NHDES Anti-Degradation Analysis Released to PSNH
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Date: 06/18/2010 02:16 PM
Subject: Edited Antideg Fact Sheet Language

Hi Allan, Gregg’s finished commenting and I included most of his suggested
changes which were minor. EPA has no comments at this point so this is what should end up in the publicly noticed Fact Sheet. Let me know if you find and glaring mistakes.

Thanks, Jeff

p.s. Beware that I’m having trouble printing this … it could be something to do with formatting or margins associated with inserting an Excel Table into the Word document

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ANTIDEGRADATION

PSNH is constructing a wet flue gas desulfurization (FDG) system at Merrimack Station to comply with New Hampshire State Law (HB 1673). This law requires that the station achieve a 90% reduction of air emissions of sulfur dioxide and an 80% reduction of air emissions of mercury by July 2013.

The FGD system scrubs the stack emissions with a slurry of limestone and water. The slurry is recirculated as much as possible to the stack. Spent slurry is sent to an absorber where it is converted to calcium sulfate (gypsum) and wastewater. The gypsum is recycled off site and a small portion of the wastewater that cannot be reused will be discharged to the ash settling basin. PSNH is constructing a new wastewater treatment system to treat the FGD wastewater prior to discharge to the ash settling basin.

The new discharge could affect the quality of the discharge of the ash settling basin (outfall 003A) to the cooling canal (outfall 003) which could in turn affect the quality of the Merrimack River. This new discharge prompted NHDES to conduct an antidegradation review to ensure that the provisions of Env-Wq 1708 are met. Further, the analysis will assist PSNH with the design of the new treatment system.

NHDES requires applicants for new or increased discharges to provide sampling of their discharge and of the river upstream of their discharge during low river flow conditions. This data is used to evaluate the resulting water quality of the river downstream of the discharge. By comparing the resulting downstream water quality with the surface water quality standards, the river's *available* remaining assimilative capacity, if any, is determined for each pollutant of concern. "Available" refers to the capacity to assimilate wastewater discharges after holding the required reserve of ten percent of the assimilative capacity pursuant to NH RSA 485-A:13,I(a) and Env-Wq 1705.01.

To determine the potential changes in water quality NHDES looked for data on existing FGD systems. Any parameters determined to be present in FGD wastewater is considered a pollutant of concern. NHDES reviewed the following information:

- EPA's Steam Electric Power Generating Point Source Category: Final Detailed Study Report, October 2009, EPA 821-R-09-008.
- Duke Energy Carolina LLC's Strategy and Initial Experience of FGD Waste Water Treatment Systems, Robert Wylie, et al, IWC-08-32
- Merrimack Station, FGD Wastewater Treatment System, WT Project 57001495, PSNH, Bow, New Hampshire, Siemens Water Technologies, Warrendale, PA, 15086, February 27, 2009
- Flue Gas Desulfurization Wastewater Treatment Primer, Thomas E. Higgins, PhD.,P.E., et al, March 1, 2009, http://www.powermag.com/issues/features/Flue-Gas-Desulfurization-Wastewater-Treatment-Primer_1739.html.

- Personal communication w/ Ronald Jordan, Engineering and Analysis Division, Office of Water, EPA, Washington, DC., May 20, 2009, 10:00 a.m.

The above information was used to determine the list of parameters that are likely to be present in the new discharge from the FGD wastewater treatment system and that PSNH should be required to test for to establish baseline conditions in outfall 003A. The list includes the following parameters: aluminum, antimony, arsenic, beryllium, cadmium, chromium III, chromium VI, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, zinc, chlorides, ammonia (as N), and nitrates (as N).

In response to the NHDES request for information needed to conduct the antidegradation review, PSNH hired URS Corporation, Washington Division, of Princeton, NJ (URS) and Eastern Analytical, Inc. of Concord, NH (EAI). For certain pollutants of concern, with extremely low surface water quality standards criteria in Env-Wq 1703.21(b), EAI sent the samples they had collected using special "clean" sampling techniques to Frontier Geosciences, Inc. of Seattle, WA for trace metals analyses in a clean laboratory.

