

From: David Sloan
Sent: Mon, 9 Mar 2015 14:00:25 +0000
To: Russell Schreiber (Wichita Falls); Brad B. Castleberry (Lloyd, Gosselink)
Cc: Daniel Nix (Wichita Falls); Shawn Garcia; Mark Southard
(mark.southard@wichitafallstx.gov)
Subject: Updated Wichita Falls Submittal to TCEQ
Attachments: DPR Exception Modification Request Transmittal.docx, Engineering Report (3-3-15).pdf, HQ Rd CT with Permeate Free Chlorine.xlsm, RRWWTP CT with Permeate Free Chlorine.xlsm, Proposed Modifications to DPR Conditions.docx, PS-1.pdf, PS-2.pdf, E-1.pdf

Attached is the updated TCEQ submittal package for the Lake Kemp supply integration. Included are the following:

1. Transmittal letter, updated with Brad's edits and offering to meet in Austin.
2. Sealed Engineering Report (deleted end date for authorization)
3. Updated CT studies (no change from last Monday)
4. Proposed Modifications to DPR Conditions (modified with additional items and explanations added)
5. Draft pump station drawings (to be sealed today prior to submitting to TCEQ)
6. [Pump specification to be added for TCEQ submittal; not attached here]

Please let me know if you have any comments, corrections or questions.

DAVID W. SLOAN, P.E., BCCE
SENIOR PROCESS ENGINEER
BOARD CERTIFIED ENVIRONMENTAL ENGINEER



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March 6, 2015

Plan & Technical Review Section (MC 159)
Technical Review and Oversight Team (MC 159)
% Mr. Joel Klumpp, Section Manager
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Re: DPR Operational Modification Request
City of Wichita Falls: PWS 2430001
Wichita County, Texas
RN105598759; CN600129316

Mr. Klumpp:

The City of Wichita Falls continues to face a catastrophic drought that threatens the municipal water supply for the citizens of Wichita Falls, as well as the surrounding communities. As discussed in our meeting on January 14, given the ongoing drought conditions, the City proposes to resume use of its Lake Kemp water supply in concert with its direct potable reuse (DPR) project at the Cypress Water Treatment Plant. With this letter, I am attaching the following documents for your review and approval:

1. Engineering Report describing the planned incorporation of the Lake Kemp supply and its use as a blending source for the DPR operation.
2. Modified CT studies for the River Road source water and the Lake Kemp source water.
3. Proposed modifications to the existing DPR authorization from TCEQ, [addressing integration of the Lake Kemp supply and selected other modifications](#).
4. Plans and specifications for supplemental pumping of permeate from the storage lagoon.

By this letter, and with these documents, the City is requesting approval to construct these facilities pursuant to 30 Tex. Admin. Code Section 290.39(d), and to authorize the blending of Lake Kemp water with the DPR pursuant to 30 Tex. Admin. Code Section 290.39(l) and 290.41(e), as needed. This request is being submitted as a supplement to the existing exception authorized for the above-referenced PWS, and in conjunction with the Governor's Drought Proclamation issued on July 5, 2011, as most recently extended on January 18, 2015, which includes all parts of the City's service area.

The City's current drought contingency planning assumes this blended source can be incorporated by mid-summer of 2015, but ideally the phased implementation should begin on or about May 1 to allow

[Mr. Joel Klumpp, TCEQ](#)

[March 6, 2015](#)

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use of the second quarter DPR testing as part of the implementation verification. [City representatives are available to meet in Austin with your staff to facilitate review and approval.](#) Please contact me if any additional information is required to further evaluate and approve this request within this timeline.

Sincerely,

David W. Sloan, P.E., BCEE
Senior Process Engineer

cc: Russell Schreiber, City of Wichita Falls
Brad Castleberry, Lloyd, Gosselink

Attachments

[WCH14515] T:/1.04 CORRESPONDENCE/~~Draft~~ DPR Exception Request Transmittal.docx

ENGINEERING REPORT



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TO:	Russell Schreiber, P.E.
FROM:	David W. Sloan, P.E., BCEE
SUBJECT:	Conceptual Plan for Integrated Desalination Treatment of Lake Kemp Water and River Road WRRF Effluent
PROJECT:	WCH14515
DATE:	March 3, 2015
CC:	Daniel Nix, Shawn Garcia, Mark Southard



FREESE AND NICHOLS, INC.
TEXAS REGISTERED
ENGINEERING FIRM
F-2144

1.00 BACKGROUND

1.01 PURPOSE

The City of Wichita Falls continues to face a historic, catastrophic drought which has diminished available municipal water supplies and challenged the City to maintain essential water service through this period. Although the intensity of heat and evaporation has abated, rainfall has continued below normal for the region, and lake levels continue to decline. The City has responded with a series of measures, most notably extreme conservation measures which have reduced water consumption, and implementation of an emergency program to blend purified effluent from the River Road Water Resource Recovery Facility (WRRF) with water from Lake Arrowhead and Lake Kickapoo prior to final treatment at the Cypress Water Treatment Plant. This program is generally referenced as the Emergency Direct Potable Reuse (DPR) program.

By letter dated June 27, 2014, The Texas Commission on Environmental Quality (TCEQ) provided conditional authorization for the City to blend effluent from the River Road WRRF, following treatment through the City's 2008 microfiltration/reverse osmosis (MF/RO) treatment facility, with other raw surface water supplies prior to final treatment. The City proceeded with blending in accordance with these provisions on July 9, 2014. The authorization was limited to an initial period of six months, but the City recently started up UV disinfection equipment to comply with the TCEQ's

principal condition for extended operation, and the authorization has now been extended through March 31, 2015 to allow final documentation and approval of the UV system. Extended authorization is anticipated with final approval of the UV system. However, concerns regarding continued loss of water supply remain, threatening even the DPR program, which is dependent on blending with equal parts of fresh water from Lakes Arrowhead and/or Kickapoo.

The City's third reservoir, Lake Kemp is a brackish source which requires desalination prior to use for drinking water. The facilities constructed for this purpose are the same facilities currently used for the DPR program, which was presumed to be of limited duration and therefore not in long-term conflict with the use of the Lake Kemp supply. The City now proposes to blend and concurrently treat reclaimed water and Lake Kemp water through the City's existing desalination facility, and credit the Lake Kemp blending as a substitute for all or a portion of the current Arrowhead/Kickapoo blending. Total finished water from the Cypress WTP derived from reclaimed water would remain at or below 50%. The City proposes to implement this source as soon as possible to conserve the Arrowhead and Kickapoo supplies for continued, but reduced, use to delay or prevent their exhaustion.

This report is to present the recommended approach and facilities to concurrently treat reclaimed water and Lake Kemp water through the City's existing desalination facility.

2.00 DATA

The Cypress Water Treatment Plant has demonstrated ability to produce high quality drinking water from raw water with significant variation in chemical parameters and suspended solids characteristics. This section focuses on the salinity parameters of different sources and the plant's ability to meet the secondary salinity standards through desalination and blending.

2.01 HISTORICAL SOURCE WATER QUALITY

Recent (2011-2014) historical water quality data for three sources of supply are summarized in this section. The sources represented are the Secondary Reservoir, blended from Lakes Arrowhead and Kickapoo, Lake Kemp, and treated effluent from the River Road WRRF. Figure 1 shows total dissolved solids, and Figure 2 shows chloride, consistently higher than sulfate and likely to be the limiting secondary parameter. This period may not be representative of long-term water quality but represents the recent years affected by the area's extreme drought, and is therefore useful in evaluating likely near-term future conditions relevant to the City's proposed contingency plans.

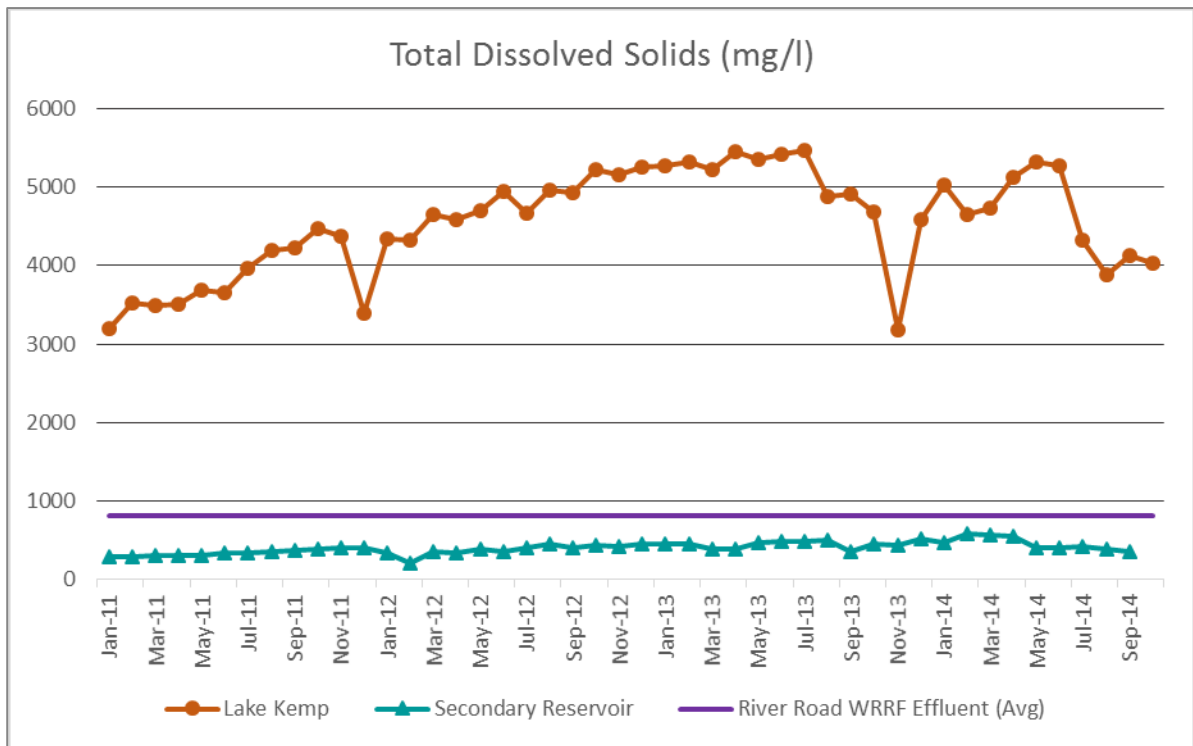


Figure 1 - Recent Historical TDS

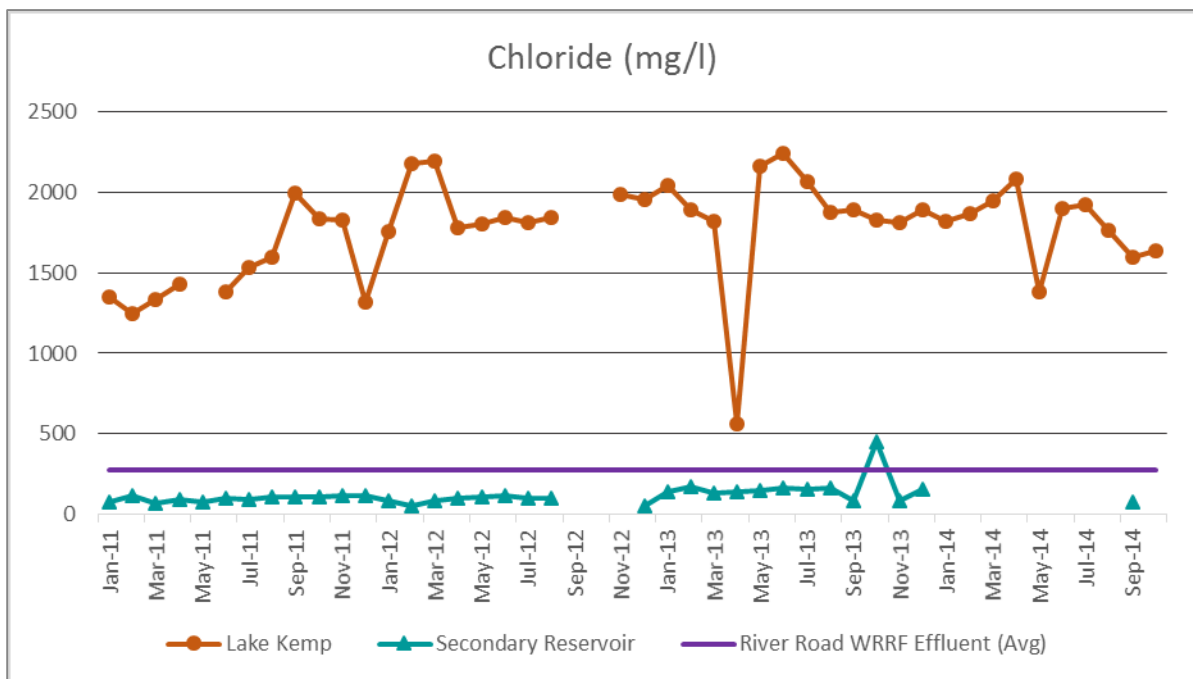


Figure 2 - Recent Historical Chloride

2.02 PROJECTED LAKE KEMP AND BLENDED RAW WATER QUALITY

Based on the recent historical data summarized in the previous section, Lake Kemp raw water is expected to have a TDS of about 4500 mg/l at the time of implementation for integrated desalination operations. If the drought intensifies with a return to high evaporation conditions, water quality could again worsen, and an extreme condition of 6000 mg/l is proposed for contingency planning. This is not considered a worst-case boundary, but does represent an extreme condition worse than measured values from the summer of 2013. Corresponding values proposed for chloride are 1800 mg/l initial and 2400 mg/l extreme. The maximum monthly value for sulfate during the period reviewed was 1394 mg/l, and is therefore not a controlling parameter.

