

Enclosure A
Revised List of Conditions October 30, 2015
CRMWD Big Spring Reclamation Facility

The following list of conditions **replaces** the conditions outlined in the May 29, 2015 letter from the Texas Commission on Environmental Quality (TCEQ) regarding the Colorado River Municipal Water District (CRMWD) Big Spring Regional Water Reclamation Project (reclamation facility) and all other previous correspondence.

The reclamation facility supplements the raw source water received for drinking water treatment at the City of Big Spring (PWS ID 1140001), City of Snyder (PWS ID 2080001), City of Odessa (PWS ID 0680002), City of Stanton (1590001), and the City of Midland (PWS ID 1650001) surface water treatment plants (SWTPs). Raw water for these systems is provided by the CRMWD through a series of pipelines from several well fields, OH Ivie Reservoir, EV Spence Reservoir, Lake JB Thomas, and the reclamation facility to each of the above public water systems (PWSs).

The reclamation facility supplements the raw groundwater and surface water sources by introducing treated reclaimed wastewater effluent as an alternate raw source water. This alternate source water is carried by the EV Spence Reservoir pipeline to the City of Big Spring's SWTP and other CRMWD raw water pipelines, allowing the blended water from the reclamation facility and raw surface water to be further distributed to the other four SWTPs for additional treatment. Up to 50% of the EV Spence Reservoir pipeline water may be the alternate source water produced by the reclamation facility.

The reclamation facility takes the WWTP effluent from the City of Big Spring Wastewater Treatment Plant (WWTP), treats it with hollow fiber (HF) microfiltration (MF) membranes, reverse osmosis (RO), and advanced oxidation with ultraviolet light and hydrogen peroxide (UV AOP) before the its-product water is discharged into the EV Spence Reservoir raw water pipeline and treated by downstream PWS. Because of the absence of an environmental buffer as part of the process, this is considered direct potable reuse (DPR) of WWTP effluent for human consumption.

This enclosure includes the minimum site-specific requirements and sets the minimum design, operation, reporting, calibration, and record keeping requirements for the reclamation facility. The requirements in this document supersede all previously stated conditions for the reclamation facility.

Title 30 Texas Administrative Code (30 TAC) Chapter 290, Subchapters D, E, and F rules apply to all PWSs. The CRMWD reclamation facility will produce a new alternate raw water source for other PWSs. However, requirements for treatment and distribution of drinking water found in Subchapters D, E and F are not applicable. The following conditions are TCEQ site-specific minimum operation, design, reporting, calibration, and record keeping requirements for the proposed innovative integrated membrane CRMWD reclamation facility which will produce an alternate raw water source for PWSs and are based on the pilot study and operational data supplied.

OPERATIONAL REQUIREMENTS

Item No. 1 contains the conditions under which the CRMWD reclamation facility, or a particular treatment process, must be shut down.

1. **Conditions Requiring Shutdown:** The reclamation facility may only discharge source water into the EV Spence Reservoir raw water pipeline when all of the following conditions are met. Failure to meet one of the conditions described will result in required follow-up actions by CRMWD which are described below. The conditions are:
 - a. **Turbidity less than 10 NTU:** The WWTP effluent turbidity is below 10 Nephelometric Turbidity Units (NTU). If the WWTP effluent turbidity level is above 10 NTU the water from the WWTP must not enter the CRMWD reclamation facility. As described in the Freese and Nichols, Inc. pilot study report on page 30, turbidity levels above 10 NTU may cause performance issues with the HF MF membranes.
 - b. **Passed DITs:** The HF MF membrane units must have passed the most recent direct integrity test (DIT) before water can be discharged to the CRMWD EV Spence Reservoir pipeline. All DITs must be conducted using a sensitivity of 4.0-log and a resolution capable of detecting a 3.0 micron breach using the parameters approved by TCEQ and shown in Table 1 of Item No. 4, below. If a HF MF membrane unit fails a DIT, it must be taken off line, inspected and, if necessary, repaired. The HF MF membrane unit cannot be returned to service until the inspection and any needed maintenance has been performed and the unit passes a subsequent DIT. The pilot study HF MF membrane test units with a DIT sensitivity of 4.0-log removal produced water with the same levels (non-detectable) of *Cryptosporidium* oocysts and *Giardia* cysts as those found in the CRMWD EV Spence Reservoir raw water pipeline.
 - c. **50:50 Ratio:** The ratio of reclamation facility effluent to EV Spence Reservoir water must be at or below 50%. If at any time the ratio is found to be above 50% the facility must be taken off line until the ratio can be returned to 50% or less.
 - d. **Increased Conductivity or TDS:** If conductivity or total dissolved solids (TDS) levels of an RO unit's permeate increase by the larger of 20% or 40 microSiemens per centimeter ($\mu\text{S}/\text{cm}$) over the last reading, then the RO unit must be removed from service, the problem repaired, and an acceptable conductivity or TDS level achieved in the permeate before discharge to the CRMWD EV Spence Reservoir raw water pipeline can be resumed.
 - e. **Nitrate < 10.0 mg/L; Nitrite < 1.0 mg/L:** The nitrate and nitrite levels in the CRMWD reclamation facility effluent must be below 10.0 mg/L and 1.0 mg/L, respectively. If sample results show the nitrate level to be above 10.0 mg/L or the nitrite level to be more than 1.0 mg/L, then the facility must sample the blended raw and reclamation facility water in the EV Spence Reservoir raw water pipeline. If nitrate concentration of the blended water is over 10.0 mg/L for nitrate or 1.0 mg/L for nitrite, the plant must be taken off line, inspected, and, if necessary, repaired. ~~Due to the acute health risk, CRMWD must notify the TCEQ and the receiving PWSs immediately after receipt of any results over 10.0 mg/L for nitrate and 1.0 mg/L for nitrite in the blended water, and in no case less than 24 hours, as described in condition No. 2, below.~~

- f. **Undetectable *E. coli*:** The *E. coli* concentration levels in the reclamation facility effluent must be below detection (less than 1.0 Colony Forming Units/Liter (CFU/L)). If *E. coli* is detected in the CRMWD reclamation facility effluent, the reclamation facility must be shut down, inspected and, if necessary, repaired. CRMWD must resample *E. coli* and receive a below detection result. (< 1.0 CFU/L) before the CRMWD reclamation facility can be returned to service.
- g. **Complete Treatment:** All the water must pass through each of the treatment units at both the WWTP process and reclamation facility, including: HF MF, RO, and UV AOP.
- h. **4-log Viral Inactivation with UV:** The reclamation facility must provide at least a 4.0-log inactivation of viruses through the use of UV light. If the CRMWD reclamation facility produces off-spec water for more than four (4) consecutive hours during a day or for more than 5% of the water produced during a month (as shown on the monthly report) the facility must be taken off line and the reactors must be inspected and, if necessary, repaired. (Off-spec water is defined in condition No. 8 below.)

2. **Notification:** Item No. 1, above contains the conditions under which the CRMWD reclamation facility, or a particular treatment process, must be shut down. If the CRMWD reclamation facility does not shut down and continues to produce source water after a shutdown trigger has been met for Item No. 1a – 1d & 1f-1h, CRMWD must contact TCEQ and the receiving PWSs. Due to the acute health risk for nitrate and nitrite, if the CRMWD reclamation facility reaches either the nitrate or nitrite trigger in the blended water as described in Item No. 1e, the reclamation facility must be shut down and CRMWD must contact the TCEQ and the Receiving PWSs.