The analytical results for the four rounds of river samples and the six rounds of samples collected during normal operating conditions from outfall 003A are found in this Fact Sheet in Attachment X-1. The administrative record contains the URS report including the Executive Summary, the Sampling and Analysis Plan, and the analytical results including the necessary Chain of Custody, Quality Assurance and Quality Control data.

The NHDES calculations to determine the available remaining assimilative capacity use the river low flow as required per Env-Wq 1705.02, the existing and proposed monthly average wastewater flows, and the criteria for each pollutant of concern found in Env-Wq 1703.21(b). Wastewater flows provided by PSNH can be found in their permit renewal application (Form 2C) submitted to EPA on May __, 2010 and are summarized below:

	Maximum daily (mgd)	Max 30-day average (mgd)
Outfall 003A(existing):	14.03	6.33
Outfall 003A(proposed):	13.0	5.3
FGD Scrubber WWTS:	0.05	0.05

The reason that the flow from outfall 003A will be reduced after the wet FGD scrubber is on line is that the source of the make up water for the scrubber will be wastewater from the ash settling basin upstream of where the new FGD wastewater treatment system discharges into it. This make up water flow will be 1.08 mgd.

To simplify the calculations, NHDES treats the existing and proposed wastewater discharge from outfall 003A as if it discharges directly to the Merrimack River. This is appropriate since although this is technically an internal outfall (in that it discharges to the cooling canal), the cooling canal does not have any common pollutants of concern and it can be considered to be just a portion of the Merrimack River where initial mixing occurs. The only pollutants added to

the condenser cooling water discharges (outfalls 001 and 002) to the cooling canal are heat and chlorine, which is only used intermittently.

The antidegradation provisions in Env-Wq 1708.08 (Assessing Waterbodies) requires that existing water quality be established based on point sources discharging at their allowed loadings and the highest loadings anticipated from nonpoint sources. There are three major point sources upstream of PSNH (Concord Hall Street, Penacook, and Winnipesaukee River Basin Program). NHDES considered the other point source discharges and determined that they could be ignored since they were either very small, already close to their design flow or located so far upstream that the pollutants of concern in their effluent would settle out or otherwise undergo biogeochemical transformation processes that made their contributions no longer measurable by the time they reached the Merrimack River upstream of Merrimack Station. NHDES used 1) the difference between the POTW's current flow and its design flow and 2) effluent data from the most recent permit reapplication (Form 2A) to estimate the future mass load from these upstream point sources. The addition of that anticipated future mass load, for each pollutant of concern, resulted in an increase in the average upstream river concentration used in the antidegradation calculations.

NHDES also considered nonpoint source discharges and determined that they could also be ignored since the pollutants of concern that may occur in stormwater runoff are not significantly associated with the low river flow conditions used for the antidegradation calculations. Further, NHDES considered nonpoint sources associated with low river flow conditions and determined that they could be ignored since new sources or increases in these sources are not anticipated. For example, new hazardous and solid waste land disposal sites are not routinely being built and existing facilities with groundwater quality problems are being remediated over time. For any that are built or expanded, and for any new groundwater discharge permits, the groundwater quality at the site boundary with surface waters must meet surface water quality standards.

The NHDES antidegradation calculations result in three possible outcomes, as follows:

1. For a parameter for which the receiving water is high quality, the permit limit that, when achieved, would utilize an insignificant (< 20%) portion of the available remaining assimilative capacity per Env-Wq 1708.09(c)(4).
2. For a parameter where the receiving water is marginal (just barely meets standards), an indication that the applicable water quality standard is being met but there is no additional capacity to add pollutants since the required reserve assimilative capacity is less than 10%.
3. An indication that the existing water quality downstream of the discharge exceeds the water quality standard.