Blended raw water quality is projected in Table 1 for two conditions, assuming an equal blend of treated effluent from the River Road WRRF and raw water from Lake Kemp. The first condition is for initial anticipated raw water quality and the second condition is for extreme water quality conditions as described above.

Table 1 - Projected Blended Raw Water Quality

Sources	Initial Concentrations (mg/l)		% Share
	TDS	Chloride	
River Road WRRF	1000	350	50%
Lake Kemp	4500	1800	50%
Blended Raw	2750	1075	

Sources	Extreme Concentrations (mg/l)		% Share
	TDS	Chloride	
River Road WRRF	1816	654	50%
Lake Kemp	6000	2400	50%
Blended Raw	3908	1527	

3.00 TREATMENT EVALUATION

3.01 PROJECTED MF/RO TREATED WATER QUALITY

RO membranes for Train 4 were replaced in December 2013, and the remainder were replaced in October 2014. Based on the current upgraded performance and allowing for some modest reduction

over time, projected water quality for this report assumes 95% rejection of TDS and chloride, as indicated in Table 2.

Table 2 - Projected Treated Water Quality

Sources	Initial Concentrations (mg/l)		Flow (mgd)
	TDS	Chloride	
Blended Raw	2750	1075	15.0
RO Removal	95%	95%	33%
Permeate	137.5	53.75	10.0

Sources	Extreme Concentrations (mg/l)		Flow (mgd)
	TDS	Chloride	
Blended Raw	3908	1527	15.0
RO Removal	95%	95%	33%
Permeate	195.4	76	10.0

3.02 PROJECTED BLENDED FINISHED WATER QUALITY

This report assumes the blending of River Road effluent with an equal or greater quantity of Lake Kemp raw water will replace the need for blending water from the secondary reservoir to meet regulatory conditions. As the MF/RO permeate continues through the conventional treatment processes, final quality for salts will be similar to that projected for the permeate, as described in the previous section. If additional Lake Kemp water is needed to meet total demands, it would exceed the capacity of the existing membrane facility. This condition could occur if all water supply was lost from Lakes Arrowhead and Kickapoo, but is not anticipated under current drought modeling scenarios. Therefore, this condition will not be addressed by this report.

4.00 CONCEPTUAL TREATMENT CONFIGURATIONS

The proposed incorporation of Lake Kemp water into the Cypress Water Treatment Plant is through the 2008 membrane facility constructed specifically to treat Lake Kemp source water. This section examines the limitations of the existing membrane treatment facility to determine the production available when treating a blend of source water from River Road WRRF and Lake Kemp. Additional

demands will require continued treatment of water from the Secondary Reservoir (Arrowhead and/or Kickapoo source water) at either the Cypress WTP or Jasper WTP.

4.01 MAXIMIZING EXISTING CONFIGURATION

The existing membrane treatment plant at Cypress WTP has a nominal treatment capacity of 10 MGD as treated permeate, requiring approximately 15 MGD of raw water as source water. The DPR operation was intended to use half the production capacity, producing up to 5 MGD of permeate to blend with an equal amount of raw water from the secondary reservoir for treatment through the 2010 conventional treatment facility, which also has a rated treatment capacity of 10 MGD.

The proposed integrated desalination concept is to blend equal portions of Kemp raw water with River Road WRRF effluent prior to treatment through the membrane plant, followed by additional treatment through the 2010 plant. Alternatively, blending could be accomplished through a combination of Lake Kemp raw water prior to membrane treatment, followed by additional blending with raw water from the secondary reservoir prior to conventional treatment.

Additional system demands would be met by water from the secondary reservoir treated at the Jasper WTP.

4.02 BLEND RATIO ACCOUNTING

As noted above, the original DPR concept assumed blending raw surface water at least equal to the amount of permeate derived from the DPR source water. If Lake Kemp is used as the sole source of blend water, an equivalent blend would result from blending raw Kemp supply at least equal to the amount of DPR source water prior to membrane treatment. However, it is also appropriate to consider a combination of raw water supplies to meet the overall blending requirement. This will allow the City maximum flexibility to utilize sources in response to their current and projected availability while maintaining compliance with TCEQ authorization.

The proposed combination blend calculation considers the share of RO permeate originating from the DPR source as a percentage of the total water produced. This approach considers the blending from brackish surface water prior to desalination, and blending from fresh surface water prior to conventional treatment.

$$\text{DPR \% of permeate} = \text{DPR source flow (MGD)} / (\text{DPR source flow} + \text{Kemp raw flow}) \times 100\%$$

$$\text{DPR share of permeate} = \text{DPR \%} \times \text{Total permeate flow}$$

$$\text{DPR \% of total} = \text{DPR share of perm. (MGD)} / (\text{permeate flow} + \text{Arrowhead/Kickapoo raw flow}) \times 100\%$$

The following **example** illustrates this approach:

7.2 MGD of DPR source water is mixed with 5 MGD of raw water from Lake Kemp. At an overall MF/RO recovery of 67%, 8.17 MGD of permeate is produced. An additional 1.8 MGD of raw water from Lake Arrowhead is blended with the permeate before treatment through the 2010 conventional plant. The resulting DPR source percentage is calculated as follows and illustrated in Figure 3:

$$\text{DPR \% of permeate} = 7.2 / (7.2 + 5) \times 100\% = 59.0\%$$

$$\text{DPR share of permeate} = 59\% \times 8.17 \text{ MGD} = 4.82 \text{ MGD}$$

$$\text{DPR \% of total} = 4.82 / (8.17 + 1.8) \times 100\% = 48.4 \%$$

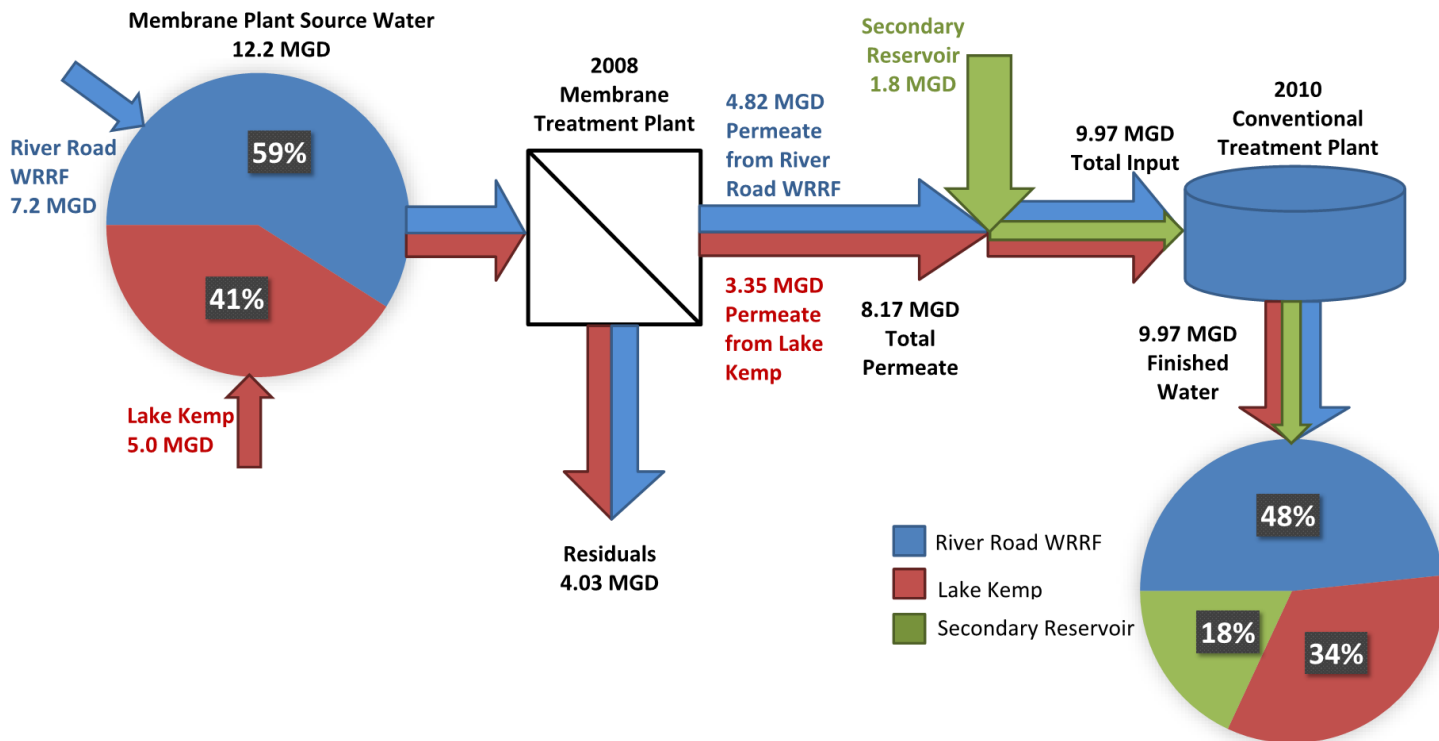


Figure 3 – Illustration of Blend Ratio Calculation Example

4.03 DISINFECTION EVALUATION

Disinfection goals will be similar to the existing DPR disinfection goals, except that Lake Kemp raw water will be disinfected with chlorine dioxide applied at the Headquarters Road pump station while DPR water will continue to be treated with chloramines applied at the River Road WRRF. As a conventional surface water source, the Lake Kemp raw water would not normally be subject to supplemental disinfection requirements, but after blending with the DPR source water, it will be subject to all subsequent disinfection zones, thus far exceeding conventional disinfection requirements. For simplicity, this section will focus on disinfection achieved through the path of the DPR source water.

The following tables summarize the projected disinfection/inactivation provided through the proposed DPR treatment processes and disinfection zones. A new free chlorine zone is proposed for the permeate discharge line between the permeate storage tanks and the permeate storage lagoon to provide standby virus inactivation during lower temperature conditions. Figure 4 is taken from the current CT Study for the DPR facility, modified to illustrate the relationship of the additional disinfection zones and facilities. An updated CT Study reflecting the additional zone for each source (River Road WRRF and Lake Kemp/Headquarters Road) is attached to this report.

Table 2 - Virus Inactivation Evaluation (9-log total inactivation required)

Process	Credit Basis	CT Zone	Flow (MGD)	30°C		7°C	
				Conc. (mg/l)	log inactivation	Conc. (mg/l)	log inactivation
RR WRRF Source Pipeline	Monochloramine	D1	7.5	1	3.87	2.5	1.97
MF/RO Pretreatment	Coagulation		15		0.5		0.5
MF/RO Clarifier	Monochloramine	D2	15	1	1.21	2.5	0.61
Microfiltration	Physical Removal		15		2		2
Microfiltration	Monochloramine	D3	15	1	0.01	2.5	0.03
Reverse Osmosis	Physical Removal		10		0		0
UV Disinfection	UV Radiation		10		0		0
Permeate Pipeline	Free Chlorine	D4 (new)	10	0	0	1	1.43
2010 Coagulation/Clarification	Physical Removal		10		0.5		0.5
2010 Filtration	Physical Removal		10		2		2
2010 Process Units	Chloramine	D5 [ex. D4]	10	3.5	2.55	4	0.59
10 MG GST	Chloramine	D6 [ex. D5]	10	3.8	9.21	4	1.97
Chemical Disinfection Sub-Total					16.85		6.6
UV Disinfection Sub-Total					0		0
Physical Removal Sub-Total					5		5
TOTAL					21.85		11.6

Table 3 - Giardia Inactivation Evaluation (8-log total inactivation required)

Process	Credit Basis	CT Zone	Flow (MGD)	30°C		7°C	
				Conc. (mg/l)	log inactivation	Conc. (mg/l)	log inactivation
RR WRRF Source Pipeline	Monochloramine	D1	7.5	1	1.4	2.5	1.33
MF/RO Pretreatment	Coagulation		15		0.5		0.5
MF/RO Clarifier	Monochloramine	D2	15	1	0.44	2.5	0.42
Microfiltration	Physical Removal		15		2.8		2
Microfiltration	Monochloramine	D3	15	1	0	2.5	0.02
Reverse Osmosis	Physical Removal		10		0		0
UV Disinfection	UV Radiation		10		3		3
Permeate Pipeline	Free Chlorine	D4 (new)	10	0	0	1	0.06
2010 Coagulation/Clarification	Physical Removal		10		0.5		0.5
2010 Filtration	Physical Removal		10		2		2
2010 Process Units	Chloramine	D5 [ex. D4]	10	3.5	0.92	4	0.4
10 MG GST	Chloramine	D6 [ex. D5]	10	3.8	3.33	4	1.34
	Chemical Disinfection Sub-Total				6.09		3.51
	UV Disinfection Sub-Total				3		3
	Physical Removal Sub-Total				5.8		5
			TOTAL		14.89		11.51

Table 4 - Cryptosporidium Inactivation Evaluation (5.5-log total inactivation required)

Process	Credit Basis	CT Zone	Flow (MGD)	Conc. (mg/l)	log inactivation
RR WRRF Source Pipeline	Monochloramine	D1	7.5	1	0
MF/RO Pretreatment	Coagulation		15		0.5
MF/RO Clarifier	Monochloramine	D2	15	1	0
Microfiltration	Physical Removal		15		2.8
Microfiltration	Monochloramine	D3	15	1	0
Reverse Osmosis	Physical Removal		10		0
UV Disinfection	UV Radiation		10		3
Permeate Pipeline	Free Chlorine	D4 (new)	10	0	0
2010 Coagulation/Clarification	Physical Removal		10		0.5
2010 Filtration	Physical Removal		10		2
2010 Ind. Filter Effluent Credit	Physical Removal		10		1
2010 Process Units	Chloramine	D5 [ex. D4]	10	3.5	0
10 MG GST	Chloramine	D6 [ex. D5]	10	3.8	0
	Chemical Disinfection Sub-Total				0
	UV Disinfection Sub-Total				3
	Physical Removal Sub-Total				6.8
			TOTAL		9.8

