PNNL-11552
UC-600

Pacific Northwest National Laboratory

Operated by Battelle for the U.S. Department of Energy

Characterization and Monitoring of 300 Area Facility Liquid Waste Streams During 1994 and 1995

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July 1997

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Abstract

Pacific Northwest National Laboratory's Facility Effluent Management Program characterized and monitored liquid waste streams from 300 Area buildings that are owned by the U.S. Department of Energy and are operated by Pacific Northwest National Laboratory.[a] The purpose of these measurements was to determine whether the waste streams would meet administrative controls that were put in place by the operators of the 300 Area Treated Effluent Disposal Facility. This report summarizes the data obtained between March 1994 and September 1995 on the following waters: liquid waste streams from Buildings 306, 320, 324, 325, 326, 327, 331, and 3720; treated and untreated Columbia River water (influent); and water at the confluence of the waste streams (that is, end-of-pipe).

Wastewater samples were collected and analyzed for chemicals, radioactivity, and general parameters. In most cases, the concentrations of monitored parameters and constituents were below the limits specified in the waste acceptance criteria for the 300 Area Treated Effluent Disposal Facility. Periodically, levels of cyanide, metals, volatile organic compounds, phthalates, and gross alpha radiation in building effluent samples exceeded the waste acceptance criteria. However, exceedances of the waste acceptance criteria were not observed in any samples from end-of-pipe where the criteria are applicable.

Although drinking water standards do not apply to facility wastewater, the U.S. Environmental Protection Agency's maximum contaminant levels were used as an additional reference for evaluating waste stream characterization and monitoring data. Most of the constituents in facility effluents were present in trace concentrations that are below the maximum contaminant levels. However, levels of nitrate and bis(2-ethylhexyl) phthalate in samples from end-of-pipe occasionally exceeded the maximum contaminant levels. Sample contamination from plastic tubing is believed to be the source of bis(2-ethylhexyl) phthalate.

The characterization and monitoring data obtained during 1994 and 1995 were severely limited because the effluents were sampled only one to four times per month. Nevertheless, the results indicated the levels of contaminants in facility discharges and showed the impact of those discharges on end-of-pipe concentrations. These data were determined to be sufficient to meet the characterization requirement in the 300 Area Treated Effluent Disposal Facility's Liquid Waste Certification Program for Pacific Northwest National Laboratory facilities.

(a) The Pacific Northwest National Laboratory is operated by Battelle for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

Summary

Liquid effluent streams from eight U.S. Department of Energy-owned and Pacific Northwest National Laboratory-operated buildings (306, 320, 324, 325, 326, 327, 331, and 3720), end-of-pipe, and influent in the 300 Area of the Hanford Site were monitored during 1994 and 1995 for six general classes of chemical and radiological parameters. These measurements were made to characterize the waste streams and to determine whether the waste streams met a list of waste acceptance criteria that define acceptable maximum levels of waste stream constituents. The waste acceptance criteria were developed to ensure that the facility which treats the waste streams (i.e., the 300 Area Treated Effluent Disposal Facility) could meet its National Pollutant Discharge Elimination System permit limits. Most of the monitoring data was generated from the analysis of 24-hr composite samples that were collected one to four times per month. Although the data is limited by the low sampling frequency (i.e., the waste streams were sampled only one to four times per month), the results provide some indications of facility discharges and the effects of those discharges on end-of-pipe concentrations.

Pollutant concentrations were primarily in the parts-per-billion (μg/L) range except for general parameters (e.g., alkalinity and total carbon) and some anions and metals (e.g., chloride, nitrate, calcium, and sodium) which were found in concentrations of parts-per-million (mg/L). As a reference point, most samples had constituent levels that were below the waste acceptance criteria and U.S. Environmental Protection Agency maximum contaminant levels for drinking water. Additional results on the six different chemical classes are summarized as follows.

Ammonia and Anions

Cyanide concentrations in 3 out of 48 samples from Building 331 exceeded the waste acceptance criteria. Nitrate levels in samples from most buildings and end-of-pipe were occasionally greater than the U.S. Environmental Protection Agency maximum contaminant level. Chloride and phosphate were also observed at elevated levels (compared to background) in building effluent samples.

Metals

Trace levels (i.e., 0.1 to 10 μg/L) of metals were routinely detected in samples from most monitoring locations. In addition, concentrations of aluminum, cadmium, chromium, copper, iron, manganese, mercury, nickel, silver, and zinc occasionally exceeded the waste acceptance criteria in samples from one or more buildings. Levels of chromium, mercury, and nickel also exceeded the U.S. Environmental Protection Agency maximum contaminant levels in samples from Buildings 324 (chromium and nickel), 325 (mercury), and 326 (nickel). No metals exceeded the waste acceptance criteria or maximum contaminant levels in end-of-pipe samples.

Volatile Organic Compounds

Chlorination of the influent (i.e., Columbia River) water introduces trihalomethanes into building source water. Two trihalomethanes, bromodichloromethane and chloroform, were frequently detected in samples from almost all locations, and several results were above the waste acceptance criteria for these compounds. However, the U.S. Environmental Protection Agency maximum contaminant level for total trihalomethanes (100 μg/L) was not exceeded.

Other volatile organic compounds that exceeded the waste acceptance criteria were methylene chloride and toluene in samples from Building 3720, and trichloroethene in Building 326 samples. No exceedances were observed in samples from end-of-pipe. However, it is postulated that the data is biased low because of volatile organic compound losses that occurred before analysis. Thus, some waste acceptance criteria exceedances at end-of-pipe may have gone undetected.

High concentrations (i.e., up to 40,800 μg/L) of volatile solvents were found in effluent samples from Buildings 320, 326, 327, 331, and 3720.

Semivolatile Organic Compounds

Extremely low levels of pesticides were found in waste stream samples from Buildings 326, 331, end-of-pipe, and in the influent waters. None of the concentrations exceeded the waste acceptance criteria or maximum contaminant levels.

Phthalates were detected in samples from most monitored locations. Levels of bis(2-ethylhexyl) phthalate and diethylphthalate exceeded the waste acceptance criteria in samples from Buildings 325, 326, 327, 331, and 3720. Sample contamination is the suspected source of these compounds.

Radiological Parameters

Gross alpha and gross beta radiation were found with varying frequencies in effluent samples from most locations. Building 3720's samples had the highest levels of gross alpha radiation (i.e., 1 to 45 pCi/L), and 16 of the 76 samples taken from Building 3720 were above the waste acceptance criteria. Gross alpha levels in end-of-pipe samples were all below the waste acceptance criteria. Average levels of gross beta radiation found in samples from each location ranged from 3 to 21 pCi/L. None of the gross beta results exceeded the waste acceptance criteria. Tritium was also detected in trace amounts (200 to 1,080 pCi/L) in samples from Buildings 306, 324, 325, 326, 327, 331, and end-of-pipe. However, many of the tritium results were probably false detections, because the counting error was typically between 200 and 300 pCi/L.

The data generated during 1994 and 1995 indicate the concentrations and types of contaminants that can be expected from individual facilities. These results cannot be considered final because the dynamic nature of research projects causes the facility waste streams to be highly variable in nature. However,

the data were determined to be sufficient to meet the characterization requirements in the 300 Area Treated Effluent Disposal Facility's Liquid Waste Certification Program for Pacific Northwest National Laboratory facilities under current operating conditions.

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Acknowledgments

The authors gratefully acknowledge those who made this report possible. Alice Ikenberry and Rodger Woodruff managed the Effluent Monitoring Program. David Douglas and Laurie True provided logistical support in sampler operations. Janet Julya coordinated sampling efforts and compiled sampling information for this report. Denise Sauer created and managed the analytical database. John Evans developed a quality control plan and Barbara Gillespie provided oversight of quality-control measures. Also, special thanks to Kristin Manke, who provided editorial support and coordinated publishing of this report.

Acronym and Abbreviation List

EPA	U.S. Environmental Protection Agency
MCL	maximum contaminant level
PS	process sewer
RPS	retention process sewer
TEDF	Treated Effluent Disposal Facility
WAC	waste acceptance criteria

1.0 Introduction

The Pacific Northwest National Laboratory operates a number of research and development facilities for the U.S. Department of Energy in the 300 Area of the Hanford Site in southeastern Washington State. Liquid wastes from these facilities are discharged to four liquid effluent systems: the sanitary sewer, the process sewer (PS), the retention process sewer (RPS), and the radioactive liquid waste system. The PS and RPS waste streams are treated by the 300 Area Treated Effluent Disposal Facility (TEDF) and are discharged to the Columbia River in accordance with a National Pollutant Discharge Elimination System permit. The permit specifies allowable limits of chemical constituents and requires "proper operation and maintenance" of the TEDF.

From March 1994 to September 1995, physical, chemical and radiological data were gathered by Pacific Northwest National Laboratory staff on the PS and RPS waste streams from several facilities. This action was in response to ongoing changes in the 300 Area sewer system. Foremost among these changes was the startup of TEDF in December 1994. Characterization of the effluents of major contributors to the waste stream was needed to ensure that TEDF could be operated to meet National Pollutant Discharge Elimination System permit requirements. Therefore, waste stream samples were collected and analyzed from the most significant Pacific Northwest National Laboratory facilities with respect to radioactive and/or hazardous material inventories. These included the following buildings (Figure 1.1):

- Building 306
- Building 320
- Building 324[(a)]
- Building 325
- Building 326
- Building 327[(a)]
- Building 331
- Building 3720.

Samples were also collected and analyzed from the end-of-pipe, which is where effluents from all of the 300 Area buildings come together before discharging to the TEDF. This was done to determine how much the total sewer system reduced pollutant concentrations from the point of discharge (i.e., at a facility) to the influent point of the TEDF.

Baseline information on water coming into the buildings was obtained by sampling and analyzing treated and untreated influent water. Columbia River water is the untreated influent. This water is

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(a) Operation of these buildings was transferred from Pacific Northwest National Laboratory to Fluor Daniel Hanford, Inc., on November 1, 1996.

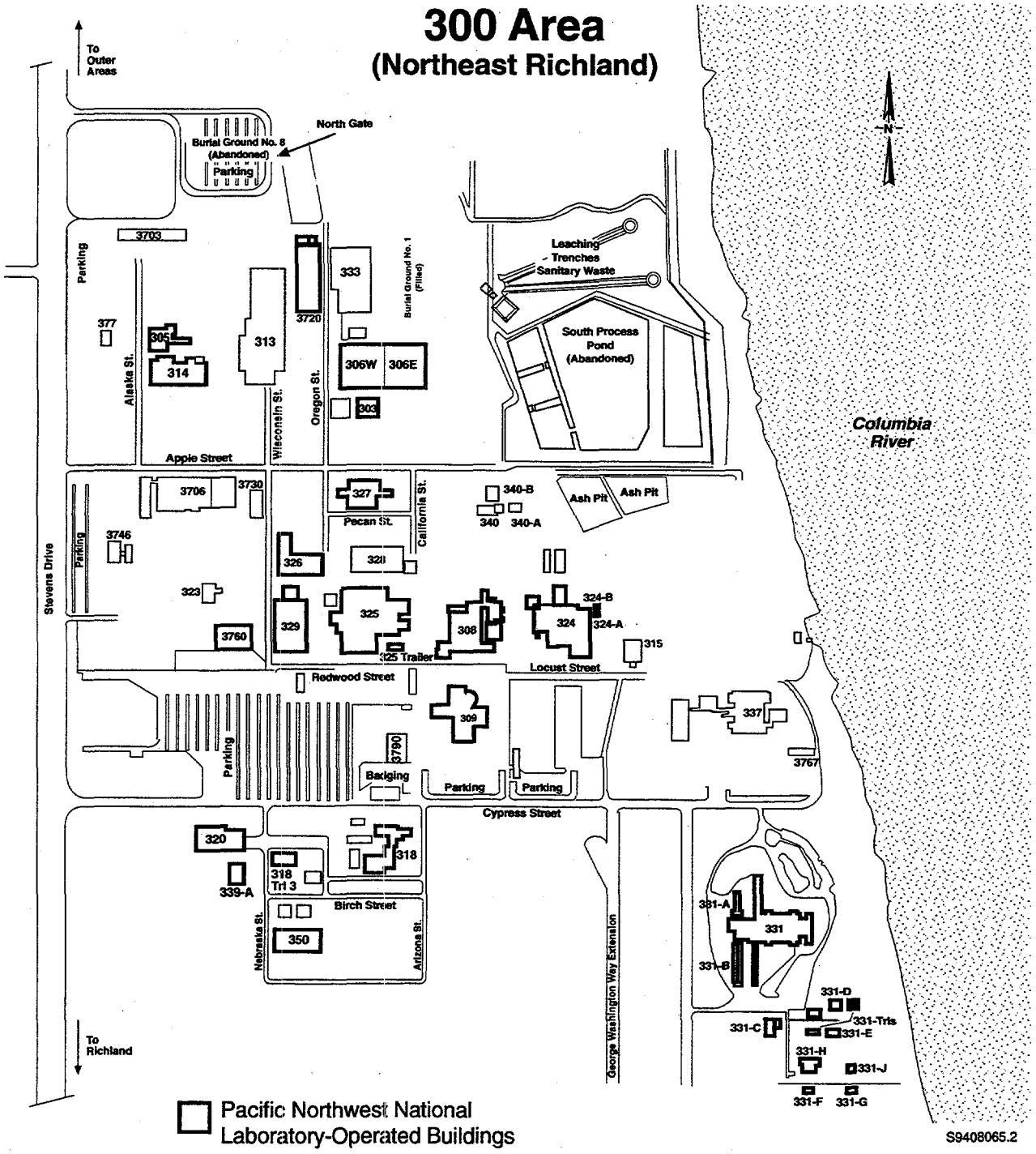

Figure 1.1. Location of Pacific Northwest National Laboratory-Operated Buildings in the 300 Area

filtered and chlorinated at Building 315 and is then designated treated influent. Treated influent is routed as potable water for 300 Area buildings. Also sampled and analyzed was alternate influent, which is city of Richland water that was used in the buildings when the primary treated influent was not available (see Appendix D for more information). Characterization data on the influent waters was used to help determine which contaminants were already in the waste stream and which were added as a result of facility discharges.

Results from the first year (1994) of the Pacific Northwest National Laboratory Liquid Effluent Monitoring Program were published in *Characterization and Monitoring of 300 Area Facility Liquid Waste Streams: 1994 Report* (Riley et al. 1995). In addition to data from routine sampling and analyses of facility liquid effluents, the report also describes two studies that were performed to improve and clarify monitoring data: 1) an evaluation of advanced characterization and monitoring technologies that could enhance data quality and reduce costs over the long term and 2) an investigation of waste stream dynamics (i.e., the extent of dilution and rate of transit for contaminants flowing from a facility to end-of-pipe).

The purpose of this report is to summarize and interpret characterization and monitoring data collected during 1994 and 1995 on the liquid effluents of major Pacific Northwest National Laboratory facilities in the 300 Area. This information can be used to support responsible management of building effluents by identifying discharge practices and providing feedback on the effectiveness of Pacific Northwest National Laboratory's administrative controls that govern the release of materials to the waste streams.

A separate report (Riley et al. 1997, in press) describes a series of field tests that were conducted during 1994 and 1995 to improve the interpretation of monitoring data and to improve the analytical data quality and sampling efficiency associated with the monitoring of building effluents. Some of the conclusions drawn from the field tests impact the interpretation of routine data and are mentioned in this report where appropriate.

2.0 Background

Operation of facilities in the 300 Area began in February 1943 when the Hanford Site was created to produce plutonium for the first atomic bombs. Activities in the 300 Area have included fabricating reactor fuel, evaluating pilot-scale separations processes, and conducting basic and applied research for industrial and government agencies.

For over five decades, chemically and radiologically contaminated wastewaters from these activities were discharged to ponds, trenches, and cribs in the 300 Area (Riley and Zachara 1992). The wastewaters were discharged using an intricate system of sewer lines linking facilities to waste disposal areas. The sewer system consisted of independently functioning sanitary and process components. Detailed information describing the history of the sewer system and the 300 Area liquid waste disposal practices can be found in *Past Practices Technical Characterization Study - 300 Area - Hanford Site* (Gerber 1992).

As part of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), also known as the Tri-Party Agreement, a compact was made to reduce the discharges of liquid waste to the Process Trenches and to build a treatment facility so that discharges to the trenches could eventually cease. Initial characterization of 300 Area process liquid effluents was performed in 1989 (McKenney 1989) to support design of the TEDF. However, the data generated in 1989 were severely limited because the grab samples collected provided only a "snapshot" of the composition of the highly variable waste streams. Moreover, flow-reduction efforts and updated administrative controls considerably changed the physicochemical characteristics of the waste streams during the period from 1989 to 1994 following this initial characterization effort. TEDF began operations in December 1994.

In spite of the limitations, the initial characterization data were used to develop waste acceptance criteria (WAC) for the TEDF. Waste generators in the 300 Area were expected to verify that discharges met WAC either through process knowledge or through characterization activities. Waivers from the WAC were allowed on a case-by-case basis. In 1994, Pacific Northwest National Laboratory initiated a liquid effluent sampling and monitoring program to 1) determine whether the discharges from Laboratory facilities met the TEDF WAC, 2) evaluate Laboratory administrative controls on discharges to the PS and RPS, and 3) generate characterization data to meet requirements in TEDF's Liquid Waste Certification Program. Two reports (Riley et al. 1994; Riley et al. 1995) documented the results from the first year of the program.

Late in fiscal year 1995, an agreement was reached between Westinghouse Hanford Company (who operated TEDF), Pacific Northwest National Laboratory, and U.S. Department of Energy in which the Laboratory would prepare a Liquid Waste Certification Plan that would replace the need to perform additional routine characterization and monitoring of Pacific Northwest National Laboratory building effluents. The plan was developed using the effluent characterization and monitoring data and was completed in June 1996. Liquid effluent monitoring of the effluents from individual 300 Area facilities operated by Pacific Northwest National Laboratory was discontinued at the end of fiscal year 1995.

3.0 Liquid Waste Stream Characterization and Monitoring

This section summarizes information about the sampling and analysis processes used during calendar years 1994 and 1995. A comprehensive listing of all samples collected and analyses performed can be found in Appendix A. This section also includes a summary of quality control data and a discussion of data limitations.

3.1 Sampling Information

Samples were collected from March 22, 1994, through September 26, 1995. Table 3.1 summarizes the number of samples collected, sample types, and sampling periods at each facility. Sampling frequency ranged from weekly to once per month but was predominantly biweekly. Some samples were collected on weekends and holidays to provide background information on effluent contaminants. Although research project-related discharges were expected to be minimal on nonbusiness days, no restriction was placed on building activities, and the background sample data may have been influenced by some research discharges.

Table 3.1. Sampling Information

Location	# Samples	Sample Types	Dates (month/yr)
306	9	Composite	9/94 - 1/95
320	77	Composite/grab/background	3/94 - 9/95
324 PS	19	Composite	11/94 - 9/95
324 RPS	17	Composite	11/94 - 9/95
325	15	Composite	2/95 - 9/95
326 PS	25	Composite	8/94 - 9/95
326 RPS	2	Composite	9/95
327	2	Grab	9/95
331	80	Composite/grab/background	3/94 - 9/95
3720	76	Composite/grab/background	3/94 - 9/95
End-of-pipe	74	Composite/grab/background	4/94 - 9/95
PS = Process sewer. RPS = Retention process sewer.			

The majority of the samples were collected using automated, refrigerated samplers that were programmed to collect flow-proportional composite samples over a 24-hr period. However, 24-hr

time-proportional composite samples were collected at Buildings 306, 326, 327, and end-of-pipe (1994 only) because either an integrated sampler and flow meter were not available, or the flow was not consistent enough for flow-proportional sampling. In addition, several grab samples were collected from Buildings 320, 331, 3720, and end-of-pipe for volatile organic compound analyses during 1994.

Composite samples were subdivided for constituent analyses by Pacific Northwest National Laboratory's Field Sampling Team. Before shipping to an offsite or onsite laboratory for analysis, samples were screened for radioactivity to ensure the samples met shipping requirements. Samples were held in a locked, refrigerated facility during the time between collection and when the screening results were reported.

3.2 Analysis Information

The process used to identify constituents to characterize and monitor is described in Appendix B. Table 3.2 lists the constituents and the methods used for analysis. All of the methods are standard, approved procedures; most are U.S. Environmental Protection Agency (EPA) methods.

