

APPENDIX R
Chlorine Contact Calculations

Town of South Prairie: Potable Water Source
Chlorine Contact Time Product (CT) Calculations

Well #1 (School Yard Well) Estimated CT at first customer

A. EXISTING (no changes to system)

| | | Pipe Dia. = 8 inch | | | | | | | | | |
|------------------------------------|---------------------|--------------------------|-------------------|-------------------------|-----|----------------------|--------------------------------|-------------------------------|---|----------------|--|
| | | Length = 100 linear feet | | | | | | | | | |
| | | Flowrate = 55 gpm | | | | | | | | | |
| | | Area = 0.35 square feet | | | | | | | | | |
| Source Capacity ¹ (gpm) | Total Flow (CF/Min) | Pipe Volume (CF) | Flowrate (CF/min) | Baffling Factor (T10/T) | 1.0 | Detention Time (Min) | Total Detention Time T10 (Min) | FREE Residual Chlorine (mg/l) | = | CT (mg/l)(min) | |
| 55 | 7.4 | 34.9 | 7.4 | x | 1 | = 4.75 | 4.7 | x 0.25 | = | 1.2 | |

B. MODIFICATION: Increase Free Residual to Meet Minimum 6.0 CT (mg/l) (min)

| | | Pipe Dia. = 8 inch | | | | | | | | | |
|------------------------------------|---------------------|--------------------------|-------------------|-------------------------|-----|----------------------|--------------------------------|-------------------------------|---|----------------|--|
| | | Length = 100 linear feet | | | | | | | | | |
| | | Flowrate = 55 gpm | | | | | | | | | |
| | | Area = 0.35 square feet | | | | | | | | | |
| Source Capacity ¹ (gpm) | Total Flow (CF/Min) | Pipe Volume (CF) | Flowrate (CF/min) | Baffling Factor (T10/T) | 1.0 | Detention Time (Min) | Total Detention Time T10 (Min) | FREE Residual Chlorine (mg/l) | = | CT (mg/l)(min) | |
| 55 | 7.4 | 34.9 | 7.4 | x | 1 | = 4.75 | 4.7 | x 1.27 | = | 6.0 | |

C. MODIFICATION: Implement Project #S6 (Replace existing 8-inch with 10-inch, lengthen transmission into distribution) and #S1b (Increase physical source capacity to maximum proposed water right of 100 GPM)

| | | Pipe Dia. = 10 inch | | | | | | | | | |
|------------------------------------|---------------------|--------------------------|-------------------|-------------------------|-----|----------------------|--------------------------------|-------------------------------|---|----------------|--|
| | | Length = 670 linear feet | | | | | | | | | |
| | | Flowrate = 100 gpm | | | | | | | | | |
| | | Area = 0.55 square feet | | | | | | | | | |
| Source Capacity ¹ (gpm) | Total Flow (CF/Min) | Pipe Volume (CF) | Flowrate (CF/min) | Baffling Factor (T10/T) | 1.0 | Detention Time (Min) | Total Detention Time T10 (Min) | FREE Residual Chlorine (mg/l) | = | CT (mg/l)(min) | |
| 100 | 13.4 | 365.4 | 13.4 | x | 1 | = 27.33 | 27.3 | x 0.22 | = | 6.0 | |

Town of South Prairie: Potable Water Source

Chlorine Contact Time Product (CT) Calculations

Well #2 (Tubbs Road Well) Estimated CT at first customer

(USING BAFFLING FACTOR OF 1.0 ASSUMING WATER ENTERS DISTRIBUTION DIRECTLY, BYPASSES RESERVOIR)