When required, CRMWD must contact the TCEQ and the receiving PWSs within 24 hours. TCEQ may be contacted by telephone at (888) 777-3186 or by email at pdws@tceq.state.tx.us. Telephone notification should also be provided to the TCEQ Region 7-Midland office at (800) 832-8224. Within five working days, the CRMWD must submit written notification to:

TCEQ Technical Review and Oversight Team (MC 159)
P.O. Box 13087
Austin, TX 78711-3087

And to:

TCEQ Region 7-Midland: Attn: Water Section Manager
9900 W IH-20, Ste 100
Midland TX 79706

The written notification must include:

- a. The problem that required the notification, either:
 - i. The WWTP effluent was required to be returned to the head of the WWTP, or
 - ii. The CRMWD reclamation facility, or a particular treatment process, had to be taken out of service; and
- b. The corrective actions taken;

- c. The quantity and duration of any unacceptable water discharged to the EV Spence Reservoir raw water pipeline; and
- d. A list of the PWSs using the water at that time.

If notice is not required by this condition, it is still recommended that the facility inform the receiving PWSs and the TCEQ if the CRMWD reclamation facility, or a treatment process such as a membrane unit, must be taken offline for any reason. This can result in less water being available to the receiving PWSs.

3. **Frequency of DITs:** The CRMWD must conduct DITs on each HF MF membrane unit to verify that the integrity of the HF MF membranes has not been compromised and the approved 4.0-log removal credit for *Cryptosporidium* oocysts and *Giardia* cysts is being continuously achieved. A DIT must be conducted on a HF MF membrane unit:
 - a. Once each day;
 - b. Before returning a HF MF membrane unit to service after failing an initial DIT and being repaired; and
 - c. After each clean-in-place (CIP) procedure.

As stated in TCEQ's December 2, 2014 letter, and the requirements of condition No. 2 above notification must be sent to TCEQ Region 7-Midland office, TCEQ Plan and Technical Review Section, and CRMWD's receiving PWSs if a HF MF unit produces water during a day without CRMWD performing a DIT on the unit. The notice must be given in the manner described in condition No. 2.

4. **DIT Procedures:** The DIT must be conducted using a procedure approved by the TCEQ including resolution and sensitivity requirements. The DIT must show 4.0-log removal sensitivity.

TABLE 1: DIT PARAMETERS FOR THE TWO HF MF MEMBRANE UNITS AT THE CRMWD RECLAMATION FACILITY ⁽¹⁾

Initial Test Pressure (P_{test}) (psi)	Upper Control Limit (UCL) (psi/min)	Log Removal Credit (LRC) (log)
25.0	0.07	4.0

(1) Based on the data and calculations shown in TCEQ's April 11, 2013; Enclosure B.

5. **0.15 NTU Triggers DIT:** The CRMWD reclamation facility must immediately conduct a DIT on any HF MF membrane unit that produces filtered water with a turbidity level above 0.15 NTU in two consecutive 5-minute readings.
6. **Indirect Integrity Every 5 Minutes:** Continuous indirect integrity monitoring of each HF MF membrane unit's filtrate turbidity levels must be conducted using the Hach Model FilterTrak method 10133, or an alternative acceptable to the TCEQ. The results must be recorded every five minutes.

7. **UV Requirements:** All of the permeate from the RO units must pass through a series of two modified Trojan UVPhox™ 72AL75 UV reactors. No bypass is allowed.
- a. **UVFit Reactors:** Because the validation study was conducted on a Trojan UVFit™ 72AL75 reactor, the sensor in each of the UVPhox 72AL75 reactors was replaced with the sensor used in the validated UVFit reactor. With the exception of the end caps on the UVPhox reactors, the parts, construction, and design of the modified UVPhox reactors must exactly match those of the validated UVFit reactor.
- b. **UV Lamp Specifications:** The two reactors must meet the following specifications.

Number/Type of Lamps and Sleeves	72 Low Pressure, High Output (LPHO) lamps
Lamp Model and Part Number	Trojan UVPhox , P/N 794447-ORD (Lamp, GA64T6HE ANG)
Sleeve Model and Part Number	Trojan UVPhox P/N 793024 (Sleeve, QTZ 28x25x)
Number of UV Intensity Sensors	1
Sensor Model and Part Number	Trojan UVFit, PN 015389-PX-S-480N

- c. **Validated UVT Ranges:** The reactor must be operated based on the validated conditions for the UVFit™ 72AL75 reactor, which are shown in the table below.

Validated UV Transmittance (UVT) Range	40.3 to 81.0 %*
Validated Flow Rate Range	0.73 to 7.39 MGD* (507 to 5,132 gpm)
Maximum Viral Inactivation Credit Allowed and its corresponding Required Validated Dose (D _{req})	2.0-log @ 100 millijoules per square centimeter (mJ/cm ²)

* The minimum validated flow and/or maximum validated UVT must be used in the calculation of Validated Dose.

- d. **D_{VAL} Calculation:** The calculated Validated Dose for each reactor must be determined using the following equation.

$$D_{VAL} = \frac{RED_{CALC}}{VF} = \frac{10^A \times Q^B \times UVT^C \times \left(\frac{S}{S_0}\right)^D}{1.183}$$

Where:

- D_{val} = the calculated Validated Dose, mJ/cm²;
- RED_{calc} = the calculated Reduction Equivalent Dose, mJ/cm²;
- VF = Validation Factor, unitless;
- Q = flow rate, MGD
 = 0.73 if the actual flow rate is less than 0.73 MGD, the minimum validated flow rate; or
 = the actual flow rate through the reactor or 0.73 MGD, the minimum validated flow rate, whichever is greater;
- UVT = percent UV transmittance of the water, %

- = 81 if the actual UVT exceeds 81%, the maximum validated UVT;
- = the actual UVT or 81%, the maximum validated transmittance, whichever is lower;
- S = the (sensor's) UV intensity measured under actual operating conditions, milliwatts per square centimeter (mW/cm^2)
- = S_0 if actual intensity reading exceeds S_0 , the maximum validated sensor reading;
- = the actual measured UV intensity or S_0 , the maximum validated sensor reading, whichever is lower;
- S_0 = the corresponding UV intensity, in mW/cm^2 , with new lamps and sensor and without any fouling
- = $1.0536 \times 10^{-5} \times \text{UVT}^{2.7691} \text{ mW}/\text{cm}^2$; and

A, B, C, and D = the regression equation coefficients shown in November 2009 Validation Report for the TrojanUVFit 72AL75 reactor.

8. **UV Inactivation Credits:** The UV facilities may only claim 4.0-log viral inactivation credit when all of the permeate from the RO units is passing through both UV reactors, the reactors are operating at flow less than 7.39 MGD, UVT greater than 40.3%, the D_{val} for each reactor is greater than or equal to D_{req} , and no more than 2 of the 144 lamps are inoperative. Conversely, the UV facilities will not be credited with providing 4.0-log viral inactivation when any of the permeate bypasses either reactor, when the reactors are not operating at validated flow rates, when the D_{val} for either reactor is lower than the D_{req} , or if more than 2 of the 144 lamps are inoperative (even if the D_{val} for each reactor exceeds D_{req}).

When the CRMWD reclamation facility is not meeting the 4.0-log viral inactivation requirement—it is producing “off-spec” water.

9. **UV Lamp Status Monitoring:** The status of each lamp, UV sensor reading, flow rate (calculated based on the combined RO filtrate flow), and D_{val} result for each reactor must be recorded at least once every 5 minutes so that the plant can determine:
 - a. The volume of permeate treated each day,
 - b. The volume of off-spec water produced each day,
 - c. The duration of each off-spec event, and
 - d. The percentage of off-spec water each month.
10. **Chloramine Monitoring:** As stated in the TCEQ's September 4, 2014 conditional plan approval letter, monochloramine, total chlorine, and free ammonia levels must be tested weekly after the MF unit and before the RO unit to ensure that a desired disinfectant residual is maintained and that break-point chlorination is not occurring.
11. **UVT Monitoring:** The UVT of the RO permeate must be recorded at least once every 4 hours.