In the first case, limits are necessary at outfall 003A when there is "reasonable potential" that the calculated limit could be violated, which is in accordance with 40 CFR 122.44(d). To determine reasonable potential, NHDES uses the approach found in Section 3.3 of the Technical Support Document for Water Quality Based Toxics Control, EPA/505/2-90-001, March 1991.

In the second case, since there is no available remaining assimilative capacity, PSNH must hold the loadings for the pollutant of concern to the loadings that they are discharging now at outfall 003A.

In the third case, there is also no available remaining assimilative capacity, and PSNH must hold the loading at outfall 003A until such time as a total maximum daily load (TMDL) study is completed. After a TMDL is completed, the allowable loading for the pollutant of concern will be allocated among all point and nonpoint sources, which could necessitate additional reductions in load by PSNH.

It is important to note that the concentration limits in outfall 003A that are required to hold the mass load (lbs/day) to that which exists now will be somewhat higher than the maximum baseline concentration. This is due to the fact that, as mentioned previously, the flow at outfall 003A will be reduced by flow of the make-up water for the scrubber. See example calculations in the section below for arsenic.

The results of the NHDES antidegradation calculations are provided in Attachment X-2.

Parameters that NHDES has determined, based on their antidegradation review, need either permit limits at outfall 003A, or monitoring during the reissued permit term to determine the need for permit limits, are discussed below and are summarized in Table X-1.

Aluminum

A limit for aluminum of 1.03 mg/l is necessary to ensure that the discharge only causes an insignificant (<20%) lowering of water quality in the Merrimack River in the assessment unit (AU) that Merrimack Station discharges into. However, the NHDES' draft 2010 303(d) list indicates that there are impairments for aluminum in the river in AUs that are adjacent to the AU that PSNH discharges into. For this reason, and the fact that the AU that PSNH discharges into could be listed as impaired in the future, PSNH plans to design the new scrubber WWTS to meet a lower limit that would hold the loading of aluminum to that which is discharged now. This is prudent since any future TMDL established for this parameter could require additional reductions by Merrimack Station.

Arsenic

The antidegradation calculations for arsenic were performed for both the aquatic life criteria (acute and chronic) and (since there are no public water supplies for over twenty miles downstream) the fish consumption human health criteria. As shown in Attachment X-2 there is no reasonable potential for the proposed discharge to cause any violations of the aquatic life criteria. However, the data collected by PSNH indicates that the Merrimack River exceeds the 140 ng/l arsenic criteria for the fish consumption use. Thus PSNH needs to hold the load.

NHDES calculated a limit at outfall 003A that will hold the mass load to that being discharged now. The limit that would hold the loading is 0.00227 mg/l, which is calculated as follows:

Existing Load = Existing Maximum Concentration x Existing Flow x 8.34
= 0.0019 mg/l x 6.33 mgd x 8.34
= 0.1 lbs/day

Limit (future) to Hold Load = Existing Load / (Future Flow x 8.34)
= 0.1 lbs/day / (5.3 mgd x 8.34)
= 0.00227 mg/l

There are no New Hampshire surface waters listed as being impaired for arsenic for either aquatic life or fish consumption. The lack of any listing for fish consumption is due to the lack of in stream analytical data at low enough detection limits and data for three lakes from the National Lake Fish Tissue Study (see www.epa.gov/fishadvisories/study/tissue.htm) all showing fish tissue concentrations for total arsenic less than a detection limit of 0.1 ppb (ug/g). Section 3.2.6 of the 2010 New Hampshire Consolidated Assessment and Listing Methodology indicates that all surface waters must support fish that are free from contamination at levels that pose a human health risk to consumers. There are currently no fish consumption advisories for arsenic.

EPA modified their methodology for deriving human health criteria in October 2000. However, EPA has not updated its human health criteria recommendation for arsenic due to ongoing research on bioaccumulation and speciation of arsenic in fish tissue and lack of agreement on a final cancer potency factor (see http://yosemite.epa.gov/sab/sabproduct.nsf/MeetingCal/1A8B1D874ECECD45852576C0005DCF0B?OpenDocument). New Hampshire promulgated its human health water quality standards for arsenic in December 10, 1999, before the new methodology and uncertainties came to light.

