WRIGHT-PIERCE
Engineering a Better Environment

Water
Wastewater
Infrastructure

July 10, 2009
Project No. 10048F

Mr. Rowland Denny
Senior Sanitary Engineer
Planning and Standards Division
Bureau of Water Protection and Land Reuse
Department of Environmental Protection
79 Elm Street
Hartford, CT, 06105-5127

Subject: Triennial Review of Water Quality Standards
Sharon WPCF Effluent Copper Limits

Dear Mr. Denny;

As posted on it's web site, the Connecticut Department of Environmental Protection (the Department) is soliciting input on any aspect of the state's Water Quality Standards (WQS) that a person believes the Department should consider for potential revision. Wright-Pierce has developed this letter to provide input on potential revisions to the WQS at the request of the Sharon Sewer & Water Commission relative to their current effluent copper limits.

As you are aware, Wright-Pierce conducted a study of potential copper sources reaching the Sharon sanitary sewer collection system and Water Pollution Control Facility (WPCF). Based on this study, no specific source with a significant copper contribution was identified and the influent copper appeared to be coming from throughout the collection system. At the time the study was completed, Wright-Pierce requested that the receiving stream for the Sharon WPCF, Indian Lake Creek, be added to the list of waters in the WQS for which site-specific criteria have been adopted. At that time, the Department indicated that it would consider the addition of Indian Lake Creek to the list of waters to which site-specific criteria have been adopted the next time the WQS were updated. With the public notice of the triennial review of the WQS, the Sharon Sewer and Water Commission is renewing this request and is submitting this letter as a formal comment for consideration. Once the Water Quality Standards have been revised the Sharon Sewer and Water Commission requests that the Department adjust the copper limits in Sharon's NDPES permit based on the site-specific criteria. Additional information in support of these requests is presented below.

BACKGROUND

The permitted design flow rate for the Sharon WPCF is 0.108 mgd. The current NPDES permit includes an allocated zone of influence (ZOI) of 0.69 cfs. This results in an in-stream waste concentration (IWC) of 19.50%. Based on the IWC, it is requested that Indian Lake Creek at the Sharon WPCF discharge be added to the list of waters to which site-specific criteria have been adopted. These criteria were adopted for areas where the in-stream waste concentration (IWC) was 20 percent or greater due to the discharge from a biological treatment facility. The Department had previously indicated that at this IWC, they would add Indian Lake Creek to this list the next time the Water Quality Standards were amended.

As a requirement of the previous draft NPDES permit, the Sharon Sewer and Water Commission expended considerable effort and funds in developing a copper mass balance of the collection system. The results of the copper mass balance are included in the report entitled *Wastewater Facilities Study and Infiltration and Inflow Evaluation* (Wright-Pierce, July 2003). One result of this effort was the determination that the receiving stream has a very high hardness concentration. The lowest value measured in three downstream samples was 174 mg/l. The copper limits included in the draft permit are calculated based on a significantly lower hardness concentration of 50 mg/l, which results in a significantly lower calculated copper limit.

We have recalculated the copper limits that would result from the site-specific criteria listed in the Connecticut Water Quality Standards. We have also recalculated the limits using the EPA's "Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness Dependent" as presented in Appendix B of the *National Recommended Water Quality Criteria: 2002*, EPA-822-R-047, November 2002. The results of these calculations are presented in Table 1 below along with the limits listed in the current permit. A copy of the calculations used to develop these limits is attached to this letter.

Table 1
Sharon WPCF Equivalent Effluent Copper Limits Using Various Criteria

Method	Average Monthly Limit, kg/d	Maximum Daily Limit, kg/d
Current CT WQS Criteria	0.010	0.017
Site-Specific CT WQS Criteria	0.038	0.057
EPA Hardness-Based Criteria	0.027	0.040

As seen in Table 1, when considering either the Connecticut site-specific criteria or the hardness criteria, the average monthly copper limits for the Sharon WPCF effluent would increase by a factor of 3.8 and 2.7, respectively. Therefore, the final copper limits based on current Connecticut state-wide criteria are overly stringent when either site-specific or hardness factors are considered. As indicated previously by the Department, the site-specific criteria would appear to support modification or elimination of the copper limit.

Based on the IWC of 19.50% and the hardness levels within Indian Lake Creek, the Sharon Sewer & Water Commission respectfully requests that Indian Lake Creek at the point of the Sharon WPCF discharge be added to the list of waters to which site-specific criteria have been adopted. In addition, it is requested that the copper limits included within the Sharon WPCF NPDES permit be adjusted based on the site specific criteria.

Should you need additional information, please feel free to call me with any questions.

