

Quality Assurance

10

CHAPTER

Brookhaven National Laboratory uses the onsite Analytical Services Laboratory (ASL) and three offsite contractor laboratories to analyze environmental samples. The oversight of laboratory analyses involves proficiency testing, auditing and ensuring adherence to a Quality Assurance Program (QAP). All analytical laboratories used are certified by New York State. ASL performs approximately 10,000 radiological and 2,000 nonradiological (chemical) analyses per year and provides supervision for the contracts with other laboratories. Quality Control is maintained through daily instrument calibration, efficiency and background checks, and testing for precision and accuracy.

All laboratories performing radiological analyses scored between 90 and 95 percent satisfactory results on state and federal proficiency evaluation tests, including ASL. On nonradiological proficiency evaluation tests, ASL had an instrument failure that caused its rating of 76 percent to fall well behind the contractors' 97-100 percent. The instrument has been replaced. Overall, analytical data reported in the 1998 BNL Site Environmental Report are of high quality.

Review of the quality assurance measures at Brookhaven National Laboratory (BNL) presented here confirm that the analytical data reported in the 1998 Site Environmental Report are reliable. Quality is an integral part of every function at BNL. A program is in place to ensure that all environmental monitoring data meet appropriate Quality Assurance (QA) requirements. Environmental samples at BNL are analyzed by an onsite laboratory (the Analytical Services Lab [ASL]). BNL also procures and maintains contracts with offsite laboratories: General Engineering Lab (GEL), (for radiological analytes), H2M Lab, (for nonradiological analytes), and Chemtex Lab, (for select nonradiological analytes). All analytical laboratories are New York State certified and subject to audits. The process of selecting laboratories involves an evaluation of past Proficiency Evaluation (PE) testing results, pre-selection bidding, post selection auditing and adherence to its own Quality Assurance Program (QAP).

The ASL performs approximately 10,000 radiological and 2,000 nonradiological (chemical) analyses per year. Routine Quality Control (QC) procedures followed by the ASL include daily instrument calibrations, efficiency and background checks, and standard tests for precision and accuracy. As in prior years, the ASL and the three contractor laboratories participated in several national and state PE testing programs. Results of those PE tests provide information on the quality of a laboratory's results and allow comparisons to be made between laboratories.

Figures 10-1 and 10-2 summarize the overall 1998 scores of the ASL and the three contractor laboratories that participated in either the Department of Energy (DOE) QAP for radiological analytes, the EPA's National Environmental Radiation Laboratory (NERL) and Environmental Monitoring Systems Laboratory (EMSL) programs (for radiological and nonradiological analytes, respectively) or the New York State Department of Health (NYS DOH) Environmental Laboratory Approval Program (ELAP). All PE testing results reported by each participating analytical laboratory during 1998 are summarized in Figures 10-1 and 10-2 and presented in detail in Tables 10-2 through 10-15. The bar graphs show both radiological and nonradiological results (as percentage scores) that were accept-

able, within warning limits, and unacceptable for each analytical laboratory, and by PE testing program. A 'warning' is considered satisfactory, being within two and three standard deviations of the target value; an 'unacceptable' result is greater than three standard deviations of the target value.

Overall, BNL's radiological scores were comparable to those of the radiological contractor laboratory (GEL), with a 90 to 95 percent rate of satisfactory results. With the exception of the NYS DOH ELAP organic results, BNL's nonradiological scores were comparable to those of the nonradiological contractor laboratory (H2M), with a 97 to 100 percent rate of acceptable results. The 76 percent overall score in the ELAP for organics test was attributable to an instrument malfunction that occurred in one of four testing rounds during the year. Overall, proficiency testing results for BNL showed an improvement over 1997.

10.1 THE BNL QUALITY ASSURANCE PROGRAM

Responsibility for quality at BNL starts with the Laboratory Director and extends down through the entire organization. The BNL Quality Management (QM) Program coordinates and evaluates QA implementation at the Laboratory, and provides professional assistance to the Departments and Divisions. The objectives of BNL's Environmental Monitoring QA Program are to ensure proper planning, organization, direction, control, and support in order to achieve the objectives of the environmental program. Overall performance is reviewed and evaluated using a rigorous assessment process described in the following Sections of this Chapter. This QA program was developed to ensure compliance with requirements established by the DOE in Orders 5700.6C (QA), and 5400.1 (General Environmental Protection Program).

10.2 SCOPE OF THE PROGRAM

BNL has adopted or adapted program elements specified in DOE Order 5700.6C as well as the additional environmental QA requirements of DOE Order 5400.1 into sampling, analysis, and data handling activities. QA practices and procedures are documented in manuals and Standard Operating Procedures (SOP)(e.g., sample collection,

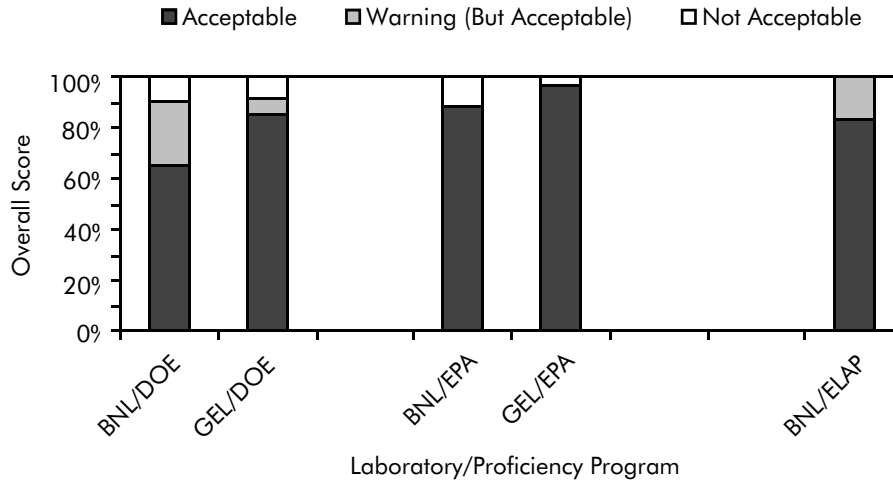


Figure 10-1. Summary of Proficiency Evaluation Scores in U.S. DOE, U.S. EPA and NYS DOH ELAP Radiological Programs

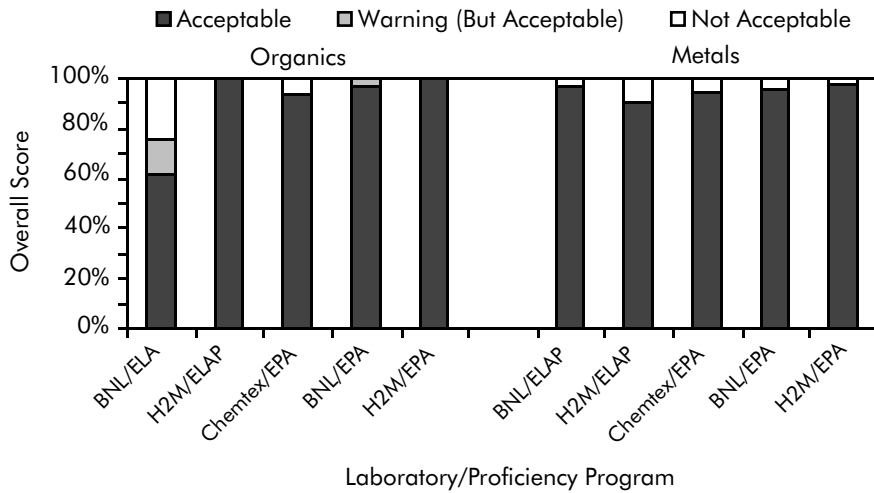


Figure 10-2. Summary of Proficiency Evaluation Scores in U.S. EPA and NYS DOH ELAP Non-Radiological Programs

radiation measurements, chain-of-custody and analytical chemistry).

BNL ensures that environmental media are sampled and analyzed in a way that provides representative, defensible data. The QA program supports this activity by incorporating QA elements, such as field sampling designs, documented procedures, chain of custody, a calibration/standardization program, acceptance criteria, statistical data analyses, software QA, and data processing systems, in the environmental surveillance and effluent monitoring programs. The offsite contractor laboratories that perform radiological and chemical analyses for BNL are also

required to incorporate QA elements into their operation.

In addition, BNL has established a program of internal and external audits to verify the effectiveness of the environmental sampling, analysis, and database activities. Contractor laboratories are subject to audits by BNL personnel. The BNL QM Office, DOE Brookhaven Group, DOE Chicago Operations, regulatory agencies, and other independent groups periodically audit the environmental programs.

For in-house analyses, SOPs are established to calibrate instruments, analyze samples, and check quality control. Quality control checks

are performed and include: analysis of blanks or background concentrations, use of Amersham or National Institute for Standards and Technology (NIST) traceable standards, and analysis of reference standards, spiked samples, and duplicate samples. The Laboratory supervisor and/or QA Officer reviews all analytical and quality control results before the data are reported and incorporated into the database.

10.3 QUALITY ASSURANCE PROGRAM FOR CERCLA GROUNDWATER MONITORING ACTIVITIES

This section briefly describes the QA requirements for activities that were conducted as part of the 1998 Environmental Restoration groundwater monitoring program. By regulation, offsite contractor laboratories perform the radiological and chemical analyses for Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The Environmental Restoration Calendar Year 1998 Site-wide Groundwater Monitoring Program Quality Assurance Project Plan describes the QA program and the QC requirements followed. The plan defines the project organization structure, documentation requirements, sample custody requirements, acceptance criteria, auditing functions, corrective action provisions, and guidance on the collection of QA/QC samples.

10.4 ANALYSES PERFORMED OFFSITE

Samples collected for regulatory compliance purposes are analyzed by offsite contractor laboratories. Contractors also augment the capabilities of the ASL. For example, strontium-90 and Toxicity Characteristic Leachate Procedure (TCLP) samples are sent offsite, when demand on the ASL exceeds its capacity.

10.4.1 THE CONTRACT PROCESS

During 1998, BNL had three contracts with offsite laboratories. The contracts specify the analytes, methods, required detection limits, and deliverables (which include standard batch QA/QC performance checks). Successful bidders must also provide BNL with a copy of their QA/QC Manual.

In December 1996, a contract was established with H2M Laboratories, Inc. (Melville, NY) with an option for second and third year renewal. A second nonradiological contract

was established in 1997 with Chemtex Lab (Port Arthur, TX) in order to provide special analytical services required to meet BNL discharge permit requirements. These samples are wastewater samples collected from various recharge basins and one cooling tower.

In January 1997, a contract was established with General Engineering Environmental Physics Laboratory, Inc. (Charleston, SC) with an option for a second and third year renewal. Samples sent offsite for radiological analyses were those requiring either EPA methods or DOE Standard Methods that the ASL did not perform. Examples are Sr-90 and actinide analyses in soil, vegetation and water.

