Revised Total Coliform Rule – Level 2 Assessment Form
Florida Department of Environmental Protection

NOTE: Form to be completed based on data and documents available to the Public Water System and submitted to the DEP district or DOH county office which has jurisdiction of the water system as soon as practical, but **no later than 30 days** after learning that the PWS has triggered this Level 2 Assessment. Failure to conduct the Assessment and complete corrective actions within these 30 days may result in monthly monitoring. **A Level 2 Assessment is triggered if there is an *E. coli* MCL violation or a second Level 1 trigger in a rolling 12-month period. For systems on annual monitoring, a Level 1 trigger in 2 consecutive years triggers a Level 2.**

PWS ID#: 4501229 **PWS Name:** City of Riviera Beach Utility Special District **City/Town:** Riviera Beach

System Type: ☑ **Community** ☐ **Non-transient, Non-community** ☐ **Transient, Non-community** ☐ **Seasonal**

Person Conducting Assessment: Nigel Grace **Person's Title:** P.E. (FL 46605)

Phone: 954-260-9587 **Email:** NGrace@brwncald.com

Date Assessment Triggered: February 9, 2024 **Date Assessment Completed:** March 8, 2024

Level 2 Triggers:

☑ *E. coli* MCL violation **Note: Refer to Exhibit 1**

☐ Second Level 1 Trigger | Person completing first Level 1: _____

Section A: Review and evaluate elements 1-6. Check any potential causes of contamination identified. **Each section requires a response. Please provide additional explanations in Issue Description.** Use that space to provide additional information on potential causes of contamination identified during your assessment. Include corresponding dates with your findings such as dates of sample collection, low pressure events, extreme weather, etc.

1. SAMPLING SITES

Issues Identified: ☑ No If yes, please check below and add additional information in Issue Description.

☐ Unclean/unsuitable sample tap
☐ Unapproved sample site
☐ Cross connections around sample site
☐ Other: _____
☐ Change in conditions at sample site
☐ POE/POU site identified
☐ Hot water intrusion

Issue Description:

Readily observable elements of SP #38 appear to be appropriately installed and well-suited for its use as a routine RTCR monitoring location. The area was free of visible conditions, indicating a potential sanitary hazard that requires corrective measures. Consequently, no permanent condition was observed that would indicate an increased vulnerability to contamination of the sampling site. Refer to Exhibit 2 for details.

2. SAMPLING PROTOCOL

Issues Identified: ☐ No If yes, please check below and add additional information in Issue Description.

- ☑ Sampling error
- ☐ Lab indicates possible lab error
- ☐ Auto sensing faucet/swivel-type faucet
- ☐ Change in sample collector
- ☐ Aerator not removed from tap
- ☐ Improper hold time/storage temperature
- ☑ Inadequate tap flushing
- ☐ Improper sample container/preservative
- ☐ Tap disinfected/flamed
- ☐ Seasonal system start-up procedure problems
- ☐ Other: _____

Issue Description:

While there were no definitive indicators of sampling protocol contributing to the TC+ result at SP #38 on June 6th, 2023, this is an area that presents opportunities for contamination that can lead to false positives. Particularly in light of the review of system hydraulics, negative TC results from nearby/upstream samples and follow-up monitoring of SP #38 that were negative - all of which suggest a highly localized source of contamination, it's reasonable to deductively conclude that sampling protocols may have played a role in producing the TC+ result. The potential issues identified above represent presumptive findings and not definitive conclusions. RBUSD has made comprehensive updates to its Sampling Plan, which is currently under review by USEPA and will be submitted to FDOH for review and approval. As a result of the site visit to SP #38, a few refinement opportunities were identified for further investigation. Refer to Exhibit 3 for details.

3. TREATMENT PROCESS

Issues Identified: ☑ No If yes, please check below and add additional information in Issue Description.

- ☐ O & M procedures not followed
- ☐ Unprotected by-pass in treatment process
- ☐ Inadequate disinfection
- ☐ Turbidity measurements out of range
- ☐ Filter/media contamination
- ☐ Raw water changes
- ☐ Treatment added/changed
- ☐ Interruption in treatment/power loss
- ☐ Recent installation/repair
- ☐ Backwashing increase (algae)
- ☐ Coagulant added during filtration
- ☐ Vandalism/Tampering
- ☐ Change in flow rates/dosages/coagulants
- ☐ Other: _____

Issue Description:

The collective findings of this assessment indicate treatment operations did not have an impact on the TC+ event at SP #38 on June 6th, 2023. While a direct or indirect connection was not established, effective treatment performance is essential to mitigating microbial risks that may arise from source water contamination. Consequently, Brown and Caldwell conducted a site visit to the WTP and interviewed staff with the goal of assessing opportunities to improve the effectiveness of key treatment barriers that can impact the microbial characteristics of the finished water. The assessment also considered the findings of the October 2023 USEPA Inspection Report and built upon those findings to assess practices that could impact the effectiveness of treatment barriers in place. As a result of the WTP assessment, a number of deficiencies were identified that require corrective measures. Areas for further investigation were also identified. The identified issues and recommended corrective measures are discussed in further detail in Exhibit 4.

4. DISTRIBUTION SYSTEM

Issues Identified: ☑ No If yes, please check below and add additional information in Issue Description.

- ☐ Illegal use of hydrants
- ☐ Improper surge control
- ☐ Low disinfectant residual
- ☐ Known bio-film accumulation
- ☐ Unprotected cross-connection
- ☐ Improper operation of gate valves
- ☐ Booster pump failure/repair
- ☐ Backflow maintenance
- ☐ Leaks
- ☐ Low flow
- ☐ Main breaks
- ☐ Power loss
- ☐ Flow reversal
- ☐ Dead end
- ☐ Valves exercised to direct flow
- ☐ Low pressure/loss of pressure (<20 psi)
- ☐ Operation of isolation valves resulting in breakage
- ☐ Flushing of fire hydrants/blow-offs
- ☐ Improper operation of air-relief/air-vacuum valves
- ☐ Installation of new mains/construction activity
- ☐ Fire-fighting event/sheared hydrant
- ☐ Standing water/debris in valve vault
- ☐ Other: _____

Issue Description:

Based on the collective findings of the review of system hydraulics and other monitoring data, distribution system activities are not believed to have played a contributing role in the TC+ result at SP #38 on June 6th, 2023. It is noted, however, that related improvement opportunities have been identified for further investigation or corrective actions in Exhibit 2 (Sampling Point) and Exhibit 6 (Storage Tanks). Refer to Exhibit 5 for further details.

5. STORAGE TANKS

Issues Identified: ☑ No If yes, please check below and add additional information in Issue Description.

- ☐ Low disinfectant residual
- ☐ Lack of maintenance/cleaning/inspection
- ☐ Standing water/debris in control vault
- ☐ Tank design issues (overflow, vent, hatch, screen size, etc.)
- ☐ Unauthorized access/signs of vandalism
- ☐ Evidence of contamination from animals/insects
- ☐ High flows through tank (main break/fire event)
- ☐ Sample taken when tank at low-level mark
- ☐ Incorrect operation of level control valves/altitude valves/related appurtenances
- ☐ Deterioration, rust, holes, or other breaches in vent, overflow pipe, access hatch, screens, ladders, etc.
- ☐ Other: Refer to Exhibit 6 for a summary of observations and recommended corrective measures
- ☐ Water age/inadequate turnover
- ☐ Unaddressed inspection findings
- ☐ Recent work on tank
- ☐ Hatch not sealed
- ☐ Tank(s) out of service
- ☐ Power loss
- ☐ Compliant mesh screen properly installed

Issue Description:

Of the three remote storage tanks operated by RBUSD, the avenue U tank was determined to be the only one that could potentially have an impact on water quality delivered to the vicinity of SP #38 under normal operating conditions. Furthermore, based on the collective findings of the review of system hydraulics and TC monitoring data, the Avenue U storage tank operation is not believed to have played a contributing role in the TC+ result at SP #38 on June 6th, 2023. While a direct or indirect impact on the TC+ result at SP #38 is not indicated, a site visit was conducted to review the condition and operational configuration of this facility. During this inspection, manual sampling and testing indicated favorable chlorine residuals were being maintained. However, a number of operational deficiencies were identified that require corrective measures. Refer to Exhibit 6 for details of the observations and recommended corrective measures.

6. SOURCES

Issues Identified: ☑ No If yes, please check below and add additional information in Issue Description.

- ☐ Damaged pitless adaptor
- ☐ Well flooded/run-off inundation
- ☐ Missing/damaged grout seal
- ☐ Recent work on well pump
- ☐ Ground slopes towards well
- ☐ Recent heavy rainfall
- ☐ Used for backup/emergency
- ☐ Evidence of animals near source
- ☐ Water quality issue with supplier
- ☐ Defective/damaged/missing well cap/well seal
- ☐ Damaged/missing/unscreened vent
- ☐ Source(s) added/removed
- ☐ Unprotected opening in pump/pump assembly
- ☐ Low disinfectant residual from supplier
- ☐ Improper development/poorly maintained spring box
- ☐ Well pit with standing water/evidence of flooding
- ☐ Disturbances near well (sewer/source water spill)
- ☐ Source water system *E. coli* positive
- ☐ Damaged well casing
- ☐ Unapproved source(s)
- ☐ Change in source(s)
- ☐ Algal blooms
- ☐ Well pump-to-waste
- ☐ Unprotected Cross Connection
- ☐ Unauthorized access/ vandalism
- ☐ Other: _____

Issue Description:

A site visit was conducted to Well #14 to inspect the well for visible potential sanitary defects and to review well isolation protocols. No readily visible defects were noted. Refer to Exhibit 7 for pertinent details and a summary of well isolation protocols.

Section B – Corrective Action Taken or to be Taken: For any possible issues not already being addressed, use this space to describe corrective actions completed at the time of this assessment, a proposed timetable for any corrective actions not already completed, and any interim measures the Public Water System plans to implement prior to the completion of any corrective actions, including specific milestone dates.

☐ Check if PWS did not find any causes for the contamination.

The assessment did not identify a direct or indirect cause of the RTCR MCL violation. However, based on the collective findings of all data reviewed, it was deduced that contamination during the sampling of SP #38 is the most likely cause. While a direct/indirect contributing cause was not identified, several conditions were observed that require corrective measures. Considerations for supplemental investigations were also identified to assess the feasibility of further enhancing protocols and operational performance. Recommended corrective measures, together with implementation timeframes, are identified in Exhibits 2 to 6 for the respective areas of the assessment.

