

CLF EXHIBIT 02

**Expert Report of John H. Koon in the Matter of Comments
on the NPDES Permit for PSNH's Merrimack Station (2012)**

Expert Report of John H. Koon, Ph.D., P.E., BCEE

In the Matter Of:

Comments on the National Pollutant Discharge
Elimination System (NPDES) Permit for Public Service
Company of New Hampshire's (PSNH) Merrimack
Station

Submitted to: Conservation Law Foundation

Prepared by



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Report of John H. Koon, Ph.D., P.E., BCEE Regarding Comments on the Draft NPDES Permit for the PSNH Merrimack Station

1.0 Summary

A draft NPDES permit for Public Service Company of New Hampshire's (PSNH) Merrimack Station was issued by the U.S. EPA Region 1 in 2011, and placed on public notice for comment. At the request of the Conservation Law Foundation, the FGD discharge was assessed to evaluate EPA's determination that vapor-compression evaporation (VCE) should not be selected as the basis for BAT permit limits.

It is my opinion, based on this evaluation, that BAT for FGD wastewater treatment at Merrimack Station should be VCE.

Other findings which support this conclusion include the following:

1. The Merrimack FGD wastewater treated using VCE would reduce the toxicity (as measured by the EPA toxicity weighting procedure) discharged to the environment by 5, 295 lb-eq TWPE¹/yr compared to the wastewater receiving chemical-physical plus biological treatment (the technologies EPA selected as the basis for its BAT effluent limits).
2. VCE is an available technology. It has been successfully used for FGD wastewater treatment at seven locations in the United States and Italy. In addition there are two installations of VCE treating FGD wastewater in China and Japan.
3. VCE is cost-effective. The annual cost for VCE treatment at Merrimack Station is estimated to comprise only 1.5% of the operating revenue of the site. In addition, documents demonstrate that PSNH has already included sufficient funds for the construction of a VCE system in the FGD system construction budget.
4. VCE is the technology that best meets the BAT directives included in the Clean Water Act and in court decisions including that EPA must set effluent limitations that work toward "the national goal of eliminating the discharge of all pollutants;" (EPA 2011c, p. 8, Sect. 2.4) and that EPA should "use the latest . . . technology in setting effluent limits, pushing industries toward the goal of zero discharge as quickly as possible." (EPA 2011c, p. 9 Sect. 2.4)
5. There are no adverse implications of the use of VCE treatment with respect to the EPA "BAT factors" including age of the equipment and facilities involved, process employed and process changes, and the engineering aspects of the application.
6. The electrical energy required for operation of the process is estimated to be very small, approximately 0.8% of the energy generated at Merrimack Station.
7. Other non-water quality impacts including air emissions and solid waste generation would be very small. The solids generated by the VCE treatment system would be no more than 1.8% of the weight of ash and gypsum currently generated at the site.
8. PSNH has already proceeded with plans to design and construct VCE at the Merrimack Station.
9. Sampling and monitoring requirements should be included in the permit to provide reasonable assurance to EPA that the limits are being met. Sampling and monitoring recommendations are

¹ TWPE = toxicity-weighted pound equivalents.

included in Table 6 for VCE used as the basis of BAT and for chemical-physical plus biological treatment should EPA decide to continue with these technologies as the basis for BAT. In addition, sampling and monitoring is recommended for the untreated FGD wastewater.

2.0 Introduction

2.1 Background Information

This report has been prepared at the request of the Conservation Law Foundation regarding draft NPDES permit NH0001465 prepared for Merrimack Station. Specifically, I have been asked to comment on the appropriateness of the technologies upon which the BAT limits were based.

Merrimack Station is located at Bow, NH and is owned and operated by PSNH. The station contains four electrical generation units and has a total capacity of 520 MW. Two units are coal-fired, steam-driven generating units having a total capacity of 470 MW. The remaining two generating units are combustion turbines having a total capacity of 50 MW and are fueled by No. 1 fuel oil. The two coal-fired units are referred to as MK-1 which has a capacity of 120 MW and began operation in 1960 and Unit MK-2 which has a capacity of 350 MW and began operation in 1968 (EPA 2011a).

The draft permit (EPA 2011a) was placed on public notice on September 30, 2011. This document was accompanied by a Fact Sheet (EPA 2011b) and was based partially on a "Determination Document" developed by EPA Region 1 (EPA 2011c). In turn the Determination Document was based partially upon a memorandum from Ronald Jordan and Cuc Schroeder of the EPA Engineering and Analysis Division to EPA Region 1 on August 11, 2011 (EPA 2011d). To correct several transcription errors in the permit and Fact Sheet, EPA subsequently issued a letter delineating the corrections. (EPA 2011e) These documents contain a BPJ-based (best professional judgment) determination of BAT (best available treatment) limits for the FGD (flue gas desulfurization) unit wastewater discharge as required by the Clean Water Act.

This report concerns Outfall 003C of the permit which contains effluent limits for the FGD wastewater treatment system. The FGD system was required by the State of New Hampshire to begin operation no later than July 1, 2013. In fact, construction was completed early and, according to PSNH, the unit was placed into operation during the fourth quarter of 2011. The effluent limits for Outfall 003C are summarized in Table 1 below.

2.2 Information Concerning the Expert

Qualifications and Experience of the Expert

This report was prepared by John H. Koon. Dr. Koon is a specialist in the treatment of industrial wastewaters. During his career of over 30 years, he has worked with industrial companies, military installations, and municipal agencies at over 400 locations in solving environmental problems, the majority of which have involved water and wastewater issues. Early in his career, he worked with an engineering company in which he played a key role in the full-scale application of new technologies required to treat industrial wastewaters to meet the recently enacted Clean Water Act. His career has continued to consist predominately of work addressing complex issues in the treatment of industrial

**Table 1. Draft Permit Limits and BAT Recommendations
for Merrimack Station Outfall 003C**

Pollutant	Merrimack Station Draft Permit Limits for FGD Discharge (ug/L) ^{a,b}	
	Monthly Average	Daily Maximum
Arsenic	8	15
Cadmium	Report	50
Chromium	Report	10
Copper	8	16
Lead	Report	100
Manganese	Report	3,000
Mercury	Report	0.014
Selenium	10	19
Zinc	12	15
Chlorides	Report	18,000,000
Total Dissolved Solids	Report	35,000,000

^aFrom EPA 2011a.

^bPermit also reporting requirements for flow, boron, iron, BOD₅, total nitrogen, and total phosphorus.

wastewaters. His experience includes the evaluation and design of systems to remove a variety of metals from wastewaters including arsenic, mercury, and selenium. Recently Dr. Koon has consulted with Earth Justice regarding the setting of BAT standards for the TVA Bull Run station in Tennessee. One of the streams receiving extensive evaluation at this site is wastewater discharged from the FGD scrubber at the site. His experience includes the conduct of experimental investigations having the objective of determining information needed for system design; evaluating and recommending technologies for application to the treatment of a wide variety of wastewaters; and participation in capital projects for which tasks of design, construction, and start-up have been included.

His education includes three degrees in civil and environmental engineering. His terminal degree is a Ph.D. in civil engineering (environmental engineering option) from the University of California-Berkeley. He is a licensed professional engineer. He also has been designated a Board Certified Environmental Engineer (BCEE) by the American Academy of Environmental Engineers. His CV is presented in Appendix 1 of this report.

3.0 EPA's BPJ Analysis

EPA's BPJ analysis was presented in the "Determination Document" (EPA 2011c) authored by EPA Region I. The observations and findings of this document may be summarized as follows:

1. PSNH selected a system to treat the FGD wastewater which "consists of chemical precipitation, coagulation/flocculation, clarification, filtration and sludge dewatering." The system will also

include a “proprietary adsorbent media (or “polishing” step) for further removal of mercury from the effluent.” (EPA 2011c, p. 5, Sect. 1.4).

2. PSNH “for the most part” (EPA 2011c, p. 5, Sect. 1.4) constructed the FGD wastewater treatment system without first discussing with the treatment requirements with EPA or receiving a draft permit for the discharge.
3. EPA considered the following technologies in its BAT evaluation:
 - a. Discharge to a POTW.
 - b. Evaporation ponds.
 - c. Flue gas injection.
 - d. Fixation.
 - e. Deep well injection.
 - f. FGD wastewater treatment system effluent reuse/recycle.
 - g. Settling ponds.
 - h. Treatment by the existing wastewater treatment system (three rectangular concrete settling basins with chemical feed and basic mixing capability using compressed air).
 - i. Vapor-compression evaporation.
 - j. Physical-chemical treatment.
 - k. Physical-chemical treatment plus biological treatment for selenium removal.
4. EPA determined that physical-chemical treatment coupled with biological treatment for selenium removal constituted BAT for the FGD wastewater.
5. In arriving at this determination, EPA also determined that there was no reason associated with the statutory “BAT factors” (set forth in CWA §304(b)(2)(B) and at 40 CFR 125.3(d)(3)) that physical-chemical plus biological treatment not be selected. The findings related to the EPA “BAT factors” are summarized as follows:
 - a. Age of Equipment and Facilities Involved – PSNH had a physical-chemical treatment system under construction at the time the determination was made. In addition EPA found nothing that would preclude adding biological treatment to this facility.
 - b. Process Employed and Process Changes – EPA found that the wastewater treatment system would not interfere with the station’s primary process for generating electricity.
 - c. Engineering Aspects of the Application of Various Types of Control Techniques – EPA found that physical-chemical and biological treatment had been successfully designed and constructed at other power stations without significant engineering problems.
 - d. Cost of Achieving Effluent Reductions – EPA observed that PSNH’s decision to install a physical-chemical treatment system demonstrated that this system was not cost-prohibitive. In addition EPA estimated that the added cost of biological treatment could “reasonably be borne by PSNH. (EPA 2011c, p. 29, Sect. 4.0(iv)) EPA also observed that the capital cost for physical-chemical plus biological treatment was estimated to be approximately \$9,800,000 compared to a capital cost for the FGD scrubber system of \$430,000,000 – “a small fraction of this total” (which I have calculated to be 2.3%). (EPA 2011c, p. 29, Sect. 4.0(iv))
 - e. Non-Water Quality Environmental Impacts (including energy requirements) – EPA concluded that “nothing about either physical/chemical treatment or biological

treatment that is likely to generate any significant adverse non-water quality environmental effects at Merrimack Station.” (EPA 2011c, p. 30, Sect. 4.0(v) In addition EPA estimated that this treatment system would generate 1,986 tons/year of solids and would require 354,000 kW-hr of electricity. While EPA acknowledged that there would also be some indirect air emissions associated with the energy needed to operate the treatment system, the incremental increases would, in EPA’s opinion, be “insignificant.” (EPA 2011c, p. 30, Sect. 4.0(v)

6. While EPA considered VCE, it did not recommend this technology as BAT. In its evaluation, EPA countered statements by PSNH that there essentially was no experience with this technology in the United States by recognizing that there was (as of September 2011 when the Determination Document was issued) one VCE system in operation in the United States and six in operation in Italy, all at coal-fired power plant locations. EPA also agreed with PSNH statements that the operation of this technology “requires proper control of wastewater chemistry . . . and may require pretreatment steps.” (EPA 2011c, p. 21, Sect. 3.9) EPA concluded that it “was not clear at the present time whether or not this technology is feasible for application at Merrimack Station.” (EPA 2011c, pp. 22, Sect. 3.9) However, EPA added that it is continuing to evaluate VCE and stated that it “could potentially find it to be part of the BAT for Merrimack Station for the final NPDES permit.” (EPA 2011c, pp. 22, Sect. 3.9) EPA also considered the BAT factors in its evaluation of VCE. These findings are presented later in this report.

In reviewing and presenting the legislative and regulatory requirements and objectives of best available treatment, EPA quoted some instructive language related to its determination. Excerpts from this discussion include the following statements:

- “The BAT standard requires achievement of ‘effluent limitations . . . which . . . shall require application of the best available technology economically achievable . . . , which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants, . . . ” (33 USC § 1311(b)(2)(A) quoted at (EPA 2011c, p. 8, Sect. 2.4)
- EPA further emphasized this by quoting the Congressional intent that EPA “use the latest scientific research and technology in setting effluent limits, pushing industries toward the goal of zero discharge as quickly as possible.” (EPA 2011c, p. 9, Sect. 2.4)
- It also cited federal case law requiring that “the BAT standard must establish effluent limitations that utilize the latest technology.” (EPA 2011c, p. 9, Sect. 2.4)

4.0 Consideration of VCE

4.1 Wastewater Characteristics

The characteristics of the untreated FGD wastewater was compared to treated FGD wastewater characteristics.

In evaluating and comparing wastewaters subjected to different treatment sequences, the pollutant loadings can be adjusted for toxicity by multiplying the estimated quantity by a “normalizing weight”

called a toxic weighting factor (TWF). The TWF factors have been developed by EPA, though they are not required by any statute or regulation. The TWF for each pollutant measures its toxicity relative to copper with more toxic pollutants having higher TWF values. The weighted quantities for individual pollutants are summed to yield aggregate measures for each waste stream. (ERG 2005)

The wastewater flow discharged from the Merrimack Station FGD system was taken to be 70,000 gpd. This is the value contained in the draft NPDES permit. While early documents indicated that the FGD wastewater flow would be 50,000 gpd², PSNH requested that EPA change the flow to an average flow of 70,000 gpd with an allowance for a maximum flow of 100,000 gpd.³ (Palmer 2011)

The characteristics of the FGD scrubber blowdown (*i.e.*, untreated wastewater from the FGD system) were evaluated and compared to treated wastewater characteristics. Since the FGD system is new, no samples of the untreated blowdown are available and data contained in an evaluation of FGD wastewaters developed for EPA by Eastern Research Group (ERG 2009) were used. ERG defined “small” and “large” model plants and developed wastewater loading information for each model plant. For this evaluation, the loadings for the small model plant were modified to Merrimack Station conditions by changing the FGD wastewater flow rate from 175 gpm to the Merrimack Station flow of 49 gpm (equivalent to 70,000 gpd discussed previously in this report). The resulting wastewater characteristics are presented in Table 2. Characteristics are shown for 25 metals (including some metalloids) and five other pollutants (fluoride, nitrite/nitrate nitrogen, and total phosphorus). Those pollutants were, with some exceptions for conventional and non-conventional pollutants, included by EPA in its sampling and evaluation of FGD wastewaters in its detailed study of the industry. (EPA 2009)

Table 2. Waste Loads Associated with Untreated FGD Wastewater and Following Treatment

Waste Stream/Treatment System	Waste Load (lb-eq TWPE/yr)	Fraction TWPE Removed (%)
FGD Scrubber Purge/Blowdown (prior to treatment)	7,952	--
Chemical Precipitation + Biological Treatment Effluent	742	90.7
Chemical Precipitation + Vapor-Compression Evaporation Effluent	0	100

In addition, data related to a January 5, 2012, sample of Merrimack Station FGD wastewater following chemical precipitation treatment were also analyzed. This sample was from pretreated FGD wastewater taken to the Allentown, NH publically owned treatment works (POTW) for further treatment and discharge to the environment. (The station currently is disposing of the FGD wastewater in this manner

² A flow of 50,000 gpd was contained in the PSNH NPDES renewal permit application (PSNH 2010a). The 50,000 gpd flow was also included on a “Schematic of Water Flow” diagram (PSNH 2010b).

³ It is noted that limits for flow were removed from the draft NPDES permit (EPA 2011a) in a letter from EPA to PSNH dated December 16, 2011 (EPA 2011e). However, the flow requested by PSNH seems to be the most credible flow for the FGD discharge.

since the Station's permit does not yet include provisions for the FGD discharge.) These data were reported to the POTW by PSNH's consultant, GZA GeoEnvironmental, Inc. (GZA 2012) The GZA report is attached as Appendix 2 to this report. Since not all of the pollutants included in the ERG evaluation (ERG 2009) were reported from this source, the PSNH sample data were supplemented with data contained in the ERG report.⁴

Observations from these calculations are as follows:

- Based on the modified ERG model plant, the Merrimack Station untreated FGD wastewater was estimated to contain 7,952 lb-eq TWPE/yr of pollutants as expressed by TWPE toxicity.
- Based on the modified ERG model plant, following physical-chemical and biological treatment, the Merrimack FGD wastewater was estimated to contain 742 lb-eq TWPE/yr of pollutants expressed as TWPE toxicity. This represents the removal of 90.6% of the TWPE.
- Following VCE treatment, the Merrimack FGD wastewater was estimated to contain no TWPE. This represents the removal of 100% of the TWPE.
- Based on the Merrimack Station FGD wastewater sample, the effluent from PSNH's current FGD wastewater system, if also treated for selenium removal, would contain 5,280 lb-eq TWPE/yr. The one sample available of Merrimack FGD wastewater pretreated using chemical-physical treatment indicates that it contains considerably greater amounts of pollutants compared to the ERG model plant wastewaters. Thus, it can be concluded that VCE treatment of the Merrimack FGD wastewater would result in the removal of a significantly greater amount of TWPE than chemical-physical + biological treatment as shown with the ERG data analysis.

4.2 The Availability of VCE Technology

EPA reported in 2009 that one coal-fired power plant in the U.S. and six coal-fired power plants in Italy are treating FGD wastewaters using vapor-compression evaporation.

An update to this information was obtained from Aquatech, the supplier of the evaporation systems at the Italian plants mentioned above. (Randall 2011a) It was learned that another system for a U.S. site is in the equipment procurement phase of construction; and another is being designed for a location in the U.S. Others are being planned and preliminary engineering is being developed. It was also learned that the Italian plants, placed in operation in 2006-2008, continue to operate well and without any significant problems.

