

**Triennial Review
Dissolved Metal Standards
Impact on NPDES Permits and
Pretreatment**

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Triennial Review

The State is obligated under the federal “Clean Water Act” to review surface water quality standards every three years.

- Since 1980’s - US EPA has published revisions to several metals not yet adopted by NC

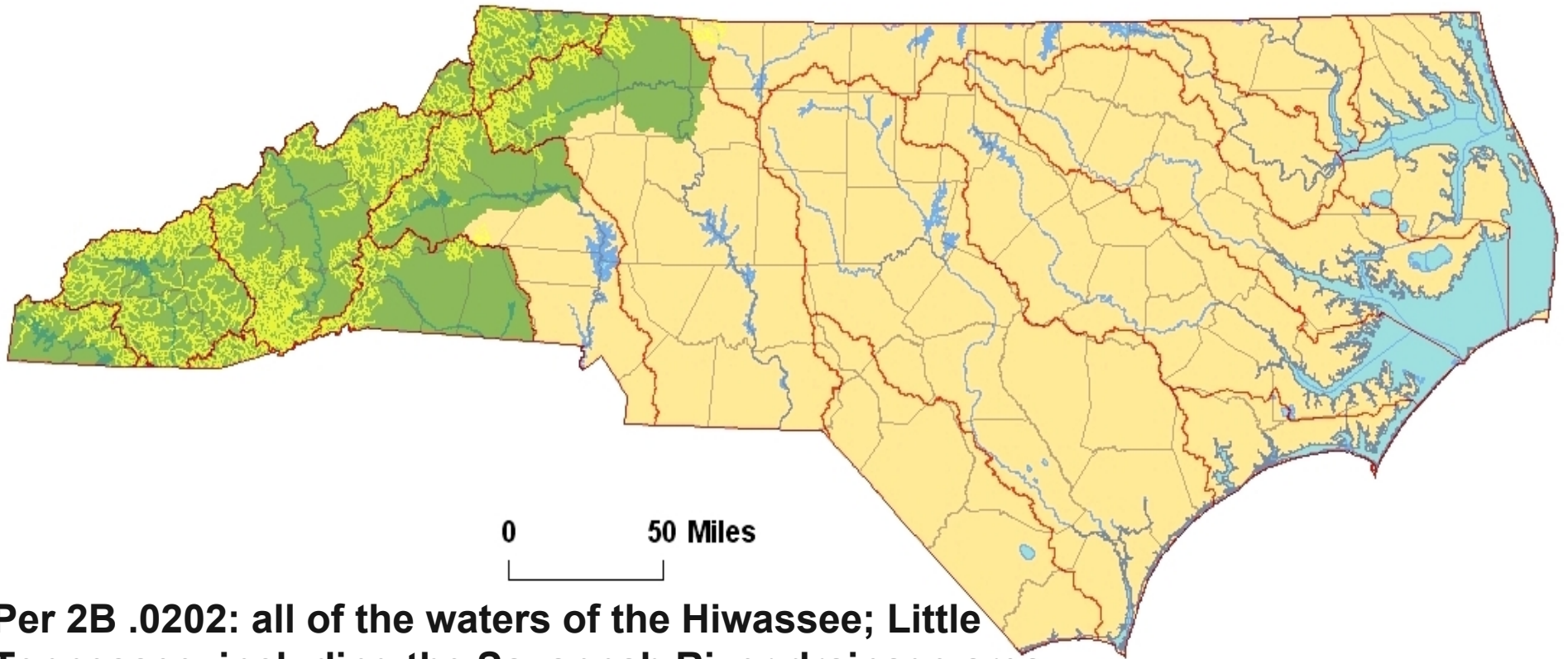
Greatest concern to you is

- Chlorophyll a
- Aquatic life metals standards

Chlorophyll a

- Current “max not to exceed” language modified to “not greater than 10% of data can exceed”
- Addition of a regionalized standard for mountains and upper piedmont
 - 25 ug/L
- No other change to standard
- Separate proposal to establish threshold level before water becomes impaired