Section C – Unaddressed Significant Deficiencies: Are there any unaddressed significant deficiencies? If so, describe:

The assessment did not identify a direct or indirect cause of the RTCR MCL violation. However, based on the collective findings of all data reviewed, it was deduced that contamination during the sampling of SP #38 is the most likely cause. While a direct/indirect contributing cause was not identified, several conditions were observed that require corrective measures. Considerations for supplemental investigations were also identified to assess the feasibility of further enhancing protocols and operational performance. Recommended corrective measures, together with implementation timeframes, are identified in Exhibits 2 to 6 for the respective areas of the assessment.

Certification: I, the owner or responsible party for the public water system named above, hereby certify that all statements provided above are true and accurate to the best of my knowledge.

Print Name: _____ Title: _____

Signature: _____ Date: _____

Phone Number: _____ Email: _____

NOTE: Form to be completed based on data and documents available to the Public Water System and submitted to the DEP district or DOH county office which has jurisdiction of the water system as soon as practical, but **no later than 30 days** after learning that the PWS has triggered this Level 2 Assessment. Failure to conduct the Assessment and complete corrective actions within these 30 days may result in monthly monitoring. **A Level 2 Assessment is triggered if there is an *E. coli* MCL violation or a second Level 1 trigger in a rolling 12-month period. For systems on annual monitoring, a Level 1 trigger in 2 consecutive years triggers a Level 2.**

DEP/DOH Official Use Only

DEP/DOH Reviewer: _____ PWS corrected problem(s): _____

Level 2 Assessment Sufficient: _____ Consultation Date: _____

Corrective Action Plan Approved: _____ Approved with changes (attached): _____

Revisions Required: _____

Comments

Exhibit 1. Introduction

Exhibit 1 - RTCR MCL Violation Background

On July 24th, 2023, Riviera Beach Utility Special District (RBUSD) received notification from the Florida Department of Health (FDOH) informing them of possible Revised Total Coliform Rule (RTCR) related violations, including an *Escherichia coli* (*E. coli* or EC). Maximum Contaminant Level (MCL) violation. The scope of the violations includes the failures of RBUSD to follow the regulatory protocols required by the RTCR. This Level 2 Assessment reviews potential factors that may have contributed to those violations and provides recommended corrective measures to reduce the risk of recurrence. The triggering conditions for the violations involve activities associated with RBUSD's response to the following compliance events:

1. Sample Point #38 (SP #38, located near 4822 Caribbean Blvd) — actions associated with RBUSD's response to a total coliform positive test (TC+) result for a routine distribution system sample collected on June 6th, 2023.
2. Raw Water Well #14 — actions associated with RBUSD's response and clearance protocols associated with the triggered monitoring TC+ test result for the sample collected on June 27th, 2023.

A summary of the triggering conditions, along with the findings and recommendations of the Level 2 Assessment, are provided below and in attached Exhibits 2 to 7.

The RTCR requires the preparation of a Level 2 Assessment in response to an MCL violation to investigate contributing factors and recommend corrective measures. The focus of the Level 2 Assessment is on the elements of the system that are directly pertinent to the noted violations and are not intended to represent a comprehensive performance review of the water supply, treatment, and transmission system. Consequently, the focus of this assessment centers on factors that could have a bearing on the SP #38 and Well #14 violations. The RTCR Level 2 Assessment Florida Department of Environmental Protection (FDEP) Form was employed and has been augmented with supporting exhibits where noted.

Sample Point #38 – near 4822 Caribbean Blvd.

On June 6, 2023, RBUSD collected eight (8) routine distribution samples, one of which was taken from SP #38. The following day, on June 7, 2023, the lab notified the RBUSD that SP #38 had tested positive for total coliforms (TC+) and (EC+).

RTCR Mandatory Response

Under the RTCR, in response to a TC+ result from a routine distribution system monitoring site, the RBUSD is required to:

1. Notify FDOH within 24 hours of receiving notification of the TC+ result.
2. Collect three (3) repeat samples from SP #38, as well as two (2) repeat monitoring samples located within five (5) service connections upstream and downstream (i.e., one sample each) of SP #38.
3. Conduct triggered source water monitoring, as required under the Groundwater Rule (GWR) of each raw water well in service when the TC+ sample was collected.

RBUSD Response and Area of Uncertain Water Quality

RBUSD re-sampled all eight (8) routine monitoring locations (including SP#38) on June 8th, 2023 (within 24 hours of the lab notifying them of the TC+ result at SP#38). However, the required upstream and downstream repeat samples within five (5) service connections were not collected, FDOH was not notified, and triggered raw water monitoring required under the GWR was not conducted.

Although all eight (8) re-sampled sites yielded negative TC results, the failure to conduct repeat samples upstream and downstream, as required under the RTCR, constituted an MCL violation that is subject to Tier 1 Public Notice (PN), which includes a system-wide Boil Water Order (BWO), within 24 hrs. The mandatory Tier 1 PN was not issued by RBUSD until January 19th, 2024. The other noted procedural missteps resulted in additional violations that underscore the need to improve procedures, systems, communication, and training to minimize the likelihood of future recurrence.

Figure 1 below summarizes the monitoring results conducted on June 6th, 2023, and a general characterization of the system hydraulics that indicate the likely area of uncertain water quality due to TC+ at SP#38. This figure, which was excerpted from supplemental information submitted to FDOH on February 14th, 2024, demonstrates that the zone of uncertain water quality resulting from the failure of RBUSD to collect repeat samples from the appropriate locations is limited to the homes highlighted in the figure.

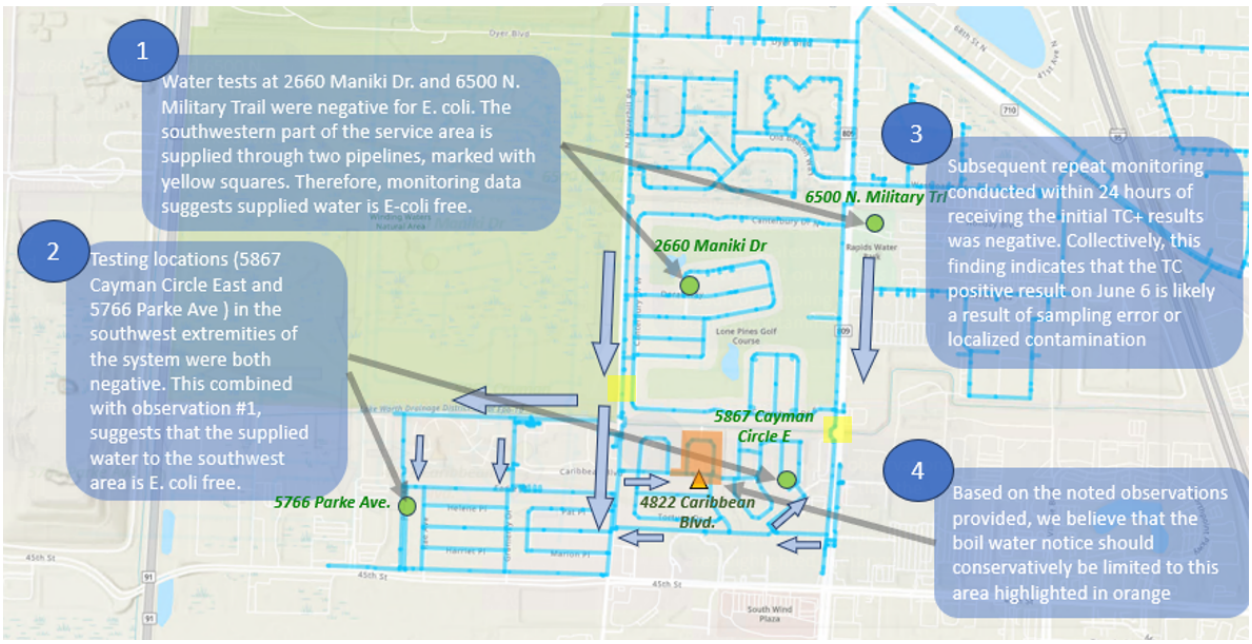

Figure 1. Directional flow of water at the southwestern part of RBUSD's distribution system. The highlighted area represents the predicted impacted area of the contamination event.

Additional considerations based on hydraulic modeling indicate that other areas in the system would not have been affected due to water flow directions (see Figure 1). Furthermore, the other seven (7) sites within the distribution system collected on the same day (June 6th, 2023) tested negative for TC and EC. Upon re-sampling on June 8th, 2023, they continued to show negative results, indicating that the impacted area was contained within SP #38 (near 4822 Caribbean Blvd). Ultimately, RBUSD failed to take the necessary steps to alert FDOH and adhere to the required testing protocols that follow a positive TC and EC sample. As a result, RBUSD incurred violations, necessitating a Tier 1 PN.

Well #14

Well #14 is located south of Blue Heron Blvd and west of Avenue 'H' W. (see Figure 2). On June 27th, 2023, lab samples collected from Well #14 tested positive for TC and EC.

Figure 2. Well #14

RBUSD was required to take the following steps in response to the TC+ result for Well #14:

1. Notify FDOH of the test result within 24 hours of being notified of the TC+ result and solicit their guidance regarding the necessary steps as well as the scope and timing of public notification that may be required.
2. Remove and isolate the well from operation while inspecting it to identify potential sanitary hazards.
3. Implement corrective measures to address identified defects.
4. Bacteriologically clear the well by purging the developed flow to waste while conducting repeat sampling that produces five (5) negative TC test results within 24 hours.

Upon notification, RBUSD took steps to shut down Well #14 immediately and removed it from service, conducted an inspection to identify potential defects, and retained the services of a well drilling contractor to implement corrective measures. Maintenance work was conducted from July 20th,2023, and completed by July 25th, 2023. To clear the well for service, staff collected seven (7) water samples over a four-day (4) day period on August 8th, 2023, which yielded negative results for TC and EC, leading to the reinstatement of Well #14 into service on August 23rd, 2023. While aggressive steps were taken initially to remove the well from service, inspect for potential sanitary defects, and take corrective measures, RBUSD failed to comply with the following requirements:

1. Notifying FDOH within 24 hours of initially becoming aware of TC+ and taking action to issue public notification based on guidance received.
2. Collecting clearance samples within the required 24-hour period.