The commercial laboratories are audited periodically by the ASL manager (or his designee) and QA Officer to verify competence in analytical methodology and implementation of a comprehensive QA program. H2M Laboratory was audited by the ASL in the summer of 1996, and both GEL and Chemtex were audited in the Fall of 1997.

10.4.2 QA/QC VALIDATION PERFORMED AT BNL

External: Data packages for onsite samples sent to a contractor laboratory are reviewed at BNL by subject matter experts in either radiological analyses or analytical chemistry to ensure they comply with the contract specifications before the data are reported. In addition, data packages are examined to determine if samples exceeded holding times, if there are poor recoveries, if the proper method was used and if field blanks are less than the method Minimum Detection Limit (MDL). Nonradiological data analyzed offsite were verified and validated using EPA Contract Laboratory Protocol guidelines (EPA 1990, 1996). Radiological packages were verified and validated using both BNL and EPA guidance documents (BNL, 1997 and DOE EM-73, 1994).

Internal: In July of 1998, the ASL initiated plans to acquire a full-time, dedicated QA Officer whose function is to verify that all analytical batches fulfill internal QA/QC acceptance criteria. These criteria include: (a) precision, (b) accuracy (c) recovery, (d) instrument background checks, and (e) stable instrument efficiency performance. All QA/QC data were reviewed before the results were reported. The QA Officer and technical staff maintained the detailed QA/QC trend-charts included in this chapter.

10.4.3 PROFICIENCY TESTING RESULTS OF OFFSITE LABS

Nonradiological: In 1998, the contract laboratory responsible for analyzing the BNL State Pollution Discharge Elimination Systems (SPDES) samples was H2M Laboratory, which was required to participate in the SPDES performance evaluation study. These results

are presented in Table 10-1. The results showed 100 percent acceptance for the thirty-three analytes listed. Acceptance is based on analytic-specific limits placed on the ratio of known to test values by the PE Program.

This same contractor participated in the EMSL-CI Water Pollution (WP) performance evaluation study (WP39 and WP040) in May

**Table 10-1. H2M Performance Evaluation Study
BNL State Pollution Discharge Elimination System (SPDES) - DMR QA 18**

Analyte	Units	Date	USEPA	H2M	Ratio (a)	Comments (b)
Cu	µg/L	Dec-98	700.00	714.00	1.02	
Fe	µg/L	Dec-98	834.00	804.00	0.96	
Pb	µg/L	Dec-98	70.60	71.40	1.01	
Ni	µg/L	Dec-98	2501.00	2590.00	1.04	
Zn	µg/L	Dec-98	631.00	671.00	1.06	
Cr	µg/L	Dec-98	650.00	663.00	1.02	
Mn	µg/L	Dec-98	240.00	237.00	0.99	
Cd	µg/L	Dec-98	170.00	169.00	0.99	
Al	µg/L	Dec-98	3105.00	2885.00	0.93	
As	µg/L	Dec-98	160.00	162.00	1.01	
Co	µg/L	Dec-98	503.00	505.00	1.00	
Hg	µg/L	Dec-98	1.15	1.08	0.94	
Se	µg/L	Dec-98	260.00	247.00	0.95	
V	µg/L	Dec-98	4202.00	4310.00	1.03	
pH		Dec-98	8.60	8.46	0.98	
Oil and Grease	mg/L	Dec-98	19.10	18.50	0.97	
Ammonia - N	mg/L	Dec-98	4.80	4.54	0.95	
NO3 - N	mg/L	Dec-98	12.00	11.90	0.99	
Orthophosphate	mg/L	Dec-98	0.58	0.58	1.00	
Kjeldahl - N	mg/L	Dec-98	5.40	5.01	0.93	
Non-filterable residue	mg/L	Dec-98	64.00	39.00	0.61	
COD	mg/L	Dec-98	60.70	63.30	1.04	
TOC	mg/L	Dec-98	24.00	26.30	1.10	
5 Day BOD	mg/L	Dec-98	37.60	40.00	1.06	
Total Cyanide	mg/L	Dec-98	0.14	0.13	0.96	
Total Phenolics	mg/L	Dec-98	0.07	0.05	0.69	
Total Phosphorus	mg/L	Dec-98	4.00	3.98	1.00	
Fathead Minnow Chronic Data -						
Survival, NOEC	%	Dec-98	25.00	12.50	0.50	
Growth, IC25	%	Dec-98	39.60	21.70	0.55	
Growth, NOEC	%	Dec-98	25.00	12.50	0.50	
<i>Ceriodaphnia</i> Chronic Data						
Survival, NOEC	%	Dec-98	25.00	12.50	0.50	
Growth, IC25	%	Dec-98	17.60	8.97	0.51	
Growth, NOEC	%	Dec-98	12.50	6.25	0.50	

Notes:

- The ratio is the reported Lab result divided by the target value result.
- Comment column provides evaluation of analytical performance which is based on 95 and 99% prediction interval calculated from samples analyzed by EPA and State laboratories. No comment indicates performance within acceptable limits.

**Table 10-2. H2M Water Pollution Performance Evaluation Studies WP39/40
USEPA Environmental Monitoring Systems Laboratory - Cincinnati**

Analyte	Units	Date	EMSL-CI	H2M	Ratio (a)	Comments (b)
Cu	µg/l	May-98	74.30	76.40	1.03	
		Nov-98	700.00	714.00	1.02	
Fe	µg/l	May-98	191.00	177.00	0.93	
		Nov-98	834.00	804.00	0.96	
Pb	µg/l	May-98	1900.00	1860.00	0.98	
		Nov-98	70.60	71.40	1.01	
Ni	µg/l	May-98	702.00	729.00	1.04	
		Nov-98	2501.00	2590.00	1.04	
Zn	µg/l	May-98	131.00	136.00	1.04	
		Nov-98	631.00	671.00	1.06	
pH		May-98	5.03	5.05	1.00	
		Nov-98	8.60	8.77	1.02	
TDS at 180 C	mg/l	May-98	156.00	145.00	0.93	
		Nov-98	274.00	336.00	1.23	
Oil and Grease	mg/l	May-98	44.00	16.10	0.37	Not Acceptable
		Nov-98	19.10	18.50	0.97	
Ammonia - N	mg/l	May-98	0.84	0.83	0.99	
		Nov-98	4.80	4.54	0.95	
NO3 - N	mg/l	May-98	1.10	1.14	1.04	
		Nov-98	12.00	11.90	0.99	
Kjeldahl - N	mg/l	May-98	0.36	0.37	1.03	
		Nov-98	5.40	5.01	0.93	
5 Day BOD	mg/l	May-98	119.00	118.00	0.99	
		Nov-98	37.60	40.00	1.06	
Total Phenolics	mg/l	May-98	0.80	0.73	0.91	
		Nov-98	0.07	0.05	0.69	
Total Residual Chlorine	mg/l	May-98	0.28	0.31	1.12	
		Nov-98	0.93	1.06	1.14	

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
b. Comment column provides evaluation of analytical performance which is based on 95 and 99% prediction interval calculated from samples analyzed by EPA and State laboratories.
No comment indicates performance within acceptable limits.

and November of 1998. For the 28 routine analyses shown in Table 10-2, 27 results were acceptable corresponding to an overall score of 96 percent. Results for oil and grease were unacceptable. In actuality, H2M reported results for 75 chemical analytes (two results per analyte) during both WP39 and 40. The acceptable scores for H2M were 97 and 100 percent, respectively, for the 150 results they reported to the EPA (data not shown).

Table 10-3 shows H2M's performance in the EPA Water Supply (WS) Evaluation conducted in March and September 1998. For the 59 routine analyses shown in Table 10-3, 56 were acceptable and three unacceptable. The overall scores for the data shown in Table 10-3 were 95

percent acceptable and five percent unacceptable. H2M actually reported results for 98 chemical analytes (two results per analyte) in both WS testing rounds, scoring 90 percent acceptable and ten percent unacceptable (data not shown).

Table 10-4 shows H2M's performance in the NYS DOH ELAP WS Chemistry Program for July and October 1998. H2M scored 100 percent for the 16 organic results shown. H2M also participated in the NYS DOH ELAP WS Program for metals. The results in Table 10-5 show 100 percent acceptable results.

Table 10-6 shows the 1998 Chemtex results for select chemical analytes in the EPA WS and WP Programs. The overall acceptable

**Table 10-3. H2M Water Supply Performance Evaluation Studies - WS040/041
USEPA Environmental Monitoring Systems Laboratory - Cincinnati**

Analyte	Units	Date	EMSL-CI	H2M	Ratio (a)	Comments (b)
As	µg/l	Mar-98	102.00	104.00	1.02	
	µg/l	Sep-98	65.60	63.00	0.96	
Ba	µg/l	Mar-98	2700.00	2730.00	1.01	
	µg/l	Mar-98	1150.00	1290.00	1.12	
B	µg/l	Sep-98	790.00	848.00	1.07	
	µg/l	Mar-98	6.60	6.90	1.05	
Be	µg/l	Mar-98	6.60	6.90	1.05	
	µg/l	Sep-98	2.58	2.70	1.05	
Cd	µg/l	Mar-98	6.31	6.80	1.08	
	µg/l	Sep-98	18.20	18.30	1.01	
Cr	µg/l	Mar-98	90.90	86.40	0.95	
	µg/l	Sep-98	55.50	54.00	0.97	
Cu	µg/l	Mar-98	1700.00	1700.00	1.00	
	µg/l	Sep-98	702.00	705.00	1.00	
Hg	µg/l	Mar-98	1.50	1.43	0.95	
	µg/l	Sep-98	5.82	5.53	0.95	
Mn	µg/l	Mar-98	32.00	31.60	0.99	
	µg/l	Sep-98	183.00	181.00	0.99	
Mo	µg/l	Mar-98	35.00	37.30	1.07	
	µg/l	Sep-98	76.70	79.30	1.03	
Na	mg/l	Mar-98	15.80	16.10	1.02	
	mg/l	Sep-98	23.30	22.90	0.98	
Ni	µg/l	Mar-98	25.00	21.10	0.84	Not Acceptable
	µg/l	Sep-98	352.00	355.00	1.01	
Pb	µg/l	Mar-98	71.00	68.00	0.96	
Sb	µg/l	Mar-98	13.00	12.60	0.97	
	µg/l	Sep-98	31.40	32.30	1.03	
Se	µg/l	Mar-98	74.00	78.00	1.05	
	µg/l	Sep-98	46.30	48.20	1.04	
Tl	µg/l	Mar-98	10.00	9.20	0.92	
Zn	µg/l	Mar-98	1700.00	1700.00	1.00	
	µg/l	Sep-98	402.00	420.00	1.04	
NO3 - N	mg/l	Mar-98	7.10	7.71	1.09	
	mg/l	Sep-98	15.00	14.70	0.98	
NO2 - N	mg/l	Mar-98	1.30	1.36	1.05	
	mg/l	Sep-98	1.70	1.72	1.01	
SO4	mg/l	Mar-98	225.00	205.00	0.91	
	mg/l	Sep-98	49.00	50.00	1.02	
Fluoride	mg/l	Mar-98	1.29	1.26	0.98	
	mg/l	Sep-98	6.20	5.60	0.90	
OrthoP	mg/l	Mar-98	0.82	1.00	1.21	Not Acceptable
	mg/l	Sep-98	1.30	1.38	1.06	
Turbidity	ntu	Mar-98	7.8	7.50	0.96	Not Acceptable
	ntu	Sep-98	2.6	3.90	1.50	
Chloroform	µg/l	Mar-98	27.40	28.50	1.04	
	µg/l	Sep-98	14.40	16.70	1.16	
1,2-trans-DCE	µg/l	Mar-98	26.80	26.70	1.00	
1,1-DCE	µg/l	Sep-98	5.25	4.90	0.93	
1,1,2-TCA	µg/l	Mar-98	17.20	16.20	0.94	
TCA	µg/l	Sep-98	12.60	12.20	0.97	
TCE	µg/l	Sep-98	6.87	6.65	0.97	
Benzene	µg/l	Mar-98	16.70	17.20	1.03	
	µg/l	Sep-98	18.70	17.60	0.94	
PCE	µg/l	Sep-98	11.50	11.40	0.99	
Toluene	µg/l	Mar-98	14.60	14.80	1.01	
	µg/l	Sep-98	18.70	19.20	1.03	
Ethylbenzene	µg/l	Mar-98	17.80	16.80	0.94	
	µg/l	Sep-98	14.70	14.40	0.98	
Total Xylenes	µg/l	Mar-98	30.30	34.20	1.13	
	µg/l	Sep-98	30.80	31.60	1.03	