Mountain and Upper Piedmont Waters



Per 2B .0202: all of the waters of the Hiwassee; Little Tennessee, including the Savannah River drainage area; French Broad; Broad; New; and Watauga River Basins; and those portions of the Catawba River Basin above Lookout Shoals Dam & the Yadkin River Basin above the junction of Forsyth, Yadkin, & Davie County lines

Current Aquatic Life Standards expressed as “Chronic”

- Acute standards will be proposed
 - Exceptions: Selenium and Mercury
- **1Q10** flow used for calculating acute limits since Feb 2010 memo
- Even though no published Acute criteria currently used for some permit limits
- Acute is daily max limit vs. Chronic monthly

Dissolved Metals

- Current standards are “total” metals
- “Total metals” includes the dissolved and particulate fractions
- Dissolved metals better represent the bioavailable fraction
- Dissolved fraction varies in natural waters
- With the exception of Mercury and Selenium, DWQ will propose the use of dissolved metals standards

Hardness Dependent Metals

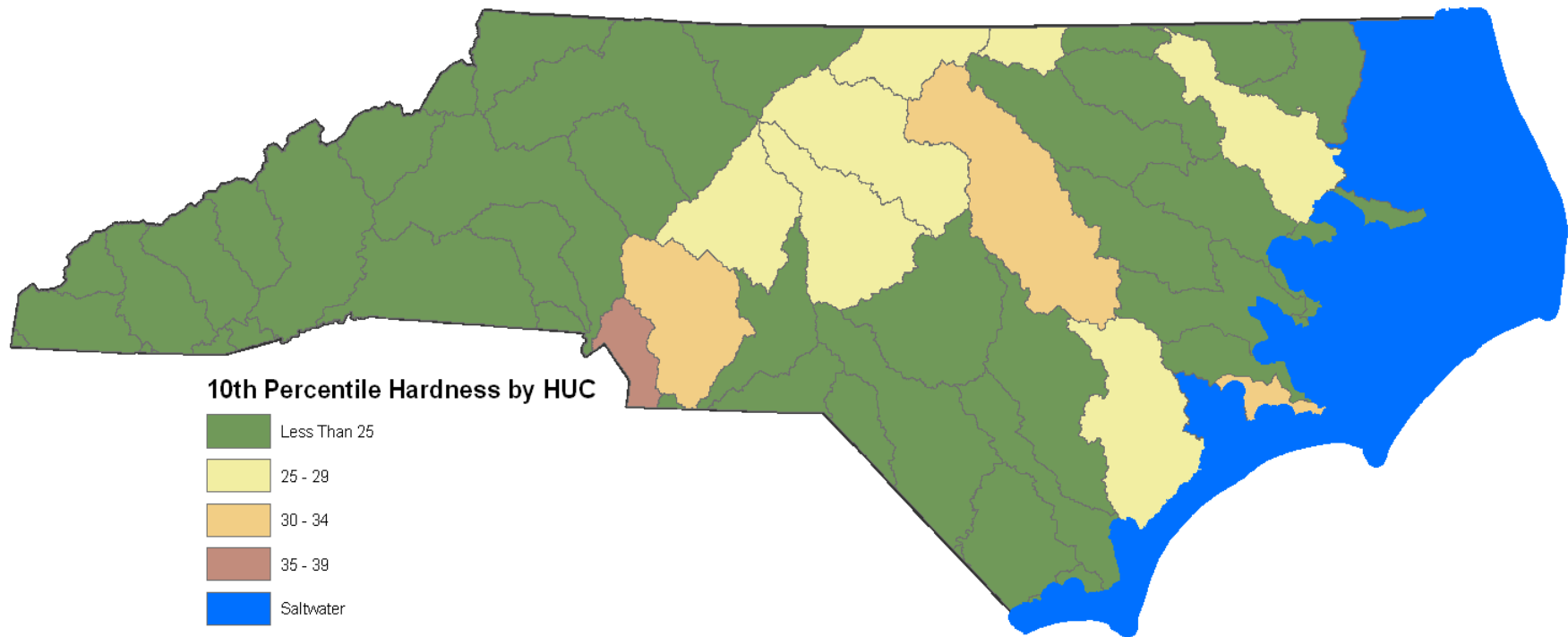
- For some metals:
 - ↓ water hardness is associated with
 - ↑ aquatic toxicity
- Proposed numerical standards are based upon a default hardness of 25 mg/L