Exhibit 2. Sampling Sites

Exhibit 2 – Sampling Sites

A site visit to inspect SP #38 (near 4822 Caribbean Blvd) was conducted on February 22nd, 2024, to perform the associated component of the Level 2 Assessment. The following individuals participated in the site visit:

1. Melvin Pinkney (RBUSD WTP Manager
2. Margie Deberry (RBUSD Compliance Manager)
3. Swan Allen-Davis (RBUSD Lab Tech)
4. Samantha Ducasse (RBUSD Compliance Technician)
5. Nigel Grace (Brown and Caldwell)
6. Charmane Gabriel (Brown and Caldwell)

During the site visit, SP #39 was also inspected due to similarities in configuration and its hydraulic location, which is more distal relative to SP #38. Both sites are among the routinely monitored distribution system's microbial sample collection sites under the RTCR. Refer to Figure 1 below for SP #38 and SP #39 locations relative to the Water Treatment Plant (WTP) and all other monitoring sites. Other routine monitoring sites that were also sampled on June 6th, 2023 (the date SP #38 tested positive for total coliforms) are also highlighted in Figure 1. SP #38 is located at the southwesternmost extremity of the water distribution system, specifically within Grammercy Park, an unincorporated part of Palm Beach County.

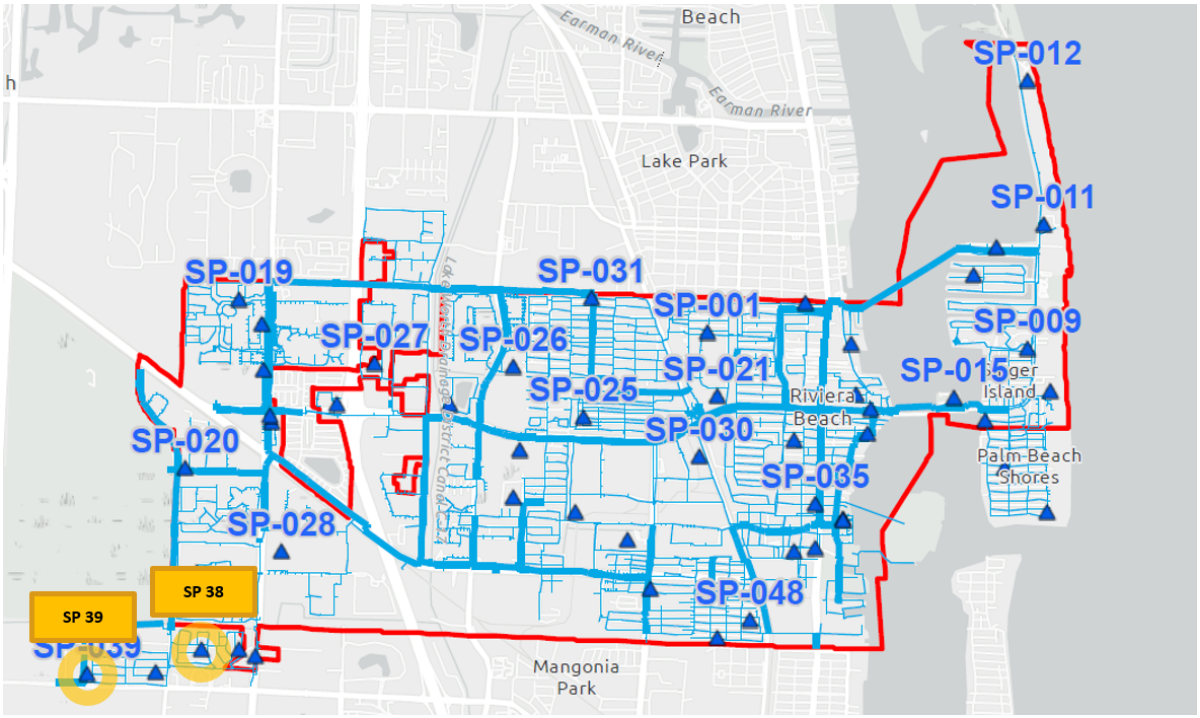

Figure 1. Sampling Sites within RBUSD

As noted in the introductory background of this Level 2 Assessment, SP #38 is located within a residential subdivision at a hydraulic extremity of the system and is supplied by two transmission mains. The configuration of these mains serves to increase water age further as it travels from the transmission mains to the area near SP #38. Figure 2 shows the average flow directions from the

transmission corridors leading into the vicinity of SP #38. Flushing may be used as a method of increasing the turnover of water in this area. However, RBUSD staff noted that flushing can be challenging due to inadequate stormwater drainage in the area.

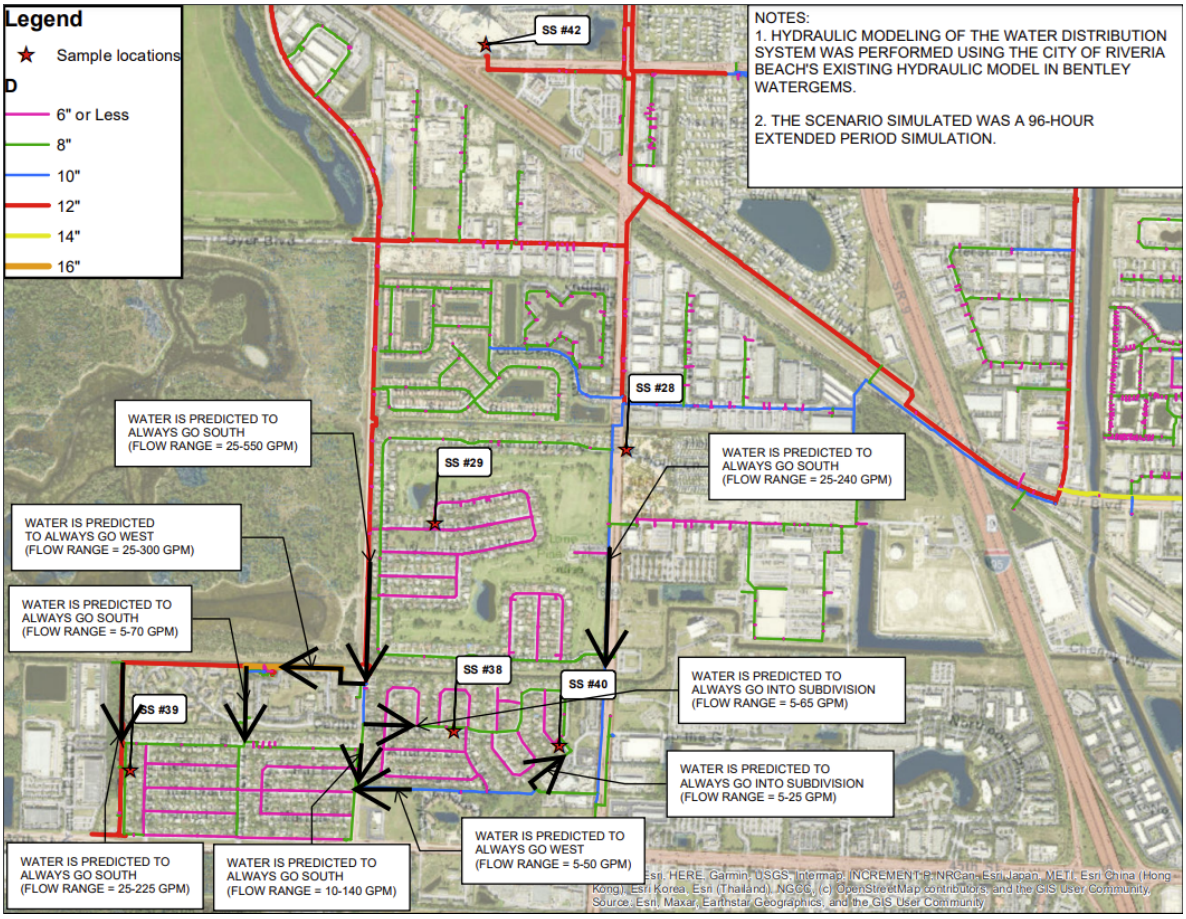

Figure 2. Initial hydraulic modeling results of water flow around SP #38

The inspection involved a review of field conditions, site-specific factors that could impact water quality, and sample collection protocols. The water sampling sites are located in locked boxes to protect the smooth-nosed spigot from environmental and human/animal contact. RBUSD staff noted that ants and small insects sometimes enter the boxes, prompting sampling staff to inspect sampling stations to detect and remove insects prior to collecting samples. During the visit to the site, a dog approached the area and attempted to interact with the water flowing from the spigot while the lab tech was demonstrating its operation. Staff quickly intervened to remove the dog and close the protective box around the spigot, recognizing the potential contamination risk posed by the dog's interaction with the water. Sampling demonstration procedures continued once the dog was safely removed. The laboratory technician confirmed that such an encounter was not uncommon. The staff is aware of animals that may approach them during testing, and they follow proper procedures to remove any potential contamination risk promptly. Testing only proceeds once the risk, such as the presence of animals, is effectively mitigated. Refer to Figure 3 for a photo of SP #38 with the protective box opened.

Figure 3. Photo of SP #38

SP #38 is situated within approximately 20 feet of a fire hydrant (refer to Figure 4) and is reportedly tapped directly into the distribution water main via a 2-inch tap that's reduced to a 1-inch feed line to the SP. Subsequent to the site visit, RBUSD furnished a GIS map to the consultant's team to assess the connection points to SP #38. However, the map did not depict SP #38 to be positioned where it was observed in the field, and water main connection details were unavailable from the GIS maps. Specifically, RBUSD compliance staff indicated that the water main is believed to be in the roadway; however, the GIS map indicated that the water main is located in the unpaved shoulder. Furthermore, no pavement cuts were observed in the roadway at locations that would be expected for a recently installed connection to the water main.

Figure 4. Proximity of SP #38 to Fire Hydrant

During the June 6th, 2023 monitoring event, the observed chlorine residual collected from SP #38 was lower than samples collected from nearby routinely monitored sites supplied from the same transmission mains. It was recommended that the actual connection of the SP to the water main be verified. RBUSD took immediate action to uncover the sample line and confirmed that it was appropriately installed on the water main (note – the sample line for SP #39 was also uncovered and verified to be appropriately installed on the water main).

Findings and Recommendations

Readily observable elements of SP #38 appear to be appropriately installed and well-suited for its use as a routine RTCR monitoring location. The area was free of visible conditions, indicating a potential sanitary hazard that requires corrective measures. Consequently, no permanent condition was observed that would indicate an increased vulnerability to contamination of the sampling site. Since the inspection was conducted over eight (8) months after the TC+ sampling event on June 6th, 2023, observed conditions may not represent the field conditions that existed at the time. However, the site visit identified the following areas for additional investigation:

1. Update the GIS record to align with actual field conditions (within 60 days).
2. Further assess the need for and approach to periodically flushing the area, with the goal of improving the water turnover in the area (within 60 days).
3. Conduct limited sampling for typical nitrification indicators (nitrite, nitrate, pH, alkalinity, and free ammonia) near SP #38 to determine if nitrifying activity could impact residual levels (within 60 days).