As of December 2011 it was learned that one of the evaporation plants in Italy had been shut down because another less costly method of handling the FGD wastewater had been identified. I understood that there were no operations problems with the unit that influenced or led to the shutdown. (Randall 2011b)

VCE has been used for a number of years in other industries including the treatment of cooling tower blowdown and the treatment of coal gasification wastewaters. While FGD wastewaters have different

⁴ The metals included boron, cobalt, magnesium, titanium, vanadium, and yttrium.

characteristics compared to these wastewaters, the technology has been in use for at least 30 years. (Shaw 2011)

In addition, there is documentation that PSNH has proceeded with plans to install VCE at the Merrimack Station. The events are summarized in reports prepared by Jacobs Consultancy for the New Hampshire Public Utilities Commission. (Jacobs 2011) Jacobs performed due diligence on the project and monitored on-going activities during the project. The documentation consists of the following:

1. On November 17, 2010 Burns & McDonald was tasked to evaluate VCE as a “supplemental WWTS option” and that supplemental option would include a “brine concentrator, crystallizer.” (Jacobs 2011a, p. 67) The Jacobs report also noted that Burns & McDonald was engaged for this task partially because of “their experience with the only other similar system in the United States.” (Jacobs 2011a, p. 67)
2. Burns & McDonald found that VCE “would reduce the liquid waste stream to between zero to five gpm . . . ” (Jacobs 2011a, p. 67) Jacobs made no mention of any reservations that Burns & McDonald had with the installation of this system at Merrimack Station.
3. On January 12, 2011 Requests for Proposal (RFPs) for equipment and construction of the supplemental WWTS (a VCE system) were approved for release.
4. In January 2011 project management personnel revised the project budget to include \$20.2 million for the supplemental WWTS. The Jacobs report noted that “the overall project budget did not increase since Clean Air Project management utilized funds from reserve and contingency accounts. (Jacobs 2011a, p. 67)
5. On January 20, 2011 bids from Aquatech and one other bidder were reviewed. Discussions were held with both bidders concerning scope, schedule and guarantee. Both bidders provided best and final offers.
6. On February 3, 2011 a purchase order (PO) was opened with Aquatech for “a provision for potential future options, design development and shipping as well as a contingency provision allowance.” (Jacobs 2011a, p. 67)

Other information in the Jacobs reports indicated that the cost of the FGD project as of September 20, 2011 was adjusted to \$422 million. (Jacobs 2011b) Since the project was reported to be 86 percent complete in July 2011 (Jacobs 2011c), this amount is expected to be an accurate reporting of the actual project cost. In addition since the purchase order with Aquatech was issued in February 2011, it is reasonable to conclude that PSNH expected to complete the project (including the VCE system) for a cost noticeably less than the original forecast cost of \$457 million. (Jacobs 2011b)

Based on this information, I have concluded that vapor-compression evaporation is an available technology that could be applied to the treatment of FGD wastewater at Merrimack Station.

I have also concluded that the capital cost of VCE was affordable within the FGD construction project, and, thus, certainly was affordable within the overall financial situation of Merrimack Station.

4.3 The Cost of VCE

EPA presented its cost estimates for FGD wastewater treatment options in its Determination Document. These costs were also communicated from EPA Headquarters to EPA Region 1 in an email from Ron Jordan to Sharon DeMeo on September 13, 2011. (EPA 2011d) The costs are summarized in Table 3.

Table 3. Summary of Treatment Cost Estimates for FGD Wastewater

Technology Option	Capital Cost (2010\$)	Annual O&M Cost (2010\$/yr)	Annualized Cost (2010\$/yr)
Chemical Precipitation	4,869,000	430,000	889,000
Chemical Precipitation + Biological Treatment	9,823,000	727,000	1,654,000
Chemical Precipitation/Softening + Evaporation	27,949,000	1,524,000	4,162,000

The cost of VCE by itself was calculated to be \$23,080,000 by subtracting the cost for chemical precipitation from the EPA cost estimate for “Chemical Precipitation/Softening plus Evaporation” given in Table 3 above. This compares favorably to the \$20,200,000 budgeted by PSNH for VCE design and construction. The EPA estimate is 14% greater than the PSNH cost estimate, a reasonable difference given the nature of the EPA estimate. Thus, it appears that the EPA cost estimate of VCE is reasonable.

In order to put these costs in the context of the affordability of VCE at Merrimack Station, it was necessary to locate additional cost factors related to the production cost of electrical energy and the cost of electrical generating facilities. The following costs were identified and the related metrics for Merrimack Station calculated for use in this evaluation:

- **Merrimack Station Operating Revenue Estimate.** An estimate of the amount of electricity generated from the coal-fired units at Merrimack Station was developed from the 2010 winter capacity figures for each unit (ISO NE 2011) and the capacity factors for each unit. (Cannata 2011) The calculated electricity generated in 2010 was 2.8 billion kW based on the winter capacity figures for MK-1 and MK-2 (122,700 and 352,500 kWh, respectively) and the capacity factors for each unit (67.2 and 67.5%, respectively). This value was multiplied by the cost of energy service for PSNH, \$0.0898, (Baumann 2011) to obtain the estimate of revenues derived from the sale of electricity generated in the two coal-fired units at Merrimack Station. This revenue was estimated to be \$252,000,000 for 2010.
- In order to estimate the value of the Merrimack Station facilities, two approaches were taken. First the asset value and book value of the facilities at the site were obtained from PSNH. (PSNH 2011) The cost of the FGD scrubber reported by Jacobs, \$422,000,000 (Jacobs 2011b), was added to these amounts to reflect the added value of the FGD system.
- In addition, the replacement value of the coal-fired generating facilities was estimated. The capital cost of coal-fired power plants has been reported as \$1,000 - \$1,500/kW for units under

construction or planned that could be commissioned between 2010 and 2015 (EIA 2010) and \$1,500 - \$1,800/kW generating capacity in 2005. (Synapse 2008) However, the Synapse report also stated that construction cost estimates for new coal-fired power plants . . . have increased significantly to \$3,500/kW. This estimate is for units being planned when the report was issued in 2008.

Using construction costs of \$1,500/kW and \$3,500/kW generating capacity found above, it is estimated that it would cost between \$705,000,000 and \$1,645,000,000 to replace the 470 MW of coal-fired capacity at Merrimack Station. Adding an additional 10% to these costs to account for cost escalation between 2008 and 2012, the replacement cost would be expected to be between \$776,000,000 and \$1,810,000,000.

- The cost of treatment is shown compared to these values in Table 4 below.

Table 4. Treatment Costs as a Fraction of Generating Plant Investment and Operating Revenue

Treatment Option	Capital Cost (\$)	Annual Cost (\$ million/yr)	Capital Cost as Fraction of Generating Plant Value (%) ^a				Annual Cost as Fraction of Operating Revenue (%) ^b
			\$776 M Capital Cost	\$1.8 B Capital Cost	\$537 M Net Book Value	\$664 M Asset Value	
FGD - Chemical Precipitation + Biological Treatment	9,823,000	1,654,000	1.3	0.6	1.8	1.5	0.7
FGD - Evaporation	25,069,000	3,890,000	3.2	1.4	4.7	3.8	1.5

^aSee text for source of generating plant values.

^bBased on operating revenue estimate of \$252,000,000. See text for details.

The cost of constructing and operating VCE is a very small fraction of comparable costs that the station has already and is continuing to incur. The capital cost of VCE would increase the value of the site facilities by 1.4 to 4.7%, depending on the basis for the comparison.

The annual cost of VCE (including amortized capital cost plus annual operating costs) would comprise only 1.5% of the estimated annual operating revenue of the site. This is a very low fraction of the station operating revenue.

4.4 Reconsideration of the BAT Factors

In its Determination Document (EPA 2011c), EPA considered the statutory and regulatory “BAT factors” for the application of VCE technology for the treatment of the FGD wastewater. In summary EPA found the following:

1. **Age of the Equipment and Facilities Involved.** The age of the station would neither preclude nor create special problems with the application of VCE.
2. **Process Employed and Process Changes.** VCE would not require changes to or interfere with the station’s other pollution control processes or its power production process. In addition EPA

found that VCE could be used together with the physical-chemical treatment system that PSNH has already constructed at the site.

3. **Engineering Aspects of the Application of Various Types of Control Techniques.** EPA observed that VCE has been applied to the treatment of FGD wastewater at other coal-fired power plants and that no engineering issues have been identified in the design and construction of these facilities.
4. **Non-Water Quality Environmental Impacts (Including Energy Requirements).** With respect to the non-water quality environmental effects of VCE, EPA noted that the energy demands of the process “might not be insignificant” and that the process would produce a solid waste that would require proper management. (EPA 2011c, p. 22, Sect. 3.9)
5. **Cost of Achieving Effluent Reductions.** With respect to cost, EPA determined that VCE would “add significant cost.” (EPA 2011c, p. 22, Sect. 3.9) EPA quoted costs estimated by EPA Headquarters that included a capital cost of \$27,949,000, an operating cost of \$1,524,000/yr, and a total annualized cost of \$4,162,000/yr. The analysis in Section 4.3 above demonstrates that, in fact, the cost of VCE is not significant in considering the cost that it will add to the site investment value nor would the annualized cost impose a significant burden on the site. In addition the fact that PSNH has already budgeted for the construction of VCE in its Clean Air Project cost provides further demonstration that the construction cost is not a burden to the site.

4.4.1 Energy Impacts

With respect to the energy demands of VCE, energy consumption associated with this process was estimated for conditions that apply at the Merrimack Station. The findings are summarized in Table 5.

Power requirements for VCE were estimated from information provided by Aquatech (Randall 2011) for a recent project with adjustment for the comparative sizes of this system and that which is required at Merrimack Station.

The energy requirements of all options are a minimal fraction of both the electrical power produced at Merrimack Station and that produced in the entire USA. In addition this energy use will not result in any significant increase in air emissions from the Merrimack Station or from all air emissions generated from power production in the USA. This demonstrates that EPA concerns about energy demands for VCE are unfounded.

Table 5. Energy Use for VCE Compared to Station Energy Generated

Treatment Option	Estimated Energy Required (kW hr/yr)	Fraction of Total Energy Generated at Merrimack Station ^a (%)	Fraction of Total USA Electrical Energy Used in 2012 ^b (%)
VCE/Brine Crystallization (including chemical precipitation)	17 x 10 ⁶	0.8	0.00005

^aBased on Bull Run generation of 2.8 x 10⁹ kWh in 2005. (TVA 2005)

^bBased on total USA electrical power generation projected for 2012 of 4,405 x 10⁹ kWh.

4.4.2 Air Emissions

VCE does not generate significant air emissions. In addition, as evidenced by the very small fraction of energy generated at Merrimack Station required to power the VCE treatment system, the incremental air emissions from power generation at the site will not be significant. Implementation of this technology is not expected to impact the Merrimack Station facility's ability to comply with air pollution permits and standards.

4.4.3 Solid Waste Generation

Based on the FGD scrubber purge composition summarized in Table 2, the mass of the dissolved solids in the wastewater plus an added amount to account for lime and soda ash that would be added to precipitate calcium and magnesium in the precipitation unit ahead of the VCE process were calculated to estimate the solids which would be generated from the VCE process. This system will generate approximately 7,000 tons/yr of solids that will require disposal. When netted against the 1,976 tons/yr estimated by EPA that would be generated in chemical precipitation treatment (EPA 2011c, p.30, Sect. 4.0(v)), the VCE process will generate an additional 5,000 tons/yr of solids that will require disposal.

The limestone handling system which prepares limestone for feed to the FGD unit has a capacity of 17.4 tons/hr of limestone. (PSNH 2008) Extending this rate to an annual basis and applying the Merrimack coal-fired unit capacity factors previously mentioned (Cannata 2011), an annual limestone usage of 102,000 tons was estimated⁵. This is equivalent to 187,000 tons/yr of gypsum which is estimated to be generated from the FGD system.

In addition, the Merrimack facility generates ash from the burning of coal. According to the permit application for the FGD system installation, the station burns 1,256,896 tons/yr of coal which has an ash content of 7.3 – 7.6%. This calculates to an annual ash generation rate of 94,566 tons/yr. (PSNH 2007)

Thus, when the gypsum and coal ash generation rates are summed, it is estimated that the Merrimack facility currently generates approximately 281,000 tons/yr of solids from these two sources.

Based on these estimates and projections, wastewater treatment operations considered in this evaluation might result in an increase of solids generated at the Merrimack site of 1.8%. Another site has reported that these solids can be disposed in a non-hazardous landfill. (Wylie 2008)

The increased solids generation associated with wastewater treatment operations is not expected to pose compliance or regulatory problems for the site.

4.5 VCE as BAT for FGD Wastewater

VCE was evaluated against the BAT factors required by the Clean Water Act and regulations promulgated to implement this legislation. It is my opinion that BAT for FGD wastewater at the Merrimack Station should be based on VCE technology. As a result, it is my opinion that the permit limits for Outfall 003C in the NPDES permit for Merrimack Station should contain limits of zero discharge

⁵ It is acknowledged that the limestone handling system might not process limestone at the design capacity during all times that the FGD system is operated. However, this value was used as for approximate estimating purposes as explained in the text.

of pollutants (*i.e.*, the concentration of all pollutants in the discharge should be less than the detection limit). The pollutants listed in the permit should include the 25 metals for which EPA has characterized FGD wastewaters in its detailed study of coal-fired power plants and non-conventional pollutants included in that study.

The reasons to set BAT limits based on the use of VCE technology include the following:

1. VCE is an available technology. It has been successfully used for FGD wastewater treatment at seven locations.
2. VCE is cost-effective. The annual cost for VCE treatment at Merrimack Station is estimated to comprise only 1.5% of the operating revenue of the site. In addition, documents demonstrate that PSNH has already included sufficient funds for the construction of a VCE system in the FGD system budget.
3. There are no adverse implications of the use of VCE treatment with respect to the EPA “BAT factors” including age of the equipment and facilities involved, process employed and process changes, and the engineering aspects of the application.
4. The electrical energy required for operation of the process is estimated to be very small, approximately 0.8% of the energy generated at Merrimack Station.
5. Other non-water quality impacts including air emissions and solid waste generation would be very small.

5.0 Effluent Limits and Monitoring of the FGD Discharges

Recommended sampling and monitoring requirements for the FGD treatment system are specified in Table 6 below. The opinions that I have set forth in this report consistently support establishing BAT for FGD wastewater on VCE technology. It is recommended that monitoring requirements for BAT based on this technology should include periodic determination of the metals that present the greatest problem in the environment (listed in Table 6 below) plus two of the species that consistently appear in FGD wastewaters in very high concentrations (calcium and chloride).

Should EPA decide to retain chemical-physical plus biological treatment as its basis for BAT and continue with the effluent limits for Outfall 003C contained in the draft permit (as subsequently corrected by EPA), it is recommended that a more complete analysis of the treated effluent be required. Specifically, it is recommended that EPA require monitoring for all additional pollutants used by EPA to characterize FGD wastewaters in its 2009 detailed study of the industry on a quarterly basis. (EPA 2009) While the monitoring required in the draft permit provides surrogates for the removal of many of these pollutants, these data will be valuable to EPA and the engineering community.

In addition, it is recommended that EPA require periodic monitoring of the untreated FGD wastewater in the NPDES permit.

Monitoring for pH has also been recommended for each discharge. Although it is not a BAT pollutant, it should be measured in all wastewater discharges to aid the understanding of the other data.

Table 6. Recommended Sampling and Monitoring Requirements for Merrimack Station NPDES Permit Outfall 003C

Effluent Characteristic	Discharge Limitation		Monitoring Requirements	
	Average Monthly	Maximum Daily	Frequency	Sample Type
For BAT Defined Based on VCE				
Arsenic	0 ^a	0 ^a	1/Week	24-hour Composite
Mercury	0 ^a	0 ^a	1/Week	24-hour Composite
Selenium	0 ^a	0 ^a	1/Week	24-hour Composite
Calcium	0 ^a	0 ^a	1/Week	24-hour Composite
Chloride	0 ^a	0 ^a	1/Week	24-hour Composite
pH	7.0-9.0 Range	7.0-9.0 Range	Continuous	Recorder
For BAT Defined Based on Physical-Chemical + Biological Treatment – in addition to requirements contained in the draft permit^b				
Aluminum, Antimony, Barium, Beryllium, Calcium, Cobalt, Magnesium, Molybdenum, Nickel, Silver, Sodium, Thallium, Titanium, Vanadium, Yttrium, Ammonia Nitrogen, Nitrite/Nitrate Nitrogen, Total Kjeldahl Nitrogen, COD, Total Suspended Solids, pH, Alkalinity, Sulfate, Hexane Extractable Material (HEM)	Report	Report	1/Month	24-hour Composite
pH	7.0-9.0 Range	7.0-9.0 Range	Continuous	Recorder

Table 6. Recommended Sampling and Monitoring Requirements for Merrimack Station NPDES Permit Outfall 003C (continued)

Effluent Characteristic	Discharge Limitation		Monitoring Requirements	
	Average Monthly	Maximum Daily	Frequency	Sample Type
For the Untreated FGD Purge/Blowdown Before Treatment				
Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Sodium, Thallium, Titanium, Vanadium, Yttrium, Zinc, Ammonia Nitrogen, Nitrite/Nitrate Nitrogen, Total Kjeldahl Nitrogen, BOD, COD, Total Suspended Solids, pH, Alkalinity, Chloride, Sulfate, Total Suspended Solids, Hexane Extractable Material (HEM)	Report	Report	1/Month	24-hour Composite
Arsenic, Cadmium, Calcium, Lead, Mercury, Selenium, pH, Alkalinity, BOD, COD, Total Suspended Solids, Chloride, Sulfate, Total Dissolved Solids	Report	Report	1/week for one year from effective date of permit	24-hour Composite

^a“Zero” means that all pollutants will be non-detectable when analyzed using appropriately sensitive analytical methods to be defined by EPA.

