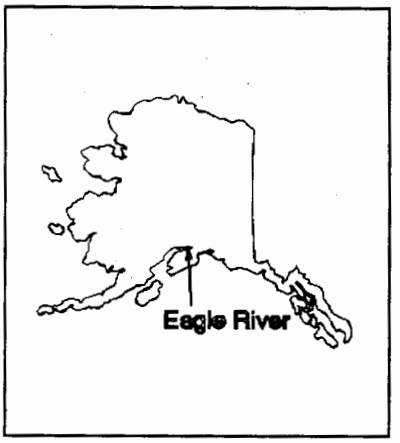
EAGLE RIVER

WQ CONCERNS AT A GLANCE:

Segment Identifiers:	*19050-002*
Parameters of Concern:	*Copper, Lead, Silver, Chlorine, Ammonia*
Uses Affected:	*Aquatic Life*
Known Sources:	*Point Sources - Publicly Owned Treatment Works, Storm water*



I. Introduction

The draft total maximum daily loads (TMDLs) for copper, lead, silver, ammonia, and chlorine in the Eagle River near Eagle River, Alaska, were developed in conjunction with the National Pollutant Discharge Elimination System (NPDES) permit for the Municipality of Anchorage (MOA), Eagle River Wastewater Treatment Facility (WTF). The draft TMDLs were included in the fact sheet for the permit and the public comment period was concurrent with the comment period for the draft permit (September 14, 1994, to October 14, 1994). Comments on the draft permit were received from the MOA, two of which are relevant to the TMDLs for metals. These comments were considered by EPA in establishing the final TMDLs. No comments were received on the TMDLs for chlorine or ammonia: therefore, the final TMDLs for those pollutants remain unchanged. For silver, information received from the MOA indicated that the discharge from the Eagle River WTF does not have the reasonable potential to cause or contribute to an exceedance of the water quality criterion for silver. In addition, there are no data to indicate that the Eagle River exceeds the criterion for silver, nor is there any reason to believe that the criterion will be exceeded in the foreseeable future. Therefore, EPA will not finalize the TMDL for silver at this time.

II. Background

Under Section 303(d)(1) of the Clean Water Act and 40 CFR §130.7, where technology-based limits or other pollution control requirements (e.g., best management practices) are not sufficient to achieve compliance with water quality standards, a total maximum daily load (TMDL) must be established. A TMDL is an implementation plan which identifies the degree of pollution control needed to attain

and maintain compliance with state water quality standards, including a margin of safety. As described in 40 CFR §130.7, the margin of safety is intended to address "any lack of knowledge concerning the relationship between effluent limitations and water quality." A margin of safety may be provided in two ways: 1) by using conservative assumptions in calculating the loading capacity and wasteload allocations, and 2) by establishing allocations that are lower than the defined loading capacity.

Analysis of the effluent data submitted by the WTF showed that technology-based limitations alone were not adequate to ensure that water quality standards for copper, lead, silver, chlorine, and ammonia are met at the point of discharge. Therefore, draft TMDLs were developed for these pollutants.

The first step in establishing a TMDL is to determine the assimilative capacity (the loading of pollutant that a water body can assimilate without causing or contributing to a violation of water quality standards). The next step is to divide the assimilative capacity into allocations for non-point sources (called load allocations, or LAs) and allocations for point sources (called wasteload allocations, or WLAs), after taking into account natural background loadings and a margin of safety to account for any uncertainties. The TMDL is the sum of the LAs, WLAs, background, and the margin of safety. Permit limitations are then developed for point sources that are consistent with the WLAs.

In the case of Eagle River, there were insufficient data to establish load allocations for nonpoint sources or background concentrations for any of the parameters. Therefore, these TMDLs consist of wasteload allocations for the Eagle River WTF and appropriate margins of safety to account for the lack of data. Monitoring required in the WTF's NPDES permit will be used to develop the data needed to determine background concentrations, possible contributions from nonpoint sources and the MOA's storm water discharge.

III. Applicable Criteria

The first step in determining the loading capacity for a parameter is calculating the criterion. The State of Alaska regulations at 18 AAC 70.020(b)(1) establish the criteria on which the loading capacities are based. Except for chlorine, Alaska's standards refer to EPA's *Quality Criteria for Water* (*Gold Book*) for the criteria.

Table 1 provides a summary of the draft and final criteria used in calculating the loading capacity for each of the TMDL parameters. Because the chronic criteria are generally more restrictive, the chronic criteria were used in determining the loading capacity for all parameters except silver, for which there is only an acute criterion. The calculations of the criteria are discussed below.