Exhibit 3. Sampling Protocol

Exhibit 3 – Sampling Protocol

The USEPA Region 4 conducted an inspection of the RBUSD water system during a site visit that was conducted between October 16th and 17th, 2023. As a result of the inspection, an important RTCR deficiency noted was the lack of a written sampling plan that addressed the varied requirements of the rule. The inspection findings were documented in an Inspection Report that was provided on November 21st, 2023. Since then, RBUSD has prepared a draft Sampling Plan that addresses sample collection, schedule, repeat sampling, chain of custody, communication enhancements, public notification requirements, triggered monitoring, Level 1/Level 2 assessments, other pertinent decision diagrams, and other relevant elements to align with utility best practices. A draft of the updated standard operating procedures (SOPs) was submitted to USEPA on February 29th, 2024, as part of a mandatory response to the findings of the Inspection Report. In its USEPA submittal, RBUSD noted that the draft report will be finalized once the suitability of the proposed locations of repeat sampling sites is confirmed. Upon receiving comments from the EPA, the updated Sampling Plan will be submitted to FDOH for review and comment, following which approval is anticipated once comments are appropriately addressed.

Brown and Caldwell did not conduct a formal review of the draft Sampling Plan but focused on observing the typical protocols employed by RBUSD staff involved with sample collection. The site visit during which the sampling protocols were discussed and observed was conducted on February 22nd, 2024. The findings and recommendations summarized below are intended to build upon and complement the SP #38 inspection findings presented previously in Exhibit 2 (see for the list of attendees). It is noted that the RBUSD staff member who collected the sample from SP #38 on June 6th, 2023, is no longer employed with RBUSD, so an opportunity did not exist to interview or observe the practices of the staff involved at the time. Additionally, the site visit did not align with a routine sampling event, so the reported protocol was based on a combination of feedback received from the sampling tech in response to questions and visual observations of various elements of the typical sampling method employed.

Generally, the routine RTCR sample collection protocol involves inspection of the locked sampling station and smooth-nosed spigot for visible signs of potential contamination, followed by swabbing the exterior of the spigot, and flushing the spigot for approximately 2 to 3 minutes, after which the flow rate is reduced to a steady/uniform stream prior to sample collection. The sampling tech utilized gloved hands and exercised due care in sample collection efforts. There were no observed deficiencies that would indicate any systemic vulnerability to contamination due to the sampling methods employed. However, due to natural variability in environmental and human factors, there is always a risk that a TC+ result is due to contamination, either during sample collection or subsequent handling in the laboratory. Particularly, when considered in light of hydraulic factors, other upstream routine monitoring sites in reasonably close proximity to SP #38 (though not within the required five connections upstream and downstream) and repeat sampling of SP #38 – all of which produced negative TC results – it is reasonable to conclude that localized contamination during or subsequent to collecting the sample on June 6th, 2023 may have been a potential factor for TC+ at SP #38.

While typical sampling protocols appeared to be generally aligned with appropriate practices, the following refinements were identified to help optimize the sampling protocols to site-specific factors:

1. Confirm Adequacy of Flushing Duration (within 14 days) - to gauge the adequacy of the typical 2 to 3-minute spigot flushing duration, monitor and record the water temperature at 1-minute intervals until the temperature stabilizes for two to three minutes. The period beyond which the water temperature ceases to change should be used as the minimum flushing duration for future sampling events. This test may only be conducted once to confirm/establish the adequacy of the required minimum flushing duration. Note that this duration may be somewhat different for each site.
2. In situations where visual indicators of potential localized contamination are observed, use a double-gloved approach that allows outer gloves to be removed prior to sample collection efforts.
3. For sites with a history of low chlorine residuals, consider establishing a second tier of repeat sampling sites to allow for expanded repeat sampling, if necessary.
4. Implement improvements resulting from follow-up recommendations presented in Exhibit 2 – Sample Sites.

Exhibit 4. Treatment Process

Exhibit 4 – Water Treatment Plant

The USEPA Region 4 conducted an inspection of the RBUSD water system during a site visit conducted between October 16th and 17th, 2023. The inspection conducted by the USEPA is most proximate to the incidents in June 2023 that triggered the RTCR-related violations. The USEPA inspection (Sanitary Survey) covered the full scope of treatment operations, the findings of which were presented in the Inspection Report that was provided to RBUSD on November 21st, 2023. In response, RBUSD initiated corrective measures and issued a formal response summarizing the completion status of corrective measures on February 29th, 2023. By reference, RBUSD's response (prepared by the RBUSD staff) to the USEPA Inspection Report is incorporated herein and supplemented by a targeted review conducted by Brown and Caldwell.

As part of the Level 2 Assessment, Brown and Caldwell conducted a site visit to the WTP on February 28th, 2024. During the visit, elements of the treatment process that could impact the efficacy and resilience of microbial protective treatment barriers were reviewed. The review focused primarily on the RBUSD's chloramination practices and turbidity removal performance. The RBUSD's WTP Manager participated in the site visit.

Under the 2006 USEPA Groundwater Rule (GWR), groundwater systems like RBUSD are given the option of implementing process improvements to achieve a 4-log reduction of virus (which translates to at least 99.99% reduction), which is typically achieved through a combination of filtration (2-log removal) and chemical disinfection (2-log inactivation). With this optional capability in place, triggered monitoring of raw water wells in response to TC+ distribution system results is eliminated because treatment is assumed to be capable of achieving a satisfactory microbial barrier. Since the passage of the GWR, South Florida utilities have been gradually implementing a 4-log disinfection capability. At present, RBUSD's WTP is not permitted under FDEP to achieve 4-log virus reduction capabilities and is therefore subject to triggered source water monitoring in response to any TC+ routine sample collected in compliance with RTCR.

Because the typical benchmarks for assessing the effectiveness of microbial barriers center on disinfection and filtration performance, those related capabilities and performance were the focus of this Level 2 Assessment. It is noted that since the WTP is not permitted for primary disinfection (i.e., 4-log virus reduction), the review was limited to documenting the consistency of secondary disinfectant residuals maintained at the point of entry, opportunities to improve overall practices, combined filtered water turbidity levels, and the results of finished water TC monitoring in the distribution system for June 2023 – the period when the violations occurred,

The RBUSD recently completed significant improvements (over $12 million) in the WTP that included the following major improvements:

1. Installation of a new sodium hypochlorite feed system to replace the old gaseous chlorine feed system.
2. Replacement of the ammonia feed system components, inclusive of feeders, piping, valves, and controls.
3. Installation of new online monitors to continuously monitor and record chlorine, ammonia residuals, and turbidity.

4. Comprehensive rehabilitation of eight (8) filters, including replacement of underdrains, media, controls, and, where needed, troughs, valves, and other appurtenances.
5. Installation of a new lime storage and slaker feed system intended to replace the old and functionally constrained existing units.
6. Installation of a new carbon dioxide feed system to enhance post-softening pH control.
7. Installation of a new dry polymer feed system.
8. Installation of new flow meters on the raw water influents to the lime softening process.
9. Other improvements aimed at addressing select deferred needs, including high service pumping, lime softening rehabilitation, and structural demolition of an unstable north chemical building.

This Level 2 Assessment did not contemplate a functional or performance review of all recent process improvements beyond the limited scope indicated. It is recommended that RBUSD conduct a comprehensive performance review to assess whether the improvements are being operated in a manner that aligns with their functional intent and to identify opportunities for improvement.

Relationship of WTP Performance to SP #38 MCL Violation

The analysis previously presented in Exhibit 1 demonstrated that there is no indication that the performance of the WTP had an impact on the TC+ result from SP #38 that occurred on June 6th, 2023. The following combined facts support this finding, which is illustrated in Figure 1:

1. Remote hydraulic extremity of SP #38 from the WTP (refer to Figure 1)
2. Seven (7) sample sites located between the WTP and SP #38, including one site in close proximity to the water treatment plant (2300 President Barack Obama Hwy), were also sampled on June 6th, 2023, and tested negative for TC.
3. Results of hydraulic modeling, coupled with monitoring data for nearby sites, demonstrate that the zone of uncertain water quality is limited to a few homes near SP #38 (refer to Exhibit 1).

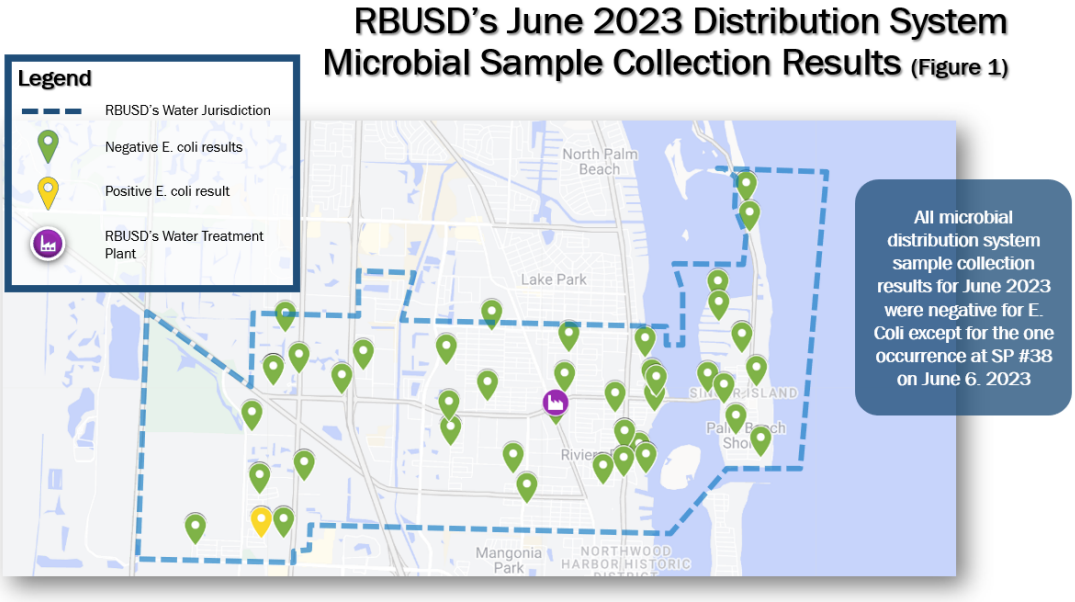

Figure 1. RBUSD's June 2023 Distribution System Microbial Sample Collection Results

Finished Water Quality

Figure 2 presents a plot of finished water total chlorine residual and turbidity, as well as distribution system TC levels in the distribution system, is provided for the month of June 2023. The chlorine residual and turbidity data plotted represent daily averages. Box and whisker plots are also provided, showing the statistical distribution of the turbidity and chlorine residual data sets evaluated for the review period.