^bThese recommendations apply only in the event that EPA determines not to base BAT on VCE technology.

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Appendix 1

Resume of John H. Koon, Ph.D., P.E.,
BCEE

John H. Koon

CONTACT

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EDUCATION

B.E., Civil Engineering, 1967,
Vanderbilt University, Nashville,
Tennessee

M.S., Civil and Environmental
Engineering, 1969, Vanderbilt
University, Nashville, Tennessee

Ph.D., Environmental Engineering,
1971, University of California,
Berkeley, California

LICENSES AND CERTIFICATIONS

Registered Professional Engineer,
Georgia 1991 No. 19285;
Kentucky 1988, No. 15408.

SPECIAL RECOGNITION

Tau Beta Pi
Chi Epsilon, founding president,
Vanderbilt University chapter, 1967
Shield of Irene Award given by the
DuPont Safety, Health, and
Environmental Division for Excellence
in Engineering Design, 1994
DuPont - Victoria, Texas Plant Quality
Award for the Deep Well Elimination
Project, 1996
BASF Water Team Award of Merit,
1996

Dr. Koon is an environmental engineer, licensed as a Professional Engineer, and a Board Certified Environmental Engineer. In addition to his experience in the U.S. with industry, municipalities, and federal facilities, he has worked with industrial clients in Western Europe, Canada, Latin and South America, and the South Pacific. With more than 35 years of experience, he expertise in industrial and municipal wastewater treatment (including the treatment of groundwaters), contaminated site remediation, strategy development, technology evaluations, water quality assessment, and permitting. He has extensive experience working with capital projects delivery teams with client organizations and other engineering firms. A significant amount of his experience has involved solving environmental problems in chemically complex systems. He has been a key contributor to significant advances in the technologies used worldwide in the treatment of industrial wastewaters.

Dr. Koon began his career at AWARE, Inc.(Associated Water and Air Resources Engineers), a leading industrial environmental engineering firm during the 1970s and 1980s. Since that time Dr. Koon has played key roles in the industrial environmental practices of three other engineering organizations. For 14 years he led the industrial wastewater practice at Engineering-Science, now part of Parsons Corporation. He has worked with industrial clients at over 400 locations in the U.S.A. and abroad on projects covering a broad range of environmental problems. In addition to working with the design and operation of these facilities, he also has extensive experience working with clients and attorneys to negotiate settlements to complex problems, resolve permitting and compliance issues, and serve as expert witness.

EXPERIENCE RECORD

- | | |
|--------------|--|
| 2010-Present | John H Koon & Associates
President. Individual consulting on a variety of topics for industrial corporations and plant sites and engineering companies based on 39 years of experience in environmental engineering. This practice concentrates on providing strategic direction to engineering projects and engineering company business direction, providing senior level support and direction to engineering departments and teams, advising clients on projects, and performing project work. |
| 2010-Present | Professor of the Practice in Environmental Engineering,
Georgia Institute of Technology, Atlanta, GA
Teach environmental engineering design courses. |

2005-2009

Malcolm Pirnie, Inc.

Senior Consultant, Vice President, National Director for Industrial Wastewater Management. Responsible for the firm's industrial wastewater practice. Responsible for significant increases in company's industrial business on capital projects and at overseas locations.

1991-2005

Parsons

Parsons Commercial Technology Group; Vice President; Director of Technical and Resource Management. (New division formed in 2003) (2003-2005)

Responsible for technical quality and competency of Industrial Division work products. Division's business base included providing environmental services to major industrial manufacturing corporations. At the time of formation of this unit, responsible for definition of technical procedures, work product-related policies, and technical program features; development of senior technical staff job responsibilities; and development of operating budget. Responsible for work assignments and productivity of 400 person technical staff; met productivity goal of 90+%. Also served as industrial wastewater practice leader; responsibilities included revenue production, sales support, technical quality program, and work product quality.

Parsons Engineering-Science, Vice President; Director of Technical Direction (1996-2002)

Led the company's Technical Direction program. Reconfigured program following company reorganization with objective of preserving company reputation while accommodating new management structure. Program included management of eight practice leaders, twenty-five Technology Leaders, the company's technical committees, and other elements of the company's

technology program. Also served as practice leader for industrial water and wastewater management. Member of senior management team of the company. Significant work in pharmaceuticals, plastics, synthetic fibers, chemicals, and petroleum refining. Supported projects in South America, Mexico, Europe. Significant project experience working with industrial capital projects teams.

Engineering-Science, Inc. (a part of Parsons)

Technical Manager (Practice Leader) for Industrial Water and Wastewater Management. (1991-2002)

Responsible for direction and competency of industrial water and wastewater management business; led business development (sales) for the program; provided technical direction (overview and review) on industrial wastewater and hazardous waste projects. Led three-fold increase in revenues over ten year period to \$8 million in 2001. Scope included working to achieve annual sales goal for the practice; leading the business development work of the practice across the company; client development; overseeing the development of project approaches to achieve desired results; working with industrial clients to resolve difficult and complex issues; participating in engineering investigations, designs, and operations reviews; and reviewing projects to ensure conformance to company standards and client needs.

1984-1991

Post, Buckley, Schuh & Jernigan, Inc.

Vice President - Director of Industrial Services. (1990-1991) Directed the firm's work with industrial clients to meet revenue targets and to insure completion of quality projects within time and budget constraints. Also responsible for the technical direction and quality control of major environmental projects.

Vice President - Manager of Industrial and Hazardous Waste Division. (1988-1990) Directed technical, administrative, and business development operations for all industrial wastewater and hazardous waste projects.

financial performance, business development, staffing, and technical quality of the division's work products.

Founding Regional Manager - Nashville office (1983-1988) Opened office and built to a 25 person staff with diversified client base consisting of local/municipal government, industrial, and federal government clients. Responsible for business development, administrative management, financial performance, and technical direction of office. Directed project efforts to assure completion of projects within time and budget constraints. Developed and supervised projects in industrial and municipal wastewater treatment system design, contaminated site remediation, and NPDES permitting.

1983-1984

John H. Koon Company

President. Responsible for all engineering work provided by the company; provided environmental engineering services for the treatment of industrial and municipal wastewaters, hazardous waste management, and expert testimony before regulatory agencies and courts of law.

1972-1983

AWARE, Inc.

Vice President/Technical Director;
Manager of Operations Division
(1980-1983)

Director of Wastewater Management
(1974-1980)

Senior Engineer (1972-1974)

Played key role in the firm's emergence as one of the nation's leading industrial environmental management firms in the 1970s. As Operations Division Manager, reorganized three divisions into one unit, implemented management structure to increase efficiency and cohesiveness of the division. Responsibilities included

SELECTED PROJECT EXPERIENCE

Design of a Wastewater Treatment and Reuse System for a Major Pharma/biotech Site, Amgen, Juncos, Puerto Rico. The system includes equalization, neutralization, biological treatment using membrane bioreactors (MBRs), a two-stage reverse osmosis (RO) system for TDS reduction, inter-stage chemical precipitation incorporating microfiltration for scale control, and centrifuge dewatering of sludge. The MBR system was designed in the modified Ludzak-Etinger (MLE) configuration to achieve required removals of nitrogen. Work included system planning and development, modeling to project wastewater characteristics, experimental work to prove the design and establish some design parameters, design, construction assistance, operator training, and startup. 60% of the product water from the system is reused on the site.

Marathon Ashland Petroleum: Wastewater Treatment Upgrade / Catlettsburg KY. Developed preliminary engineering package for a wastewater treatment upgrade and relocation to resolve toxicity issues and organic removal capacity at the client's integrated refinery in Catlettsburg. A new biological treatment system, process wastewater cooling system, sludge management system, and effluent diffuser were constructed.

Development of a Total Water Reclamation and Reuse System at a Pharmaceutical Manufacturing Site, Warner-Lambert, Inc., (now Pfizer), Vega Baja, PR. A new wastewater treatment system was developed and designed for this pharma manufacturing plant site to meet demanding discharge limits. To take advantage of the high quality effluent produced, the Team also conducted water reuse feasibility evaluations, developed a water reuse implementation plan, and evaluated associated water chemistries. The plan was implemented. The site has reused every drop of product water for more than ten years. (Treatment system included biological nutrient removal system (BNR), GAC adsorption, reverse osmosis for TDS and metals reduction, chemical precipitation of metals in RO reject, and sludge dewatering using belt filtration.)

Development of Biological and Advanced Oxidation Processes to Treat 1, 4 Dioxane. Following the findings that 1, 4 dioxane occurred at problematic concentrations in

wastewaters and groundwaters at a number of industrial installations, Dr. Koon worked with clients to extend early research on treatment methods to design and construct biological and advanced chemical oxidation systems to reduce contaminant concentrations to required levels for discharge to the environment. Biological process developed employed moving bed bioreactor (MBBR) technology. The AOP system employed UV/peroxide technology.

Design of an MBR Upgrade to an Organic Chemical Plant Wastewater Treatment System, Boehringer-Ingelheim Chemicals, Inc., Petersburg, VA. In order to accommodate an increased waste load generated by a new production unit at the site, an existing sequencing batch reactor (SBR) system was modified to an MBR process by adding membrane units. This made it possible to accommodate a significant increase in waste load without increasing the footprint of the existing WWT system. Pilot testing was performed to investigate potential fouling problems with this particular application. Subsequently, the design was developed; the system constructed; and is now in operation and meeting expectations.

Advisor to Global Biopharmaceutical Company Regarding Disinfection Issues of a POTW Effluent, Confidential Client, Northeastern U.S. Location. The POTW to which this site discharged its process wastewater for final treatment experienced disinfection effectiveness problems. The POTW asked the industry for assistance troubleshooting the problems and in identifying solutions. Investigations led to the identification of disinfection ineffectiveness in the presence of the buffer HEPES as the likely cause of the problems. A team of stakeholders worked to understand the problem, identify remedial measures, and develop a plan to implement these measures.

Development and Implementation of a Wastewater Management Strategy for a Major Synthetic Fiber Manufacturing Complex Associated with Exiting Deep Well Disposal of Wastes. DuPont; Victoria, Texas. Participated on the "Water Team" charged with developing technology to treat a high COD, high nitrate wastewater (classified as a hazardous waste) at the largest nylon Intermediates chemicals plant in the world. In addition to setting strategy for the project, work involved the conduct of extensive bench- and pilot-scale testing of

treatment alternatives; identifying pretreatment criteria for individual production areas; overseeing design development.

Development of a Method to Reduce the Explosive Chemical RDX in an Ammunition Plant Wastewater, Holston Army Ammunition Plant, Kingsport, TN.

Faced with the need to achieve significant reductions in the discharged RDX load to the environment, the site operator commissioned work to identify, test, demonstrate, and design a process capable of achieving the new discharge limits. Bench- and pilot-scale work conducted in preparation for full-scale design. Processes evaluated included anoxic reduction, anaerobic treatment in a fluidized bed reactor, and electrolytic oxidation.

Development of Rescue and Recovery Plans from Alleged Clean Water Act Violations, BASF Corporation, Lowland, TN.

When this synthetic fiber plant was accused by a regulator of 24 violations of the Clean Water Act, quick and decisive action was required to respond. A plan was developed to trace and characterize all alleged illegal drains to the alleged “water of the state;” communications were established with senior regulatory representatives to whom appeals for reasonableness were made. In addition hydrologic investigations of the alleged “water of the state” were conducted to demonstrate that this “ditch” did not meet the definition of a “water of the state.” A video was made to demonstrate the salient points of the investigation. Through the implementation of remedial measures and negotiations with the state regulatory agency, all issues were resolved and the permit was renewed.

Development and Negotiation of a New Discharge Permit for a Pharmaceutical Manufacturing Facility Using “Clean” Water Sampling Techniques, Warner-Lambert, Inc. (now part of Pfizer), Vega Baja, PR.

New discharge permit applied for and negotiated for this pharmaceutical site to govern the performance of a new WWTP on site. Work included “clean” sampling to establish metals limits, water quality modeling, preparation of technical support document, and negotiations before regulatory agencies. Application of the “clean” techniques provided data needed to negotiate significantly higher discharge limits for some constituents.

Development of an Adsorbent Resin System for the

Removal of Seventeen Pesticides Intermediates and Products from a Pesticide Manufacturing Plant Wastewater, Velsicol Chemical Corp., Memphis, TN.

Seventeen chemicals of concern were identified in the process wastewaters from this manufacturing site. Adsorption using granular activated carbon and adsorbent resins were evaluated in experimental tests to determine the relative advantages and operating characteristics of each process. Adsorbent resins were selected for application because of the ability to regenerate the resin and effectively manage the concentrated spent regenerant on site. In order to properly conduct these tests, it was necessary to develop methods for the analysis of the seventeen chemicals of concern in the water matrix and at the concentrations needed.

Evaluation of a 100-mgd Wastewater Treatment Facility to Determine Its Operability, U.S. EPA Region IV.

The Morris Foreman Wastewater Treatment Plant owned and operated by the Louisville, KY Metropolitan Sewer District was shut down following repeated operational problems. EPA requested that the U.S. Army Corps of Engineers and a team led by Dr. Koon conduct a design and operational evaluation of the plant to see if it was operable and, if so, what was needed to return the plant to operating status. The evaluation was conducted, recommendations made, and the plant returned to effective operation in one month.

Development of a System to Treat a High Nitrate Wastewater from the Production of Nitroparaffins, IMC Corporation, Sterlington, LA. Bench- and pilot-scale testing was conducted to develop a biological treatment process capable of treating this wastewater. The successful configuration used what is now referred to as the modified Ludzak-Ettinger process in which incoming wastewater containing high concentrations of nitrate was combined with second stage mixed liquor in order to reduce nitrate to nitrogen gas and, simultaneously, use the nitrate oxygen to oxidize wastewater organics. Aeration was applied in a second treatment stage in order to further reduce organics (i.e., BOD/COD) to acceptable levels for discharge.

Development of Techniques to Treat High TDS Wastewaters, various industrial clients, worldwide locations. Over several years, teams on which Dr. Koon played a key role, developed methods for treating

wastewaters containing TDS concentrations up to 6% or so. Experience from a number of experimental investigations and the operation of an increasing number of full-scale systems led to the identification of a threshold level beyond which effects were observed, BOD removal characteristics, expected effluent TSS concentrations, and treatment techniques which could be successfully applied. In some cases, saline bacterial cultures obtained from the vicinity of wastewater outfalls to the ocean were successfully used to treat the high saline wastewaters. Development of a Wastewater Segregation, Zero Discharge Treatment, and Water Reuse System for an Elemental Phosphorus Plant, Hooker Chemicals, Columbia, TN. Worked with this elemental phosphorus plant in resolving significant NPDES permit problems before State of Tennessee and Region IV EPA. New permit limits were negotiated and compliance achieved. This project was conducted during the “Love Canal” era. All meetings with regulatory agencies were attended by attorneys of regulatory agencies and US Department of Justice in addition to state and DPA regulatory agency representatives. As part of the project, the Team developed, demonstrated, and designed a new process for removing elemental phosphorus from water (i.e. wastewater) that achieved a two order of magnitude lower residual concentration than previous methods.

Development of a New Anaerobic Process for the Treatment of Municipal Wastewater, Oak Ridge National Laboratory, Oak Ridge, TN. Worked with an ORNL team developing this technology. Participated in strategy development and planning activities; provided oversight to bench- and pilot-scale testing; provided consultation during design phase.

Testing and Development of Best Available Treatment Technology for a Pulp and Paper Mill Including a Chemical Reuse Color Removal Process, Great Southern Paper Company (part of Georgia Pacific Corp.), Cedar Springs, GA. Developed candidate BAT process trains; built and operated pilot-scale systems to evaluate two alternate systems; provided recommended recommendations for mill to anticipate upcoming regulations. Color removal employing an alum reclamation and reuse process was tested as the method for meeting anticipated color limits.

Review and Consultation on Bromide Removal Technologies, Birmingham Water and Wastewater

Board, Birmingham, AL. Worked with the BWWB to investigate an unusually high bromide concentration in its intake water, identify the source (an upstream industrial manufacturing operation), and negotiate the selection and installation of a treatment system to reduce bromide concentrations to acceptable levels. Bromide is a very unusual contaminant in wastewater treatment systems. This problem demanded that a relatively new technology be tested and installed by the industry to reduce bromide discharges. Ion exchange was selected by the industry, and confirmed during this review process to be a very good method of meeting the imposed limits.

Design of Modifications and Upgrades for a Wastewater Treatment System at a Beverage Manufacturing Plant, PepsiCo, Cidra, PR. An existing wastewater treatment system was modified to address aging of the original system, needed capacity increases, and the imposition of more stringent discharge standards. Anaerobic/aerobic and all aerobic biological options were evaluated for BOD reduction. Color removal options including advanced oxidation using UV/peroxide, ozone, and chlorine chemistry; and chemical coagulation and powdered activated carbon were tested and evaluated for several criteria. The selected design included MBR biological treatment, color removal using chemical coagulation and powdered activated carbon addition with an advanced oxidation backup, and sludge dewatering.

Development and Process Engineering for an Anaerobic/Aerobic Treatment System Including Nitrogen Removal, Dixie Yeast, Inc., Gastonia, NC. In order to achieve required reductions in BOD and ammonia nitrogen for discharge to the POTW, a system was designed that included a first phase anaerobic treatment for BOD reduction followed by an aerobic second stage for ammonia oxidation. Work included pilot testing, process design development, negotiation of limits with POTW officials, and consulting during detailed design. The Biothane UASB process was selected for the anaerobic technology.