Notes:

a. The ratio is the reported Lab result divided by the target value result.

b. Comment column provides EMSL-CI evaluation of analytical performance which is based on 40CFR141 analyte-specific acceptance limits.

No comment indicates performance within acceptable limits.

**Table 10-4. H2M Non-Potable Water Chemistry Proficiency Test #193,198 Results
Environmental Laboratory Approval Program**

Analyte	Date	ELAP (µg/L)	H2M (µg/L)	Ratio (a)	Comment (b)
1,1-Dichloroethane	Jul-98	15.70	15.20	0.97	
	Oct-98	blank	<0.5	1.00	
Tetrachloroethene	Jul-98	24.60	26.10	1.06	
	Oct-98	10.00	9.93	0.99	
1,1,2-Trichloroethane	Jul-98	19.20	18.40	0.96	
	Oct-98	blank	<0.5	1.00	
Trichloroethene	Jul-98	22.10	22.70	1.03	
	Oct-98	9.06	9.75	1.08	
Benzene	Jul-98	37.10	37.10	1.00	
	Oct-98	6.34	6.83	1.08	
Ethyl benzene	Jul-98	25.60	28.20	1.10	
	Oct-98	9.49	10.80	1.14	
Toluene	Jul-98	18.50	20.20	1.09	
	Oct-98	blank	<0.5	1.00	
Total Xylenes	Jul-98	27.20	31.10	1.14	
	Oct-98	blank	<0.5	1.00	

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
 b. Comment column provides ELAP evaluation of analytical performance which is based on 95 and 99% confidence interval about the target value.
 No comment indicates performance within acceptable limits.

scores for Chemtex, in both the EPA WS41 (20 analyses reported) and WP40 (18 analyses reported) were 90 and 94 percent, respectively.

Radiological: On occasion, the ASL sent samples to GEL, an offsite contractor laboratory, for radiological analyses. GEL's performance in the DOE's EML Quality Assessment Program and EPA NERL Program are presented in Tables 10-7 and 10-8, respectively.

Overall, GEL performance in the DOE EML intercomparison study was acceptable or within warning limits in 94 percent of the analyses performed on the four matrices (air, vegetation, water and soil) shown in Table 10-7. Eighty of 93 analyses (86 percent) were within EML's acceptance limit; six of 93 (seven percent) were within upper and lower warning limits, demonstrating satisfactory agreement; seven analyses (eight percent) fell outside the acceptance limits. Most of the warning and non-acceptable results were for the air-filter

matrix. It should be noted that the EML test filter is not the same geometry used by GEL (or BNL) to calibrate their gamma spectrometers, which would account for a positive bias.

Overall, GEL performance in the EPA NERL intercomparison study was acceptable or within warning limits in 97 percent of the radiological analyses performed in a water matrix shown Table 10-8. Thirty-six of 37 analyses were within EPA's acceptance limits, showing excellent agreement with the known value; one analysis (Ra-228) fell outside the acceptance limits.

10.5 ANALYSES PERFORMED IN-HOUSE

ASL performs radiological and nonradiological analyses in support of both environmental monitoring and facility operations. The ASL is certified by the NYS DOH for tritium, gross alpha/beta and gamma in potable and non-potable waters. It is also NYS

**Table10-5. H2M Potable Water Chemistry Proficiency Tests #187, #197 Results
Environmental Laboratory Approval Program**

Analyte	Date	ELAP (µg/L)	H2M (µg/L)	Ratio (a)	Comment (b)
Cadmium	Apr-98	5.00	4.70	0.94	
	Apr-98	12.50	12.90	1.03	
	Oct-98	16.70	17.50	1.05	
Chloride	Apr-98	22.70	23.60	1.04	
	Apr-98	142.00	138.00	0.97	
	Oct-98	129.00	135.00	1.05	
Chromium	Apr-98	37.50	37.60	1.00	
	Apr-98	62.50	61.30	0.98	
	Oct-98	100.00	103.00	1.03	
Copper	Apr-98	50.00	52.70	1.05	
	Apr-98	75.00	78.00	1.04	
	Oct-98	1330.00	1340.00	1.01	
Iron	Apr-98	88.10	87.50	0.99	
	Apr-98	112.00	111.00	0.99	
	Oct-98	299.00	299.00	1.00	
Lead	Apr-98	25.00	21.80	0.87	
	Apr-98	50.00	45.30	0.91	
	Oct-98	83.30	78.80	0.95	
Manganese	Apr-98	61.80	63.30	1.02	
	Apr-98	92.10	93.30	1.01	
	Oct-98	334.00	340.00	1.02	
Mercury	Apr-98	1.10	1.10	1.00	
	Apr-98	4.69	3.70	0.79	
	Oct-98	6.00	4.20	0.70	
Nitrate (as N)	Apr-98	1.11	1.09	0.98	
	Apr-98	7.10	6.93	0.98	
	Oct-98	12.00	11.30	0.94	
Silver	Apr-98	18.70	18.70	1.00	
	Apr-98	49.20	50.50	1.03	
	Oct-98	25.20	25.10	1.00	
Sodium	Apr-98	29.90	27.10	0.91	
	Apr-98	49.70	46.90	0.94	
	Oct-98	13.70	12.80	0.93	
Sulfate (as SO4)	Apr-98	52.00	57.00	1.10	marginal
	Apr-98	203.00	216.00	1.06	
	Oct-98	99.40	117.00	1.18	
Zinc	Apr-98	63.30	63.60	1.00	
	Apr-98	100.00	103.00	1.03	
	Oct-98	1670.00	1720.00	1.03	

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
b. Comment column provides ELAP evaluation of analytical performance which is based on 95 and 99% confidence interval about the target value. No comment indicates performance within acceptable limits.

**Table 10-6. ChemTex Water Supply and Water Pollution Performance Evaluation Studies-
WS041, WPO40
USEPA Environmental Monitoring Systems Laboratory - Cincinnati**

WS-041 Study Analyte	Units	Date	EMSL-CI	ChemTex	Ratio (a)	Comments (b)
Cd	µg/l	Sep-98	65.60	67.00	1.02	
Cr	µg/l	Sep-98	18.20	19.80	1.09	
Cu	µg/l	Sep-98	702.00	713.00	1.02	
Hg	µg/l	Sep-98	5.82	3.45	0.59	Not Acceptable
Be	µg/l	Sep-98	31.40	29.50	0.94	
Mn	µg/l	Sep-98	183.00	156.00	0.85	
Sb	µg/l	Sep-98	702.00	713.00	1.02	
Zn	µg/l	Sep-98	402.00	400.00	1.00	
Cl	mg/l	Sep-98	1.90	1.78	0.94	
SO4	mg/l	Sep-98	42.00	49.00	1.17	Not Acceptable
Turbidity		Sep-98	2.60	2.00	0.77	
Chloroform	µg/l	Sep-9	14.40	13.43	0.93	
DCE	µg/l	Sep-98	18.50	15.27	0.83	
TCA	µg/l	Sep-98	12.60	12.10	0.96	
TCE	µg/l	Sep-98	6.87	5.65	0.82	
Benzene	µg/l	Sep-98	18.70	15.45	0.83	
PCE	µg/l	Sep-98	11.50	9.80	0.85	
Toluene	µg/l	Sep-98	18.70	17.20	0.92	
Ethylbenzene	µg/l	Sep-98	14.70	12.50	0.85	
Total Xylenes	µg/l	Sep-98	30.80	24.68	0.80	
WP-040 Study						
Chloroform	µg/l	Nov-98	18.40	18.41	1.00	
1,1,1 Trichloroethane	µg/l	Nov-98	32.80	29.90	0.91	
Trichloroethene	µg/l	Nov-98	23.40	19.53	0.83	
Tetrachloroethene	µg/l	Nov-98	32.50	28.13	0.87	
Benzene	µg/l	Nov-98	25.70	30.43	1.18	
Ethylbenzene	µg/l	Nov-98	42.60	37.54	0.88	
Toluene	µg/l	Nov-98	32.30	34.05	1.05	
1,2-Dichlorobenzene	µg/l	Nov-98	36.30	32.15	0.89	
1,3-Dichlorobenzene	µg/l	Nov-98	33.70	38.50	1.14	
1,4-Dichlorobenzene	µg/l	Nov-98	41.60	30.23	0.73	Not Acceptable
1,2-Dichloroethane	µg/l	Nov-98	14.60	14.20	0.97	
Bromodichloromethane	µg/l	Nov-98	16.50	16.07	0.97	
Dibromochloromethane	µg/l	Nov-98	32.70	29.56	0.90	
Chlorobenzene	µg/l	Nov-98	24.70	24.50	0.99	
Bromoform	µg/l	Nov-98	14.70	14.73	1.00	
Carbon Tetrachloride	µg/l	Nov-98	26.30	23.51	0.89	
TDS	mg/l	Nov-98	274.00	299.50	1.09	
Total Residual Cl	mg/l	Nov-98	0.93	1.08	1.16	

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
b. Comment column provides EMSL-CI evaluation of analytical performance which is based on 40CFR141 analyte-specific acceptance limits.
No comment indicates performance within acceptable limits.