Table 3.2. Analytical Methods Used to Characterize Waste Stream Samples

Parameter	Method Number	Basis of Method
General Chemical Parameter		
Alkalinity	310.2[a]	Titrimetry
Chemical oxygen demand	410.4[a]	Colorimetry
Total dissolved solids	209B[b]	Gravimetry
Total carbon	D2579A[c]	Combustion/infrared absorption
Total organic carbon	9060[d]	Combustion/infrared absorption
Ammonia and Anions		
Ammonia	D1426C[c]	Colorimetry
Cyanide	9012[d]	Colorimetry
Sulfides	9030[d]	Titrimetry
Other anions	D4327-88[c]	Ion chromatography
Metals		
Arsenic	7060[d]	Atomic absorption
Lead	7421[d]	Atomic absorption
Mercury	7470[d]	Atomic absorption
Selenium	7740[d]	Atomic absorption
Thallium	7841[d]	Atomic absorption
Other metals	6010[d]	Inductively coupled plasma/atomic emission
Organic Compounds		
Volatile organics	8240[d], 502.2[e]	Gas chromatography/mass spectrometry
Semivolatile organics	8270[d]	Gas chromatography/mass spectrometry
Pesticides	8080[d]	Gas chromatography

Table 3.2. (continued)

Parameter	Method Number	Basis of Method
Phenols	8040[d]	Gas chromatography
Radiological Parameters		
Gross alpha	9310[d]	Liquid scintillation
Gross beta	9310[d]	Liquid scintillation
Tritium	906[f]	Liquid scintillation

(a) U.S. Environmental Protection Agency (EPA). 1983. *Methods for chemical analysis of water and wastes*, EPA/600/4-79/020, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio.

(b) American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1985. *Standard methods for the examination of water and wastewater*, 16th ed., American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D.C.

(c) American Society for Testing and Materials (ASTM). 1986. *Annual book of ASTM standards*, Volume 11.01 and 11.02. American Society for Testing Materials, Philadelphia, Pennsylvania.

(d) U.S. Environmental Protection Agency (EPA). 1986. *USEPA methods for evaluating solid waste: physical/ chemical methods*. SW-846, 3rd ed., Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Note: this method was used for all volatile organic samples collected before October 1, 1994.

(e) In-house method based on EPA method 502.2 (EPA 1983). This method was used on samples collected between October 1, 1994, and February 28, 1995.

(f) Krieger, HL and EL Whittaker. 1980. *Section 10, tritium in drinking water, method 906.0, prescribed procedures for measurement of radioactivity in drinking water*, EPA/600/4-80/032. U.S. Environmental Protection Agency, Cincinnati, Ohio.

Radiological screening and analyses were performed by Pacific Northwest National Laboratory's Analytical Chemistry Laboratory. Radiological analyses were also performed by IT Corporation (Richland, Washington). Most of the chemical assays were performed by DataChem Laboratories (Salt Lake City, Utah). However, volatile organic compound and anion analyses were performed by Pacific Northwest National Laboratory's Sigma 5 Laboratory on samples collected from October 1994 through February 1995.

3.3 Quality Assurance and Quality Control

Liquid effluent monitoring was performed under a quality assurance program based on a number of regulatory guidance documents as identified in Riley et al. (1995). These documents were used to prepare a quality assurance plan specifically for 300 Area liquid effluent monitoring that provided requirements for procedures, training, sample custody, analytical services, data handling, and other related areas.

A quality control plan was also developed that specified quality control elements to be used for evaluation of sample contamination and data precision and accuracy. These elements include sample

blanks, duplicate samples, blind standards, and interlaboratory comparisons. A brief summary of the data generated from these elements is provided in Sections 3.3.1 through 3.3.2.

3.3.1 Quality Control Blanks

Table 3.3 describes the five types of quality control blanks that were used to evaluate potential sources of sample contamination. In general, the frequencies at which blank samples were prepared and submitted to the laboratories for analysis varied by blank type from 1 per month to approximately 1 per 20 sampling events, as described in the program quality control plan. Laboratory reagent blanks were analyzed at a frequency of 1 per sample batch (i.e., typically 1 per 10 samples). The analytical results for the various types of quality control blanks are summarized in Table 3.4 and in Sections 3.3.1.1 through 3.3.1.4.

3.3.1.1 Laboratory Reagent Blanks

Total carbon, iron, lead, mercury, sodium, zinc, and methylene chloride were detected in the laboratory reagent blanks associated with 10% or more of the routine monitoring samples. However, the detection of mercury may have been false because of the trace levels involved and the fact that mercury was not seen in any bottle blanks. The detection of lead in 31% of the reagent blanks and in the bottle blanks at levels similar to effluent samples suggests that some of the positive routine monitoring results for lead may be artifacts of the sampling and analysis process. The detection frequency for methylene chloride was 58%, indicating frequent laboratory contamination. Thus, many of the positive effluent sample results for methylene chloride were probably false detections.

3.3.1.2 Bottle Blanks

Several constituents were detected in the bottle blanks at levels similar to those in effluent samples. The most significant of these were lead, acetone, chloroform, methylene chloride, tetrahydrofuran, and diethylphthalate. All were detected in two or more bottle blanks.

3.3.1.3 Equipment Blanks

Several constituents were detected in equipment blanks at concentrations similar to those in effluent samples (Table 3.4). However, with the exception of methylene chloride, the average concentrations were less than the average concentrations found in effluent samples.

3.3.1.4 Field Transfer Blanks and Trip Blanks

Acetone, methylene chloride, and toluene were detected in the field transfer blanks at levels similar to those in effluent samples. In addition, chloroform, tetrachloroethene, tetrahydrofuran, trichloroethene, and several metals were detected in trip blanks at concentrations similar to those in effluent samples.

Table 3.3. Quality Control Blank Types and Descriptions

Type	Description	Parameter Evaluated
Laboratory reagent blanks	A sample of reagent water that is carried through an entire analysis procedure	Laboratory contamination
Bottle blanks	A sample of reagent water that is poured into a sample bottle containing any preservatives used with actual field samples	Contamination from bottles and sample preservatives
Equipment blanks	A sample of reagent water that has been passed through and collected by an automated sampler	Contamination from sampling equipment
Field transfer blanks	A sample of reagent water that is poured at the sampling site into a sample bottle containing any preservatives used with effluent samples	Contamination from conditions at the sampling site
Trip blanks	A bottle blank that is transported out to the field (unopened at all times)	Contamination from bottles, preservatives, and sample handling

Table 3.4. Quality Control Blanks Summary

Parameter	Laboratory Reagent Blanks	Bottle Blanks	Equipment Blanks	Field Transfer Blanks	Trip Blanks
General Chemical Parameters					
Chemical oxygen demand			◇		
Total carbon	★	▾	▾		▾
Total organic carbon		▾	▾		▾
Anions					
Ammonia			◇		◇
Fluoride					◇
Nitrate		▾	◇		
Sulfides		◇			
Sulfate			▾		◇
Metals					
Aluminum		◇	◇		◇
Barium			▾		
Beryllium		◇	◇		◇
Cadmium			◇		

Table 3.4. (continued)

Parameter	Laboratory Reagent Blanks	Bottle Blanks	Equipment Blanks	Field Transfer Blanks	Trip Blanks
Calcium		▾	▾		▾
Chromium		◇	◇		◇
Copper					◇
Iron	★	◇	◇		◇
Lead	★	◇	◇		◇
Manganese			◇		◇
Mercury	★		◇		◇
Nickel					◇
Potassium			◇		
Sodium	★		▾		
Strontium			▾		
Thallium		◇			
Vanadium			◇		
Zinc	★	◇	◇		◇
Volatile Organic Compounds					
Acetone		◇	◇	◇	◇
Chloroform		◇	◇		◇
Methylene chloride	★	◇	◇	◇	◇
Tetrachloroethene					◇
Tetrahydrofuran		◇	◇		◇
Toluene		◇		◇	
Trichloroethene		▾			◇
Semivolatile Organic Compounds					
Adipic acid ester					◇
Benzyl alcohol					◇
2,4,6-Trichlorophenol		▾	◇		
Diethylphthalate		◇			
Phenol			◇		
Radiological Parameters					
Gross alpha			◇		
Gross beta			◇		
Tritium			◇		

★ = Detected in 10% or more of the laboratory reagent blanks.
▾ = Average concentration was below levels found in effluent samples.
◇ = Average concentration was greater than the minimum concentration found in one or more effluent samples.

3.3.2 Blind Standard Results

Two sets of spiked samples were prepared and submitted in triplicate to measure the laboratories' precision and accuracy. Table 3.5 summarizes the laboratories' results for these blind standards. Deviations greater than ±30% of the expected values were considered poor. Constituents and parameters which fell into this category included mercury, 2,4,6-trichlorophenol, 2-(2-butoxyethoxy)ethanol, and gross beta radiation. One result for lead also exceeded the control limits with a relative percent difference of 38%. The remaining results demonstrated acceptable accuracy and precision.

Table 3.5. Summary of Blind Quality Control Standard Results[a]

Parameter	Accuracy Range RPD[b]	Precision Range Standard Deviation of RPD[c]
Metals		
Copper	0 to -7	1 to 4
Lead	**-38**	NA
Mercury	**-40 to -70**	**8 to 36**
Sodium	-4 to 5	1 to 3
Zinc	-6 to 8	2 to 5
Anions		
Fluoride	0 to -10	4 to 6
Nitrate	0 to -6	0 to 1
Sulfate	0 to -5	0
Volatile Organic Compounds		
2-Butanone	-19	0
Chloroform	-13 to -16	2
Toluene	-19 to -24	4
Semivolatile Organic Compounds		
2,4,6-Trichlorophenol	**10 to -61**	**48**
2-(2-Butoxyethoxy)ethanol	**-34 to -39**	4
Radiological Parameters		
Gross alpha	-20 to 21	15
Gross beta	**11 to 185**	21 to 24

(a) Bold text indicates accuracy or precision exceeded the ±30% limits.
(b) Relative Percent Difference = [(Result - True Value)/True Value] x 100%.
(c) The standard deviation of the relative percent difference for samples submitted in triplicate.

3.4 Data Limitations

Characterization and monitoring of research facility liquid effluents is difficult because of the dynamic nature of research activities that contribute to facility discharges. Ideally, building effluents should be monitored continuously to provide information on concentrations of parameters and constituents in a real-time mode. However, financial and technological limitations restrict the frequency at which building effluents can be monitored. As noted in the previous characterization report (Riley et al. 1995), the adopted practice of weekly to monthly collection of 24-hr composite samples is at most sampling only 4 to 13% of the effluent discharged from a facility over the course of one month. This obviously results in a high degree of uncertainty in determining whether the waste streams are continuously in compliance with the waste acceptance or other compliance criteria.

Another limitation in the data arises from composite sampling. By their nature, composite samples actually represent a time- or flow-weighted average of the waste stream composition. Most of the composite samples collected during 1994 and 1995 were comprised of 80 to 100 200-mL aliquots of effluent. Thus, an individual aliquot containing a contaminant of concern could be diluted by a factor of 100 in an extreme case. Results from the 1995 field test at Building 331 showed that several grab samples collected based on high or low pH or conductivity readings had concentrations of selected metals and anions that were one to two orders of magnitude higher than had previously been found in composite samples (Riley et al. 1997, in press). Because most of the samples collected during 1994 and 1995 were composites, the data in this report should be recognized as potentially biased low compared to the actual composition of the waste streams during discharge events.

Additional negative bias resulting from analyte losses is likely in the case of data on volatile organic compounds. A hold-time study conducted during a 1995 field test showed that samples analyzed within 1 hour of collection had 1.5 to 3 times higher concentrations of volatile organic compounds than those analyzed 1.5 to 4 weeks later (Riley et al. 1997, in press). The study also showed that hold times can have a significant impact on the number of volatile organic compounds detected. The average hold time of most of the 1994 and 1995 routine monitoring samples was 11 $\pm$5 days. Thus, without regard to sampling limitations, the corresponding volatile organic compound data is probably biased low by a factor of 1.5 to 3 and likely contains several false nondetects.

A relatively small number of samples were collected at several locations, including the influent waters. Also, the time periods in which samples were collected from some locations was fairly short (Table 3.1). In these cases, the variability in the data may not be an accurate indication of long-term fluctuations in composition. Therefore, caution should be used when drawing conclusions from these data.

4.0 Results

This section summarizes all of the routine-monitoring data collected on facility effluents during calendar years 1994 and 1995. Results were divided into six classes: general chemical parameters (alkalinity, chemical oxygen demand, conductivity, pH, total carbon, total dissolved solids, and total organic carbon), ammonia and anions, metals, volatile organic compounds, semivolatile organic compounds, and radiological parameters. For simplicity, all of the data within each class were grouped together, even though different sample types (i.e., grabs and 24-hr flow- or time-proportional composites) were collected in some cases. Where possible, results were compared to the TEDF WAC and EPA maximum contaminant levels (MCLs) (i.e., primary drinking water standards). However, the reader should be aware that building effluents are not meant to be drinking water, and the comparisons with the MCLs are for reference only. In addition, exceedances of the WAC at the facility discharge points do not indicate noncompliance because the WAC are only applicable at end-of-pipe.

4.1 General Chemical Parameters

Summary data for general chemical parameters are presented in Table C.1. None of the parameters have regulatory standards of comparison; thus, building and end-of-pipe results were compared to each other and to treated influent data.

In general, the average alkalinity and chemical oxygen demand levels were not more than 25% greater than the treated influent values (i.e., 50 mg/L for alkalinity and 10 mg/L for chemical oxygen demand). Exceptions include alkalinity at Buildings 306 (66% higher), 326 (43% higher), and 331 (37% higher) and chemical oxygen demand at Buildings 325 (RPS only), 326, 331, and at end-of-pipe (approximately 4, 5, 2, and 1.3 times higher, respectively). Each of the three buildings with elevated chemical oxygen demand had one exceptionally high result that was greater than 100 mg/L.

Conductivity and total dissolved solids were strongly correlated at most locations and tended to fall within the respective ranges of 100 to 400 μmhos/cm and 70 to 200 mg/L. Several buildings had one or more conductivity excursions greater than 500 μmhos/cm. Building 320 had two extreme results (751 and 940 μmhos/cm), Building 324 had one such result (1,588 μmhos/cm), and Building 331 and end-of-pipe each had two exceptional results (641 and 920 μmhos/cm, and 583 and 5,110 μmhos/cm, respectively). Building 331 and end-of-pipe also had the highest individual total dissolved solids results: 480 and 730 mg/L.

Average facility waste stream pH levels ranged from 6.44 to 7.97, and most locations had a standard deviation of approximately 1 pH unit. Buildings 324 (PS and RPS), 325 (RPS only), 326 (PS only), 3720, and end-of-pipe had one or two results that were less than 5. High pH excursions above

9 were less common, occurring once at Building 320, once at Building 324 RPS, twice at Building 3720, and twice at end-of-pipe. Overall, Building 3720 had the largest pH range (i.e., 2.37 to 12.20).

Compared to the treated influent, most locations had slightly elevated (i.e., 25% higher) total carbon levels and 9 to 65% lower total organic carbon concentrations. However, four facilities had total carbon averages that were more than 40% higher than the treated influent: Buildings 306 (43% higher), 325 (RPS only; 41% higher), 326 (PS only; 99% higher), and 331 (42% higher). Moreover, these locations and the RPS at Building 326 also had total organic carbon levels that ranged from 22% (Building 306) to 203% higher (Building 326 RPS) than the treated influent.

Locations with background monitoring data (i.e., Buildings 320, 331, 3720, and end-of-pipe) tended to have significantly reduced general chemical parameter concentrations and smaller fluctuations in these concentrations during nonbusiness days. The only exception was at Building 331, which had an unusually low pH of 3.3 on July 18, 1994. The lowest business-day pH reading at Building 331 was 5.1. Altogether, the background data on all general chemical parameters suggests that most significant chemical discharges to the PS occur on normal working days.

4.2 Ammonia and Anions

Ammonia, cyanide, and nitrite are the only analytes in this class which are included in the WAC. EPA MCLs exist for cyanide, fluoride, nitrate, and nitrite. A summary of WAC and EPA MCL exceedences is presented in Table 4.1. Summary statistics on ammonia and all detected anions data are listed in Table C.2.

Cyanide concentrations exceeded the WAC of 50 μg/L in 3 out of 43 samples from Building 331. In all three cases, the cyanide concentration was 70 μg/L. Two of the results were obtained on the same day in duplicate samples. However, the elevated results at Building 331 were less than the EPA MCL of 200 μg/L. Cyanide was also detected in samples from Buildings 320, 324, 325 RPS, 326 (PS only), 3720, and end-of-pipe, but all of the results were below the WAC.

Samples analyzed from several locations had one or more elevated nitrate levels that were greater than the EPA MCL (i.e., 10 mg/L). The highest result, 310 mg/L, was found in a sample from the Building 325 RPS. Another Building 325 RPS sample also exceeded the MCL with a concentration of 31 mg/L. Nitrate concentrations in water samples from end-of-pipe exceeded the MCL 5 times, with concentrations ranging from 10.1 to 110 mg/L. Building 331 effluent had the greatest number of sample exceedances (9 times); levels ranged from 10.2 to 33.0 mg/L. Other locations where samples exceeded the MCL included Buildings 306, 320, 324 PS and RPS, 326 (PS only), and 3720 (Table 4.1). Background and influent nitrate concentrations were lower than those of all locations except the Building 326 RPS.

None of the waste stream ammonia, fluoride, or nitrite results were greater than the WAC or EPA MCLs. Ammonia was detected in samples from all facilities and had the highest average concentrations in samples from Buildings 326 PS (191 μg/L) and 331 (136 μg/L). Fluoride was also detected in samples from all locations; levels ranged from 200 to 1,100 μg/L. Nitrite was infrequently measured at 300 μg/L or less in samples from Buildings 325 RPS, 326, 331, and end-of-pipe.

Chloride concentrations varied widely among facilities. While maximum levels at most locations were within a factor of 2 of the average treated influent concentration (i.e., 4.7 mg/L), Buildings 326, 331, 3720, and end-of-pipe had excursions up to 40 times higher. Average chloride concentrations in samples from these four locations were 9.4, 10.9, 5.9, and 11.4 mg/L, respectively.

Elevated levels of phosphate (i.e., up to 81.7 mg/L) were observed in samples from Building 331. Phosphate was also infrequently detected in samples from Buildings 324, 326 PS and RPS, 3720, and end-of-pipe. Concentrations in the samples from these latter locations ranged from 0.4 to 3.0 mg/L.

Table 4.1. Waste Acceptance Criteria and U.S. Environmental Protection Agency Maximum Contaminant Level Exceedances: Ammonia and Anions

Constituent	WAC (μg/L)	EPA MCL (μg/L)	Location	# of WAC Exceedances	# of MCL Exceedances	# Samples Analyzed	Max. Conc. (μg/L)
Cyanide	50	200	331	3	0	43	70
Nitrate	—	10,000	306	—	2	7	14,200
			320	—	2	41	15,600
			324	—	1	16	59,000
			324 RPS	—	1	15	15,400
			325 RPS	—	2	12	310,000
			326	—	2	21	12,400
			331	—	9	43	33,000
			3720	—	3	40	32,000
			EOP	—	5	41	110,000

EOP = End-of-pipe.
EPA = U.S. Environmental Protection Agency.
MCL = Maximum contaminant level.
RPS = Retention process sewer.
WAC = Waste acceptance criteria.

4.3 Metals

Sixteen of the monitored metals are listed in the WAC: aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, and zinc. Primary drinking water standards also exist for antimony, arsenic, barium, beryllium, cadmium, chromium, mercury, nickel, selenium, and thallium. Table 4.2 contains a summary of WAC and EPA MCL exceedances. Frequencies of detection and concentration ranges, averages, and standard deviations for all detected metals are listed in Table C.3.

Aluminum exceeded the WAC of 418 μg/L in five samples from Building 331, with concentrations of 460, 480, 560, 580, and 630 μg/L. All five exceedances occurred between May 3, 1994, and August 23, 1994. The lower building average (147 μg/L) and background concentrations suggest that the exceedances resulted from research activities rather than building system sources. Average aluminum concentrations in samples from other locations ranged from 53 μg/L (Building 324 RPS) to 120 μg/L (Building 326 RPS). End-of-pipe had one result of 410 μg/L, which is 2% lower than the WAC.