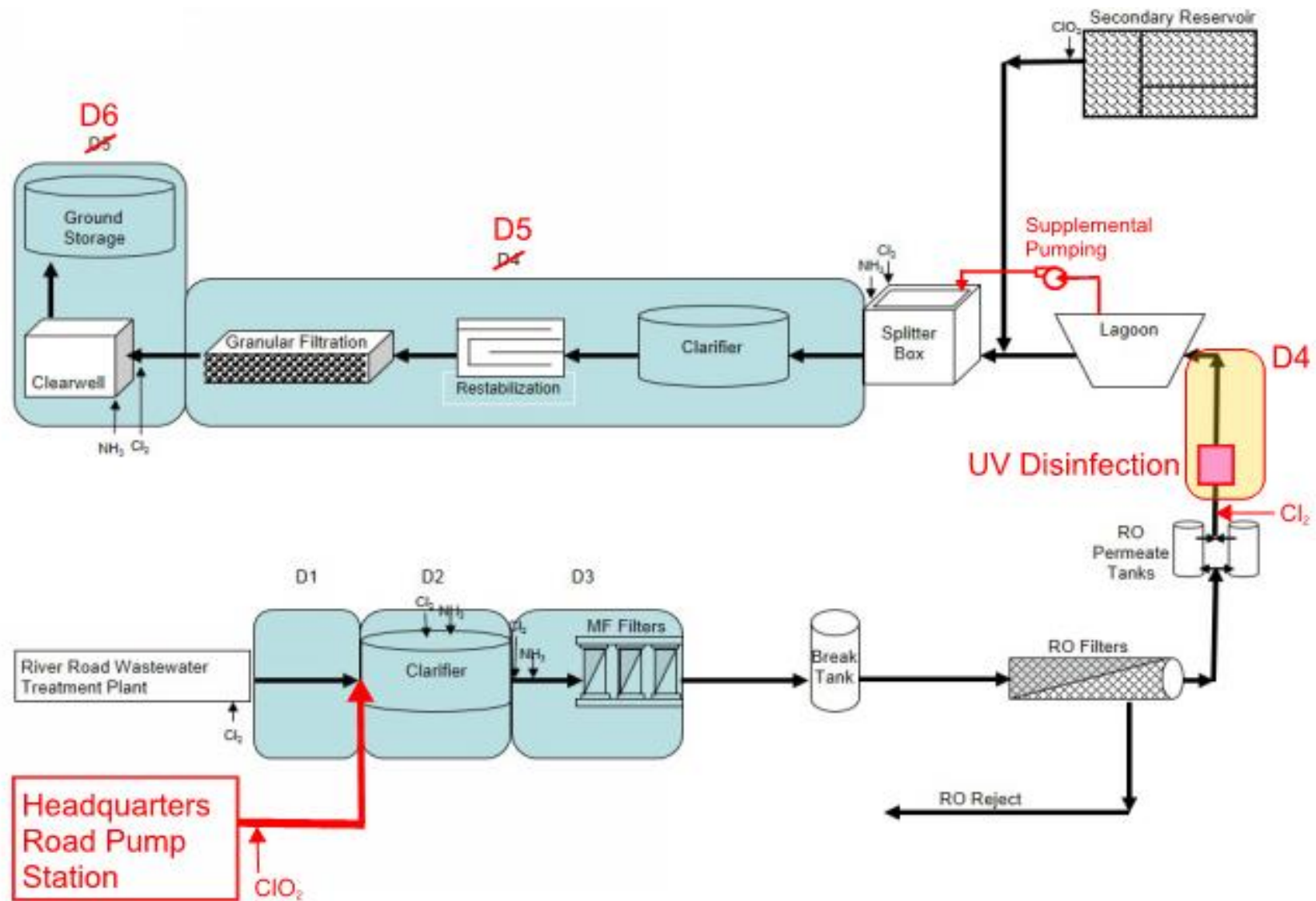


Figure 4 - Flow Schematic with Disinfection Zones

5.00 CONCEPTUAL IMPLEMENTATION PLAN

5.01 STEP-WISE IMPLEMENTATION OF INITIAL INTEGRATION

No major improvements are required to begin the initial integration plan. Lake Kemp raw water is already piped to the proposed flow path and no additional infrastructure is required. The 2008 membrane facility was designed to treat water from Lake Kemp, and has been extensively proven and monitored treating effluent from the River Road WRRF. While adjustments to chemical feed and RO recovery rate are to be expected to optimize treatment of the blended water, the blended water quality is within the range for which the facility was designed. Final treatment through the 2010 conventional plant will continue, initially with continued raw water blending, and phasing out the fresh blend water over time. Supplemental pumping will eventually be required to augment the existing Washwater Reclaim Pump Station, lifting water into the raw water splitter box as illustrated in Figure 4. Approximately 4 MGD of additional capacity is proposed, based on the 6 MGD design capacity of the existing station.

A. Implementation Sequence

1. **Minimum Lake Kemp Flow.** The minimum flow available from the Headquarters Road Pump Station (HRPS) is 3 MGD, which provides a reasonable starting flow for demonstration. Flow from the River Road WRRF will be reduced to approximately 3 MGD and the raw water valve on the Lake Kemp inlet will be opened. One pump at HRPS will be started up at 3 MGD, providing a raw water blend of approximately 50% reclaimed water. This 6 MGD of blended raw water will yield approximately 4 MGD of permeate to the backwash lagoon. Consistent with current practice, this will be blended in the line approaching the splitter box with an equal amount of raw water from the secondary reservoir. This mode of operation will be operated for one week to verify continued consistent operation of both the membrane and conventional processes, with particular attention to salinity, nitrate and turbidity performance.
2. **Ramp Up to 2010 Capacity.** Following successful operation at minimum flow, flow from both the DPR source and Lake Kemp will be brought up to approximately the current flow of the MF/RO facility, about 3.75 MGD from each source. After stabilizing operation at this level, a sampling event will be scheduled to test for pathogens and other parameters of special concern as agreed between the City and TCEQ. Operation will remain in this mode for approximately an additional month to allow for receipt and review of test results.
3. **Taper Fresh Water Contribution.** Following successful operation and testing at current flow and blending, the contribution from the Secondary Reservoir will be reduced in stages, allowing the Kemp water to substitute for the Arrowhead/Kickapoo supply to continue meeting the overall 50% dilution requirement. Following testing at 50% DPR, 50% Kemp, TCEQ approval of the full range of flow combinations will be sought, subject to the overall limitation of 50% total DPR as described in Section 4.02.

B. Proposed Testing Plan

1. **Minimum Lake Kemp Flow.** Testing for the initial Lake Kemp/DPR blend will follow the existing DPR test protocol. Daily RO rejection rates will be compared to recent values to assess any variation in performance due to changed salinity conditions. A summary of RO rejection and finished water turbidity for the first 7 days of operation will be submitted to TCEQ prior to proceeding with increased production rates.
2. **Ramp Up to 2010 Capacity.** A quarterly sampling event will be conducted after reaching consistent operation of the facility at a production of 5 MGD with approximately 50% contribution from Lake Kemp. Following receipt of results, a summary of results will be prepared and submitted to TCEQ prior to proceeding with final substitution of Lake Kemp water for all blending.
3. **Taper Fresh Water Contribution.** Upon submission of Step 2 results, the membrane plant will be gradually ramped up to approach the nominal capacity of 10 MGD, limiting the DPR contribution to less than 50%. An additional quarterly sampling event will be conducted following achieving consistent operation at greater than 9 MGD permeate production. A summary of results will be prepared and submitted to TCEQ.

5.02 PROPOSED CHANGES TO EXISTING DPR AUTHORIZATION

Several requirements contained in the TCEQ authorization (final version dated August 5, 2014) will require modification to accommodate the proposed integrated desalination. Specific proposed language is included in Attachment A, but the modifications primarily concern the following items:

- A. Adjusted blend ratio calculation to account for blending credit from Lake Kemp flow
- B. Modification to isolation provisions at Lake Kemp pipeline connection and splitter box

5.03 SUPPLEMENTAL PUMPING FROM PERMEATE LAGOON

The Washwater Reclaim Pump Station (WRPS) is currently used to lift stored permeate from the membrane treatment facility into the raw water splitter box for subsequent conventional treatment. This pump station has not been tested to its full capacity, but is estimated to have a capacity of 6 MGD, and has consistently pumped 5 MGD since the DPR operation began. Additional capacity is needed to allow full usage of the 10 MGD desalination capacity through the existing membrane plant. Two temporary pumps are proposed to provide the additional capacity. Each pump should have a nominal capacity of 1500 gpm to provide a total supplemental capacity of 3000 gpm. These pumps will be placed on a concrete slab on the south side of the lagoon and pump into the forebay of the splitter box to mix with discharge from the WRPS and any flow arriving from the Secondary Reservoir. Each pump will be a horizontal self-priming type, provided with a dedicated 12" HDPE suction line placed to access the pond contents to a depth of approximately five feet. Both pumps will discharge to a common 18" HDPE discharge line to convey water to the west end of the splitter box. An

ultrasonic transit time flow meter will be included to continuously monitor flow from the supplemental pumping. Plans and specifications for the proposed pump station are provided with this report.

6.00 CONCLUSIONS

Current water supply conditions in Wichita Falls warrant modification of the emergency direct potable reuse operation to allow blending of River Road WRRF effluent and Lake Kemp raw water to allow integrated desalination treatment of both sources to extend the City's available fresh water supplies for the benefit of Wichita Falls as well as other users of Lakes Arrowhead and Kickapoo during the continuing drought conditions. Modest physical improvements will be required to fully utilize the existing desalination facilities at the Cypress Water Treatment Plant, as well as simple changes to the City's current TCEQ authorization to operate the DPR facility. The overall blend ratio, conservative disinfection practices and other protections will continue in place to maintain the production of safe and excellent quality water from the Cypress Water Treatment Plant. Prioritized evaluation is sought to allow the City increased flexibility to manage limited water supplies through the remainder of the drought.

Enclosure H1: CT STUDY
FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
Description Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls Reuse Project **PWS ID No.:** 2430001

PLANT NAME

OR NUMBER: HQ Rd to Cypress through MF/RO/Conventional **Month:** _____

Day: _____

Year: _____

Enter a detailed narrative description of the plant treatment processes and disinfection protocol.

The City of Wichita Falls Cypress Water Treatment Plant (CWF CWTP) Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis (MF/RO) treatment facilities with the conventional 2010 CWTP. This CT study takes into account the treated water pumped from the Headquarters Road Pump Station (HQ Rd PS) to the CWTP through a 42-inch diameter raw water pipe at a flow of 7.5 million gallons per day (MGD), where it will then be mixed with 7.5 million gallons per day of River Road treated wastewater effluent and treated through the MF/RO treatment facility, piped to a raw water lagoon and treated through the conventional 2010 CWTP. The treatment process includes clarification prior to micro-filtration, reverse osmosis where the 10 MG permeate will be sent to a raw water lagoon, pumped back to the splitter basin and sent to the 2010 CWTP. The 2010 CWTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10.0-MG ground storage tank. Total capacity through the 2010 CWTP is 10.0-MGD.

The treatment processes for the water from the HQ Rd PS must achieve a 0.5-log removal or inactivation of Giardia, and a 2.0-log removal or inactivation of viruses before water is distributed to the customers.

The proposed disinfection protocol involves the injection of chlorine dioxide (ClO₂) at the HQ Rd PS before being pumped to the CWTP through the 42-inch raw water pipe. In the micro-filtration clarifier, chlorine (Cl₂) and liquid ammonium sulfate (LAS) are injected in the mix zone to form chloramines. Chlorine (Cl₂) and liquid ammonium sulfate are again added at the clarifier effluent to form chloramines through the micro-filtration trough and cells. Sodium hypochlorite is added to the reverse osmosis permeate to form a free chlorine residual through the RO permeate piping to the lagoon. Once the reverse osmosis permeate is sent to the splitter basin, chlorine (Cl₂) and liquid ammonia gas (NH₄) are added in the splitter box and again just upstream of the CWTP's 0.20 MG clearwell and transfer pump station.

Chlorine dioxide residuals are monitored in the raw water vault, prior to the micro-filtration clarifier, monochloramine residuals are monitored in the mix zone of the clarifier, at the effluent collection box of the clarifier, in the micro-filtration feed trough and cell filtrate. Free chlorine residuals are monitored at the RO permeate lagoon influent. Chloramine residuals are monitored downstream of the five multi-media gravity filters, downstream of the 0.20 MG clearwell and transfer pump station and downstream of the 10 MG ground storage tank, prior to entering the distribution system.