12. **HF MF Flow Monitoring:** The flow to the HF MF membrane units must be monitored continuously and the results must be recorded every 30 minutes.
13. **RO Conductivity Monitoring:** The performance of the individual RO units shall be continuously monitored by a conductivity meter or a TDS meter. The results must be recorded every 5-minutes. The highest confirmed reading shall be recorded each day. The confirmation formulas used in the DailyReport_Apr_09_2015.xlsx document for RO are acceptable.
14. **On-line Data Collection:** Data collected from on-line instruments may be recorded electronically by a SCADA system or on a strip-chart recorder. If a strip-chart recorder is used, it must be designed so that the operator can accurately determine the value of the readings at the required monitoring interval for reporting. Instrumentation ranges set must be able to capture the shutdown triggers listed in item 1. If SCADA is used, the data collected from the on-line instruments must be stored in a format that allows it to be retained for the length of time described in the conditions under "Record Retention," below, and provided to TCEQ upon request.
15. **Grab Samples During Monitoring Failure:** If there is a failure in the continuous monitoring equipment, grab sampling must be conducted every four hours in lieu of continuous monitoring, but for no more than five working days following the failure of the equipment.
16. **Blending Ratio Monitoring:** The ratio of CRMWD reclamation facility effluent to raw water in the EV Spence Reservoir raw water pipeline must be determined and recorded every four hours. The highest daily ratio must be reported on the monthly operating report.
17. **Nitrate/Nitrite Monitoring:** The nitrate levels must be measured and recorded once per day in the CRMWD reclamation facility effluent. The nitrite levels must be measured and recorded once per day, except for on weekends and holidays, in the CRMWD reclamation facility effluent as stated in the May 10, 2013 TCEQ letter.
18. **TTHM Monitoring:** The total trihalomethane (TTHM) levels must be measured monthly for 12 months after beginning chloramination across the RO membranes, as stated in the September 4, 2014 conditional plan approval letter. The analytical results must be included on the monthly report or sent to:

TCEQ Utilities Technical Review Team (MC 159)
P.O. Box 13087
Austin, Texas 78711-3087

19. **E. coli Monitoring:** *E. coli* enumeration must continue to be performed and recorded once every seven days in the WWTP effluent and the CRMWD reclamation facility effluent. Samples for *E. coli* enumeration must be collected by a licensed operator and analyzed at a NELAP accredited lab.
20. **Reclamation Facility Effluent Pathogen Monitoring:** Source water sampling must be performed on effluent from the reclamation facility. *Cryptosporidium* and *Giardia* analysis must be performed by a laboratory approved for EPA method 1623

in its most current form. *Cryptosporidium* and *Giardia* sampling must be performed once a month until the end of the Texas Water Development Board (TWDB) funded research project or 24 months of completed sampling whichever is longer. If the sample results remain at the levels seen in the already completed sampling, the monitoring of *Cryptosporidium* and *Giardia* can be discontinued after 24 months of samples are completed. If the sampling shows levels of pathogens that are above the treatment capacity of the CRMWD reclamation facility then the sampling may be required to be continued.

After the 24 months of *Cryptosporidium* and *Giardia* sampling are completed or beginning July, 2016, whichever is earlier, Virus analysis must be performed by a laboratory approved for EPA method 1615 in its most current form. Virus sampling must be performed once a month for 24 months. The monitoring frequency will be reevaluated at that time.

21. **50:50 Blend Notification:** CRMWD must contact each of the PWSs that can receive water from the CRMWD reclamation facility to notify them of the change in blending ratio so that they can be aware of source water quality changes that may impact their SWTPs.

22. **WWTP Effluent Pathogen Monitoring:** CRMWD must continue to collect monthly samples for *Cryptosporidium* and *Giardia* in the WWTP effluent. *Cryptosporidium* and *Giardia* analysis must be performed by a laboratory approved for EPA method 1623 in its most current form. *Cryptosporidium* and *Giardia* sampling must be performed once a month until the end of the TWDB funded research project or 24 months of completed sampling whichever is longer. If the sample results remain at less than the detection level, the monitoring of *Cryptosporidium* and *Giardia* can be discontinued after 24 months of samples are completed. If the sampling shows elevated levels of pathogens then the sampling may be required to be continued.

After the 24 months of *Cryptosporidium* and *Giardia* sampling are completed or beginning July, 2016, whichever is earlier, Virus analysis must be performed by a laboratory approved for EPA method 1615 in its most current form. Virus sampling must be performed once a month for 24 months. The monitoring frequency will be reevaluated at that time.

23. **Analytical Methods:** All monitoring required as a condition of this exception must be conducted using methods that conform to the requirements of 30 TAC §290.119. If alternative methods are preferred, reasonable field methods may be approved by the TCEQ, if requested.

Based on the comparison results provided for the test strips and colorimetric methods, the Hach Method 8192, 8171 and 8507 and nitrate and nitrite HACH test strip test methods are acceptable field sampling methods for nitrate and nitrite. The test strips showed higher results than the colorimetric method and can be used, but if a non-compliant results is obtained using a test strip the result should be validated with the colorimetric method.

As stated in TCEQ's July 15, 2013 letter, these methods must be documented and updated in the systems Lab Approval Form (TCEQ Form 10450). The form must list the make and model of the equipment, and the methods used, and accuracy for all equipment and provided to the TCEQ upon request.

24. **Operations and Maintenance Manual:** A plant operations manual that meets the requirements of 30 TAC §290.42(l) must be kept on site and must be made available to TCEQ staff upon request. The operations manual shall include the communication plan with local health officials of all receiving PWS. The manual shall also include the procedures and contact information for the TCEQ and the receiving PWSs.

The operations and maintenance manual shall be complete and up-to-date. The following items were requested or required after the initial startup of the facility and must also be included in the manual.

- a. Chloramine dosing as a membrane anti-foulant, as noted in TCEQ's September 2, 2014 letter;
- b. Response to alarms and shutdowns, as noted in TCEQ's July 15, 2013 letter;
- c. Hydrogen peroxide tank inspection and response as noted in TCEQ's July 15, 2013 letter;
- d. UVT sensor verification as noted in TCEQ's July 15, 2013 letter;
- e. Daily DITs as noted in TCEQ's December 2, 2014 letter; and
- f. Emergency procedures as required in Condition No. 32.
- g. Include holding and releasing the turbidimeter output as steps in the turbidimeter flushing and maintenance SOP. This was added due to findings during the 2015 Comprehensive Compliance Investigation (CCI). During the CCI it was noted that the turbidimeter output had been held and then not released once water was flowing again.

25. **Licensed Operators:** A Class B surface water operator must be employed by the CRMWD reclamation facility. Class C surface water operators can operate the CRMWD reclamation facility if the Class B operator is on call. Operators having both a water and wastewater license may work in the CRMWD reclamation facility and Big Spring WWTP, but not during the same shift, to prevent the introduction of contaminants.

The CRMWD reclamation facility must have a Class C or higher Surface Water operator on site when CIP procedures are being conducted on the HF MF and RO membrane units, lab instruments and UV sensors are calibrated, any time UV maintenance (lamp, sensor, sleeve or other replacements) occur, and to respond to alarms and shut-downs caused by the automated control system.

26. **Alarm and Shutdown:** As stated in the July 15, 2013 letter, alarms and shutdowns must be set and procedures to respond to the alarms must be in place. TCEQ recommends the test be performed once per year.