**Table 10-7. GEL Quality Assessment Program #48, #49 Results
Environmental Measurements Laboratory**

Matrix	Units	Isotope	Date	EML	GEL	Ratio	Comments
Air Filter	Bq/Filter	Alpha	Mar-98	1.40	1.38	0.98	
			Sep-98	1.65	1.63	0.99	
		Beta	Mar-98	1.96	1.94	0.99	
			Sep-98	2.16	1.78	0.82	Warning
		Ce-144	Mar-98	8.21	7.51	0.91	
		Co-57	Mar-98	11.11	10.67	0.96	
		Co-60	Mar-98	9.09	9.01	0.99	
			Sep-98	9.16	9.18	1.00	
		Cs-134	Mar-98	19.74	18.27	0.93	
		Cs-137	Mar-98	11.86	11.58	0.98	
			Sep-98	22.47	22.58	1.00	
		Mn-54	Mar-98	5.44	5.40	0.99	
			Sep-98	4.92	5.30	1.08	
		Sr-90	Mar-98	1.76	1.03	0.58	Not Acceptable
			Sep-98	1.12	1.18	1.06	
		Sb-125	Mar-98	12.16	13.22	1.09	
			Sep-98	8.89	2.72	0.31	Not Acceptable
		U-234	Mar-98	0.03	0.03	1.10	
			Sep-98	0.26	0.24	0.93	
		U-238	Mar-98	0.03	0.04	1.17	
			Sep-98	0.26	0.25	0.95	
		µg U	Mar-98	2.47	2.93	1.19	
			Sep-98	20.96	16.94	0.81	Warning
		Pu-238	Mar-98	0.07	0.07	0.96	
			Sep-98	0.46	0.51	1.11	
		Pu-239	Mar-98	0.06	0.07	1.15	
Sep-98	0.42		0.46	1.10			
Am-241	Mar-98	0.07	0.13	1.94	Not Acceptable		
	Sep-98	0.51	0.55	1.08			
Vegetation	Bq/kg	Co-60	Mar-98	10.58	11.14	1.05	
			Sep-98	20.00	19.35	0.97	
		Cs-137	Mar-98	181.50	189.40	1.04	
			Sep-98	390.00	377.96	0.97	
		K-40	Mar-98	707.50	812.52	1.15	
			Sep-98	460.00	468.42	1.02	
		Sr-90	Mar-98	359.01	339.96	0.95	
			Sep-98	606.00	588.24	0.97	
		Pu-239	Mar-98	1.77	2.28	1.29	Warning
			Sep-98	3.72	5.03	1.35	Warning
		Am-241	Mar-98	1.11	1.43	1.30	
			Sep-98	2.33	2.69	1.15	
Cm-244	Mar-98	2.17	2.66	1.23			
Water	Bq/L	Alpha	Mar-98	1421.00	1650.86	1.16	Warning
			Sep-98	1080.00	1124.80	1.04	
		Beta	Mar-98	2200.00	2156.40	0.98	
			Sep-98	1420.00	1228.40	0.87	
		Co-60	Mar-98	13.60	14.73	1.08	
			Sep-98	49.40	53.50	1.08	
		Cs-137	Mar-98	46.00	51.60	1.12	
			Sep-98	50.00	52.56	1.05	
		H3	Mar-98	218.30	212.04	0.97	
			Sep-98	76.20	91.87	1.21	
		Mn-54	Mar-98	57.00	63.23	1.11	
			Sep-98	32.40	36.42	1.12	
		Sr-90	Mar-98	4.36	4.52	1.04	
			Sep-98	2.11	0.20	0.10	Not acceptable

**Table 10-7. GEL Quality Assessment Program #48, #49 Results
Environmental Measurements Laboratory (cont'd.)**

Matrix	Units	Isotope	Date	EML	GEL	Ratio	Comments		
Soil	Bq/kg	Fe-55	Mar-98	202.80	260.37	1.28			
			Sep-98	139.00	116.97	0.84			
		U-234	Mar-98	0.40	0.39	0.97			
			Sep-98	0.51	0.54	1.06			
		U-238	Mar-98	0.40	0.39	0.99			
			Sep-98	0.52	0.52	1.00			
		µg U	Mar-98	0.03	0.04	1.09			
			Sep-98	0.04	0.04	1.03			
		Pu-238	Mar-98	2.53	2.32	0.92			
			Sep-98	1.10	1.14	1.03			
		Pu-239	Mar-98	1.65	1.60	0.97			
			Sep-98	1.41	1.46	1.04			
		Am-241	Mar-98	1.23	1.36	1.11			
			Sep-98	1.25	1.23	0.98			
		N-163	Sep-98	95.70	55.45	0.58	Not acceptable		
		Soil	Bq/kg	Ac-228	Sep-98	52.60	53.60	1.02	
					Bi-212	Sep-98	58.30	31.76	0.54
				Cs-137	Mar-98	329.50	353.18	1.07	
					Sep-98	954.00	980.69	1.03	
				K-40	Mar-98	313.50	354.09	1.13	
Sep-98	314.00				350.32	1.12			
Pb-212	Sep-98			52.80	56.53	1.07			
Pb-214	Sep-98			29.10	32.56	1.12			
Sr-90	Mar-98			13.09	11.29	0.86			
	Sep-98			39.63	32.93	0.83	Warning		
U-234	Mar-98			31.13	27.00	0.87			
	Sep-98			113.00	103.05	0.91			
U-238	Mar-98			31.90	27.52	0.86			
	Sep-98			120.00	117.29	0.98			
µg U	Mar-98	2.58	0.95	0.37	Not acceptable				
Pu-239	Mar-98	5.31	5.42	1.02					
	Sep-98	13.09	12.17	0.93					
Am-241	Sep-98	7.47	6.96	0.93					
Ra-226	Sep-98	29.00	29.98	1.03					
Th-228	Sep-98	52.70	53.60	1.02					
Th-234	Sep-98	114.00	109.28	0.96					

Notes:

- The ratio is the reported Lab result divided by the target value result.
- Comment column provides EML evaluation of analytical performance which is based on control limits established from percentiles of historic data distributions. No comment indicates performance within acceptable limits.

**Table 10-8. GEL Quality Assessment Program Results
National Exposure Research Laboratory (NERL-LV)**

Matrix	Units	Isotope	Date	NERL	GEL	Ratio (a)	Comments (b)
Water	pCi/L	Alpha	Jan-98	30.50	19.30	0.63	
			Apr-98	54.40	58.07	1.07	
			Jul-98	7.20	6.17	0.86	
		Beta	Jan-98	3.90	6.70	1.72	
			Apr-98	94.70	83.80	0.88	
			Oct-98	94.00	87.97	0.94	
		H3	Mar-98	2155.00	2041.67	0.95	
			Aug-98	17996.00	16460.00	0.91	
		Sr-90	Jan-98	32.00	28.33	0.89	
			Apr-98	18.00	14.33	0.80	
			Jul-98	7.00	5.33	0.76	
		Co-60	Oct-98	8.00	5.33	0.67	
			Jun-98	12.00	14.00	1.17	
			Apr-98	50.00	49.67	0.99	
		Cs-134	Oct-98	21.00	23.67	1.13	
			Apr-98	22.00	20.33	0.92	
			Jun-98	31.00	26.67	0.86	
		Cs-137	Oct-98	6.00	6.33	1.06	
			Apr-98	10.00	13.00	1.30	
			Jun-98	35.00	35.67	1.02	
		Zn-65	Oct-98	50.00	50.00	1.00	
			Jun-98	104.00	115.00	1.11	
			Sr-89	Jan-98	8.00	6.33	0.79
		Sr-89	Apr-98	6.00	9.00	1.50	
			Jul-98	21.00	17.67	0.84	
			Oct-98	19.00	12.67	0.67	
		I-131	Feb-98	104.90	108.7	1.04	
		Ba-133	Jun-98	40.00	40.33	1.01	
		Ra-226	Feb-98	16.00	18.20	1.14	
			Apr-98	15.00	18.93	1.26	
Jun-98	4.90		5.40	1.10			
Ra-228	Feb-98	33.30	31.63	0.95			
	Apr-98	9.30	9.87	1.06			
	Jun-98	2.10	4.30	2.05	Not Acceptable		
U	Feb-98	32.00	30.57	0.96			
	Apr-98	5.00	5.17	1.03			
	Jun-98	3.00	3.00	1.00			

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
- b. Comment column provides NERL evaluation of analytical performance which is based on 2 and 3 normalized standard deviations about the known value. Results outside these control limits are deemed not acceptable or a statistical outlier. No comment indicates performance within acceptable limits.

certified for metals and anions (silver, cadmium, chromium, copper, iron, mercury, manganese, sodium, lead, zinc, chloride, nitrate [as nitrogen], and sulfate) under the environmental analyses of potable water category, and specific purgeable organic compounds (benzene, toluene, xylene, ethylbenzene, chloroform, 1,1-dichloroethylene [DCE], 1,1-dichloroethane [DCA], 1,1,1-trichloroethane [TCA], trichloroethylene [TCE], and tetrachloroethylene [PCE]) under the environmental analyses of non-potable water category.

The ASL performs gross alpha, gross beta, gamma, and tritium analyses in several matrices, all of which are approved EPA methods. In 1998, the ASL developed a method to measure actinides (Pu, Am, Cm, Th and U) in water using a state-of-the-art alpha liquid scintillation detection system. The ASL also evaluated a new Sr-90 analytical method that utilizes crown-ether separation technology. The results of this evaluation will be published in 1999 in the *Health Physics Journal*. All analytic methods performed by the ASL are described in detail in Appendix C.

10.5.1 RADIOLOGICAL LAB RELOCATION TO MEDICAL 490

In accordance with DOE recommendations, the ASL Radiological Laboratory was moved from its cramped quarters in Bldg. 535 to Bldg. 490, where the laboratory size and storage space eliminates the possibility of cross contamination of samples. There are five separate laboratories and a counting room for instruments.

10.6 ASL'S INTERNAL QUALITY ASSURANCE PROGRAM

During the last quarter of 1998, the ASL began upgrading its Quality Assurance Program Plan (QAPP) following EPA Region-5 guidelines (U.S. EPA QA/R-5, 1998). Some elements were in SOPs or revised SOPs maintained by the ASL (BNL RM-SOP, January 1994). The ASL has upgraded its internal QA/QC program as a result of corrective actions from two 1997 audits. All suggested corrective actions were implemented and successfully completed before the end of 1998. The QA for radiological analyses was improved by the addition of spikes and spiked duplicates to each analytical batch (see Section 10.4.2 for details). Additional efforts are underway to

update quality assurance documents.

The QA procedures followed at ASL include daily instrument calibrations, efficiency and background checks, and routine tests for precision and accuracy. A brief summary of the methods and results of these procedures follows.

10.6.1 ASL INSTRUMENT CALIBRATIONS

Figures 10-3 through 10-6 summarize the internal quality control checks for the ASL's radiological instruments. Figure 10-3 shows the annual mean efficiencies, with 99 percent confidence interval, for the ASL's alpha, beta, tritium, and Sr-90 analyzers. Efficiency is the measure by which radiological decaying events are converted into observable counts (counts per minute). Instrument efficiencies were determined daily, using a calibration standard, and averaged for the calendar year. The data points show the annual mean and one standard deviation for each analyzer. All analyzers exhibited stable behavior. A power pack was replaced on one alpha/beta detector during the last quarter of 1998 which did not affect the data shown.