The EPA Region 6 identified several problems in the derivation of the existing human health criteria recommendation for arsenic in their "Interim Strategy: Arsenic – Freshwater Human Health Criterion for Fish Consumption" (See www.epa.gov/region6/water/ecopro/watershd/standard/arsenic.htm). The latest (August 2, 2007) update of the interim strategy reports that states are continuing to use the arsenic criteria without recognizing that it applies to inorganic arsenic rather than total recoverable arsenic. It is also reported that the bioconcentration factor used in the derivation is too high in that it is based on a marine species (eastern oyster) rather than the range found for freshwater fish.

In the interim period until EPA finalizes the new human health criteria recommendation for arsenic, many states have chosen to adopt different fish consumption human health criteria (Table X). EPA has approved these new criteria when states 1) use the maximum contaminant level as the human health criteria, 2) recalculate the criteria using different bioconcentration factors, or 3) recalculate the criteria to recognize that inorganic arsenic is a small fraction of the total recoverable arsenic contained in fish tissue.

Table X

Arsenic Water Quality Standards (WQS) for Fish Consumption in Various States[1]		
State	**Fish Consumption WQS, ug/l**	**Basis**
Kansas	20.5	Recalculated
Nebraska	16.7	Unknown, 10^{-5} risk
North Carolina	10	MCL
California	5	EPA's CA Toxics Rule
Vermont	1.5	Recalculated
Iowa	1.4	Proposed 2007, 10^{-5} risk
Rhode Island	1.4	304(a) criteria w/ 10^{-5} risk
New Hampshire	0.14[2]	304(a) criteria w/ 10^{-6} risk
South Carolina	0.14[2]	304(a) criteria w/ 10^{-6} risk
Connecticut	0.021[3]	Unknown, 10^{-6} risk

1. Compare with EPA's Clean Water Act Section 304(a) Recommended Criteria of 0.14 ug/l for the 10^{-6} cancer risk.
2. Inorganic arsenic only
3. Arsenic+3 only

NHDES is concerned about 1) the arsenic water quality standard being outdated and subject to revision by EPA, 2) the proposed limit possibly being unnecessarily stringent, 3) the potential for the federal antibacksliding regulations to require such a limit to be retained in the permit, 4) the excessive cost of monitoring for arsenic using clean sampling and analytical procedures, not just for PSNH but possibly for other permittees and 5) the technical feasibility of achieving the limit.

NHDES has determined that it would be inappropriate to include a numeric permit limit for arsenic in NPDES permits at this time. NHDES is proposing that the draft permit require PSNH to monitor and report the concentrations of arsenic in outfalls 003A and 003C (FGD WWTF) and to conduct fish tissue monitoring for arsenic. The goal of the fish tissue monitoring will be to develop a site specific bioaccumulation factor (BAF) for arsenic for the middle Merrimack River. In addition to the effluent and fish tissue monitoring requirements, NHDES believes that a permit reopener clause should be added to allow the permit to be modified to include a limit if new information, such as a new water quality standard, indicates that a limit is necessary.

NHDES believes that monitoring of the discharge and fish tissue for arsenic and the inclusion of a permit reopener clause will meet water quality standards for the following reasons:

1. New information is available that suggests that the existing water quality criteria for the protection of human health are incorrect and should be revised.
2. EPA has approved state water quality standards for human health for fish consumption set equal to the MCL (of 10 ug/l) or recalculated with state specific information.

3. When new information becomes available, that was not available when the existing water quality standard was developed, Env-Wq 1704 allows for the development of alternative site specific criteria.
4. Arsenic does not biomagnify, or increase in concentration higher in the food chain.
5. Human exposure to arsenic is decreasing since the manufacture of pesticides containing arsenic is being phased out and since the drinking water MCL has been lowered.
6. Using the updated MCL of 10 ug/l as the water quality standard for fish consumption in the antidegradation calculations results in assimilative capacity for arsenic and no reasonable potential for the calculated limit to be violated.
7. Using a preliminary estimate of an alternative site specific arsenic criterion of 0.842 ug/l (Attachment X-3) as the water quality standard for fish consumption in the antidegradation calculations results in assimilative capacity for arsenic and no reasonable potential for the calculated limit to be violated.