The disinfection process will utilize five disinfection zones which are summarized as follows:

- D1: 42-inch raw water pipeline from the HQ Rd PS to the Cypress WTP
- D2: 2008 SWTP's clarification unit at the MF/RO treatment facility
- D3: 2008 SWTP's MF treatment units and associated piping
- D4: RO permeate piping to lagoon
- D5: 2010 SWTP's clarifier, recarbonation basin, filters, and associated piping
- D6: 2010 SWTP's 0.20-MG clearwell and Cypress 10-MG ground storage tank

Submitted by: _____

Contact

Information: _____

Detailed narrative description of the plant treatment processes and disinfection protocol (cont)

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
Schematic Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls Reuse Project

PLANT NAME
OR NUMBER:

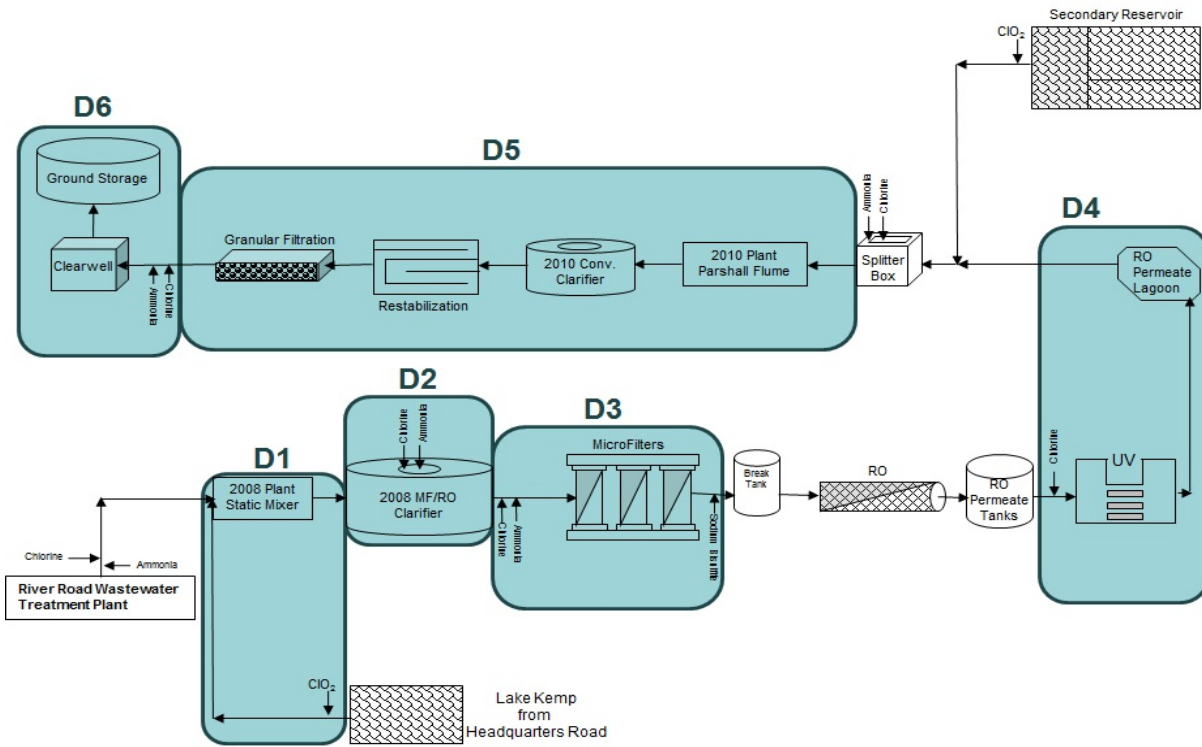
HQ Rd to Cypress through MF/RO/Conventional

PWS ID No.:

2430001

Date:

Use this worksheet to create your plant schematic with the Microsoft Drawing Tools.
If you are not familiar with the drawing tools, you may create your schematic using any other suitable medium.
Please refer to Section 3.3 of the Guidance Manual for instructions and guidance.



Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls Reuse Project

PWS ID No.: 2430001

PLANT NAME

OR NUMBER: HQ Rd to Cypress through MF/RO/Conventional

Date: _____

Treatment Plant Capacity 10.000 mgd
6,944 gpm

The peak flow rate through the MF/RO facilities will be 10 MGD. There is the potential that 100% of the water being treated through the 2010 Conventional Plant will be from the MF/RO Plant.

Disinfection Zone: D1A

Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	First Sampling Location
Diameter	42 in	As per CT Submittal Dated April 4, 2011
Length	85 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	6,118 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	1.2 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: _____
T ₁₀	1.2 min	

D1A FLOW RATE 7.500 mgd

T10 SUM FOR D1A 1.2 min

Disinfection Zone: D1B

Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Second Sampling Location

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Diameter	42 in	As per CT Submittal Dated April 4, 2011
Length	2225 ft	As per CT Submittal Dated April 4, 2011

Volume (each)	160,157 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	30.8 min	

Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: Perfect
		Approved Baffling Factor:

T₁₀ 30.8 min

D1B FLOW RATE	7.500 mgd
---------------	-----------

T10 SUM FOR D1B	30.8 min
-----------------	----------

Disinfection Zone: D1C Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Third Sampling Location
Diameter	42 in	As per CT Submittal Dated April 4, 2011
Length	9722 ft	As per CT Submittal Dated April 4, 2011

Volume (each)	699,794 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	134.4 min	

Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: Perfect
		Approved Baffling Factor:

T₁₀ 134.4 min

D1C FLOW RATE	7.500 mgd
---------------	-----------

T10 SUM FOR D1C	134.4 min
-----------------	-----------

Disinfection Zone: D2 Disinfectant: Chloramines

Unit - 1 Type: Clarifier Shape: Circular

Further Description: MF/RO Flocc-Clarifier

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Characteristic		Comments
Number of Units	1	
Diameter	155 ft	Based on two engineer drawings for the clarifier structure (the CH2MHill DWG 4A-S-2, dated 2002 and the USFilter DWG 40507-101, dated 2004)
Side Water Depth	25.3 ft	" " "
Center Water Depth	31.76 ft	" " "
Volume (each)	3,875,583 gal	
Flow Rate (each)	10,417 gpm	15 MGD Flow
Detention Time	372.0 min	
Baffling Factor	0.3	Based on a concentric cylindrical baffle wall with a diameter of approximately 50 ft that extends 10 ft into the basin and settled water launder along the perimeter of the basin
		Baffling Characteristics: Poor
		Approved Baffling Factor:
T ₁₀	111.6 min	
D2 FLOW RATE 15.000 mgd		
T10 SUM FOR D2 111.6 min		

Disinfection Zone: D3 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Clarifier to Micro-filtration Trough
Diameter	36 in	41501
Length	250 ft	41501
Volume (each)	13,221 gal	
Flow Rate (each)	10,417 gpm	15 MGD Flow
Detention Time	1.3 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: Perfect
		Approved Baffling Factor:
T ₁₀	1.3 min	

Unit - 2 Type: Other Shape: Rectangular

Further Description: Micro-filtration Trough

Characteristic	Comments
----------------	----------

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Number of Units	1	Based on CH2MHill DWG 4-S-10 dated 2002, and the length of the channel from the inlet to the center of the first pair of filter cells
Length	25.16 ft	Based on DWG 4-S-10
Width	11 ft	Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002
Side Water Depth	2.66 ft	
Volume (each)	5,508 gal	
Flow Rate (each)	10,417 gpm	15 MGD Flow
Detention Time	0.5 min	
Baffling Factor	0.1	Baffling Characteristics: Unbaffled
		Approved Baffling Factor:
T ₁₀	0.1 min	

Unit - 3 Type: Other Shape: Other

Further Description: Micro-filtration Cells

Characteristic		Comments
Number of Units	1	The flow rate through each individual MF tank must be monitored and the highest flow rate entered on the Calculator Worksheet.
Volume (each)	9,557 gal	Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002
Volume (each)	9,557 gal	
Flow Rate (each)	2,060 gpm	Based on 504 modules with a total surface area of 334.9 ft ² per module and an approved flux rate of 19.6 gfd.
Detention Time	4.6 min	
Baffling Factor	0.7	Based on the configuration of the filter cell and the submerged membrane units
		Baffling Characteristics: Superior
		Approved Baffling Factor:
T ₁₀	3.2 min	

D3 FLOW RATE 2.966 mgd

T10 SUM FOR D3 4.6 min

Disinfection Zone: D4 Disinfectant: Free Chlorine

Unit - 1 Type: Piping Shape: Pipe

Further Description: Permeate piping through UV disinfection area

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Characteristic		Comments
Number of Units	1	
Diameter	24 in	
Length	104 ft	
Volume (each)	2,444 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	0.4 min	
Baffling Factor	1.0	
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>

T₁₀ **0.4 min**

Unit - 2 Type: Piping Shape: Pipe

Further Description: Permeate piping through meter vault

Characteristic		Comments
Number of Units	1	
Diameter	20 in	
Length	32 ft	
Volume (each)	522 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	0.1 min	
Baffling Factor	1.0	
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>

T₁₀ **0.1 min**

Unit - 3 Type: Piping Shape: Pipe

Further Description: Permeate piping to diversion point

Characteristic		Comments
Number of Units	1	
Diameter	36 in	
Length	114 ft	
Volume (each)	6,029 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	0.9 min	
Baffling Factor	1.0	
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>

T₁₀ **0.9 min**

Unit - 4 Type: Piping Shape: Pipe

Further Description: HDPE Diversion to Lagoon

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Characteristic		Comments
Number of Units	1	
Diameter	24 in	
Length	320 ft	
Volume (each)	7,521 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	1.1 min	
Baffling Factor	1.0	
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	1.1 min	

D4 FLOW RATE	10.001 mgd
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T10 SUM FOR D4	2.4 min
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Disinfection Zone: D5 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Splitter Box to Rapid Mix
Diameter	36 in	As per CT Submittal Dated April 4, 2011
Length	220 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	11,634 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	1.7 min	
Baffling Factor	1.0	
		Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	1.7 min	

Unit - 2 Type: Rapid Mix Shape: Rectangular

Further Description: Rapid Mix Basin

Characteristic		Comments
Number of Units	1	
Length	27 ft	As per CT Submittal Dated April 4, 2011
Width	6 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	4 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	4,848 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Detention Time 0.7 min

Baffling Factor 0.1
Typical Baffling Factor for an "Unbaffled" Basin
Baffling Characteristics: Unbaffled
Approved Baffling Factor:

T₁₀ 0.1 min

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Rapid Mix to Clarifier
Diameter	30 in	As per CT Submittal Dated April 4, 2011
Length	85 ft	As per CT Submittal Dated April 4, 2011

Volume (each)	3,122 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.4 min	

Baffling Factor 1.0
Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 0.4 min

Unit - 4 Type: Clarifier Shape: Circular

Further Description: Clarifier

Characteristic		Comments
Number of Units	1	
Diameter	90 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	18.9 ft	As per CT Submittal Dated April 4, 2011
Center Water Depth	20.6 ft	As per CT Submittal Dated April 4, 2011

Volume (each)	926,521 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	133.4 min	

Baffling Factor 0.3
Typical Baffling Factor for Clarifiers
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 40.0 min

Unit - 5 Type: Other Shape: Rectangular

Further Description: Recarbonation Basin

Characteristic		Comments
Number of Units	1	
Length	45.5 ft	As per CT Submittal Dated April 4, 2011
Width	32 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	16.8 ft	As per CT Submittal Dated April 4, 2011

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Volume (each)	183,003	gal	
Flow Rate (each)	6,944	gpm	10 MGD Flow
Detention Time	26.4	min	

Baffling Factor	0.5	Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)
		Baffling Characteristics: <u>Average</u>
		Approved Baffling Factor: _____

T₁₀ 13.2 min

Unit - 6 Type: Filter Shape: Rectangular

Further Description: Gravity Filters

Characteristic		Comments
Number of Units	4	
Length	24 ft	As per CT Submittal Dated April 4, 2011
Width	15 ft	As per CT Submittal Dated April 4, 2011
Media Depth	6 ft	As per CT Submittal Dated April 4, 2011
Underdrain Depth	1 ft	As per CT Submittal Dated April 4, 2011
Minimum Water Depth Over Media	6.8 ft	As per CT Submittal Dated April 4, 2011
Average Porosity	50 %	

Volume (each)	29,088	gal	10 MGD Flow Divided Equally Between Four Filters (Filters Rated at 2.5 MGD Flow Each). Four filters must always be operated together at equal flow rates.
Flow Rate (each)	1,736	gpm	
Detention Time	16.8	min	

Baffling Factor	0.7	Typical Baffling Factor for Filters
		Baffling Characteristics: <u>Superior</u>
		Approved Baffling Factor: _____
T ₁₀	11.7	min

D5 FLOW RATE	9.999	mgd
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T10 SUM FOR D5	67.1	min
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Disinfection Zone: D6 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: Clearwell/Transfer Pump Station

Characteristic		Comments
Number of Units	1	
Length	98.4 ft	As per CT Submittal Dated April 4, 2011
Width	26 ft	As per CT Submittal Dated April 4, 2011

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Side Water Depth	11.3	ft	As per CT Submittal Dated April 4, 2011
Maximum Volume (each)	216,290	gal	
Minimum Operating Level	5.7	ft	
Worst Case Volume (each)	109,102	gal	
Percent of Maximum Volume	50	%	Based on the clearwell's minimum operating level, i.e., 50% of Total Volume
Worst Case Volume (each)	109,102	gal	
Flow Rate (each)	6,944	gpm	10 MGD Flow
Detention Time	15.7	min	
Baffling Factor	0.5		Typical Baffling Factor for Basins with Two Internal Baffles Lenth to Width (30:1) Baffling Characteristics: Average Approved Baffling Factor:
T ₁₀	7.9	min	

Unit - 2 Type: Clearwell Shape: Circular

Further Description: 10 MG Ground Storage Tank

Characteristic		Comments
Number of Units	1	
Diameter	206	ft As per CT Submittal Dated April 4, 2011
Side Water Depth	40	ft As per CT Submittal Dated April 4, 2011
Center Water Depth	40	ft As per CT Submittal Dated April 4, 2011
Maximum Volume (each)	9,974,083	gal
Minimum Operating Level	20	ft Assumes a "Worst Case" operating level that is 50% of the maximum water depth
Worst Case Volume (each)	4,987,042	gal
Percent of Maximum Volume	50	%
Worst Case Volume (each)	4,987,042	gal
Flow Rate (each)	6,944	gpm
Detention Time	718.2	min
Baffling Factor	0.3	Typical Baffling Factor for Basins Having 2 Inlets, 1 Outlet and 3 Interior Baffles Baffling Characteristics: Poor Approved Baffling Factor:
T ₁₀	215.5	min

