



November 18, 2022

MS. DENICE NELSON
JOHNSON CONTROLS, INC
5757 N. GREEN BAY AVENUE
MILWAUKEE, WI 53209

Via Email Only to denice.karen.nelson@jci.com

SUBJECT: Response to Potable Well Sampling Area (PWSA)
Deep Well Design Plan and Deep Aquifer Long-Term Monitoring Plan
JCI/Tyco FTC PFAS, 2700 Industrial Parkway South, Marinette, WI
BRRTS #02-38-580694

Dear Ms. Nelson:

On September 27, 2022, the Wisconsin Department of Natural Resources (DNR) received the *Potable Well Sampling Area (PWSA) Drinking Water Update* (the “Deep Well Design Plan”) and the *Deep Aquifer Bedrock Well Design and Long-Term Monitoring Work Plan* (the “Deep Aquifer Monitoring Plan”) for the above-referenced site (the “Site”). The reports were submitted by Arcadis U.S., Inc. (Arcadis) on behalf of Johnson Controls, Inc. and Tyco Fire Products LP (JCI/Tyco) and were accompanied by the appropriate fees required under Wisconsin Administrative Code (Wis. Admin. Code) § NR 749.04(1) for formal DNR review and response.

JCI/Tyco has proposed new deep private wells (“deep drinking water wells”) as an action to address per- and polyfluoroalkyl substances (PFAS) detected in existing private wells in the PWSA. On September 8, 2022, the DNR sent a letter requesting JCI/Tyco submit information documenting how it plans to construct and monitor the new wells to be protective of public health and the environment (Wis Admin. Code § NR 708.11(3)(a)).

The DNR reviewed the PWSA Deep Well Design Plan and Deep Aquifer Monitoring Plan, and this letter includes a response to both reports. While JCI/Tyco’s design considerations for the deep drinking water wells demonstrate a goal of being protective of human health and the environment, there are no guarantees; additional monitoring will be needed to establish if deep drinking water wells achieve this goal and can be a “permanent” solution to safe drinking water. The DNR recommends that JCI/Tyco enhance its monitoring program to support its evaluation of deep drinking water wells as a long-term solution in the PWSA, and this letter provides JCI/Tyco with recommended modifications to its proposed monitoring plan.

The DNR’s comments herein relate to JCI/Tyco’s plans for residents who select deep wells in the PWSA. As a reminder, JCI/Tyco must complete the site investigation and evaluate and offer safe drinking water solutions to all residents impacted by PFAS contamination from the Site (Wis. Admin. Code chs. NR 716 and 722).

Background

JCI/Tyco is investigating and responding to the discharge of PFAS to the environment at the JCI/Tyco Fire Technology Center (FTC), located at 2700 Industrial Parkway South in Marinette, Wisconsin. The discharge occurred as the result of fire suppressant training, testing, research and development of PFAS-containing aqueous film forming foams (AFFF) at the Site starting in the early 1960s.

PFAS from the FTC have impacted private drinking water wells in the area. As a result, JCI/Tyco currently provides residents in the PWSA with an alternative source of drinking water as required by Wis. Admin. Code § NR 708.05(4)(f). To date, JCI/Tyco has sampled 173 wells, maintains 46 point of entry treatment (POET) systems and offers bottled water to any resident in the PWSA.

JCI/Tyco has been evaluating potential long-term solutions to safe drinking water in the PWSA, including public water supply, new deep wells and continued operation of POET systems or supply of bottled water. Recent outreach efforts conducted by JCI/Tyco found that some residents in the PWSA preferred the concept of deep drinking water wells. Based on this, JCI/Tyco took steps to evaluate the local water quality of the deep aquifer and develop plans for construction and monitoring of the deep drinking water wells.

Interim Action vs. “Permanent” Solution

Currently, deep drinking water wells installed in the PWSA are considered an interim action (as defined in Wis. Admin. Code ch. NR 700.03(29)). Previously, JCI/Tyco evaluated deep wells as a remedial alternative for long-term safe drinking water in its Remedial Action Options Reports (RAORs) that were submitted between May 2018 and October 2019. In the October 2019 version of the RAOR, JCI/Tyco identified several concerns that may limit the ability of deep wells to meet the final remedy selection criteria in Wis. Admin. Code NR § 722.07(4) and concluded that “deep wells are unlikely to be a viable and reliable safe long-term water supply for generations to come.” The reasons being that naturally-occurring contaminants that pose a health risk are present in the deep aquifer and construction deficiencies in a deep well or local fractures in the bedrock could cause PFAS to migrate from the shallow to the deep aquifer.