Flexibility Provided

- Stakeholders expressed desire for a more flexible approach to be allowed
- Draft proposed rules **provide for numerical standards and metal specific formulas** which may be used to develop more localized standards
- Applicable **localized** hardness at **10th** percentile of sub-basin data is proposed

10th percentile Hardness by HUC

Surface Water Hardness in North Carolina



**Hardness Data: 1969-2001; 645 stations;
35,743 samples**

Metal	Current Total Aquatic	Proposed Dissolved Freshwater	
	Life Standard (ug/L)	Standard (ug/L)	
	Chronic 50 mg/L Hardness	Chronic 25 mg/L	Acute 25 mg/L
Arsenic	50	150	340
Beryllium	6.5	6.5	65
Cadmium*	2 / 0.4 trout	0.15	0.82 / 0.51 trout
Chromium (total)	50	Proposed for removal	
Chromium III *	none	24	180
Chromium VI	none	11	16
Copper *	7 (AL)	2.7 (AL)	3.6 (AL)
Iron	1 mg/L (AL)	Proposed for removal	
Lead *	25	0.54	14
Nickel *	88	16	140
Silver *	0.06 (AL)	0.06 (AL)	0.30 (AL)
Zinc *	50 (AL)	36 (AL)	36 (AL)

Action Levels

- Standards still exist for waterbodies but not used to calculate permit limits
- EPA has **UNOFFICIALLY** expressed concerns with NC's continuation use of Action levels
- If Action Levels disappear could have major ramifications for Zn and Cu and a little Silver

Biological Assessment (Bio trumps Chemistry)

- Proposal : Instream biological integrity indicates attainment of aquatic life use
- Biological integrity supersedes instream metal sampling results
- Exceptions: Mercury and Selenium

Variations

In accordance with State regulations (.0226) – variations from the State standards may be approved by the Commission

It is important to note that the variance **does not** change the Standard – just the effluent conditions allowed by a discharger. The discharger must continue to investigate ways to comply with the state standard

e.g. chlorides for pickle companies

Dissolved Metal Standards Implementation

- Upon permit renewal, new standards for metals will be used to calculate limits
- Permits are, have and must be written as total metals 40 CFR 122.45 (c)

Dissolved Standards Implementation

- Regulations allow for permittees to perform site – specific translator studies
- Permit writer can give compliance schedule Inside or Outside of permit (SOC)
- Possible need for “Authorization to Construct” if increased treatment is necessary to increase metals removal rate

To convert *Dissolved Metal* Water Quality Standards to a *Total Metal* permit writers must use a dissolved metals **Translator**

Dissolved Metal Standard ÷ Translator =
Total Metal (allocated to the permittee)

Metal Translators

- Account for the fraction of the effluent's metal that will be dissolved in the receiving water
- May offer permittees relief in some water bodies
- Translators must be determined for each metal and can be unique for each receiving stream

- Simplified Example

60% of Cu is dissolved = 0.6 Translator

6 ug/L dissolved metal vs 10 ug/L total metal

2.7 ug/L dissolved Cu Chronic Std \div 0.6 Translator = 4.5 ug/L
Total Metal allowed for use in calculating permit limits

Default Partition Coefficients (DPC)