Antimony concentrations were less than the WAC (100 μg/L) but greater than the EPA MCL (6 μg/L) in two samples from Building 320, in one background sample from Building 331, and in one sample from Building 3720. However, these results are tentative, because their low concentrations (33 to 42 μg/L) were near the method detection limit for antimony (24 μg/L). The method detection limit was raised by the analytical service laboratory to 62 μg/L in April 1995. Antimony was not detected in any samples from other monitoring locations.

Trace concentrations of cadmium and thallium were found infrequently at several locations. Cadmium exceeded the WAC of 10 μg/L in 1 out of 24 samples collected from the Building 326 PS. The EPA MCL for cadmium (5 μg/L) was also exceeded in two Building 326 samples. Cadmium was also detected in samples from Buildings 320, 326 RPS, 331, 3720, and end-of-pipe. Average concentrations were approximately 4 μg/L at all locations. Thallium levels equaled or slightly exceeded the MCL of 2 μg/L twice at Building 3720 and once at Buildings 324 (RPS only), 326 (PS only), and end-of-pipe. Slightly lower concentrations (i.e., 0.58 to 1.80 μg/L) of thallium were also found in samples from Buildings 306, 320, 324 PS, 325 (RPS only), and 331. However, none of the thallium results approached the WAC of 100 μg/L.

Chromium exceeded both the WAC and the EPA MCL in 1 out of 16 samples from the Building 324 RPS. The elevated concentration of 670 μg/L was approximately 13 times higher than the WAC (50 μg/L) and nearly 7 times greater than the MCL (100 μg/L). Chromium was also detected at much lower concentrations (i.e., 4.6 and 4.7 μg/L) in samples from the Building 324 RPS. Other locations whose samples had measurable levels of chromium included Buildings 306, 320, 324 PS, 325 RPS, 326, 331, 3720, and end-of-pipe. Average concentrations for these locations ranged from 5.0 μg/L (Building 306) to 12.5 μg/L (Building 331).

Copper exceeded the WAC of 80 μg/L in samples from four locations: Buildings 324 (RPS only), 326 (PS only), 331, and 3720. The highest concentration (1,400 μg/L) and greatest number of exceedances (11 out of 24 samples) were found in samples from Building 326. Most of the elevated concentrations (i.e., 9 out of 11) at Building 326 fell within the range 87 to 140 μg/L. Copper exceeded the WAC twice at Buildings 331 and 3720 with results of 110 and 930 μg/L (Building 331) and 130 and 1,701 μg/L (Building 3720). The WAC was also exceeded in 1 out of 16 samples from the Building 324 RPS with a concentration of 120 μg/L. However, most of the copper results (i.e., 80% or more) associated with the Building 324 RPS and Buildings 331 and 3720 were less than 40 μg/L. Low levels of copper (i.e., 3 to 72 μg/L) were also frequently observed in samples from all other locations; many of the results were probably associated with piping corrosion.

Iron and nickel concentrations exceeded the WAC (1,460 and 60 μg/L, respectively) in 1 sample out of 16 from the Building 324 RPS and in 1 sample out of 24 from the Building 326 PS. The elevated nickel results were also greater than the EPA MCL (100 μg/L) at both locations. The Building 324 RPS sample had 3,100 μg/L of iron and 480 μg/L of nickel, while the sample from Building 326 had 6,000 μg/L of iron and 340 μg/L of nickel. Iron was also frequently detected at all other monitored locations. Average iron concentrations varied by almost an order of magnitude, ranging from 36 μg/L at Building 320 to 354 μg/L at Building 306 (Table C.3). Trace amounts of nickel (i.e., 13 to 21 μg/L) were found in a small number (4 or less) of samples from Buildings 320, 324 PS, 326 RPS, 331, 3720, and end-of-pipe.

Levels of manganese were equal to or greater than the WAC of 60 μg/L in 4 out of 24 Building 326 PS samples. The highest concentration, 1,500 μg/L, was 25 times greater than the WAC and was measured in the same sample that contained the elevated iron and nickel concentrations. The other elevated results at Building 326 included 60, 86, and 280 μg/L. Manganese concentrations in samples from other locations were much lower, ranging from 0.86 to 36 μg/L.

Mercury exceeded the WAC (3 μg/L) and the EPA MCL (2 μg/L) in a duplicate sample pair (2 out of 15 samples) from the Building 325 RPS. The samples' concentrations were 6.6 and 6.7 μg/L. All of the other mercury results from the Building 325 RPS fell within the range 0.057 to 0.450 μg/L. Samples from Buildings 306, 320, 324 (PS and RPS), 326 (PS and RPS), 331, 3720, and end-of-pipe also had low levels of mercury. The average concentrations for most of these locations were less than 0.2 μg/L. Many of the results were close to the applicable detection limits (i.e., 0.05 μg/L for results before April 1, 1995, and 0.019 μg/L for all other data); thus, some may be false detections. However, the Building 326 RPS average was notably higher (0.67 μg/L) and was strongly influenced by one elevated result of 1.3 μg/L.

Silver exceeded the WAC of 20 μg/L with a concentration of 56 μg/L in one of two samples from the Building 326 RPS. However, silver was not detected in the second sample. Trace concentrations of silver (i.e., 3.6 to 7.1 μg/L) were also found in samples from Buildings 306, 320, 326 RPS, 331, and 3720. These latter results are suspect, however, because they were only slightly above the method detection limit of 3.6 μg/L.

Several locations had one or more zinc results that were equal to or greater than the WAC (i.e., 210 μg/L). The highest concentration (6,100 μg/L) and the most exceedances (8 out of 24 samples) were found in samples from the Building 326 PS. Zinc levels in samples from the RPS of Building 326 also exceeded the WAC twice (2 out of 2 samples) with results of 250 and 440 μg/L. Other locations with samples that exceeded the WAC included Buildings 306, 325 (RPS only), 327, 331, and 3720 (Table 4.2). Zinc concentrations in samples from the remaining locations (i.e., Buildings 320, 324, and end-of-pipe) generally fell within the range 10 to 120 μg/L. The frequent detection of zinc at all monitored locations and in background samples suggests that the source of zinc in many samples was corrosion of galvanized pipes or flux and solder used to join copper piping together.

None of the results for arsenic, barium, beryllium, lead, or selenium exceeded the WAC or EPA MCLs. All of the arsenic, beryllium, and selenium results were within a factor of 2 of the method detection limits; thus, these results probably include several false detections. Barium was frequently detected in samples from all locations with average concentrations ranging from 24 to 46 μg/L. Low levels of lead (i.e., 0.6 to 20 μg/L) were also found in samples from all locations.

Table 4.2. Waste Acceptance Criteria and U.S. Environmental Protection Agency Maximum Contaminant Level Exceedances: Metals

Constituent	WAC (μg/L)	EPA MCL (μg/L)	Location	# of WAC Exceedances	# of MCL Exceedances	# Samples Analyzed	Max. Conc. (μg/L)
Aluminum	418	—	331	5	—	44	630
Antimony	100	6	320	0	2	43	39
			331 (background)	0	1	5	42
			3720	0	1	43	33
Cadmium	10	5	326	1	2	24	14
Chromium	50	100	324 RPS	1	1	16	670
Copper	80	—	324 RPS	1	—	16	120
			326	11	—	24	1,400
			331	2	—	44	930
			3720	2	—	43	170
Iron	1460	—	324 RPS	1	—	16	3,100
			326	1	—	24	6,000
Manganese	60	—	326	4	—	24	1,500
Mercury	3	2	325 RPS	2	2	15	6.7
Nickel	60	100	324 RPS	1	1	16	480
			326	1	1	24	340
Silver	20	—	326 RPS	1	—	2	56

Table 4.2. (continued)

Constituent	WAC (μg/L)	EPA MCL (μg/L)	Location	# of WAC Exceedances	# of MCL Exceedances	# Samples Analyzed	Max. Conc. (μg/L)
Thallium	100	2	324 RPS	0	1	16	2.3
			326	0	1	20	2.9
			3720	0	1	43	2.0
			3720 (background)	0	1	5	2.0
			EOP	0	1	46	2.0
Zinc	210	—	306	1	—	8	280
			325 RPS	1	—	15	210
			326	8	—	24	6,100
			326 RPS	2	—	2	440
			327	1	—	2	250
			331	1	—	44	230
			3720	2	—	43	470

EOP = End-of-pipe.
EPA = U.S. Environmental Protection Agency.
MCL = Maximum contaminant level.
RPS = Retention process sewer.
WAC = Waste acceptance criteria.

4.4 Volatile Organic Compounds

Thirteen of the detected volatile organic compounds are included in the WAC: benzene, bromodichloromethane, bromoform, chlorobenzene, chloroform, 1,4-dichlorobenzene, ethylbenzene, methylene chloride, tetrachloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, toluene, and trichloroethene. In addition, EPA MCLs exist for benzene, chlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethene, ethylbenzene, styrene, tetrachloroethene, toluene, total trihalomethanes, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, and total xylenes. Table 4.3 summarizes the results that exceeded the WAC and EPA MCLs. The actual number of WAC and MCL exceedances may have been much higher than is indicated in Table 4.3 because of volatile organic compound losses that occur between the time samples are collected and analyzed (see Section 3.4). In fact, if one assumes the data is biased low by a factor of 3, the number of WAC exceedances for chloroform would have been 252. Similarly, bromodichloromethane and trichloroethene would have had 56 exceedances, methylene chloride would have had 10, and toluene would have had 5. Tabulated data on all detected volatile organic compounds are shown in Table C.4.

Chlorination of the influent (i.e., Columbia River) water introduces at least two and possibly as many as four trihalogenated byproducts (i.e., chloroform, bromodichloromethane, bromoform, and dibromochloromethane) into the building source water.

The first two trihalomethanes, chloroform and bromodichloromethane, were found in the treated influent and in facility effluents. Both compounds exceeded the WAC in samples from one or more locations. Chloroform was detected in 85% or more samples from all monitored facilities; average concentrations ranged from 1.6 μg/L (Building 326 RPS) to 20.2 μg/L (Building 320). The treated influent average was slightly higher at 22 μg/L. Locations whose chloroform concentrations exceeded the WAC (26 μg/L) included Buildings 320 (seven business day exceedances and three nonbusiness day exceedances), 324 PS (four exceedances), 324 RPS (one exceedance), 331 (three business day exceedences and one nonbusiness day exceedance), 3720 (two business day exceedances and one nonbusiness day exceedance), and the treated influent (one exceedance). Bromodichloromethane concentrations exceeded the WAC (4 μg/L) at Building 331 in three business day samples and in one nonbusiness day sample. Bromodichloromethane was also found between 0.5 and 3.3 μg/L in samples from Buildings 320, 324 PS and RPS, 331, 3720, and end-of-pipe.

Low concentrations of bromoform and dibromochloromethane were sporadically found at a few locations. Samples from Buildings 306 and 320 and end-of-pipe had bromoform levels ranging from 0.5 to 2.0 μg/L. Higher concentrations of bromoform (i.e., 15 and 26 μg/L) were measured in business and nonbusiness day samples from Building 331. Dibromochloromethane was detected in samples from Buildings 320, 324 PS and RPS, 331, 3720, and end-of-pipe; average concentrations ranged from 0.7 μg/L (Building 324 RPS) to 6.3 μg/L (nonbusiness day samples from Building 331). Although neither bromoform nor dibromochloromethane were found in samples of the treated influent (possibly because of the relatively small number of treated influent samples collected), both compounds may have been introduced into the source water during the treatment process.

The EPA MCL for total trihalomethanes (100 μg/L) was not exceeded at any location.

Methylene chloride was detected in samples from Buildings 306, 320, 326 PS only, 327, 331, 3720, end-of-pipe, and all of the source waters. However, most of these results were probably false detections because methylene chloride was also found at similar concentrations (i.e., 2 μg/L or less) in the majority of the laboratory reagent blanks. Two exceptions include a result of 9.7 μg/L in a Building 3720 sample and a result of 4.8 μg/L in a sample from Building 331. The former value exceeded the WAC and the EPA MCL (5 μg/L).

Toluene exceeded the WAC (9 μg/L) in 4 out of 63 samples from Building 3720, with concentrations of 9.7, 28, 33, and 410 μg/L. Much lower concentrations of toluene (i.e., 0.14 to 0.86 μg/L) were infrequently found in samples from Buildings 320 and 331, end-of-pipe, and the treated influent. However, these latter results are tentative because the concentrations were near the method detection limit for toluene (0.14 or 0.3 μg/L, depending on the analysis date and method of analysis).

Trichloroethene exceeded both the WAC (3 μg/L) and the EPA MCL (5 μg/L) in 1 out of 22 samples from the Building 326 PS. The sample's trichloroethene concentration was 5.9 μg/L. The regulatory standards of comparison were not exceeded at any other location, but Buildings 324, 326 RPS, 327, 331, 3720, and end-of-pipe had one or more trichloroethene results in the range 0.32 to 2.9 μg/L.

Moreover, trichloroethene was detected in almost all (i.e., 97%) of the business day and background samples from Building 3720.

None of the results for other detected volatile organic compounds with EPA MCLs or WAC (i.e., benzene, chlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethene, ethylbenzene, styrene, tetrachloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, or xylenes) exceeded either regulatory criteria. Furthermore, except for tetrachloroethene, all of the results for these compounds were less than 15% of the WAC or primary drinking water standard. End-of-pipe had one result of tetrachloroethene of 2 μg/L that was 40% of the EPA MCL (5 μg/L).

Several volatile solvents, including acetone, acetonitrile, tetrahydrofuran, 2-butanone, hexone, ethanol, and isopropanol, were occasionally found in the effluent samples from some buildings.

Acetone was observed most frequently and in samples from the most locations (i.e., all monitored buildings and end-of-pipe). In most cases, the acetone concentrations were less than 75 μg/L. However, the Building 325 RPS had one result of 100 μg/L, Building 326 PS had 12 results in the range from 77 to 2,535 μg/L, Building 331 had a result of 1,800 μg/L, and Building 3720 had four results ranging from 220 to 530 μg/L.

Significant concentrations of acetonitrile were found once in samples from Buildings 320, 331, 3720, and end-of-pipe. Levels ranged from 76 μg/L at end-of-pipe to 2,400 μg/L at Building 3720.

Tetrahydrofuran was detected with varying frequencies in samples from the source waters and Buildings 320, 326 PS only, 331, 3720, and end-of-pipe. While the tetrahydrofuran concentrations of the influent, Building 331, and end-of-pipe were similar to levels in the sample blanks (i.e., 3 to 17 μg/L), one result at Building 320 (36 μg/L) and two results at Building 3720 (31 and 406 μg/L) were significantly higher.

Hexone and 2-butanone were sporadically found in samples from Buildings 320, 326 PS, and 331. Hexone was also detected in samples from Buildings 324 PS and RPS, 325 RPS, 3720, and end-of-pipe. Most of the hexone results were less than 50 μg/L, although Building 320 had two elevated results of 57 and 110 μg/L. Concentrations of 2-butanone varied from 26 μg/L (Building 320) to 170 μg/L (Building 331).

Two alcohols, ethanol and isopropanol, were detected in samples from Buildings 326, 331, and 3720. Ethanol was also found in a sample from the Building 325 RPS, and isopropanol was detected in two end-of-pipe samples. In most cases, the average concentrations of both alcohols were reported as approximately 14 to 20 μg/L. However, the actual sample concentrations were probably 100 to 1000 times higher, due to limitations of the method of analysis (i.e., purge and trap gas chromatography/mass spectrometry) and the calibration procedure used by the analytical service laboratory. Exceptions include the isopropanol result at Building 326 (40,800 μg/L) and one of the isopropanol

Table 4.3. Waste Acceptance Criteria and U.S. Environmental Protection Agency Maximum Contaminant Level Exceedances: Volatile Organic Compounds

Constituent	WAC (μg/L)	EPA MCL (μg/L)	Location	# of WAC Exceedances	# of MCL Exceedances	# Samples Analyzed	Max. Conc. (μg/L)
Bromodichloromethane	4	100[(a)]	331	3	0	34	9.8
			331 (background)	1	0	8	9.5
Chloroform	26	100[(a)]	320	7	0	62	32
			320 (background)	3	0	12	30
			324	4	0	17	35
			324 RPS	1	0	15	28
			331	3	0	66	33
			331 (background)	1	0	10	26
			3720	2	0	63	32
			3720 (background)	1	0	10	40
			Treated influent	1	0	10	41
Methylene chloride	5	5	3720	1	1	63	9.7
Toluene	9	1000	3720	4	0	63	410
Trichloroethene	3	5	326	1	1	22	5.9

(a) 100 μg/L is the MCL for total trihalomethanes.
EPA = U.S. Environmental Protection Agency.
MCL = Maximum contaminant level.
RPS = Retention process sewer.
WAC = Waste acceptance criteria.

results at end-of-pipe (575 μg/L). These values were determined at Pacific Northwest National Laboratory using a more accurate calibration procedure for alcohols.

4.5 Semivolatile Organic Compounds

Twenty-two of the detected semivolatile organic compounds are listed in the WAC, and nine have EPA MCLs. Table 4.4 lists those compounds that exceeded either the WAC or the primary drinking water standards. Summary statistics on all detected semivolatile organic compounds are presented in Table C.5.

One or more phthalates were detected in samples from most of the monitored locations. Bis(2-ethylhexyl) phthalate was found at concentrations ranging from 0.44 to 38 μg/L in samples from Buildings 325 (RPS only), 326 (PS and RPS), 327, 331, 3720, and end-of-pipe. Several of these results exceeded the EPA MCL of 6 μg/L. Twelve end-of-pipe samples had exceedances, including two in background samples. Other locations where the samples exceeded the MCL for bis(2-ethylhexyl)

phthalate were Building 325 RPS (1 exceedance in 15 samples) and Buildings 331 (3 exceedances in 46 samples) and 3720 (2 exceedances in 42 samples). However, none of the results were greater than the WAC of 80 μg/L. A related compound, diethylphthalate, was found in up to three samples from Buildings 326 and 3720. While the concentration of diethylphthalate ranged from 0.81 to 6.6 μg/L in samples from Building 326, much higher levels (35 to 170 μg/L) were found in samples from Building 3720. The highest concentration, 170 μg/L, was greater than the EPA MCL of 100 μg/L. Three other phthalates, butylbenzylphthalate, di-n-butylphthalate, and di-n-octylphthalate, were also found at low concentrations (1.3 to 7.6 μg/L) in samples from one or more locations (Table 4.4). None of these results were greater than the EPA MCLs.

Several pesticides were found in samples from Buildings 326 (PS only), 331, and end-of-pipe. However, concentrations were generally less than 0.1 μg/L, and none of the results exceeded the WAC or EPA MCLs.

A number of unidentified or tentatively identified semivolatile organic compounds were found in building effluent samples; these results are not listed in the summary tables. The most predominant constituents in this category were several forms of butoxyethoxyethanol, which were found at all monitored locations and in several sample blanks at concentrations ranging from approximately 20 to 600 μg/L. Sample contamination is the suspected source of the butoxyethoxyethanol isomers.

Table 4.4. Waste Acceptance Criteria and U.S. Environmental Protection Agency Maximum Contaminant Level Exceedances: Semivolatile Organic Compounds

Constituent	WAC (μg/L)	EPA MCL (μg/L)	Location	# of WAC Exceedances	# of MCL Exceedances	# Samples Analyzed	Max. Conc. (μg/L)
Bis(2-ethylhexyl) phthalate	80	6	325 RPS	0	1	15	15
			331	0	3	46	6.4
			3720	0	2	42	8.6
			EOP	0	10	45	38
			EOP (background)	0	2	6	31
Diethylphthalate	—	100	3720	—	1	14	170

EOP = End-of-pipe.
EPA = U.S. Environmental Protection Agency.
MCL = Maximum contaminant level.
RPS = Retention process sewer.
WAC = Waste acceptance criteria.

4.6 Radiological Parameters

Gross alpha, gross beta, and tritium are all included in the WAC. EPA MCLs also exist for gross alpha and beta, but the limit for gross beta, 4 mrem/yr, is in annual dosage units that are difficult to compare with individual counting measurements. Table 4.5 lists the radiological parameters which exceeded the WAC and MCLs. A summary of all data on radiological parameters is given in Table C.6.