27. **Chemical Monitoring Frequency:** As stated in our August 28, 2014 email, based on the potential public health risk, TCEQ will continue to require the regulated chemicals to be sampled quarterly. If during future sampling events, the chemical sample results are higher than the MCL for any constituent, the receiving PWSs may need to increase their sampling frequency.

28. **Notification of Monitoring Results:** The CRMWD must notify all of the PWSs that have the potential to receive the CRMWD reclamation facility with a summary of the monitoring results of the DBP sampling in condition No. 18, so they can assess the impact to their finished drinking water compliance.
29. **Disinfection of New or Repaired Facilities:** TCEQ recommends that CRMWD disinfect newly constructed or repaired facilities and verify the effectiveness of the disinfection procedure in accordance with American Water Works Association (AWWA) regulations as described in 30 TAC §290.46(g) as practical.
30. **Annual Tank Inspection:** The CRMWD reclamation facility HF MF membrane filtrate tank and the RO membrane permeate storage tank must be inspected annually by the facility's licensed water operators or a contract inspection service as described in 30 TAC §290.26(m).
31. **Electrical Code Compliance:** All electrical wiring must be securely installed and maintained in compliance with local or national electrical codes.
32. **Emergency Procedures:** The CRMWD reclamation facility must maintain internal procedures to notify TCEQ immediately if an emergency event would negatively impact the delivery of the alternative blended source water. A list of such events is located in 30 TAC §290.46(w).
33. **Back Flow and Cross Connection Control:** All backflow prevention assemblies that are required by this enclosure shall be tested upon installation and then once every 12 months as described in 30 TAC §290.44(h)(4).
34. **TCEQ Investigations:** Comprehensive Compliance Investigations of the CRMWD reclamation facility will be conducted by TCEQ staff periodically to assure the conditions of this letter and enclosures are being met. The investigations will be conducted as part of a PWS investigation, not a wastewater investigation because the effluent of the CRMWD reclamation facility is being discharged into a pipeline, not a water body.
35. **Wastewater Permits:** The Texas Pollutant Discharge Elimination System (TPDES) and 30 TAC Chapter 210 permits of the Big Spring WWTP must be current. For assistance, please contact TCEQ's Wastewater Permitting Section (MC 148) for information at (512) 239-2369.
36. **Emerging Contaminant Monitoring:** The TCEQ recommends that CRMWD monitor quarterly for the untreated WWTP's effluent, and the CRMWD reclamation facility's effluent for the potential chemical and microbiological contaminants of concern contained in Enclosure D of TCEQ's April 11, 2013 letter: Unregulated Contaminants of Concern.

DESIGN REQUIREMENTS

These conditions represent the approved design requirements for the CRMWD reclamation facility, superseding all prior correspondence.

37. As stated in TCEQ's July 15, 2013 letter, the facility must continue to be configured so that the water cannot bypass the UV system.
38. The CRMWD reclamation facility must notify TCEQ prior to making any change (increase or decrease) in production, treatment, storage, disinfection (disinfectant method/type used, application points, or monitoring points), replacement of membranes (HF MF or RO), blending ratio, or any additional treatment processes (such as corrosion control) as described in 30 TAC §290.39(j).
39. All waste discharge must be in accordance with federal and state requirements as described in 30 TAC §290.42(i). For assistance, please contact TCEQ's Wastewater Permitting Section (MC 148) for information required for the proper disposal of generated waste (such as RO membrane reject, CIP cleaning solutions, etc.) and any required discharge permit at (512) 239-2369.
40. The full-scale HF MF membrane system with Pall Microza® Model UNA-620A HF MF membrane modules (See the HF MF Membrane Details section for further details.) must meet the following design specifications:
 - a. Pre-treatment facilities consisting of a 300 micron strainer;
 - b. Pall Microza® Model UNA-620A HF MF membrane modules with the following specifications:
 - i. A HF MF pressure membrane module six inches in diameter, approximately 80 inches (in) in length and containing polyvinylidene fluoride (PVDF) fibers with a total feed side surface area of 538-square feet (sf);
 - ii. A membrane fiber nominal pore size of 0.1 microns;
 - iii. Outside-to-inside flow mode with dead-end operation;
 - iv. Allowable transmembrane pressure (TMP) operating range of 1 to 43.5 pounds per square-inch (psi);
 - v. Allowable operating temperature range of 0° to 40° C;
 - vi. A 1,000 mg/L chlorine tolerance; and
 - vii. Manufacture's allowable feed water turbidity level spike of 600 NTU;
 - c. Facilities to allow a filtrate duration of 23,400 gallons (approximately 26 minutes);
 - d. Facilities for a backwash cycle procedure on each HF MF membrane unit every cycle using a Simultaneous Air Scrubbing and Reverse Filtration (SASRF) procedure for 60 seconds followed by Forward Flush (FF) for 20 seconds;
 - e. Facilities to conduct both a sodium hypochlorite and citric acid enhanced filtrate maintenance (EFM) wash procedure utilizing RO permeate as make up water as needed. One EFM will be conducted once every 2.5 million gallons (MG), approximately every 2 days, with a circulation duration of approximately 30 minutes;
 - f. Facilities to conduct a HF MF membrane unit chemical CIP procedure no less than once every 30 days for a duration of approximately six hours utilizing RO permeate as makeup water; and
 - g. Facilities to provide an average instantaneous filtrate flux rate of 37.2 gallons per square-foot per day (gfd) (temperature corrected to 20° C).

41. A full-scale RO membrane system of Toray TML 10 RO elements, or another TCEQ acceptable Toray element (see the RO Membrane Details section for further details) must be installed in pressure vessels arranged in a two-stage configuration with twice as many pressure vessels and elements in each Stage 1 as are in the corresponding Stage 2 (2:1 array) with the following specifications.
 - a. Toray TML 10 RO elements model must have the following specifications:
 - i. 4-inch diameter or if a larger Toray membrane is used, the elements must have the same leaf length as the pilot TML 10;
 - ii. A leaf length of 40 inches;
 - iii. An active membrane area of 75 sf;
 - iv. Minimum salt rejection of 99%;
 - v. Recovery rate of 75%;
 - vi. Maximum operating temperature of 113° F;
 - vii. Maximum allowed continuous free chlorine value of non-detectable;
 - viii. An operating pH range of 2 to 11;
 - ix. A pH cleaning range of 1 to 12;
 - x. A maximum operating pressure of 600 psi;
 - xi. A maximum pressure drop per element of 20 psi; and
 - xii. A maximum silt density index (SDI) of 5.
 - b. Based on the conditional plan approval letter dated September 4, 2014, the CRMWD reclamation facility may carry a small chloramine residual across the membranes to prevent biofouling.
 - c. Facilities to feed sulfuric acid or another antiscalant for scale control must be provided.
 - d. Facilities for performing an RO membrane unit CIP procedure using both caustic and acid heated solutions must be provided.
 - e. Facilities to achieve an average flux rate of 10.5 gfd must be provided.
42. Open tanks or basins at the CRMWD reclamation facility must be located at least 500 feet from any wastewater treatment units or lands irrigated with sewage effluent. The enclosed portion of the CRMWD reclamation facility must be located at least 150 feet from any wastewater treatment units or lands irrigated with sewage effluent.
43. The CRMWD reclamation facility shall be located at a site that is accessible by an all-weather road as described in 30 TAC §290.42(a)(3).
44. All water discharged to the CRMWD EV Spence Reservoir raw water pipeline must be treated by the HF MF and RO membrane units and the advanced oxidation (using UV and hydrogen peroxide) processes. This means, the CRMWD reclamation facility units must be designed to treat all of the WWTP effluent received. Blending of WWTP effluent with reclamation facility effluent is not approved.