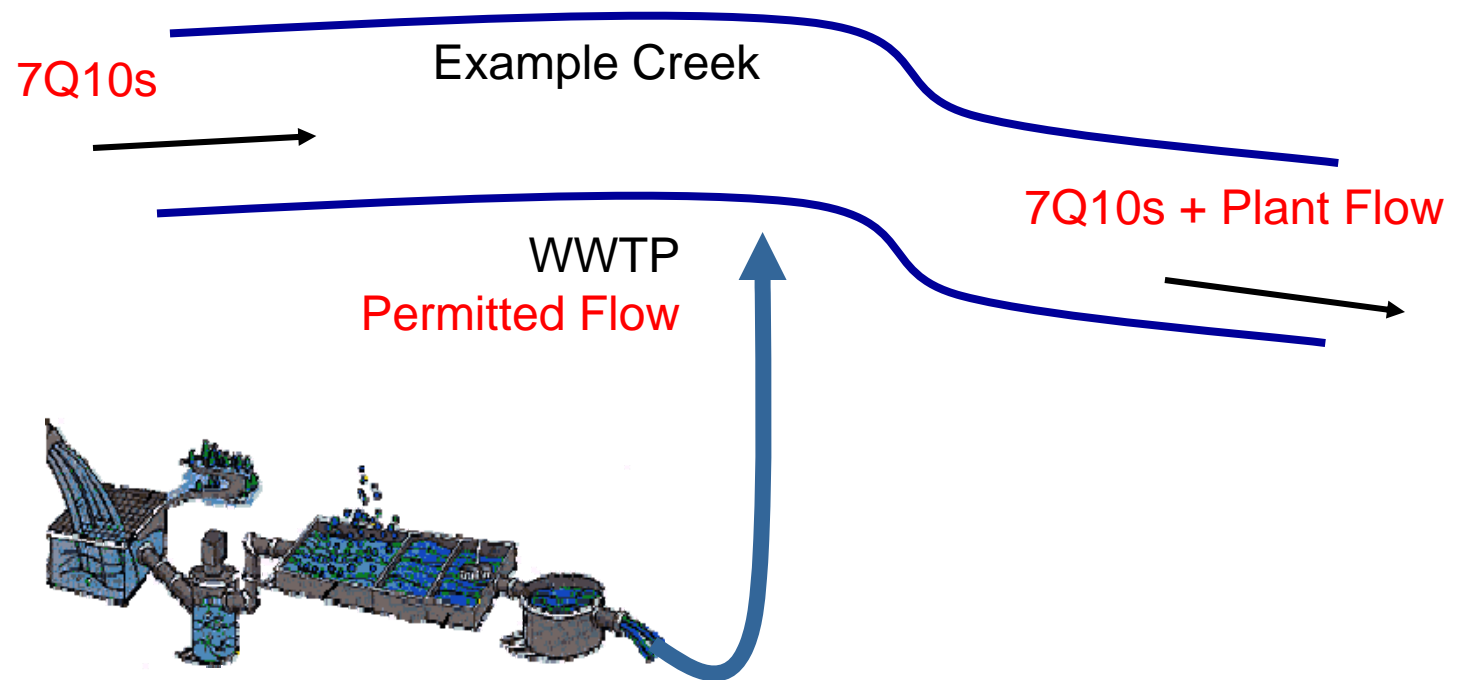
- Type of translator often used when insufficient data exists for calculating stream segment's dissolved fraction
- EPA equations developed in 1984
- Used by all Region IV States with Dissolved Criteria
- Equation is Total Suspended Solids dependent
- NC lacks sufficient data for site specific translator

NC will use the default partition coefficients in establishment of permit limits

Dissolved Metal ÷ Translator = Total Metal (allocated to permittee)

