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MEMORANDUM

Date: October 26, 2022

To: Water Utility Board

From: Joe Grande, Project Manager
Adam Wiederhoeft, Staff Engineer
Pete Holmgren, Chief Engineer

Subject: Well 15 PFAS Treatment Project – Recommended Treatment Alternative

Recommendation

Staff recommends Well 15 PFAS Treatment Alternative #2 for approval by the Water Utility Board (Board).

Background

Unit Well 15 is located at 3900 E Washington Avenue, surrounded by Reindahl Park and a small commercial shopping mall. Historically, the well has reliably supplied up to one billion gallons of water annually to the East Washington Avenue corridor in northeast Madison, including East Towne Mall and the growing commercial, office, and residential developments located to the east of I-90/94. The production well was removed from service in 2019 following the detection of PFAS contamination.

Constructed in 1965, the well has a history of producing water containing manufactured organic contaminants – specifically volatile organic compounds (VOC) including tetrachloroethene (PCE) and trichloroethene (TCE). More recently, per and polyfluoroalkyl substances (PFAS), including PFOA and PFOS, were found. Aeration (low profile air stripping) was added in 2013 to remove the VOCs because PCE levels were approaching the safe drinking water limit. Importantly, aeration removes PCE and TCE to below detectable levels but is not effective on PFAS chemicals. Hence, additional treatment is required to remove PFAS from water produced from Unit Well 15.

Engineering Services Contract

This past April, the Board authorized an engineering services contract with AECOM to provide bench-scale testing, an alternatives analysis, and preliminary and final designs for the Well 15 PFAS Treatment project.

Bench-Scale Testing

This past summer, AECOM completed the bench-scale testing that successfully evaluated the relative performance of two Granular Activated Carbon (GAC) products and two Ion Exchange (IX) resins. The study demonstrated that:

- All four adsorbents reduced all PFAS chemicals to non-detectable levels
- GAC media will require earlier and more frequent replacement than IX resins
- Out of the GAC media tested, Filtrasorb® 400 was superior to AV1240LDX
- Both GAC media removed VOC for the entirety of the bench-scale test

Alternatives Analysis

Proven treatment technologies for PFAS removal from drinking water include adsorbent media (i.e. GAC and IX resins) and membranes that are the basis of reverse osmosis and nanofiltration. Because membrane separation requires high energy input, produces large waste streams, and must be followed by post-treatment conditioning of the treated water, membranes are neither a viable nor cost-effective alternative and were not investigated further.

AECOM evaluated five treatment alternatives including various combinations of air stripping (existing equipment for VOC removal), GAC, and IX. Each option involves installing four or six pressure vessels that contain GAC media or IX resin. PFAS will be removed by the adsorbent media and/or resin as water flows through two parallel treatment trains. Except for Alternative #3, the existing air strippers will be eliminated because GAC will remove VOCs as well as PFAS. See the attachment for general schematics and additional detail of each treatment alternative.

For all five alternatives, treated water will satisfy each of the following treatment objectives:

- Non-detect for PFOA & PFOS and all other PFAS chemicals analyzed
- Non-detect for PCE & TCE (two VOCs)
- Meet all WI Department of Health Services PFAS guidance including a Hazard Index (HI) value that is below 1
- Meet all federal and state drinking water regulations

Please see **Table 1** on the next page for a summary of the five treatment alternatives evaluated.

Table 1. Treatment Alternatives Evaluated

Treatment Alternative*	Number of **GAC Vessels**	Number of **IX Vessels**	Annual Media Changes	
			GAC	**IX**
*Installed **Within Existing Building Footprint***				
1. GAC → GAC	4	0	3.5	NA
2. GAC → IX	2	2	2.3	0.7
*Building **Footprint Expansion would be Required***				
3. Air Stripping → IX → IX	0	4	NA	2.1
4. GAC → IX → IX	2	4	2.3	1.0
5. GAC → GAC → IX	4	2	3.0	0.3
***Sequence of lead / lag treatment where one follows the other				

Regular monitoring of VOCs and PFAS at the outlet of the first of two or three pressure vessels in the treatment sequence will identify when media replacement is required, thereby ensuring no PFAS chemicals are present after treatment. Routine confirmatory testing of the treated water will also be conducted.

Rising PFAS levels in the source water or more stringent future regulatory requirements may reduce the water throughput, require earlier media replacement and, consequently, increase future operating expenses associated with PFAS removal.