D6 FLOW RATE 9.999 mgd

T10 SUM FOR D6 223.3 min

Disinfection Zone: D7 Disinfectant: _____

Disinfection Zone: D8 Disinfectant: _____

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Summary Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls Reuse Project PWS ID No.: 2430001

PLANT NAME

OR NUMBER: HQ Rd to Cypress through MF/RO/Conventional Date: _____

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1A	42-inch Raw Water Pipe (1)	6,118	7.500	1	1.175	1.17
D1B	42-inch Raw Water Pipe (1)	160,157	7.500	1	30.752	30.75
D1C	42-inch Raw Water Pipe (1)	699,794	7.500	1	134.369	134.37
D2	MF/RO Flocc-Clarifier (1)	3,875,583	15.000	0.3	111.613	111.61
D3	36 Inch Raw Water Pipe (1)	13,221	15.000	1	1.269	4.57
	Micro-filtration Trough (1)	5,508	15.000	0.1	0.053	
	Micro-filtration Cells (1)	9,557	2.966	0.7	3.248	
D4	Permeate piping through UV disinfection area (1)	2,444	10.001	1	0.352	2.38
	Permeate piping through meter vault (1)	522	10.001	1	0.075	
	Permeate piping to diversion point (1)	6,029	10.001	1	0.868	
	HDPE Diversion to Lagoon (1)	7,521	10.001	1	1.083	
D5	36 Inch Raw Water Pipe (1)	11,634	9.999	1	1.675	67.13
	Rapid Mix Basin (1)	4,848	9.999	0.1	0.070	
	30 Inch Raw Water Pipe (1)	3,122	9.999	1	0.450	
	Clarifier (1)	926,521	9.999	0.3	40.028	
	Recarbonation Basin (1)	183,003	9.999	0.5	13.177	
D6	Gravity Filters (4)	29,088	2.500	0.7	11.728	223.31
	Clearwell/Transfer Pump Station (1)	109,102	9.999	0.5	7.856	
	10 MG Ground Storage Tank (1)	4,987,042	9.999	0.3	215.454	

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13)

CT STUDY

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
CT Calculator Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls Reuse Project

PLANT NAME

OR NUMBER:

HQ Rd to Cypress through MF/RO/Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS										
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations				
	D1A	D1B	D1C	D2	D3	Giardia lamblia Cysts		Viruses		
Flow Rate (MGD)	7.500	7.500	7.500	15.000	2.966	0.5		2.0		
T ₁₀ (minutes)	1.2	30.8	134.4	111.6	4.6					

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL		
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CLO2 D1A	0.0	7.500	7.0	7.5	0.0	NA	NA	0.00	0.00	2.23	5.32	2.66
CLO2 D1B	0.0	7.500	7.0	7.5	0.0	NA	NA	0.00	0.00			
CLO2 D1C	0.1	7.500	7.0	7.5	13.4	4.2	5.0	1.60	5.40	2.23	5.32	2.66
CLA D2	2.5	15.000	7.0	7.0	279.0	334.5	746.1	0.42	0.75			
CLA D3	2.5	2.966	7.0	7.0	11.4	334.5	746.1	0.02	0.03			

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (05-01-13)

CT STUDY

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
CT Calculator Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls Reuse Project

PLANT NAME

OR NUMBER:

HQ Rd to Cypress through MF/RO/Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS			
Parameters	Disinfection Zones					Log Inactivations			
	D4	D5	D6	D7	D8	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	10.001	9.999	9.999			0.5		2.0	
T ₁₀ (minutes)	2.4	67.1	223.3						

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL		
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
FCL D4	1.0	10.000	7.0	7.0	2.4	21.6	3.3	0.06	1.43			
CLA D5	4.0	10.000	7.0	9.4	268.5	334.5	746.1	0.40	0.72			
CLA D6	4.0	10.000	7.0	8.8	893.2	334.5	746.1	1.34	2.39	SEE	PAGE	1
D7												
D8												

SUBMITTED BY:

Certificate No.

and Grade:

Date:

TCEQ - (05-01-13)

CT STUDY

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Description Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls Reuse Project PWS ID No.: 2430001

PLANT NAME

OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional Month: _____

Day: _____

Year: _____

Enter a detailed narrative description of the plant treatment processes and disinfection protocol.

pipe (with a 27-inch inside diameter, I.D.) at a flow of 7.5 million gallons per day (MGD), and mixed with 7.5 MGD of raw water from the Headquarters Rd Pump Station (Lake Kemp) prior to treatment in the MF/RO treatment facility, then sent to a raw water lagoon where 10 MG will then be treated through the conventional 2010 CWTP. The treatment process includes clarification prior to micro-filtration, reverse osmosis where the 10 MG permeate will be sent to a raw water lagoon, pumped back to the splitter basin and sent to the 2010 CWTP. The 2010 CWTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10.0-MG ground storage tank. Total capacity through the 2010 CWTP is 10.0-MGD.

The treatment processes for the water from the RRWWTP must achieve a 5.5-log removal or inactivation of Cryptosporidium, a 6.0-log removal or inactivation of Giardia, and a 9.0-log removal or inactivation of viruses before water is distributed to the customers. Based on the combination of treatment processes that will be used at the MF/RO facilities and 2010 CWTP, the disinfection process must be able to achieve a 2.0-log inactivation of Giardia and a 5.0-log inactivation of viruses before treated water enters the distribution system.

The proposed disinfection protocol involves the injection of chlorine (Cl₂) and liquid ammonium sulfate at the RRWWTP chlorine contact basin to create "per-formed chloramines" as a disinfectant (i.e, not adding enough Cl₂ to reach breakpoint) before being pumped to the CWTP through the 32-inch O.D. raw water pipe to. In the micro-filtration clarifier, chlorine (Cl₂) and liquid ammonium sulfate (LAS) are injected in the mix zone to form chloramines. Chlorine (Cl₂) and liquid ammonium sulfate are again added at the clarifier effluent to form chloramines through the micro-filtration trough and cells. Sodium hypochlorite is added to create a free chlorine residual in the RO permeate piping to the lagoon. Once the reverse osmosis permeate is sent to the splitter basin, chlorine (Cl₂) and liquid ammonia gas (NH₄) are added in the splitter box and again just upstream of the CWTP's 0.20 MG clearwell and transfer pump station.

Mono-chloramine residuals are monitored in the raw water vault, prior to the micro-filtration clarifier, in the mix zone of the clarifier, at the effluent collection box of the clarifier, in the micro-filtration feed trough and cell filtrate. Free chlorine residuals are monitored at the RO permeate lagoon influent. Chloramine residuals are also monitored downstream of the five multi-media gravity filters, downstream of the 0.20 MG clearwell and transfer pump station and downstream of the 10 MG ground storage tank, prior to entering the distribution system.

The disinfection process will utilize five disinfection zones which are summarized as follows:

- D1: 32-inch O.D. HDPE raw water pipeline from the River Road WWTP to the Cypress WTP
- D2: 2008 SWTP's clarification unit at the MF/RO treatment facility
- D3: 2008 SWTP's MF treatment units and associated piping
- D4: RO permeate piping to lagoon
- D5: 2010 SWTP's clarifier, recarbonation basin, filters, and associated piping
- D6: 2010 SWTP's 0.20-MG clearwell and Cypress 10-MG ground storage tank

Submitted by: _____

Contact Information: _____

Detailed narrative description of the plant treatment processes and disinfection protocol (cont)

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
Schematic Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls Reuse Project

PLANT NAME
OR NUMBER:

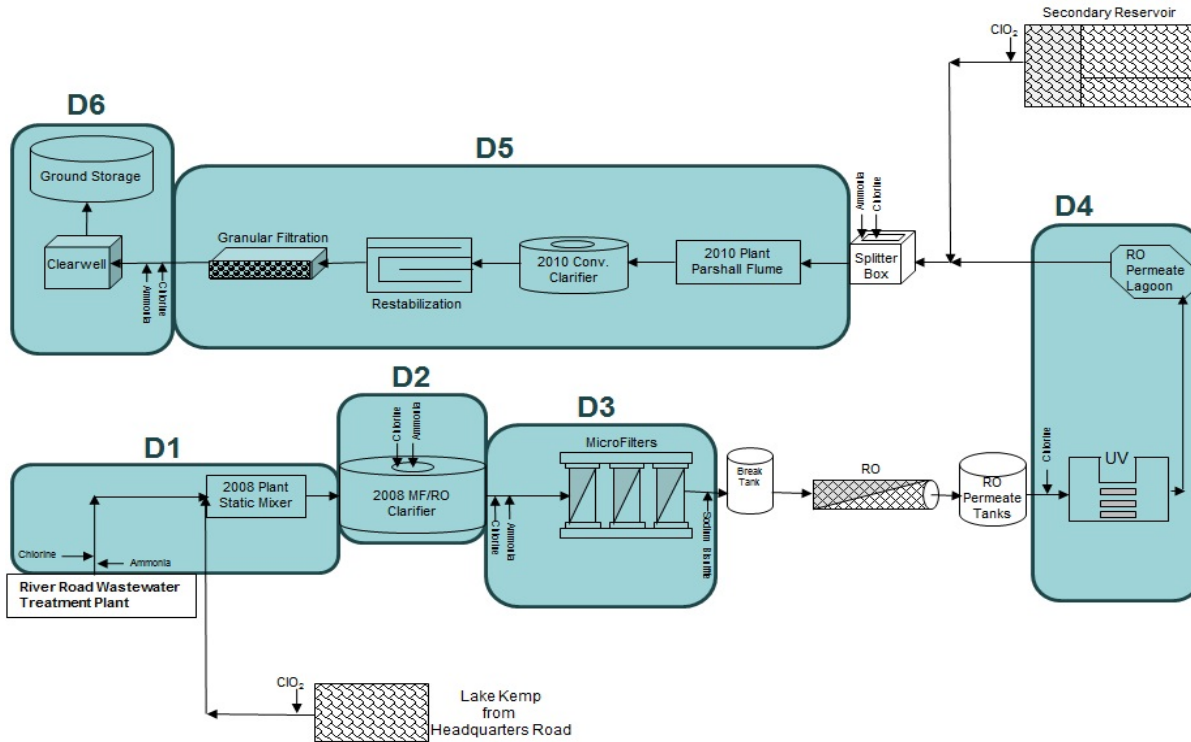
RRWWTP to Cypress through MF/RO/Conventional

PWS ID No.:

2430001

Date:

Use this worksheet to create your plant schematic with the Microsoft Drawing Tools.
If you are not familiar with the drawing tools, you may create your schematic using any other suitable medium.
Please refer to Section 3.3 of the Guidance Manual for instructions and guidance.



Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls Reuse Project

PWS ID No.: 2430001

PLANT NAME

OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional

Date: _____

Treatment Plant Capacity 10.000 mgd
6,944 gpm

The peak flow rate through the MF/RO facilities will be 10 MGD. There is the potential that 100% of the water being treated through the 2010 Conventional Plant will be from the MF/RO Plant.

Disinfection Zone: D1

Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 13 Mile Pipe from RRWWTP to Cypress WTP

Characteristic		Comments
Number of Units	1	Pipe from RRWWTP to CWTP
Diameter	27 in	32" O.D. HDPE with a 27" I.D. per K. Maroney
Length	62500 ft	8/29/2013 email
		8/15/2013 email
Volume (each)	1,859,189 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	357.0 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: _____
T ₁₀	357.0 min	

D1 FLOW RATE 7.500 mgd

T10 SUM FOR D1 357.0 min

Disinfection Zone: D2

Disinfectant: Chloramines

Unit - 1 Type: Clarifier Shape: Circular

Further Description: MF/RO Flocc-Clarifier

Characteristic	Comments
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Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Number of Units

1

Based on two engineer drawings for the clarifier structure (the CH2MHill DWG 4A-S-2, dated 2002 and the USFilter DWG 40507-101, dated 2004)

Diameter

155 ft

Side Water Depth

25.3 ft

Center Water Depth

31.76 ft

Volume (each)

3,875,583 gal

Flow Rate (each)

10,417 gpm

Detention Time

372.0 min

15 MGD Flow

Baffling Factor

0.3

Based on a concentric cylindrical baffle wall with a diameter of approximately 50 ft that extends 10 ft into the basin and settled water launder along the perimeter of the basin

Baffling Characteristics: Poor

Approved Baffling Factor:

T₁₀

111.6 min

D2 FLOW RATE

15.000 mgd

T10 SUM FOR D2

111.6 min

Disinfection Zone:

D3

Disinfectant:

Chloramines

Unit - 1

Type: **Piping**

Shape: **Pipe**

Further Description: 36 Inch Raw Water Pipe

Characteristic

Number of Units

1

Diameter

36 in

Length

250 ft

Comments

Clarifier to Micro-filtration Trough

8/15/2013

8/15/2013

Volume (each)

13,221 gal

Flow Rate (each)

10,417 gpm

Detention Time

1.3 min

15 MGD Flow

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor:

T₁₀

1.3 min

Unit - 2

Type: **Other**

Shape: **Rectangular**

Further Description: Micro-filtration Trough

Characteristic

Number of Units

1

Comments

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

		Based on CH2MHill DWG 4-S-10 dated 2002, and the length of the channel from the inlet to the center of the first pair of filter cells	
Length	25.16	ft	
Width	11	ft	Based on DWG 4-S-10
		Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002	
Side Water Depth	2.66	ft	
Volume (each)	5,508	gal	
Flow Rate (each)	10,417	gpm	15 MGD Flow
Detention Time	0.5	min	
Baffling Factor	0.1		
		Baffling Characteristics:	Unbaffled
		Approved Baffling Factor:	
T ₁₀	0.1	min	