Building 3720 effluent samples had gross alpha radiation levels ranging from approximately 1 to 45 pCi/L, and 16 out of 52 results, including 3 from nonbusiness day samples, exceeded the WAC and MCL of 15 pCi/L. Gross alpha was also found in samples from most other monitored locations, including Buildings 306, 320, 324 (PS and RPS), 325 RPS, 326 PS, 327 RPS, 331, and end-of-pipe. Average levels at these sites were considerably lower than those at Building 3720, ranging from approximately 1 to 5 pCi/L.

Gross beta radiation was found in samples from most buildings and end-of-pipe (Table C.6). For the most part, the results fell between 2 and 10 pCi/L. However, higher results were observed in samples from the Building 327 RPS (20.6 pCi/L) and Buildings 306 (19.7 pCi/L), 331 (15.4 pCi/L), and 3720 (17.6 pCi/L). None of the gross beta levels exceeded the WAC of 50 pCi/L.

Because of the relatively high gross alpha and gross beta results as well as past practices and inventories at Building 3720, one Building 3720 sample was analyzed for several potential alpha and beta emitters. Specific isotopes included in the analyses were ^{241}Am, ^{60}Co, ^{137}Cs, ^{238}Pu, $^{239,240}Pu$, ^{106}Ru, ^{125}Sb, ^{90}Sr, ^{234}U, ^{235}U, and ^{238}U. The only three radionuclides detected were the three uranium isotopes, and the activity of the enriched form, ^{235}U, was negligible compared to the other two. As a result, the gross alpha radiation was attributed to residual ^{234}U and ^{238}U, which are probably adsorbed onto the building piping.

Low levels of tritium (200 to 1,080 pCi/L) were detected in samples from Buildings 306, 324, 325 RPS, 326, 327, 331, and end-of-pipe. However, many of the results were probably false detections, because the counting error was typically between 200 and 300 pCi/L.

Table 4.5. Waste Acceptance Criteria and U.S. Environmental Protection Agency Maximum Contaminant Level Exceedances: Radiological Parameters

Constituent	WAC (pCi/L)	EPA MCL (pCi/L)	Location	# of WAC Exceedances	# of MCL Exceedances	# Samples Analyzed	Max. Conc. (pCi/L)
Gross alpha	15	15	3720	13	13	47	44.6
			3720 (background)	3	3	5	28

EPA = U.S. Environmental Protection Agency.
MCL = Maximum contaminant level.
WAC = Waste acceptance criteria.

4.7 Facility Rankings

For each constituent class, the facilities were ordered according to the detection frequencies and concentrations of monitored chemicals and parameters. Appendix E contains a detailed description of the process used to calculate each facility's cumulative significance value (i.e., rank). Only those results for chemicals and parameters that are listed in the WAC and EPA MCLs were included in the analysis. Thus, a ranking for general chemical parameters was not determined. In addition, Building 327 was not included in the ordering, because only two samples from Building 327 were analyzed during 1994 and 1995. Plots of the facilities' significance values are shown in Figure 4.1. In general, a relatively high significance value indicates one or both of the following: frequent detection of one or more analytes and/or above-average concentrations of one or more analytes.

Buildings 325 (RPS) and 331 had the highest rankings for ammonia and anions. This was primarily the result of elevated nitrate concentrations in samples from both locations and relatively high levels of cyanide in three samples from Building 331. The Building 326 PS had the third-highest ranking because of the frequent detection of elevated levels of ammonia and nitrate in samples from that location.

The PS and RPS of Building 326 were ranked highest based on their samples' metals results. The PS had relatively high concentrations of copper, iron, manganese, nickel, and zinc, and the RPS had elevated manganese, silver, and zinc concentrations. The RPS of Building 325 had the third-highest significance value due to relatively high concentrations of mercury and zinc.

Based on the data on volatile organic compounds, Buildings 3720, 320, and 331 had the highest rankings. This resulted from elevated levels of toluene and methylene chloride in samples from Building 3720, the frequent observation of elevated chloroform concentrations in samples from Building 320, and above-average levels of bromodichloromethane and chloroform in samples from Building 331.

End-of-pipe and Building 331 had the highest semivolatile organic compound rankings. Phthalates and pesticides in samples from both locations had the largest influence on the rankings.

Relative to other facilities, Building 3720 had the highest levels of gross alpha radiation, which resulted in the highest ranking with respect to radiological parameters. Building 306 was ranked second because of above-average detection frequencies for gross alpha and gross beta and a relatively high average activity of gross beta.

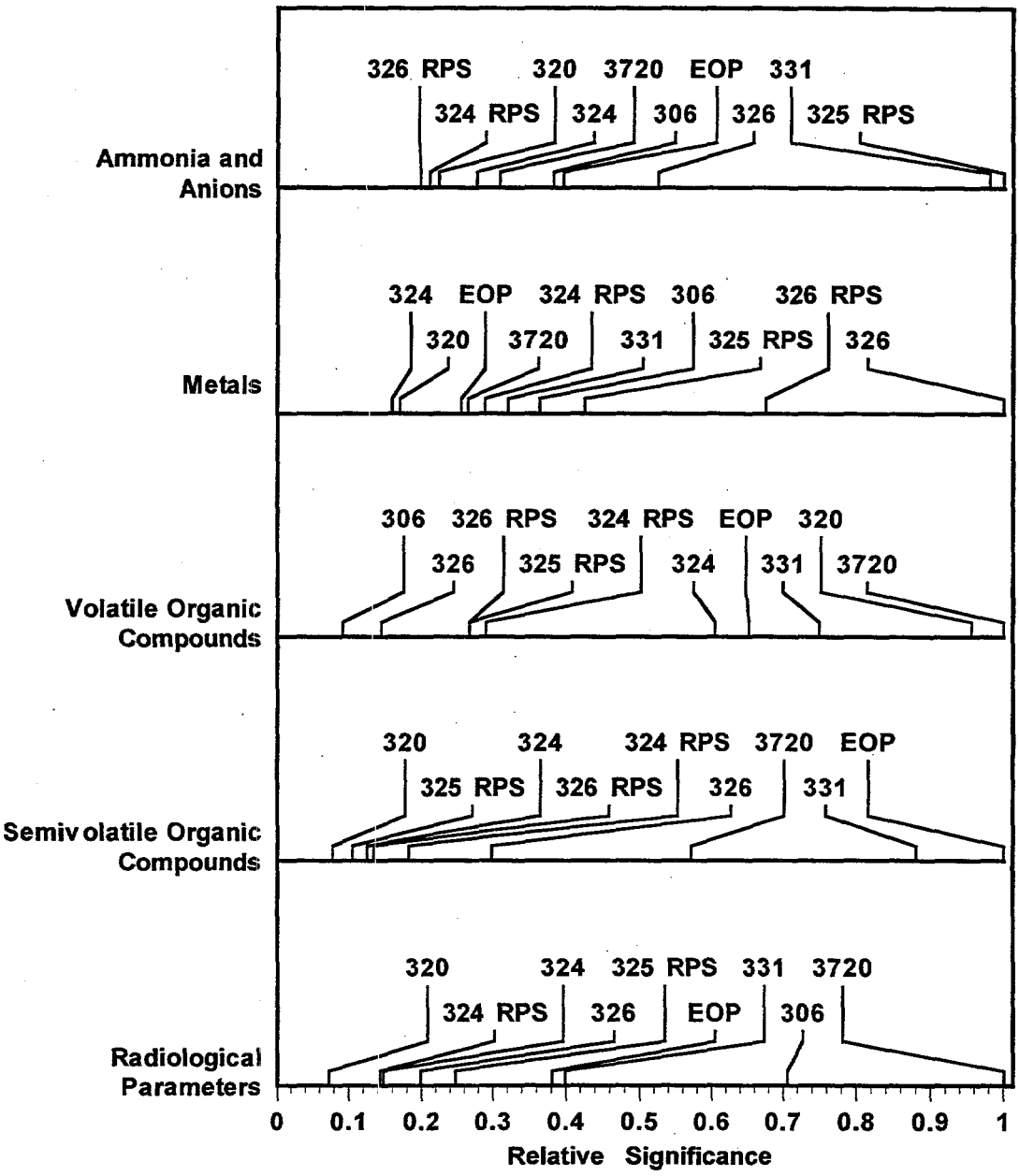

Figure 4.1. Significance Values for Facilities

5.0 Conclusions

During 1994 and 1995, Pacific Northwest National Laboratory's Facility Effluent Management Program characterized and monitored liquid waste streams from eight 300 Area research facilities and end-of-pipe for six general classes of parameters and constituents. The facilities were Buildings 306, 320, 324, 325, 326, 327, 331, and 3720. The six classes of constituents were 1) general chemical parameters, 2) ammonia and anions, 3) metals, 4) volatile organic compounds, 5) semivolatile organic compounds, and 6) radiological parameters. Baseline characterization data was also generated on building source waters and during nonbusiness days at four locations (Buildings 320, 331, 3720, and end-of-pipe) to help determine the waste stream contributions made by individual facilities. Building and end-of-pipe data were compared to the TEDF WAC and primary drinking water standards. Significant findings from these evaluations are summarized in the following paragraphs.

A variety of constituents were found in discharges from primary Pacific Northwest National Laboratory facilities. In general, the concentrations of these constituents were in the parts-per-billion (μg/L) to parts-per-million (mg/L) range. Many of the constituents were at levels low enough to meet drinking water standards. Although a number of constituents exceeded the WAC at the facilities, the end-of-pipe data suggests that the dispersion in the sewer system reduced the concentrations below the WAC by the time the pollutants reached the influent to TEDF.

Table 5.1 lists the number of times sample analyses indicated contaminant levels exceeded the TEDF WAC or EPA MCLs. The table also lists the total number of analyses performed. The PS of Building 326 had the most WAC exceedances (27). This number corresponds to only about 2% of the analyses that were performed for WAC constituents on Building 326 PS samples. Thus, most of the monitoring results at all locations indicated that pollutant concentrations were below the WAC. Other facilities with several exceedances were Buildings 3720 (24) and 331 (17). All other locations had seven or fewer WAC exceedances; Building 327 RPS and end-of-pipe had none. Most (i.e., approximately 75%) of the MCL exceedances were found in samples from Buildings 331, 3720, and end-of-pipe.

The constituent class with the greatest number of WAC exceedances was metals. However, the constituent class with the highest exceedances/analyses ratio was radiological parameters. This ratio ranged from 0% for semivolatile organic compounds to 2% for radiological parameters.

Assuming the data for volatile organic compounds is biased low by a factor of 3 (Riley et al. 1997, in press), the total number of additional MCL exceedances for volatile organic compounds was estimated to be 14, while the total number of additional WAC exceedances was estimated to be 297. This is 11 times more WAC exceedances than were actually detected. Fifty-four of the additional exceedances would have occurred at end-of-pipe for the compounds bromodichloromethane and chloroform. These compounds are introduced into building source water during chlorination of the influent.

Based on the quality control data, the WAC and MCL exceedances observed for some metals (i.e., antimony, cadmium, and thallium) are suspected to have been caused by sample contamination or false detection. Altogether, these metals had 1 WAC exceedance and 11 MCL exceedances.

Table 5.1. Summary of Waste Acceptance Criteria and Maximum Contaminant Levels Exceedances[a,b]

Location	Ammonia and Anions		Metals		Volatile Organic Compounds		Semivolatile Organic Compounds		Radiological Parameters	
	WAC	MCL	WAC	MCL	WAC	MCL	WAC	MCL	WAC	MCL
306		2/42	1/144							
320		2/284		2/976	7/729					
324		1/126			4/97					
324 RPS		1/82	4/324	3/324	1/57					
325 RPS		2/89	3/260	2/260				1/49		
326		2/174	26/500	5/500	1/185	1/185				
326 RPS			3/38							
327			1/28							
327 RPS										
331	3/418	9/418	8/973		6/819			3/607		
3720		3/317	4/993	2/993	7/866	1/866		3/179	13/97	13/97
EOP		5/399		1/986				10/329		
Total	3/1122	27/1122	50/4100	15/4100	26/2786	2/2786	0/1204	17/1204	13/650	13/650

(a) Values are listed as (number of exceedences)/(total number of analyses). Blank entries indicate no exceedences were observed.
(b) Exceedances observed in background samples were not included in the totals.
EOP = End-of-pipe.
MCL = Maximum contaminant level.
RPS = Retention process sewer.
WAC = Waste acceptance criteria.

6.0 References

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Appendix A

List of Samples Collected and Analyses Performed

Appendix A

List of Samples Collected and Analyses Performed

Table A.1. Code Interpretation

Code	Definition
Heading	
Alpha	Analysis include alpha and beta radioactivity
Grab	Noncomposited sample for volatile organic compounds analysis
ICP	Analysis includes inductively coupled plasma metals, arsenic, lead, selenium, and thallium
Comment	
BBL	Bottle Blank
BKG	Background Sample
CO	Unusual Water Color
CL	Composite Bottle Cleaned in Prep Laboratory
DUP	Duplicate
F	Unusual Field Conditions
FER	Transfer Blank
FTR	Full Trip Blank
LW	Low Water in Composite Bottle
M	Mechanical Problems
NW	No Water in Composite Bottle
NT	New Tubing
NB	New Bottle
P	Priority
QC	QC Report
R	Rapid
S	Scheduled
SC	Scheduled and Collected
SCL	Scheduled and Collected for Long List of Constituents
SE	Sediment in Composite Bottle
T	Less Than 24 Hour Composite
TE	Improper Sample Temperature
TRP	Trip Blank
W	Unusual Water Conditions
X	Misc

Table A.2. Summary of Composite and Grab Samples Collected and Analyzed During CY 1994 and 1995

Sample Site	Collection	GRAB	VOA	ABN	PHENOL	PEST PCB	ICP	HG	IONS	ALKA	AMMO	COD	CYAN	SULF	TC	TDS	TOC	ALPHA	TRIT	TYPE	COMMENT
306	9/27/94		SCL	S	S	S	SC	SC	S	S	S	S	S	S	SC	S	SC	SC	SC		LW
306	10/12/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
306	10/26/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
306	11/09/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
306	11/29/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
306	12/09/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		S/COAL DUST & F/COAL DUST/TRAFFIC
306	12/20/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
320	3/31/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			P
320	4/07/94		S	S			S	S	S	S	S	S	S	S	S	S	S	S			LW
320	4/12/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			F/CHLORINE SMELL
320	4/19/94		SC	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	4/26/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	5/03/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			QC
320	5/11/94	SCL	SCL	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	5/18/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	5/23/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
320	5/25/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	6/01/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	6/06/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
320	6/09/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	6/15/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	6/15/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		DUP	
320	6/20/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
320	6/21/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	6/28/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	7/06/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
320	7/08/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	7/12/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			QC
320	7/18/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
320	7/20/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			X/INFLUENT RICHLAND CITY
320	7/26/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	8/01/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	QC
320	8/04/94		S	S			S	S	S	S	S	S	S	S	S	S	S	S			NW
320	8/10/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	8/15/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
320	8/18/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	8/18/94		S	S			S	S	S	S	S	S	S	S	S	S	S	S		DUP	LW
320	8/23/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	8/31/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			

Table A.2. (continued)

Sample Site	Collection	GRAB	VOA	ABN	PHENOL	PEST PCB	ICP	HG	IONS	ALKA	AMMO	COD	CYAN	SULF	TC	TDS	TOC	ALPHA	TRIT	TYPE	COMMENT
320	9/06/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	9/15/94	SC	SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	9/21/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	9/27/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	10/12/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	10/26/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	11/09/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	11/29/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	12/09/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
320	12/20/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
324 PS	11/29/94		SCL	SCL			S	S	S	S	S	S	S	S	S	S	S	SC	S		LW
324 PS	12/09/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
324 PS	12/20/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
324 RPS	11/29/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
324 RPS	12/09/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
324 RPS	12/20/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
325 DIVE	5/20/94																				X/SCREEN ONLY
326 PS	8/31/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S	S		NW
326 PS	9/27/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
326 PS	10/12/94		SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
326 PS	10/26/94		SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
326 PS	11/09/94		SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
326 PS	11/29/94		SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
326 PS	12/09/94		SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
326 PS	12/20/94		SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
327 PS	12/20/94																	SC	SC		X/HAZ CHEM SAMPLES COLLECTED/HELD
327 RPS	12/20/94																	SC	SC		C/BROWN & X/HAZ CHEM SAMPLES COL
329	8/04/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S	S		NW
331	3/22/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			P & S/BROWN
331	3/30/94		SC	SC		SC	SC	SC	SC	SC	SC	S	SC	SC	SC	SC	SC	SC			S & X/COD BROKEN & P
331	4/06/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		S	
331	4/13/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	4/19/94		SC	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			

Table A.2. (continued)

Sample Site	Collection	GRAB	VOA	ABN	PHENOL	PEST PCB	ICP	HG	IONS	ALKA	AMMO	COD	CYAN	SULF	TC	TDS	TOC	ALPHA	TRIT	TYPE	COMMENT
331	4/26/94		SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		S
331	4/26/94		SCL	SCL		SC	SC	SC	SC	SC	SC		SC						SC	DUP	
331	5/03/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			C/MILKY
331	5/11/94	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	5/18/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			C/CLOUDY
331	5/23/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S			NW
331	5/25/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			C/MILKY
331	6/01/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	6/06/94	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
331	6/09/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	6/15/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	6/20/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
331	6/21/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	6/28/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	7/06/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
331	7/08/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	7/12/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	7/18/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
331	7/20/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			X/INFLUENT RICHLAND CITY
331	7/26/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	8/01/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S		BKG	NW
331	8/04/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			QC
331	8/10/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	8/15/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
331	8/18/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			QC
331	8/23/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			C/MILKY
331	8/23/94	SC	SC	SC		SC	SC	S	SC	S	S	SC	S	S	S	S	S	SC		DUP	LW
331	8/31/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S			NW
331	9/06/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	9/15/94		SC	SC		S	S	SC	SC	SC	SC	SC	S	SC	SC	S	SC	S			LW
331	9/21/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	9/27/94	SCL	SCL	SCL		SC	S	S	SC	SC	SC	SC	S	SC	SC	SC	SC	SC			LW
331	10/12/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	10/26/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	11/09/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	11/29/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
331	12/09/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			S/BROWN
331	12/20/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
340	6/15/94			SCL																	

Table A.2. (continued)

Sample Site	Collection	GRAB	VOA	ABN	PHENOL	PEST PCB	ICP	HG	IONS	ALKA	AMMO	COD	CYAN	SULF	TC	TDS	TOC	ALPHA	TRIT	TYPE	COMMENT
3720	3/30/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			P & R/RADS & S
3720	4/06/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	4/19/94		S	S			S	S	S	S	S	S	S	S	S	S	S	S			NW
3720	4/26/94		S	S			S	S	S	S	S	S	S	S	S	S	S	S			NW
3720	5/03/94		SC	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	5/11/94		SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	5/18/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	5/23/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
3720	5/25/94		SC	SC			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	6/01/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	6/06/94		S	S			S	S	S	S	S	S	S	S	S	S	S	S		BKG	NW
3720	6/09/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	6/15/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			F/GENERATOR RUNNING
3720	6/20/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
3720	6/21/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			QC
3720	6/28/94	SCL	SCL	SCL			SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	7/06/94	SCL	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
3720	7/08/94	SCL	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			C/LAVENDER
3720	7/12/94	SCL	SCL	S	S		SC	SC	SC	SC	SC	SC	S	S	SC	SC	SC	SC			LW
3720	7/12/94	SCL	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			DUP	LW
3720	7/18/94	SCL	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
3720	7/20/94		S	S	S		S	S	S	S	S	S	S	S	S	S	S	S			NW
3720	7/26/94	SCL	SCL	SCL	SC		SC	S	SC	SC	SC	SC	S	S	S	S	S	SC			LW
3720	8/01/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
3720	8/04/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	8/10/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	8/15/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
3720	8/18/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	8/23/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			C/PINK
3720	8/31/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	9/06/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	9/15/94	SC	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			QC
3720	9/21/94	SCL	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	9/27/94	SCL	SCL	SCL	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	9/27/94	SCL	SCL	SCL			SC		SC	SC	SC	SC	S	SC	SC		SC	SC		DUP	
3720	10/12/94		SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	10/26/94		S	S	S		S	S	S	S	S	S	S	S	S	S	S	S			M/ELECTRICAL OUT
3720	11/09/94		S	S	S		S	S	S	S	S	S	S	S	S	S	S	S			M/ELECTRICAL OUT
3720	11/29/94		SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
3720	12/09/94		SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			