For these reasons the draft permit requires monitoring of the effluent and fish tissue for arsenic and contains a permit reopener clause. As described in Part I._ of the draft permit, PSNH will have 180 days to develop a fish tissue monitoring program for review and approval by EPA and NHDES such that the monitoring can begin in year two.

Copper

The NHDES antidegradation calculations indicate that there is assimilative capacity for copper but there is a need for both monthly average and daily maximum permit limits.

A monthly average limit of 0.028 mg/l is necessary to ensure that the discharge only causes an insignificant (<20%) lowering of water quality in the Merrimack River. A maximum daily limit of 0.086 mg/l is also required to ensure that the acute water quality criteria is met at the anticipated maximum daily flow of outfall 003A of 13 mgd. Copper was the only pollutant that NHDES determined during the antidegradation review would require a maximum daily limit. None of the other pollutants evaluated showed reasonable potential for the calculated limit to be violated.

Mercury

The NHDES antidegradation calculations indicate that there is assimilative capacity for mercury and no reasonable potential that a limit that would use less than 20% of the available remaining assimilative capacity for either the aquatic life criteria or the human health criteria would be violated. However, all New Hampshire surface waters are listed as being impaired for mercury due to fish tissue concentrations that have led to a statewide fish consumption advisory and therefore a permit limit is needed to ensure that the loading of mercury in the discharge will not increase.

The major source contributing to the fish tissue impairment is air emissions from coal fired power plants. The EPA approved Northeast Regional Mercury TMDL

(see http://des.nh.gov/organization/divisions/water/wmb/tmdl/documents/mercury_final.pdf) states that point sources only account for 2.1% of the total load. Reductions in point sources of mercury are not required in this phase of implementation of the TMDL. However, reductions are anticipated due to New England states implementing mercury amalgam separation programs, recycling programs such as mercury switches being collected at automobile salvage yards and mercury products legislation.

If and when the TMDL is revised to require additional reductions from point sources, PSNH could be required to reduce their existing load. Until that time NHDES has determined that the existing load (0.000315 lbs/day) should be held by requiring a new limit for outfall 003A of 0.0072 ug/l. Although this limit is required at outfall 003A it is not measurable using standard analytical procedures and the draft permit states that the compliance will be assumed to be achieved when the concentration in the effluent is at or below the minimum level for mercury of 0.2 ug/l (EPA methods 245.1 or 7470A). NHDES is also proposing that a limit for mercury of 0.13 ug/l be required at the new FGD WWTF outfall 003C to determine compliance with the hold the load requirement. This limit is derived using the following equation that relates the maximum existing mercury concentration at the ash settling pond weir (outfall 003A) with the allowable concentrations in the new FGD WWTF (outfall 003C):

$$\mathbf{C_{003C} = (C_{MAX\ 003A} \times Q_{FGD}) / (Q_{003C})}$$

Where: $C_{MAX\ 003A}$ = max existing mercury concentration at outfall 003A = 0.006 ug/l
Q_{FGD} = Intake flow to scrubber (withdrawal) from ash settling pond = 1.08 mgd
Q_{003C} = flow of discharge from FGD WWTF into ash settling pond = 0.05 mgd
C_{003C} = concentration limit at FGD WWTF outfall 003A to hold load

Resulting in Q_{003C} = 0.13 ug/l

Since PSNH will be required to implement a fish tissue monitoring program for arsenic, they should consider analyzing the fish tissue samples for mercury as well. Baseline and ongoing fish tissue data for mercury should show the benefits of the scrubber installation over time and provide a basis for the eventual lifting of the fish consumption advisory.