The primary concerns were how – over the decades – JCI/Tyco could monitor the individual deep wells to assess for the presence of PFAS compounds and how JCI/Tyco plans to monitor any treatment systems added to homes receiving new a deep well to ensure that all naturally-occurring contaminants posing a health risk are being sufficiently removed. As stated in the DNR’s September 28, 2022, letter, “...while deep wells could be a permanent solution... Determinations that deep wells are a final remedial action ...can occur once JCI/Tyco has complied with Wis. Admin. Code ch. NR 722 and 724 ... to document that [deep wells] ... meet criteria for a final remedial action that can achieve long-term protection based on approved-remedial standards.”

Summary of the Deep Well Design Plan and Deep Aquifer Monitoring Plan

JCI/Tyco’s Deep Well Design Plan and Deep Aquifer Monitoring Plan are for the installation of replacement private drinking water wells in the deep aquifer for any property in the PWSA not within an area annexed by the city of Marinette. (At the time of this letter, some residents in the PWSA were interested in evaluating if portions of the PWSA could be annexed by the city of Marinette to allow for an expansion of the Marinette Municipal Water System to provide their properties with public water.) JCI/Tyco did not include a map of the boundaries of the area(s) of the PWSA evaluating potential annexation to receive municipal water, but does state that if annexation efforts are unsuccessful, then JCI/Tyco will offer to install replacement private drinking water wells in the deep aquifer for everyone in the PWSA.

JCI/Tyco’s PWAS Deep Well Design Plan includes the following:

- Summary of prior evaluations of options for long-term safe drinking water in the PWSA.
- Overview of its outreach to discuss these options with the public.
- Information on the water quality and hydrogeology of the deep aquifer.
- Design plans for the deep wells.
- Design plans for in-home water treatment.

JCI/Tyco’s PWSA Deep Aquifer Monitoring Plan includes the following:

- Information on PFAS results and hydrogeology of the deep aquifer.
- Plan to monitor the PFAS conditions in the deep aquifer using three deep monitoring wells.
- Request to construct the deep monitoring wells the same as the deep drinking water wells, rather than as Wis. Admin. Code ch. NR 141 piezometers, so that the water quality in samples from the monitoring wells better replicate the water quality in the drinking water wells.
- Plan to geophysically log the monitoring well boreholes to evaluate the local the bedrock geology, and plan to conduct pump test on each well to evaluate drawdown and stable yield.

The DNR’s understanding of JCI/Tyco’s criteria and plans for deep wells are as follows:

Criterion 1 – Well Design, PFAS and Geology: Deep drinking water wells must draw water from a deeper aquifer that is hydraulically separated from overburden and shallow bedrock where PFAS may be present, and the wells must be constructed with permanent casings designed to prevent potential downward leakage of PFAS within the well.

- Regionally, there is a thick (~200 feet) bedrock aquitard that separates the shallow (unconsolidated) aquifer and the deep (bedrock) aquifer. The aquitard is a dolomite/shale with very low fractures and porosity. While the bulk of the bedrock aquitard has low permeability, the upper surface is weathered, fractured and permeable.
- Perfluorooctanesulfonamide (FOSA) was detected in some of the current deep wells in the PWSA at concentrations less than 6 parts per trillion (ppt). JCI/Tyco concluded that the FOSA detections were not from the Site and could be an artifact of well materials. While this is possible, it is also possible that the FOSA is from the Site. For example, downward migration of PFAS could occur at wells whose casing does not extend below the permeable weathered bedrock surface – many of the current deeper wells are known to have casings set at depths between 60 and 115 feet below ground surface (bgs).
- JCI/Tyco plans to construct the deep drinking water wells with a deep well casing that extends 75-feet into the bedrock aquitard – approximately 150 to 200 feet below ground surface (bgs) – to prevent the downward migration of PFAS.

