0.025	<0.025
	Fluoride	mg/L	4	2	0.19	<0.050
	Odor	ton		3	<1	<1
	Silica	mg/L			46	14
	Total Organic Carbon	mg/L			0.2	0.74
	Total Suspended Solids	mg/L			<10	<10
Disinfection Byproducts (DBPs)	Bromate	mg/L	0.01		NA	<0.001
	Bromodichloromethane	mg/L			NA	0.0021
	Bromoform	mg/L			NA	<0.0005
	Chlorine as Cl2	mg/L	4		NA	<0.1
	Chlorite	mg/L	1		NA	<0.01
	Chloroform	mg/L			NA	0.025
	Dibromoacetic Acid (DBAA)	mg/L			NA	<0.001
	Dibromochloromethane	mg/L			NA	<0.0005
	Dichloroacetic Acid (DCAA)	mg/L			NA	0.004
	Monobromoacetic Acid (MBAA)	mg/L			NA	<0.001
	Monochloroacetic Acid (MCAA)	mg/L			NA	<0.002
	Total Haloacetic Acids	mg/L	0.06		NA	0.018
	Total Trihalomethanes	mg/L	0.08		NA	0.027
	Trichloroacetic Acid (TCAA)	mg/L			NA	0.014

Notes

NA = Not Analyzed; NC = Noncorrosive; ND = Non-detect

Shaded = Value greater than MCL

Table 2. Mixing Model Predicted Composition of Source Water-Groundwater Mixtures

Type	Parameter	Units	Primary MCL	Secondary MCL	City of Stayton Source Water in Mixture 0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
General	Dissolved Oxygen	mg/L			0.2	1.0	1.9	2.8	3.7	4.6	5.5	6.3	7.2	8.1	9.0
	Eh	mV			760	779	790	798	806	814	821	828	836	845	856
	pH	s.u.		6.5-8.5	7.7	7.5	7.4	7.3	7.2	7.1	7.0	6.9	6.8	6.6	6.5
	Temperature	degC			13	13	13	13	13	12	12	12	12	12	11.5
	Total Dissolved Solids	mg/L		500	165	155	144	133	122	111	100	89	78	67	57
Cations	Calcium	mg/L			10	10	9	9	8	8	8	7	7	6	6
	Magnesium	mg/L			5	4	4	4	3	3	3	2.2	1.9	1.5	1.2
	Potassium	mg/L			1.3	1.2	1.0	0.9	0.8	0.7	0.5	0.4	0.3	0.1	ND
	Sodium	mg/L			16	15	14	13	12	11	10	9	8	7	6
Anions	Bicarbonate	mg/L			83	78	73	68	62	57	52	47	42	37	32
	Chloride	mg/L		250	6	6	7	8	8	9	9	10	10	11	11.4
	Sulfate	mg/L		250	2.9	2.7	3	2	2	2	2	2	1	1	1
Redox Species	Iron, Dissolved	mg/L		0.3	0.068	0.066	0.065	0.063	0.061	0.060	0.058	0.056	0.054	0.053	0.051
	Manganese, Dissolved	mg/L		0.05	0.017	0.015	0.014	0.012	0.010	0.009	0.007	0.005	0.003	0.002	ND
	Nitrate as N	mg/L	10		ND	0.0	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4
	Nitrite as N	mg/L	1		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals	Aluminum	mg/L		0.05 to 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Antimony	mg/L	0.006		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Arsenic	mg/L	0.01		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Barium	mg/L	2		0.007	0.006	0.006	0.005	0.005	0.005	0.004	0.004	0.003	0.003	0.003
	Beryllium	mg/L	0.004		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Cadmium	mg/L	0.005		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Chromium	mg/L	0.1		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Copper	mg/L	1.3	1	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006
	Lead	mg/L	0.015		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Mercury	mg/L	0.002		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Nickel	mg/L			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Selenium	mg/L	0.05		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Silver	mg/L		0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Thallium	mg/L	0.002		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Zinc	mg/L		5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Other Parameters	Fluoride	mg/L	4	2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	ND
	Silica	mg/L			46	43	40	36	33	30	27	24	20	17.2	14.0
	Total Organic Carbon	mg/L			0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.64	0.69	0.74
Disinfection Byproducts (DBPs)	Chlorine as Cl2	mg/L	4		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Total Haloacetic Acids	mg/L	0.06		ND	0.002	0.004	0.005	0.007	0.009	0.011	0.013	0.014	0.016	0.018
	Total Trihalomethanes	mg/L	0.08		ND	0.003	0.005	0.008	0.011	0.014	0.016	0.019	0.022	0.024	0.027