Selenium

Selenium was identified as a pollutant likely to be present at elevated concentrations in FGD system effluent. The NHDES antidegradation calculations show there is assimilative capacity for selenium and no reasonable potential for a limit to be violated for outfall 003A as it exists now. However, NHDES has determined that a limit of 0.058 mg/l may be needed to ensure that the discharge only causes an insignificant (<20%) lowering of water quality in the Merrimack River. This is due to the uncertainty as to the effluent concentration achievable with the new FGD WWTF which is reportedly between 3 and 9mg/l.

NHDES has proposed that monitoring for selenium be included in the draft permit and that a reopener clause be added to allow the permit to be modified to include the limit of 0.058 mg/l at outfall 003A if it is determined during the permit term that there is reasonable potential for the limit to be violated. Accordingly, the draft permit contains a reopener clause and a monitoring requirement for selenium.

Chloride

There is no reasonable potential for the existing discharge to cause a violation of the chronic aquatic life criteria for chloride. Similar to selenium, however, chloride was identified as a pollutant likely to be present at elevated concentrations in FGD system effluent. Due to the uncertainty as to the effluent quality NHDES has determined that it would be appropriate to require monitoring for chloride. Accordingly, the draft permit contains a reopener clause and a monitoring requirement for chloride.

Table X-1

Summary of New Water Quality-Based Limits or Monitoring Requirements at Outfall 003A Resulting from NHDES Antidegradation Calculations				
Parameter	Existing Permit Limits		Proposed Permit Limits	
	Monthly Average	Maximum Daily	Monthly Average	Maximum Daily
Flow[1], mgd	9.0	19.1	5.3	13.0
Aluminum, total	NA	NA	1.03 mg/l	Report
Arsenic[2], total	NA	NA	Report, ug/l	Report, ug/l
Copper, total	NA	0.2 mg/l[3]	0.028 mg/l	0.086, mg/l
Mercury[4], total	NA	NA	0.0072 ug/l	Report, ug/l
Selenium, total	NA	NA	Report, mg/l	Report, ug/l
Chloride	NA	NA	Report, mg/l	Report, mg/l

1. The new flow limits are values requested by PSNH in the permit application Form 2C and were the flows used to develop the proposed monthly average and maximum daily permit limits.
2. Additional monitoring of FGD WWTF (outfall 003C) and of fish tissue required
3. Existing limit based on Effluent Limitation Guideline (ELG)
4. Limit of 0.13 ug/l (monthly average) also required at internal FGD WWTF outfall 003C

Attachment X-1

Water Quality Criteria and Sampling Results[1] Used in NHDES Antidegradation Calculations, bold values non-detects, All Units ug/l				
Chemical Name	Criteria Used	Criteria from Table 1703.1[2]	River Upstream of PSNH[3]	Outfall 003A Baseline[4]
Aluminum, total	Chronic	87	49.15 / 50	650
Antimony, total	Chronic	1,600	0.047 / 0.14	0.158
Arsenic, total	Fish Cons.	0.14	0.36 / 0.41	1.9
Arsenic, diss.	Chronic	150	0.36 / 0.41	1.9
Beryllium, total	Chronic	5.3	0.06 / 0.109	1.08
Cadmium, diss.	Chronic	0.8	**0.02** / 0.044	0.1857
Chromium^{+3}, diss	Chronic	24	0.195 / .251	1.625
Chromium^{+6}, diss	Chronic	11	0.34 / 0.34	**0.192**
Copper, diss.	Chronic	2.7	0.508 / 1.14	9.6
Iron, total	Chronic	1,000	297.5 / 297.5	700
Lead, dissolved	Chronic	0.54	0.131 / 0.189	1.06
Manganese, total	Fish Cons.	100	23.75 / 23.75	55
Mercury, total	Fish Cons.	0.051	0.0015/ 0.01428	0.006
Mercury, diss.	Chronic	0.77	0.001275/0.01214	0.0051
Nickel, diss.	Chronic	16.1	0.275 / 0.3997	2.19
Selenium, total	Chronic	5	**0.525** / 0.618	1.5
Silver, dissolved	Acute	0.32	**0.02** / 0.161	**0.034**
Thallium, total	Fish Cons.	6.3	0.009 / 0.04374	0.289
Zinc, dissolved	Acute	36.2	1.993 / 3.546	18.58
Chlorides, total	Chronic	230,000	18,250 / 18,250	27,000
Ammonia (as N), total	Chronic	3,420	82.5 / 651.4	2,600
Nitrates (as N), total	Water + Fish Cons.[5]	10,000	500 / 510	500