A. EXISTING (no changes to system)

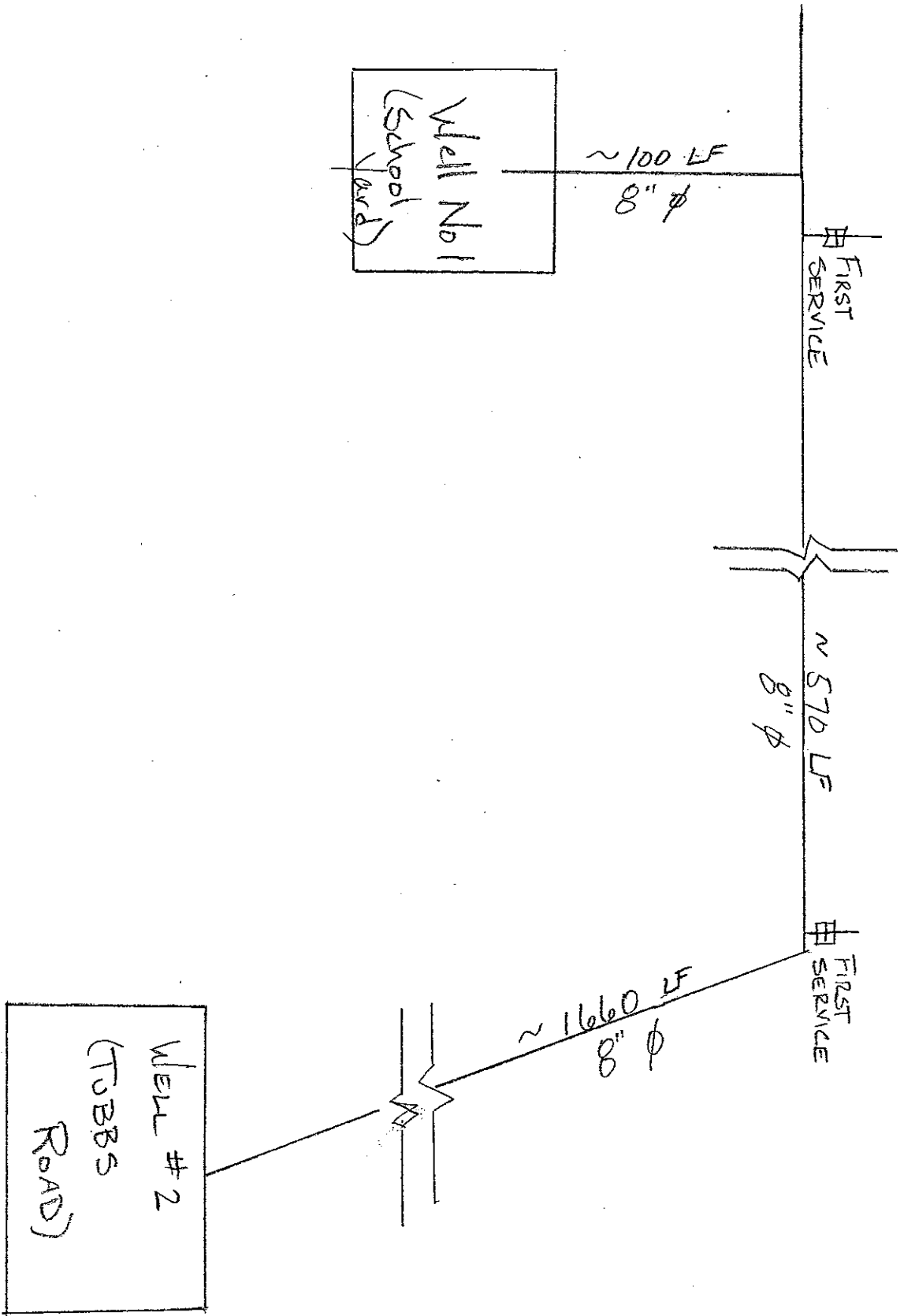
| | | Pipe Dia. = 8 inch | | | | | | | | |
|------------------------------------|---------------------|---------------------------|-------------------|-------------------------|-----|----------------------|--------------------------------|-------------------------------|----------------|--|
| | | Length = 1660 linear feet | | | | | | | | |
| | | Flowrate = 325 gpm | | | | | | | | |
| | | Area = 0.35 square feet | | | | | | | | |
| Source Capacity ¹ (gpm) | Total Flow (CF/Min) | Pipe Volume (CF) | Flowrate (CF/min) | Baffling Factor (T10/T) | 1.0 | Detention Time (Min) | Total Detention Time T10 (Min) | FREE Residual Chlorine (mg/l) | CT (mg/l)(min) | |
| 325 | 43.4 | 579.4 | / 43.4 | x | 1 | = 13.34 | 13.3 | x 0.25 | = 3.3 | |