Feasibility of Treatment Building Footprint Expansion

As indicated in **Table 1**, Treatment Alternatives #3, #4, and #5 require a building footprint expansion. Unit Well 15 sits on a small land parcel nearly fully occupied by the existing well building. The parcel is adjacent to Reindahl Park, with limitations on the activities permitted on the underlying parkland. Given these constraints, building expansion is not feasible since it would require an adjustment to the existing lot line and would inevitably encroach on the deed-restricted parklands.

Any potential attractiveness of Alternatives #3, #4, and #5 is more than outweighed by this likely insurmountable obstacle, and hence these options are not considered viable, from a practical standpoint.

Cost Considerations

Table 2 (next page) compares estimated capital costs and annual operating costs as well as the estimated 25-year life cycle cost for all five treatment alternatives.

Table 2. Estimated Cost Comparison

	Within Existing Building Footprint		*Footprint Expansion would be Required*		
Treatment Alternative	**#1**	**#2**	**#3**	**#4**	**#5**
Estimated Capital Cost	$5.0 M	$4.6 M	$5.0 M	$5.7 M	$6.1 M
Est Annual Operating Cost	$0.3 M	$0.3 M	$0.4 M	$0.4 M	$0.4 M
Net Present Value of 25 Years of Operating Costs	$3.1 M	$3.5 M	$4.5 M	$4.3 M	$3.8 M
25-Year Life Cycle Cost	**$8.1 M**	**$8.1 M**	**$9.5 M**	**$10.0 M**	**$9.9 M**

The Net Present Value of 25-years of operating cost ranges from $3.1 million to $4.5 million. It is significant to note that federal funding under Bipartisan Infrastructure Law does not cover operating costs; only the design and capital costs are covered.

As is seen from **Table 2** above, Alternatives #1 or #2 have the advantage of lower life cycle costs compared to Alternatives #3, #4, and #5, and the added advantage of not having to go outside the existing building footprint.

Preferred Treatment Alternative

The preferred treatment is one that meets all treatment objectives: produces PFAS-free and VOC-free water and meets all regulatory requirements and WI Department of Health Services PFAS guidance. GAC alone or IX in combination with air stripping or GAC can achieve each of these treatment objectives. A secondary objective is for the treatment equipment to remain within the existing building footprint, thereby limiting the anticipated cost of construction.

The bench-scale testing showed that IX resins performed exceptionally well and PFAS removal lasted longer when compared to GAC; however, IX resins do not remove VOCs. To meet all treatment objectives, IX resin must be coupled with air stripping or GAC. Alternative #2 is the only option that combines IX with air stripping or GAC and does not require expansion beyond the existing building footprint.

GAC was shown to effectively remove both VOCs and PFAS, albeit for a smaller volume of water. The lower relative cost of GAC media compared to IX resin makes GAC alone an attractive PFAS removal solution at Well 15. However, the lower relative effectiveness of GAC compared to IX resin will result in the generation of more waste through more frequent media replacement.

Combining GAC and IX resin leverages the complementary advantages of both technologies to accomplish the following objectives: organic contaminant removal (PFAS and VOC) for a longer duration, reduced waste generation, and no need to expand the building footprint.

Although Alternative #1 produces the lowest expected 25-year life cycle cost, this alternative will require more frequent media replacements and generate more solid waste. For a slightly greater cost, Alternative #2 offers superior PFAS removal performance over a longer duration and less waste generation.

A cost-effective alternative that satisfactorily meets the treatment objectives, while avoiding construction activities that encroach on adjacent parkland and limiting solid waste generation, ranks highly from a staff perspective. Therefore, staff recommends Alternative #2 for approval by the Board.

Project Timeline

AECOM will complete the preliminary and final designs for the Well 15 PFAS Treatment project after a treatment alternative is selected. City of Madison permitting and regulatory approvals of a final design are anticipated by June 2023. The project schedule is as follows:

October 2022	– finalize bench-scale testing report
	– select treatment alternative
	– complete preliminary design report
	– submit Drinking Water Loan application
April 2023	– grant funding status update from DNR
June 2023	– final construction design: City, DNR and PSC approvals complete
Spring 2024	– begin construction
Spring 2025	– final testing & commissioning of Well 15 treatment plant

ATTACHMENTS:

A. Treatability Study Technical Memorandum
B. General Schematics for Five Treatment Alternatives