Unit - 3 Type: Other Shape: Other

Further Description: Micro-filtration Cells

Characteristic			Comments
Number of Units	1		The flow rate through each individual MF tank must be monitored and the highest flow rate entered on the Calculator Worksheet.
Volume (each)	9,557	gal	Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002
Volume (each)	9,557	gal	
Flow Rate (each)	2,060	gpm	Based on 504 modules with a total surface area of 334.9 ft ² per module and an approved flux rate of 19.6 gfd.
Detention Time	4.6	min	
Baffling Factor	0.7		Based on the configuration of the filter cell and the submerged membrane units
		Baffling Characteristics:	Superior
		Approved Baffling Factor:	
T ₁₀	3.2	min	

D3 FLOW RATE	2.966	mgd
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T10 SUM FOR D3	4.6	min
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Disinfection Zone: D4 Disinfectant: Free Chlorine

Unit - 1 Type: Piping Shape: Pipe

Further Description: Permeate piping through UV disinfection area

Characteristic	Comments
----------------	----------

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Number of Units	1	
Diameter	24 in	
Length	104 ft	

Volume (each)	2,444 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	0.4 min	

Baffling Factor	1.0	
	Baffling Characteristics:	Perfect
	Approved Baffling Factor:	

T₁₀ **0.4 min**

Unit - 2 Type: **Piping** Shape: **Pipe**

Further Description: Permeate piping through meter vault

Characteristic		Comments
Number of Units	1	
Diameter	20 in	
Length	32 ft	

Volume (each)	522 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	0.1 min	

Baffling Factor	1.0	
	Baffling Characteristics:	Perfect
	Approved Baffling Factor:	

T₁₀ **0.1 min**

Unit - 3 Type: **Piping** Shape: **Pipe**

Further Description: Permeate piping to diversion point

Characteristic		Comments
Number of Units	1	
Diameter	36 in	
Length	114 ft	

Volume (each)	6,029 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	0.9 min	

Baffling Factor	1.0	
	Baffling Characteristics:	Perfect
	Approved Baffling Factor:	

T₁₀ **0.9 min**

Unit - 4 Type: **Piping** Shape: **Pipe**

Further Description: HDPE Diversion to Lagoon

Characteristic	Comments
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Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Number of Units	1	
Diameter	24 in	
Length	320 ft	
Volume (each)	7,521 gal	
Flow Rate (each)	6,945 gpm	
Detention Time	1.1 min	
Baffling Factor	1.0	
		Baffling Characteristics: Perfect
		Approved Baffling Factor:
T ₁₀	1.1 min	

D4 FLOW RATE	10.001 mgd
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T10 SUM FOR D4	2.4 min
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Disinfection Zone: D5 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Splitter Box to Rapid Mix
Diameter	36 in	As per CT Submittal Dated April 4, 2011
Length	220 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	11,634 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	1.7 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: Perfect
		Approved Baffling Factor:
T ₁₀	1.7 min	

Unit - 2 Type: Rapid Mix Shape: Rectangular

Further Description: Rapid Mix Basin

Characteristic		Comments
Number of Units	1	
Length	27 ft	As per CT Submittal Dated April 4, 2011
Width	6 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	4 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	4,848 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.7 min	

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Baffling Factor 0.1 Typical Baffling Factor for an "Unbaffled" Basin
Baffling Characteristics: Unbaffled
Approved Baffling Factor:

T₁₀ 0.1 min

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Rapid Mix to Clarifier
Diameter	30 in	As per CT Submittal Dated April 4, 2011
Length	85 ft	As per CT Submittal Dated April 4, 2011

Volume (each)	3,122 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.4 min	

Baffling Factor 1.0 Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 0.4 min

Unit - 4 Type: Clarifier Shape: Circular

Further Description: Clarifier

Characteristic		Comments
Number of Units	1	
Diameter	90 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	18.9 ft	As per CT Submittal Dated April 4, 2011
Center Water Depth	20.6 ft	As per CT Submittal Dated April 4, 2011

Volume (each)	926,521 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	133.4 min	

Baffling Factor 0.3 Typical Baffling Factor for Clarifiers
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 40.0 min

Unit - 5 Type: Other Shape: Rectangular

Further Description: Recarbonation Basin

Characteristic		Comments
Number of Units	1	
Length	45.5 ft	As per CT Submittal Dated April 4, 2011
Width	32 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	16.8 ft	As per CT Submittal Dated April 4, 2011

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Volume (each) 183,003 gal
Flow Rate (each) 6,944 gpm
Detention Time 26.4 min

10 MGD Flow

Baffling Factor 0.5

Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)

Baffling Characteristics: Average

Approved Baffling Factor:

T₁₀ 13.2 min

Unit - 6 Type: Filter Shape: Rectangular

Further Description: Gravity Filters

Characteristic		Comments
Number of Units	4	
Length	24 ft	As per CT Submittal Dated April 4, 2011
Width	15 ft	As per CT Submittal Dated April 4, 2011
Media Depth	6 ft	As per CT Submittal Dated April 4, 2011
Underdrain Depth	1 ft	As per CT Submittal Dated April 4, 2011
Minimum Water Depth Over Media	6.8 ft	As per CT Submittal Dated April 4, 2011
Average Porosity	50 %	

Volume (each) 29,088 gal

10 MGD Flow Divided Equally Between Four Filters (Filters Rated at 2.5 MGD Flow Each). Four filters must always be operated together at equal flow rates.

Flow Rate (each) 1,736 gpm
Detention Time 16.8 min

Baffling Factor 0.7

Typical Baffling Factor for Filters

Baffling Characteristics: Superior

Approved Baffling Factor:

T₁₀ 11.7 min

D5 FLOW RATE 9.999 mgd

T10 SUM FOR D5 67.1 min

Disinfection Zone: D6 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: Clearwell/Transfer Pump Station

Characteristic		Comments
Number of Units	1	
Length	98.4 ft	As per CT Submittal Dated April 4, 2011
Width	26 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	11.3 ft	As per CT Submittal Dated April 4, 2011

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Maximum Volume (each)	216,290	gal	
Minimum Operating Level	5.7	ft	
Worst Case Volume (each)	109,102	gal	
Percent of Maximum Volume	50	%	Based on the clearwell's minimum operating level, i.e., 50% of Total Volume
Worst Case Volume (each)	109,102	gal	
Flow Rate (each)	6,944	gpm	10 MGD Flow
Detention Time	15.7	min	
Baffling Factor	0.5		Typical Baffling Factor for Basins with Two Internal Baffles Length to Width (30:1) Baffling Characteristics: Average Approved Baffling Factor:
T ₁₀	7.9	min	

Unit - 2 Type: Clearwell Shape: Circular

Further Description: 10 MG Ground Storage Tank

Characteristic		Comments
Number of Units	1	
Diameter	206	ft As per CT Submittal Dated April 4, 2011
Side Water Depth	40	ft As per CT Submittal Dated April 4, 2011
Center Water Depth	40	ft As per CT Submittal Dated April 4, 2011
Maximum Volume (each)	9,974,083	gal
Minimum Operating Level	20	ft Assumes a "Worst Case" operating level that is 50% of the maximum water depth
Worst Case Volume (each)	4,987,042	gal
Percent of Maximum Volume	50	%
Worst Case Volume (each)	4,987,042	gal
Flow Rate (each)	6,944	gpm 100% of 10 MGD Max at Cypress. All water produced will pass through the 10 MG GST for the DPR full scale operation.
Detention Time	718.1	min
Baffling Factor	0.3	Typical Baffling Factor for Basins Having 2 Inlets, 1 Outlet and 3 Interior Baffles Baffling Characteristics: Poor Approved Baffling Factor:
T ₁₀	215.4	min

D6 FLOW RATE	10.000	mgd
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T10 SUM FOR D6	223.3	min
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Disinfection Zone: D7 Disinfectant: _____

Disinfection Zone: D8 Disinfectant: _____

Disinfection Zone: D9 Disinfectant: _____

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Disinfection Zone: D10

Disinfectant: _____

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Summary Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls Reuse Project PWS ID No.: 2430001

PLANT NAME

OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional Date: _____

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1	13 Mile Pipe from RRWWTP to Cypress WTP (1)	1,859,189	7.500	1	356.964	356.96
D2	MF/RO Flocc-Clarifier (1)	3,875,583	15.000	0.3	111.613	111.61
D3	36 Inch Raw Water Pipe (1)	13,221	15.000	1	1.269	4.57
	Micro-filtration Trough (1)	5,508	15.000	0.1	0.053	
	Micro-filtration Cells (1)	9,557	2.966	0.7	3.247	
D4	Permeate piping through UV disinfection area (1)	2,444	10.001	1	0.352	2.38
	Permeate piping through meter vault (1)	522	10.001	1	0.075	
	Permeate piping to diversion point (1)	6,029	10.001	1	0.868	
	HDPE Diversion to Lagoon (1)	7,521	10.001	1	1.083	
D5	36 Inch Raw Water Pipe (1)	11,634	9.999	1	1.675	67.13
	Rapid Mix Basin (1)	4,848	9.999	0.1	0.070	
	30 Inch Raw Water Pipe (1)	3,122	9.999	1	0.450	
	Clarifier (1)	926,521	9.999	0.3	40.028	
	Recarbonation Basin (1)	183,003	9.999	0.5	13.177	
D6	Gravity Filters (4)	29,088	2.500	0.7	11.728	223.30
	Clearwell/Transfer Pump Station (1)	109,102	10.000	0.5	7.855	
	10 MG Ground Storage Tank (1)	4,987,042	10.000	0.3	215.440	

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13)

CT STUDY

Enclosure H1: CT STUDY
 FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
 OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
CT Calculator Worksheet

PUBLIC WATER SYSTEM NAME: City of Wichita Falls Reuse Project PLANT NAME OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional

PWS ID No.: 2430001 Date: _____

DISINFECTION PROCESS PARAMETERS										
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations				
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses		
Flow Rate (MGD)	7.500	15.000	2.966	10.001	9.999	2.0		5.0		
T ₁₀ (minutes)	357.0	111.6	4.6	2.4	67.1					

						DISINFECTION PROCESS DATA						
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL		
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CLA D1	2.5	7.500	7.0	7.0	892.4	1338.0	2269.1	1.33	1.97			
CLA D2	2.5	15.000	7.0	7.0	279.0	1338.0	2269.1	0.42	0.61			
CLA D3	2.5	2.966	7.0	7.0	11.4	1338.0	2269.1	0.02	0.03	3.56	6.59	1.32
FCL D4	1.0	10.000	7.0	7.0	2.4	86.5	8.3	0.06	1.43	(V)		
CLA D5	4.0	10.000	7.0	9.4	268.5	1338.0	2269.1	0.40	0.59			

SUBMITTED BY: _____

Certificate No. and Grade: _____

Date: _____

TCEQ - (05-01-13)

CT STUDY

Enclosure H1: CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
CT Calculator Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls Reuse Project

PLANT NAME

OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS											
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS					
Parameters	Disinfection Zones					Log Inactivations					
	D6	D7	D8	D9	D10	Giardia lamblia Cysts			Viruses		
Flow Rate (MGD)	10.000					2.0			5.0		
T ₁₀ (minutes)	223.3										

DISINFECTION PROCESS DATA														
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL				
Disinfectant		C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio	
CLA	D6	4.0	10.000	7.0	8.8	893.2	1338.0	2269.1	1.34	1.97				
	D7													
	D8										SEE		PAGE	1
	D9													
	D10													

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (05-01-13)

CT STUDY

Wichita Falls Emergency DPR Facilities

Proposed Modifications to Conditions for the Temporary DPR WTP

Reference Enclosure A of TCEQ Conditional Approval Letter dated August 5, 2014

March 6, 2015

*Explanation/justification for proposed modifications provided in italics. Simple changes/substitutions noted by **highlighted** words.*

Introduction: [Delete the words “for a period of six months” from the end of the first sentence. Delete the second paragraph in its entirety.]

The DPR project will remain subject to review through the monthly reporting process and subject to regulatory updates as indicated, but through eight months of operation has proven reliable and capable of continuously providing safe, high quality water. A fixed reauthorization date is unnecessary.

- 4.f. The *Escherichia coli* (*E. coli*) concentrations in the RRWWTP effluent (after the chlorine contact basin) must be no greater than **200** colony forming units (CFU)/100 mL. If the RRWWTP *E. coli* effluent concentration is above **200** CFU/100 mL (when the results are received), the RRWWTP effluent must stop entering the pipeline leading to the temporary DPR WTP and the entire temporary DPR WTP must be shut down until corrective action is taken and the entire temporary DPR WTP must be shut down until corrective action is taken and the *E. coli* levels return to below **200** CFU/mL.

*Given the addition of the UV disinfection barrier to pathogens, a slight relaxation of the *E. coli* limit is requested for flexibility, although no process or operational changes are proposed which would reduce the RRWWTP effluent quality.*

- 4.h. [second sentence:] The unit must have any problems repaired and retested until the salt rejection returns to **within 10%** of the unit’s acceptable daily salt rejection total from the previous day before the RO unit can resume discharging to the next stage of treatment.

This language is suggested for improved clarity; no change is proposed in the requirement.