Very truly yours;

WRIGHT-PIERCE

Christopher N. Pierce, P.E.
Project Manager

Cc: Stephen Szalewicz, Chairman, Sharon Sewer & Water Commission
Alan Goettel, United Water

Attachments

BY CNP DATE 4/7/03 SHEET NO. 1 OF

CHCKD. BY DATE PROJECT NO. 10048A

Wright-Pierce

PROJECT Sharon - Copper Limits BOOK NO.

Recalculate copper limits based on site-specific criteria and based on EPA data for hardness

Site-specific criteria

Acute = 25.7 µg/l

Chronic = 18.1 µg/l IWC = $\frac{0.108 \text{ MGD}}{(0.108 + 0.446 \text{ cfs})} = 0.195$

Acute WLA = $\frac{25.7}{0.195} = 131.8$ µg/l

Chronic WLA = $\frac{18.1}{0.195} = 92.8$ µg/l

Acute LTA = 131.8 µg/l × 0.715 = 94.2 µg/l

Chronic LTA = 92.8 µg/l × 1.0 = 92.8 µg/l

Average Monthly Limit = 92.8 µg/l
Maximum Daily Limit = 92.8 × 1.5 = 139.2 µg/l

Monthly Mass Limit = 92.8 µg/l × $\frac{\text{mg}}{10^3 \text{ µg}}$ × 0.108 MGD × 8.34 × kg/l.c/lb = 0.038 kg/d

Maximum Day Limit = 0.038 kg/d × 1.5 = 0.057 kg/day

BY CNP DATE 4/7/03 SHEET NO. 2 OF

CHCKD. BY DATE Wright-Pierce PROJECT NO. 100148A

PROJECT Sharon - Copper Limits BOOK NO.

Adjust limits for hardness

Round	1	downstream hardness	198 mg/l
	2		179 mg/l
	3		174 mg/l

Lowest hardness measured 174 mg/l - do calcs @ 150 mg/l hardness

$$CMC = e^{\{m_A [\ln(\text{hardness})] + b_A\}} \times CF$$

$m_A = 0.9422$

$b_A = -1.70$

$CF = 0.96$

$$CMC = e^{\{0.9422 [\ln(150)] + (-1.70)\}} \times 0.96 = 19.69 \text{ µg/l}$$

$$CCC = e^{\{m_c [\ln(\text{hardness})] + b_c\}} \times CF$$

$m_c = 0.8545$

$b_c = -1.702$

$CF = 0.96$

$$CCC = e^{\{0.8545 [\ln(150)] + (-1.702)\}} \times 0.96 = 12.66 \text{ µg/l}$$

Acute $WLA = \frac{19.69}{0.195} = 100.9$ µg/l $LTA = 100.9 \times 0.715 = 72.14$ µg/l

Chronic $WLA = \frac{12.66}{0.195} = 64.9$ µg/l $LTA = 64.9$ µg/l

$$AML = 64.9 \text{ µg/l} \times \frac{\text{mg}}{10^3 \text{µg}} \times 0.1008 \text{ mgd} \times 8.34 \times \frac{\text{kg/l}}{0.1161 \text{ d}} = 0.0246 \text{ kg/d}$$

$MDL = 0.0246 \times 1.3 = 0.0398$ kg/d.

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

June 26, 2001

Mr. William Buehrle, Chairman
Sharon Sewer & Water Commission
Town Hall
Sharon, CT 06069

RE: Town of Sharon
NPDES Permit No. CT0101052

Dear Mr. Buehrle,

Below is a step by step explanation of how our spreadsheet calculated water quality limits for copper for the Sharon POTW. These calculations follow EPA guidance in *Technical Support Document For Water Quality-based Toxics Control*, EPA/505/2-90-001. Attached are copies of the related tables for your convenience.

1. Calculate the acute and chronic wasteload allocations (WLA) by dividing the criteria by the instream waste concentration (IWC) under critical conditions, taking into account the background concentration. Note in these calculations, the background concentration is zero (0.0), therefore the WLA is simply the criteria divided by the IWC. The IWC is defined as the decimal fraction of the downstream flow comprised of discharge effluent.

   IWC = (design flow / design flow + 7Q10) = 0.108 MGD / (0.108 MGD + 0.69 cfs) = 0.195

   Acute WLA = acute criteria / iwc
   or
   = 14.3 µg/l / 0.195 = 73.3 µg/l

   Chronic WLA = chronic criteria / iwc
   or
   = 4.8 µg/l / 0.195 = 24.6 µg/l

2. Utilize the WLA multiplier in Table 5-1 of EPA's guidance to calculate the Long Term Average (LTA) effluent quality that will meet the acute and chronic WLAs given the variability in effluent quality expected based on past monitoring. Those data show that a cv (coefficient of variance) of 0.3 is representative of the variability of copper in the Sharon POTW effluent. The acute LTA uses the Chronic formula (multiplier) and the chronic LTA uses the Health multiplier (1.0, see Note below).