45. No return of decanted water or solids to the beginning of the CRMWD reclamation facility is allowed. If recycle return is desired in the future, please contact the TCEQ Technical Review & Oversight Team (MC 159) at the following address:

TCEQ Technical Review & Oversight Team (MC 159)
P.O. Box 13087
Austin, Texas 78711-3087
46. The CRMWD reclamation facility, including all filtrate and permeate storage tanks, shall be enclosed by an intruder-resistant fence as described in 30 TAC §290.38(37). The gates shall be locked during periods of darkness and when the plant is unattended.
47. Chemical storage facilities shall comply with the applicable requirements in 30 TAC §290.42(f)(1). Consistent with the details provided in the January 15, 2014 CRMWD letter in response to TCEQ's July 15, 2013 letter, CRMWD is not required to provide a day tank for hydrogen peroxide storage and the hydrogen peroxide bulk storage tank may have a bottom penetration of the double wall containment due to the "leak inspector port assembly" and other details that allow leaks to be readily apparent.
48. Chemical feed facilities shall comply with the applicable requirements in 30 TAC §290.42(f)(2).
49. Pipe galleries shall provide ample working room, good lighting, and good drainage provided by sloping floors, gutters, and sumps. Adequate ventilation to prevent condensation and to provide humidity control is also required as detailed in 30 TAC §290.42(d)(12).
50. The identification of piping shall be accomplished by the use of labels or various colors of paint as described in 30 TAC §290.42(d)(13).
51. Sanitary facilities for water works installations must be provided as described in 30 TAC §290.42(h).
52. The safety requirements of 30 TAC §290.42(k)(1) must be followed.
53. No cross-connection shall be permitted to exist between the WWTP effluent and the CRMWD reclamation facility effluent or any stage of prior treatment as described in 30 TAC §290.42(d)(2).
54. All reclaimed customer connections between the CRMWD reclamation facility and the CRMWD EV Spence Reservoir raw water pipeline shall be provided with backflow/back-siphonage protection to eliminate the possibility of chemical contamination and pathogen contamination as described in 30 TAC §290.44(h)(1)(A).
55. Separation distances between the CRMWD reclamation facility's effluent distribution/transmission piping and potable water piping shall be as specified in 30 TAC §290.44(e)(7).

56. Separation distances between the CRMWD reclamation facility's effluent distribution/transmission piping and wastewater collection mains and other potential sources of contamination shall be as described in 30 TAC §290.44(e)(7). As stated in TCEQ's July 15, 2013 letter, the spent water piping from the MF membrane racks and the overflow for the MF filtrate storage tank both discharge into a manhole that collects and returns water to the WWTP by gravity flow. To prevent backflow into the MF units and a potential for insects and small animals to enter the overflow pipe for the MF filtrate tank, covers with no greater than a 1/16" gap shall be provided.
57. Sampling taps must be located after the CRMWD reclamation facility's source water (WWTP effluent) storage tank, on the HF MF membrane filtrate storage tanks' effluent, RO membrane permeate storage tanks' effluent and the CRMWD reclamation facility's discharge piping to the CRMWD EV Spence Reservoir raw water pipeline as described in 30 TAC §290.43(c) and §290.42(d)(14). These sample taps must be readily accessible to the plant operators and TCEQ representatives.
58. All treatment chemicals and media used in the full-scale facility must conform to American National Standard Institute/NSF International (ANSI/NSF) Standard 60 for drinking water treatment chemicals and ANSI/NSF Standard 61 for drinking water systems components and be certified by an organization accredited by ANSI as described in 30 TAC §290.42(j). This includes disinfectants, anti-scalants, acids, caustics and other membrane cleaning chemicals.
59. Flow measuring devices are required on the WWTP effluent, the feed to each HF MF membrane unit, the HF MF membrane backwash supply, the combined HF MF membrane filtrate, RO concentrate, UV reactor influent stream(s) (measured as the combined RO filtrate flow), and the CRMWD reclamation facility discharge piping to the CRMWD EV Spence Reservoir raw water pipeline as described in 30 TAC §290.42(d)(5). The RO permeate flow rate may be calculated by subtracting the RO concentrate flow from the RO influent flow or by direct measurement.
60. The CRMWD reclamation facility must be designed to continuously conduct and record 15 minute turbidity monitoring of the WWTP effluent.
61. The HF MF membrane system must be designed to continuously conduct and record every 5 minutes indirect integrity monitoring on each HF MF membrane unit using the Hach FilterTrak method 10133, or an acceptable TCEQ alternative as described in 30 TAC §290.42(g)(3)(C).
62. The RO membrane system must be designed to continuously conduct and record conductivity or TDS on each RO membrane unit every 5-minutes.
63. The HF MF and RO membrane systems must be designed so that the membrane units' feed water, filtrate, backwash supply, waste, and chemical cleaning piping shall have cross-connection protection to prevent chemicals from all chemical cleaning processes from contaminating other membrane units' filtrate and permeate in other modes of operations. This may be accomplished by the installation of a double block and bleed valving arrangement, a removable spool system, or other alternative method approved by the TCEQ.

64. The CRMWD reclamation facility's feed water must receive the same pretreatment, at a minimum, under full-scale operation as received during the pilot study. The treatment is provided at the Big Spring WWTP and is as follows. Raw wastewater is first screened and de-gritted, then flows to a primary clarifier. Primary effluent then proceeds to a single rock-media trickling filter for biological stabilization and then is pumped to the aeration basin for additional biological treatment. The contents of the aeration basin flow to the final clarifier, where the active biomass is separated from the treated effluent and recycled to the aeration basin. The treated effluent is chlorinated. The filtered effluent containing the chlorine residual was the source water for the pilot study.
65. The CRMWD reclamation facility must remain designed to conduct and record the results of DITs as described in 30 TAC §290.42(g)(3)(B). The DIT values are calculated as described in the *DIT Resolution and LRV_{DIT} Sensitivity Calculations* under the HF MF Membrane Details section.
66. An adequately equipped laboratory must remain available so that frequent tests such as disinfectant residual, UVT, turbidity, pH, conductivity or TDS, and other tests required by the conditions of this letter may be performed.
67. The water storage tank used to store CRMWD reclamation facility's effluent before it is sent to the CRMWD EV Spence Reservoir raw water pipeline must meet the requirements of 30 TAC §290.43(c).

CALIBRATION

68. Conductivity or TDS meters used to monitor the RO membrane units' permeate shall be calibrated with a solution of known concentrations at least once every 90 days.
69. Flow measuring devices and rate-of-flow controllers shall be calibrated at least once every 12 months. Magnetic flow meters shall be verified at least once every 12 months and calibrated if needed.
70. pH meters shall be properly calibrated as described in 30 TAC §290.46(s)(2)(A).
71. Turbidimeters shall be properly calibrated as described in 30 TAC §290.46(s)(2)(B).
72. Pressure monitors used for DIT measurements shall be calibrated or verified at least once every 12 months.
73. Instruments used to monitor nitrate and nitrite shall be calibrated or verified at least once every 12 months.
74. As noted in the TCEQ's July 15, 2013 letter, CRMWD must calibrate the on-line temperature sensors, as directed by the manufacturer.

75. The accuracy of the UV sensor in each reactor must be checked against a reference sensor at least once each month. If the duty sensor does not read within 20% of the reference sensor, the duty sensor must be recalibrated or replaced.
76. If an online UVT monitor is used, the accuracy of the online unit must be checked against a calibrated benchtop unit at least once each week. If the on-line analyzer reads more than 2% UVT higher than the benchtop monitor, the online sensor must be replaced or recalibrated.