Criterion 2 - Water Quality: Deep wells must supply water that is of good quality for drinking and general household use, and potentially harmful constituents or cosmetically unpleasant characteristics in the water must be able to be addressed with in-home water treatment.

- The water the deep aquifer contains high levels of radium, sulfate and other naturally-occurring contaminants. JCI/Tyco’s testing of current deep wells in the area showed the following:

WELL ID	Depth (ft)	Radium (pCi/L)	Strontium (ppm)	Sulfate (ppm)	Iron (ppm)	Hardness (ppm)
Irrigation Well 1	374	14	6.4	440	0.47	550
Irrigation Well 2	540	33	5.7	380	1.4	500
WS-006	521	21	11	370	0.27	480
WS-130	506	25	13	500	2.5	600
Standard or Criteria		5⁽¹⁾	1.5⁽²⁾	250⁽³⁾	0.3⁽³⁾	180⁽⁴⁾

Notes

pCi/L = picocuries per liter, ppm = parts per million or milligrams per liter

⁽¹⁾ Wis. Admin. Code ch. NR 809 Maximum Contaminant Level (MCL) in drinking water

⁽²⁾ Wisconsin Department of Health Services (DHS) Recommendation

⁽³⁾ Wis. Admin. Code ch. NR 140 Enforcement Standard

⁽⁴⁾ Hardness as calcium carbonate - Very hard defined as > 180 ppm

- JCI/Tyco plans to install in-home treatment to address the water quality issues present in the deep aquifer. The in-home treatment will include whole-house water softening and sediment filtration and under-the-sink reverse osmosis (RO) for drinking water. The proposed RO system meets the NSF/ANSI 58 standard for the reduction of radium and the RO filter is designed to last for 1,000 gallons of use (approximately 12 months at the point-of-use).
- JCI/Tyco plans to pay for maintenance of the in-home treatment system for 20 years; after which the homeowner will be responsible for upkeep of the system.

Criterion 3 - Water Production: Deep wells must be constructed in an aquifer with reliable yield, sufficient for normal household use.

- The first highly transmissive zone encountered in the deep aquifer is a dolomite containing small cavities/veins and some sandstone layers.
- Pump tests conducted on two irrigation wells at Marinette High School found the transmissive zone in the deep bedrock aquifer was encountered between 405 to 415 feet bgs in one well and 420 to 470 ft bgs in the other well; specific capacities of 5.5 and 8.5 gallons per minute (gpm) per foot of drawdown were measured in these two wells.
- JCI/Tyco plans to extend the deep wells approximately 500 feet bgs or at least 50 feet beyond the top of the transmissive zone based on the well drillers observations of water production in each deep well.
- No evaluation was provided on the cumulative effects pumping from deep wells will have on yield or drawdown on the deeper aquifer. (Bedrock wells with low yield are known to occur in this area.)

Monitoring Plan: JCI/Tyco has proposed the following monitoring plan for the deep wells/aquifer:

Parameter	New Deep Drinking Water Wells	Three Deep Aquifer Monitoring Wells		
Water Quality ¹ & PFAS	at Well and at Point-of-Use ² @ time the well is installed	--		
PFAS Only	at Point-of-Use ² 6 and 12 months after installation	Year 1 Quarterly	Year 2 Semiannual	Thereafter ³ Annual

¹ Radium, Hardness, Metal, Major Ions, Alkalinity, Sulfur & Sulfides and Uranium

² After water softener, sediment filter and RO treatment.

³ Until Site closure or change in frequency otherwise approved by the DNR.

DNR Review

While deep drinking water wells are currently an interim action that JCI/Tyco can implement without DNR approval (Wis. Admin. Code ch. NR 708.11(3)), it is apparent that it is JCI/Tyco's goal is to have the deep wells eventually be approved as a permanent solution for residents in the PWSA that select this option. Thus, the DNR reviewed the Deep Well Design Plan and the Deep Aquifer Monitoring Plan with that end goal in mind and provides comments based on two fundamental questions:

- Has JCI/Tyco *designed* the deep wells to be protective of public health and the environment based on currently available information?
- Are its *monitoring* plans sufficient to ensure that the deep wells provide safe drinking water in the long term?