1. Results Provided by either Eastern Analytical, Inc.of Concord, NH or Frontier Geosciences, Inc. of Seattle, WA. Results are expressed in a form consistent with the standards (total recoverable or dissolved)
2. For hardness dependent metals a hardness of 25 mg/l as $CaCO_3$ was used.
3. Average of four rounds of river samples / adjusted value that includes future load of three major upstream POTW (Concord Hall Street, Penacook and Franklin)
4. Maximum of six baseline samples from outfall 003A
5. There is no fish consumption only criteria. This value, which is the same as the MCL is used only as a check.

Attachment X-2

Parameter	Dissolved or Total	Number of Effluent Samples "n"	Maximum Value measured in Outfall 003A (ug/l)	Reasonable Potential Multiplication Factor	Max Value x Factor (ug/l)	Maximum Allowable Permit Concentration to use < 20% ARAC* (ug/l)	Reasonable Potential (Yes/No)
Aluminum (Chronic)	Total	6	650	3.8	2,470	1,036	YES
Antimony (Chronic)	Total	6	0.158	3.8	0.60	21,049	NO
Arsenic (Fish cons.)	Total	6	1.9	3.8	7.2	Not Applicable	Exceeds Criteria
Arsenic (chronic)	Dissolved	6	1.9	3.8	7.2	1,969	NO
Beryllium (Chronic)	Total	6	1.08	3.8	4.1	69.2	NO
Cadmium (Chronic)	Dissolved	6	0.18566	3.8	0.7055	10.1	NO
Chromium +3 (Chronic)	Dissolved	6	1.63	3.8	6.18	313.7	NO
Chromium +6 (Chronic)	Dissolved	6	0.192	3.8	0.7296	140	NO
Copper (Chronic)	Dissolved	**8**	9.6	**3.3**	31.7	28	YES
Lead (Chronic)	Dissolved	6	1.06	3.8	4.04	5.4	NO
Mercury (Fish cons.)	Total	6	0.006	3.8	0.0228	0.47	NO
Mercury (chronic)	Dissolved	6	0.0051	3.8	0.0194	9.96	NO
Nickel (Chronic)	Dissolved	6	2.19	3.8	8.33	208.1	NO
Selenium (Chronic)	Total	6	1.5	3.8	5.7	58.2	NO
Silver (Acute)	Dissolved	6	0.034	3.8	0.1292	1.89	NO
Thallium (Fish cons.)	Total	6	0.289	3.8	1.1	82.5	NO
Zinc (Chronic)	Dissolved	6	18.58	3.8	70.6	442.3	NO
Manganese (Fish cons.)	Total	6	55	3.8	209	1,022	NO
Iron (Chronic)	Total	**8**	700	**3.3**	2,310	9,489	NO
Ammonia (Chronic)	Total	6	2,600	3.8	9,880	37,984	NO
Nitrate (Water + fish)	Total	6	500	3.8	1,900	124,611	NO
Chloride (Chronic)	Total	6	27,000	3.8	102,600	2,806,980	NO

*ARAC = available remaining assimilative capacity

ATTACHMENT X-3

PRELIMINARY ESTIMATE OF ALTERNATIVE SITE SPECIFIC HUMAN HEALTH FISH CONSUMPTION ONLY CRITERIA FOR ARSENIC IN FRESHWATER IN NEW HAMPSHIRE