Notes
ND = Non-detect
Shaded = Value greater than MCL

Table 3. Mixing Model Predicted Mineral Saturation Indices of Source Water-Groundwater Mixtures

Type	Mineral	SI Units	Critical Value[1]	City of Stayton Source Water in Mixture										
				0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Silica Minerals	Chalcedony	unitless	>0	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.4
	Cristobalite-a	unitless	>0	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.1
	Cristobalite-b	unitless	>0	0.1	0.1	0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4
	Quartz	unitless	>0	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.9	0.8	0.8	0.7
	SiO2(am)	unitless	>0	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4	-0.4	-0.5	-0.5	-0.6	-0.7
	Tridymite	unitless	>0	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.7	0.6	0.6	0.5
Carbonate Minerals	Calcite	unitless	>0	-1.0	-1.1	-1.3	-1.5	-1.6	-1.8	-2.0	-2.2	-2.4	-2.7	-3.1
	Dolomite	unitless	>0	-0.9	-1.3	-1.7	-2.0	-2.4	-2.8	-3.2	-3.6	-4.1	-4.7	-5.5
	Magnesite	unitless	>0	-1.7	-1.9	-2.1	-2.2	-2.4	-2.6	-2.9	-3.1	-3.4	-3.7	-4.1
	Witherite	unitless	>0	0.5	0.3	0.1	-0.1	-0.2	-0.4	-0.6	-0.8	-1.1	-1.4	-1.8
Sulfate Minerals	Barite	unitless	>0	-1.8	-1.9	-1.9	-2.0	-2.0	-2.1	-2.2	-2.3	-2.4	-2.5	-2.6
	Gypsum	unitless	>0	-3.8	-3.8	-3.9	-3.9	-4.0	-4.0	-4.1	-4.2	-4.3	-4.3	-4.4
	MgSO4	unitless	>0	-14	-14	-14	-14	-14	-14	-14	-15	-15	-15	-15
Iron Minerals	Fe(OH)3(am)	unitless	>0	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.0	2.9	2.8	2.6
	Goethite	unitless	>0	6.3	6.2	6.1	6.0	5.9	5.8	5.6	5.5	5.4	5.2	5.0
	Hematite	unitless	>0	14	13	13	13	13	12	12	12	12	11	11
	Magnetite	unitless	>0	2.0	1.5	1.1	0.7	0.3	-0.1	-0.5	-0.9	-1.3	-1.8	-2.4
	Siderite	unitless	>0	-11	-11	-12	-12	-12	-12	-12	-12	-12	-12	-12
Manganese Minerals	Birnessite	unitless	>0	38	39	37	36	34	32	30	27	24	19	U
	Bixbyite	unitless	>0	7.1	7.0	6.5	6.1	5.6	5.1	4.5	3.8	3.0	1.9	U
	Hausmannite	unitless	>0	4.1	3.7	3.0	2.3	1.5	0.7	-0.2	-1.2	-2.4	-4.2	U
	Manganite	unitless	>0	3.9	3.9	3.7	3.5	3.2	3.0	2.7	2.4	2.0	1.4	U
	Pyrolusite	unitless	>0	7.5	7.7	7.5	7.3	7.1	6.9	6.6	6.3	5.9	5.4	U
	Rhodochrosite	unitless	>0	-1.8	-2.0	-2.2	-2.4	-2.6	-2.9	-3.1	-3.4	-3.8	-4.3	U
Other Minerals	Al(OH)3	unitless	>0	U	U	U	U	U	U	U	U	U	U	U
	Gibbsite	unitless	>0	U	U	U	U	U	U	U	U	U	U	U