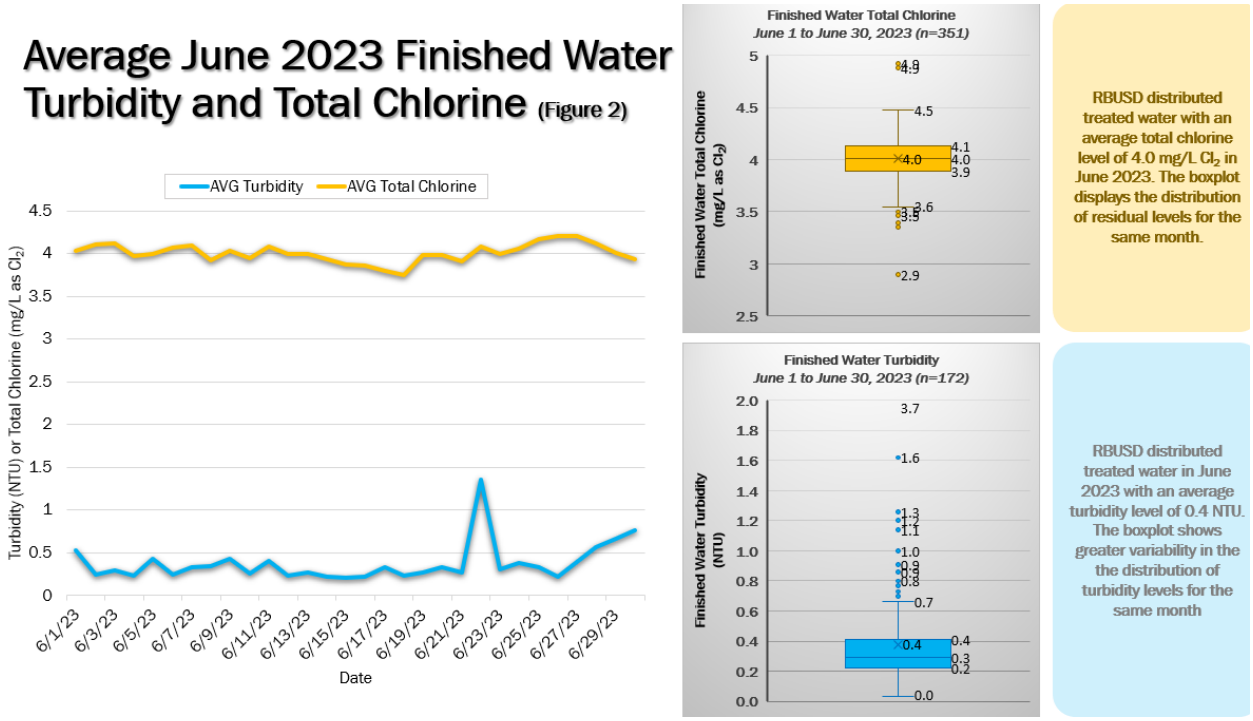

Figure 2. RBUSD's June 2023 Daily Average Finished Water Turbidity and Total Chlorine Levels

From the plot, the following is apparent:

1. The total chlorine residual levels leaving the plant remained fairly consistent, averaging approximately 4 mg/L. This residual level is favorable for maintaining a secondary disinfectant residual in the system. Note that to protect the system from contamination, a minimum combined chlorine residual of 0.6 mg/L is required to be maintained at the extremities of the system.
2. Turbidity levels showed more variability than chlorine residual, with a spike and increasing trend noted towards the end of the review period. Turbidity produced in lime softening plants is generally due to calcium carbonate particles generated in the softening process and subsequently breaking through the filtration process. While turbidity levels were generally within the typical range for much of the review period, further assessment of the potential cause of performance instability should be investigated further, and appropriate improvements should be implemented. It should also be noted that historically, elevated turbidity levels in the filtered water have resulted in an accumulation of calcium carbonate

deposits in the system, which has been the source of customer complaints and can impair the hydraulic capacity of the transmission system.

In Figure 3, the distribution TC monitoring results are overlaid on the finished water turbidity and chlorine residual results to graphically relate the key plant operating parameters to the observed microbial water quality in the distribution system. On June 6th, the date SP #38 produced a TC+ result, seven (7) other distribution sites were monitored, including the location near the WTP, and all system locations yielded negative TC results.

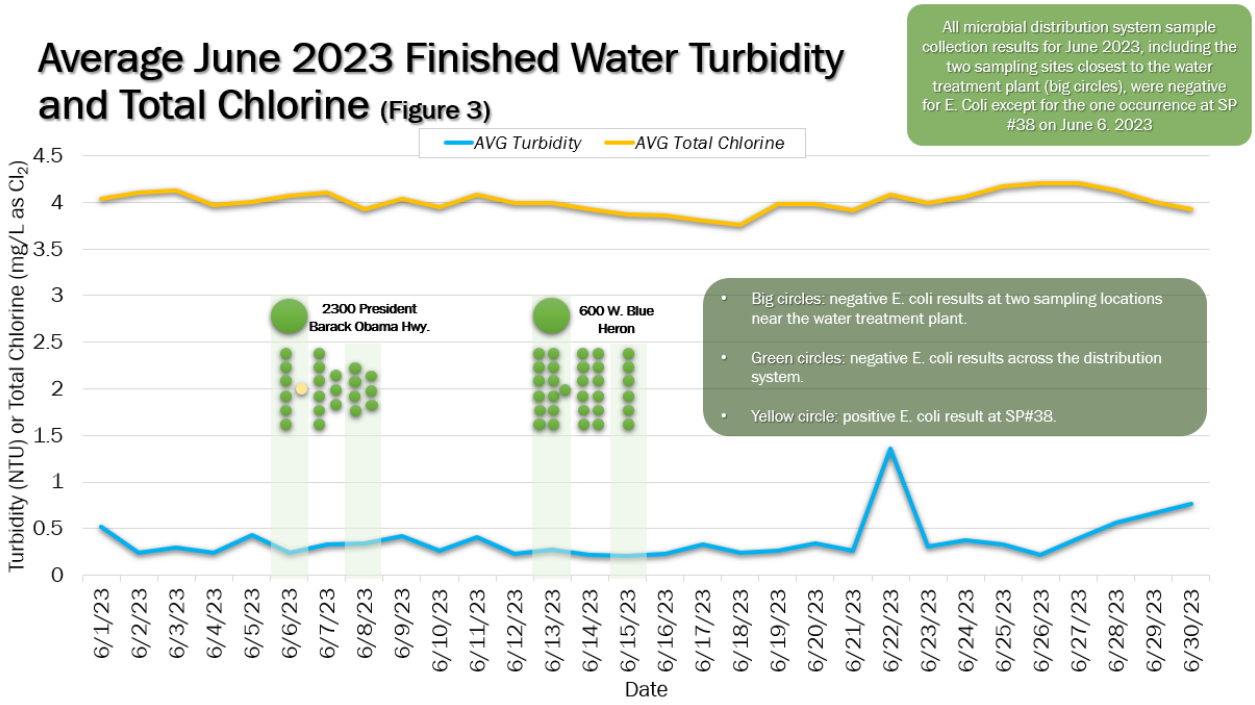

Figure 3. RBUSD's June 2023 Daily Average Finished Water Turbidity and Total Chlorine Levels with the Distribution System Microbial Sample Collection Results

WTP Chloramination Practices

The WTP is equipped to apply sodium hypochlorite (chlorine) and anhydrous ammonia (ammonia) at the following locations throughout the treatment process:

1. Raw water (chlorine) – intended to be used only for periodic maintenance purposes.
2. Raw water post air stripping (chlorine and ammonia) – intended to be an optional primary application to establish a chloramine residual through the lime softening and filtration processes.
3. Post-filtration clearwell (chlorine and ammonia) – intended to be a secondary dosing point to provide the RBUSD with the flexibility to adjust chlorine and ammonia applications in response to upstream process instability. However, this location is not well suited for long-term continuous use due to mixing challenges associated with the clearwell operation and connected high service pumping wetwell.

4. Miscellaneous chlorine trim locations (chlorine only) – supplemental dosing locations not intended to be normally used, but are available to give the RBUSD flexibility to adjust chlorine application points to respond to unanticipated changes.

During the site visit, the chloramination application point in use was the raw water post air stripping location. Effective chlorine and ammonia dose control practices were in place, as evidenced by the consistent total chlorine residuals maintained in the finished water. Applied chemical dosages are paced to deliver a setpoint dose based on metered raw water flows. Post injection residual is monitored manually on a typical 4-hour cycle. It is noted that online residual analyzers are available but were not functional at the time of the site visit. While the performance is effective in consistently producing the desired residual leaving the plant, operating without real-time continuous monitoring of dosing effectiveness gives the plant operating staff little time to detect and respond to a potential temporary interruption in chlorine and ammonia application before increasing the risk of unchlorinated water being released to the system. A review of the plant's daily operating records did not indicate the occurrence of such an incident. The manual monitoring on a 4-hour cycle of chlorine residual post application does not provide effective and timely feedback to detect and respond to excursions. This approach could result in unchlorinated water being produced for several hours before an operator detects the excursion and implements corrective measures. To mitigate this vulnerability, the following alternative approaches are recommended:

1. Maintain the functionality of post injection online residual monitors. These monitors should continuously report residuals to SCADA, trend results, detect excursions, and automatically notify operators of identified excursions. This is the preferred approach that is consistent with the design intent of the system. Manual sampling and testing should continue in tandem with continuous online monitoring.
2. If any element of the preferred approach is not achieved, plant staff should manually monitor residuals at the post injection locations no less frequently than every 30 minutes until functionality of the online instrumentation is restored.
3. Repair and return to service all online continuous residual analyzers to monitor real-time performance of chlorine and ammonia dosing performance. The system should be configured to report to SCADA, archive performance, and provide automatic operator notification of excursions.
4. The post-filtration application point should be maintained in an operationally ready state in the event post treatment chlorine trim is required. Given the potential challenges associated with the use of the post-filtration chlorine and ammonia application points, consideration should be given to a limited demonstration assessment with the goal of establishing guidelines for its temporary use should future conditions necessitate.