Table A.2. (continued)

Sample Site	Collection	GRAB	VOA	ABN	PHENOL	PEST PCB	ICP	HG	IONS	ALKA	AMMO	COD	CYAN	SULF	TC	TDS	TOC	ALPHA	TRIT	TYPE	COMMENT
3720	12/20/94		SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
382B	8/04/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC				
EOP	4/06/94		SC	SC		S	SC	SC	SC	SC	S	S	SC	S	SC	S	SC	SC	SC		LW
EOP	4/14/94		SC	SC		S	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		LW
EOP	4/19/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S	S		NW
EOP	5/03/94		SCL	SCL		S	SC	SC	SC	SC	SC	SC	S	SC	SC	SC	SC	S	SC		LW & F/DIRTY
EOP	5/11/94		SCL	SCL		SC	SC	S	SC	S	S	SC	SC	SC	SC	SC	SC	SC	SC		LW & F/DIRTY
EOP	5/18/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
EOP	5/23/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	BKG	F/DIRTY
EOP	5/25/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
EOP	6/01/94		SCL	S		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		X/ABNL IN WRONG BOTTLE
EOP	6/06/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	BKG	
EOP	6/09/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
EOP	6/15/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
EOP	6/20/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	BKG	
EOP	6/21/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		
EOP	6/28/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S	S		NW
EOP	7/06/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S	S	BKG	NW
EOP	7/08/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	7/12/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	7/18/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	QC
EOP	7/20/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			X/INFLUENT RICHLAND CITY
EOP	7/26/94	SCL	SCL	SCL		SC	SC	S	S	SC	SC	SCSC	S	SC	SC	SC	S				LW
EOP	7/26/94	SCL	SCL	SCL		SC	SC	S	S	SC	S	SC	SC	S	SC	S	SC	SC		DUP	LW
EOP	8/01/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
EOP	8/01/94	SC	SC	SC		S	SC	S	SC	SC	SC	SC	SC	S	S	S	SC	SC		DUP	LW
EOP	8/04/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	8/10/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	8/15/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC		BKG	
EOP	8/18/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			S
EOP	8/23/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			QC
EOP	8/31/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	9/06/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	9/15/94	SC	SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	9/21/94	SCL	SCL	SCL	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	9/27/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	10/12/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	10/26/94		SC	SC		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	11/09/94		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	11/29/94		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			

Table A.2. (continued)

Sample Site	Collection	GRAB	VOA	ABN	PHENOL	PEST PCB	ICP	HG	IONS	ALKA	AMMO	COD	CYAN	SULF	TC	TDS	TOC	ALPHA	TRIT	TYPE	COMMENT
EOP	12/09/94		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC			
EOP	12/20/94		S	S		S	S	S	S	S	S	S	S	S	S	S	S	S			NW
RIVER	5/11/94	SCL	SCL	SCL		SC	SC	S	S	S					SC	S	SC				LW
RIVER	5/25/94	SC	SCL	SCL		SC	SC	SC	SC	SC					SC	SC	SC				
RIVER	6/09/94	SCL	SCL	SCL		SC	SC	SC	SC	SC					SC	SC	SC				
RIVER	6/21/94	SCL	SCL	SCL		SC	SC	SC	SC	SC					SC	SC	SC				
RIVER	7/08/94	SCL	SCL	SCL		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC				QC
TREAT MENT	5/11/94	SCL	SCL	SCL		SC	S	S	SC	S					SC	S	SC				LW & F/GENERATOR RUNNING
TREAT MENT	5/25/94	SC	SCL	SCL		SC	SC	SC	SC	SC			SC	SC	SC						
TREAT MENT	6/01/94																				
TREAT MENT	6/09/94	SCL	SCL	SCL		SC	SC	SC	SC	SC			SC	SC	SC						
TREAT MENT	6/21/94	SCL	SCL	SCL		SC	SC	SC	SC	SC			SC	SC	SC						
TREAT MENT	7/08/94	SCL	SCL	SCL		SC1	SC	SC	SC	SC	SC	SC	SC	SC1	SC	SC	SC				LW

Appendix B

Process Used to Identify Constituents to Characterize and Monitor

Appendix B

Process Used to Identify Constituents to Characterize and Monitor

In early April 1993, the Pacific Northwest National Laboratory's Facility Effluent Monitoring Program manager sent a memo to all users of U.S. Department of Energy-owned and Pacific Northwest National Laboratory-operated facilities that discharge liquid wastes to the process and retention process sewers in the 300 Area. The memo described the goals and objectives of the liquid effluent monitoring task and requested the users to attend a follow-up meeting to discuss sewer usage. Approximately 2 weeks after the memo was distributed, members of the liquid effluent monitoring task team met with building managers, group leaders, and senior researchers from these facilities. The audience was further briefed on the goals and objectives of the task, and time was allowed for questions. At the end of the meeting, the users were asked to complete a wastewater discharge survey form and return it within 2 weeks. To facilitate cooperation, information was collected in an anonymous fashion. The survey requested information on types, concentrations, and volumes of liquid wastes discharged to process and retention process sewers during conduct of their work.

The survey information was compiled into a table that listed material discharged by building. The table included volumes of liquid waste discharged, estimated concentrations of constituents in the discharge, and the frequency of discharges. Information from the table was compared against constituents listed in 1) the Westinghouse Hanford Company waste acceptance criteria, 2) U.S. Environmental Protection Agency drinking water standards, and 3) proposed discharge limits in the National Pollutant Discharge Elimination System permit under negotiation with the U.S. Environmental Protection Agency for the operation of the 300 Area Treated Effluent Disposal Facility. From this comparison, a list of targeted constituents was identified for characterizing and monitoring as part of the routine liquid effluent monitoring subtask. The classes of parameters and constituents identified for monitoring are summarized in Table B.1. In some instances, nonregulated constituents were included on the list because the task team believed they should be monitored based upon responsible management practices. The targeted constituent list was used to establish methods for sample collection and specify analytical methods for the conduct of analyses to be performed by the analytical services contractors.

Table B.1. Classes of Parameters and Constituents Identified for Monitoring

General Chemical Parameters
alkalinity chemical oxygen demand conductivity pH total carbon total dissolved solids total organic carbon
Ammonia and Anions
ammonia cyanide sulfides other anions amendable to analysis by ion chromatography
Metals
heavy metals common cations
Volatile Organic Compounds
Semivolatile Organic Compounds
acids/bases/neutrals
pesticides
Radiological Parameters
gross alpha gross beta tritium

Appendix C

Analytical Results Listed by Constituent Class

Appendix C

Analytical Results Listed by Constituent Class

This appendix contains tabulated information on the parameters and constituents detected in building effluent, end-of-pipe, and influent samples. For each constituent, the data from all monitored locations are grouped together to simplify comparison of results. Appendix D contains the same information grouped by monitoring location.

Parameters and constituents that were analyzed for but never detected in samples from a given location are not included in the tables. Thus, the absence of results for a location does not necessarily mean that analyses were not performed. Appendix A lists the analyses that were performed on all of the samples.

Table C.1. General Chemical Parameters

Parameter	Location [a]	Frequency [b]	Concentration (µg/L)[c]		
			Range	Average	Standard Deviation
Alkalinity					
	306	7/7	60000 - 120000	82857	24976
	320	38/38	6000 - 130000	58447	20091
	320 (background)	6/6	40000 - 70000	51000	10040
	324	8/8	40000 - 60000	52500	7071
	324 RPS	7/7	48000 - 120000	62429	25896
	325 RPS	5/5	30000 - 50000	43400	8473
	326	13/13	20000 - 130000	71385	32989
	331	45/45	40000 - 130000	68322	19929
	331 (background)	5/5	45000 - 50000	48200	2049
	3720	43/43	30000 - 120000	55744	14821
	3720 (background)	5/5	40000 - 70000	51200	11189
	EOP	34/34	40000 - 140000	59618	19920
	EOP (background)	6/6	40000 - 70000	54500	12550
	Untreated influent	4/4	48000 - 60000	52000	5416
	Treated influent	4/4	40000 - 60000	50000	11547
	Alternate influent	1/1	—	70000	—
Chemical Oxygen Demand					
	306	7/7	4500 - 13000	9014	2835
	320	9/38	2600 - 13000	6311	3419
	324	5/8	3000 - 6400	4520	1270
	324 RPS	4/7	2800 - 8800	6100	3156
	325 RPS	3/4	6000 - 110000	42333	58654
	326	12/13	4000 - 360000	49583	100847
	331	32/38	6000 - 140000	21938	24314
	331 (background)	2/5	7000 - 8000	7500	—
	3720	27/36	3000 - 51000	11552	10584
	EOP	24/34	4700 - 84000	13421	15834
	EOP (background)	1/6	—	9000	—
	Untreated influent	1/1	—	9000	—
	Treated influent	1/1	—	10000	—
Conductivity					
	306	8/8	168 - 324	228	55
	320	31/31	58 - 940	208	182
	320 (background)	5/5	128 - 151	138	10
	324	20/20	131 - 1588	255	325

Table C.1. (continued)

Parameter	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Conductivity (continued)	324 RPS	17/17	135 - 387	183	68
	325 RPS	15/15	92 - 249	155	35
	326	23/23	98 - 347	198	71
	326 RPS	2/2	191 - 202	197	—
	327	2/2	227 - 365	296	—
	327 RPS	1/1	—	364	—
	331	34/34	72 - 920	250	154
	331 (background)	4/4	155 - 180	167	11
	3720	36/36	123 - 467	197	95
	3720 (background)	5/5	122 - 146	136	9
	EOP	36/36	125 - 5110	488	1141
	EOP (background)	4/4	125 - 162	145	16
	Untreated influent	3/3	103 - 125	116	12
	Treated influent	3/3	116 - 133	126	9
	Alternate influent	4/4	160 - 187	172	13
pH					
	306	8/8	6.2 - 8.29	7.39	0.87
	320	31/31	5.5 - 10	7.9	0.8
	320 (background)	5/5	7.55 - 8.33	7.82	0.30
	324	20/20	4.8 - 8.15	7.12	1.08
	324 RPS	17/17	4.61 - 9.3	7.43	1.07
	325 RPS	15/15	3.94 - 8.59	7.55	1.28
	326	23/23	1.77 - 8.89	7.27	1.53
	326 RPS	2/2	7.72 - 8	7.86	—
	327	2/2	7.04 - 8.03	7.54	—
	327 RPS	1/1	—	6.49	—
	331	34/34	5.1 - 8.84	7.59	0.85
	331 (background)	4/4	3.3 - 7.64	6.44	2.10
	3720	36/36	2.37 - 12.2	7.75	1.51
	3720 (background)	5/5	5.31 - 8.32	7.32	1.16
	EOP	37/37	4.63 - 9.13	7.97	0.82
	EOP (background)	4/4	6.26 - 8.3	7.50	0.87
	Untreated influent	3/3	6.66 - 7.27	6.94	0.31
	Treated influent	3/3	6.31 - 7.22	6.70	0.47
	Alternate influent	4/4	7.03 - 8.15	7.80	0.52

Table C.1. (continued)

Parameter	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
pH (continued)	306	8/8	18000 - 30000	22625	4534
	320	38/38	11000 - 31000	16079	3982
	320 (background)	6/6	12000 - 16000	13333	1633
	324	8/8	13000 - 16000	14750	1035
	324 RPS	6/6	14000 - 30000	17333	6250
	325 RPS	4/4	12000 - 46000	22250	15924
	326	13/13	13000 - 120000	31462	28582
	331	38/38	14000 - 76000	22368	9971
	331 (background)	5/5	13000 - 15000	13800	837
	3720	35/35	12000 - 30000	17800	4269
	3720 (background)	5/5	11000 - 17000	13800	2168
	EOP	34/34	13000 - 42000	17882	5370
	EOP (background)	5/5	12000 - 17000	13800	1924
	Untreated influent	5/5	16000 - 21000	18200	2280
	Treated influent	5/5	13000 - 19000	15800	2588
	Alternate influent	1/1	—	17000	—
Total dissolved solids	306	7/7	100000 - 180000	137143	34017
	320	38/38	70000 - 210000	101579	31324
	320 (background)	6/6	80000 - 110000	93333	10328
	324	8/8	80000 - 100000	88750	8345
	324 RPS	6/6	90000 - 200000	108333	44907
	325 RPS	5/5	70000 - 90000	82000	8367
	326	13/13	80000 - 210000	128462	49134
	331	43/43	90000 - 480000	143488	62369
	331 (background)	5/5	90000 - 120000	102000	10954
	3720	41/41	80000 - 190000	106341	22667
	3720 (background)	5/5	90000 - 100000	96000	5477
	EOP	32/32	80000 - 730000	142813	136694
	EOP (background)	5/5	90000 - 100000	92000	4472
	Untreated influent	4/4	80000 - 90000	82500	5000
	Treated influent	4/4	80000 - 90000	82500	5000
	Alternate influent	4/4	90000 - 110000	97500	9574
Total organic carbon	306	8/8	2000 - 15000	4625	4307
	320	39/39	1000 - 3000	1756	627

Table C.1. (continued)

Parameter	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Total organic carbon (continued)	320 (background)	6/6	1000 - 2000	1500	548
	324	19/19	1000 - 3700	2132	910
	324 RPS	15/15	600 - 3000	1313	665
	325 RPS	14/15	1400 - 31000	4850	7630
	326	20/20	2000 - 110000	10560	23947
	326 RPS	2/2	3000 - 20000	11500	—
	327	2/2	1600 - 2700	2150	—
	331	44/44	2000 - 61000	6539	8969
	331 (background)	5/5	2000 - 3000	2400	548
	3720	42/42	1000 - 16000	2876	2539
	3720 (background)	5/5	1000 - 3000	1800	837
	EOP	46/46	1000 - 36000	3470	5054
	EOP (background)	6/6	2000 - 3000	2167	408
	Untreated influent	5/5	3000 - 7000	4400	1517
	Treated influent	5/5	3000 - 5000	3800	837
	Alternate influent	4/4	1500 - 2700	2100	497

(a) Building number, end-of-pipe (EOP), or influent type.

(b) Number of samples with detectable concentrations/total number of samples analyzed.

(c) Conductivity units are µmhos/cm.

Table C.2. Ammonia and Anions

Constituent	Location [a]	Frequency [b]	Concentration (µg/L)		
			Range	Average	Standard Deviation
Ammonia					
	306	4/7	40 - 100	58	29
	320	4/43	30 - 40	33	5
	320 (background)	1/6	—	50	—
	324	4/19	30 - 40	38	5
	324 RPS	5/15	40 - 80	50	17
	325 RPS	6/15	30 - 200	70	64
	326	14/24	40 - 500	191	144
	326 RPS	1/2	—	40	—
	327	1/2	—	50	—
	331	34/45	30 - 1000	136	226
	331 (background)	3/5	23 - 30	28	4
	3720	7/43	30 - 100	63	35
	3720 (background)	1/5	—	23	—
	EOP	13/43	23 - 100	45	22
	EOP (background)	1/6	—	60	—
	Alternate influent	1/4	—	30	—
Bromide					
	326 RPS	1/2	—	350	—
	327	1/2	—	140	—
	331	2/42	140 - 200	170	—
	331 (background)	1/5	—	110	—
	EOP	2/40	100 - 200	150	—
Chloride					
	306	7/7	4740 - 11700	7331	2549
	320	41/41	2100 - 11800	4678	1781
	320 (background)	6/6	1800 - 5500	4400	1308
	324	16/16	2920 - 5300	3943	856
	324 RPS	15/15	2800 - 12000	4376	2259
	325 RPS	12/12	2700 - 5100	3937	845
	326	21/21	2900 - 84500	9490	17384
	326 RPS	2/2	3100 - 3800	3450	—
	327	2/2	5100 - 9300	7200	—
	331	43/43	3600 - 167000	10940	24465
	331 (background)	5/5	4700 - 6800	6060	847
	3720	40/40	2200 - 32000	5911	4559

Table C.2. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Chloride (continued)	3720 (background)	5/5	1900 - 5800	4100	1409
	EOP	41/41	2500 - 190000	11369	28900
	EOP (background)	6/6	2200 - 6100	4650	1909
	Untreated influent	4/4	1000 - 1200	1075	96
	Treated influent	5/5	4000 - 5700	4740	709
	Alternate influent	4/4	1800 - 2900	2550	507
Cyanide	320	2/39	2 - 20	11.0	—
	324	1/19	—	1.0	—
	325 RPS	1/15	—	2.0	—
	326	1/20	—	2.0	—
	331	33/43	1 - 70	16.5	19.7
	331 (background)	2/5	2 - 8	5.0	—
	3720	5/40	1 - 10	4.4	3.5
	EOP	9/45	1 - 5	2.7	1.2
Fluoride	306	6/7	231 - 459	351	107
	320	38/41	230 - 700	475	130
	320 (background)	6/6	200 - 900	600	228
	324	16/16	300 - 600	422	89
	324 RPS	15/15	228 - 600	368	92
	325 RPS	12/12	300 - 700	432	131
	326	21/21	265 - 600	403	98
	326 RPS	2/2	300 - 500	400	—
	327	2/2	500 - 700	600	—
	331	43/43	300 - 1100	636	151
	331 (background)	5/5	600 - 800	700	71
	3720	40/40	200 - 1000	506	161
	3720 (background)	5/5	200 - 800	560	219
	EOP	40/41	200 - 940	545	159
	EOP (background)	6/6	200 - 800	517	256
	Untreated influent	4/4	100 - 400	225	126
	Treated influent	5/5	500 - 600	540	55
	Alternate influent	4/4	200 - 300	225	50
Nitrate	306	7/7	1450 - 14200	7913	4847

Table C.2. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Nitrate (continued)	320	41/41	100 - 15600	1711	3229
	320 (background)	6/6	200 - 1700	733	528
	324	16/16	300 - 59000	4227	14608
	324 RPS	15/15	300 - 15400	1652	3826
	325 RPS	12/12	300 - 310000	28983	88927
	326	21/21	400 - 12400	3451	3632
	326 RPS	2/2	390 - 400	395	—
	327	2/2	2200 - 5100	3650	—
	331	43/43	300 - 33000	6065	7855
	331 (background)	5/5	300 - 2700	1200	1005
	3720	40/40	400 - 32000	3513	5635
	3720 (background)	5/5	500 - 1000	720	192
	EOP	41/41	200 - 110000	6105	18180
	EOP (background)	6/6	500 - 900	733	186
	Untreated influent	3/4	200 - 300	267	58
	Treated influent	4/5	100 - 500	325	171
	Alternate influent	4/4	400 - 700	593	142
Nitrite	325 RPS	2/11	—	300	—
	326	3/12	—	200	0
	331	2/35	110 - 130	120	—
	EOP	1/34	—	200	—
Phosphate	324	2/16	715 - 3010	1863	—
	326	1/21	—	1060	—
	326 RPS	1/2	—	700	—
	331	31/43	212 - 81700	7077	14622
	331 (background)	1/5	—	2200	—
	3720	2/40	598 - 800	699	—
	EOP	10/41	383 - 1860	777	493
Sulfate	306	7/7	13400 - 22600	17457	2881
	320	41/41	10000 - 23500	16256	2190
	320 (background)	6/6	8500 - 18000	15583	3584
	324	16/16	12900 - 19000	15963	1977
	324 RPS	15/15	12000 - 23800	15653	2960

Table C.2. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Sulfate (continued)	325 RPS	12/12	12000 - 17000	15383	1646
	326	21/21	13000 - 53000	22752	12350
	326 RPS	2/2	14000 - 20000	17000	—
	327	2/2	27000 - 45000	36000	—
	331	43/43	10000 - 47900	19251	5797
	331 (background)	5/5	17000 - 21000	19000	1871
	3720	40/40	8500 - 28000	15733	3206
	3720 (background)	5/5	15000 - 40000	20600	10877
	EOP	41/41	10000 - 36900	18402	4372
	EOP (background)	6/6	10000 - 20000	15667	4179
	Untreated influent	4/4	8500 - 10000	9000	707
	Treated influent	5/5	16000 - 17000	16200	447
	Alternate influent	4/4	8500 - 14000	12125	2462
Sulfides	306	3/7	220 - 300	273	46
	320	9/38	220 - 400	296	50
	320 (background)	4/6	200 - 300	225	50
	324	1/8	—	300	—
	324 RPS	3/7	300 - 400	357	51
	326	3/13	220 - 400	307	90
	331	12/38	200 - 400	235	64
	331 (background)	1/5	—	300	—
	3720	11/34	200 - 300	231	37
	3720 (background)	3/5	200 - 300	267	58
	EOP	8/32	200 - 400	283	63
	EOP (background)	2/5	—	200	—
	Untreated influent	1/1	—	300	—

(a) Building number, end-of-pipe (EOP), or influent type.