2. (continued)

Acute LTA = 73.3 µg/l x 0.715 = 52.4 µg/l
Chronic LTA = 24.6 µg/l x 1.0 = 24.6 µg/l

(Both WLAs, acute and chronic, must be met therefor the more restrictive chronic LTA is used for subsequent calculations)

3. The adopted copper criteria are treated as health criteria from this point forward. The AML is equal to the LTA reflecting the allowable exceedance frequency for copper criteria in Connecticut's Water Quality Standards. The Maximum Daily Limit is calculated by multiplying the AML by a factor based on the relationship between the AML and the MDL, and the variability in the effluent (0.3) as shown in Table 5-2 of EPA's guidance (4 samples per month, which is the minimum frequency of monitoring for limit calculations).

Average Monthly Limit = 24.6 µg/l
Maximum Daily Limit = 24.6 µg/l x 1.50 = 36.9 µg/l

4. Convert the concentration limits from step 3 to mass equivalents by multiplying by the permitted design flow for the WPCF.

Average Monthly Limit = 24.6 µg/l x (0.108 MGD / 0.264 gal/l) = 10.1 g/day
Maximum Daily Limit = 36.9 µg/l x (0.108 MGD / 0.264 gal/l) = 15.1 g/day

Note: Connecticut's copper criteria are median and rare exceedance values, and thus do not follow the same formulas as other parameters. Copper follows the same calculations as Health Criteria in that the AML is equal to the LTA which is equal to the WLA (or more simply, the AML is equal to the Criteria/IWC when the background copper concentration is set = 0).

I hope this information proves useful. If I can be of further assistance, please do not hesitate to call me.

Sincerely,

Thomas T. Haze
Water Toxics Program
(860) 424-3734

Table 5-2. Calculation of Permit Limits

CV	LTA multipliers $e^{[z\sigma - 0.5\sigma^2]}$	
	95th Percentile	99th Percentile
0.1	1.17	1.25
0.2	1.36	1.55
0.3	1.55	1.90
0.4	1.75	2.27
0.5	1.95	2.68
0.6	2.13	3.11
0.7	2.31	3.56
0.8	2.48	4.01
0.9	2.64	4.46
1.0	2.78	4.90
1.1	2.91	5.34
1.2	3.03	5.76
1.3	3.13	6.17
1.4	3.23	6.56
1.5	3.31	6.93
1.6	3.38	7.29
1.7	3.45	7.63
1.8	3.51	7.95
1.9	3.56	8.26
2.0	3.60	8.55

Maximum Daily Limit

$$MDL = LTA \cdot e^{[z\sigma - 0.5\sigma^2]}$$

where $\sigma^2 = ln[CV^2 + 1]$,
z = 1.645 for 95th percentile occurrence probability, and
z = 2.326 for 99th percentile occurrence probability

Average Monthly Limit

$$AML = LTA \cdot e^{[z\sigma_n - 0.5\sigma_n^2]}$$

where $\sigma_n^2 = ln[CV^2 / n + 1]$,
z = 1.645 for 95th percentile,
z = 2.326 for 99th percentile, and
n = number of samples/month

CV	LTA Multipliers $e^{[z\sigma_n - 0.5\sigma_n^2]}$									
	95th Percentile					99th Percentile				
	n=1	n=2	n=4	n=10	n=30	n=1	n=2	n=4	n=10	n=30
0.1	1.17	1.12	1.08	1.06	1.03	1.25	1.18	1.12	1.08	1.04
0.2	1.36	1.25	1.17	1.12	1.08	1.55	1.37	1.25	1.16	1.09
0.3	1.55	1.38	1.26	1.18	1.09	1.90	1.59	1.40	1.24	1.13
0.4	1.75	1.52	1.36	1.25	1.12	2.27	1.83	1.55	1.33	1.16
0.5	1.95	1.66	1.45	1.31	1.16	2.68	2.09	1.72	1.42	1.23
0.6	2.13	1.80	1.55	1.38	1.19	3.11	2.37	1.90	1.52	1.28
0.7	2.31	1.94	1.65	1.45	1.22	3.56	2.66	2.08	1.62	1.33
0.8	2.48	2.07	1.75	1.52	1.26	4.01	2.96	2.27	1.73	1.39
0.9	2.64	2.20	1.85	1.59	1.29	4.46	3.28	2.48	1.84	1.44
1.0	2.78	2.33	1.95	1.66	1.33	4.90	3.59	2.68	1.96	1.50
1.1	2.91	2.45	2.04	1.73	1.36	5.34	3.91	2.90	2.07	1.56
1.2	3.03	2.56	2.13	1.80	1.39	5.76	4.23	3.11	2.19	1.62
1.3	3.13	2.67	2.23	1.87	1.43	6.17	4.55	3.34	2.32	1.68
1.4	3.23	2.77	2.31	1.94	1.47	6.56	4.86	3.56	2.45	1.74
1.5	3.31	2.86	2.40	2.00	1.50	6.93	5.17	3.78	2.58	1.80
1.6	3.38	2.95	2.48	2.07	1.54	7.29	5.47	4.01	2.71	1.87
1.7	3.45	3.03	2.56	2.14	1.57	7.63	5.77	4.23	2.84	1.93
1.8	3.51	3.10	2.64	2.20	1.61	7.95	6.06	4.46	2.98	2.00
1.9	3.56	3.17	2.71	2.27	1.64	8.26	6.34	4.68	3.12	2.07
2.0	3.60	3.23	2.78	2.33	1.68	8.55	6.61	4.90	3.26	2.14