- 4.j. The **percentage of finished water from the Cypress WTP originating as RRWWTP effluent** must be no greater than 50.00%. This calculation shall consider the impact of surface water (Lake Kemp) blending occurring prior to the MF/RO treatment process as well as blending of surface water from the secondary reservoir with RO permeate. No single instantaneous 15 minute reading may be above 55.00% and the 2-hour averages of instantaneous 15-minute readings must be below 50.00%. The 2-hour averages begin at midnight and continue every 8 readings. If the instantaneous or averaged ratios are above the threshold then the water from the lagoon to the splitter box or the water from the secondary reservoir must be adjusted to establish a ratio below 50.00%. **Continuous flow metering of the following streams will be used to determine the percentage originating as RRWWTP effluent:**

- | | |
|-----|--|
| (1) | RRWWTP effluent delivered to the Cypress WTP |
| (2) | Lake Kemp raw water delivered to the Cypress WTP |
| (3) | RO permeate produced from DPR treatment train |

- (4) Permeate pumped from Waste Lagoon No. 3
- (5) Secondary Reservoir raw water delivered to the Cypress WTP

$\text{DPR \% of permeate} = \text{DPR source flow (1)} / [\text{DPR source flow} + \text{Kemp raw flow (2)}] \times 100\%$

$\text{DPR share of permeate} = \text{DPR \%} \times \text{Total permeate flow (3) OR (4)}$

$\text{DPR \% of total} = \text{DPR share of permeate} / [\text{permeate flow} + \text{Secondary Reservoir RW (5)}] \times 100\%$

Proposed incorporation of blending credit for Lake Kemp raw water.

16. Because of concerns regarding the potential introduction of contamination into the Lake Kemp/Headquarters Road Reservoir raw water line, the 1961 SWTP and 1987 SWTP treatment equipment and associated clearwells and piping, the following conditions must be met:
- a. The 2008 SWTP flow control vault's valve located on the Lake Kemp/Headquarters Road Reservoir pipeline must continue to remain closed unless the Headquarters Road Pump Station is delivering water to the Cypress WTP. **[delete remainder.]**
 - b. The weir gates in the Cypress Splitter Box to the 1961 and 1987 SWTPs must be maintained closed and:
 - i. Visually inspected **weekly** for leakage.
 - ii. If leaking from either of these two weir gates is noted, the extent of leakage must be noted for disinfection activities prior to resuming normal operation.
 - iii. [language from existing item]
 - iv. [language from existing item]
 - v. The results of the **weekly** visual inspections and any follow-up inspections must be recorded, kept onsite, and made available to the TCEQ upon request.

The HQ Road valve must be opened to accommodate reintroduction of the Lake Kemp supply. The facilities under consideration by these provisions are related to raw water supplies, and therefore do not require the frequency of inspection stipulated. DPR closure activities will verify that all facilities are properly disinfected.

- 24.l. The **DPR% of total finished water** must be determined and recorded every 15 minutes. The highest instantaneous 15-minute ratio for the day must be reported each month. The two-hour averages must also be reported if the maximum daily 15-minute instantaneous ratio is above 50.00%.

Language modified for modified blending provisions.

- 24.q. **Total Culturable Virus** sampling must be performed once a month at the RRWWTP effluent and two times per month at the entry point to the distribution system from the temporary DPR WTP using EPA method 1615. **[delete remainder.]**

Total culturable virus results are quicker and are sufficient to verify that adequate virus disinfection is achieved.

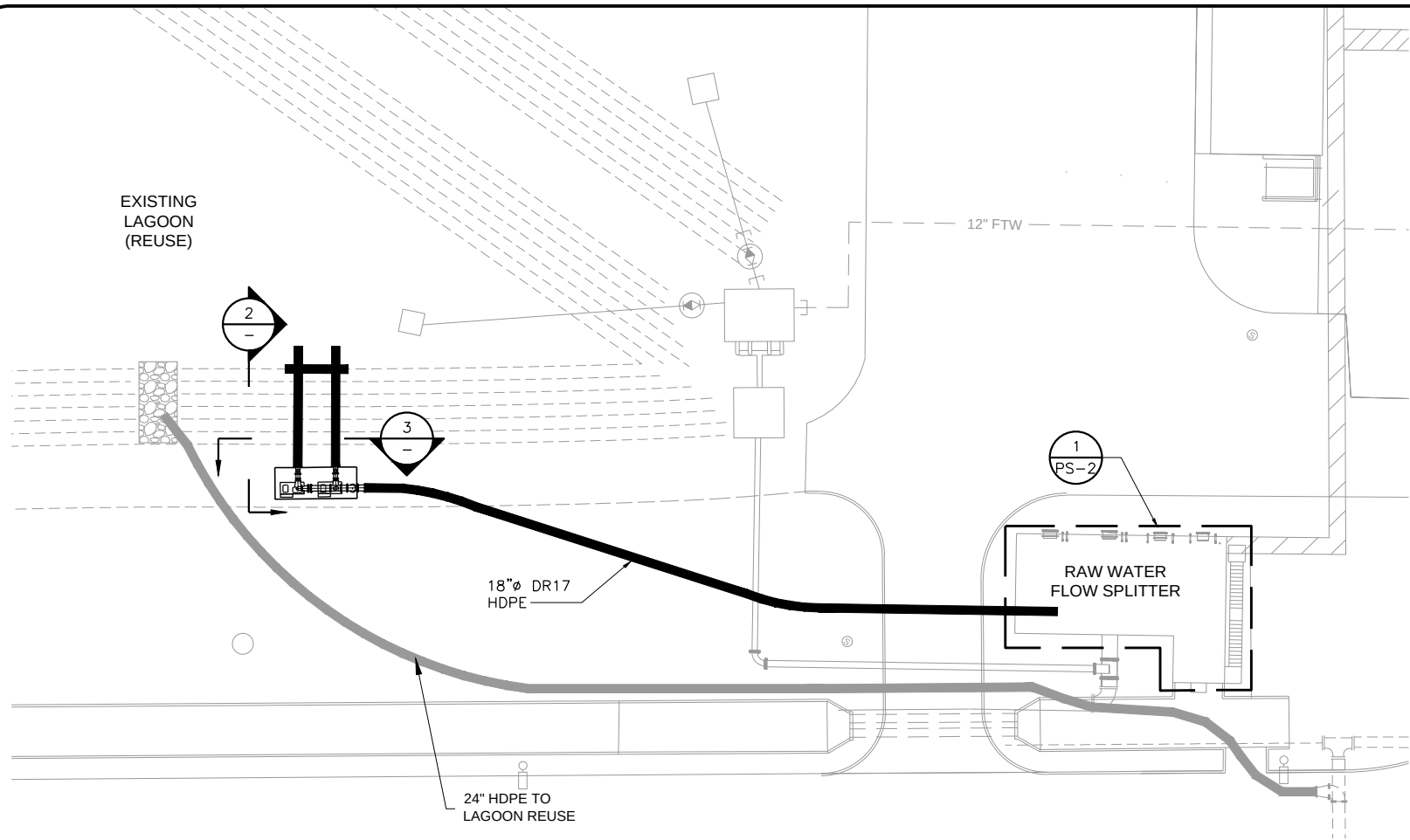
- 33.d. action to reduce the output of the permeate transfer pumps at Waste Lagoon No. 3 when the DPR % of total finished water exceeds 50.00%; and

Language modified for modified blending provisions.

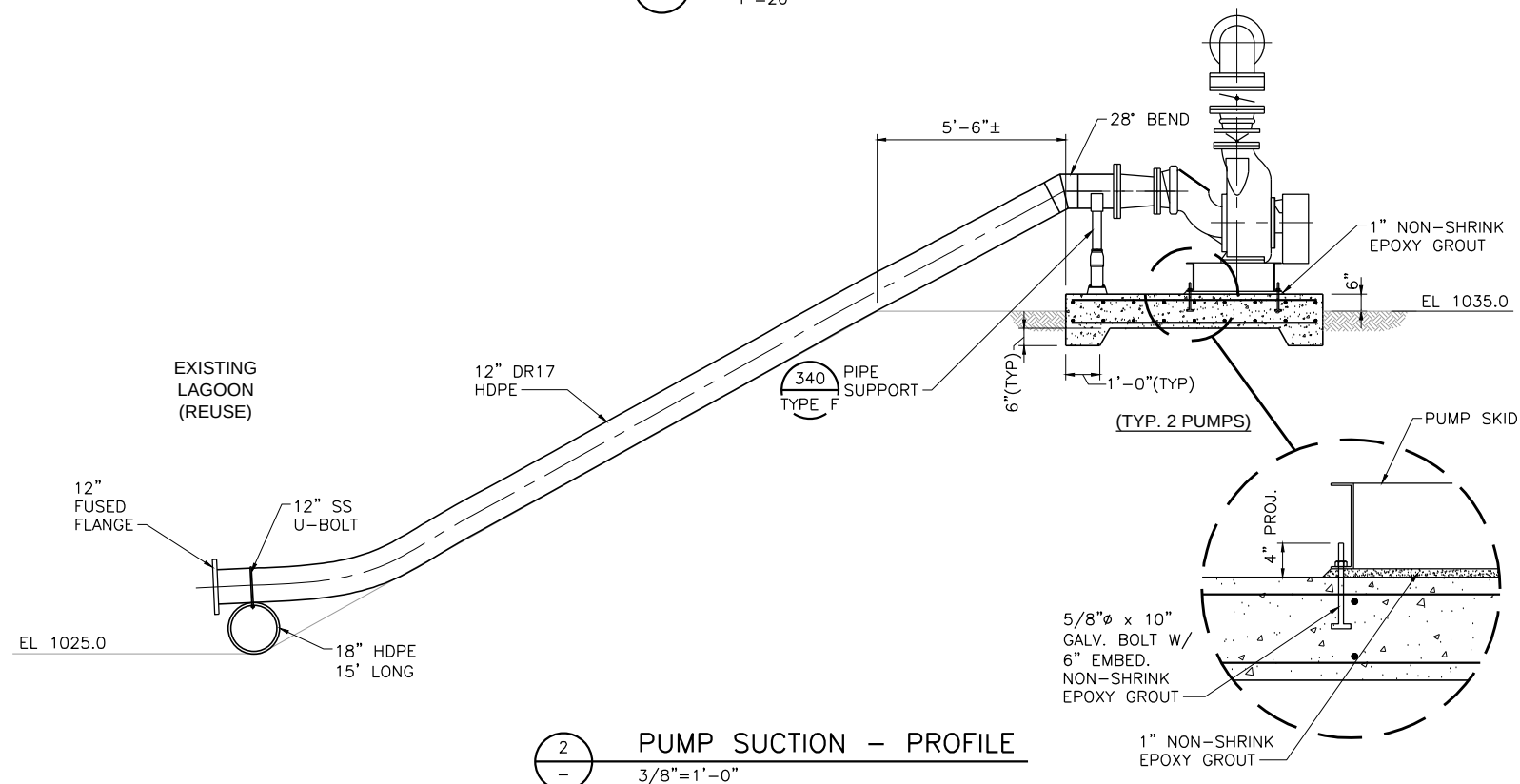
63. [delete]

This language unnecessary with approval of integrating the Lake Kemp supply.

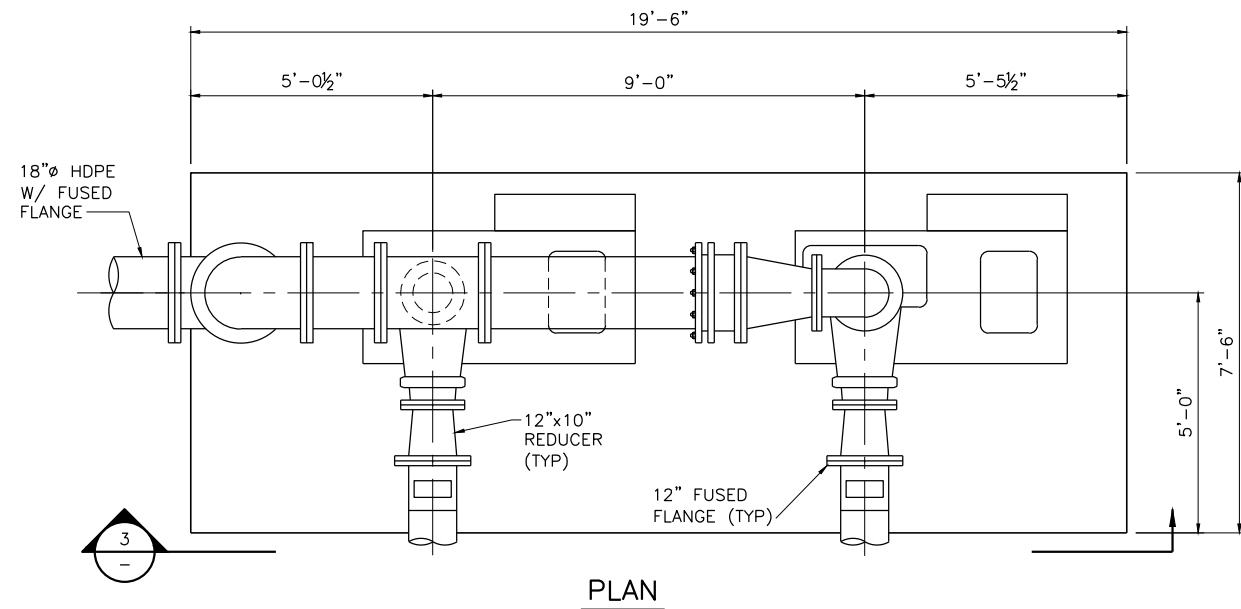
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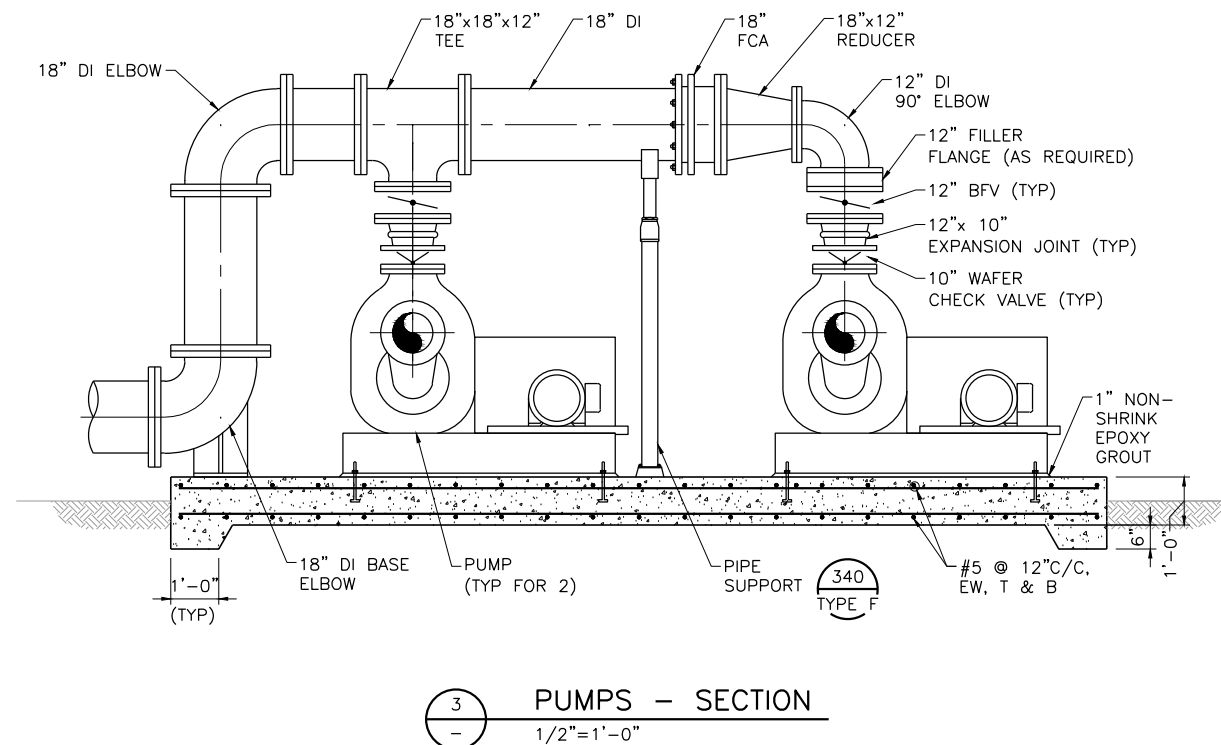
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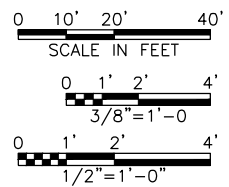
2 PUMP SUCTION - PROFILE
3/8"=1'-0"