Equation 1-3 from page 1-10 of the "Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health, October 2000" (EPA 2000) reads:

$$AWQC = RSD \times \left[BW \; / \; \left[DI + \sum_{i=2}^{4} (FI_i \times BAF_i) \right] \right]$$

where,

AWQC = Ambient Water Quality Criterion, mg/l
RSD = Risk-specific dose for carcinogens based on a linear low-dose extrapolation. Equal to risk divided by q*1 (cancer slope factor), mg/kg-day
BW = Human body weight, kg
DI = Drinking water intake, L/day
FI_i = Fish intake at trophic level, kg/day
BAF_i = Bioaccumulation factor at trophic level I, lipid normalized, L/kg

Best available input for New Hampshire:

RSD = risk/q*1 = 10^{-6} / 1.5 = 6.67 x 10^{-7} mg/kg-day
Source: q*1 from IRIS, Section II.B.1., Oral slope factor in Summary of Risk Estimates, see http://www.epa.gov/ncea/iris/subst/0278.htm#quaoral.
Note – Env-Wq 1704.02(a) references "Assessment and Control of Bioconcentratable Contaminants in Surface Waters, March 1991" which in turn references the EPA's Integrated Risk Information System or IRIS.

BW = 70 kg
Source: EPA 2000, default human body weight for adults

DI = 0 L/day
Source: Fish consumption only criteria uses oral exposure for fish only

FI = 0.0175 kg/day
Source: EPA 2000, default for total fish (all trophic levels) intake for general adult population and sport anglers.

BAF = 3.17 L/kg (48 x 0.33 x 0.2)
BAF = 48 L/kg x 0.33 (conversion from whole fish BAF to fillet BAF)
x 0.2 (estimated worst-case percent of inorganic As in freshwater fish tissue)
Source: BAF of 48 L/kg is from page D-7 of EPA 2003, Office of Science and Technology, Technical Summary of Information Available on the Bioaccumulation of Arsenic in Aquatic Organisms, December 2003. Average for wet weight BAFs for black crappie, bluegill, yellow perch and largemouth bass from Upper Mystic Lake, MA.

AWQC (Preliminary Estimate of Alternate Site Specific Criteria) = 0.000842 mg/l

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http://epa.gov/sab/pdf/sab-07-008.pdf
http://www.epa.gov/waterscience/criteria/wqctable/#B
http://www.epa.gov/ncea/iris/subst/0278.htm#quaoral
http://www.epa.gov/ncea/iris/subst/0278.htm#quaoral
http://www.epa.gov/waterscience/criteria/arsenic/tech-sum-bioacc.pdf
http://www.epa.gov/region6/water/ecopro/watershd/standard/arsenic.htm#geninfo
http://www.epa.gov/waterscience/criteria/humanhealth/method/tsdvol3.pdf
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http://www.epa.gov/waterscience/criteria/arsenic/sab/ASIssues_SAB.pdf
http://www.epa.gov/fishadvisories/study/tissue.htm#methods
http://yosemite.epa.gov/sab/sabproduct.nsf/MeetingCal/1A8B1D874ECECD45852576C0005DCF0B?OpenDocument

Fish Tissue Info from Bob Estabrook

Disk 4,

10/30/2003, composite of five largemouth bass (fillets)
from Little Island Pond, Hillsboro County

Results (Dup) Arsenate = 0.1 ug/g in sample 63406, episode 6322
Arsenite = 0.1 ug/g in sample 63406, episonde 6322

Results (Std) Arsenate = 0.1 ug/g in sample 63404, episode 6322
Arsenite = 0.1 ug/g in sample 63404, episonde 6322

Results same for Samples 63225 (White sucker, Big Diamond Pond)
Sample 63224 (Yellow perch, Big Diamond Pond)
Sample 63202 (Largemouth bass , Horn Pond)

0.1 ug/g = 0.1 mg/kg (DL too high to compare to action level of 0.016 mg/kg wet weight)