REPORTING

77. The CRMWD reclamation facility must record the following:
 - a. The highest daily confirmed* turbidity in the WWTP's effluent;
 - b. The daily maximum flow rates to each HF MF membrane units;
 - c. Total water produced by each HF MF membrane unit each day;
 - d. The total daily flow to the RO membrane units;
 - e. The highest confirmed* daily turbidity of each HF MF membrane unit;
 - f. Any HF MF membrane unit DIT's starting test pressure and decay pressure rate in pounds per square inch per minute (psi/min);
 - g. Any corrective actions taken, such as pinning, to correct a failed HF MF membrane DIT;
 - h. Any CIP that has been performed on a HF MF or RO membrane unit;
 - i. The daily highest confirmed conductivity or TDS for each RO membrane unit;
 - j. The minimum validated UV dose (D_{val}) achieved each day in each UV reactor, the values of the parameters used to calculate the minimum D_{val} , the volume of off-spec water produced each day, the number of consecutive hours that the UV facility produced off-spec water each day, and the percentage of off-spec water produced each month;
 - k. The amount of each chemical used per day, except on weekends and holidays;
 - l. The amount of WWTP effluent treated per day;
 - m. The amount of water sent to the EV Spence Reservoir raw water pipeline per day;
 - n. The daily maximum ratio of CRMWD reclamation facility effluent to raw water in the EV Spence Reservoir raw water pipeline;
 - o. The nitrate results found in the CRMWD reclamation facility effluent and if necessary the EV Spence Reservoir raw water pipeline each day and the nitrite results found in the CRMWD reclamation facility effluent and, if necessary, the EV Spence Reservoir raw water pipeline each day, except for on weekends and holidays, as stated in the May 10, 2013 TCEQ letter;
 - p. The weekly *E. coli* of the WWTP and CRMWD reclamation facility effluent;
 - q. Any *Cryptosporidium* or *Giardia* sample results received; and
 - r. The volume of water diverted back to the WWTP as required in TCEQ's July 15, 2013 letter.

*The term "confirmed" for turbidity as seen in items a and e above is defined as any turbidity over 10 and 0.154 NTU, respectively, that occurs in two consecutive

readings. If no readings are over 10 and 0.154 NTU, then report the highest turbidity found in a day.

78. The CRMWD reclamation facility must record the following:
- The dates that storage tanks and other facilities were cleaned and/or repaired; and
 - The maintenance and/or replacement activities for the system equipment and facilities.
79. The CRMWD reclamation facility shall record the daily and monthly data required by this Enclosure using a self-created, TCEQ approved form until the time TCEQ produces a customized report. The records must be completed in ink, typed, or computer printed and must be signed by a Class B Surface Water Operator
80. The CRMWD reclamation facility must submit the monthly operating reports and other reports listed in the reporting section of this enclosure to the TCEQ by the tenth day of the month following the end of the reporting period. Send the reports to:
81. The TCEQ requires the reclaimed wastewater to be identified as a raw water source on the consumer confidence report (CCR) for any community PWS using this water as a raw water source.
82. The CRMWD must report to TCEQ as described in condition No. 2. If the CRMWD reclamation facility produces source water that does not meet the conditions in condition No. 1 or does not complete a DIT as described in condition No. 3, it must contact the TCEQ within 24 hours by telephone at (888) 777-3186 or by e-mail at pdws@tceq.state.tx.us, notify Region 7-Midland by phone at (800) 832-8224, and immediately notify all PWSs receiving the source water. Within five working days, submit written notification regarding the problem that required the CRMWD reclamation facility, or part of the facility, to be taken out of service, the corrective actions taken, quantity of any unacceptable water discharged to the CRMWD raw water pipeline, and the PWSs using the water at that time to:

TCEQ Technical Review and Oversight Team (MC 159)
P.O. Box 13087
Austin, TX 78711-3087

And to:

TCEQ Region 7-Midland: Attn: Water Section Manager
9900 W IH-20, Ste 100
Midland TX 79706

83. Data on system ownership and management must be provided as detailed in 30 TAC §290.46(p)(1).

RECORD RETENTION

84. The following records must be retained for at least two years:
 - a. The amount of chemicals used each day except for on weekends and holidays;
 - b. The volume of water treated each day;
 - c. The dates that storage tanks and other facilities were cleaned;
 - d. The maintenance records for the system equipment and facilities; and
 - e. backflow prevention assembly test records.
85. The following records must be retained for at least three years:
 - a. Turbidity monitoring results for the individual HF MF membrane units;
 - b. The online and benchtop data for all parameters used to determine the viral inactivation achieved in the UV reactors; and
 - c. The calibration records for laboratory equipment, flow meters, on-line turbidimeters, on-line conductivity or TDS meters, UV sensors, and disinfectant residual analyzers.
 - d. As stated in the September 4, 2014 conditional plan approval letter, the records of the monochloramine, total chlorine, and ammonia monitoring.
86. This letter and its enclosures must be retained while the exception is valid and then for at least five years after the exception is no longer valid. Also, as requested in the July 15, 2013 TCEQ letter, the Trojan UVFit 72AL75 validation report must be kept on-site for the operators and TCEQ staff to verify the proper control algorithms and coefficients are being used for each UV unit.
87. Results of inspections of all water storage facilities must be retained for at least five years.
88. The following records must be retained for at least ten years:
 - a. The daily highest confirmed turbidity in the wastewater effluent;
 - b. The daily maximum flow rates to the HF MF membrane units;
 - c. Total water produced by each HF MF membrane unit each day;
 - d. The total daily flow to the RO membrane units;
 - e. The highest daily confirmed turbidity in the HF MF membrane effluent;
 - f. Any HF MF membrane unit DIT's starting test pressure, and decay pressure rate in psi/min;
 - g. Any corrective actions taken, such as pinning, to correct a failed DIT or to address performance problems with the UV reactors;
 - h. Each CIP performed on a HF MF or RO membrane unit;
 - i. The daily highest confirmed conductivity or TDS for each RO membrane unit;
 - j. The minimum validated UV dose (D_{val}) achieved each day in each UV reactor, the values of the parameters used to calculate the minimum D_{val} , the volume of off-spec water produced each day, the number of consecutive hours that the UV facility produced off-spec water each day, and the percentage of off-spec water produced each month;
 - k. The amount of WWTP effluent treated per day;

- l. The amount of water sent to the EV Spence Reservoir raw water pipeline per day;
 - m. The daily maximum ratio of CRMWD reclamation facility effluent to raw water in the EV Spence Reservoir raw water pipeline;
 - n. The nitrate and nitrite results found in the CRMWD reclamation facility effluent and if necessary, the EV Spence Reservoir raw water pipeline each day, except for on weekends and holidays, respectively as stated in the May 10, 2013 TCEQ letter;
 - o. The weekly *E. coli* of the WWTP and CRMWD reclamation facility effluents;
 - p. A laboratory report containing *Cryptosporidium* and *Giardia* concentrations in the WWTP and CRMWD reclamation facility effluent; and
 - q. The results of all chemical analyses.
89. Accurate, up-to-date, detailed plans and specification for the facility shall be maintained at the system until the facility is decommissioned.
90. As stated in the TCEQ July 15, 2013 letter, TCEQ form 10450: "Laboratory Approval Form," must also be accurately maintained.