TABLE 1: Criteria for Eagle River				
Parameter	Draft TMDL (µg/l)		**Final TMDL (µg/l)**	
	Summer	Winter	Summer	Winter
Copper	4.6	8.3	**11**	**12**
Lead	0.78	1.9	**2.7**	**3.1**
Silver	0.60	2.0	**3.3**	**3.9**
Ammonia	1800	2000	**1800**	**2000**
Chlorine	2.0	2.0	**2.0**	**2.0**

Metals

For metals, the criteria are a function of hardness. Due to significant differences in ambient conditions in summer and winter, seasonal criteria were calculated for Eagle River.

The hardness in the final TMDLs for metals has been changed based on comments received from the MOA. In calculating the criteria for the draft TMDLs, hardness data were arranged seasonally, and the fifth percentile for each season was selected. The MOA submitted data showing that flow and natural logarithm (ln) of the hardness are inversely related; that is, high flow is correlated with low ln hardness and low flow is correlated with high ln hardness. This means that a low flow and a fifth percentile hardness were unlikely to occur together, so using both of these parameters to determine the loading capacity was unnecessarily stringent. EPA concurred with this comment and, in the final TMDLs based the criteria on the fifth percentile hardness that corresponds to the low flow for each season. The low flow is represented by the 7 day, 10 year low flow (7Q10). A 7Q10 flow is the average of 7 consecutive days flow that has a one-in-ten chance of occurring in any given year.

Figure 1 shows the correlation between flow and ln hardness (solid line) as well as the 90 percent confidence interval around the line (dotted lines). The lower dotted line represents the 5th percentile, which means that, for a particular flow, the corresponding ln hardness will be greater than that value 95 percent of the time. Similarly, the upper dotted line represents the 95th percentile.

The fifth percentile ln hardness corresponding to summer low flow (205 cubic feet per second, cfs) is 4.49, which translates to a hardness of 89 mg/l as calcium carbonate ($CaCO_3$). There are no hardness data corresponding to winter low flow (31 cfs). In this case, EPA determined that it was not appropriate to extrapolate beyond the range