Design: The DNR concurs with JCI/Tyco’s design criteria for the deep drinking water wells and approves JCI/Tyco’s request to construct the deep aquifer monitoring wells using the same design as the deep drinking water wells. The DNR’s concurrence with the design criteria does not guarantee that the deep drinking water wells will achieve the criteria – monitoring to document water quality, well production and effectiveness of the in-home treatment systems will be needed to make that determination.

- Because the new deep monitoring wells will have an open borehole from approximately 150 to 500-feet bgs, the sampling results, while useful for assessing water quality in the drinking water wells, will have limited use in defining the degree and extent of contamination as required for the site investigation. Therefore, the DNR requests that JCI/Tyco refrain from calling these “sentinel wells” – as it did in the Deep Aquifer Monitoring Plan – to avoid confusion as to their purpose and function.
- As a basic guide for construction of the wells, mud drilling the upper drillhole is a good method, but the driller needs to be aware of their drilling mud weights and utilize additives to keep it in good condition to prevent an influx of PFAS-laden water entering the borehole from the formation.
- The DNR recommends that the deep monitoring wells be installed before the deep drinking water wells to confirm the local bedrock geology, confirm that PFAS is not present in the deeper aquifer and evaluate if stable yields can be achieved for deep wells with deep well casings in this area. JCI/Tyco should be prepared to adjust the plans for deep drinking water wells based on findings from construction and logging of the deep monitoring wells.
- The DNR agrees that the in-home treatment system will likely be needed to provide water that is of “good quality for drinking and general household use” from individual wells installed in the deep aquifer. JCI/Tyco did not specify numeric criteria; thus, it is expected that JCI/Tyco will use the applicable MCL, NR 140 ES or DHS recommendation. (If this assumption is incorrect, please provide the numeric criteria).
- When in-home treatment is needed to remove naturally-occurring contaminants that pose a health risk from water supplied by a new deep drinking water well, the DNR recommends *additional monitoring* to verify the design and maintenance plan for the treatment system and clear *written communication* to each resident to document why in-home treatment is needed and what taps are suitable for drinking water.¹

Monitoring: The DNR recommends modifications to JCI/Tyco’s monitoring plan to document if the deep wells are protective of public health and the environment (Wis Admin. Code § NR 708.11(3)(a)) and if they meet the criteria for a “permanent solution” to long-term safe drinking water (Wis. Admin. Code NR § 722.07(4)).

JCI/Tyco’s plans to transition from short-term (1-year) monitoring at each deep drinking water well to long-term water quality monitoring using the deep monitoring wells is a practical approach to minimize disturbance to individual home homeowners, provided that the sampling results from the deep monitoring wells are representative of the water quality in the deep drinking water wells and if better coverage can be achieved for the deep aquifer monitoring network in the PWSA. Local fractures or breaches in the aquitard or variations in well construction could result in differences in the water quality at specific well locations that are not picked up by the monitoring wells, but better coverage in the monitoring well network will lessen this chance.

¹ Recommended changes to the frequency and parameters are described under *Monitoring*; in addition, another sampling location between the whole-house sediment filter and point-of-use RO is recommended to evaluate if the RO system is needed to achieve safe drinking water for an individual well. If the testing shows the RO system is not needed, then the future costs for maintenance of the treatment system would improve (be less) for residents. If testing shows the RO system is needed, the communication to residents should specify which tap(s) are suitable for drinking water.

Specific recommendations to the deep well/aquifer monitoring plan:

1. Add at least one more deep monitoring well to evaluate water quality near center of the PWSA (e.g., along Green Gable Road near WS-163). Another deep monitoring well is recommended along Shore Drive if deep wells are constructed in this area of the PWSA.
2. Include water quality parameters (e.g., radium, sulfate, strontium and hardness) in the sampling plan for the deep monitoring wells. The water quality results may be used in the short term to check if results from the deep monitoring wells are representative of results in the deep drinking water wells; dis-similar results would signal a need to adjust the approach to long-term monitoring plan. The water quality results may be used long-term as indicators of change in water quality in the deep aquifer. Changes in water quality could signal a need to re-evaluate the maintenance plan for in-home treatment and/or keep a closer eye on potential contaminant migration from the shallow aquifer.
3. Record water level in each deep aquifer monitoring wells to look for changes/trends that could be associated with increased pumping from the aquifer. Refrain from using water levels from large open boreholes in fractured bedrock to estimate hydraulic gradient in the deep aquifer (as suggested in the Deep Aquifer Monitoring Plan).
4. Expand the monitoring plan for the deep drinking water wells to evaluate the effectiveness and establish a maintenance schedule for the in-home treatment system.
 - Test for water quality parameters quarterly for at least the first year of use to verify the lifespan and effectiveness of the treatment components. (The water quality parameters analyzed during the first year of monitoring could be limited to specific constituents of concern that are identified in the initial testing of each well.)
 - After one year of use, collect a sample from the well (prior to any treatment) and analyze for water quality parameters and PFAS to look for changes resulting from pumping and to compare results and confirm that the deep aquifer monitoring results are representative of the deep drinking water wells.
 - Establish a maintenance schedule based on findings from the first year of testing and operations.
 - Evaluate if additional, albeit less frequent, monitoring is needed for the deep drinking water wells based on the results of the first year of monitoring.
 - Provide each homeowner with an estimate of their future annual costs for maintenance and the anticipated lifespan and cost for replacement of the treatment system (after JCI/Tyco's 20 years of maintenance is complete).

Questions: Finally, JCI/Tyco should be prepared to address the following as it moves forward with this interim action.

- What is the plan if an individual deep well has low production because of local variations in geology and transmissivity of the deep aquifer?
- What is the plan if the in-home treatment system cannot achieve the design criteria or requires more frequent and costly maintenance than anticipated?
- What is the plan if monitoring results signal potential for PFAS migration into the deep aquifer? What parameters and criteria will be used as indicators of potential migration?
- What is the plan if a homeowner does not want to abandon the existing drinking water well?

Next Steps

- The DNR requests that JCI/Tyco review the recommendations and questions posed in this letter and respond to these in writing within 45 days. A review fee is not required with this response and the response can be a letter, a revised monitoring plan or other format selected by JCI/Tyco.
- The DNR requests that JCI/Tyco provide the DNR with the construction dates for the deep drinking water wells.
- Wis. Admin. Code § NR 708.15 - Submit an interim action report within 6 months after the deep monitoring wells are installed.
 - Document the well construction and the findings from the geophysical logging, pump test and initial sampling of the deep monitoring wells. Discuss any modifications to the design of the deep drinking water wells that resulted from evaluations of this data.
 - To the extent that deep drinking water wells have been installed, include all available well construction report and initial testing results (pre- and post-water treatment).
 - Document and summarize the private wells that were abandoned.
 - Provide the Wisconsin Unique Well ID assigned to each well and a provide a map with the locations of the new deep drinking water and deep monitoring well locations.
 - Use this report to evaluate if the at the deep monitoring wells are representative of conditions in the deep drinking water wells.
 - Use this report to evaluate whether the deep wells (with in-home treatment system) are currently meeting the design criteria.
 - Propose a schedule for a subsequent interim action report to document the construction of additional deep wells and the on-going monitoring results.
- Wis. Admin. Code § NR 708.11(5) - Continue with the site investigation during the implementation of this interim action.

As a reminder, this Site is subject to an enforcement action and therefore all submittals to the DNR under Wis. Admin. Code chs. NR 700-799 (unless otherwise directed by the DNR) must be accompanied by a Wis. Admin. Code ch. NR 749 fee per Wis. Stat. § 292.94. These fees are not pro-ratable or refundable per Wis. Admin. Code § NR 749.04(1). If you have any questions about whether to include a fee with a submittal, please contact DNR staff prior to submitting a document without a fee.

The DNR appreciates your efforts to investigate and remediate this Site. If you have any questions about this letter, please contact me, the DNR Project Manager, at (608) 622-8606 or Alyssa.Sellwood@wisconsin.gov.

Sincerely,



Alyssa Sellwood, PE
Complex Sites Project Manager
Remediation & Redevelopment Program

cc: Christine Sieger, DNR (via email: Christine.Sieger@wisconsin.gov)
Jodie Peotter, DNR (via email: Jodie.Peotter@wisconsin.gov)
Kyle Burton, DNR (via email: Kyle.Burton@wisconsin.gov)