Figure 10-4 summarizes the variability in background counts experienced by each analyzer in 1998. Instrument background is used to determine the MDL of a radiological analyte. In 1998, there was no unusual drift or variability in instrument background for each type of analyzer, based on the mean background count-rates and their one standard deviation. The observed variability in the tritium background was normal.

Figure 10-5 shows the mean, with 99 percent confidence intervals, for eight high-purity germanium gamma detectors. Each detector was calibrated for energy and instrument efficiency daily using a NIST traceable cesium-137 standard. Geometry efficiency calibrations are performed quarterly. Cs-137 is illustrated on the graph, and the acceptance limit of 1 keV is shown as the upper and lower lines. The data showed that all eight gamma-detectors performed well within the EPA acceptance limit during 1998.

Figure 10-6 compares the mean, with 99 percent confidence interval, for each Sr-90 detector. The plot shows that the annual mean detector efficiencies, using calibration standards, were within 2 percent of each other and each of the daily efficiency checks performed

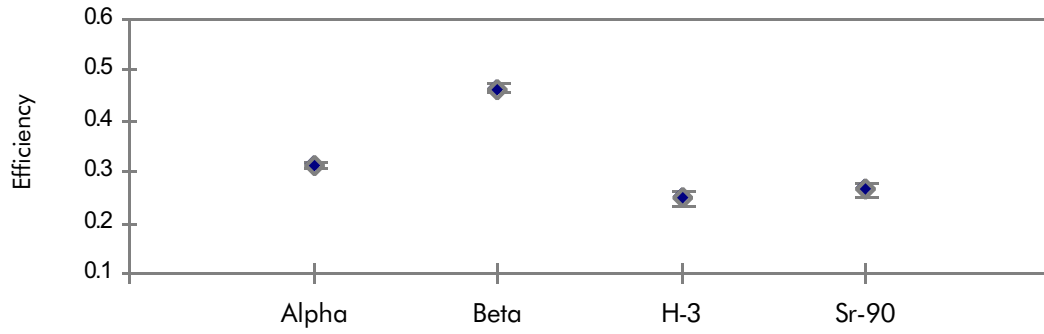


Figure 10-3.
Instrument Efficiency
Summary for 1998

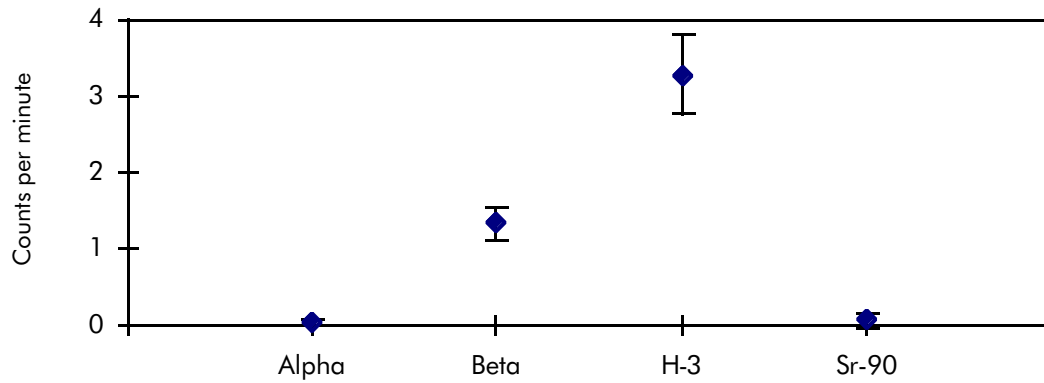


Figure 10-4
Instrument Background
Summary for 1998

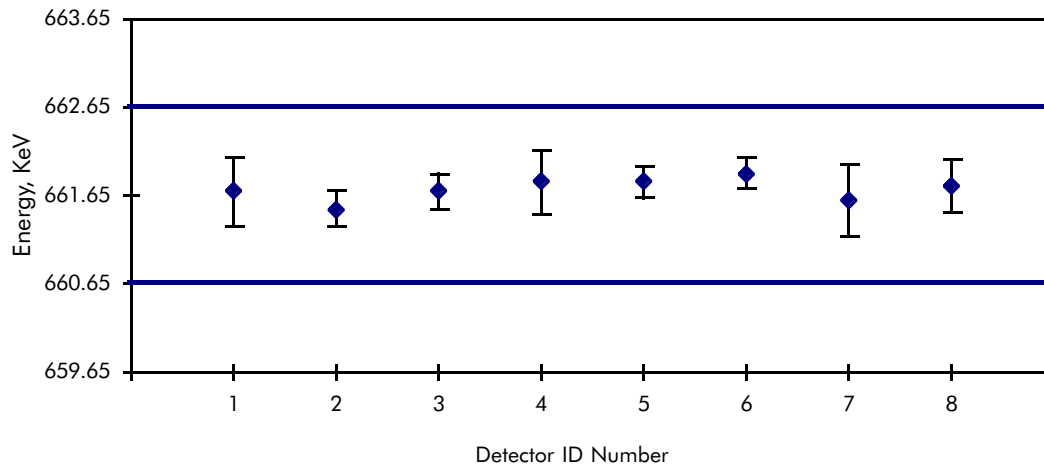


Figure 10-5
Cesium 137
Energy Calibration
Summary for 1998

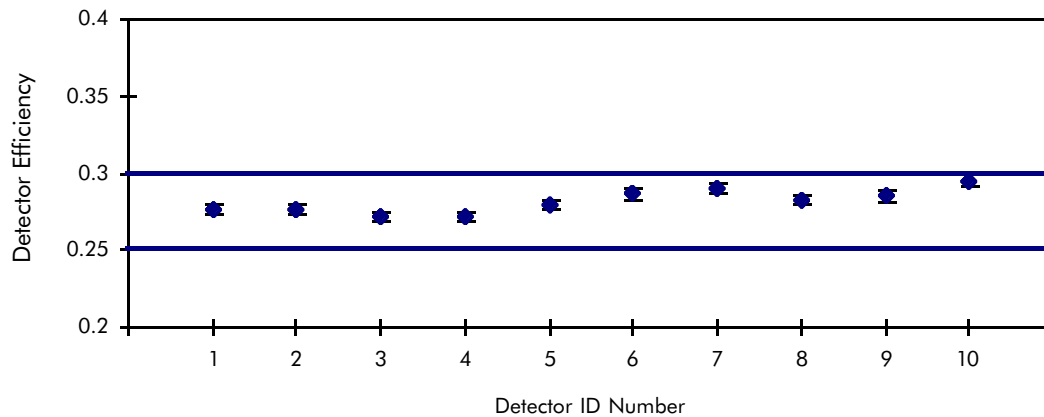


Figure 10-6.
Strontium-90
Instrument Efficiency
Summary for 1998

were within the five percent EPA acceptance limit.

10.6.2 PRECISION AND ACCURACY

Precision is the percent difference between two measured values whereas accuracy is the percent difference between a measured value and its known (expected) value. The Relative Percent Difference (RPD) statistic is the measure of batch precision and is defined as the difference between two results divided by the average of both results. Typically, a radioactive tracer solution (i.e., spike) is added to either a routine sample or tap water sample as a means

of determining both precision and accuracy. In the case of nonradiological analyses, a known amount of a given analyte is added to a sample, and the percent recovery is the measure of accuracy.

Radiological: Gross Alpha/Beta and Tritium Analyses

Figure 10-7 shows the RPD statistics for the 310 batches of gross alpha and beta (GAB) analyses performed by the ASL in 1998. Tap water was spiked with known amounts of Am-241 (for alpha) and Sr/Y-90 (for beta) in order to determine batch precision. The acceptance criteria for batch precision is an RPD statistic

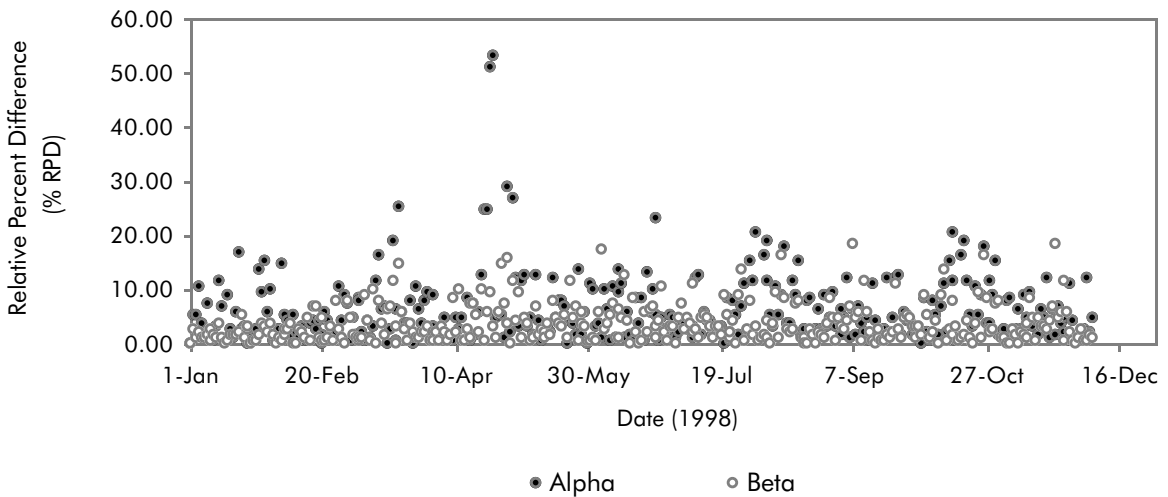


Figure 10-7. ASL Gross Alpha and Beta Precision

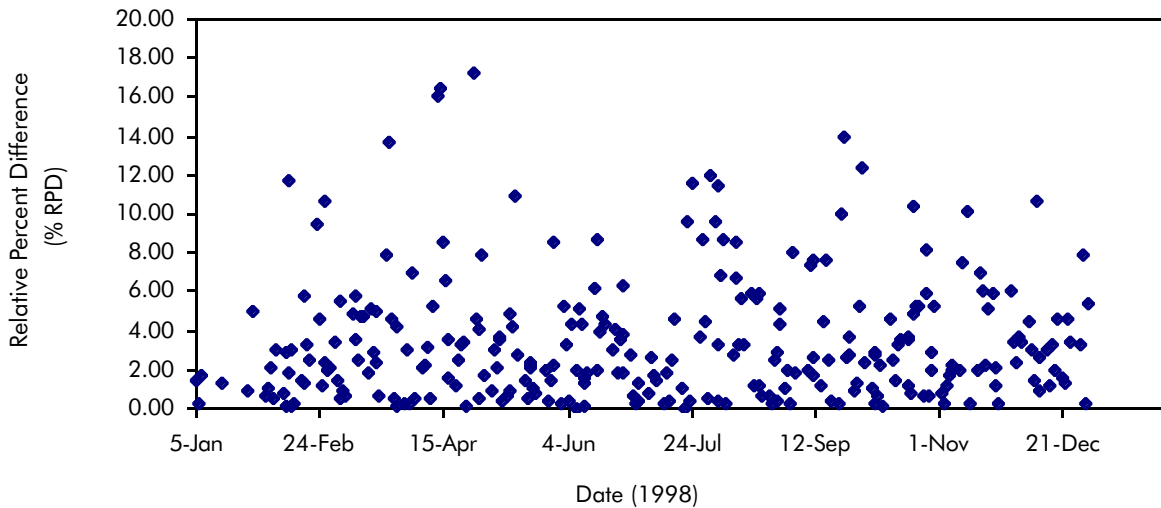


Figure 10-8. ASL Tritium Precision

less than 20 percent for activity concentrations that are five times greater than the method MDL. During 1998, GAB batch precision was consistently less than 20 percent, except for ten instances where precision exceeded the 20 percent acceptance criteria. In those instances, analytical results were rejected and the entire batch reanalyzed. In no cases were sample data lost. The rejection rate for GAB analyses performed in 1998 was 3.2 percent.