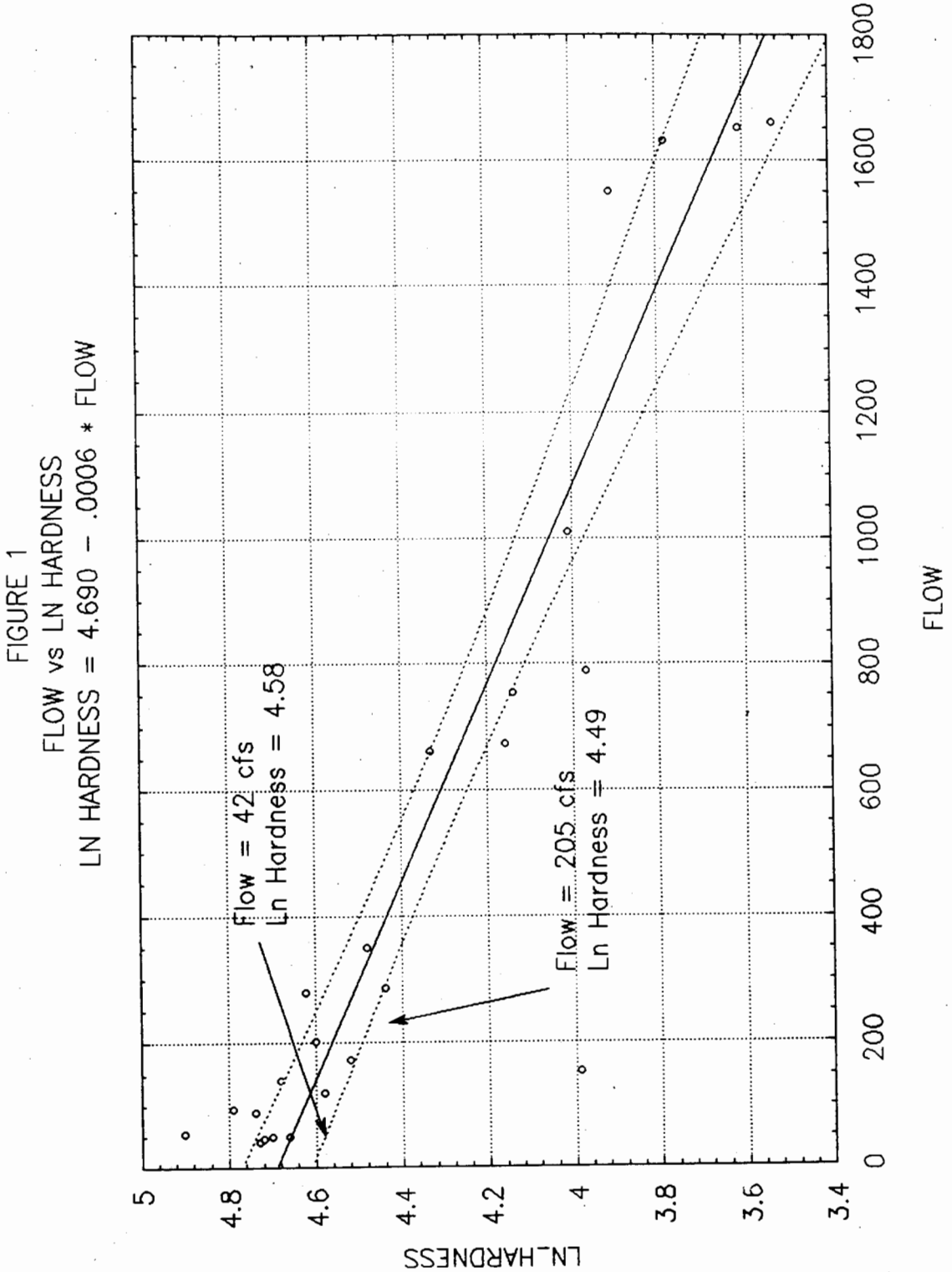


FIGURE 1
FLOW vs LN HARDNESS
LN HARDNESS = 4.690 - .0006 * FLOW
flow = 42 cfs
Ln Hardness = 4.58
Flow = 205 cfs
Ln Hardness = 4.49
LN_HARDNESS
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
0
200
400
600
800
1000
1200
1400
1600
1800
FLOW

of the data. Therefore, EPA used the lowest flow for which hardness data were available, 42 cfs, resulting in a ln hardness of 4.58, which corresponds to a hardness of 97 mg/l $CaCO_3$. These values compare with hardness values of 33 and 66 mg/l $CaCO_3$ for summer and winter, respectively, in the draft TMDLs.

Using the above hardness values, EPA calculated the seasonal criteria for copper, lead, and silver, based on the following equations, using the values for m_A, b_A, m_C, and b_C from the National Toxics Rule (listed in Table 2):

$$\text{Acute Criteria} = \exp\{m_A[\ln(\text{hardness})] + b_A\}$$
$$\text{Chronic Criteria} = \exp\{m_C[\ln(\text{hardness})] + b_C\}$$

TABLE 1: Factors for Calculating Metals Criteria

Parameter	m_A	b_A	m_C	b_C
Copper	0.9422	-1.464	0.8545	-1.465
Lead	1.273	-1.460	1.273	-4.705
Silver	1.72	-6.52	NA	NA

Ammonia

The ammonia criteria are a function of pH and temperature. As with hardness, there are significant seasonal differences in temperature and pH. Therefore, seasonal ammonia criteria were calculated. To represent worst-case conditions, the 95th percentile temperatures and fifth percentile pHs were used for each season in both the draft and final TMDL. The fifth percentile summer and winter pH values for Eagle River are 6.3 and 7.1, respectively. The respective summer and winter temperatures are 11.4 and 3.6 degrees centigrade. Using these conditions, the following formulae were used to calculate the acute and chronic criteria:

$$\text{Acute Criterion} = 0.52/FT/FPH/2$$

and

$$\text{Chronic Criterion} = 0.80/FT/FPH/RATIO$$

where:

FT, the temperature factor, is calculated as:

$$FT = 10^{0.03(20-T)}$$

FPH, the pH factor, is calculated as:

$$FPH = \frac{1 + 10^{7.4-pH}}{1.25}$$

and RATIO, the acute to chronic ratio, is calculated as:

$$RATIO = \frac{24(10^{7.7-pH})}{1 + 10^{7.4-pH}}$$

Chlorine

The Alaska water quality criterion for chlorine is 2.0 μg/l.

IV. Loading Capacity

The loading capacities for each of the parameters were calculated based on the criteria (in μg/l) derived from the above equations, multiplied by the receiving water flow (in cfs) and a conversion factor. The summer and winter flows are 205 cfs and 31 cfs, respectively.

Table 3 summarizes the draft and final loading capacities.