HF MF MEMBRANE DETAILS

Pall Microza® Model UNA-620A HF MF Membrane Details

Based on approximately 30 days of operation (Cycle #7 of the pilot study report), from October 8, 2009 through November 10, 2009, of the Pall HF MF membrane test unit, the TCEQ finds that the following piloted operating parameters are accepted to yield a maximum of 17,959 gallons per day (GPD) of total filtrate water at 20° C per 538 sf membrane module.

These specifications are therefore designated as conditions of operation for the CRMWD reclamation facility. The CRMWD must submit plans and specifications to request any variation for the specifications below.

1. Pre-treatment consists of a 300-micron strainer;
2. The water is not dechlorinated until after the HF MF membrane unit, thus the treatment unit has a 1 to 5 mg/L chloramine residual across the membranes;
3. The maximum recorded turbidity from the submitted pilot study turbidity data was approximately 80 NTU, but the CRMWD reclamation facility is choosing to divert the wastewater back to the WWTP if the turbidity is over 10 NTU. Based on this choice, the maximum allowable feed water turbidity for the treatment plant will be 10 NTU;
4. Pall Microza® Model UNA-620A HF MF membrane modules with the following specifications:

- a. A HF MF pressure membrane module six inches in diameter, approximately 80 inches (in) in length and containing polyvinylidene fluoride (PVDF) fibers with a total feed side surface area of 538-sf;
 - b. A membrane fiber nominal pore size of 0.1 microns;
 - c. Outside-to-inside flow mode with dead-end operation;
 - d. Allowable TMP operating range of 1 to 43.5 psi;
 - e. Allowable operating temperature range of 0° to 40° C;
 - f. A 1,000 mg/L chlorine tolerance; and
 - g. Manufacture's allowable feed water turbidity level spike of 600 NTU.
5. A filtrate duration of 23,400 gallons (approximately 26 minutes);
6. A backwash cycle using a SASRF frequency of once every cycle at a flow rate of 8 gallons per minute (gpm) of filtrate and 3 standard cubic feet per minute (SCFM) of air for a duration of 1.0 minute, followed by a forward flush (FF) at a flow rate of 18 gpm of feed water for a duration of 20 seconds;
7. A sodium hypochlorite enhanced filtrate maintenance (EFM) wash procedure once every 2,449,470 gallons of filtrate produced per rack for a duration of approximately 40 minutes with 500 parts per million (ppm) sodium hypochlorite solution circulated for 30.0 minutes followed by a SASRF and FF for a total filtrate water use of 3,313 gallons per unit. In addition to the sodium hypochlorite EFM is a citric acid EFM. This is operator initiated on an as-needed basis not less than 15 days (once at midpoint of CIP interval). A 1% citric acid solution is circulated for 30.0 minutes followed by a SASRF and FF for total filtrate water use of 3,313 gallons per unit. RO permeate is used for EFM make up volume;
8. A minimum chemical CIP frequency of no less than once every 30 days for a duration of approximately six hours. The CIP uses a heated 1% caustic and sodium hypochlorite pH 11 solution re-circulated through the membranes and filtrate piping for 2 hours with a subsequent air scrub and feed side rinse. The process is repeated with a heated 1% citric acid pH 3 solution re-circulated for 1 hour. RO permeate is used for the CIP make up volume;
9. An average instantaneous filtrate flux rate of 37.2 gfd (temperature corrected to 20° C).

Based on two units with 78 Pall UNA-620A HF MF membrane modules each, the HF MF membranes can produce 2.38 MGD.

The TCEQ determines the capacity of HF MF membrane facilities based on an instantaneous filtrate flux corrected to 20° C. This amount is determined by subtracting the total in-plant use of filtrate (for backwashing membranes and maintenance cleaning such as EFMs, and any other in-plant use) from the gross potential filtrate production of a membrane unit in service for a 24-hour period of operation.

$$\text{Pall's filtrate flux}_{\text{at feed water temperature}} = \frac{(\text{filtrate flux}_{\text{at 20 C}}) * 0.9826}{0.0004481 * T^2 - 0.03946 * T + 1.5926}$$

Where T is the HF MF membranes' feed water temperature in degrees centigrade, and filtrate flux at 20°C is 37.2 gfd.

**** Please note this is a Pall specific formula. It must be used at the CRMWD reclamation facility, and cannot be used with other manufactures membrane units. ****

DIT Resolution and LRV_{DIT} Sensitivity Calculations

The following DIT values are required. To comply with the conditions of this letter, CRMWD must conduct daily DITs to verify the removal efficiency of the membrane treatment process.

Membrane Filtration Units – Unit 1 - 2

Table 1 is provided to help the CRMWD reclamation facility operators complete the monthly report for units 1-2.

TABLE A-1: DIT PARAMETERS FOR THE TWO UNITS AT THE CRMWD RECLAMATION FACILITY ⁽¹⁾

Initial Test Pressure (P_{test}) (psi)	Upper Control Limit (UCL) (psi/min)	Log Removal Credit (LRC) (log)
25.0	0.07	4.0

(1) Based on the data and calculations shown in Enclosure B of the April 11, 2013 TCEQ letter

Direct Integrity Test (DIT) Resolution and Sensitivity Calculations:

Removal credit awarded to the CRMWD reclamation facility membrane filtration system is based on the lower of either the log removal value (LRV) demonstrated by a direct integrity test (LRV_{DIT}) or the log removal value validated by a challenge study (LRV_{C-Test}). The values used in these calculations are required for the TCEQ to approve removal credits for the CRMWD reclamation facility, TCEQ Plant ID 21710 .

Pall Corporation provided detailed descriptions of the calculations methods and values for the DIT. All formulas and methods of calculation are from the EPA Membrane Filtration Guidance Manual and are in accordance with the DIT requirements of 40 Code of Federal Regulations (40 CFR) §141.719(b)(3). **Based on our review of the submitted calculations for determining the necessary values to verify a DIT test pressure resolution of 3.0 microns and sensitivity for the log removal credit (LRC) required, the following are TCEQ accepted values:**

Approved Minimum Test Pressure for DIT

The DIT procedure must be conducted at a pressure high enough to detect a 3-micron breach in the membrane.

1. The TCEQ accepts the use of 25.0 psi for the Minimum Test Pressure (P_{test}).

EPA Equation 4.1 (for a 3.0 micron defect):

$$P_{test} = (0.193 * \kappa * \sigma * \cos(\theta) + BP_{max})$$

Where:

Membrane specific pore shape correction factor (κ) = 1.0,

Surface tension at the air-liquid interface (σ) = 74.9 dynes/centimeter (cm),

Liquid-membrane contact angle (θ) = 0 degrees, and

Maximum back pressure (BP_{max}) on the system = 3.0 psi.

The TCEQ accepts the use of the most conservative values for κ , σ , and θ (as described above). This test pressure meets the required DIT resolution to detect a 3-micron defect or larger. The equation above calculates a P_{test} of 17.5 psi, but the documentation provided states that the facility utilizes a P_{test} of 25 psi. The 25 psi P_{test} is further used throughout the UCL calculations, thus a P_{test} of 25 psi has been granted as the minimum test pressure.

Please note that the plant may conduct its DITs at any pressure that is greater than or equal to the approved minimum test pressure shown above.

Approved Log Removal Credit (LRC) for the Membrane Unit

2. The TCEQ accepts the volume of pressurized air in the system during the test (V_{sys}) of 1,875 liters (L) for the full-scale HF MF membrane unit.

V_{sys} is used in equation 4.9 of the US EPA's Membrane Filtration Guidance Manual to verify that the sensitivity of the DIT conducted during the pilot study is equal to, or greater than, the required Log Removal Credit (LRC) of **4.0-log**.