(b) Number of samples with detectable concentrations/total number of samples analyzed.

Table C.3. Metals

Constituent	Location [a]	Frequency [b]	Concentration (µg/L)		
			Range	Average	Standard Deviation
Aluminum					
	306	6/8	33 - 190	74	60
	320	39/43	29 - 170	66	34
	320 (background)	6/6	26 - 80	54	19
	324	16/19	31 - 100	58	19
	324 RPS	12/16	39 - 74	53	11
	325 RPS	11/15	37 - 170	78	46
	326	19/24	29 - 180	64	38
	326 RPS	1/2	—	120	—
	327	2/2	36 - 85	61	—
	331	43/44	22 - 630	147	159
	331 (background)	5/5	56 - 81	70	11
	3720	40/43	21 - 190	70	33
	3720 (background)	5/5	42 - 77	55	16
	EOP	46/47	40 - 410	92	64
	EOP (background)	6/6	36 - 89	62	19
	Untreated influent	5/5	36 - 260	93	94
	Treated influent	4/4	51 - 93	75	19
Antimony					
	320	2/43	37 - 39	38	—
	331 (background)	1/5	—	42	—
	3720	1/43	—	33	—
Arsenic					
	306	1/8	—	2.8	—
	320	1/39	—	0.73	—
	320 (background)	1/6	—	2.0	—
	324	1/19	—	2.1	—
	331	5/44	2 - 3	2.4	0.5
	3720	1/43	—	2.0	—
	EOP	2/46	2 - 3	2.5	—
	EOP (background)	1/6	—	2.0	—
	Untreated influent	2/5	—	2.0	—
Barium					
	306	8/8	26 - 43	34	5
	320	43/43	16 - 46	29	5
	320 (background)	6/6	15 - 31	27	6

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Barium (continued)	324	19/19	23 - 32	27	2
	324 RPS	16/16	21 - 48	28	7
	325 RPS	15/15	21 - 31	25	3
	326	24/24	21 - 100	33	17
	326 RPS	2/2	20 - 27	24	—
	327	2/2	37 - 55	46	—
	331	44/44	17 - 48	29	6
	331 (background)	5/5	28 - 33	30	2
	3720	43/43	14 - 66	29	8
	3720 (background)	5/5	15 - 28	24	5
	EOP	47/47	15 - 130	31	18
	EOP (background)	6/6	16 - 31	25	7
	Untreated influent	5/5	27 - 33	29	2
	Treated influent	4/4	27 - 30	28	1
	Alternate influent	4/4	12 - 25	21	6
Beryllium	306	1/8	—	0.19	—
	320	5/43	0.17 - 0.68	0.34	0.21
	324	2/19	0.19 - 0.38	0.29	—
	324 RPS	1/16	—	0.24	—
	326	4/24	0.19 - 0.26	0.21	0.03
	331	1/44	—	0.19	—
	3720	1/43	—	0.18	—
	EOP	3/47	0.19 - 0.68	0.40	0.25
Boron	326 RPS	1/2	—	210	—
Cadmium	320	2/43	3.5 - 4.3	3.9	—
	320 (background)	1/6	—	3.6	—
	326	6/24	1 - 14	4.2	5.0
	326 RPS	1/2	—	4.9	—
	331	2/44	—	3.4	—
	3720	3/43	—	4.0	0.0
	3720 (background)	1/5	—	3.3	—
	EOP	2/47	1 - 2.3	1.6	—
	EOP (background)	1/6	—	3.4	—

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Calcium					
	306	8/8	22000 - 41000	29500	6845
	320	43/43	16000 - 44000	21372	5464
	320 (background)	6/6	18000 - 22000	19333	1366
	324	19/19	16000 - 22000	19211	1782
	324 RPS	16/16	16000 - 45000	20375	6781
	325 RPS	15/15	15000 - 21000	17800	1821
	326	24/24	14000 - 43000	23917	7967
	326 RPS	2/2	20000 - 21000	20500	—
	327	2/2	35000 - 47000	41000	—
	331	44/44	16000 - 43000	23568	6274
	331 (background)	5/5	19000 - 21000	20000	1000
	3720	43/43	16000 - 43000	21674	4664
	3720 (background)	5/5	19000 - 21000	19600	894
	EOP	47/47	14000 - 100000	24085	14059
	EOP (background)	6/6	19000 - 22000	20333	1366
	Untreated influent	5/5	17000 - 21000	18600	1517
	Treated influent	4/4	17000 - 19000	18250	957
	Alternate influent	4/4	21000 - 22000	21250	500
Chromium					
	306	1/8	—	5.0	—
	320	5/43	5.7 - 18	10.6	5.0
	324	6/19	4.1 - 8.1	5.63	1.53
	324 RPS	3/16	4.6 - 670	226.4	384.1
	325 RPS	3/15	3.7 - 7.2	5.6	1.8
	326	8/24	3.7 - 7.7	5.5	1.3
	331	6/44	4.3 - 22	12.5	8.0
	3720	7/43	4.7 - 27	11.4	8.6
	EOP	6/47	3.8 - 20	12.0	6.0
	Untreated influent	1/5	—	13	—
Cobalt					
	320	2/43	7.5 - 7.6	7.5	—
	324 RPS	1/16	—	10	—
	326	1/24	—	8.4	—
	3720	1/43	—	6.9	—
	Untreated influent	1/5	—	6.6	—

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Copper					
	306	8/8	9.4 - 56	19.8	16.7
	320	40/43	2.9 - 13	6.8	2.3
	320 (background)	6/6	3.4 - 14	6.9	3.7
	324	17/19	4.2 - 13	7.3	2.6
	324 RPS	8/16	2.8 - 120	19.7	40.6
	325 RPS	14/15	3.6 - 71	17.2	22.6
	326	24/24	31 - 1400	158	301
	326 RPS	2/2	32 - 72	52	—
	327	2/2	5.9 - 17	11.4	—
	331	44/44	9.5 - 930	50.8	136.9
	331 (background)	5/5	9.6 - 36	20.3	13.0
	3720	43/43	4.3 - 170	19.7	30.6
	3720 (background)	5/5	6.6 - 13	9.5	3.2
	EOP	47/47	7.9 - 49	17.9	10.3
	EOP (background)	6/6	9.3 - 15	11.12	2.15
	Untreated influent	3/5	4.4 - 35	15.2	17.2
	Treated influent	2/4	3.1 - 3.7	3.4	—
	Alternate influent	3/4	2.5 - 34	13.6	17.7
Iron					
	306	8/8	160 - 910	354	320
	320	37/43	8.7 - 170	36.29	28.94
	320 (background)	3/6	28 - 62	42	18
	324	19/19	17 - 260	49	53
	324 RPS	16/16	20 - 3100	247	763
	325 RPS	15/15	25 - 580	186	172
	326	24/24	23 - 6000	481	1184
	326 RPS	2/2	270 - 290	280	—
	327	2/2	100 - 200	150	—
	331	42/44	18 - 460	85	78
	331 (background)	4/5	23 - 65	39	19
	3720	43/43	27 - 230	96	43
	3720 (background)	5/5	44 - 84	63	14
	EOP	47/47	23 - 250	97	48
	EOP (background)	6/6	55 - 90	76	13
	Untreated influent	5/5	56 - 530	160	207

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Iron (continued)	Treated influent	2/4	23 - 69	46	—
	Alternate influent	3/4	20 - 31	24	6
Lead					
	306	3/8	3.2 - 7.2	5.4	2.0
	320	21/39	0.6 - 15	2.1	3.1
	320 (background)	5/6	0.62 - 1.2	0.86	0.22
	324	1/19	—	0.88	—
	324 RPS	5/16	0.9 - 6.7	3.1	2.3
	325 RPS	7/15	1.2 - 12	3.8	3.9
	326	14/20	1.5 - 8.6	3.4	2.3
	326 RPS	2/2	1.8 - 2	1.9	—
	327	1/2	—	2.9	—
	331	36/44	0.6 - 17	2.5	2.8
	331 (background)	3/5	0.66 - 1.5	1.05	0.42
	3720	32/43	1.1 - 20	3.4	3.4
	3720 (background)	4/5	0.95 - 3.3	1.91	0.99
	EOP	39/46	0.7 - 5.9	2.4	1.1
	EOP (background)	5/6	1.3 - 3	2.1	0.8
	Untreated influent	5/5	0.62 - 8.1	2.43	3.19
	Treated influent	3/4	0.74 - 1.2	0.91	0.25
	Alternate influent	2/4	2.3 - 4.2	3.3	—
Magnesium					
	306	8/8	4800 - 8800	6450	1389
	320	43/43	3600 - 9300	4786	1099
	320 (background)	6/6	3900 - 4300	4117	133
	324	19/19	3700 - 5100	4558	445
	324 RPS	16/16	3600 - 9600	4719	1362
	325 RPS	15/15	3500 - 4800	4220	474
	326	24/24	2400 - 9100	5067	1634
	326 RPS	2/2	—	4500	—
	327	2/2	7800 - 12000	9900	—
	331	44/44	3900 - 18000	5536	2155
	331 (background)	5/5	4300 - 5000	4700	292
	3720	43/43	3600 - 9100	4728	879
	3720 (background)	5/5	4100 - 4300	4200	100
	EOP	47/47	3400 - 24000	5528	3346

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Magnesium (continued)	EOP (background)	6/6	4300 - 4600	4500	126
	Untreated influent	5/5	4100 - 5100	4440	397
	Treated influent	4/4	4100 - 4500	4275	206
	Alternate influent	4/4	4300 - 4400	4350	58
Manganese					
	306	8/8	7.2 - 27	15.9	6.4
	320	29/43	0.89 - 7.1	1.52	1.15
	320 (background)	3/6	1.2 - 1.6	1.3	0.2
	324	17/19	0.94 - 10	2.33	2.21
	324 RPS	16/16	0.86 - 36	4.71	8.59
	325 RPS	15/15	1.9 - 11	5.1	2.6
	326	24/24	2.2 - 1500	96.1	304.3
	326 RPS	2/2	20 - 29	25	—
	327	2/2	5 - 7.8	6.4	—
	331	35/44	1 - 16	3.4	3.3
	331 (background)	1/5	—	2.6	—
	3720	41/43	0.98 - 13	3.90	2.54
	3720 (background)	3/5	1.5 - 3.3	2.1	1.0
	EOP	47/47	1.5 - 9.3	3.39	1.68
	EOP (background)	5/6	1.4 - 3.5	2.2	0.8
	Untreated influent	5/5	4.5 - 16	7.2	4.9
	Treated influent	1/4	—	1.1	—
	Alternate influent	3/4	0.86 - 1.4	1.04	0.31
Mercury					
	306	2/8	0.083 - 0.084	0.084	—
	320	8/39	0.052 - 0.46	0.146	0.134
	320 (background)	2/6	0.14 - 0.15	0.15	—
	324	5/19	0.03 - 0.48	0.15	0.19
	324 RPS	6/15	0.053 - 0.21	0.093	0.059
	325 RPS	14/15	0.057 - 6.7	1.167	2.326
	326	5/20	0.026 - 0.23	0.109	0.075
	326 RPS	2/2	0.043 - 1.3	0.671	—
	331	11/44	0.055 - 0.17	0.096	0.036
	3720	27/41	0.05 - 0.87	0.19	0.17
	3720 (background)	4/5	0.11 - 0.26	0.17	0.06
	EOP	18/43	0.019 - 0.48	0.154	0.114

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Nickel					
	320	2/43	13 - 16	15	—
	324	1/19	—	21	—
	324 RPS	1/16	—	480	—
	326	5/24	14 - 340	89	141
	326 RPS	1/2	—	15	—
	331	2/44	16 - 17	17	—
	3720	4/43	15 - 18	17	1
	EOP	2/47	16 - 18	17	—
	EOP (background)	1/6	—	24	—
Potassium					
	306	8/8	1200 - 3100	1938	711
	320	28/43	860 - 2900	1352	475
	320 (background)	2/6	1100 - 1200	1150	—
	324	15/19	830 - 2700	1272	471
	324 RPS	14/16	440 - 2900	1053	596
	325 RPS	13/15	520 - 1600	946	316
	326	22/24	840 - 3900	1705	911
	326 RPS	2/2	700 - 940	820	—
	327	2/2	1400 - 2500	1950	—
	331	43/44	940 - 12000	3410	2536
	331 (background)	4/5	1000 - 2000	1400	432
	3720	36/43	700 - 2800	1325	507
	3720 (background)	2/5	1000 - 1300	1150	—
	EOP	44/47	580 - 5000	1545	783
	EOP (background)	6/6	940 - 1700	1357	323
	Untreated influent	3/5	1200 - 1400	1267	115
	Treated influent	2/4	1100 - 1500	1300	—
	Alternate influent	4/4	1000 - 1300	1125	126
Selenium					
	306	1/8	—	0.73	—
	320	8/43	0.66 - 2.3	1.14	0.60
	324	5/19	0.84 - 1.9	1.32	0.46
	324 RPS	2/16	0.85 - 1.4	1.13	—
	325 RPS	4/15	0.77 - 1.3	1.02	0.27
	326	3/24	0.73 - 1.2	1.04	0.27

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Selenium (continued)	331	5/44	0.95 - 2	1.49	0.51
	331 (background)	1/5	—	2.0	—
	3720	6/43	0.65 - 2	1.18	0.57
	EOP	7/46	0.97 - 2.2	1.61	0.49
Silicon	320	1/1	—	2800	—
	324	2/2	2800 - 3000	2900	—
	324 RPS	2/2	2600 - 2800	2700	—
	325 RPS	2/2	2600 - 2700	2650	—
	326	3/3	2200 - 2600	2467	231
	326 RPS	2/2	2200 - 2400	2300	—
	327	2/2	4300 - 5500	4900	—
	331	2/2	3000 - 3200	3100	—
	3720	2/2	2600 - 2700	2650	—
	EOP	2/2	2400 - 2500	2450	—
	Alternate influent	2/2	2600 - 2700	2650	—
Silver	306	1/8	—	3.6	—
	320 (background)	1/6	—	4.8	—
	326 RPS	1/2	—	56	—
	331	2/44	3.6 - 7.1	5.35	—
	331 (background)	2/5	3.4 - 4.2	3.8	—
	3720 (background)	1/5	—	4.7	—
Sodium	306	8/8	3400 - 11000	6275	2618
	320	43/43	2300 - 11000	3374	1751
	320 (background)	6/6	2500 - 3200	2817	240
	324	19/19	2400 - 7300	3347	1076
	324 RPS	16/16	2400 - 11000	3325	2064
	325 RPS	15/15	2600 - 8800	3473	1533
	326	24/24	2600 - 24000	6458	5140
	326 RPS	2/2	3800 - 11000	7400	—
	327	2/2	4800 - 7500	6150	—
	331	44/44	3300 - 110000	13270	16563
	331 (background)	5/5	3200 - 7200	4140	1714
	3720	43/43	2700 - 13000	5216	2196

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Sodium (continued)	3720 (background)	5/5	2700 - 3400	2860	305
	EOP	47/47	3200 - 230000	18000	39632
	EOP (background)	6/6	3200 - 4100	3533	403
	Untreated influent	5/5	2300 - 3000	2600	292
	Treated influent	4/4	2600 - 2800	2675	96
	Alternate influent	4/4	2700 - 2900	2750	100
Strontium					
	320	2/2	92 - 100	96	—
	324	3/3	100 - 110	107	6
	324 RPS	3/3	93 - 100	97	4
	325 RPS	3/3	88 - 110	98	11
	326	5/5	90 - 100	94	5
	326 RPS	2/2	95 - 97	96	—
	327	2/2	180 - 240	210	—
	331	3/3	93 - 110	101	9
	3720	4/4	88 - 110	96	10
	EOP	5/5	88 - 100	95	5
	Alternate influent	3/3	93 - 100	97	4
Thallium					
	306	1/8	—	0.88	—
	320	7/39	0.62 - 1.6	0.85	0.37
	324	4/19	0.68 - 1.8	1.15	0.47
	324 RPS	2/16	0.88 - 2.3	1.59	—
	325 RPS	2/15	0.89 - 1.1	1.00	—
	326	5/20	0.93 - 2.9	1.49	0.80
	331	4/44	0.58 - 1.1	0.83	0.21
	3720	7/43	0.58 - 2	1.03	0.48
	3720 (background)	1/5	—	2.0	—
	EOP	4/46	1.2 - 2	1.6	0.4
Tin					
	320	4/43	26 - 82	46	25
	320 (background)	2/6	24 - 66	45	—
	324	2/19	33 - 49	41	—
	324 RPS	1/16	—	32	—
	325 RPS	2/15	32 - 34	33	—
	326	2/24	34 - 49	42	—

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Tin (continued)	326 RPS	1/2	—	36	—
	331	5/44	24 - 110	71	31
	331 (background)	1/5	—	33	—
	3720	6/43	34 - 65	47	14
	3720 (background)	1/5	—	24	—
	EOP	8/47	26 - 68	41	16
	EOP (background)	1/6	—	100	—
	Untreated influent	1/5	—	69	—
	Treated influent	2/4	61 - 62	62	—
	Alternate influent	1/4	—	47	—
Vanadium	320	2/43	3.3 - 3.5	3.4	—
	324	6/19	2.3 - 3.7	2.9	0.5
	324 RPS	4/16	2.2 - 5.5	3.9	1.8
	325 RPS	5/15	2.2 - 3.4	2.6	0.6
	326	6/24	2 - 4	2.5	0.8
	327	1/2	—	2.7	—
	331	6/44	2 - 7.8	4.3	2.6
	3720	2/43	2.5 - 3.7	3.1	—
	EOP	8/47	2 - 4.6	2.9	0.9
	Alternate influent	1/4	—	2.9	—
Zinc	306	8/8	66 - 280	114	77
	320	43/43	11 - 120	29	18
	320 (background)	6/6	19 - 61	38	15
	324	19/19	11 - 110	31	27
	324 RPS	13/16	3.9 - 62	17.6	16.9
	325 RPS	15/15	11 - 210	72	48
	326	24/24	48 - 6100	472	1257
	326 RPS	2/2	250 - 440	345	—
	327	2/2	190 - 250	220	—
	331	44/44	22 - 230	67	39
	331 (background)	5/5	42 - 79	58	15
	3720	43/43	16 - 470	65	77
	3720 (background)	5/5	15 - 49	34	13
	EOP	47/47	19 - 110	41	19

Table C.3. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Zinc (continued)	EOP (background)	6/6	18 - 52	33	15
	Untreated influent	3/5	10 - 110	44	57
	Treated influent	3/4	4.8 - 11	8.9	3.6
	Alternate influent	4/4	9 - 200	137.3	88.2
(a) Building number, end-of-pipe (EOP), or influent type.					
(b) Number of samples with detectable concentrations/total number of samples analyzed.					