Development of an Innovative Process for a Pharmaceutical Manufacturing Facility to Minimize the Cost of Effluent Guidelines Compliance, Merck, Barcelloneta, PR. Faced with the requirement to pretreat its wastewater to meet a new Effluent Guidelines requirement to significantly reduce concentrations of two EG organics, Merck agreed to select an MBBR process

over conventional activated sludge treatment. The MBBR system enabled the elimination of secondary clarifiers, sludge return facilities, and the sludge dewatering and disposal system by taking advantage of high pretreatment limits for BOD and TSS. This resulted in significant cost savings for the industry while providing a system that has consistently complied with the EG limits.

Incorporation of Innovative Technology into Designs.

Innovative processes included in designs includes: MBBR systems – 3 designed and in operation; MBR systems – 7 designed, 2 in operation; AOP – 4 designed and in operation; nitrogen blanketed API separators and DNF (dissolved nitrogen flotation) systems – 2 designed and in operation (in petroleum refineries); reverse osmosis (RO) systems – 2 designed and in operation; microfiltration (MF) systems – 1 designed and in operation; evaporation – 3 systems designed and in operation (two mechanical and one pond system).

Advisor to a Major Caribbean Petroleum Refinery Regarding the Development of a Strategy for Wastewater Treatment Upgrade, Hovensa, St. Croix, VI.

The strategy addressed replacing earthen aeration basins with above-ground tanks and included an evaluation of alternative technologies for biological treatment to meet an aggressive EPA-mandated schedule. Strategy included review of front end design package prepared by others and development of a detailed check cost estimate for the project.

Development of a Treatment System to Handle a High COD, High Organic Nitrogen Content Wastewater from the Production of a New Artificial Sweetener; McNeil Specialty Products, Inc. (a division of Johnson & Johnson), McIntosh, AL. Led efforts to procure NPDES permit for a greenfield chemical plant site. Developed engineering report describing WW treatment system; completed application forms; negotiated limits with state agency.

Development of a Wastewater Treatment System for Nissan Manufacturing Corporation's Smyrna, Tennessee plant.

Development of Wastewater Management Plans for a Steel Mill, Sydor, Puerto Ordaz, Venezuela. This privatized mill was required to meet applicable

environmental standards as a condition of the sale to the private company. Existing facilities were inspected and the performance evaluated; new facilities were identified which would be needed to meet required discharge levels; planning level capital estimates were developed for the recommended plan.

Development of wastewater treatment facilities for a new pulp and paper mill in Alabama, Parsons & Whittemore, Clairborne, AL. Biological treatment accomplished using an oxygen activated sludge process.

Technical Review and Permit Modifications for a Petroleum Refinery, Exxon-Mobil, Joliet, IL.

Evaluation of a refinery wastewater treatment system to identify problems achieving nitrification of the wastewater. Subsequently, support was provided to seek permit relief from a nitrification requirement.

Development of a Moving Bed Bioreactor Design to Upgrade an Existing Treatment System, ExxonMobil: Baton Rouge LA. Developed a moving-bed bioreactor process (Kaldnes process) to replace existing first-stage wastewater treatment process.

Development of an aerated stabilization wastewater treatment system to achieve New Source Performance Standards at a new pulp mill in Georgia.

Development of Permitting Options and Treatment Requirements; Y-12 Plant, Oak Ridge, TN. NPDES permit requirements were projected based on water quality requirements, stream characteristics, and technology-based requirements and treatment upgrading alternatives to meet these requirements for five on-site treatment systems.

Water Reuse

Development and Design of Wastewater Treatment System and Water Reuse System for a Pharmaceutical Plant, Warner-Lambert (now Pfizer), Vega Baja, PR. This plant including the water reuse plan was the recipient of several design and performance awards including the WEF Schroepfer Medal for Innovative Design.

Development and Design of a Wastewater Treatment System and Water Reuse System for a Pharmaceutical Biotech Plant, Amgen, Juncos, PR.

Development of a Wastewater Treatment and Water

Reuse System for an Elemental Phosphorus Plant, Hooker Chemicals (now OxyChem), Columbia, TN.

An innovative treatment system was developed and designed for this site which included a new process for the removal of elemental phosphorus to the detection limit.

Development of a Base-Wide Water Reuse Plan, U.S. Army, Ft. Lewis, WA.

Development of Water Reuse Plans for a Pharmaceutical Plant, Jensson (part of J&J), Gurabo, PR.

Development of a Closed Cycle Wastewater Treatment and Water Reuse System for Commercial Application (the Cyclet® Process), Thetford Corporation, Ann Arbor, MI. Worked with a client team to develop the technology for a system capable of managing black and grey water and treating to a level for reuse. The process, was developed in the late 1970's and, though modified, is still on the market.

Environmental Permitting

Environmental Permitting for a Greenfield Chemical Plant Site, Confidential Chemical Industry Client, Southeastern US Locations. Assisted client in identifying local and national permitting issues related to all media for a new greenfield chemical plant site. Developed permitting strategies for the selected site. Interacted with site design contractor to design environmental control systems and conveyance systems to facilitate permitting.

Technical Support for Challenges to Revised Pharmaceutical Effluent Guidelines, Pfizer Corp., New York, NY. Provided technical support in the development of challenges to revised draft effluent guidelines.

Environmental Permitting Support for a Bio/Pharma Production Site, Amgen, Juncos, PR. Supported site staff in procuring all site environmental permits. Work included river sampling using 'clean' techniques to develop good data for metals limits, water quality modeling, preparation of NPDES permit application, PR permit application, and interface with PR EQB and EPA representatives.

Resolution of Permit Compliance Issues with the State

of Tennessee Department of Environment and Conservation, BASF Corporation, Lowland TN.

Warner-Lambert, Inc.,(now Pfizer), Vega Baja, PR. New discharge permit applied for and negotiated for this pharmaceutical site to govern the performance of a new WWTP on site. Work included "clean" sampling to establish metals limits, water quality modeling, preparation of technical support document, and negotiations before regulatory agencies.

Review of BAT Permit Application for an Institute, WV Chemical Production Site, Region III EPA, work in Institute, WV. At the suggestion of the chemical plant site, assisted EPA in reviewing, drafting, and issuing the first BAT permit issued in EPA Region III.

Environmental Permitting for a Greenfield Chemical Production Facility, McNeil Specialty Products, McIntosh, AL. Environmental Permitting for a Greenfield Pulp Mill, Alabama River Pulp Co., Claiborne, AL.

Environmental Permitting of a Wastewater Treatment Facility, BASF Corporation, Enka, NC. Worked with site to apply for and negotiate NPDES permit for this synthetic fibers production facility.

Environmental Permitting of a Wastewater Treatment Facility, BASF Corporation, Lowland, TN. Worked with site to apply for and negotiate NPDES permit for this synthetic fibers production facility.

Resolution of Permitting Issues with State and Federal Regulatory Agencies, Hooker Chemicals, Columbia, TN. Worked with this elemental phosphorus plant in resolving NPDES permit problems before State of Tennessee and Region IV EPA. New permit limits were negotiated and compliance achieved. This project was conducted during the "Love Canal" era. All meetings with regulatory agencies were attended by attorneys of regulatory agencies and US Department of Justice in addition to state and DPA regulatory agency representatives.

Development and Presentation of a Permit Modification Petition, ExxonMobil, Joliet, IL.

Evaluation of a refinery wastewater treatment system to

evaluate problems achieving nitrification of the wastewater. Subsequently, support was provided to seek permit relief from a nitrification requirement.; provided testimony at state agency hearing; relief granted.

Development of Technical Information to Support Challenges to the Phosphorus-Derived Chemicals Effluent Guidelines, Phosphorus Chemical Producers Group. Developed technical support document a group of phosphorus chemical producers to challenge EPA Effluent Guidelines for the Phosphorus Chemicals Segment of the chemical industry.

Amoco Fabrics, Roanoke, AL. Provided technical support and testimony at public hearing concerning wastewater discharge and air emissions permits for the site.

GE Nuclear Fuels Corporation, Wilmington, NC.
Prepared storm water permit applications including technical support documents.

Municipal Wastewater Management
Development and Design of Sludge Management Plans for 100 MGD Central WWTP / Municipal Government of Nashville and Davidson County TN.

Development of long range plan; development and design of sludge composting and dewatering facilities; rehabilitation design of incineration facilities. Roles: Team management; scope, schedule, and financial responsibility; work product quality; scope development and overview; client relations.

Design of BNR Upgrades for Two WWTP Systems, Chesterfield County, VA.

Development of a Plan for Recommissioning and Expansion of a Regional Wastewater Treatment System, Allentown PA, Lehigh County Authority, PA.

Facilities Planning for the Mauldin Road WWTP, Greenville SC, Western Carolina Regional Sewer Authority, Greenville, SC.

Evaluation of and Design of an Expansion (Oxidation Ditch) to the 60 MGD City of Augusta WWT System, Augusta GA, Augusta County, GA.

Development of a Master Plan and Design for a 32-

MGD WWTF, City of Cranston, RI.

Treatment Testing and Preliminary Design Development in a WWT System Expansion, Providence RI, City of Providence, RI.

Design, Startup, and Troubleshooting of a Community Water Reclamation Facility Including MBRs , Atlanta GA, Cawley Creek, LLC, Atlanta, GA.

Contaminated Site Remediation Including Groundwater Treatment

Development of Specifications to Guide the Treatment of Construction Dewatering Fluids at a Contaminated Site, Chesterfield Co., Virginia. Contaminants included a organic phosphorus compounds, fluorocarbon compounds and a variety of heavy metals.

Development of Treatment Recommendations for the Removal of a Complex Ether and Benzene from Groundwater, Confidential Chemical Industry Client, New Jersey. Performed tests to evaluate advanced oxidation processes (UV/peroxide and ozone/peroxide) for the removal of BCEE and benzene from groundwater beneath the chemical plant site.

Testing of Contaminated Soil and Groundwater Remove Two Ethers (BCEE and BCEM), Rohm & Haas, Alabama and Pennsylvania.

Evaluation of an Existing System Treating Groundwater Contaminated with Diesel Fuel Components, Metropolitan Boston Transportation Authority, Boston, MA. Compared an existing vapor phase carbon adsorption system with catalytic oxidation for treatment of vapor phase petroleum hydrocarbon compounds. Also performed an evaluation of the liquid phase system to resolve problems with iron interference with the removal of petroleum hydrocarbon components.

Development of Plans for the Remediation of Organic Chemicals and Mercury Contamination at a Plant Producing Chlorofluorocarbons, Chlorine, and Caustic, Pennwalt Corp., Calvert City, KY. Provided technical review and oversight for characterization of waste disposal units on the site, groundwater characterization, wastewater treatment systems evaluation, and development of remedial plans. Work also included

regulatory interface with the State of Kentucky and Region 4 EPA.

Remediation of 1, 4 Dioxane in Landfill Leachate and Groundwater, Lowry Landfill Superfund Site, Denver, CO. Identification of leachate/groundwater flows from a section of the landfill containing 1, 4 dioxane. Development and design of a moving bed bioreactor system (MBBR; Kaldnes process) to remove the 1, 4 dioxane from the groundwater.

Lake Onondaga Remediation Program - Cleanup of Waste Pits at Former Chemical Manufacturing Site, Honeywell Inc., Syracuse, NY. Identification of extent of contamination of waste contained in pits associated with a closed manufacturing facility. Development of closure plans to deal with remaining sediments and water contained in the pits which was contributing to groundwater contamination.

Development of Remediation Plans for the Remediation of Chromium Ore from an Urban Site, Honeywell, Inc., Jersey City, NJ. Development of plans to implement the court-ordered remediation of this 30+ acre site to remove residual chromium ore. Plan included transportation plans, dust control plans, sediment remediation, and treatment of chromium-contaminated runoff from the site during the cleanup period. Management of Chromium-Contaminated Groundwater from a Former Chromium Ore Processing Site, Honeywell, Inc., Baltimore, MD. Projection and characterization of chromium-contaminated groundwater and runoff from this site which contained spent ore from a former chromium processing facility. A treatment system was designed and constructed to remove hexavalent chromium from the waters.

Development of Plans to Remediate Two Contaminated Sites at Arnold AFB, TN. Work included extent of contamination evaluations; groundwater modeling; development of removal and disposal plans; design of a groundwater treatment system.

Development of a System to Treat Residual Contaminants at an Elemental Phosphorus Plant, FMC Corporation, Pocatello, ID. Developed, designed and operated a system to treat residual waters in two ponds. Waters included elemental phosphorus, a variety

of phosphites, a variety of heavy metals, complex cyanides, fluoride, and radon.

Development and Design of a UV/peroxide System for the Removal of 1, 4 Dioxane, Benzidine, and Other Organics from Groundwater at a Former Pharmaceutical Manufacturing Site, Pharmacia, North Haven, CT. The selected system included a fluidized bed biological reactor and a UV/peroxide advanced oxidation system.

International Experience

Worked with clients at over forty industrial locations in countries outside the U.S. Locations include South America, Southeast Asia, Europe, Canada, and Mexico.

PROFESSIONAL SOCIETY ACTIVITY

Accreditation Board for Engineering and Technology (ABET), Engineering Accreditation Commission Executive Committee 2009-present; Commissioner 2005-present; Program Evaluator for Environmental Engineering programs 2001-present.

American Academy of Environmental Engineers (BCEE), Education Committee, Chair 2001-2004; committee member 2005-present; Georgia state representative 1997-2004.

Water Environment Federation (Awards Committee; 2000-present, Canham Scholarship Subcommittee member 2000-present, Rudolfs Medal Subcommittee Chair 2008-present, Industrial Water Quality Lifetime Achievement Award Subcommittee Chair 2008-present; former member of Program Committee; Hazardous Waste Committee; Industrial Waste Committee; Industrial Wastes Symposium Committee)

American Society of Civil Engineers, Fellow; Specialty Certification Task Force

American Water Works Association

COMMUNITY LEADERSHIP

Westminster Presbyterian Church, Nashville, TN, Deacon and Elder – 1975-1978

Trinity Presbyterian Church, Atlanta, GA, Elder and Member of Church Executive Committee – 1996-1998; Sustainability Committee Chair 2009-present

Harding Academy, Nashville, TN, Board Member and President – 1981-1985

Westminster School, Nashville, TN Board of Directors, – 1987-1990 (school for learning disabled children)

PUBLICATIONS

Author of over fifty publications and conference presentations. Selected ones listed below.

Rushing, J.C., Koon, J.H., and Tucker, D., A Review of Acid Rock Drainage Sulphate Treatment Methods, Enviromine 2009 Proceedings, Santiago, Chile, 2009.

Rushing, J.C., Bott C.B., and Koon J.H., “Using Simple Numerical Methods to Solve Complicated Mass Balance Problems,” WEF Industrial Water Quality Conference Proceedings, 2007.

Koon, J.H., “Experience with Denitrification of Industrial Wastewaters, Virginia Water Environment Association Industrial Wastewater Seminar, 2006.

Plazio, L.J., Bott, C.B., Rushing, J.C., Steiner, M.F., Plaugar, J.C., and Koon, J.H., “Reconfiguration of an Industrial Wastewater Treatment System for PCB, Phenol, Zinc, and Suspended Solids Removal and Installation of a Biological Leachate Treatment System at a Former Viscose Rayon Production Facility. Proceedings of the 78th Annual Water Environment Federation Technical Exposition and Conference (WEFTEC – National Conference of the Water Environment Federation), 2005.

W. Plaehn, W., Stanfill, J.C., Koon, J.H., Shangraw, T., Bollman, D., and Richtel, S., “Full-Scale Treatment of 1, 4 Dioxane Using a Bioreactor, Battelle Conference Proceedings, 2005.

Stanfill, J.C., Koon, J.H., Plaehn, W., Murphy, M., “1, 4 Dioxane Biodegradation Pilot Study at the Lowry Landfill Superfund Site,” WEFTEC Proceedings, 2004.

Stanfill, J.C., Koon, J.H., Shangraw, T., Bollmann, D., “1,4-Dioxane Bio-Degradation Bench Study At The Lowry Landfill Superfund Site,” Proceedings of the WEF/A&WMA 10th Annual Industrial Wastes Technical and Regulatory Conference, 2004.

Bott, C.B., Brummer, J.R., and Koon, J.H. “Pretreatment of Phosphorus Plant Process Wastewater Containing Elevated Levels of Phosphite, Hypophosphite, Cyanide, and Heavy Metals,” Proceedings of the Water Environment Federation 9th Annual Industrial Wastes Technical and Regulatory Conference, 2003.

Bott, C.B., Brummer, J.R., and Koon, J.H., “Physical-Chemical Pretreatment of Process Wastewater from a Phosphorus Plant for Discharge to a POTW,” Proceedings of the WEF Industrial Wastewater Treatment and Best Available Technologies Conference, 2003.

Bott, C.B., Plazio, L.J., Rushing, J.C., Koon, J.H., and

Metcalf, T.J., Treatment of Acid Mine Drainage at an Inactive Pyritic Mineral Mine Using Constructed Wetlands and a Waterwheel Quicklime Feeder, Proceedings of the WEF/AWMA 10th Annual Industrial Wastes Technical and Regulatory Conference, 2004.

Bott, C.B., Martin, T., Koon, J.H., Brooks, P., Rich, P., Bement, D., and Cutler, W., "Physicochemical and Biological Treatment of a Concentrated Industrial Leachate from Aged Process Waste at a Viscose Rayon Production Facility," Proceedings of the Water Environment Federation 75th Annual Technical Conference and Exposition, 2002.

Lund, D.J., Koon, J.H., Patrick, G.C., Rodriguez, J., Robles, B., and Tracey, K., "Reuse of Wastewater at a Pharmaceutical Plant," WEFTEC Proceedings, 1998.