Total Metal ÷ Instream Waste Concentration (IWC) = Permit Limit

$$IWC = \left(\frac{\text{Plant Flow}}{\text{(Plant Flow + 7Q10s)}} \right)$$



7Q10 is the critical low stream flow over 7 days in a 10 year period

Cadmium (Cd) Permit Limit Example

Critical low flow (7Q10) = 1 cubic foot per second

Plant Flow = 1.3 MGD = 2 cubic feet per second

Instream Waste Concentration (IWC) = 67%

Proposed Dissolved Cadmium Std = 0.15 ug/L (at hardness of 25 mg/L)

Translator = 0.257 (calculated default partition coefficient)

WQS ÷ DPC translator = Total Metal (allocated to permittee)

$$0.15 \text{ ug/L} \div 0.257 = 0.58 \text{ ug/L Total Metal}$$

Allow for stream dilution:

$$0.58 \text{ ug/L Total Cd} \div 0.67 \text{ IWC} = .86 \text{ ug/L Permit Limit}$$

Water Quality Standards for some metals are Hardness Dependent

- To Determine the Permittee's specific in-stream allowable dissolved metal concentration use a Hardness (H) mass balance equation:

$$H = \frac{(H_{\text{in-stream, mg/L}} * 7Q_{10, \text{MGD}}) + (H_{\text{effluent, mg/L}} * \text{Plant flow, MGD})}{(7Q_{10, \text{MGD}} + \text{Plant flow, MGD})}$$

7Q10 is the critical low stream flow over 7 days in a 10 year period
Use 25 mg/L if no effluent hardness data is available

Dissolved Water Quality Criteria – chronic standards examples

Lead standard is 1.2 ug/L - Hardness = 50 mg/L

Lead standard is 0.54 ug/L - Hardness = 25 mg/L

Hardness ↑

WQC standard ↑

Nickel standard is 29 ug/L - Hardness = 50 mg/L

Nickel standard is 16 ug/L - Hardness = 25 mg/L

Total Metals Allocated to Dischargers

Example: Assume TSS = 12 mg/L	Proposed Dissolved Metals WQS (ug/L)		Translator Using Default Partition Coefficient	Proposed Calc Total Metals (permittee) (ug/L)		Current Total Metal WQS (ug/L)	
	chronic	acute		chronic	acute	chronic	Acute Not currently promulgated
Hardness = 25 mg/L							
Nickel	16	140	0.413	39	339	88	261
Cadmium	0.15	0.82	0.257	0.6	3.2	2.0	15
Lead	0.54	14	0.178	3.0	78	25	34
Hardness = 50 mg/L							
Nickel	29	261	0.413	70	632	88	261
Cadmium	0.25	1.5	0.257	0.97	5.8	2.0	15
Lead	1.2	30	0.178	6.6	169	25	34

Default Partition Coefficients are Total Suspended Solids Dependent

- To Determine Total Suspended Solids (TSS)
use mass balance equation

$$\text{TSS} = \frac{(\text{TSS in-stream, mg/L} * 7\text{Q10, MGD}) + (\text{TSS effluent, mg/L} * \text{Plant flow, MGD})}{(7\text{Q10, MGD} + \text{Plant flow, MGD})}$$

7Q10 is the critical low stream flow over 7 days in a 10 year period

Translator examples using the Default Partition Coefficients (DPC) -

Lead's translator is 0.178 using TSS of 12 mg/L

Lead's translator is 0.158 using TSS of 25 mg/L

TSS ↑

Translator ↓

Total Metal (allocation) ↑

Not the same for all metals:

Cadmium's translator is 0.257 using TSS of 12 mg/L

Cadmium's translator is 0.276 using TSS of 25 mg/L

TSS ↑

Translator ↑

Total Metal (allocation) ↓

Translator Scenarios at Default

	Proposed WQC diss.		DPC Translator	Total Metals(WLA) using DPC as the Translator TM = WQC diss./DPC translator		NC WQC Total Metal Stds.	
	Dissolved metal criteria (Hardness dependent)		Default Partition Coefficient Translator (TSS dependent)			Current Total Metal Stds. in NC used for WLA	
	Chronic	Acute		Chronic	Acute	Chronic	Acute
PARAMETER	[ug/l]	[ug/l]	[Fraction]	[ug/l]	[ug/l]	[ug/l]	[ug/l]
TSS value of 12 mg/L Hardness 25 mg/L CaCO3							
Copper Action Level	2.70	3.60	0.337	8.01	10.68	7.00	7.30
Chromium III	24.00	180.00	0.200	119.87	898.99		
Chromium VI	11.00	16.00	1.000	11.00	16.00		
Chromium, Total	N/A	N/A	N/A	N/A	N/A	50.00	1022.00
Nickel	16.00	145.00	0.413	38.72	338.76	88.00	261.00
Cadmium	0.15	0.82	0.257	0.58	3.19	2.00	15.00
Lead	0.54	14.00	0.178	3.03	78.44	25.00	33.80
Silver AL	0.06	0.30	1.000	N/A	0.30	0.06	1.23
Zinc AL	36.00	36.00	0.277	129.94	129.94	50.00	67.00
<p>Black- Proposed WQC dissolved metals</p> <p>Brown - Total Recoverable Metals using Default Partition Coefficients as translators to develop permittee's waste load allocation (WLA).</p> <p>Blue - NC's current Total Metal Water Quality Criteria used for permittee's WLA.</p> <p>Green - Total Recoverable Metals using Conversion Factors as a translator.</p> <p>Red - Total Recoverable Metals using a Fractional translator of 0.8. This Total Metal would be used to develop the permittee's WLA.</p>							
TSS value is of the receiving stream							

NPDES Implementation Summary

- Use Default Partition Coefficients and equations as Translators
- Hardness determination - use a mass balance equation (25 mg/L hardness as a default)
- Compliance schedules will be written into permits if treatment is necessary to meet standards

Pretreatment Calculations

- Allowable Headworks Loading (AHL)
based on Pass Through/WQS =

$$(8.34) \frac{\text{NC Water Quality Standard, mg/l}}{(1 - \text{POTW Removal Rate, as decimal})} \times \frac{\text{POTW Average Flow, mgd} + \text{Receiving Stream 7Q10, mgd}}$$

Allocation Table Example

IUP Count	INDUSTRY NAMES (please list alphabetically)	Industry Permit number	FLOW		Cadmium	
			Permit Limits		Permit Limits	
			MGD	gal/day	Conc. mg/l	Load lbs/day
1	Metal Finisher 1	0001	0.1000	100,000	0.0100	0.0083
2	Aluminum Former	0002	0.0090	9,000	0.0300	0.0023
3	Metal Finisher 2	0004	0.0100	10,000	0.0350	0.0029
4	non_categorical SIU	0009	0.0250	25,000	0.0100	0.0021
Column Totals =>			0.1440	144,000		0.0156
Basis=>			NPDES			Stream Std
MAHL from HWA (lbs/day) =>			3.6000			0.1169
Uncontrollable Loading (lbs/day) =>			2.2483			0.0188
Total Allowable for Industry (MAIL) (lbs/day) =>			1.3517			0.0981
Total Permitted to Industry (lbs/day) =>			0.1440			0.0156
MAIL left (lbs/day) =>			1.2077			0.0826
Percent Allow. Ind. (MAIL) still available (%) =>			89.3 %			84.1 %
Percent MAHL still available (%) =>			33.5 %			70.6 %
5 Percent MAHL (lbs/day) =>			0.1800			0.0058