With these operating configuration and monitoring improvements, any unanticipated interruption of a chlorine and ammonia dosing point or performance excursion will: 1) reduce the risk of unchlorinated water being released to the system with operational interruption of a single dosing point and 2) significantly shorten the time to respond and make up any residual shortfall. The re-balancing of chlorine application between two dosing points could also potentially reduce overall chlorine demand and the formation of disinfection byproducts that are regulated under the USEPA Stage 2 Disinfectant/Disinfection Byproduct Rule.

General Observations

1. The monitoring of finished water chlorine residual and turbidity levels is conducted manually by an operator who periodically collects a sample from a spigot for analysis with results logged on daily sheets with handwritten records. The capabilities exist to continuously monitor and record finished water chlorine residual and turbidity data; however the available instruments were reportedly inoperable.
2. The use of handwritten records for important water quality data is inefficient and ineffective in that the data is not readily accessible, it is not available for routine trend analysis, timely detection of excursions, and is more prone to operator error. The use of manual sampling and analysis is a useful complement and back check for online monitoring capabilities.
3. A review of Monthly Operating Reports indicates daily volumes of backwash waste that are inconsistent with expectations and widely variable cumulative filter run times that are indicative of inconsistent filtration operations. Operations staff indicate that the inconsistent run times often result from limitations in available raw water supplies or receiving backwash water basin capacity. It was reported that a standardized filtration run time of 72 hours has been recently instituted in the plant.
4. An online finished water turbidity meter was observed to produce a result inconsistent with expectations, and the manually sampled data (see Figure 4). It is noted that this instrument is not relied upon for reporting purposes; however, if functioning as intended, it can provide useful early notification of turbidity excursion, performance trending, and an independent backcheck of manually recorded data.

Figure 4. MTOL+ Turbidity Meter

To mitigate these limitations, it is recommended that RBUSD assess the impediments to maintaining the operability of available monitoring equipment and implement required training, procedural, and

system improvements to achieve reliable and continuous monitoring, analysis, and archiving of key process parameters.

Summary of Improvement Recommendations

Based on the limited review of treatment operations, the following supplemental investigations and corrective measures are recommended:

Supplemental Investigations

1. Assess and demonstrate a split dosing approach that would support the development of operating protocols for applying chlorine and ammonia post softening, to be used in scenarios where interruption in the primary dosing location occurs. Where feasible, identify specific improvements to address identified limitations (120 days).
2. Review the filtration process with the goal of further assessing operational performance, constraints, and operational measures to mitigate with the goal of further stabilizing treatment induced turbidity breakthrough (90 days).
3. Conduct a process-wide performance review to assess whether the recent improvements are being operated in a manner that aligns with their functional intent and identify opportunities for improvement.

Recommended Improvements

1. Monitoring Instruments
    a. Restore the functionality of all chlorine analyzers and turbidity meters (30 days).
    b. Assess and address maintenance challenges that have impacted the reliability of monitors and implement corrective measures that may include training, material resources, staffing accountability, and other measures) (60 days).
2. Establish automated trending, excursion detection, and operator notification capabilities for all online chlorine residual and turbidity monitors.
3. Manually sample and record post injection chlorine and ammonia application on 30-minute cycles in situations when online residuals are not appropriately functional and calibrated.

Exhibit 5. Distribution System

Exhibit 5 – Distribution System

An analysis of distribution system hydraulics and TC monitoring results was presented in Exhibit 1, which indicates a limited zone of uncertain water quality in the immediate vicinity of SP #38. To complement the prior analysis, the Distribution System Manager was also interviewed as part of this Level 2 Assessment to determine whether any unusual events that occurred within the distribution system, on or immediately prior to June 6th, 2023, could potentially have a contributing role in the TC positive result at SP #38. The following summarizes the key points discussed:

1. Water Main Failure—There were no known water main breaks in the vicinity of SP #38.
2. Flushing Activities – There were no non-routine flushing activities conducted by RBUSD in June 2023. However, it is noted that this area is a part of unincorporated Palm Beach County and RBUSD Distribution Manager reported that the County Fire Department occasionally conducts fire hydrant testing in the area and does not coordinate with RBUSD. Consequently, the possibility of flushing activities that RBUSD was unaware of exists.
3. Leakage Repairs – There were no service line repair activities in the month of June 2023. The only reported service line leakage repair activity in the area occurred in October 2023.

While there is no direct link between system activities and the RTCR MCL violation at SP #38, a number of related improvement opportunities were identified in other exhibits that could impact distribution system operations. This includes;

- Exhibit 2 (Sampling Sites) - further assess flushing needs in the area and conduct nitrification testing to determine the potential cause of depressed residuals in the vicinity of SP #38,
- Exhibit 5 (Storage Tanks) - improve the monitoring of chlorine residuals and control of booster chloramination dosing activities.

Resources to archive and retrieve system operation and maintenance data and work activities were found to be generally lacking and in need of improvement. RBUSD is in the process of implementing a GIS based system called iWater. This is a software tool that can integrate work order/maintenance activities, customer complaints, water quality and other spatial data into a single platform that can handle archiving, reporting, work order and data management. Once implemented, it is anticipated that the RBUSD's asset management capabilities and its ability to quickly determine the operational status of its system will be significantly upgraded.

Exhibit 6. Storage Tank

Exhibit 6 – Avenue U Storage and Repump Station

RBUSD owns and operates the following three distribution system storage and repump stations: 1) Avenue C Storage and Repump Station (1.0 mgal capacity); 2) Singer Island Storage and Repump Station (1.0 mgal capacity); and 3) Avenue U Storage and Repump Station (1.0 mgal capacity). A map of the distribution system showing the location of each storage facility relative to SP #38 and the WTP is shown below in Figure 1.

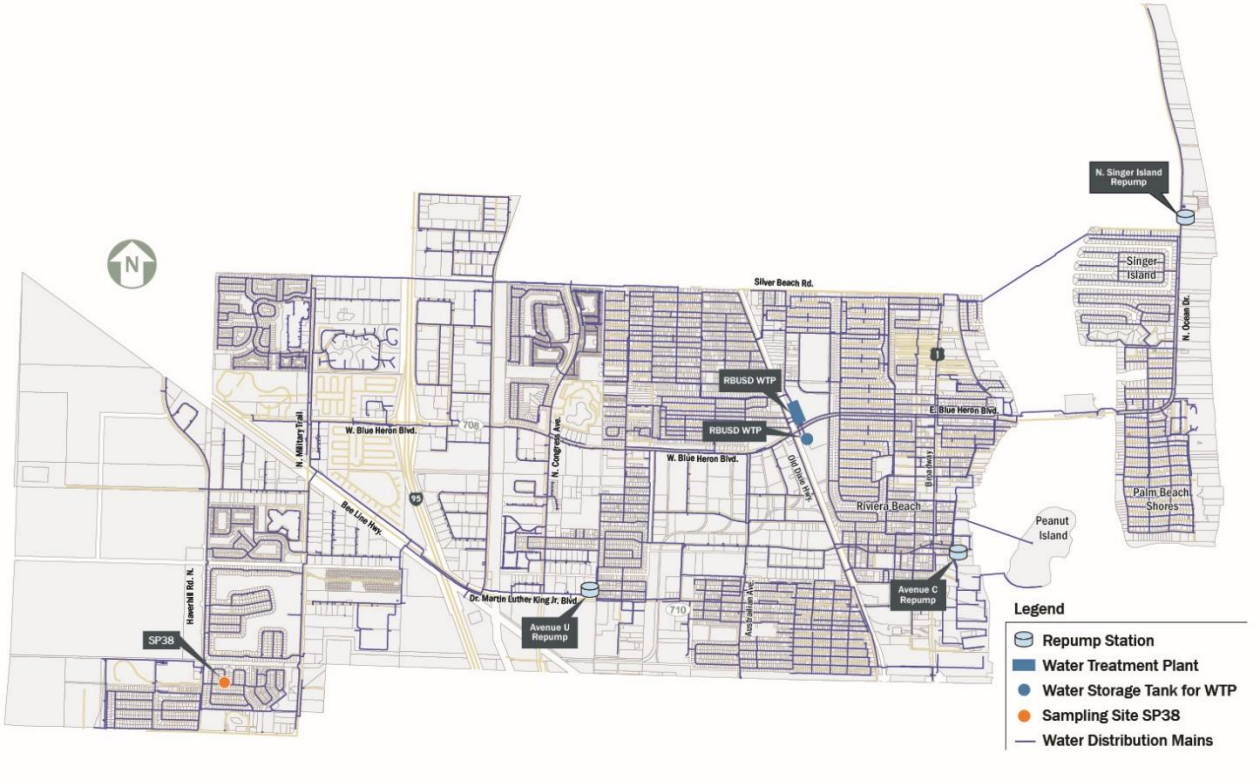

Figure 1 RBUSD Distribution System Map

Based on the configuration of the water distribution system, the only storage/repump facility capable of directly impacting the quality of water delivered to SP #38 is the Avenue U storage/repump facility. Consequently, this facility is the focus of this component of the Level 2 Assessment. Brown and Caldwell conducted a site visit on February 22nd, 2024 to inspect the facility. The inspection was limited to readily observable conditions that could be viewed from ground level without climbing structures, entering confined spaces, opening electrical cabinets, or activating equipment. Key findings from the site visit are summarized below:

1. Ground Storage Tank – the tank appeared to be in reasonably good condition, showing no visible signs of deterioration. Each overflow was fitted with screens – one readily visible coarse screen and an interior mounted (not visible) 24 mesh fine screen. The tank is fitted with an internal mixing system designed to prevent thermal stratification and promote uniform water quality throughout the stored volume. A water sample was collected from the discharge of the tank and tested for total chlorine residual, which was found to be 4.4 mg/L.
2. Booster Chloramination System – the chemical feed systems for boosting chloramine residual levels were reviewed. The system is designed to apply chlorine and ammonia (delivered as

aqueous solutions) into metered inflow to the ground storage tank. Instrumentation is in place to monitor total/monochloramine residuals, as well as ammonia residuals. During the site visit, the residual monitoring equipment was inoperable, and the flow meter reading did not change throughout the duration of the visit and did not reflect the rate or units that would be reasonably expected. Furthermore, both chlorine and ammonia metering pumps were operating in manual mode and set to deliver low chemical feed rates. The observed conditions and operating modes indicate the need for corrective measures to establish an appropriate level of monitoring and controls required to maintain consistent performance.