Ganze, K.G., Cashion, B.S., Koon, J.H., Davoren, D.J., and Donohoe, C., "Moving Bed Aerobic Treatment of Exxon Baton Rouge Chemical Plant (BRCP) Wastewater, WEFTEC Proceedings, 1997.

Oppelt, M.K., Levine, L., Frank, P., Ganze, K., Kowalik, J., and Koon, J.H., "Predicting Air Emissions Compliance Using Activated Sludge as a Control Device," WEFTEC Proceedings, 1996.

Koon, J.H., Griffith, D.B., and Keough, E.B., "Planning for the Elimination of Deep Wells: Developing Environmentally Compatible Technologies for the Disposal of a Chemical Plant Waste," Proceedings of the 1996 Environmental Technology Conference, Clemson University, 1996.

Dell, J.J., Koon, J.H., Griffith, D.B., Robertaccio, F.L., Hockenberry, M.R., McManus, C.N., and Dragotta, D.A., "Planning for the Elimination of Deepwells: Development of a Process to Treat a High COD, High Nitrate Wastewater," WEFTEC Proceedings, 1995.

Atere-Roberts, S.O., and Koon, J.H., "Self-Monitoring to Meet General Permitting Requirements for Storm Water Discharges from Industrial Facilities," Proceedings of the Industrial Pollution Control Conference, Georgia Water Pollution Control Association, 1993.

Koon, J.H., and Boggs, F.L., "Applications of a Kinetic Analysis Using Historic Operating Data to Redesign an Industrial Activated Sludge System, Proceedings of the

48th Industrial Waste Conference, Purdue University, 1993.

Koon, J.H., "Designing and Operating Groundwater Treatment Systems: Still Trying to Get it Right," 1993.

Koon, J.H., "Resolving Complex NPDES Permitting Issues at a Major Industrial Plant," Proceedings of the 1993 Food Industry Environmental Conference, Georgia Institute of Technology, 1993.

PROFESSIONAL CONTINUING EDUCATION SEMINARS

Presented lectures at over 50 professional continuing education seminars on topics related to wastewater characterization and treatment; operation of wastewater treatment systems; and hazardous waste management. Seminars organized by/for a variety of organizations including universities, professional organizations, industrial manufacturing corporations, and government agencies.

Appendix 2

Merrimack Station Pretreated FGD Characterization

January 16, 2012
File No. 04.0029307.00



Mr. Dana Clement
Superintendent
Allentown Wastewater Treatment Facility
35 Canal Street
Allentown, New Hampshire 03275

Re: Industrial Wastewater Discharge Monitoring
Public Service of New Hampshire (PSNH)
Merrimack Station
Bow, New Hampshire

380 Harvey Road
Manchester
New Hampshire
03103-3347
603-623-3600
FAX 603-624-9463
www.gza.com

Dear Dana:

On behalf of PSNH, GZA GeoEnvironmental, Inc. is pleased to submit the attached Analytical Report from PSNH's technologically advanced wastewater treatment system (WWTS). The WWTS has now been operating in accordance with the design criteria for several weeks. The attached analytical results obtained from sampling on January 5, 2012 are representative of the Flue Gas Desulfurization (FGD) treated wastewater generated. The characteristics of the treated wastewater are expected to be consistent going forward.

In consideration of available representative analytical data, we respectfully request that the Town accept the attached analytical report to satisfy the first month sampling requirements as established in PSNH's Industrial Discharge Permit (IDP). Specifically, we request the sampling frequency be for metals and selenium be reduced to monthly as outlined in PSNH's IDP. Additionally, we request this data satisfy the requirement to sample the "first load."

ANALYTICAL NOTATION

FGD wastewater requires specialized analytical techniques to overcome matrix interference on some trace metals analysis. Many analytical laboratories may be unaware of this. We offer an excerpt below from the Environmental Protection Agency's (EPA's) web site and a link to their draft procedure that contains further guidance.

LABORATORY ANALYSIS OF FGD WASTEWATER

Wastewater from FGD systems can contain constituents known to cause matrix interferences. EPA has observed that, during inductively coupled plasma – mass spectrometry (ICP-MS) analysis of FGD wastewater, certain elements commonly present in the wastewater may cause polyatomic interferences that bias the detection and/or quantization of certain elements of interest. These potential interferences may become significant when measuring trace elements at concentrations in the low parts-per-billion range.



As part of a recent sampling effort for the steam electric power generating effluent guidelines rulemaking, EPA developed a standard operating procedure (SOP) that was used in conjunction with EPA Method 200.8 to conduct ICP-MS analyses of FGD wastewater. The SOP describes critical technical and quality assurance procedures that were implemented to mitigate anticipated interferences and generate reliable data for FGD wastewater. EPA regulations at 40 CFR 136.6 already allow the analytical community flexibility to modify approved methods to lower the costs of measurements, overcome matrix interferences, or otherwise improve the analysis. The draft SOP developed for FGD wastewater takes a proactive approach toward looking for and taking steps to mitigate matrix interferences, including using specialized interference check solutions (i.e., a synthetic FGD wastewater matrix). EPA's draft SOP is being made available to laboratories contemplating ICP-MS analysis of FGD wastewater, either for adoption as currently written or to serve as a framework for developing their own laboratory-specific SOPs. Standard Operating Procedure: Inductively Coupled Plasma/Mass Spectrometry for Trace Element Analysis in Flue Gas Desulfurization Wastewaters (30 pp, 174K)

We trust that this submittal adequately address your informational needs. Should you have any questions, please contact me at 232-8744.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

A handwritten signature in black ink that reads 'Ronald A. Breton'.

Ronald A. Breton, P.E.
Principal

RAB/tmd

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Attachment(s)

SUMMARY ANALYTICAL DATA
Public Service Company of New Hampshire
Merrimack Station
Bow, New Hampshire

PARAMETER	RESULTS (mg/L) 1/05/2012
Alkalinity	180
Aluminum	0.0411
Ammonia	0.92
Antimony	0.000520
Arsenic	0.00498
Barium	0.300
Beryllium	0.000522
BOD	< 6
Cadmium	0.000207
Calcium	5,050
Chloride	11,000
Chlorine (Total Residual)	< 0.05
Chromium (T)	< 0.00050
COD	130
Copper	< 0.00050
Cyanide (T)	0.02
Fluoride	10
Iron	< 0.050
Lead	< 0.000200
Manganese	0.293
Mercury	0.0000105
Molybdenum	0.140
Nitrate	100
Nickel	0.00803
O&G	< 5
pH	7.3
Selenium	0.074
Silver	< 0.000100
Sodium	277.4
Sulfate	1,200
Sulfide	< 0.1
Sulfite	< 2
TDS	21,000
Thallium	0.00664
TSS	14
TTO	ND (1)
Zinc	< 0.001
VOC EPA 624	(2)
Semi VOCs 625	ND (3)
Phenolic Compounds	< 0.3
PCBs	ND (4)

NOTES:

1. No TTO compounds were detected above 0.01 mg/L.
2. One compound was detected by Method 624: Toluene at 2 µg/L.
3. Semi VOCs were not detected by Method 625 above detection limits (1 µg/L and 5 µg/L depending on parameter and 50 µg/L for benzoic acid).
4. PCB compounds analyzed by method 608 were not detected at concentrations greater than 0.3 µg/L.

Arthur Auclair
Northeast Utilities
97 River Road
Bow, NH 03304



Subject: Laboratory Report

Eastern Analytical, Inc. ID: 106677
Client Identification: Merrimack Station
Date Received: 1/5/2012

Dear Mr. Auclair:

Enclosed please find the laboratory report for the above identified project. All analyses were performed in accordance with our QA/QC Program. Unless otherwise stated, holding times, preservation techniques, container types, and sample conditions adhered to EPA Protocol. Samples which were collected by Eastern Analytical, Inc. (EAI) were collected in accordance with approved EPA procedures. Eastern Analytical, Inc. certifies that the enclosed test results meet all requirements of NELAP and other applicable state certifications. Please refer to our website at www.eailabs.com for a copy of our NELAP certificate and accredited parameters.

The following standard abbreviations and conventions apply to all EAI reports:

Solid samples are reported on a dry weight basis, unless otherwise noted
< : "less than" followed by the reporting limit
> : "greater than" followed by the reporting limit
%R : % Recovery

Eastern Analytical Inc. maintains certification in the following states: Connecticut (PH-0492), Maine (NH005), Massachusetts (M-NH005), New Hampshire/NELAP (1012), Rhode Island (269) and Vermont (VT1012).

The following information is contained within this report: Sample Conditions summary, Analytical Results/Data, Quality Control data (if requested) and copies of the Chain of Custody. This report may not be reproduced except in full, without the the written approval of the laboratory.

If you have any questions regarding the results contained within, please feel free to directly contact me or the chemist(s) who performed the testing in question. Unless otherwise requested, we will dispose of the sample(s) 30 days from the sample receipt date.

We appreciate this opportunity to be of service and look forward to your continued patronage.

Sincerely,

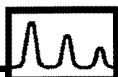
Lorraine Olashaw, Lab Director

1.13.12

Date

44

of pages (excluding cover letter)



SAMPLE CONDITIONS PAGE

EAI ID#: 106677

Client: **Northeast Utilities**Client Designation: **Merrimack Station**Temperature upon receipt (°C): **4.7**Received on ice or cold packs (Yes/No): **Y**

Acceptable temperature range (°C): 0-6

Lab ID	Sample ID	Date	Date	Sample	% Dry	Exceptions/Comments (other than thermal preservation)
		Received	Sampled	Matrix	Weight	
106677.01	Treat Tank Eff Composite	1/5/12	1/5/12	aqueous		Adheres to Sample Acceptance Policy
106677.02	Treat Tank Eff Grab	1/5/12	1/5/12	aqueous		Adheres to Sample Acceptance Policy
106677.03	Treat Tank Eff Grab	1/5/12	1/5/12	aqueous		Adheres to Sample Acceptance Policy

Samples were properly preserved and the pH measured when applicable unless otherwise noted. Analysis of solids for pH, Flashpoint, Ignitibility, Paint Filter, Corrosivity, Conductivity and Specific Gravity are reported on an "as received" basis.

All results contained in this report relate only to the above listed samples.

References include:

- 1) EPA 600/4-79-020, 1983
- 2) Standard Methods for Examination of Water and Wastewater : Inorganics, 19th Edition, 1995; Microbiology, 20th Edition, 1998
- 3) Test Methods for Evaluating Solid Waste SW 846 3rd Edition including updates IVA and IVB
- 4) Hach Water Analysis Handbook, 2nd edition, 1992



LABORATORY REPORT

EAI ID#: 106677

Client: **Northeast Utilities**Client Designation: **Merrimack Station**

Sample ID: Treat Tank Eff Grab

Lab Sample ID: 106677.02
Matrix: aqueous
Date Sampled: 1/5/12
Date Received: 1/5/12
Units: ug/l
Date of Analysis: 1/6/12
Analyst: KJP
Method: 624
Dilution Factor: 1

Chloromethane	< 5
Vinyl chloride	< 2
Bromomethane	< 2
Chloroethane	< 5
Trichlorofluoromethane	< 5
Acrolein	< 50
Acetone	< 50
1,1-Dichloroethene	< 1
Methylene chloride	< 5
Carbon disulfide	< 5
Acrylonitrile	< 50
Methyl-t-butyl ether(MTBE)	< 10
trans-1,2-Dichloroethene	< 2
Vinyl acetate	< 10
1,1-Dichloroethane	< 2
cis-1,2-Dichloroethene	< 2
2-Butanone(MEK)	< 10
Chloroform	< 2
1,1,1-Trichloroethane	< 2
Carbon tetrachloride	< 2
Benzene	< 1
1,2-Dichloroethane	< 2
Trichloroethene	< 2
1,2-Dichloropropane	< 2
Bromodichloromethane	< 2
2-Chloroethylvinylether	< 2
4-Methyl-2-pentanone(MIBK)	< 10
cis-1,3-Dichloropropene	< 2
Toluene	2
trans-1,3-Dichloropropene	< 2
1,1,2-Trichloroethane	< 2
2-Hexanone	< 10
Tetrachloroethene	< 2
Dibromochloromethane	< 2
Chlorobenzene	< 2
Ethylbenzene	< 1
mp-Xylene	< 1
o-Xylene	< 1
Styrene	< 1
Bromoform	< 2
1,1,2,2-Tetrachloroethane	< 2
1,3-Dichlorobenzene	< 1
1,4-Dichlorobenzene	< 1
1,2-Dichlorobenzene	< 1
4-Bromofluorobenzene (surr)	98 %R
1,2-Dichlorobenzene-d4 (surr)	90 %R
Toluene-d8 (surr)	100 %R



QC REPORT

EAI ID#: 106677

Client: Northeast Utilities

Client Designation: Merrimack Station

Parameter Name	Blank	LCS	LCSD	Analysis Date	Units	Limits	RPD	Method
Chloromethane	< 5	19 (97 %R)	21 (105 %R) (8 RPD)	1/6/2012	ug/l	0 - 273	20	624
Vinyl chloride	< 2	18 (91 %R)	20 (101 %R) (10 RPD)	1/6/2012	ug/l	0 - 251	20	624
Bromomethane	< 2	21 (105 %R)	23 (113 %R) (7 RPD)	1/6/2012	ug/l	0 - 242	20	624
Chloroethane	< 5	19 (95 %R)	20 (101 %R) (6 RPD)	1/6/2012	ug/l	14 - 230	20	624
Trichlorofluoromethane	< 5	17 (84 %R)	18 (88 %R) (5 RPD)	1/6/2012	ug/l	17 - 181	20	624
Acrolein	< 50	< 50 (%R N/A)	< 50 (%R) (RPD)	1/6/2012	ug/l			624
Acetone	< 50	< 50 (78 %R)	< 50 (90 %R) (14 RPD)	1/6/2012	ug/l			624
1,1-Dichloroethene	< 1	17 (83 %R)	18 (89 %R) (7 RPD)	1/6/2012	ug/l	0 - 234	20	624
Methylene chloride	< 5	18 (88 %R)	19 (93 %R) (6 RPD)	1/6/2012	ug/l	0 - 221	20	624
Carbon disulfide	< 5	17 (%R)	19 (%R) (RPD)	1/6/2012	ug/l			624
Acrylonitrile	< 50	< 50 (%R)	< 50 (%R) (RPD)	1/6/2012	ug/l			624
Methyl-t-butyl ether(MTBE)	< 10	20 (%R)	20 (%R) (RPD)	1/6/2012	ug/l			624
trans-1,2-Dichloroethene	< 2	18 (89 %R)	18 (92 %R) (3 RPD)	1/6/2012	ug/l	54 - 156	20	624
Vinyl acetate	< 10	30 (%R)	30 (%R) (RPD)	1/6/2012	ug/l			624
1,1-Dichloroethane	< 2	19 (93 %R)	20 (98 %R) (5 RPD)	1/6/2012	ug/l	59 - 155	20	624
cis-1,2-Dichloroethene	< 2	19 (%R)	20 (%R) (RPD)	1/6/2012	ug/l			624
2-Butanone(MEK)	< 10	20 (%R)	20 (%R) (RPD)	1/6/2012	ug/l			624
Chloroform	< 2	19 (94 %R)	20 (99 %R) (5 RPD)	1/6/2012	ug/l	51 - 138	20	624
1,1,1-Trichloroethane	< 2	18 (91 %R)	19 (97 %R) (6 RPD)	1/6/2012	ug/l	52 - 162	20	624
Carbon tetrachloride	< 2	18 (91 %R)	19 (95 %R) (4 RPD)	1/6/2012	ug/l	70 - 140	20	624
Benzene	< 1	19 (97 %R)	20 (102 %R) (5 RPD)	1/6/2012	ug/l	37 - 151	20	624
1,2-Dichloroethane	< 2	18 (91 %R)	19 (94 %R) (3 RPD)	1/6/2012	ug/l	49 - 155	20	624
Trichloroethene	< 2	19 (93 %R)	20 (98 %R) (5 RPD)	1/6/2012	ug/l	71 - 157	20	624
1,2-Dichloropropane	< 2	19 (95 %R)	20 (98 %R) (3 RPD)	1/6/2012	ug/l	0 - 210	20	624
Bromodichloromethane	< 2	19 (96 %R)	20 (100 %R) (4 RPD)	1/6/2012	ug/l	35 - 155	20	624
2-Chloroethylvinylether	< 2	23 (115 %R)	24 (121 %R) (5 RPD)	1/6/2012	ug/l	0 - 305	20	624
4-Methyl-2-pentanone(MIBK)	< 10	20 (%R)	20 (%R) (RPD)	1/6/2012	ug/l			624
cis-1,3-Dichloropropene	< 2	22 (109 %R)	23 (113 %R) (4 RPD)	1/6/2012	ug/l	0 - 227	20	624
Toluene	< 1	20 (101 %R)	21 (103 %R) (2 RPD)	1/6/2012	ug/l	47 - 150	20	624
trans-1,3-Dichloropropene	< 2	18 (90 %R)	19 (93 %R) (3 RPD)	1/6/2012	ug/l	17 - 183	20	624
1,1,2-Trichloroethane	< 2	20 (100 %R)	21 (104 %R) (4 RPD)	1/6/2012	ug/l	52 - 150	20	624
2-Hexanone	< 10	20 (%R)	20 (%R) (RPD)	1/6/2012	ug/l			624
Tetrachloroethene	< 2	20 (100 %R)	21 (106 %R) (6 RPD)	1/6/2012	ug/l	64 - 148	20	624
Dibromochloromethane	< 2	20 (102 %R)	21 (104 %R) (2 RPD)	1/6/2012	ug/l	53 - 149	20	624
Chlorobenzene	< 2	20 (98 %R)	20 (100 %R) (2 RPD)	1/6/2012	ug/l	37 - 160	20	624
Ethylbenzene	< 1	20 (101 %R)	21 (105 %R) (4 RPD)	1/6/2012	ug/l	37 - 162	20	624
mp-Xylene	< 1	40 (101 %R)	43 (106 %R) (5 RPD)	1/6/2012	ug/l	70 - 130	20	624
o-Xylene	< 1	21 (104 %R)	22 (109 %R) (5 RPD)	1/6/2012	ug/l	70 - 130	20	624
Styrene	< 1	21 (%R)	22 (%R) (RPD)	1/6/2012	ug/l			624
Bromoform	< 2	18 (88 %R)	18 (90 %R) (2 RPD)	1/6/2012	ug/l	45 - 169	20	624
1,1,2,2-Tetrachloroethane	< 2	20 (99 %R)	20 (100 %R) (1 RPD)	1/6/2012	ug/l	46 - 157	20	624
1,3-Dichlorobenzene	< 1	20 (100 %R)	21 (104 %R) (4 RPD)	1/6/2012	ug/l	59 - 156	20	624
1,4-Dichlorobenzene	< 1	20 (98 %R)	20 (102 %R) (4 RPD)	1/6/2012	ug/l	18 - 190	20	624
1,2-Dichlorobenzene	< 1	20 (98 %R)	20 (102 %R) (4 RPD)	1/6/2012	ug/l	18 - 190	20	624
4-Bromofluorobenzene (surr)	100 %R	101 %R	102 %R	1/6/2012	% Rec	70 - 130		624



QC REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Client Designation: **Merrimack Station**

Parameter Name	Blank	LCS	LCSD	Analysis Date	Units	Limits	RPD	Method
1,2-Dichlorobenzene-d4 (surr)	93 %R	90 %R	89 %R	1/6/2012	% Rec	70 - 130		624
Toluene-d8 (surr)	100 %R	102 %R	102 %R	1/6/2012	% Rec	70 - 130		624

Samples were extracted and analyzed within holding time limits.
Instrumentation was calibrated in accordance with the method requirements.
The method blanks were free of contamination at the reporting limits.
Sample surrogate recoveries met the above stated criteria.
The associated matrix spikes and/or Laboratory Control Samples met acceptance criteria.
There were no exceptions in the analyses, unless noted.
*!! Flagged analyte recoveries deviated from the QA/QC limits. Any impact to data is addressed below.