The proper enforcement of this type of WLA depends on the parameter limited. For nutrients and biochemical oxygen demand (BOD), the WLA value generally has been used as the average daily permit limit. However, the impact associated with toxic pollutants is more time dependent, as reflected in the 4-day average duration for the criteria continuous concentration (CCC) (see Chapter 2). Where there is only one water quality criterion and therefore only one WLA, permit limits can be developed using the following procedure:

- Consider the single WLA to be the chronic WLA and derive an chronic LTA for this WLA using the procedures in Box 5-2 (Step 2, Part 2).
- Derive MDLs and AMLs using the procedures in Box 5-2 (Step 4).

The principal advantages and disadvantages of this procedure are similar to those for the two-value permit limit derivation method discussed previously except that it does not examine two WLAs.

5.4.2 Other Approaches to Permitting for Aquatic Life

Other approaches for translating WLA outputs into permit limits have been used by some permitting authorities. These methods may combine elements of the statistical procedures discussed earlier with specific technical and policy requirements of the permitting authority to derive limits that may be protective of water quality and consistent with the requirements of the WLA. Such approaches may use simplified statistical procedures.

Table 5-1. Back Calculations of Long-Term Average

CV	WLA Multipliers $e^{[0.5\sigma^2 - z\sigma]}$	
	95th Percentile	99th Percentile
0.1	0.853	0.797
0.2	0.736	0.643
0.3	0.644	0.527
0.4	0.571	0.440
0.5	0.514	0.373
0.6	0.468	0.321
0.7	0.432	0.281
0.8	0.403	0.249
0.9	0.379	0.224
1.0	0.360	0.204
1.1	0.344	0.187
1.2	0.330	0.174
1.3	0.319	0.162
1.4	0.310	0.153
1.5	0.302	0.144
1.6	0.296	0.137
1.7	0.290	0.131
1.8	0.285	0.126
1.9	0.281	0.121
2.0	0.277	0.117

Acute

$$LTA_{a,c} = WLA_{a,c} \cdot e^{[0.5\sigma^2 - z\sigma]}$$

where $\sigma^2 = ln[CV^2 + 1]$,
$z = 1.645$ for 95th percentile occurrence probability, and
$z = 2.326$ for 99th percentile occurrence probability

Chronic
(4-day average)

$$LTA_c = WLA_c \cdot e^{[0.5\sigma_4^2 - z\sigma_4]}$$

where $\sigma_4^2 = ln[CV^2/4 + 1]$,
$z = 1.645$ for 95th percentile occurrence probability, and
$z = 2.326$ for 99th percentile occurrence probability

CV	WLA Multipliers $e^{[0.5\sigma_4^2 - z\sigma_4]}$	
	95th Percentile	99th Percentile
0.1	0.922	0.891
0.2	0.853	0.797
0.3	0.791	0.715
0.4	0.736	0.643
0.5	0.687	0.581
0.6	0.644	0.527
0.7	0.606	0.481
0.8	0.571	0.440
0.9	0.541	0.404
1.0	0.514	0.373
1.1	0.490	0.345
1.2	0.468	0.321
1.3	0.449	0.300
1.4	0.432	0.281
1.5	0.417	0.264
1.6	0.403	0.249
1.7	0.390	0.236
1.8	0.379	0.224
1.9	0.369	0.214
2.0	0.360	0.204

The principal disadvantages of this procedure are:

- Necessary data for effluent variability and receiving water flows may be unavailable, which prevents the use of this approach.
- The amount of staff resources needed to explain how the limits were developed and to conduct the WLA also is a concern. The permit documentation (i.e., fact sheet) will need to clearly explain the basis for the LTA and CV and this can be resource intensive.

Permit Limit Derivation From Single, Stead Output

Some State water quality criteria and the corresp reported as a single value from which to defin level of effluent quality. For example, "copp must not exceed 0.75 milligrams per liter (mg/l) in state analyses assume that the effluent is constan the WLA value will never be exceeded. Thi ese deriving permit limits because permit l n effluent variability.