3. Discharge Flow Meter – the discharge from the high service pumps is fitted with a venturi meter intended to monitor and report flows discharged from the Avenue U facility. The flow meter and associated instrumentation were observed to be inoperable and did not appear to have been maintained for a long time. Attempts by RBUSD staff to vent the sensor line (which is under system pressure) failed to produce any fluid flow, which indicates the line may be plugged.
4. Miscellaneous Observations – excessive vegetation growth was observed in the tank drain vault (used to receive various water streams intended to be discharged to waste) during the site visit. Chase water used for the operation of the residual analyzers represents a steady and continuous discharge into the tank drain vault that should be metered or otherwise estimated for proper accounting of authorized unmetered water demands that must be reported as part of RBUSD's Water Use Permit (WUP).

Recommended Corrective Measures

1. Repair and establish the functionality of all equipment necessary for residual monitoring, the automated control of chlorine and ammonia dose (i.e. chloramination control), and the remote reporting of operating data that has the potential to impact water quality (30 days).
2. Review and update the maintenance plan, training requirements and resource allocation to improve the reliability of water quality monitoring instruments (60 days).
3. Remove vegetation growth from the tank drain vault and implement ongoing maintenance to control regrowth (30 days).
4. Estimated authorized unmetered water use for water quality monitoring and include allowance in periodic reporting required by WUP (14 days).
5. Repair and restore the functionality of the pump station discharge flow meter and remote monitoring and archival of flows (schedule to be determined following assessment of repair needs and availability of replacement parts).

Photographs

The following photographs were captured on February 22nd, 2024, during the site visit to Avenue U.

Figure 2. Chemical Injection Vault

Figure 3. Fill and Flow Meter Vault

Figure 4. 12” Ductile Iron Pipe Watermain. Note: The water sample for total chlorine residual (4.4 mg/L) was collected from the discharge of the tank here.