Figure 10-8 shows the RPD for each of the 190 analytical batches of tritium analyses performed by the ASL in 1998. The data in

Figure 10-8 show tritium precision for all 190 analytical batches performed by the ASL during 1998. The RPD value was consistently less than 20 percent with no rejected batches.

Nonradiological: Organic and Inorganic Analyses

Figures 10-9 and 10-10 summarize the internal quality control program for the ion chromatography and atomic absorption methods used for inorganic analyses. Figure 10-9 presents the annual mean and 99 percent confidence interval for reference check and calibration check sample recoveries analyzed in

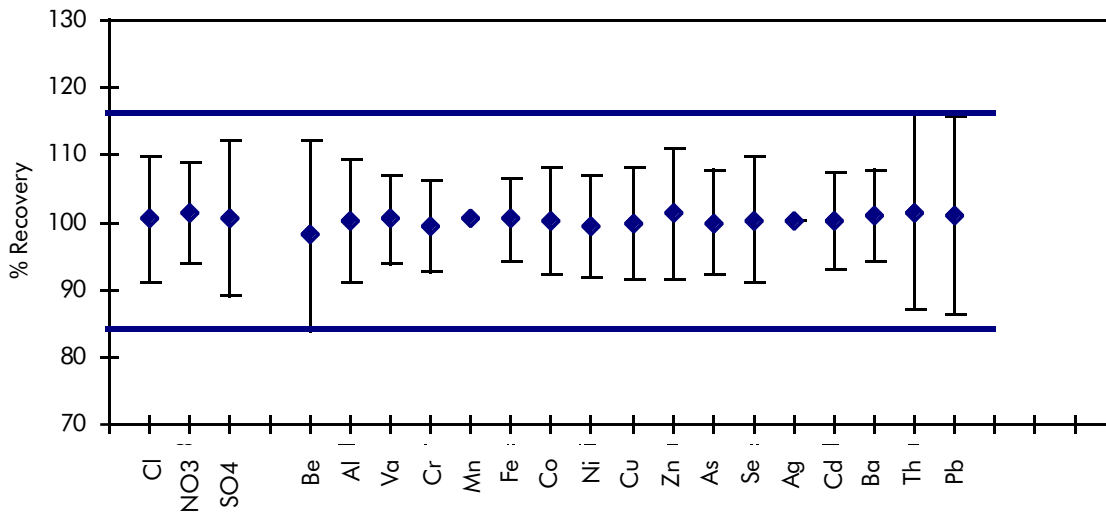


Figure 10-9. Reference Check Summary for 1998 Inorganic Analysis

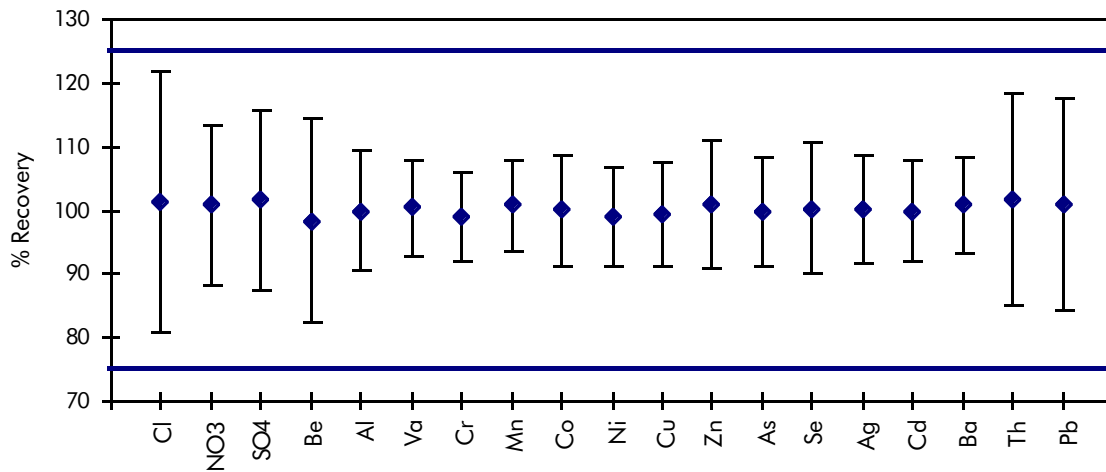


Figure 10-10. Spiked Recovery Summary for 1998 Inorganic Analysis

Figure 10-11.
Reference Check
Summary for Organic
Analysis in 1998

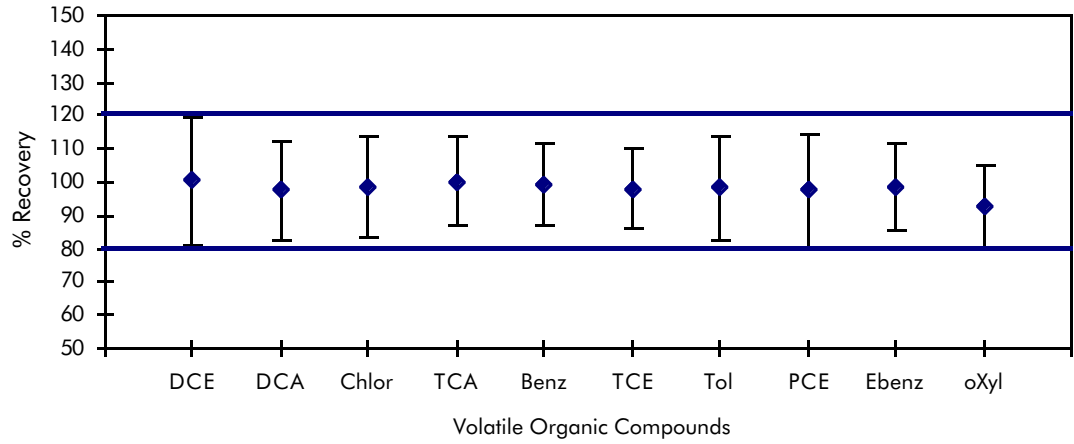


Figure 10-12.
Surrogate and Spike
Recovery Summaries for
1998 Organic Analysis

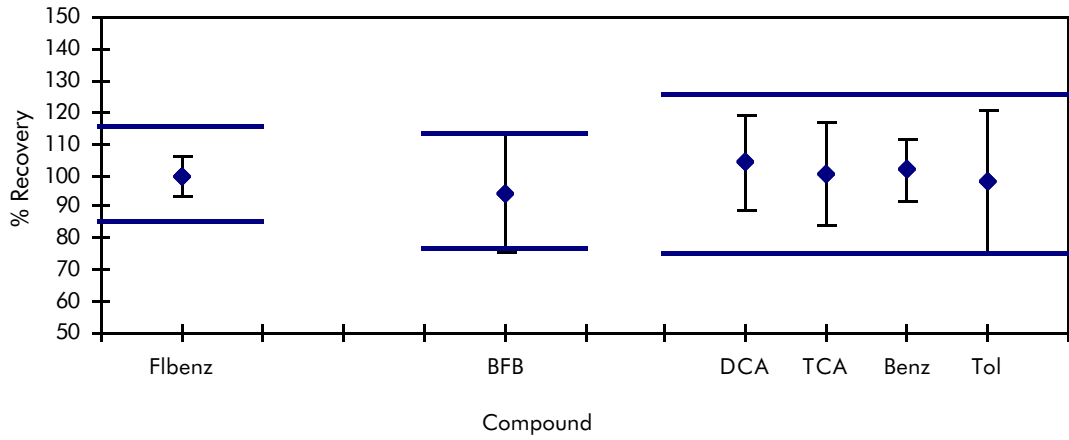
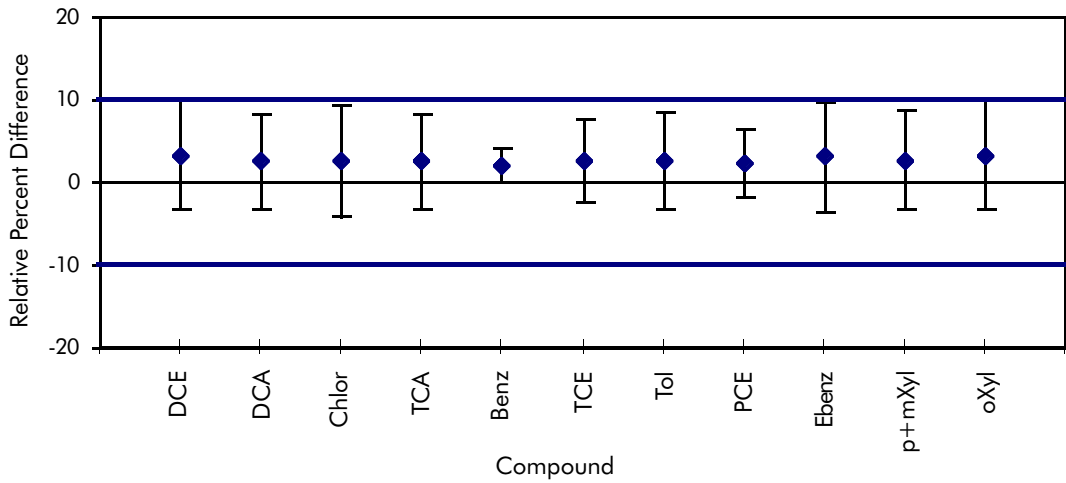


Figure 10-13.
Matrix Spike Duplicate
Summary for Organic
Analysis in 1998



68 batches of metals and anions. All reference check results were within the + 15 percent EPA acceptance limit.

Figure 10-10 shows the mean and 99 percent confidence interval of spike recoveries performed for both metals and anions. The data represent the average of 68 batches. Each batch of spiked samples resulted in recoveries that were within the 25 percent EPA acceptance limit for 16 metals and three anions.