LABORATORY REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Client Designation: **Merrimack Station**

Sample ID: Treat Tank Eff Grab

Lab Sample ID: 106677.02

Matrix: aqueous

Date Sampled: 1/5/12

Date Received: 1/5/12

Units: ug/l

Date of Extraction/Preparation 1/6/12

Date of Analysis: 1/6/12

Analyst: JMR

Method: 625mod

Dilution Factor: 1

Phenol < 1

2-Chlorophenol < 1

2,4-Dichlorophenol < 1

2,4,5-Trichlorophenol < 1

2,4,6-Trichlorophenol < 1

Pentachlorophenol < 5

2-Nitrophenol < 1

4-Nitrophenol < 5

2,4-Dinitrophenol < 5

2-Methylphenol < 1

3/4-Methylphenol < 1

2,4-Dimethylphenol < 1

4-Chloro-3-methylphenol < 1

4,6-Dinitro-2-methylphenol < 5

Benzoic Acid < 50

N-Nitrosodimethylamine < 1

n-Nitroso-di-n-propylamine < 1

n-Nitrosodiphenylamine < 1

bis(2-Chloroethyl)ether < 1

bis(2-chloroisopropyl)ether < 1

bis(2-Chloroethoxy)methane < 1

1,3-Dichlorobenzene < 1

1,4-Dichlorobenzene < 1

1,2-Dichlorobenzene < 1

1,2,4-Trichlorobenzene < 1

2-Chloronaphthalene < 1

4-Chlorophenyl-phenylether < 1

4-Bromophenyl-phenylether < 1

Hexachloroethane < 1

Hexachlorobutadiene < 1

Hexachlorocyclopentadiene < 5

Hexachlorobenzene < 1

4-Chloroaniline < 1

2-Nitroaniline < 5

3-Nitroaniline < 1

4-Nitroaniline < 1

Benzyl alcohol < 5

Nitrobenzene < 1

Isophorone < 1

2,4-Dinitrotoluene < 1

2,6-Dinitrotoluene < 1

Benzidine (estimated) < 5

3,3'-Dichlorobenzidine < 1

Pyridine < 5

Azobenzene < 1



LABORATORY REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Client Designation: **Merrimack Station**

Sample ID: Treat Tank Eff Grab

Lab Sample ID:	106677.02
Matrix:	aqueous
Date Sampled:	1/5/12
Date Received:	1/5/12
Units:	ug/l
Date of Extraction/Preparation	1/6/12
Date of Analysis:	1/6/12
Analyst:	JMR
Method:	625mod
Dilution Factor:	1
Carbazole	< 1
Dimethylphthalate	< 1
Diethylphthalate	< 1
Di-n-butylphthalate	< 5
Butylbenzylphthalate	< 1
bis(2-Ethylhexyl)phthalate	< 5
Di-n-octylphthalate	< 1
Dibenzofuran	< 1
Naphthalene	< 1
2-Methylnaphthalene	< 1
Acenaphthylene	< 1
Acenaphthene	< 1
Fluorene	< 1
Phenanthrene	< 1
Anthracene	< 1
Fluoranthene	< 1
Pyrene	< 1
Benzo[a]anthracene	< 1
Chrysene	< 1
Benzo[b]fluoranthene	< 1
Benzo[k]fluoranthene	< 1
Benzo[a]pyrene	< 1
Indeno[1,2,3-cd]pyrene	< 1
Dibenz[a,h]anthracene	< 1
Benzo[g,h,i]perylene	< 1
2-Fluorophenol (surr)	33 %R
Phenol-d6 (surr)	24 %R
2,4,6-Tribromophenol (surr)	90 %R
Nitrobenzene-D5 (surr)	71 %R
2-Fluorobiphenyl (surr)	72 %R
p-Terphenyl-D14 (surr)	84 %R



QC REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Batch ID: 734507-32510/A010512E6251

Client Designation: **Merrimack Station**

Parameter Name	Blank	LCS	LCSD	Analysis Date	Units	Limits	RPD	Method
Phenol	< 1	14 (27 %R)	14 (29 %R) (7 RPD)	1/5/2012	ug/l	15 - 130	20	625mod
2-Chlorophenol	< 1	29 (59 %R)	30 (60 %R) (2 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
2,4-Dichlorophenol	< 1	35 (70 %R)	36 (72 %R) (3 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
2,4,5-Trichlorophenol	< 1	18 (72 %R)	19 (75 %R) (4 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
2,4,6-Trichlorophenol	< 1	34 (68 %R)	36 (71 %R) (4 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
Pentachlorophenol	< 5	34 (68 %R)	39 (78 %R) (14 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
2-Nitrophenol	< 1	35 (70 %R)	37 (73 %R) (4 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
4-Nitrophenol	< 5	16 (32 %R)	17 (35 %R) (9 RPD)	1/5/2012	ug/l	15 - 130	20	625mod
2,4-Dinitrophenol	< 5	38 (75 %R)	40 (81 %R) (8 RPD)	1/5/2012	ug/l	15 - 130	20	625mod
2-Methylphenol	< 1	15 (61 %R)	16 (64 %R) (5 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
3/4-Methylphenol	< 1	13 (53 %R)	14 (54 %R) (2 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
2,4-Dimethylphenol	< 1	33 (66 %R)	34 (67 %R) (2 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
4-Chloro-3-methylphenol	< 1	36 (73 %R)	36 (73 %R) (0 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
4,6-Dinitro-2-methylphenol	< 5	39 (77 %R)	41 (81 %R) (5 RPD)	1/5/2012	ug/l	30 - 130	20	625mod
Benzoic Acid	< 50	< 50 (31 %R)	< 50 (34 %R) (9 RPD)	1/5/2012	ug/l	15 - 140	20	625mod
N-Nitrosodimethylamine	< 1	12 (46 %R)	12 (47 %R) (2 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
n-Nitroso-di-n-propylamine	< 1	17 (67 %R)	17 (69 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
n-Nitrosodiphenylamine	< 1	22 (90 %R)	23 (90 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
bis(2-Chloroethyl)ether	< 1	16 (63 %R)	16 (64 %R) (2 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
bis(2-chloroisopropyl)ether	< 1	15 (61 %R)	15 (62 %R) (2 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
bis(2-Chloroethoxy)methane	< 1	17 (69 %R)	18 (70 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
1,3-Dichlorobenzene	< 1	13 (52 %R)	13 (52 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
1,4-Dichlorobenzene	< 1	13 (52 %R)	13 (52 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
1,2-Dichlorobenzene	< 1	14 (54 %R)	14 (55 %R) (2 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
1,2,4-Trichlorobenzene	< 1	14 (57 %R)	14 (58 %R) (2 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
2-Chloronaphthalene	< 1	16 (63 %R)	16 (65 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
4-Chlorophenyl-phenylether	< 1	18 (71 %R)	18 (72 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
4-Bromophenyl-phenylether	< 1	19 (75 %R)	19 (75 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Hexachloroethane	< 1	11 (43 %R)	11 (43 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Hexachlorobutadiene	< 1	10 (40 %R)	10 (42 %R) (5 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Hexachlorocyclopentadiene	< 5	* 9 (37 %R)	10 (41 %R) (10 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Hexachlorobenzene	< 1	18 (73 %R)	19 (78 %R) (7 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
4-Chloroaniline	< 1	20 (80 %R)	20 (80 %R) (0 RPD)	1/5/2012	ug/l	15 - 140	20	625mod
2-Nitroaniline	< 5	17 (67 %R)	18 (71 %R) (6 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
3-Nitroaniline	< 1	18 (73 %R)	19 (76 %R) (4 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
4-Nitroaniline	< 1	18 (73 %R)	19 (77 %R) (5 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Benzyl alcohol	< 5	16 (65 %R)	17 (67 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Nitrobenzene	< 1	16 (65 %R)	17 (68 %R) (5 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Isophorone	< 1	20 (79 %R)	20 (81 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
2,4-Dinitrotoluene	< 1	20 (81 %R)	21 (85 %R) (5 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
2,6-Dinitrotoluene	< 1	19 (75 %R)	20 (79 %R) (5 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Benzidine (estimated)	< 5	23 (92 %R)	20 (81 %R) (13 RPD)	1/5/2012	ug/l	15 - 168	20	625mod
3,3'-Dichlorobenzidine	< 1	19 (75 %R)	19 (76 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Pyridine	< 5	11 (45 %R)	11 (46 %R) (2 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Azobenzene	< 1	18 (71 %R)	18 (71 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod



QC REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Batch ID: 734507-32510/A010512E6251

Client Designation: **Merrimack Station**

Parameter Name	Blank	LCS	LCSD	Analysis Date	Units	Limits	RPD	Method
Carbazole	< 1	20 (79 %R)	20 (81 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Dimethylphthalate	< 1	18 (73 %R)	18 (74 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Diethylphthalate	< 1	19 (76 %R)	19 (77 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Di-n-butylphthalate	< 5	19 (77 %R)	19 (76 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Butylbenzylphthalate	< 1	19 (76 %R)	19 (77 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
bis(2-Ethylhexyl)phthalate	< 5	19 (76 %R)	19 (76 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Di-n-octylphthalate	< 1	18 (73 %R)	19 (75 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Dibenzofuran	< 1	16 (66 %R)	17 (67 %R) (2 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Naphthalene	< 1	17 (67 %R)	17 (67 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
2-Methylnaphthalene	< 1	16 (62 %R)	16 (62 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Acenaphthylene	< 1	16 (63 %R)	16 (65 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Acenaphthene	< 1	17 (70 %R)	18 (71 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Fluorene	< 1	17 (70 %R)	18 (71 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Phenanthrene	< 1	19 (74 %R)	19 (76 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Anthracene	< 1	19 (77 %R)	19 (77 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Fluoranthene	< 1	19 (75 %R)	19 (76 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Pyrene	< 1	18 (73 %R)	18 (73 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Benzo[a]anthracene	< 1	19 (75 %R)	19 (76 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Chrysene	< 1	19 (77 %R)	19 (77 %R) (0 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Benzo[b]fluoranthene	< 1	19 (75 %R)	19 (77 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Benzo[k]fluoranthene	< 1	19 (77 %R)	20 (79 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Benzo[a]pyrene	< 1	19 (76 %R)	19 (77 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Indeno[1,2,3-cd]pyrene	< 1	19 (78 %R)	19 (77 %R) (1 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Dibenz[a,h]anthracene	< 1	20 (80 %R)	19 (77 %R) (4 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
Benzo[g,h,i]perylene	< 1	20 (79 %R)	19 (77 %R) (3 RPD)	1/5/2012	ug/l	40 - 140	20	625mod
2-Fluorophenol (surr)	39 %R	39 %R	39 %R	1/5/2012	% Rec	21 - 110	20	625mod
Phenol-d6 (surr)	28 %R	28 %R	29 %R	1/5/2012	% Rec	15 - 94	20	625mod
2,4,6-Tribromophenol (surr)	76 %R	92 %R	82 %R	1/5/2012	% Rec	15 - 110	20	625mod
Nitrobenzene-D5 (surr)	76 %R	75 %R	77 %R	1/5/2012	% Rec	35 - 114	20	625mod
2-Fluorobiphenyl (surr)	77 %R	73 %R	75 %R	1/5/2012	% Rec	43 - 116	20	625mod
p-Terphenyl-D14 (surr)	89 %R	95 %R	90 %R	1/5/2012	% Rec	33 - 130	20	625mod

Samples were extracted and analyzed within holding time limits.

Instrumentation was calibrated in accordance with the method requirements.

The method blanks were free of contamination at the reporting limits.

Sample surrogate recoveries met the above stated criteria.

The associated matrix spikes and/or Laboratory Control Samples met acceptance criteria.

There were no exceptions in the analyses, unless noted.

*!Flagged analyte recoveries deviated from the QA/QC limits.

Hexachlorocyclopentadiene exhibited recovery below acceptance limits in the LCS. Hexachlorocyclopentadiene was not detected in the sample.



LABORATORY REPORT

EAI ID#: 106677

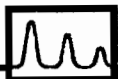
Client: **Northeast Utilities**

Client Designation: **Merrimack Station**

Sample ID: Treat Tank Eff
Grab

Lab Sample ID: 106677.02
Matrix: aqueous
Date Sampled: 1/5/12
Date Received: 1/5/12
Units: mg/L
Date of Extraction/Prep: 1/9/12
Date of Analysis: 1/9/12
Analyst: LAS
Method: 1664A
Dilution Factor: 1

Oil & Grease (HEM) < 5



QC REPORT

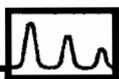
EAI ID#: 106677

Client: **Northeast Utilities**

Client Designation: **Merrimack Station**

Parameter Name	Blank	LCS	LCSD	Analysis Date	Units	Limits	RPD	Method
Oil & Grease (HEM)	< 5	37 (93 %R)	33 (82 %R) (13 RPD)	1/9/2012	mg/L	78 - 114	18	1664A

Samples were extracted and analyzed within holding time limits.
Instrumentation was calibrated in accordance with the method requirements.
The method blanks were free of contamination at the reporting limits.
Sample surrogate recoveries met the above stated criteria.
The associated matrix spikes and/or Laboratory Control Samples met acceptance criteria.
There were no exceptions in the analyses, unless noted.
*/! Flagged analyte recoveries deviated from the QA/QC limits. Any impact to data is addressed below.



LABORATORY REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Client Designation: **Merrimack Station**

Sample ID:

Treat Tank Eff
Grab

Lab Sample ID: 106677.02
Matrix: aqueous
Date Sampled: 1/5/12
Date Received: 1/5/12
Units: ug/l
Date of Extraction/Prep: 1/6/12
Date of Analysis: 1/6/12
Analyst: JW
Method: 608
Dilution Factor: 1

PCB-1016	< 0.3
PCB-1221	< 0.3
PCB-1232	< 0.3
PCB-1242	< 0.3
PCB-1248	< 0.3
PCB-1254	< 0.3
PCB-1260	< 0.3
TMX (surr)	81 %R
DCB (surr)	96 %R



QC REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Batch ID: 734508-43146/A010612E608P1

Client Designation: **Merrimack Station**

Parameter Name	Blank	LCS	LCSD	Analysis Date	Units	Limits	RPD	Method
PCB-1016	< 0.3	2.0 (101 %R)	2.1 (106 %R) (5 RPD)	1/6/2012	ug/l	40 - 140	20	608
PCB-1221	< 0.3	< 0.3 (%R N/A)	< 0.3 (%R N/A) (RPD N/A)	1/6/2012	ug/l			608
PCB-1232	< 0.3	< 0.3 (%R N/A)	< 0.3 (%R N/A) (RPD N/A)	1/6/2012	ug/l			608
PCB-1242	< 0.3	< 0.3 (%R N/A)	< 0.3 (%R N/A) (RPD N/A)	1/6/2012	ug/l			608
PCB-1248	< 0.3	< 0.3 (%R N/A)	< 0.3 (%R N/A) (RPD N/A)	1/6/2012	ug/l			608
PCB-1254	< 0.3	< 0.3 (%R N/A)	< 0.3 (%R N/A) (RPD N/A)	1/6/2012	ug/l			608
PCB-1260	< 0.3	2.0 (102 %R)	2.1 (105 %R) (3 RPD)	1/6/2012	ug/l	40 - 140	20	608
TMX (surr)	84 %R	88 %R	90 %R	1/6/2012	% Rec	30 - 150		608
DCB (surr)	95 %R	101 %R	100 %R	1/6/2012	% Rec	30 - 150		608

Samples were extracted and analyzed within holding time limits.