Figure 5. Ammonia Sulfate Metering Pumping Skid

Figure 6. Chlorine Room with Hypo Pumping Skid and Hypo Tank

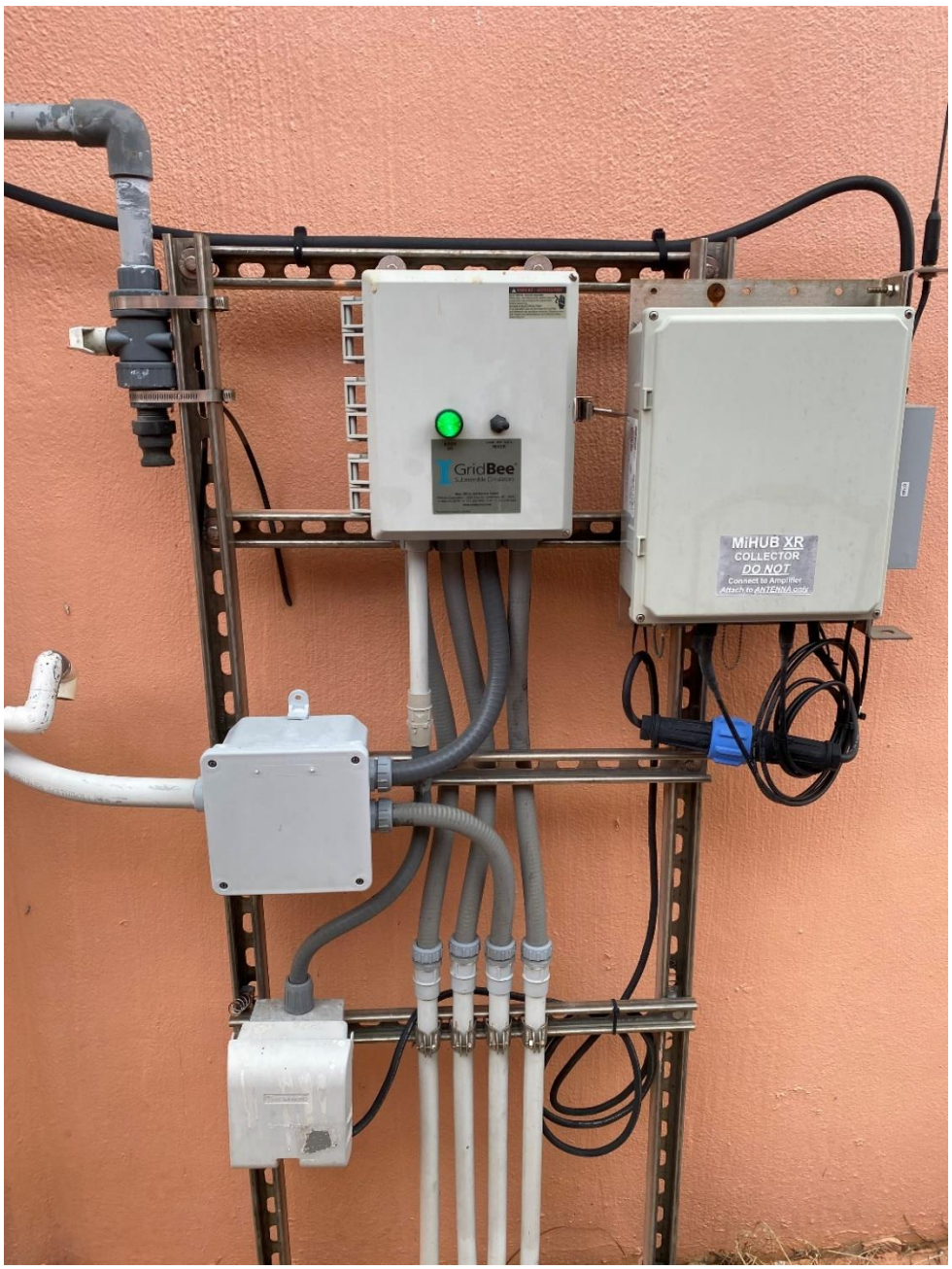

Figure 7. GridBee Tank Mixers Control Panel System

Figure 8. Vegetation Growth in the Tank Drain Vault

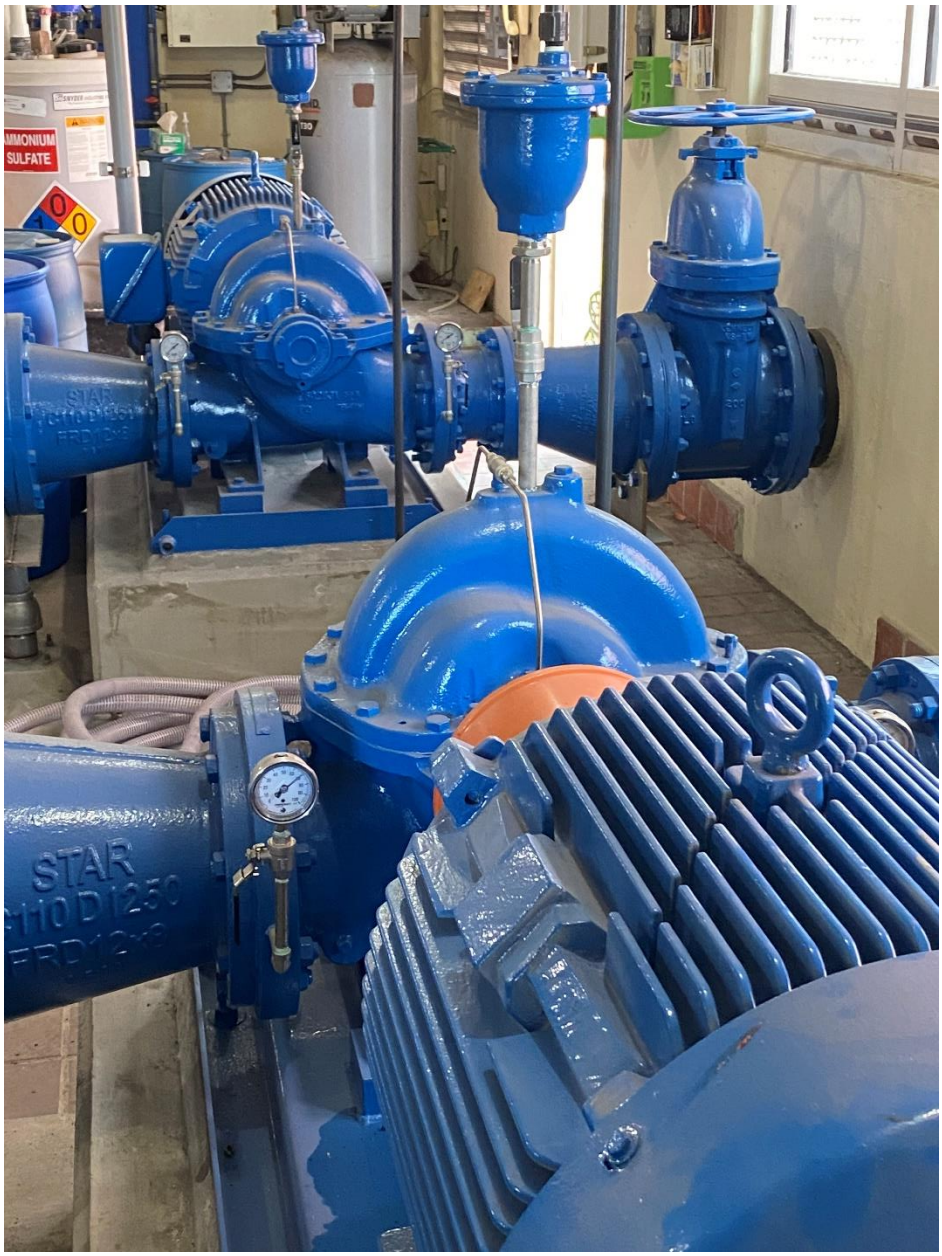

Figure 9. High Service Pumping Area

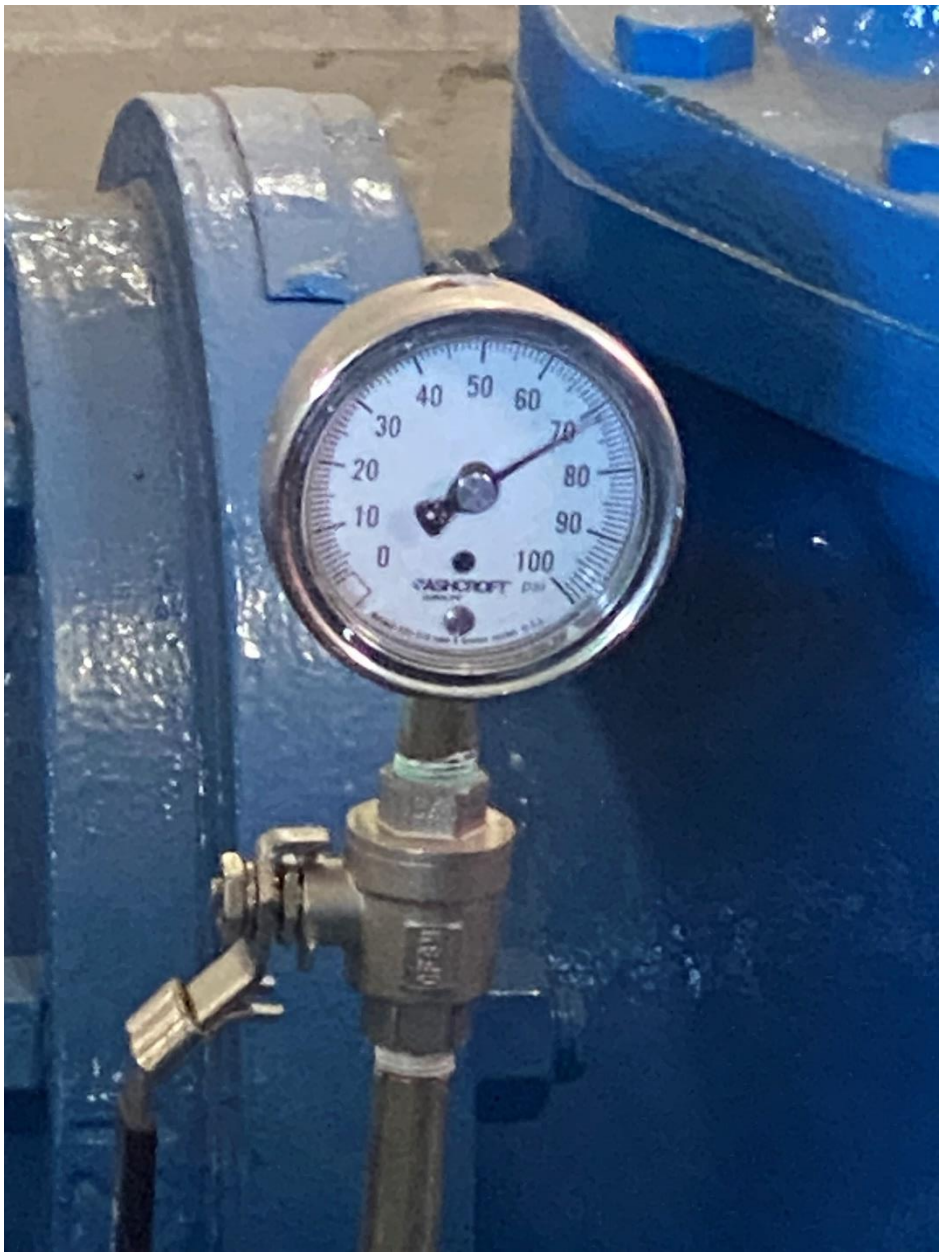

Figure 10. High Service Pump Discharge Pressure

Exhibit 7. Sources

Exhibit 7 - Well #14 Isolation Configuration

An inspection of Well #14 was conducted by Brown and Caldwell on February 22nd, 2024, during which the sanitary condition of the well was observed, together with the protocols for isolating the well when offline for inspection and bacteriological clearance. It is noted that the USEPA conducted an Inspection of Well #14 during facility inspections that occurred between October 16th and 17th, 2023 during which the only identified sanitary hazard for Well #14 was a hole in the well screen. This hole has since been repaired by RBUSD, as documented in a status report on corrective actions that was submitted to USEPA on February 29th, 2024. During Brown and Caldwell's subsequent inspection on February 28th, 2024, there were no observable conditions that are indicative of an ongoing potential sanitary defect.

It is also noted that the violations associated with the well and other incidents are due in large part to the failure of RBUSD to adhere to appropriate protocols in response to routine or triggered monitoring events. All procedural modifications are being addressed by RBUSD in an updated Sampling Plan that is currently under review by the USEPA and will be subsequently submitted to FDOH for review and approval. Consequently, a recommendation of this assessment is to conduct a downhole inspection of the well to determine whether any conditions exist that will increase the risk of contamination.

An important focus of this site visit was to review the well isolation protocols and identify opportunities for improvement. The RBUSD standard practice is to isolate any raw water supply well from the transmission system whenever a well sample tests positive for total coliforms. Other conditions that may trigger well isolation include removal from service for maintenance, bacteriological clearance, or other conditions requiring extended standby durations. A site visit to Well #14 was conducted on February 22nd, 2024, during which the isolation protocol was reviewed with WTP Operations Manager (Melvin Pinkney). The photographs below show the general configuration of Well #14 at the time of the site visit.

Figure 1. Well #14 Discharge Piping

The protocols and illustrations provided below are based on the feedback and observations received during the site visit. These steps were reported to be a typical protocol for all wells subject to isolation.

The City's routine practice upon receiving confirmation of a TC+ collected from a well sample is to isolate the well, inspect it for signs of potential sanitary defects, implement required maintenance/corrective measures, and then subject the well to approved protocols to bacteriologically clear it for return to service. The results of the observed sanitary defect on Well #14 and corrective measures taken were reported to FDOH and are not repeated herein.

The protocols used to isolate Well #14 from the raw water transmission system are summarized below. Refer to Figure 2 to visualize the well isolation steps indicated below.

1. Shutoff and lock out the well pump.
2. Close the main well isolation valve (refer to Figure 2).
3. Open the blow-off valve to allow horizontal alignment of well discharge piping to drain (evidenced by no discharge from blow off). Cessation of water discharge from blow off is used as an indicator of a tight seal in the closed well isolation valve (against a back pressure of approximately 20 psi in the raw water transmission main). During the inspection, isolation of Well #14 was demonstrated to be successfully achieved using this standard.
4. If isolation is not successfully demonstrated, the piping wye fitting and spool piece connecting the well to the transmission system may be removed, and the transmission end capped during well clearance protocols. This approach was not observed during the site visit.
5. Upon successfully isolating the well from the raw water transmission system, the well pump is activated, and all produced water is continuously discharged through the blow off connection.
6. Samples required for bacteriological clearance are collected from a sampling spigot located immediately downstream from the wellhead.

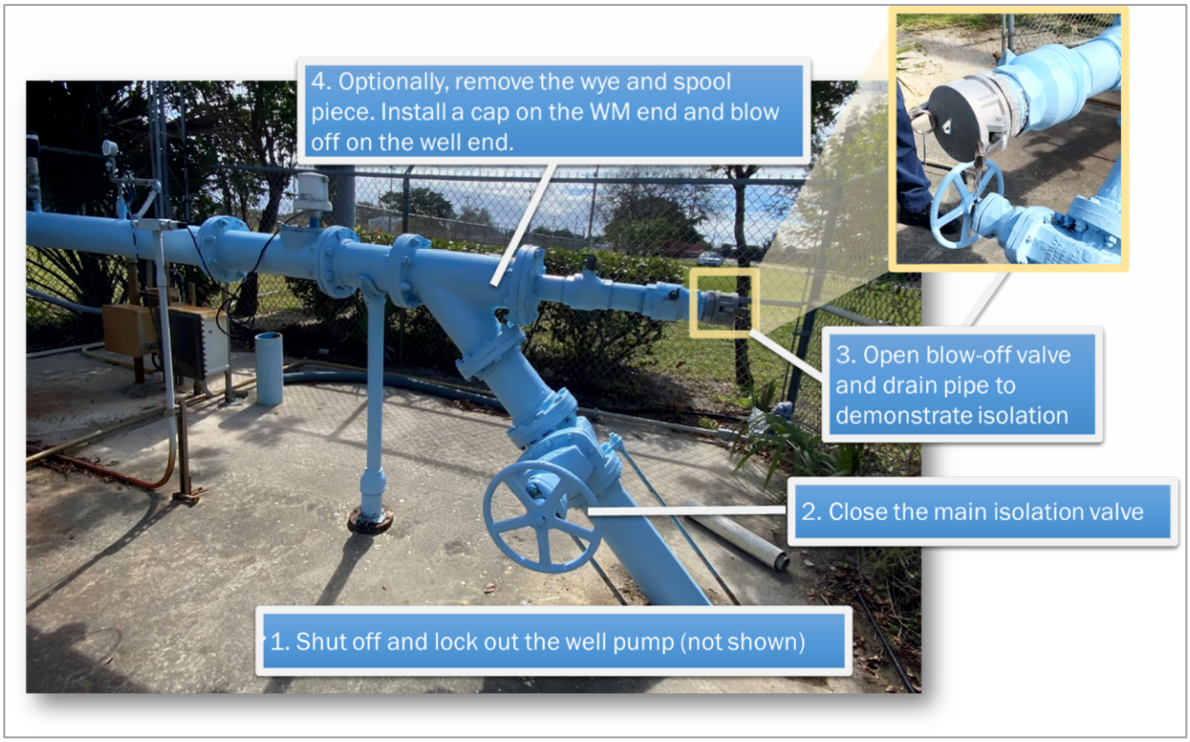

Figure 2. Major Well Isolation Elements

Isolation Improvement Considerations

Additional steps that may be taken to demonstrate and establish a record of well isolation effectiveness include the following:

1. Establish a written isolation protocol for each active raw water supply well. Submit to FDOH for review and comment (60 days).
2. Train staff involved in wellfield operations/maintenance in approved isolation protocols and required documentation (90 days).
3. Install a pressure gauge downstream of the transmission main isolation valve and document that the elevation corrected pressure upstream of the valve is consistently less than the downstream pressure during isolation (30 days).

Supplemental Investigation of Well #14

Because the inspection of the surface features of Well #14 did not indicate a probable cause of the TC+, it is recommended that further investigation be conducted to ascertain the condition of the well. To that end, it is recommended that a downhole investigation be conducted to assess the downhole condition and potential factors that may increase the risk of contamination. The investigation should include an initial video inspection, brushing the casing, purging, follow-up video survey while discharging pumped flow to waste, disinfection, and clearance. Upon reviewing the inspection findings, a determination may be made of whether any sanitary defects exist that require further remedial measures. Duration (60 days)