EPA Equation 4.9:

$$LRV_{DIT} = \log [(Q_p \times ALCR \times P_{atm}) \div (\Delta P_{test} \times V_{sys} \times VCF)]$$

Where Q_p is the design capacity filtrate flow, ALCR is air-liquid conversion ratio, P_{atm} is atmospheric pressure, VCF is the volumetric concentration factor, and ΔP_{test} (0.06 psi per minute as given by the manufacturer) is the smallest rate of pressure decay that can be reliably measured during the integrity test.

3. The TCEQ accepts the use of 24.32 for the ALCR;

EPA Equation C.4:

$$ALCR = 170 \times Y \times [(P_{test} - BP) \times (P_{test} + P_{atm}) / (460 + T) \times TMP]^{1/2}$$

Using the following values:

- P_{test} = 25 psi;
- P_{atm} = 14.7 psia;
- BP = 0.0 psi;
- Temperature (T) = 90°F ;
- TMP = 35 psi maximum allowable per Pall Corporation;
- Net expansion factor for compressible flow through pipe to a larger area (Y) = 0.630. (from Appendix C Equation C.5 Membrane Filtration Guidance)

The above equation, Eq. C.4, is based on the Darcy Pipe Flow Model assuming turbulent flow such as from a broken hollow fiber (as defined in the EPA Membrane Filtration Guidance Manual).

4. **The TCEQ accepts the use of 4103.65 liters per minute (L/min) as the design capacity Q_p** for full scale operations based on a flow of 37.2 gallons per square foot per day (gfd) as in the TCEQ letter dated November 30, 2010, module square footage of 538 ft², and 78 modules per rack as verified by the water treatment plant.
5. **A VCF of 1.08 for the full scale HF MF membrane units is acceptable.**
6. Using the smallest verifiable decay rate of 0.06 psi/min (ΔP_{test}), as provided by the manufacturer, a sensitivity of 4.08-log was determined from the LRV_{DIT} calculation specified in Equation 4.9. For the purpose of validating that the response from the pressure decay test can verify **a 4.0 log removal credit (LRC), the TCEQ accepts the use of an upper control limit (UCL) of 0.07 psi/min.**

EPA Equation 4.17:

$$UCL = (Q_p \times ALCR \times P_{\text{atm}}) / (10^{\text{LRC}} \times V_{\text{sys}} \times VCF)$$

Where:

- $Q_p = 4103.65 \text{ L/min};$
- $ALCR = 24.32;$
- $P_{\text{atm}} = 14.7 \text{ psia};$
- $LRC = 3.0;$
- $V_{\text{sys}} = 1,875 \text{ L};$ and,
- $VCF = 1.08$

Challenge Study

Pall Corporation has provided challenge test data for the installed Pall UNA 620A. The TCEQ has received the data and approved a Challenge Test Log Removal Value (LRV_{CT}) of 5.68. TCEQ has also approved the Non-Destructive Performance Testing (NDPT) method, corresponding Quality Control Release Value (QCRV) and method for the DIT Log Removal Value (LRV_{DIT}) as specified in the EPA's LT2ESWTR and Membrane Filtration Guidance Manual.

Because the approved pathogen removal values are based on the lower of the LRV_{CT} and the LRV_{DIT} the 4.0 *Cryptosporidium* and *Giardia* log removal shown in the challenge study can be verified in full scale using the above DIT parameters.

RO MEMBRANE DETAILS

Toray TML 10 RO Membrane Details

Toray TML 10 RO membranes were piloted in conjunction with the HF MF membrane units in a simulated full-scale design configuration. The Toray RO test unit consisted of six pressure vessels (PV) each containing three RO test elements. Two PV were piloted in parallel with HF MF membrane filtrate water as their feed water source. Each of these two PVs' concentrate was fed to two more PVs in parallel. The concentrate from the second set of PVs was blended and used as feed water for a fifth PV. The fifth PV's concentrate was fed to the sixth and final PV. The first four PVs simulated two full-scale PVs operating in parallel with six RO elements each and the last two PVs simulated a single full-scale PV containing six RO elements. This is a commonly used pilot study arrangement achieving a 2:2:1:1 test array and simulating a full-scale 2:1 array with 6 membranes per PV.

Based on our review of Cycle #6, performed November 6, 2009 to November 24, 2009, the Toray TML 10 RO membrane elements full-scale units met the following conditions at start up:

1. Each array achieved an average flux rate of 10.5 gfd for the Toray TML 10 RO membrane element's feed side surface area.
2. Each full-scale RO membrane unit was required at start up and are still required to use a two-stage 2:1 array.
 - a. All RO elements were required at start up and are still required to be the same model, or a larger TCEQ-approved Toray RO element model having the same leaf length, salt rejection, removal efficiency and design (no mixing of non-piloted elements); and
 - b. Twice the number of PV and RO elements in each Stage 1 as in Stage 2.
3. The specifications and limiting operating parameters for the new RO elements were:
 - a. 8-inch diameter;
 - b. An active membrane area of 400 square feet;
 - c. A leaf length of 40 inches;
 - d. Minimum salt rejection of 99%;
 - e. Recovery rate of 75%;
 - f. Maximum operating temperature of 113° F;
 - g. Maximum allowed continuous free chlorine value of non-detectable;
 - h. An operating pH range of 2 to 11;
 - i. A pH cleaning range of 1 to 12;
 - j. A maximum operating pressure of 600 psi;
 - k. A maximum pressure drop per element of 20 psi; and
 - l. A maximum silt density index (SDI) of 5.
4. The full-scale Toray membrane elements, internal surface of the PVs and associated RO membrane unit piping were required at start up and are still required continue to be ANSI/NSF 61 certified.
5. ANSI/NSF Standard 60 certified chemicals must continue to be used. It is noted that Hypersperse MDC150 by GE Betz Inc. and sulfuric acid were used as the RO anti-scaling products during pilot testing.
6. A CIP must continue be conducted on each RO membrane unit using ANSI/NSF Standard 60 certified cleaning chemicals. The following procedure was used at startup:
 - a. Perform a flush of the pressure vessels using clean RO permeate or potable water;
 - b. Start recirculation of cleaning solution through the system;
 - i. Allow low pH ~ 3, 1% citric acid cleaning solution to circulate through the system for approximately one hour while maintaining the solution at approximately 95°F;
 - ii. Drain the RO unit;
 - iii. Collect waste and neutralize;
 - c. Perform another flush of the system to remove any traces of the cleaning solution;

- d. Repeat the recirculation of the cleaning solution with 0.1% caustic soda solution at a pH of 12 for 1 hour at 95°F through the system; and
- e. Flush the system with dechlorinated potable water or permeate.

EXCEPTION DETAILS

This exception for the alternative raw water source approval is subject to periodic review and may be revoked or amended if warranted. All conditions contained are site-specific minimum operation, design, reporting, calibration and record keeping requirements for the CRMWD reclamation facility as specified in 30 TAC §290.39(l)(4). Failure by the CRMWD reclamation facility to comply with these conditions can result in the water produced no longer being able to be used as a source of raw water for public drinking water systems.

Please be aware that this granted exception is subject to TCEQ revision or revocation if:

- Monitoring results, on-site alarms, or other data indicate that the CRMWD reclamation facility is producing a water quality that is a potential risk to public health;
- The U.S. Environmental Protection Agency (EPA) revises the allowable maximum contaminant levels (MCLs) for existing regulated contaminants or establishes MCLs or treatment technique requirements for chemical or microbiological contaminants that are currently unregulated;
- Substantiated data becomes available establishing a public health risk for one or more unregulated contaminants at a specified concentration level in drinking water; or
- CRMWD fails to comply with one or more of the conditions of the granted exceptions.