Footnotes: 1) Shading for mineral saturation indices shown where supersaturation indicated (SI > 0)
2) U = mineral undersaturated (SI could not be calculated due to non-detect constituent concentrations)

Table 4. Comparison of Water Quality Data for City of Stayton Native Groundwater and Select Columbia River Basalt Wells

Type	Parameter	Units	MCL	SMCL	City of Stayton Native Groundwater (Test Well) 2021	City of Beaverton (Hanson Well) ASR 1 7/14/1994	City of Beaverton ASR No. 3 Pilot Well 3/18/2004	City of Tigard ASR 1 11/29/2001	City of Tigard ASR 2 8/4/2004	Grabhorn Well 5/15/2003	TVWD Miller Hill Road Well 10/21/2011	Cornelius Test Well 1/20/2015	City of Salem ASR Well 1 6/26/1996
General	Conductivity	us/cm			121	377	902	NT	349	252	218	957	98
	Dissolved Oxygen	mg/L			0.16	4.20	6.30	6.98	1.50	NT	1.86	0.39	3.00
	ORP	mV			2	NT	NT	NT	NT	73	NT	-90	149
	pH	unitless		6.5-8.5	7.66	6.88	6.78	6.78	7.14	7.2	7.45	7.53	6.62
	Temperature	degC			13	NT	16	12	15	14	16	20	14
	Total Dissolved Solids	mg/L		500	110	245	530	200	220	210	150	870	110
Cations	Calcium	mg/L			10	36	58	25	26.1	23.4	15	31	5.9
	Magnesium	mg/L			4.5	19	27	11	13.7	11.9	7.7	10	2.4
	Potassium	mg/L			1.3	2.6	7.9	3	5.3	2.8	2.6	30	2
	Sodium	mg/L			16	12.1	73	8.2	21.3	13.3	20	220	6.3
Anions	Alkalinity, Total as CaCO3	mg/L			68	110	NT	109	139	135	100	140	26
	Bicarbonate	mg/L			82	110	NT	133	139	138	120	170	26
	Chloride	mg/L		250	3.6	47.5	210	3.7	16	3.86	3.5	380	2.2
	Sulfate	mg/L		250	2.9	ND	NT	4.3	ND	2.33	2.3	ND	16
Redox Species	Iron, Dissolved	mg/L		0.3	0.068	NT	NT	NT	ND	NT	ND	0.160	--
	Iron, Total	mg/L		0.3	0.075	ND	0.12	ND	0.13	ND	0.18	0.15	0.26
	Manganese, Dissolved	mg/L		0.05	0.017	NT	NT	NT	0.14	0.01	ND	0.15	--
	Manganese, Total	mg/L		0.05	0.018	NT	0.085	0.0024	0.14	ND	0.021	0.14	0.022
	Nitrate as N	mg/L	10		<0.050	0.56	NT	1.7	0.9	0.09	ND	ND	--
	Nitrite as N	mg/L	1		<0.050	0	NT	ND	ND	ND	ND	ND	--
Other Parameters	Fluoride	mg/L	4	2	0.19	ND	NT	0.09	ND	0.11	0.18	1.2	ND
	Odor	ton		3	<1	NT	NT	NT	NT	ND	1	ND	--
	Silica	mg/L			46	NT	NT	NT	55	67	59	66	--
	Total Organic Carbon	mg/L			0.2	0.7	NT	NT	ND	ND	ND	0.54	--
	Total Suspended Solids	mg/L			<10	ND	NT	NT	ND	NT	ND	ND	--

Footnotes:

Analytical data shown in shading exceed the applicable regulatory standard

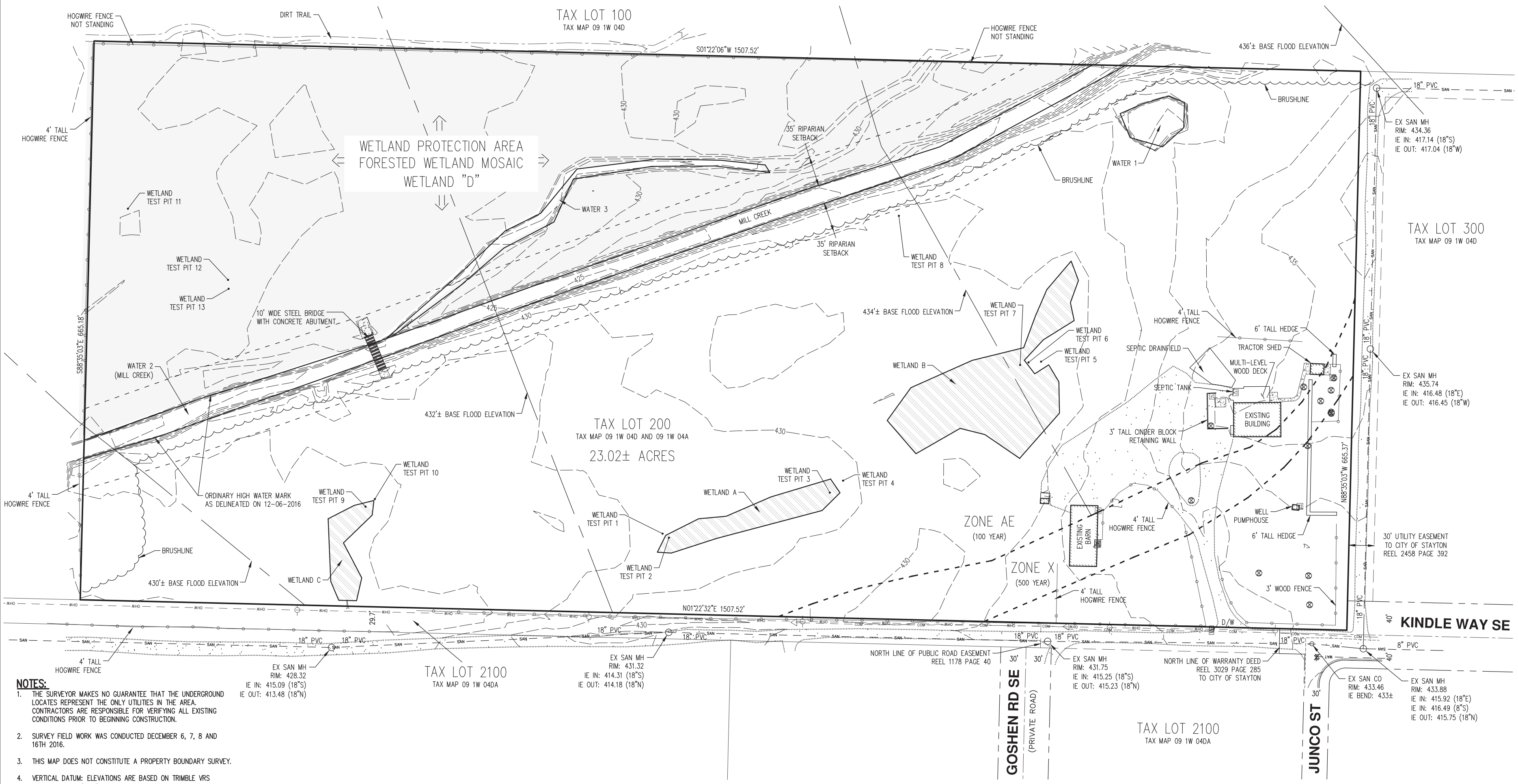
SMCL = Secondary MCL

ND = not detected

NT = not tested

Appendix G

Environmental Figures



NOTES:

1. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND LOCATES REPRESENT THE ONLY UTILITIES IN THE AREA. CONTRACTORS ARE RESPONSIBLE FOR VERIFYING ALL EXISTING CONDITIONS PRIOR TO BEGINNING CONSTRUCTION.
2. SURVEY FIELD WORK WAS CONDUCTED DECEMBER 6, 7, 8 AND 16TH 2016.
3. THIS MAP DOES NOT CONSTITUTE A PROPERTY BOUNDARY SURVEY.
4. VERTICAL DATUM: ELEVATIONS ARE BASED ON TRIMBLE VRS NETWORK NAD88(2011). OBSERVED ELEVATIONS WERE THEN ADJUSTED TO NGVD29 DATUM -3.507 FROM A COMPUTED DATUM SHIFT AT A POINT WITH GRID VALUES OF (NORTH 425879.408 EAST 7603616.408).
5. SURVEY IS ONLY VALID WITH SURVEYOR'S STAMP AND SIGNATURE.
6. BUILDING FOOTPRINTS ARE MEASURED TO SIDING UNLESS NOTED OTHERWISE. CONTACT SURVEYOR WITH QUESTIONS REGARDING BUILDING TIES.
7. WETLAND BOUNDARIES SHOWN WERE DELINEATED BY AKS ENGINEERING & FORESTRY, LLC. ON DECEMBER 6, 2016 AND WERE PROFESSIONALLY SURVEYED BY AKS ON DECEMBER 6, 2016.
8. RIPARIAN AND WETLAND BUFFERS PER CITY OF STAYTON DEVELOPMENT AND IMPROVEMENT STANDARDS, CHAPTER 17.20.
9. BASIS OF BEARING IS OREGON STATE PLANE COORDINATE SYSTEM OF 1983. A LOCAL DATUM PLANE SCALED FROM OREGON STATE PLANE NORTH 3601 NAD83(2011)EPOCH 2010.0000 BY HOLDING A PROJECT MEAN GROUND COMBINED SCALE FACTOR OF 1.0001036254 AT A CALCULATED CENTRAL PROJECT POINT WITH GRID VALUES OF (NORTH 425879.408 EAST 7603616.408).
10. FLOODWAY AND BASE FLOOD ELEVATIONS DEPICTED ARE BASED ON FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) GIS OVERLAY, WHICH IS BASED ON FLOOD INSURANCE RATE MAP PANEL 708 OF 1150 WITH A COMMUNITY NUMBER 410170 & 410154 PANEL 0708, MAP NUMBER 41047C0716 G AND AN EFFECTIVE DATE OF JANUARY 19, 2000.

LEGEND

EXISTING: DECIDUOUS TREE; CONIFEROUS TREE; FIRE HYDRANT; WATER BLOWOFF; WATER METER; WATER VALVE; DOUBLE CHECK VALVE; IRRIGATION CONTROL VALVE; SANITARY SEWER CLEAN OUT; SANITARY SEWER MANHOLE; SIGN; STREET LIGHT; MAILBOX

EXISTING: STORM SEWER CLEAN OUT; STORM SEWER CATCH BASIN; STORM SEWER AREA DRAIN; STORM SEWER MANHOLE; GAS METER; GAS VALVE; GUY WIRE ANCHOR; POWER POLE; POWER VAULT; POWER JUNCTION BOX; POWER PEDESTAL; COMMUNICATIONS VAULT; COMMUNICATIONS JUNCTION BOX; COMMUNICATIONS RISER

EXISTING: RIGHT-OF-WAY LINE; BOUNDARY LINE; PROPERTY LINE; CENTERLINE; DITCH; CURB; EDGE OF PAVEMENT; EASEMENT; FENCE LINE; GRAVEL EDGE; POWER LINE (PWR); OVERHEAD WIRE (OHW)

EXISTING: COMMUNICATIONS LINE (COM); FIBER OPTIC LINE (CFO); GAS LINE (GAS); STORM SEWER LINE (STM); SANITARY SEWER LINE (SAN); WATER LINE (WAT)

SCALE 1" = 60 FEET

60 0 24 36 48 60

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ENGINEERING · SURVEYING · NATURAL RESOURCES
FORESTRY · PLANNING · LANDSCAPE ARCHITECTURE