Instrumentation was calibrated in accordance with the method requirements.

The method blanks were free of contamination at the reporting limits.

Sample surrogate recoveries met the above stated criteria.

The associated matrix spikes and/or Laboratory Control Samples met acceptance criteria.

There were no exceptions in the analyses, unless noted.

*! Flagged analyte recoveries deviated from the QA/QC limits.



LABORATORY REPORT

EAI ID#: 106677

Client: **Northeast Utilities**

Client Designation: **Merrimack Station**

Sample ID: Treat Tank Eff
Composite

Lab Sample ID: 106677.01

Matrix: aqueous

Date Sampled: 1/5/12

Date Received: 1/5/12

Solids Suspended 14
Solids Dissolved 21000
Fluoride 10
Sulfate 1200
Chloride 11000
Nitrate-N 100
Alkalinity Total (CaCO₃) 180
Ammonia-N 0.92
BOD < 6
COD 130
pH 7.3

Units	Analysis			Method	Analyst
	Date	Time			
mg/L	01/10/12	15:40	2540D	DLS	
mg/L	01/11/12	13:15	2540C	DLS	
mg/L	01/11/12	11:23	300.0	KL	
mg/L	01/11/12	11:23	300.0	KL	
mg/L	01/10/12	12:17	4500CIE	DLS	
mg/L	01/06/12	12:57	353.2	DLS	
mg/L	01/11/12	9:40	2320B	SEL	
mg/L	01/10/12	8:30	4500NH3D	SEL	
mg/L	01/06/12	14:05	5210B	SKC	
mg/L	01/12/12	10:20	H8000	SKC	
SU	01/05/12	15:10	4500H+B	NZ	

Sample ID: Treat Tank Eff Grab

Lab Sample ID: 106677.02

Matrix: aqueous

Date Sampled: 1/5/12

Date Received: 1/5/12

Cyanide Total 0.02
Sulfide < 0.1
Sulfite < 2
Total Residual Chlorine < 0.05
Total Phenols < 0.3

Units	Analysis			Method	Analyst
	Date	Time			
mg/L	01/11/12	8:45	4500CNE	KJR	
mg/L	01/11/12	13:20	8131HACH	KJR	
mg/L	01/05/12	17:30	377.1	JL	
mg/L	01/05/12	16:50	4500CIG	NZ	
mg/L	01/09/12	9:00	420.1	JCC	

Total Phenols: The reporting limit for Total Phenols has been elevated due to matrix interferences.



QC REPORT

EAI ID#: 106677

Client: **Northeast Utilities**Client Designation: **Merrimack Station**

Parameter Name	Blank	LCS	LCSD	Units	Date of Analysis	Limits	RPD	Method
Solids Suspended	< 5	90 (90 %R)	93 (93 %R) (3 RPD)	mg/L	1/10/12	90 - 110	20	2540D
Solids Dissolved	< 5	970 (97 %R)	NA	mg/L	1/11/12	85 - 115		2540C
Fluoride	< 0.1	2.0 (101 %R)	2.0 (101 %R) (0 RPD)	mg/L	1/11/12	90 - 110	20	300.0
Sulfate	< 1	21 (106 %R)	21 (103 %R) (3 RPD)	mg/L	1/11/12	90 - 110	20	300.0
Chloride	< 1	26 (103 %R)	26 (103 %R) (0 RPD)	mg/L	1/10/12	90 - 110	20	4500CIE
Nitrate-N	< 0.05	5.3 (106 %R)	5.3 (106 %R) (0 RPD)	mg/L	1/6/12	90 - 110	20	353.2
Alkalinity Total (CaCO3)	< 1	10 (99 %R)	10 (100 %R) (1 RPD)	mg/L	1/11/12	85 - 115	20	2320B
Cyanide Total	< 0.02	0.27 (106 %R)	0.23 (91 %R) (15 RPD)	mg/L	1/11/12	85 - 115	20	4500CNE
Ammonia-N	< 0.05	2.0 (100 %R)	2.1 (105 %R) (5 RPD)	mg/L	1/10/12	90 - 110	20	4500NH3DN
Sulfide	< 0.1	0.4 (98 %R)	0.4 (90 %R) (9 RPD)	mg/L	1/11/12	80 - 120	20	8131HACH
Sulfite	< 2	NA	NA	mg/L	1/5/12			377.1
Total Residual Chlorine	< 0.05	0.88 (101 %R)	0.87 (100 %R) (1 RPD)	mg/L	1/5/12	80 - 120	20	4500CIG
BOD	< 6	430 (109 %R)	390 (97 %R) (12 RPD)	mg/L	1/6/12	84 - 115	20	5210B
COD	< 10	100 (101 %R)	100 (98 %R) (3 RPD)	mg/L	1/12/12	85 - 115	20	H8000
Total Phenols	< 0.05	0.28 (112 %R)	0.27 (106 %R) (6 RPD)	mg/L	1/9/12	85 - 115	20	420.1
pH		6.0 (101 %R)	6.05 (101 %R) (0 RPD)	SU	1/5/12	5.95 - 6.07	10	4500H+B

Samples were analyzed within holding times unless noted on the sample results page.

Instrumentation was calibrated in accordance with the method requirements.

The method blanks were free of contamination at the reporting limits.

The associated matrix spikes and/or Laboratory Control Samples met the above stated criteria.

Exceptions to the above statements are flagged or noted above or on the QC Narrative page.

*// Flagged analyte recoveries deviated from the QA/QC limits.



QC REPORT

EAI ID#: 106677

Client: **Northeast Utilities**Client Designation: **Merrimack Station**

Parameter Name	Duplicate Parent ID	Duplicate Parent	Duplicate	Units	Date of Analysis	RPD	Method
Solids Suspended	106692.03	180	160 (13 RPD)	mg/L	1/10/12	20	2540D
Solids Dissolved		NA	NA	mg/L	1/11/12		2540C
Fluoride		NA	NA	mg/L	1/11/12	20	300.0
Sulfate		NA	NA	mg/L	1/11/12	20	300.0
Chloride		NA	NA	mg/L	1/10/12	20	4500CIE
Nitrate-N		NA	NA	mg/L	1/6/12	20	353.2
Alkalinity Total (CaCO ₃)		NA	NA	mg/L	1/11/12	20	2320B
Cyanide Total		NA	NA	mg/L	1/11/12	20	4500CNE
Ammonia-N	106627.02	13	13 (2 RPD)	mg/L	1/10/12	20	4500NH3D
Sulfide		NA	NA	mg/L	1/11/12	20	8131HACH
Sulfite	106677.02	< 2	< 2 (RPD N/A)	mg/L	1/5/12	20	377.1
Total Residual Chlorine		NA	NA	mg/L	1/5/12	20	4500CIG
BOD	106657.02	410	400 (3 RPD)	mg/L	1/6/12	20	5210B
COD		NA	NA	mg/L	1/12/12	20	H8000
Total Phenols		NA	NA	mg/L	1/9/12	20	420.1
pH	106649.01	6.3	6.3 (0 RPD)	SU	1/5/12	10	4500H+B

Samples were analyzed within holding times unless noted on the sample results page.

Instrumentation was calibrated in accordance with the method requirements.

The method blanks were free of contamination at the reporting limits.

The associated matrix spikes and/or Laboratory Control Samples met the above stated criteria.

Exceptions to the above statements are flagged or noted above or on the QC Narrative page.

*// Flagged analyte recoveries deviated from the QA/QC limits.



QC REPORT

EAI ID#: 106677

Client: **Northeast Utilities**Client Designation: **Merrimack Station**

Parameter Name	MS/MSD Parent ID	MS/MSD Parent	Matrix Spike	MSD	Date of Units Analysis	Limits	RPD	Method
Solids Suspended		NA	NA	NA	mg/L 1/10/12		20	2540D
Solids Dissolved		NA	NA	NA	mg/L 1/11/12			2540C
Fluoride		NA	NA	NA	mg/L 1/11/12		20	300.0
Sulfate		NA	NA	NA	mg/L 1/11/12		20	300.0
Chloride	106632.02	11	22 (110 %R)	22 (109 %R) (1 RPD)	mg/L 1/10/12	80-120	20	4500CIE
Nitrate-N	106678.01	1.2	12 (110 %R)	12 (109 %R) (1 RPD)	mg/L 1/6/12	80-120	20	353.2
Alkalinity Total (CaCO ₃)	106607.01	29	48 (98 %R)	NA	mg/L 1/11/12	80-120	20	2320B
Cyanide Total	106677.02	0.02	0.25 (93 %R)	0.23 (86 %R) (8 RPD)	mg/L 1/11/12	75-125	20	4500CNE
Ammonia-N	106627.02	13	16 (115 %R)	15 (85 %R) (30 RPD)	mg/L 1/10/12	80-120	20	4500NH3
Sulfide		NA	NA	NA	mg/L 1/11/12		20	8131HAC
Sulfite		NA	NA	NA	mg/L 1/5/12			377.1
Total Residual Chlorine		NA	NA	NA	mg/L 1/5/12		20	4500CIG
BOD	106657.02	410	760 (82 %R)	NA	mg/L 1/6/12	75-125	20	5210B
COD	106677.01	130	220 (92 %R)	230 (99 %R) (7 RPD)	mg/L 1/12/12	80-120	20	H8000
Total Phenols	106677.02	< 0.3	0.4 (42 %R)	0.4 (42 %R) (133 RPD)	mg/L 1/9/12	80-120	20	420.1
pH		NA	NA	NA	SU 1/5/12		10	4500H+B

Total Phenols: The MS and MSD recoveries were below acceptance criteria even when the parent sample was diluted indicating a matrix interference.

Samples were analyzed within holding times unless noted on the sample results page.

Instrumentation was calibrated in accordance with the method requirements.

The method blanks were free of contamination at the reporting limits.

The associated matrix spikes and/or Laboratory Control Samples met the above stated criteria.

Exceptions to the above statements are flagged or noted above or on the QC Narrative page.

*!! Flagged analyte recoveries deviated from the QA/QC limits.



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11 January 2012

Jeff Gagne
Eastern Analytical, Inc
25 Chenell Drive
Concord, NH 03301
RE: Merrimack Station

Enclosed are the analytical results for samples received by Frontier Global Sciences. All quality control measurements are within established control limits and there were no analytical difficulties encountered with the exception of those listed in the case narrative section of this report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

A handwritten signature in cursive script that reads "Liz Siska".

Liz Siska
Project Manager



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Ph: 206-622-6960
Fx: 206-622-6870

ANALYTICAL REPORT FOR SAMPLES

Laboratory: Frontier Global Sciences, Inc.

SDG:

Client: Eastern Analytical, Inc

Project: Merrimack Station

Sample ID	Lab ID	Matrix	Date Sampled	Date Received
Treat Tank Eff Composite	1201073-01	Water	05-Jan-12 10:00	06-Jan-12 09:50
Treat Tank Eff Grab	1201073-02	Water	05-Jan-12 08:00	06-Jan-12 09:50

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A handwritten signature in cursive script that reads "Liz Siska".

Liz Siska, Project Manager

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CASE NARRATIVE

SAMPLE RECEIPT

Samples were received at Frontier Global Sciences (FGS) on January 6th, 2012. The samples were received intact, on-ice with temperatures measured at 3.4 degrees Celsius.

SAMPLE PREPARATION AND ANALYSIS

Samples were prepared and analyzed for total metals in accordance with FGS-054/EPA 1638.

Samples were prepared and analyzed for total mercury in accordance with EPA Method 1631E.

ANALYTICAL AND QUALITY CONTROL ISSUES

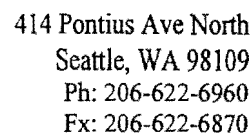
There were no analytical difficulties experienced with analysis of these samples with the exceptions flagged in the report.

Frontier Global Sciences, Inc.

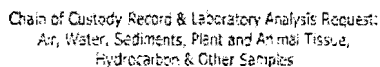
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Liz Siska, Project Manager



1201073



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1201073

[illegible]

Re: ~~W. A. Lee~~ ALVA BATHIN, FG-5 1-6-12, 1107

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ANALYTICAL RESULTS

Treat Tank Eff Composite

Matrix: Water

Laboratory ID: 1201073-01

Analyte	Result	MDL	MRL	Units	Dilution	Batch	Sequence	Analyzed	Method	Notes
Aluminum	41.1	2.2	20.0	µg/L	5	F201062	2A10002	01/09/12	FGS-054	
Antimony	0.520	0.023	0.100	µg/L	5	F201062	2A10002	01/09/12	FGS-054	
Barium	300	0.14	1.00	µg/L	5	F201062	2A10002	01/09/12	FGS-054	
Beryllium	0.522	0.114	0.300	µg/L	5	F201062	2A10002	01/09/12	FGS-054	
Cadmium	0.207	0.021	0.100	µg/L	5	F201062	2A10002	01/09/12	FGS-054	
Calcium	5050000	16200	200000	µg/L	5000	F201077	2A10015	01/10/12	FGS-054	
Chromium	ND	0.04	0.50	µg/L	5	F201062	2A10002	01/09/12	FGS-054	U
Copper	ND	0.05	0.50	µg/L	5	F201062	2A10002	01/09/12	FGS-054	U
Iron	ND	6.5	50.0	µg/L	5	F201062	2A10002	01/09/12	FGS-054	U
Lead	ND	0.020	0.200	µg/L	5	F201062	2A10002	01/09/12	FGS-054	U
Manganese	293	0.74	10.0	µg/L	100	F201062	2A10002	01/09/12	FGS-054	
Molybdenum	140	0.03	0.30	µg/L	5	F201062	2A10002	01/09/12	FGS-054	
Nickel	8.03	0.04	0.50	µg/L	5	F201062	2A10002	01/09/12	FGS-054	
Silver	ND	0.030	0.100	µg/L	5	F201062	2A10002	01/09/12	FGS-054	U
Sodium	277000	115	2000	µg/L	100	F201062	2A10002	01/09/12	FGS-054	
Thallium	6.64	0.006	0.025	µg/L	5	F201062	2A10002	01/09/12	FGS-054	QB-01
Zinc	ND	0.08	1.00	µg/L	5	F201062	2A10002	01/09/12	FGS-054	U

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Liz Siska Project Manager

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ANALYTICAL RESULTS

Treat Tank Eff Grab

Matrix: Water

Laboratory ID: 1201073-02

Analyte	Result	MDL	MRL	Units	Dilution	Batch	Sequence	Analyzed	Method	Notes
Arsenic	4.98	1.02	3.00	µg/L	20	F201062	2A10015	01/10/12	FGS-054	
Mercury	10.5	0.34	2.02	ng/L	4	F201063	2A09010	01/09/12	EPA 1631E	FB-1631
Selenium	74.0	3.88	12.0	µg/L	20	F201062	2A10015	01/10/12	FGS-054	

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MATRIX DUPLICATES/TRIPPLICATES

SOURCE: 1201073-02

Batch: F201063

Sequence: 2A09010

Preparation: BrCl Oxidation

Lab Number: F201063-DUP1

Analyte	Sample Concentration ng/L	Duplicate Concentration ng/L	MRL	% RPD	RPD Limit	Method	Notes
Mercury	10.48	10.54	2.02	0.617	24	EPA 1631E	

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-MS/MSD1

Analyte	Sample Concentration (µg/L)	Spike Added (µg/L)	MS Concentration (µg/L)	MS % Recovery	Recovery Limits	Method	Notes
Beryllium	0.522	2.0200	2.676	107	75 - 135	FGS-054	
Aluminum	41.1	151.50	210.7	112	80 - 115	FGS-054	
Chromium	0.47	7.0700	8.59	115	85 - 115	FGS-054	
Iron	ND	505.00	563.6	112	75 - 125	FGS-054	
Nickel	8.03	4.0400	11.98	97.7	68 - 134	FGS-054	
Copper	0.29	4.0400	4.00	91.8	51 - 145	FGS-054	
Zinc	0.27	10.100	9.10	87.4	46 - 146	FGS-054	
Arsenic	5.32	15.150	22.17	111	85 - 115	FGS-054	
Selenium	71.73	30.300	100.6	95.3	59 - 149	FGS-054	
Molybdenum	140.3	2.0200	142.1	88.8	80 - 115	FGS-054	
Silver	ND	1.5150	1.216	80.3	74 - 119	FGS-054	
Cadmium	0.207	0.80800	1.076	108	84 - 113	FGS-054	
Antimony	0.520	0.80800	1.360	104	79 - 122	FGS-054	
Barium	300.0	10.100	305.0	49.8	80 - 120	FGS-054	QM-02
Thallium	6.645	0.40400	6.882	58.7	64 - 137	FGS-054	QB-01, QM-02
Lead	ND	1.5150	1.635	108	72 - 143	FGS-054	

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Beryllium	2.0200	2.639	105	1.39	75 - 135	20	FGS-054	
Aluminum	151.50	213.8	114	1.50	80 - 115	20	FGS-054	
Chromium	7.0700	8.59	115	0.0611	85 - 115	20	FGS-054	
Iron	505.00	553.8	110	1.76	75 - 125	20	FGS-054	
Nickel	4.0400	12.20	103	1.83	68 - 134	20	FGS-054	
Copper	4.0400	3.95	90.7	1.15	51 - 145	20	FGS-054	
Zinc	10.100	8.87	85.2	2.51	46 - 146	20	FGS-054	
Arsenic	15.150	22.81	115	2.84	85 - 115	20	FGS-054	
Selenium	30.300	110.8	129	9.65	59 - 149	20	FGS-054	
Molybdenum	2.0200	143.5	159	0.993	80 - 115	20	FGS-054	QM-02
Silver	1.5150	1.226	81.0	0.852	74 - 119	20	FGS-054	
Cadmium	0.80800	0.956	92.7	11.8	84 - 113	20	FGS-054	