TABLE 3: Loading Capacities for Eagle River

Parameter	Draft		**Final**	
	Summer (lb/day)	Winter (lb/day)	**Summer (lb/day)**	**Winter (lb/day)**
Copper	5.1	1.4	**12**	**2.0**
Lead	0.86	0.32	**3.0**	**0.52**
Silver	0.66	NA	**NA**	**NA**
Ammonia	2000	330	**2000**	**330**
Chlorine	2.2	0.33	**2.2**	**0.33**

V. Load Allocations, Wasteload Allocations and Margin of Safety

The wasteload allocations for the Eagle River WTF are based on the dilution available in the mixing zones approved by the State. For each parameter, the criterion was multiplied by the dilution to determine the concentration the permittee would be allowed to discharge while still meeting water quality standards at the edge of the

mixing zone. This concentration was multiplied by the facility design flow (2.5 million gallons per day) and a factor to convert from μg/l and mgd to lb/day.

As discussed above, there are two ways to establish a margin of safety: 1) by using conservative assumptions in calculating loading capacities and wasteload allocations and 2) by reserving a portion of the loading capacity. In this case, both methods were used.

Conservative assumptions were used in calculating both the loading capacity and the wasteload allocations. For example, using and 5th percentile hardness values in calculating the loading capacities for metals, 5th percentile pH and 95th percentile temperature in calculating the ammonia loading capacity, and using 7Q10 flows for all parameters provides some margin of safety. In addition, using the design flow (2.5 mgd) instead of the actual flow (1.1 mgd average) when calculating the wasteload allocation over-estimates the current loading by more than a factor of 2.

In addition to using conservative assumptions, 25 percent of each of the loading capacities was reserved for a margin of safety. The TMDL also retains an unallocated loading of approximately 3 to 5 percent under winter conditions and approximately 54 percent under summer conditions. This unallocated loading is the difference between the sum of the margin of safety and the wasteload allocation for the WTF and the total loading capacity.

Information on the contributions from the MOA's storm water discharges was based on the city's storm water application. As part of the application, the MOA submitted data on copper discharges to Eagle River. Data consist of three samples ranging from non-detect (at an unspecified detection limit) to 10 μg/l. It is not clear from the application whether the copper was analyzed as total or total recoverable metal. In addition, six data points were reported for flow, ranging from zero to 0.84 cfs. There were no data collected for other metals of concern. Because of the uncertainties associated with the data, no wasteload allocation was established for the city's storm water discharge. The monitoring program required under the Eagle River WTF NPDES permit will address these uncertainties.

With regard to background concentrations, receiving water data for Eagle River (from EPA's STORET data base) are limited to a few samples for some pollutants and do not have any quality assurance/quality control information associated with them. In addition, the metals data is in dissolved form, not the total recoverable form on which the water quality standards are based. Because of these uncertainties, EPA assumed a background concentration of zero for these parameters. As mentioned above, the monitoring program required under the Eagle River WTF NPDES permit will address these uncertainties.

For silver, for which there is no effluent limitation in the final permit, the loading from the WTF was calculated using the maximum reported effluent concentration multiplied by the facility design flow, the 8.34 conversion factor, and the "reasonable potential"

multiplier recommended in EPA's *Technical Support Document for Water Quality based Toxics Control* (*TSD*). By using the multiplier, this analysis provides a worst-case estimate of the potential loading from the WTF. This analysis indicated that the discharge did not have the reasonable potential to cause or contribute to an exceedance of the water quality criterion for silver. In addition, there were no data indicating that the receiving water did not meet the criterion, nor is there any reason to believe that the criterion will be exceeded in the foreseeable future. Therefore, EPA will not finalize the TMDL for silver at this time.

Table 4 provides a summary of the wasteload allocations for the Eagle River WTF, the margins of safety, and the unallocated loadings. "S" designates summer conditions and "W" designates winter conditions. The draft TMDLs did not specifically consider unallocated loadings. Therefore, the last two columns refer only to the final TMDLs. The figures may not add up exactly due to rounding.

TABLE 4: Wasteload Allocations, Margins of Safety, and Unallocated Loadings

Parameter	Eagle River WTF WLA (lb/day)				Margin of Safety (lb/day)				Unallocated Loading (lb/day)	
	Draft		**Final**		Draft		**Final**			
	S	W	**S**	**W**	S	W	**S**	**W**	**S**	**W**
Copper	1.0	1.0	**2.5**	**1.4**	4.2	0.43	**3.0**	**0.50**	**6.6**	**0.11**
Lead	0.18	0.23	**0.63**	**0.37**	0.72	0.10	**0.74**	**0.13**	**1.6**	**0.02**
Silver	0.14	NA	**NA**	**NA**	0.52	NA	**NA**	**NA**	**NA**	**NA**
Chlorine	0.46	0.24	**0.46**	**0.24**	1.8	0.09	**1.8**	**0.09**	**1.2**	**0.01**
Ammonia	410	240	**410**	**240**	1570	90	**1570**	**90**	**1080**	**8.8**

V. Monitoring

Monitoring is required in Eagle River WTF's NPDES permit to determine natural background concentrations and any possible contributions from the MOA's storm water discharge. The WTF permit requires the facility to submit a study plan for ambient monitoring of copper, lead, silver, and zinc.