KINDLE WAY PARK

STAYTON
TAX LOT 200

OREGON
MARION COUNTY TAX MAP 091W04A & 091W04D

EXISTING CONDITIONS PLAN

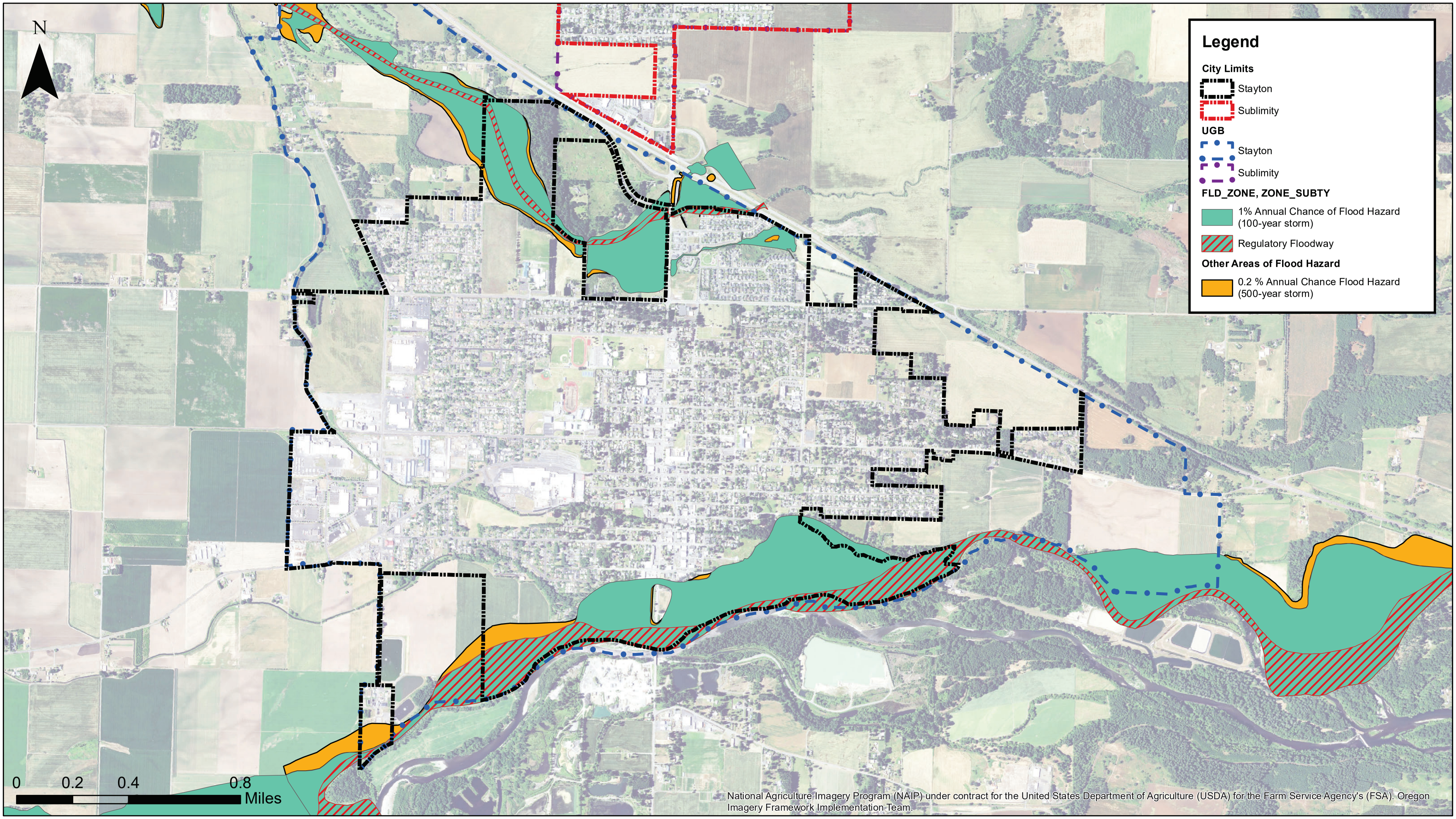
DESIGNED BY:
DRAWN BY: KAM
CHECKED BY: NSW
SCALE: AS NOTED
DATE: 12-20-2016

REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JANUARY 9, 2007
NICK WHITE
70652LS
RENEWS: 6/30/18

REVISIONS

JOB NUMBER
5723

SHEET
C101



FEMA Floodplain

Aquifer Storage and Recovery Feasibility Study

Figure G-2

City of Stayton, OR
May 2021