Figures 10-11 and 10-12 show the 1998 results of the ASL's internal quality control program for the gas chromatography/mass spectroscopy method used in the organic analyses. Figure 10-11 summarizes the recoveries of the ten organic reference check samples, presented as the means, with 99 percent confidence interval, for each of the primary volatile organic compounds (VOCs). Mean recoveries and 99 percent confidence intervals for all ten analytes were within their target ranges; that is + 20 percent.

Figure 10-12 presents the means, with 99 percent confidence intervals, of surrogate and spike recoveries for organic analyses. The method's performance for each of the two surrogate analyses (fluorobenzene [Flbenz] and 4-bromofluorobenzene [BFB]) was 16 percent and 21 percent, respectively. The matrix spike recoveries were less than 20 percent for DCA, TCA, benzene and toluene, all within the EPA acceptance limit of 25 percent.

Method precision was determined by analyzing samples in duplicate for ten compounds. Approximately 50 batches were processed in 1998. Figure 10-13 presents the results as the RPD. All duplicate analyses were within the ASL's internal acceptance limit of + 10 percent for organic compounds.

10.6.3 RADIOLOGICAL LABORATORY SWIPE TESTING

Beginning in November 1998, contamination surveys were performed in all radiological labs of the ASL in order to reduce the chance of sample contamination by analytical equipment. A BNL Radiological Control Technician (RCT) performed the contamination surveys. Monthly surveys consisted of swipe-tests of all radiological laboratories as well as the ASL Counting Room. Weekly surveys, swipe-tests and instrument surveillance, were also performed on (a) the ASL's 'Controlled Area' hood, and (b) all pipettes used to dis-

pense samples and reagents. On a quarterly basis, the RCT performs a Dose-Report Review. No measurable contamination was found during either monthly or weekly ASL surveys.

10.7 RESULTS OF THE ASL'S INDEPENDENT PROFICIENCY EVALUATION TESTS

During 1998, the ASL participated in three proficiency evaluation testing programs; two national and one state.

10.7.1 RADIOLOGICAL ASSESSMENTS

The ASL participated in the DOE's EML QAP Program and the EPA's NERL performance evaluation study. The results of the DOE, EPA and NYSDOH PE testing programs are presented in Tables 10-9 through 10-15, respectively.

Overall, the ASL's performance in the DOE EML QA Program was satisfactory in 91 percent of the analyses performed on four matrices shown in Table 10-9. Twenty-eight of 43 analyses (65 percent) were within established EML limits showing acceptable agreement with the known value; 11 of 43 results (26 percent) were within warning limits, demonstrating satisfactory agreement; four analyses (9 percent) fell outside the acceptance limits. Many of the March and September air filter gamma results were reported in the warning and unacceptable range. A review of the QC data for the unacceptable cobalt-57 and manganese-54 analyses on the air-filter matrix showed no problem associated with the sample preparation, analytical process, or data calculations, as can be seen by the acceptable soil and vegetation results. As previously noted (in the case of GEL), the EML test filter is not the same geometry used to calibrate the gamma spectrometer in the BNL air-monitoring program, which would account for a positive bias. These proficiency evaluation results imply that the environmental air sampling (i.e., filter) data presented elsewhere in this report may be overestimated by 15-30 percent. EML will be replacing its three-inch diameter filters with two-inch diameter filters that are compatible with most commercial high-purity germanium gamma detectors.

Similarly, several 'warnings' were observed for the gamma analyses in the water matrix. This is attributable to the fact that EML establishes their values using a 4-liter

**Table 10-9. BNL Quality Assessment Program #48, #49 Results
Environmental Measurements Laboratory**

Matrix	Units	Isotope	Date	EML	BNL	Ratio (a)	Comments (b)
Air Filter	Bq/Filter	Alpha	Mar-98	1.40	1.07	0.76	Warning
			Sep-98	1.65	1.49	0.90	
		Beta	Mar-98	1.96	1.79	0.91	Warning
			Sep-98	2.16	1.77	0.82	
		Ce-144	Mar-98	8.21	10.36	1.26	Warning
		Co-57	Mar-98	11.11	14.56	1.31	Warning
		Co-60	Mar-98	9.09	8.84	0.97	
		Cs-134	Mar-98	19.74	18.04	0.91	
		Cs-137	Mar-98	11.86	15.04	1.27	Warning
			Sep-98	22.47	33.67	1.50	Not Acceptable
		Mn-54	Mar-98	5.44	7.04	1.29	Warning
			Sep-98	4.92	7.29	1.48	Not Acceptable
		Sb-125	Mar-98	12.16	16.94	1.39	Warning
			Sep-98	8.89	13.99	1.57	Not Acceptable
Soil	Bq/kg	Ac-228	Sep-98	52.60	45.03	0.86	
			Sep-98	58.30	35.28	0.61	
		Bi-212	Mar-98	329.50	328.20	1.00	
			Sep-98	954.00	954.97	1.00	
		K-40	Mar-98	313.50	284.72	0.91	
			Sep-98	314.00	291.67	0.93	
		Pb-212	Sep-98	52.80	51.28	0.97	
		Pb-214	Sep-98	29.10	30.90	1.06	
		Tl-208	Sep-98	18.30	18.71	1.02	
Vegetation	Bq/kg	Co-60	Mar-98	10.58	10.25	0.97	
			Sep-98	20.00	18.63	0.93	
		Cs-137	Mar-98	181.50	196.03	1.08	
			Sep-98	390.00	432.53	1.11	
		K-40	Mar-98	707.50	712.99	1.01	
			Sep-98	460.00	451.03	0.98	
Water	Bq/L	Alpha	Mar-98	1421.00	1490.43	0.95	
			Sep-98	1080.00	982.00	1.10	(c)
		Beta	Mar-98	2200.00	2236.48	0.98	
			Sep-98	1420.00	1277.00	1.11	(c)
		Co-60	Mar-98	13.60	14.43	0.94	
			Sep-98	49.40	51.50	0.96	
		Cs-137	Mar-98	46.00	56.87	0.81	Warning
			Sep-98	50.00	61.24	0.82	Warning
		H-3	Mar-98	218.30	180.36	1.21	
			Sep-98	76.20	57.31	1.33	Warning
		Mn-54	Mar-98	57.00	65.86	0.87	
			Sep-98	32.40	39.18	0.83	Warning
		Sr-90	Mar-98	4.36	4.78	0.91	
Sep-98	2.11		7.07	0.30	Not Acceptable		

Notes:

- The ratio is the reported Lab result divided by the target value result.
- Comment column provides EML evaluation of analytical performance which is based on control limits established from percentiles of historic data distributions. No comment indicates performance within acceptable limits.
- Data transcription error in reported data; measured value is reported.

Maranelli counting geometry, whereas the ASL uses 300-mL geometry to perform its measurements. The ASL will be switching over to the 4-liter Maranelli configuration for PE testing in 1999.

The NERL-LV comparisons, shown in Table 10-10, resulted in excellent agreement for 22 of the 25 analyses (within one standard deviation of the known value); three results for

gross alpha/beta (12 percent) were not acceptable. Overall, the ASL performance in the NERL intercomparison study was acceptable in 88 percent of the water analyses. A faulty instrument power pack was suspected to be the cause of the elevated gross alpha/beta results. The power pack in one of the two ASL alpha/beta detectors has since been replaced.

The radiological results from the ELAP

**Table 10-10. BNL Quality Assessment Program Results
National Exposure Research Laboratory (NERL-LV)**

Matrix	Units	Isotope	Date	NERL	BNL	Ratio (a)	Comments (b)
Water	Bq/L	Alpha	Nov-98	1746.40	1073.00	0.61	
			Jul-98	266.40	603.00	2.26	Not Acceptable
			Apr-98	2012.80	4192.00	2.08	Not Acceptable
		Beta	Jan-98	1128.50	681.00	0.60	
			Nov-98	129.50	296.00	2.29	Not Acceptable
			Jul-98	473.60	663.50	1.40	
		H-3	Apr-98	3503.90	2268.00	0.65	
			Jan-98	144.30	252.00	1.75	
			Mar-98	79735.00	74000.00	0.93	
		Sr-90	Aug-98	665852.00	584600.00	0.88	
			Jan-98	1184.00	984.20	0.83	
		Co-60	Jul-98	259.00	203.50	0.79	
			Jun-98	444.00	445.00	1.00	
			Apr-98	1850.00	1808.00	0.98	
		Cs-134	Nov-98	1406.00	1516.00	1.08	
			Jun-98	1147.00	1054.00	0.92	
			Apr-98	814.00	769.00	0.94	
		Cs-137	Nov-98	3885.00	4020.00	1.03	
			Jun-98	1295.00	1383.00	1.07	
			Apr-98	370.00	372.00	1.01	
		Ba-133	Nov-98	4107.00	5044.00	1.23	
Jun-98	1480.00		1417.00	0.96			
Nov-98	2072.00		2238.50	1.08			
Zn-65	Jun-98	3848.00	4365.00	1.13			
	Nov-98	4847.00	5673.00	1.17			

Notes:

a. The ratio is the reported Lab result divided by the target value result.

b. Comment column provides NERL evaluation of analytical performance which is based on 2 and 3 normalized standard deviations about the known value. Results outside these control limits are deemed not acceptable or a statistical outlier. No comment indicates performance within acceptable limits.

proficiency test for gross alpha and beta showed acceptable agreement for five of six analyses performed. The overall score in Table 10-11 corresponds to 83 percent. As a result of a transcription error on the data pair submitted in April 1998, the ASL temporarily lost gross beta certification only, for potable water analyses for a six-month period. During that time, compliance samples requiring gross alpha and beta analyses were sent to an offsite contractor laboratory. Certification for gross beta was re-instated in November 1998 after compliance was demonstrated to ELAP.

10.7.2 NONRADIOLOGICAL ASSESSMENTS

The ASL also participated in the EPA Environmental Monitoring Systems Laboratory (EMSL-CI) WP and WS performance evaluation studies. Tables 10-12 and 10-13

**Table 10-11. BNL Potable Water Radiochemistry
Proficiency Test #187, #197 Results
Environmental Laboratory Approval Program**

Analyte	Date (Bq/L)	ELAP (Bq/L)	BNL	Ratio (a)	Comment (b)
Alpha	Apr-98	666.00	599.40	0.90	
	Apr-98	2701.00	2608.50	0.97	
	Oct-98	1998.00	1594.70	0.80	
Beta	Apr-98	592.00	577.20	0.98	(c)
	Apr-98	2442.00	2486.40	1.02	
	Oct-98	1776.00	1776.00	1.00	

Notes:

a. The ratio is the reported Lab result divided by the target value result.

b. Comment column provides ELAP evaluation of analytical performance which is based on 95 and 99% confidence interval about the target value. No comment indicates performance within acceptable limits.

c. Transcription error on original data submission for beta only. Corrected data are presented.