B. MODIFICATION: Increase Free Residual to Meet Minimum 6.0 CT (mg/l) (min)

| | | Pipe Dia. = 8 inch | | | | | | | | |
|------------------------------------|---------------------|---------------------------|-------------------|-------------------------|-----|----------------------|--------------------------------|-------------------------------|----------------|--|
| | | Length = 1660 linear feet | | | | | | | | |
| | | Flowrate = 325 gpm | | | | | | | | |
| | | Area = 0.35 square feet | | | | | | | | |
| Source Capacity ¹ (gpm) | Total Flow (CF/Min) | Pipe Volume (CF) | Flowrate (CF/min) | Baffling Factor (T10/T) | 1.0 | Detention Time (Min) | Total Detention Time T10 (Min) | FREE Residual Chlorine (mg/l) | CT (mg/l)(min) | |
| 325 | 43.4 | 579.4 | / 43.4 | x | 1 | = 13.34 | 13.3 | x 0.45 | = 6.0 | |

C. MODIFICATION: Implement Project #D3 (New 12" transmission main)

| | | Pipe Dia. = 12 inch | | | | | | | | |
|------------------------------------|---------------------|---------------------------|-------------------|-------------------------|-----|----------------------|--------------------------------|-------------------------------|----------------|--|
| | | Length = 1660 linear feet | | | | | | | | |
| | | Flowrate = 325 gpm | | | | | | | | |
| | | Area = 0.79 square feet | | | | | | | | |
| Source Capacity ¹ (gpm) | Total Flow (CF/Min) | Pipe Volume (CF) | Flowrate (CF/min) | Baffling Factor (T10/T) | 1.0 | Detention Time (Min) | Total Detention Time T10 (Min) | FREE Residual Chlorine (mg/l) | CT (mg/l)(min) | |
| 325 | 43.4 | 1,303.8 | / 43.4 | x | 1 | = 30.01 | 30.0 | x 0.2 | = 6.0 | |



Parametrix

PROJECT SOUTH PRAIRIE WSP SHEET 1 OF
BY J. DORAN DATE 7/12/06 CHECKED DATE
SUBJECT CT Product JOB NO. PHASE TASK

CT Product Required - 6.0 (mg/L) min
Detention time @ existing configuration - 4.7 min

∴ Required residual R
 $6.0 = 4.7 \text{ min} \times R$
 $R = 1.27 \text{ mg/L}$ SAY 1.3 mg/L

12.5% NaOCl Specific gravity = 1.165

$$\frac{1.165 \text{ g soln}}{\text{ml soln}} \times \frac{1000 \text{ ml}}{\text{L}} \times \frac{0.12 \text{ g NaOCl}}{\text{g soln}} \times \frac{1 \text{ lb}}{454 \text{ g}} \times \frac{3.785 \text{ L}}{\text{gal}}$$

= 1.165 lb NaOCl / Gal soln

Hypochlorite ion weight

| | | |
|---------|---------|----------------------------|
| Na - | 22.9898 | } OCl ⁻ = 51.45 |
| Cl - | 35.453 | |
| O - | 15.9994 | |
| <hr/> | | |
| NaOCl = | 74.44 | |

OCl⁻ fraction = 51.45 / 74.44 = .691

This represents % compound available as OCl⁻ for each unit of NaOCl and therefore available for HOCl formation.

Parametrix

PROJECT _____ SHEET _____ OF _____
BY _____ DATE _____ CHECKED _____ DATE _____
SUBJECT _____ JOB NO. _____ PHASE _____ TASK _____

$$\text{Feed rate} = \frac{\text{Residual (R)} \times \text{Flowrate (Q)}}{\text{Purity (P)}}$$

$$R = 1.3 \text{ mg/L}$$

$$Q = 60 \text{ gal/min} \times \frac{3.785 \text{ L}}{\text{gal}} = 227.1 \text{ L/min}$$

$$P = \text{Chemical purity} \times \text{OCl}^- \text{ fraction} \\ = (0.95)^{**} \times (0.691) = .66$$

* Actual source production is 55 gpm, use 60 gpm for more conservative estimate.

** Assume 95% purity.

$$\text{Feed rate} = \frac{1.3 \text{ mg/L}_{\text{H}_2\text{O}} \times \frac{227.1 \text{ L}_{\text{H}_2\text{O}}}{\text{min}}}{.66}$$

$$= 447.31 \text{ mg/min} \quad (@ 60 \text{ gpm})$$

$$447.31 \text{ mg/min (NaOCl)} \times \frac{3}{1000 \text{ mg}} \times \frac{\text{lb}}{454 \text{ g}}$$

$$= 9.85 \times 10^{-4} \frac{\text{lb (NaOCl)}}{\text{min}}$$