Table C.4. Volatile Organic Compounds

Constituent	Location [a]	Frequency [b]	Concentration (µg/L)		
			Range	Average	Standard Deviation
1,1,1-Trichloroethane	320	3/62	1.2 - 2.6	1.8	0.7
	327	1/2	—	1.5	—
	331	1/66	—	2.1	—
	EOP	1/61	—	1.4	—
1,1,2-Trichloroethane	3720	1/56	—	0.75	—
1,2-Dichloroethylene	3720	7/56	0.44 - 1.1	0.68	0.27
	3720 (background)	3/10	0.41 - 0.63	0.50	0.12
1,4-Dichlorobenzene	325 RPS	1/11	—	1.1	—
2-Butanone	320	1/62	—	26	—
	326	1/22	—	48	—
	331	3/66	51 - 170	103	61
Acetone	306	2/9	14 - 15	15	—
	320	5/62	8.8 - 43	25.96	12.52
	320 (background)	1/12	—	25	—
	324	7/17	4.8 - 15	11.0	4.3
	324 RPS	2/15	7.9 - 55	31.4	—
	325 RPS	3/12	8.2 - 110	45.07	56.41
	326	20/22	5.5 - 2535	284.6	561.0
	326 RPS	2/2	7.1 - 9.9	8.50	—
	327	1/2	—	5.7	—
	331	15/66	5.6 - 1800	138.2	460.0
	331 (background)	1/10	—	67	—
	3720	30/63	5.3 - 530	72.9	128.2
	3720 (background)	1/10	—	37	—
	EOP	17/61	5.9 - 63	24.1	17.3
	EOP (background)	1/12	—	33	—
Acetonitrile	320	1/27	—	170	—
	331	1/26	—	430	—

Table C.4. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Acetonitrile (continued)	3720	3/29	7.1 - 2400	1075	1217
	EOP	1/24	—	76	—
	EOP (background)	2/12	260 - 400	330	—
Benzene	3720	1/63	—	0.51	—
	Treated influent	1/10	—	0.71	—
Bromodichloromethane	320	25/36	0.7 - 3.3	1.6	0.7
	320 (background)	6/8	1.1 - 2.1	1.6	0.3
	324	6/6	0.5 - 1.6	1.0	0.4
	324 RPS	2/6	0.5 - 1.1	0.8	—
	331	16/34	0.5 - 9.8	2.27	2.26
	331 (background)	6/8	1.2 - 9.5	3.2	3.2
	3720	13/34	0.5 - 2	1.2	0.4
	3720 (background)	1/6	—	2.0	—
	EOP	16/31	0.5 - 3.2	1.9	0.8
	EOP (background)	3/6	1.8 - 3.3	2.4	0.8
	Treated influent	8/9	0.91 - 2.5	1.40	0.51
Bromoform	306	1/9	—	2.0	—
	320	1/36	—	0.5	—
	331	1/34	—	26	—
	331 (background)	1/8	—	15	—
	EOP	2/31	0.54 - 0.86	0.70	—
	EOP (background)	1/6	—	1.7	—
Carbon disulfide	3720	1/56	—	2.5	—
Chlorobenzene	331	1/26	—	0.39	—
	3720 (background)	1/6	—	0.66	—
	Treated influent	1/9	—	2.3	—
Chloroform	306	8/9	0.9 - 1.8	1.4	0.3
	320	62/62	6.9 - 32	18.8	6.6
	320 (background)	12/12	7.4 - 30	20.2	6.8

Table C.4. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Chloroform (continued)	324	17/17	4.9 - 35	14.5	9.5
	324 RPS	14/15	2.9 - 28	9.6	7.0
	325 RPS	12/12	2.9 - 18	9.6	4.3
	326	19/22	0.6 - 4.3	1.7	0.9
	326 RPS	2/2	1.3 - 2	1.6	—
	327	2/2	1.6 - 3.2	2.4	—
	331	66/66	3.1 - 33	11.4	6.5
	331 (background)	10/10	8.6 - 26	16.9	5.3
	3720	61/63	2.5 - 32	12.9	5.9
	3720 (background)	10/10	5.8 - 40	14.9	10.2
	EOP	61/61	3.4 - 21	11.0	4.5
	EOP (background)	12/12	3.1 - 18	9.1	4.8
	Untreated influent	1/10	—	6.2	—
	Treated influent	10/10	15 - 41	22	7
	Alternate influent	5/5	5.6 - 22	13.5	7.3
Dibromochloromethane	320	3/36	1.4 - 2	1.8	0.3
	324	2/6	0.6 - 1.4	1.0	—
	324 RPS	1/6	—	0.7	—
	331	6/34	0.7 - 11	2.7	4.1
	331 (background)	2/8	1.7 - 11	6.3	—
	3720	1/34	—	1.7	—
	EOP	7/31	1 - 2.2	1.6	0.4
	EOP (background)	2/6	1 - 2.7	1.9	—
Ethanol	325 RPS	1/12	—	6.1	—
	326 RPS	1/2	—	54	—
	331	5/66	8.3 - 47	20.5	15.4
	3720	6/63	5.5 - 26	14.1	8.7
Ethylbenzene	320	4/36	0.5 - 4.9	1.7	2.1
	320 (background)	1/8	—	0.82	—
	327	1/2	—	0.57	—
	3720	3/34	0.45 - 0.89	0.63	0.23
	EOP	1/31	—	0.22	—

Table C.4. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Hexone	320	6/62	1.4 - 110	37.1	41.1
	320 (background)	1/12	—	26	—
	324	1/17	—	9.4	—
	324 RPS	1/15	—	2.2	—
	325 RPS	6/12	6.4 - 43	18.4	15.6
	326	2/22	1.7 - 2	1.9	—
	331	4/66	1.9 - 19	11.1	9.2
	331 (background)	1/10	—	38	—
	3720	6/63	1.4 - 37	13.3	13.8
	EOP	4/61	1.7 - 20	8.5	8.5
	EOP (background)	1/12	—	33	—
	Alternate influent	1/5	—	2.6	—
Isopropyl alcohol	326	1/22	—	40798	—
	331	1/66	—	19	—
	3720	12/63	5.2 - 46	15.8	12.5
	EOP	2/61	110 - 575	342	—
Methylene chloride	306	2/9	1.1 - 1.2	1.1	—
	320	40/62	0.4 - 1.6	1.1	0.4
	320 (background)	12/12	0.35 - 1.3	0.79	0.37
	326	2/22	—	1.2	—
	327	1/2	—	0.73	—
	331	43/66	0.4 - 4.8	1.2	0.9
	331 (background)	10/10	0.37 - 1.1	0.82	0.27
	3720	41/63	0.36 - 9.7	1.36	1.50
	3720 (background)	10/10	0.34 - 1.3	0.83	0.40
	EOP	39/61	0.2 - 1.6	0.9	0.4
	EOP (background)	12/12	0.34 - 1.4	0.67	0.44
	Untreated influent	10/10	1 - 1.7	1.3	0.2
	Treated influent	10/10	1.1 - 1.6	1.3	0.2
	Alternate influent	2/5	0.45 - 0.47	0.46	—
Styrene	327	1/2	—	0.5	—
Tetrachloroethene	326	1/22	—	0.51	—

Table C.4. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Tetrachloroethene (continued)	327	1/2	—	0.8	—
	EOP	1/61	—	2.0	—
	EOP (background)	1/12	—	0.52	—
Tetrahydrofuran	320	1/62	—	36	—
	326	17/22	2.8 - 22	10.4	6.5
	331	2/66	0.52 - 3	1.76	—
	3720	10/63	3.4 - 406	53.4	124.3
	3720 (background)	1/10	—	7.0	—
	EOP	2/61	7.4 - 9.4	8.4	—
	Untreated influent	1/10	—	3.6	—
	Treated influent	2/10	3.7 - 8.6	6.2	—
Toluene	320	2/62	0.14 - 0.18	0.16	—
	320 (background)	1/12	—	0.23	—
	331	4/66	0.22 - 0.86	0.53	0.26
	331 (background)	2/10	0.37 - 0.52	0.45	—
	3720	7/63	0.14 - 410	69.39	150.77
	3720 (background)	2/10	0.23 - 0.64	0.44	—
	EOP	1/61	—	1.4	—
	Treated influent	2/10	0.13 - 0.36	0.25	—
Trichloroethene	324	1/17	—	0.5	—
	326	3/22	0.95 - 5.9	2.92	2.63
	326 RPS	2/2	0.94 - 1.3	1.12	—
	327	2/2	2.5 - 2.9	2.7	—
	331	3/66	0.51 - 0.91	0.77	0.23
	3720	61/63	0.66 - 2.1	1.28	0.35
	3720 (background)	10/10	0.84 - 1.6	1.13	0.26
	EOP	7/61	0.32 - 0.7	0.52	0.12
	EOP (background)	1/12	—	0.84	—
	Alternate influent	1/5	—	0.79	—
Trichlorofluoromethane	EOP	3/25	1.4 - 4.4	2.4	1.7
	EOP (background)	2/6	1.7 - 4.2	3.0	—

Table C.4. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Xylenes (total)	320	8/62	0.48 - 12	4.78	4.59
	320 (background)	3/12	0.51 - 4.4	2.00	2.10
	324	1/17	—	2.8	—
	327	1/2	—	2.0	—
	331	3/66	1.4 - 2.4	1.8	0.5
	331 (background)	2/10	0.32 - 1.9	1.11	—
	3720	4/63	2.1 - 2.9	2.3	0.4
	EOP	6/61	0.49 - 2	1.23	0.53
	Alternate influent	1/5	—	2.0	—
(a) Building number, end-of-pipe (EOP), or influent type.					
(b) Number of samples with detectable concentrations/total number of samples analyzed.					

Table C.5. Semivolatile Organic Compounds

Constituent	Location [a]	Frequency [b]	Concentration (µg/L)		
			Range	Average	Standard Deviation
Acids/Bases/Neutrals (ABNs)					
1,4-Dichlorobenzene	325 RPS	1/15	—	1.1	—
2,4,6-Trichlorophenol	324	1/6	—	16	—
2,6-Dichlorophenol	324	1/6	—	2.5	—
Benzyl alcohol	331	3/15	4.1 - 34	22.03	15.82
Bis(2-ethylhexyl) phthalate	325 RPS	1/15	—	15	—
	326	2/24	0.88 - 1.7	1.29	—
	326 RPS	2/2	1.4 - 2	1.7	—
	327	1/2	—	0.92	—
	331	8/46	1 - 6.4	3.7	2.3
	331 (background)	1/5	—	3.6	—
	3720	14/42	0.72 - 8.6	3.18	2.47
	3720 (background)	1/5	—	1.5	—
	EOP	13/45	0.44 - 38	19.83	11.36
	EOP (background)	2/6	21 - 31	26	—
Butylbenzylphthalate	EOP	1/12	—	7.6	—
Decane	331	1/32	—	37	—
Di-n-butylphthalate	320	2/14	2.5 - 2.6	2.5	—
	331	4/14	2 - 3.6	2.5	0.8
	3720	4/13	1.9 - 3.6	2.5	0.8
	EOP	4/12	2.6 - 5.7	3.9	1.3
	Treated influent	1/5	—	1.9	—
Di-n-octylphthalate	326	1/6	—	1.3	—
Diethylphthalate	326	1/6	—	6.6	—
	326 RPS	1/2	—	0.81	—

Table C.5. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Diethylphthalate	3720	3/14	35 - 170	81	77
Kerosene	331	1/14	—	9.5	—
Phenol	320	1/43	—	1.8	—
	320 (background)	1/6	—	2.7	—
	324	1/20	—	3.7	—
	324 RPS	3/17	1.8 - 11	5.9	4.7
	325 RPS	1/15	—	2.6	—
	326	4/24	0.83 - 3.7	1.76	1.32
	331	4/46	1 - 4.9	2.5	1.8
	3720	1/42	—	3.8	—
	Untreated influent	2/5	3.2 - 3.4	3.3	—
Tributyl phosphate	325 RPS	1/15	—	0.84	—
	3720	5/42	1.3 - 9.8	4.66	3.44
	EOP	1/45	—	6.4	—
Pesticides					
4,4'-DDE	331	3/40	0.0017 - 0.72	0.2417	0.4142
	EOP	2/29	0.004 - 0.024	0.014	—
Aldrin	326	1/9	—	0.0041	—
	331	1/40	—	0.011	—
	331 (background)	1/5	—	0.0042	—
	Treated influent	1/5	—	0.016	—
Alpha-BHC	326	2/9	0.0011 - 0.0025	0.0018	—
	331	3/40	0.0036 - 0.0073	0.0057	0.0019
	Treated influent	1/5	—	0.0032	—
Beta-BHC	331	4/40	0.0099 - 0.026	0.0170	0.0083
	EOP	1/29	—	0.0017	—
Delta-BHC	326	1/9	—	0.0041	—

Table C.5. (continued)

Constituent	Location	Frequency	Concentration (µg/L)		
			Range	Average	Standard Deviation
Delta-BHC (continued)	331	10/40	0.0017 - 0.033	0.0112	0.0088
	331 (background)	1/5	—	0.017	—
	EOP	7/29	0.002 - 0.014	0.007	0.005
	Untreated influent	2/5	0.0026 - 0.004	0.0033	—
	Treated influent	1/5	—	0.0065	—
Dieldrin	331	1/40	—	0.0032	—
Endosulfan I	331	6/40	0.0018 - 0.005	0.0032	0.0010
	331 (background)	1/5	—	0.0055	—
	EOP	2/29	0.0045 - 0.0051	0.0048	—
Endosulfan sulfate	EOP	1/29	—	0.036	—
Endrin	331	2/40	0.0025 - 0.0066	0.0046	—
Endrin aldehyde	331	1/40	—	0.012	—
Gamma-BHC (Lindane)	331	5/40	0.0023 - 0.0038	0.0029	0.0007
	331 (background)	1/5	—	0.0047	—
	EOP	1/29	—	0.0029	—
Heptachlor	EOP	3/29	0.0078 - 0.0099	0.0087	0.0011
	EOP (background)	1/5	—	0.013	—
Heptachlor epoxide	Treated influent	1/5	—	0.0016	—
Methoxychlor	331	1/40	—	0.019	—

(a) Building number, end-of-pipe (EOP), or influent type.

(b) Number of samples with detectable concentrations/total number of samples analyzed.

Table C.6. Radiological Parameters

Parameter	Location [a]	Frequency [b]	Concentration (pCi/L)		
			Range	Average	2SEM[c]
Gross alpha					
	306	8/8	0.926 - 6.39	3.526	0.562
	320	8/43	0.873 - 2.88	1.708	0.256
	324	4/20	0.832 - 1.84	1.163	0.237
	324 RPS	2/17	0.774 - 1.9	1.337	—
	325 RPS	7/15	0.422 - 10	4.922	1.288
	326	3/24	1.24 - 1.7	1.41	0.14
	327 RPS	1/1	—	1.69	—
	331	19/47	0.905 - 8.34	2.988	0.467
	331 (background)	3/5	0.877 - 12.8	4.87	3.97
	3720	41/47	0.997 - 44.6	12.07	1.21
	3720 (background)	5/5	7.41 - 28	16.66	3.47
	EOP	34/44	1.44 - 13.3	4.06	0.50
	EOP (background)	6/6	1.29 - 4.39	2.21	0.47
Gross beta					
	306	6/8	2.37 - 19.7	6.96	2.66
	320	11/43	2.13 - 4.31	3.15	0.20
	324	3/20	3.03 - 9.74	5.40	2.17
	324 RPS	4/17	2.23 - 4.18	3.22	0.40
	326	8/24	2.44 - 7.85	5.01	0.73
	327	1/3	—	6.95	—
	327 RPS	1/1	—	20.60	—
	331	27/47	2.09 - 15.4	5.22	0.58
	331 (background)	1/5	—	2.68	—
	3720	28/47	2.64 - 17.6	5.31	0.54
	3720 (background)	4/5	4.05 - 10.6	6.29	1.47
	EOP	20/44	2.11 - 12.5	4.02	0.53
	EOP (background)	3/6	2.23 - 2.72	2.41	0.15
Tritium					
	306	3/8	291 - 687	427	130
	324	6/19	237 - 545	331	49
	324 RPS	5/17	230 - 627	373	81
	325 RPS	4/14	200 - 521	318	73
	326	7/24	251 - 558	380	38
	327	2/3	284 - 1080	682	—
	331	1/2	—	330	—
	EOP	1/11	—	423	—

Table C.6. (continued)

Parameter	Location	Frequency	Concentration (pCi/L)		
			Range	Average	2SEM
Uranium-234	3720	1/1	—	7.96	—
Uranium-235	3720	1/1	—	0.346	—
Uranium-238	3720	1/1	—	6.5	—
(a) Building number, end-of-pipe (EOP), or influent type.					
(b) Number of samples with detectable concentrations/total number of samples analyzed.					
(c) Two times the standard error of the mean.					

Appendix D

Analytical Results Listed by Building

Appendix D

Analytical Results Listed by Building

This appendix contains tabulated information on the parameters and constituents detected in building effluent, end-of-pipe, and influent samples. Each table contains the results from a single monitored location. Appendix C contains the same information grouped by constituent.

Parameters and constituents that were analyzed for but never detected are not included in the tables. Thus, the absence of a constituent's results does not necessarily mean that analyses were not performed for that constituent. Appendix A lists the analyses that were performed on all of the samples.

Table D.1. Constituents Detected in Building 306 Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	7/7	60000 - 120000	82857	24976
Chemical Oxygen Demand	7/7	4500 - 13000	9014	2835
Conductivity	8/8	168 - 324	228	55
pH	8/8	6.2 - 8.29	7.39	0.87
Total carbon	8/8	18000 - 30000	22625	4534
Total dissolved solids	7/7	100000 - 180000	137143	34017
Total organic carbon	8/8	2000 - 15000	4625	4307
Ammonia and Anions				
Ammonia	4/7	40 - 100	58	29
Chloride	7/7	4740 - 11700	7331	2549
Fluoride	6/7	231 - 459	351	107
Nitrate	7/7	1450 - 14200	7913	4847
Sulfate	7/7	13400 - 22600	17457	2881
Sulfides	3/7	220 - 300	273	46
Metals				
Aluminum	6/8	33 - 190	74	60
Arsenic	1/8	—	2.8	—
Barium	8/8	26 - 43	34	5
Beryllium	1/8	—	0.19	—
Calcium	8/8	22000 - 41000	29500	6845
Chromium	1/8	—	5.0	—
Copper	8/8	9.4 - 56	19.8	16.7
Iron	8/8	160 - 910	354	320
Lead	3/8	3.2 - 7.2	5.4	2.0
Magnesium	8/8	4800 - 8800	6450	1389
Manganese	8/8	7.2 - 27	15.9	6.4
Mercury	2/8	0.083 - 0.084	0.084	—
Potassium	8/8	1200 - 3100	1938	711
Selenium	1/8	—	0.73	—

Table D.1. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Silver	1/8	—	3.6	—
Sodium	8/8	3400 - 11000	6275	2618
Thallium	1/8	—	0.88	—
Zinc	8/8	66 - 280	114	77
Volatile Organic Compounds				
Acetone	2/9	14 - 15	15	—
Bromoform	1/9	—	2.0	—
Chloroform	8/9	0.9 - 1.8	1.4	0.3
Methylene chloride	2/9	1.1 - 1.2	1.1	—
Radiological Parameters				
Gross alpha	8/8	0.926 - 6.39	3.526	0.562
Gross beta	6/8	2.37 - 19.7	6.96	2.66
Tritium	3/8	291 - 687	427	130

(a) Number of samples with detectable concentrations/total number of samples analyzed.

(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.

(c) Two times the standard error of the mean for radiological parameters.

Table D.2. Constituents Detected in Building 320 Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	38/38	6000 - 130000	58447	20091
Chemical Oxygen Demand	9/38	2600 - 13000	6311	3419
Conductivity	31/31	58 - 940	208	182
pH	31/31	5.5 - 10	7.9	0.8
Total carbon	38/38	11000 - 31000	16079	3982
Total dissolved solids	38/38	70000 - 210000	101579	31324
Total organic carbon	39/39	1000 - 3000	1756	627
Ammonia and Anions				
Ammonia	4/43	30 - 40	33	5
Chloride	41/41	2100 - 11800	4678	1781
Cyanide	2/39	2 - 20	11.0	—
Fluoride	38/41	230 - 700	475	130
Nitrate	41/41	100 - 15600	1711	3229
Sulfate	41/41	10000 - 23500	16256	2190
Sulfides	9/38	220 - 400	296	50
Metals				
Aluminum	39/43	29 - 170	66	34
Antimony	2/43	37 - 39	38	—
Arsenic	1/39	—	0.73	—
Barium	43/43	16 - 46	29	5
Beryllium	5/43	0.17 - 0.68	0.34	0.21
Cadmium	2/43	3.5 - 4.3	3.9	—
Calcium	43/43	16000 - 44000	21372	5464
Chromium	5/43	5.7 - 18	10.6	5.0
Cobalt	2/43	7.5 - 7.6	7.5	—
Copper	40/43	2.9 - 13	6.8	2.3
Iron	37/43	8.7 - 170	36.29	28.94
Lead	21/39	0.6 - 15	2.1	3.1
Magnesium	43/43	3600 - 9300	4786	1099

Table D.2. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Manganese	29/43	0.89 - 7.1	1.52	1.15
Mercury	8/39	0.052 - 0.46	0.146	0.134
Nickel	2/43	13 - 16	15	—
Potassium	28/43	860 - 2900	1352	475
Selenium	8/43	0.66 - 2.3	1.14	0.60
Silicon	1/1	—	2800	—
Sodium	43/43	2300 - 11000	3374	1751
Strontium	2/2	92 - 100	96	—
Thallium	7/39	0.62 - 1.6	0.85	0.37
Tin	4/43	26 - 82	46	25
Vanadium	2/43	3.3 - 3.5	3.4	—
Zinc	43/43	11 - 120	29	18
Volatile Organic Compounds				
1,1,1-Trichloroethane	3/62	1.2 - 2.6	1.8	0.7
2-Butanone	1/62	—	26	—
Acetone	5/62	8.8 - 43	25.96	12.52
Acetonitrile	1/27	—	170	—
Bromodichloromethane	25/36	0.7 - 3.3	1.6	0.7
Bromoform	1/36	—	0.5	—
Chloroform	62/62	6.9 - 32	18.8	6.6
Dibromochloromethane	3/36	1.4 - 2	1.8	0.3
Ethylbenzene	4/36	0.5 - 4.9	1.7	2.1
Hexone	6/62	1.4 - 110	37.1	41.1
Methylene chloride	40/62	0.4 - 1.6	1.1	0.4
Tetrahydrofuran	1/62	—	36	—
Toluene	2/62	0.14 - 0.18	0.16	—
Xylenes (total)	8/62	0.48 - 12	4.78	4.59
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Di-n-butylphthalate	2/14	2.5 - 2.6	2.5	—
Phenol	1/43	—	1.8	—

Table D.2. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Radiological Parameters				
Gross alpha	8/43	0.873 - 2.88	1.708	0.256
Gross beta	11/43	2.13 - 4.31	3.15	0.20
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				
(c) Two times the standard error of the mean for radiological parameters.				