Allocation Table Example Proposed Std

IUP Count	INDUSTRY NAMES (please list alphabetically)	Industry Permit number	FLOW		Cadmium	
			Permit Limits		Permit Limits	
			MGD	gal/day	Conc. mg/l	Load lbs/day
1	Metal Finisher 1	0001	0.1000	100,000	0.0100	0.0083
2	Aluminum Former	0002	0.0090	9,000	0.0300	0.0023
3	Metal Finisher 2	0004	0.0100	10,000	0.0350	0.0029
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MAHL from HWA (lbs/day) =>			3.6000			0.0088
Uncontrollable Loading (lbs/day) =>			2.2483			0.0188
Total Allowable for Industry (MAIL) (lbs/day) =>			1.3517			-0.0100
Total Permitted to Industry (lbs/day) =>			0.1440			0.0156
MAIL left (lbs/day) =>			1.2077			-0.0255
Percent Allow. Ind. (MAIL) still available (%) =>			89.3 %			256.7 %
Percent MAHL still available (%) =>			33.5 %			-290.3 %

Removal Rates - Cadmium

- Current WQS 0.002 mg/l, new 0.00015 mg/l
- Current Practical Quantitation Limit 0.001 mg/l
 - If 50% of data BDL; use literature removal rate [67% for Cd]
- Current literature removal rates based on 1974 data.
- What if removal rate really = 95%?
- What if removal rate really = 50%?

- Proposed WQS = 0.00015 mg/l
 - Using site specific removal rate of 95%
 - $8.34 * 2.312 \text{ MGD} * 0.00015 \text{ mg/l} / (1-0.95) = 0.0578 \text{ pounds}$



Cadmium	
Permit Limits	
Conc.	Load
mg/l	lbs/day
0.0100	0.0083
0.0300	0.0023
0.0350	0.0029
0.0100	0.0021
	0.0156
	Stream Std
	0.0578
	0.0188
	0.0390
	0.0156
	0.0235
	60.1 %
	40.6 %
	0.0029

- Proposed WQS = 0.00015 mg/l
 - Using site specific removal rate of 50%
 - $8.34 * 2.312 \text{ MGD} * 0.00015 \text{ mg/l} / (1-0.50) = 0.0578 \text{ pounds}$



Cadmium	
Permit Limits	
Conc. mg/l	Load lbs/day
0.0100	0.0083
0.0300	0.0023
0.0350	0.0029
0.0100	0.0021
	0.0156
	Stream Std
	0.0058
	0.0188
	-0.0130
	0.0156
	-0.0285
	220.4 %
	-492.2 %
	0.0003

Uncontrollable - Cadmium

- EPA Literature 0.003 mg/l
- POTW Site-Specific 0.001 mg/l
 - From collection system sampling
- Uncontrollable Mass Balance
 - Influent Load minus SIU Load
- What if uncontrollable really = 0.0005 mg/l?
- What if uncontrollable really = 0.0001 mg/l?

- Proposed WQS = 0.00015 mg/l
 - Using 0.0005 mg/l Uncontrollable (0.5 ug/l)
 - $8.34 * 2.2483 \text{ MGD}$
 - * 0.0005 mg/l
 - = 0.0094 lbs/day



Cadmium	
Permit Limits	
Conc. mg/l	Load lbs/day
0.0100	0.0083
0.0300	0.0023
0.0350	0.0029
0.0100	0.0021
	0.0156
	Stream Std
	0.0088
	0.0094
	-0.0006
	0.0156
	-0.0162
	2810.4 %
	-183.8 %

- Proposed WQS = 0.00015 mg/l
- Using 0 mg/l Uncontrollable



Cadmium	
Permit Limits	
Conc. mg/l	Load lbs/day
0.0100	0.0083
0.0300	0.0023
0.0350	0.0029
0.0100	0.0021
	0.0156
	Stream Std
	0.0088
	0.0000
	0.0088
	0.0156
	-0.0068
	-77.9 %
	-77.9 %