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-MS/MSD1

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Antimony	0.80800	1.373	106	0.924	79 - 122	20	FGS-054	
Barium	10.100	307.1	71.1	0.703	80 - 120	20	FGS-054	QM-02
Thallium	0.40400	6.918	67.6	0.520	64 - 137	20	FGS-054	QB-01
Lead	1.5150	1.580	104	3.44	72 - 143	20	FGS-054	

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01RE1

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-MS/MSD2

Analyte	Sample Concentration (µg/L)	Spike Added (µg/L)	MS Concentration (µg/L)	MS % Recovery	Recovery Limits	Method	Notes
Sodium	277400	505.00	264500	-2560	75 - 125	FGS-054	QM-02
Manganese	293.1	6.0600	287.1	-98.7	80 - 120	FGS-054	QM-02

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Sodium	505.00	270000	-1460	2.06	75 - 125	20	FGS-054	QM-02
Manganese	6.0600	289.7	-55.3	0.912	80 - 120	20	FGS-054	QM-02

Liz Siskin



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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-MS/MSD3

Analyte	Sample Concentration (µg/L)	Spike Added (µg/L)	MS Concentration (µg/L)	MS % Recovery	Recovery Limits	Method	Notes
Beryllium	0.522	10.100	10.96	103	75 - 135	FGS-054	AS
Aluminum	41.1	2020.0	2166	105	80 - 115	FGS-054	AS
Chromium	0.47	202.00	230.0	114	85 - 115	FGS-054	AS
Iron	ND	1010.0	1103	109	75 - 125	FGS-054	AS
Nickel	8.03	252.50	255.1	97.8	68 - 134	FGS-054	AS
Copper	0.29	252.50	224.5	88.8	51 - 145	FGS-054	AS
Zinc	0.27	505.00	422.7	83.7	46 - 146	FGS-054	AS
Arsenic	5.32	202.00	235.0	114	85 - 115	FGS-054	AS
Selenium	71.73	202.00	287.2	107	59 - 149	FGS-054	AS
Molybdenum	140.3	101.00	244.7	103	80 - 115	FGS-054	AS
Silver	ND	10.100	8.224	81.4	74 - 119	FGS-054	AS
Cadmium	0.207	20.200	19.18	93.9	84 - 113	FGS-054	AS
Antimony	0.520	10.100	11.16	105	79 - 122	FGS-054	AS
Barium	300.0	404.00	775.3	118	80 - 120	FGS-054	AS
Thallium	6.645	10.100	17.46	107	64 - 137	FGS-054	AS, QB-01
Lead	ND	50.500	51.95	103	72 - 143	FGS-054	AS

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Beryllium	10.100	11.25	106	2.66	75 - 135	20	FGS-054	AS
Aluminum	2020.0	2171	105	0.234	80 - 115	20	FGS-054	AS
Chromium	202.00	231.3	114	0.528	85 - 115	20	FGS-054	AS
Iron	1010.0	1112	110	0.802	75 - 125	20	FGS-054	AS
Nickel	252.50	255.9	98.2	0.346	68 - 134	20	FGS-054	AS
Copper	252.50	225.5	89.2	0.424	51 - 145	20	FGS-054	AS
Zinc	505.00	425.5	84.2	0.647	46 - 146	20	FGS-054	AS
Arsenic	202.00	236.5	114	0.629	85 - 115	20	FGS-054	AS
Selenium	202.00	287.0	107	0.0540	59 - 149	20	FGS-054	AS
Molybdenum	101.00	246.7	105	0.806	80 - 115	20	FGS-054	AS
Silver	10.100	8.290	82.1	0.798	74 - 119	20	FGS-054	AS
Cadmium	20.200	19.31	94.6	0.670	84 - 113	20	FGS-054	AS
Antimony	10.100	11.31	107	1.29	79 - 122	20	FGS-054	AS

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-MS/MSD3

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Barium	404.00	779.8	119	0.575	80 - 120	20	FGS-054	AS
Thallium	10.100	17.56	108	0.595	64 - 137	20	FGS-054	AS, QB-01
Lead	50.500	52.16	103	0.399	72 - 143	20	FGS-054	AS

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01RE1

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-MS/MSD4

Analyte	Sample Concentration (µg/L)	Spike Added (µg/L)	MS Concentration (µg/L)	MS % Recovery	Recovery Limits	Method	Notes
Sodium	277400	202000	474400	97.5	75 - 125	FGS-054	AS
Manganese	293.1	2020.0	2396	104	80 - 120	FGS-054	AS

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Sodium	202000	480300	100	1.25	75 - 125	20	FGS-054	AS
Manganese	2020.0	2405	105	0.346	80 - 120	20	FGS-054	AS

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-02

Batch: F201063

Sequence: 2A09010

Preparation: BrCl Oxidation

Lab Number: F201063-MS/MSD1

Analyte	Sample Concentration (ng/L)	Spike Added (ng/L)	MS Concentration (ng/L)	MS % Recovery	Recovery Limits	Method	Notes
Mercury	10.48	20.400	31.36	102	71 - 125	EPA 1631E	

Analyte	Spike Added (ng/L)	MSD Concentration (ng/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Mercury	20.400	27.08	81.4	14.7	71 - 125	24	EPA 1631E	

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1112278-02

Batch: F201063

Sequence: 2A09010

Preparation: BrCl Oxidation

Lab Number: F201063-MS/MSD2

Analyte	Sample Concentration (ng/L)	Spike Added (ng/L)	MS Concentration (ng/L)	MS % Recovery	Recovery Limits	Method	Notes
Mercury	7.61	20.400	27.86	99.2	71 - 125	EPA 1631E	

Analyte	Spike Added (ng/L)	MSD Concentration (ng/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Mercury	20.400	28.37	102	1.82	71 - 125	24	EPA 1631E	

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201029-01

Batch: F201063

Sequence: 2A09010

Preparation: BrCl Oxidation

Lab Number: F201063-MS/MSD3

Analyte	Sample Concentration (ng/L)	Spike Added (ng/L)	MS Concentration (ng/L)	MS % Recovery	Recovery Limits	Method	Notes
Mercury	5.34	10.200	15.58	100	71 - 125	EPA 1631E	

Analyte	Spike Added (ng/L)	MSD Concentration (ng/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Mercury	10.200	14.07	85.6	10.2	71 - 125	24	EPA 1631E	

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201030-02

Batch: F201063

Sequence: 2A09010

Preparation: BrCl Oxidation

Lab Number: F201063-MS/MSD4

Analyte	Sample Concentration (ng/L)	Spike Added (ng/L)	MS Concentration (ng/L)	MS % Recovery	Recovery Limits	Method	Notes
Mercury	5.54	10.200	14.82	91.0	71 - 125	EPA 1631E	

Analyte	Spike Added (ng/L)	MSD Concentration (ng/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Mercury	10.200	14.61	89.0	1.40	71 - 125	24	EPA 1631E	

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01RE2

Batch: F201077

Sequence: 2A10015

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201077-MS/MSD1

Analyte	Sample Concentration (µg/L)	Spike Added (µg/L)	MS Concentration (µg/L)	MS % Recovery	Recovery Limits	Method	Notes
Calcium	5052000	1515.0	5067000	1010	70 - 130	FGS-054	QM-02

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Calcium	1515.0	5034000	-1190	0.660	70 - 130	20	FGS-054	QM-02

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MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY AND RPD

SOURCE: 1201073-01RE2

Batch: F201077

Sequence: 2A10015

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201077-MS/MSD2

Analyte	Sample Concentration (µg/L)	Spike Added (µg/L)	MS Concentration (µg/L)	MS % Recovery	Recovery Limits	Method	Notes
Calcium	5052000	10100000	15570000	104	70 - 130	FGS-054	

Analyte	Spike Added (µg/L)	MSD Concentration (µg/L)	MSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Calcium	10100000	15550000	104	0.125	70 - 130	20	FGS-054	



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LABORATORY CONTROL SAMPLE/ LABORATORY CONTROL SAMPLE DUPLICATE

RECOVERY AND RPD

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-BS/BSD1

LCS Source: Blank Spike

Analyte	Spike Added (µg/L)	LCS Concentration (µg/L)	LCS % Recovery	Recovery Limits	Method	Notes
Beryllium	2.0000	2.039	102	75 - 135	FGS-054	
Sodium	500.00	487	97.4	80 - 120	FGS-054	
Aluminum	150.00	152.4	102	85 - 115	FGS-054	
Calcium	1500.0	1550	103	80 - 120	FGS-054	
Chromium	7.0000	6.82	97.4	85 - 115	FGS-054	
Manganese	6.0000	6.03	101	85 - 115	FGS-054	
Iron	500.00	481.5	96.3	80 - 120	FGS-054	
Nickel	4.0000	4.06	102	68 - 134	FGS-054	
Copper	4.0000	4.15	104	51 - 145	FGS-054	
Zinc	10.000	10.16	102	46 - 146	FGS-054	
Arsenic	15.000	15.38	103	85 - 115	FGS-054	
Selenium	30.000	31.50	105	59 - 149	FGS-054	
Molybdenum	2.0000	1.97	98.3	85 - 115	FGS-054	
Silver	1.5000	1.569	105	74 - 119	FGS-054	
Cadmium	0.80000	0.850	106	84 - 113	FGS-054	
Antimony	0.80000	0.866	108	79 - 122	FGS-054	
Barium	10.000	10.41	104	85 - 115	FGS-054	
Thallium	0.40000	0.433	108	64 - 134	FGS-054	
Lead	1.5000	1.611	107	72 - 143	FGS-054	

Analyte	Spike Added (µg/L)	LCSD Concentration (µg/L)	LCSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Beryllium	2.0000	2.078	104	1.91	75 - 135	20	FGS-054	
Sodium	500.00	496	99.2	1.88	80 - 120	20	FGS-054	
Aluminum	150.00	154.4	103	1.28	85 - 115	20	FGS-054	
Calcium	1500.0	1583	106	2.10	80 - 120	20	FGS-054	
Chromium	7.0000	6.95	99.3	1.90	85 - 115	20	FGS-054	
Manganese	6.0000	6.15	103	1.97	85 - 115	20	FGS-054	
Iron	500.00	494.6	98.9	2.69	80 - 120	20	FGS-054	

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LABORATORY CONTROL SAMPLE/ LABORATORY CONTROL SAMPLE DUPLICATE

RECOVERY AND RPD

Batch: F201062

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201062-BS/BSD1

LCS Source: Blank Spike

Analyte	Spike Added (µg/L)	LCSD Concentration (µg/L)	LCSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Nickel	4.0000	4.15	104	2.20	68 - 134	20	FGS-054	
Copper	4.0000	4.28	107	3.01	51 - 145	20	FGS-054	
Zinc	10.000	10.52	105	3.48	46 - 146	20	FGS-054	
Arsenic	15.000	15.69	105	2.00	85 - 115	20	FGS-054	
Selenium	30.000	32.57	109	3.35	59 - 149	20	FGS-054	
Molybdenum	2.0000	1.93	96.6	1.72	85 - 115	20	FGS-054	
Silver	1.5000	1.557	104	0.768	74 - 119	20	FGS-054	
Cadmium	0.80000	0.868	108	2.04	84 - 113	20	FGS-054	
Antimony	0.80000	0.872	109	0.661	79 - 122	20	FGS-054	
Barium	10.000	10.54	105	1.25	85 - 115	20	FGS-054	
Thallium	0.40000	0.443	111	2.27	64 - 134	20	FGS-054	
Lead	1.5000	1.641	109	1.85	72 - 143	20	FGS-054	

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LABORATORY CONTROL SAMPLE/ LABORATORY CONTROL SAMPLE DUPLICATE

RECOVERY AND RPD

Batch: F201063

Sequence: 2A09010

Preparation: BrCl Oxidation

Lab Number: F201063-BS/BSD1

LCS Source: Nist 1641d

Analyte	Spike Added (ng/L)	LCS Concentration (ng/L)	LCS % Recovery	Recovery Limits	Method	Notes
Mercury	15.679	15.50	98.8	80 - 120	EPA 1631E	

Analyte	Spike Added (ng/L)	LCSD Concentration (ng/L)	LCSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Mercury	15.679	15.95	102	2.89	80 - 120	24	EPA 1631E	

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LABORATORY CONTROL SAMPLE/ LABORATORY CONTROL SAMPLE DUPLICATE

RECOVERY AND RPD

Batch: F201077

Sequence: 2A10015

Preparation: Closed Vessel Nitric Oven Digestion

Lab Number: F201077-BS/BSD1

LCS Source: Blank Spike

Analyte	Spike Added (µg/L)	LCS Concentration (µg/L)	LCS % Recovery	Recovery Limits	Method	Notes
Calcium	1500.0	1517	101	80 - 120	FGS-054	

Analyte	Spike Added (µg/L)	LCSD Concentration (µg/L)	LCSD % Recovery	% RPD	Recovery Limits	RPD Limit	Method	Notes
Calcium	1500.0	1571	105	3.47	80 - 120	20	FGS-054	

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PREPARATION BLANKS

Instrument: Hg-17

Sequence: 2A09010

Preparation: BrCl Oxidation

Lab Sample ID	Analyte	Found	MRL	Units	Batch	Method	Notes
F201063-BLK1	Mercury	-0.009	0.50	ng/L	F201063	EPA 1631E	U
F201063-BLK2	Mercury	-0.006	0.50	ng/L	F201063	EPA 1631E	U
F201063-BLK3	Mercury	-0.02	0.50	ng/L	F201063	EPA 1631E	U
F201063-BLK4	Mercury	0.03	0.50	ng/L	F201063	EPA 1631E	U, QB-04
F201063-BLK5	Mercury	0.11	0.52	ng/L	F201063	EPA 1631E	U, QB-06



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PREPARATION BLANKS

Instrument: ICPMS-6

Sequence: 2A10002

Preparation: Closed Vessel Nitric Oven Digestion

Lab Sample ID	Analyte	Found	MRL	Units	Batch	Method	Notes
F201062-BLK1	Beryllium	0.0002	0.060	µg/L	F201062	FGS-054	U
F201062-BLK1	Sodium	0.09	20	µg/L	F201062	FGS-054	U
F201062-BLK1	Aluminum	0.09	4.0	µg/L	F201062	FGS-054	U
F201062-BLK1	Calcium	0.5	40	µg/L	F201062	FGS-054	U
F201062-BLK1	Chromium	0.03	0.10	µg/L	F201062	FGS-054	U
F201062-BLK1	Manganese	-0.002	0.10	µg/L	F201062	FGS-054	U
F201062-BLK1	Iron	-0.06	10.0	µg/L	F201062	FGS-054	U
F201062-BLK1	Nickel	0.004	0.10	µg/L	F201062	FGS-054	U
F201062-BLK1	Copper	-0.0003	0.10	µg/L	F201062	FGS-054	U
F201062-BLK1	Zinc	0.04	0.20	µg/L	F201062	FGS-054	U
F201062-BLK1	Arsenic	-0.07	0.15	µg/L	F201062	FGS-054	U
F201062-BLK1	Selenium	0.003	0.60	µg/L	F201062	FGS-054	U
F201062-BLK1	Molybdenum	0.005	0.06	µg/L	F201062	FGS-054	U
F201062-BLK1	Silver	0.0002	0.020	µg/L	F201062	FGS-054	U
F201062-BLK1	Cadmium	-0.00002	0.020	µg/L	F201062	FGS-054	U
F201062-BLK1	Antimony	-0.0003	0.020	µg/L	F201062	FGS-054	U
F201062-BLK1	Barium	-0.04	0.20	µg/L	F201062	FGS-054	U
F201062-BLK1	Thallium	0.007	0.005	µg/L	F201062	FGS-054	QB-10
F201062-BLK1	Lead	0.003	0.040	µg/L	F201062	FGS-054	U

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PREPARATION BLANKS

Instrument: ICPMS-6

Sequence: 2A10015

Preparation: Closed Vessel Nitric Oven Digestion

Lab Sample ID	Analyte	Found	MRL	Units	Batch	Method	Notes
F201077-BLK1	Calcium	0.2	40	µg/L	F201077	FGS-054	U

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A handwritten signature in cursive script that reads "Liz Siska".

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Notes and Definitions

- U Analyte included in the analysis, but not detected
- QM-02 The MS and/or MSD recoveries outside acceptance limits, due to spike concentration less than 1 times the sample concentration. The batch was accepted based on LCS and LCSD recoveries within control limits and, when analysis permits, acceptable AS/ASD.
- QB-10 The method blank and/or initial/continuing calibration blank contains analyte at a concentration above the MRL. Only report sample results greater than 10 times the contamination value (QB-01), or samples less than the MRL (QB-02).
- QB-06 The blank was preserved to 5% BrCl rather than 1%. The control limit for blanks preserved to greater than 1% BrCl is the preservation percentage multiplied by the MRL.
- QB-04 The blank was preserved to 2% BrCl rather than 1%. The control limit for blanks preserved to greater than 1% BrCl is the preservation percentage multiplied by the MRL.
- QB-01 The method blank and/or initial/continuing calibration blank contains analyte at a concentration above the MRL. However, the blank concentration(s) are less than 10% of the sample result.
- FB-1631 Required equipment/field/filter blank not submitted by the client. The sample has been analyzed according to 1631E, but does not meet 1631E criteria
- AS This MS and/or MSD is an analytical spike and/or an analytical spike duplicate.
- DET Analyte Detected
- MDL Minimum Detection Limit
- MRL Minimum Reporting Limit
- ND Analyte Not Detected at or above the reporting limit
- wet Sample results reported on a wet weight basis
- dry Sample results reported on a dry weight basis
- RPD Relative Percent Difference
- RSD Relative Standard Deviation