PLAN



3 PUMPS - SECTION
1/2"=1'-0"



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CITY OF WICHITA FALLS, TEXAS
SUPPLEMENTAL PERMEATE PUMP STATION
MECHANICAL
PUMP STATION
PLAN AND SECTIONS

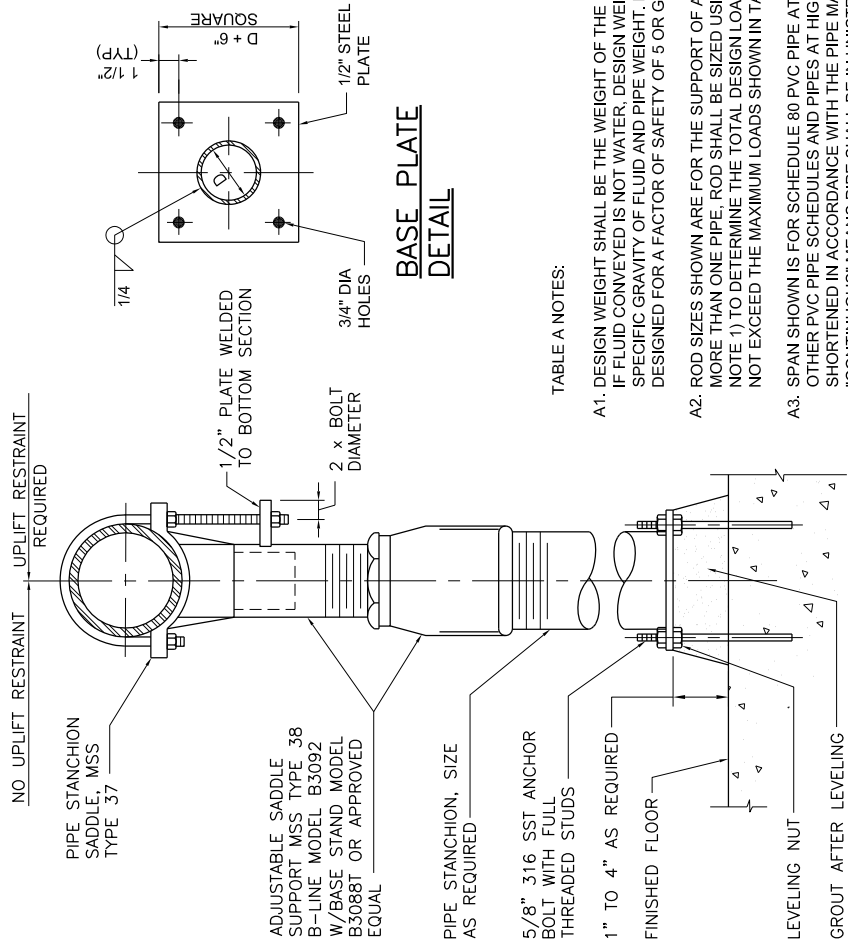
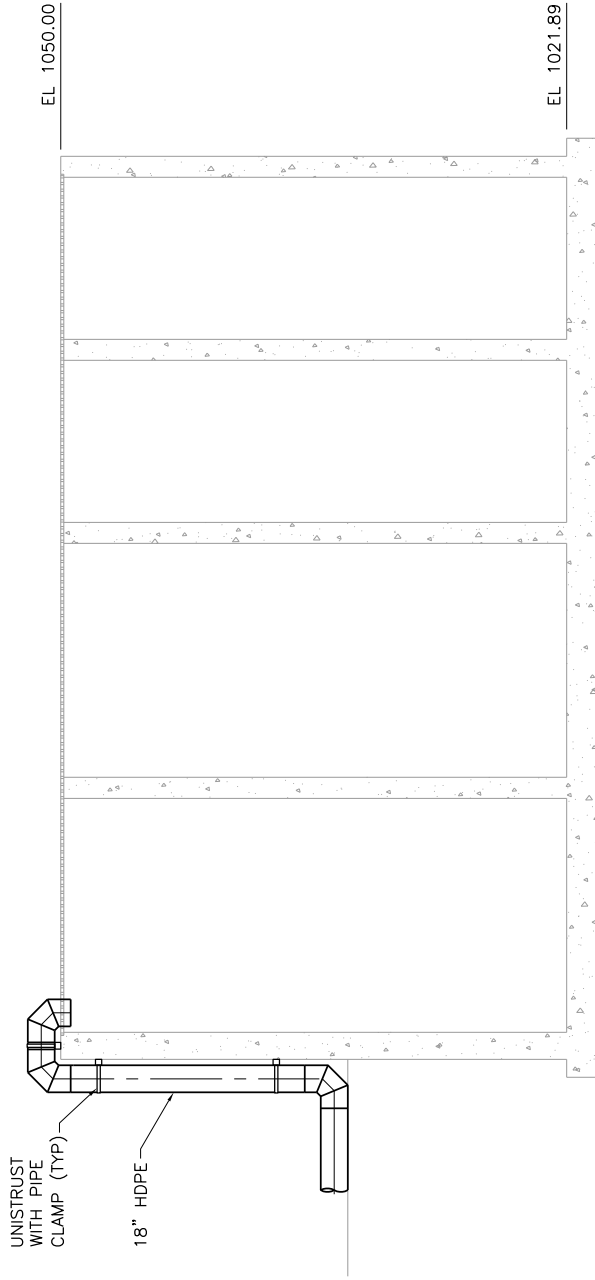
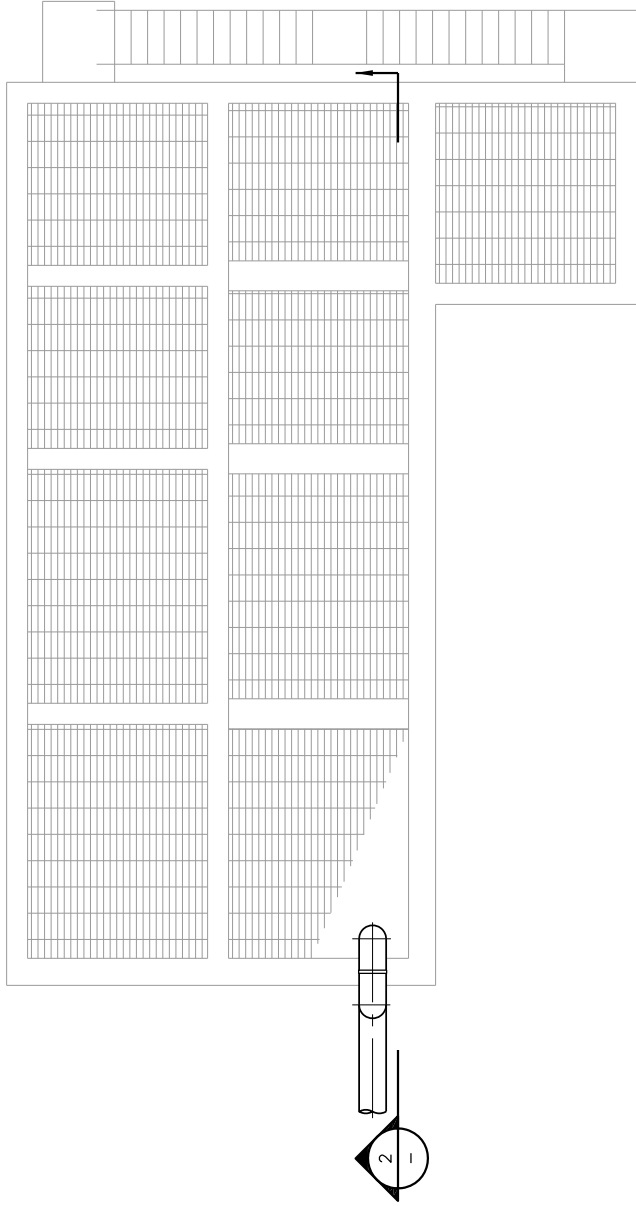
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2	ISSUE	02/12/15	DRAWN	02/12/15	WW-PST-PL-SITE.dwg
3	ISSUE	02/12/15	CHECKED	02/12/15	WW-PST-PL-SITE.dwg
4	ISSUE	02/12/15	REVIEWED	02/12/15	WW-PST-PL-SITE.dwg
5	ISSUE	02/12/15	APPROVED	02/12/15	WW-PST-PL-SITE.dwg

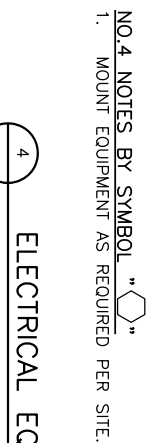
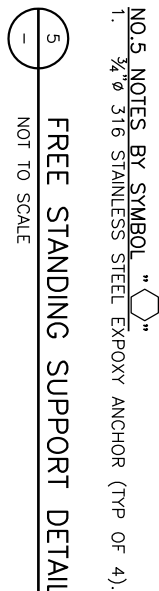
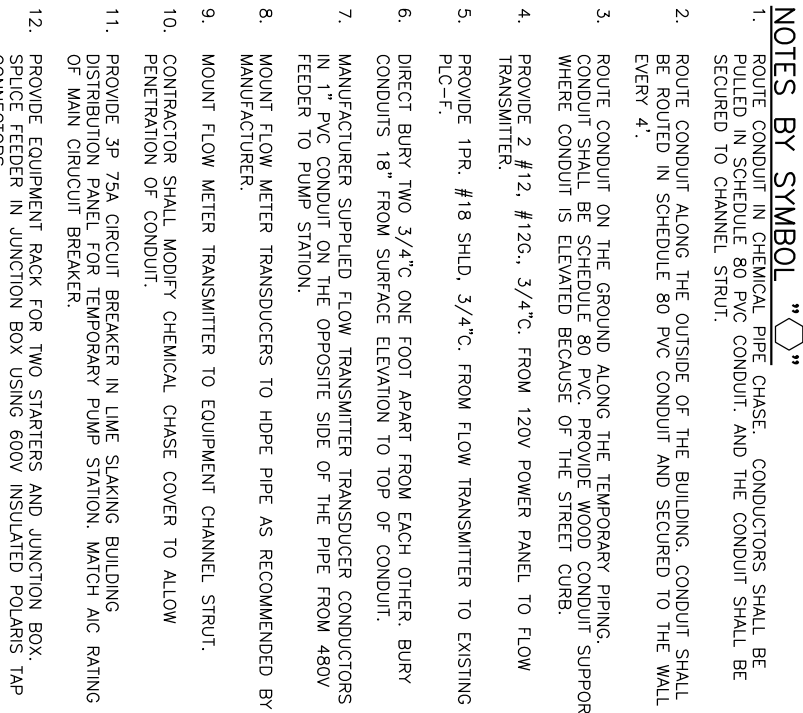
Bar is one inch on original drawing, if not one inch on this sheet, adjust scale.

VERIFY SCALE

PS-1

SEQ. 1





CITY OF WICHITA FALLS, TEXAS

SUPPLEMENTAL PERMEATE PUMP STATION

ELECTRICAL

ELECTRICAL SITE PLAN