**Table 10-12. BNL Water Pollution Performance Evaluation Studies - WP040
USEPA Environmental Monitoring Systems Laboratory - Cincinnati**

Analyte	Units	Date	EMSL-CI	BNL	Ratio (a)	Comments (b)
Chloroform	µg/l	Nov-98	18.40	18.05	0.98	
1,1,1 Trichloroethane	µg/l	Nov-98	32.80	35.08	1.07	
Trichloroethene	µg/l	Nov-98	23.40	23.19	0.99	
Tetrachloroethene	µg/l	Nov-98	32.50	31.17	0.96	
Benzene	µg/l	Nov-98	25.70	30.44	1.18	
Ethylbenzene	µg/l	Nov-98	42.60	39.20	0.92	
Toluene	µg/l	Nov-98	32.30	31.45	0.97	
Methyl Chloride	µg/l	Nov-98	44.10	45.79	1.04	
1,2-Dichlorobenzene	µg/l	Nov-98	36.30	32.81	0.90	
1,3-Dichlorobenzene	µg/l	Nov-98	33.70	29.18	0.87	
1,4-Dichlorobenzene	µg/l	Nov-98	41.60	38.63	0.93	
1,2-Dichloroethane	µg/l	Nov-98	14.60	14.20	0.97	
Bromodichloromethane	µg/l	Nov-98	16.50	14.90	0.90	
Dibromochloromethane	µg/l	Nov-98	32.70	29.15	0.89	
Chlorobenzene	µg/l	Nov-98	24.70	24.09	0.98	
Bromoform	µg/l	Nov-98	14.70	10.58	0.72	
Carbon Tetrachloride	µg/l	Nov-98	26.30	26.99	1.03	

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
b. Comment column provides EMSL-CI evaluation of analytical performance which is based on 95 and 99% prediction interval calculated from samples analyzed by EPA and State Laboratories. No comment indicates performance within acceptable limits. Samples from WP040 were not reported in time to meet reporting deadline.

**Table 10-13. BNL Water Supply Performance Evaluation Studies -
WS040/041 USEPA Environmental Monitoring Systems Laboratory - Cincinnati**

Analyte	Units	Date	EMSL-CI	BNL	Ratio (a)	Comments (b)
Cd	µg/l	Mar-98	6.31	6.30	1.00	Not Acceptable
	µg/l	Sep-98	18.20	17.30	0.95	
Cr	µg/l	Mar-98	90.90	93.30	1.03	
	µg/l	Sep-98	55.50	60.50	1.09	
Cu	µg/l	Mar-98	1700.00	1752.00	1.03	
	µg/l	Sep-98	702.00	695.00	0.99	
Hg	µg/l	Mar-98	1.50	1.47	0.98	
	µg/l	Sep-98	5.82	5.05	0.87	
Mn	µg/l	Sep-98	183.00	177.00	0.97	
Na	mg/l	Sep-98	23.30	23.20	1.00	
Zn	µg/l	Mar-98	1700.00	1760.00	1.04	
	µg/l	Sep-98	402.00	404.00	1.00	
Pb	µg/l	Mar-98	71.00	72.50	1.02	
NO ₃ - N	mg/l	Sep-98	15.00	1.51	0.10	
SO ₄	mg/l	Sep-98	49.00	49.00	1.00	
Turbidity		Sep-98	2.60	2.40	0.92	
Chloroform	µg/l	Sep-98	14.40	15.70	1.09	
DCE	µg/l	Sep-98	5.25	6.80	1.30	
TCA	µg/l	Sep-98	12.60	12.20	0.97	
TCE	µg/l	Sep-98	6.87	6.99	1.02	
Benzene	µg/l	Sep-98	18.7	17.70	0.95	
PCE	µg/l	Sep-98	11.50	10.70	0.93	
Toluene	µg/l	Sep-98	18.70	17.60	0.94	
Ethylbenzene	µg/l	Sep-98	14.70	13.40	0.91	
Total Xylenes	µg/l	Sep-98	30.80	31.60	1.03	

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
b. Comment column provides EMSL-CI evaluation of analytical performance which is based on 40CFR141 analyte-specific acceptance limits. No comment indicates performance within acceptable limits.

respectively, give the results of these nonradiological studies. Overall, the ASL performance in the EPA WP intercomparison study (WP040), shown in Table 10-12 was acceptable in 100 percent of the 17 analyses performed.

Table 10-13 shows the results from using the EPA EMSL-CI WS samples. Twenty-four of 25 PE samples (96 percent) were acceptable. An investigation into the unacceptable September 1998 results for nitrate was attributable to technician error in preparing the samples.

Tables 10-14 and 10-15 present the results of organic and inorganic proficiency samples analyzed for the NYSDOH's ELAP. The results in Table 10-14 (for organics) show that 76 percent of proficiency samples analyzed in January and July 1998 were within acceptable

or warning limits. The remaining five results (in January of 1998, only) were slightly greater than 30 percent of the known value and were not acceptable. The five results that were not acceptable in January 1998 were due to instrument failure of the purge and trap system during the second batch of samples analyzed in January 1998. The first set of the pair was not affected. The instrument has since been repaired. No environmental monitoring data were affected by this instrument failure.

The inorganic NYSDOH ELAP test results, shown in Table 10-15, were acceptable or within warning limits for 100 percent of the 39 analyses performed. This is an improvement from the 1996 and 1997 ELAP results. During the last quarter of 1996, the ASL nonradiological laboratory had relocated

Table 10-14. BNL Non-Potable Water Chemistry Proficiency Test #183 and #193 Results Environmental Laboratory Approval Program

Analyte	Date	ELAP (µg/L)	BNL (µg/L)	Ratio (a)	Comment (b)
1,1-Dichloroethane	Jan-98	24.60	28.80	1.17	
	Jan-98	48.50	61.30	1.26	Warning
	Jul-98	15.70	16.70	1.06	
Tetrachloroethene	Jan-98	24.30	23.80	0.98	
	Jan-08	37.10	43.70	1.18	
	Jul-98	24.60	23.60	0.96	
Trichloroethene	Jan-98	28.80	33.00	1.15	
	Jan-98	45.00	57.30	1.27	(c), Not Acceptable
	Jul-98	22.10	22.10	1.00	
Benzene	Jan-98	20.10	24.50	1.22	Warning
	Jan-98	45.10	59.40	1.32	(c), Not Acceptable
	Jul-98	37.10	34.80	0.94	
Ethyl benzene	Jan-98	31.90	35.70	1.12	
	Jan-98	44.20	55.40	1.25	(c), Not Acceptable
	Jul-98	25.60	24.90	0.97	
Toluene	Jan-98	27.60	32.60	1.18	
	Jan-98	40.30	54.30	1.35	(c), Not Acceptable
	Jul-98	18.50	18.10	0.98	
Total Xylenes	Jan-98	20.30	25.00	1.23	Warning
	Jan-98	36.50	51.00	1.40	(c), Not Acceptable
	Jul-98	27.20	27.00	0.99	

Notes:

- The ratio is the reported Lab result divided by the target value result.
- Comment column provides ELAP evaluation of analytical performance which is based on 95 and 99% confidence interval about the target value. No comment indicates performance within acceptable limits.
- Not acceptable because purge and trap system required repair/replacement after completion of first set of analyses in Jan.

**Table 10-15. BNL Potable Water Chemistry Proficiency Test #187 and #197 Results
Environmental Laboratory Approval Program**

Analyte	Date	ELAP (µg/L)	BNL (µg/L)	Ratio (a)	Comment (b)
Cadmium	Apr-98	5.00	4.80	0.96	
	Apr-98	12.50	11.20	0.90	
	Oct-98	16.70	16.90	1.01	
Chloride	Apr-98	22.70	23.80	1.05	
	Apr-98	142.00	146.00	1.03	
	Oct-98	129.00	133.50	1.03	
Chromium	Apr-98	37.50	39.10	1.04	
	Apr-98	62.50	62.20	1.00	
	Oct-98	100.00	103.50	1.04	
Copper	Apr-98	50.00	51.00	1.02	
	Apr-98	75.00	73.00	0.97	
	Oct-98	1330.00	1242.00	0.93	
Iron	Apr-98	88.10	88.00	1.00	
	Apr-98	112.00	117.00	1.04	
	Oct-98	299.00	304.00	1.02	
Lead	Apr-98	25.00	27.10	1.08	
	Apr-98	50.00	53.60	1.07	
	Oct-98	83.30	83.60	1.00	
Manganese	Apr-98	61.80	63.00	1.02	
	Apr-98	92.10	93.00	1.01	
	Oct-98	334.00	326.00	0.98	
Mercury	Apr-98	1.10	1.08	0.98	
	Apr-98	4.69	4.37	0.93	
	Oct-98	6.00	4.97	0.83	
Nitrate (as N)	Apr-98	1.11	1.18	1.06	
	Apr-98	7.10	6.94	0.98	
	Oct-98	12.00	12.19	1.02	
Silver	Apr-98	18.70	18.90	1.01	
	Apr-98	49.20	48.00	0.98	
	Oct-98	25.20	29.00	1.15	Warning
Sodium	Apr-98	29.90	30.10	1.01	
	Apr-98	49.70	49.00	0.99	
	Oct-98	13.70	14.10	1.03	
Sulfate (as SO ₄)	Apr-98	52.00	53.90	1.04	
	Apr-98	203.00	207.00	1.02	
	Oct-98	99.40	99.60	1.00	
Zinc	Apr-98	63.30	66.00	1.04	
	Apr-98	100.00	99.00	0.99	
	Oct-98	1670.00	1650.00	0.99	

Notes:

- a. The ratio is the reported Lab result divided by the target value result.
b. Comment column provides ELAP evaluation of analytical performance which is based on 95 and 99% confidence interval about the target value. No comment indicates performance within acceptable limits.

which resulted in repeated instrument problems that adversely affected performance evaluation results in 1997.

10.8 AUDITS AND SELF-ASSESSMENTS OF THE ASL

During 1998, there was an onsite audit of the ASL conducted by NYSDOH ELAP. Four recommendations for improvement were made, all of which were successfully completed before the end of 1998.

In addition, an appraisal of the ASL was conducted by an independent organization as part of the BNL Integrated Assessment Program. Corrective action plans for the findings and recommendations were developed and implementation is ongoing. On November 30 1998, a Self-Assessment Plan was prepared. This program was developed to foster continuous improvement in ASL's programs and

activities, and provide timely, valid performance measurements to complement the Laboratory's Assessment Program.

10.9 UNUSUAL OCCURRENCES

During 1998, the ASL did not receive many EPA PE samples in time to meet reporting deadlines (see Tables 10-12 and 10-13). However, the analyses were performed and reported in the tables. One of the ASL Quality Assurance Officer's new functions is to track shipping and receipt of all PE testing samples so that timelines for data reporting are met.

Effective December 21 1998, the EPA's NERL and EMSL Performance Evaluation Programs, for both radiological and nonradiological analytes, was terminated. A replacement for the EPA Programs is presently being sought.

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