The objective of ambient monitoring study is to determine the "natural conditions" of the receiving water, as well as to determine the concentrations of metals contributed by the city's storm water discharges. The State of Alaska water quality standards define natural conditions as ". . . the sum of the physical, chemical, biological, or radiological conditions that exist in a water body before any human-caused discharge to, or addition of material to, the water".

The permit requires the permittee to submit a study plan addressing issues such as appropriate sampling locations, temporal and spatial variability in the receiving water, appropriate sampling and analytical methods (including clean techniques, if necessary), analytical variability, and quality assurance/quality control for sampling and analysis. The draft permit required this study to be submitted within 90 days of the effective date of the permit. Based on comments received from the MOA, the final permit allows 180 days to submit the study plan.

Under the conditions of the permit, at least quarterly monitoring must be conducted at a minimum of four locations with three replicates per location. The draft permit required sampling throughout the permit term. Based on comments from the MOA, the final permit requires monitoring for one year only. EPA has determined that one year of monitoring will provide sufficient data to determine whether the TMDL is adequate.

Based on the results of this study, EPA can determine whether the TMDLs should be revised to include other load/wasteload allocations, or to adjust the background concentration. In addition, the permit contains a reopener stating that the permit may be modified if, based on a revised TMDL, changes in permit limits are determined to be necessary.

VI. Comments

The following comments received on the NPDES permit for the Eagle River WTF are applicable to the TMDL.

1. **Comment:** The MOA commented that the ambient monitoring program that was included in the NPDES permit to determine the adequacy of the TMDLs should be modified. It should require monitoring at two locations (one upstream from urban influence and one immediately upstream from the discharge) instead of four, with three replicates per sample. In addition, monitoring frequency should be reduced from quarterly to twice per year for one year only. Finally, the MOA requested that the monitoring not begin sooner than 180 days after the effective date of the permit to allow adequate time for contracting.

Response: One of the requirements of the ambient sampling program is that it adequately address spatial and temporal variability, as well as analytical variability. This is required so that, when EPA is assessing the adequacy of the TMDLs, there are sufficient data so that large margins of safety will not be necessary. With only two sample locations, it will not be possible to determine whether variability is due to urban influences or to spatial or analytical variability. Similarly, two sets of samples will not distinguish between seasonal variability and analytical variability. Therefore, the number of stations and the frequency of monitoring are unchanged in the final permit. The number of replicates per station is also unchanged from the three required in the draft permit.

EPA agrees that one year of monitoring will be sufficient to determine if the TMDLs are adequate to protect the receiving water. Therefore, the permit has been changed to require one year of ambient monitoring. The permit has also been changed to allow 180 days to develop the program.

2. **Comment:** The MOA commented that the hardness values used to calculate the metals criteria were too low. They proposed three alternatives for establishing the appropriate hardness with which to calculate the metals criteria: 1) using the average hardness, 2) basing compliance on the actual hardness measured at the time of sampling for metals, or 3) using the correlation between the natural log (ln) of the hardness and flow to determine a fifth percentile hardness for the summer and winter flows.

Response: While EPA does not support the first two proposals, the third proposal, using the correlation between hardness and flow, is acceptable.

With respect to the first proposal, EPA does not believe it is appropriate to use an average hardness because the acute and chronic criteria are based on one-hour and four-day exposures, respectively. EPA's *Technical Support Document for Water Quality-based Toxics Control* (*TSD*) recommends the use of "worst-case" conditions when developing permit limits based on steady-state modeling.

Regarding the second proposal, EPA does not support the approach of determining compliance with metals limits based on the hardness measured at the time the metals sample is taken. This approach does not ensure protection of the receiving water. The purpose of permit limits is to ensure that the criteria are met under most receiving water conditions. This approach provides only a "snapshot" and does not account for the variability in the effluent or the receiving water.

As discussed in section III. of this document, EPA considers the third proposal to be basically sound. The fifth percentile hardness correlated with the seasonal 7Q10 flows was used to determine the appropriate metals criteria upon which the TMDLs were based.