Receiving Stream Dilution:7Q10

- The lowest observed 7 day average flow over a 10 year time frame
- Instream Waste Concentration (IWC) =
NPDES Permitted Flow / (NPDES Permitted Flow + 7Q10)
- 7Q10 = 0 – IWC = 100 %
- $8.34 * 2.312 \text{ MGD} * 0.00015 \text{ mg/l} / (1-0.67)$
= 0.0088 pounds
- 7Q10=1.2 - IWC = 75%
- $8.34 * (2.312+1.2 \text{ MGD}) * 0.00015 \text{ mg/l} / (1-0.67)$
= 0.0133 pounds

7Q10 & Hardness

Removal rate = 67%

Uncontrollable = 0.001 mg/l

Hardness = 25 mg/l

WQS = 0.00015 mg/l Cadmium

7Q10	0	1.2	3.6	10.8
MAHL, lbs	0.0088	0.0133	0.0224	0.0497
% MAHL remaining	-290	-158	-53.3	30.9

7Q10 & Hardness

Removal rate = 95%

Uncontrollable = 0.001 mg/l

Hardness = 25 mg/l

WQS = 0.00015 mg/l Cadmium

7Q10	0	1.2	3.6	10.8
MAHL, lbs	0.0578	0.0879	0.1479	0.3281
% MAHL remaining	40.6	60.9	76.8	89.5

IWC Range

IWC % Range	# of programs
90-100	35
80-89.9	3
70-79.9	3
60-60.9	1
50-50.9	4
40-40.9	9
30-30.9	9
20-20.9	3
10-19.9	14
0-9.9	37

EPA Default Translator

- Dissolved standard / translator
 - $0.00015 \text{ mg/l} / 0.252 = 0.00059 \text{ mg/l}$

Rec. Stream (7Q10) [MGD]	Rec. Stream 1Q10 [MGD]	NPDES Flow Limit [MGD]	Ttl. Susp. Solids [mg/l]	Hardness (as CaCO ₃) [mg/l]
0.000	0.000	3.600	10.000	25.000

PARAMETER	4	5	6
	EPA Default Coefficient Partition Translator	Aquatic Life instream allowable Total	
		Chronic [ug/l]	Acute [ug/l]
Cadmium (a,b) (NC)	0.252	0.59	3.25

Translator

WQS = 0.00059 mg/l

Removal rate = 67%

Uncontrollable =
0.001 mg/l

Hardness = 25 mg/l



Cadmium	
Permit Limits	
Conc. mg/l	Load lbs/day
0.0100	0.0083
0.0300	0.0023
0.0350	0.0029
0.0100	0.0021
	0.0156
	Stream Std
	0.0345
	0.0188
	0.0157
	0.0156
	0.0002
	1.0 %
	0.4 %

Chromium

- Total Chrome No longer Std spilt into Cr III and Cr VI
- Practical Quantitation Limits vary
- No test for Chrome III
- PQL for Chrome VI is 50 ug/L
- PQL for Total Chrome III is 10 ug/L
- $10\text{ug/L} - 50\text{ug/L} = -40\text{ ug/L}$
- So unless RPA or sampling indicates higher than 50 ug/l no need to run separate species test

What's next

- New, lower PQLs for Cadmium, Lead Chrome
 - May verify compliance with new WQS
 - May verify higher removal rates, lower uncontrollable
- Clean Sampling
- Pollution Prevention
 - Source control

Pretreatment Implications

- Pretreatment Program only permits industry
- Few over allocations are expected
- NC surveyed surrounding States plus Fla, MI, OR
- All states require calculation of a pollutant Maximum Allowable Headworks Load
- All states considered uncontrollable domestic loading in Maximum Allowable Industrial Load calculation, i.e., how much town has to allocate to industry

Pretreatment Implications

- Every State, the EPA & NC Statutes prohibit over allocation of a pollutant
- Anticipate Lower detection will demonstrate higher metal removal rates and more accurate representation of current metals loading
- DWQ HWA Policies Review ie. Which pollutants require MAHL if loading below 50% of capacity