Table D.3. Constituents Detected in Building 320 Background Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation
General Chemical Parameters				
Alkalinity	6/6	40000 - 70000	51000	10040
Conductivity	5/5	128 - 151	138	10
pH	5/5	7.55 - 8.33	7.82	0.30
Total carbon	6/6	12000 - 16000	13333	1633
Total dissolved solids	6/6	80000 - 110000	93333	10328
Total organic carbon	6/6	1000 - 2000	1500	548
Ammonia and Anions				
Ammonia	1/6	—	50	—
Chloride	6/6	1800 - 5500	4400	1308
Fluoride	6/6	200 - 900	600	228
Nitrate	6/6	200 - 1700	733	528
Sulfate	6/6	8500 - 18000	15583	3584
Sulfides	4/6	200 - 300	225	50
Metals				
Aluminum	6/6	26 - 80	54	19
Arsenic	1/6	—	2.0	—
Barium	6/6	15 - 31	27	6
Cadmium	1/6	—	3.6	—
Calcium	6/6	18000 - 22000	19333	1366
Copper	6/6	3.4 - 14	6.9	3.7
Iron	3/6	28 - 62	42	18
Lead	5/6	0.62 - 1.2	0.86	0.22
Magnesium	6/6	3900 - 4300	4117	133
Manganese	3/6	1.2 - 1.6	1.3	0.2
Mercury	2/6	0.14 - 0.15	0.15	—
Potassium	2/6	1100 - 1200	1150	—
Silver	1/6	—	4.8	—
Sodium	6/6	2500 - 3200	2817	240
Tin	2/6	24 - 66	45	—

Table D.3. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Zinc	6/6	19 - 61	38	15
Volatile Organic Compounds				
Acetone	1/12	—	25	—
Bromodichloromethane	6/8	1.1 - 2.1	1.6	0.3
Chloroform	12/12	7.4 - 30	20.2	6.8
Ethylbenzene	1/8	—	0.82	—
Hexone	1/12	—	26	—
Methylene chloride	12/12	0.35 - 1.3	0.79	0.37
Toluene	1/12	—	0.23	—
Xylenes (total)	3/12	0.51 - 4.4	2.00	2.10
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Phenol	1/6	—	2.7	—
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm.				

Table D.4. Constituents Detected in Building 324 Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	8/8	40000 - 60000	52500	7071
Chemical Oxygen Demand	5/8	3000 - 6400	4520	1270
Conductivity	20/20	131 - 1588	255	325
pH	20/20	4.8 - 8.15	7.12	1.08
Total carbon	8/8	13000 - 16000	14750	1035
Total dissolved solids	8/8	80000 - 100000	88750	8345
Total organic carbon	19/19	1000 - 3700	2132	910
Ammonia and Anions				
Ammonia	4/19	30 - 40	38	5
Chloride	16/16	2920 - 5300	3943	856
Cyanide	1/19	—	1.0	—
Fluoride	16/16	300 - 600	422	89
Nitrate	16/16	300 - 59000	4227	14608
Phosphate	2/16	715 - 3010	1863	—
Sulfate	16/16	12900 - 19000	15963	1977
Sulfides	1/8	—	300	—
Metals				
Aluminum	16/19	31 - 100	58	19
Arsenic	1/19	—	2.1	—
Barium	19/19	23 - 32	27	2
Beryllium	2/19	0.19 - 0.38	0.29	—
Calcium	19/19	16000 - 22000	19211	1782
Chromium	6/19	4.1 - 8.1	5.63	1.53
Copper	17/19	4.2 - 13	7.3	2.6
Iron	19/19	17 - 260	49	53
Lead	1/19	—	0.88	—
Magnesium	19/19	3700 - 5100	4558	445
Manganese	17/19	0.94 - 10	2.33	2.21
Mercury	5/19	0.03 - 0.48	0.15	0.19

Table D.4. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Nickel	1/19	—	21	—
Potassium	15/19	830 - 2700	1272	471
Selenium	5/19	0.84 - 1.9	1.32	0.46
Silicon	2/2	2800 - 3000	2900	—
Sodium	19/19	2400 - 7300	3347	1076
Strontium	3/3	100 - 110	107	6
Thallium	4/19	0.68 - 1.8	1.15	0.47
Tin	2/19	33 - 49	41	—
Vanadium	6/19	2.3 - 3.7	2.9	0.5
Zinc	19/19	11 - 110	31	27
Volatile Organic Compounds				
Acetone	7/17	4.8 - 15	11.0	4.3
Bromodichloromethane	6/6	0.5 - 1.6	1.0	0.4
Chloroform	17/17	4.9 - 35	14.5	9.5
Dibromochloromethane	2/6	0.6 - 1.4	1.0	—
Hexone	1/17	—	9.4	—
Trichloroethene	1/17	—	0.5	—
Xylenes (total)	1/17	—	2.8	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
2,4,6-Trichlorophenol	1/6	—	16	—
2,6-Dichlorophenol	1/6	—	2.5	—
Phenol	1/20	—	3.7	—
Radiological Parameters				
Gross alpha	4/20	0.832 - 1.84	1.163	0.237
Gross beta	3/20	3.03 - 9.74	5.40	2.17
Tritium	6/19	237 - 545	331	49
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				
(c) Two times the standard error of the mean for radiological parameters.				

Table D.5. Constituents Detected in Building 324 RPS Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	7/7	48000 - 120000	62429	25896
Chemical Oxygen Demand	4/7	2800 - 8800	6100	3156
Conductivity	17/17	135 - 387	183	68
pH	17/17	4.61 - 9.3	7.43	1.07
Total carbon	6/6	14000 - 30000	17333	6250
Total dissolved solids	6/6	90000 - 200000	108333	44907
Total organic carbon	15/15	600 - 3000	1313	665
Ammonia and Anions				
Ammonia	5/15	40 - 80	50	17
Chloride	15/15	2800 - 12000	4376	2259
Fluoride	15/15	228 - 600	368	92
Nitrate	15/15	300 - 15400	1652	3826
Sulfate	15/15	12000 - 23800	15653	2960
Sulfides	3/7	300 - 400	357	51
Metals				
Aluminum	12/16	39 - 74	53	11
Barium	16/16	21 - 48	28	7
Beryllium	1/16	—	0.24	—
Calcium	16/16	16000 - 45000	20375	6781
Chromium	3/16	4.6 - 670	226.4	384.1
Cobalt	1/16	—	10	—
Copper	8/16	2.8 - 120	19.7	40.6
Iron	16/16	20 - 3100	247	763
Lead	5/16	0.9 - 6.7	3.1	2.3
Magnesium	16/16	3600 - 9600	4719	1362
Manganese	16/16	0.86 - 36	4.71	8.59
Mercury	6/15	0.053 - 0.21	0.093	0.059
Nickel	1/16	—	480	—
Potassium	14/16	440 - 2900	1053	596

Table D.5. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Selenium	2/16	0.85 - 1.4	1.13	—
Silicon	2/2	2600 - 2800	2700	—
Sodium	16/16	2400 - 11000	3325	2064
Strontium	3/3	93 - 100	97	4
Thallium	2/16	0.88 - 2.3	1.59	—
Tin	1/16	—	32	—
Vanadium	4/16	2.2 - 5.5	3.9	1.8
Zinc	13/16	3.9 - 62	17.6	16.9
Volatile Organic Compounds				
Acetone	2/15	7.9 - 55	31.4	—
Bromodichloromethane	2/6	0.5 - 1.1	0.8	—
Chloroform	14/15	2.9 - 28	9.6	7.0
Dibromochloromethane	1/6	—	0.7	—
Hexone	1/15	—	2.2	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Phenol	3/17	1.8 - 11	5.9	4.7
Radiological Parameters				
Gross alpha	2/17	0.774 - 1.9	1.337	—
Gross beta	4/17	2.23 - 4.18	3.22	0.40
Tritium	5/17	230 - 627	373	81
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				
(c) Two times the standard error of the mean for radiological parameters.				

Table D.6. Constituents Detected in Building 325 RPS Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	5/5	30000 - 50000	43400	8473
Chemical Oxygen Demand	3/4	6000 - 110000	42333	58654
Conductivity	15/15	92 - 249	155	35
pH	15/15	3.94 - 8.59	7.55	1.28
Total carbon	4/4	12000 - 46000	22250	15924
Total dissolved solids	5/5	70000 - 90000	82000	8367
Total organic carbon	14/15	1400 - 31000	4850	7630
Ammonia and Anions				
Ammonia	6/15	30 - 200	70	64
Chloride	12/12	2700 - 5100	3937	845
Cyanide	1/15	—	2.0	—
Fluoride	12/12	300 - 700	432	131
Nitrate	12/12	300 - 310000	28983	88927
Nitrite	2/11	—	300	—
Sulfate	12/12	12000 - 17000	15383	1646
Metals				
Aluminum	11/15	37 - 170	78	46
Barium	15/15	21 - 31	25	3
Calcium	15/15	15000 - 21000	17800	1821
Chromium	3/15	3.7 - 7.2	5.6	1.8
Copper	14/15	3.6 - 71	17.2	22.6
Iron	15/15	25 - 580	186	172
Lead	7/15	1.2 - 12	3.8	3.9
Magnesium	15/15	3500 - 4800	4220	474
Manganese	15/15	1.9 - 11	5.1	2.6
Mercury	14/15	0.057 - 6.7	1.167	2.326
Potassium	13/15	520 - 1600	946	316
Selenium	4/15	0.77 - 1.3	1.02	0.27
Silicon	2/2	2600 - 2700	2650	—

Table D.6. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Sodium	15/15	2600 - 8800	3473	1533
Strontium	3/3	88 - 110	98	11
Thallium	2/15	0.89 - 1.1	1.00	—
Tin	2/15	32 - 34	33	—
Vanadium	5/15	2.2 - 3.4	2.6	0.6
Zinc	15/15	11 - 210	72	48
Volatile Organic Compounds				
1,4-Dichlorobenzene	1/11	—	1.1	—
Acetone	3/12	8.2 - 110	45.07	56.41
Chloroform	12/12	2.9 - 18	9.6	4.3
Ethanol	1/12	—	6.1	—
Hexone	6/12	6.4 - 43	18.4	15.6
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
1,4-Dichlorobenzene	1/15	—	1.1	—
Bis(2-ethylhexyl) phthalate	1/15	—	15	—
Phenol	1/15	—	2.6	—
Tributyl phosphate	1/15	—	0.84	—
Radiological Parameters				
Gross alpha	7/15	0.422 - 10	4.922	1.288
Tritium	4/14	200 - 521	318	73

(a) Number of samples with detectable concentrations/total number of samples analyzed.

(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.

(c) Two times the standard error of the mean for radiological parameters.

Table D.7. Constituents Detected in Building 326 Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	13/13	20000 - 130000	71385	32989
Chemical Oxygen Demand	12/13	4000 - 360000	49583	100847
Conductivity	23/23	98 - 347	198	71
pH	23/23	1.77 - 8.89	7.27	1.53
Total carbon	13/13	13000 - 120000	31462	28582
Total dissolved solids	13/13	80000 - 210000	128462	49134
Total organic carbon	20/20	2000 - 110000	10560	23947
Ammonia and Anions				
Ammonia	14/24	40 - 500	191	144
Chloride	21/21	2900 - 84500	9490	17384
Cyanide	1/20	—	2.0	—
Fluoride	21/21	265 - 600	403	98
Nitrate	21/21	400 - 12400	3451	3632
Nitrite	3/12	—	200	0
Phosphate	1/21	—	1060	—
Sulfate	21/21	13000 - 53000	22752	12350
Sulfides	3/13	220 - 400	307	90
Metals				
Aluminum	19/24	29 - 180	64	38
Barium	24/24	21 - 100	33	17
Beryllium	4/24	0.19 - 0.26	0.21	0.03
Cadmium	6/24	1 - 14	4.2	5.0
Calcium	24/24	14000 - 43000	23917	7967
Chromium	8/24	3.7 - 7.7	5.5	1.3
Cobalt	1/24	—	8.4	—
Copper	24/24	31 - 1400	158	301
Iron	24/24	23 - 6000	481	1184
Lead	14/20	1.5 - 8.6	3.4	2.3
Magnesium	24/24	2400 - 9100	5067	1634

Table D.7. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Manganese	24/24	2.2 - 1500	96.1	304.3
Mercury	5/20	0.026 - 0.23	0.109	0.075
Nickel	5/24	14 - 340	89	141
Potassium	22/24	840 - 3900	1705	911
Selenium	3/24	0.73 - 1.2	1.04	0.27
Silicon	3/3	2200 - 2600	2467	231
Sodium	24/24	2600 - 24000	6458	5140
Strontium	5/5	90 - 100	94	5
Thallium	5/20	0.93 - 2.9	1.49	0.80
Tin	2/24	34 - 49	42	—
Vanadium	6/24	2 - 4	2.5	0.8
Zinc	24/24	48 - 6100	472	1257
Volatile Organic Compounds				
2-Butanone	1/22	—	48	—
Acetone	20/22	5.5 - 2535	284.6	561.0
Chloroform	19/22	0.6 - 4.3	1.7	0.9
Hexone	2/22	1.7 - 2	1.9	—
Isopropyl alcohol	1/22	—	40798	—
Methylene chloride	2/22	—	1.2	—
Tetrachloroethene	1/22	—	0.51	—
Tetrahydrofuran	17/22	2.8 - 22	10.4	6.5
Trichloroethene	3/22	0.95 - 5.9	2.92	2.63
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	2/24	0.88 - 1.7	1.29	—
Di-n-octylphthalate	1/6	—	1.3	—
Diethylphthalate	1/6	—	6.6	—
Phenol	4/24	0.83 - 3.7	1.76	1.32
Semivolatile Organic Compounds (Pesticides)				
Aldrin	1/9	—	0.0041	—
Alpha-BHC	2/9	0.0011 - 0.0025	0.0018	—

Table D.7. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Delta-BHC	1/9	—	0.0041	—
Radiological Parameters				
Gross alpha	3/24	1.24 - 1.7	1.41	0.14
Gross beta	8/24	2.44 - 7.85	5.01	0.73
Tritium	7/24	251 - 558	380	38
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				
(c) Two times the standard error of the mean for radiological parameters.				

Table D.8. Constituents Detected in Building 326 RPS Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation
General Chemical Parameters				
Conductivity	2/2	191 - 202	197	—
pH	2/2	7.72 - 8	7.86	—
Total organic carbon	2/2	3000 - 20000	11500	—
Ammonia and Anions				
Ammonia	1/2	—	40	—
Bromide	1/2	—	350	—
Chloride	2/2	3100 - 3800	3450	—
Fluoride	2/2	300 - 500	400	—
Nitrate	2/2	390 - 400	395	—
Phosphate	1/2	—	700	—
Sulfate	2/2	14000 - 20000	17000	—
Metals				
Aluminum	1/2	—	120	—
Barium	2/2	20 - 27	24	—
Boron	1/2	—	210	—
Cadmium	1/2	—	4.9	—
Calcium	2/2	20000 - 21000	20500	—
Copper	2/2	32 - 72	52	—
Iron	2/2	270 - 290	280	—
Lead	2/2	1.8 - 2	1.9	—
Magnesium	2/2	—	4500	—
Manganese	2/2	20 - 29	25	—
Mercury	2/2	0.043 - 1.3	0.671	—
Nickel	1/2	—	15	—
Potassium	2/2	700 - 940	820	—
Silicon	2/2	2200 - 2400	2300	—
Silver	1/2	—	56	—
Sodium	2/2	3800 - 11000	7400	—
Strontium	2/2	95 - 97	96	—

Table D.8. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Tin	1/2	—	36	—
Zinc	2/2	250 - 440	345	—
Volatile Organic Compounds				
Acetone	2/2	7.1 - 9.9	8.50	—
Chloroform	2/2	1.3 - 2	1.6	—
Ethanol	1/2	—	54	—
Trichloroethene	2/2	0.94 - 1.3	1.12	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	2/2	1.4 - 2	1.7	—
Diethylphthalate	1/2	—	0.81	—
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm.				

Table D.9. Constituents Detected in Building 327 Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Conductivity	2/2	227 - 365	296	—
pH	2/2	7.04 - 8.03	7.54	—
Total organic carbon	2/2	1600 - 2700	2150	—
Ammonia and Anions				
Ammonia	1/2	—	50	—
Bromide	1/2	—	140	—
Chloride	2/2	5100 - 9300	7200	—
Fluoride	2/2	500 - 700	600	—
Nitrate	2/2	2200 - 5100	3650	—
Sulfate	2/2	27000 - 45000	36000	—
Metals				
Aluminum	2/2	36 - 85	61	—
Barium	2/2	37 - 55	46	—
Calcium	2/2	35000 - 47000	41000	—
Copper	2/2	5.9 - 17	11.4	—
Iron	2/2	100 - 200	150	—
Lead	1/2	—	2.9	—
Magnesium	2/2	7800 - 12000	9900	—
Manganese	2/2	5 - 7.8	6.4	—
Potassium	2/2	1400 - 2500	1950	—
Silicon	2/2	4300 - 5500	4900	—
Sodium	2/2	4800 - 7500	6150	—
Strontium	2/2	180 - 240	210	—
Vanadium	1/2	—	2.7	—
Zinc	2/2	190 - 250	220	—
Volatile Organic Compounds				
1,1,1-Trichloroethane	1/2	—	1.5	—
Acetone	1/2	—	5.7	—
Chloroform	2/2	1.6 - 3.2	2.4	—

Table D.9. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Ethylbenzene	1/2	—	0.57	—
Methylene chloride	1/2	—	0.73	—
Styrene	1/2	—	0.5	—
Tetrachloroethene	1/2	—	0.8	—
Trichloroethene	2/2	2.5 - 2.9	2.7	—
Xylenes (total)	1/2	—	2.0	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	1/2	—	0.92	—
Radiological Parameters				
Gross beta	1/3	—	6.95	—
Tritium	2/3	284 - 1080	682	—

(a) Number of samples with detectable concentrations/total number of samples analyzed.

(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.

(c) Two times the standard error of the mean for radiological parameters.

Table D.10. Constituents Detected in Building 327 RPS Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation
General Chemical Parameters				
Conductivity	1/1	—	364	—
pH	1/1	—	6.49	—
Radiological Parameters				
Gross alpha	1/1	—	1.69	—
Gross beta	1/1	—	20.60	—
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				

Table D.11. Constituents Detected in Building 331 Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	45/45	40000 - 130000	68322	19929
Chemical Oxygen Demand	32/38	6000 - 140000	21938	24314
Conductivity	34/34	72 - 920	250	154
pH	34/34	5.1 - 8.84	7.59	0.85
Total carbon	38/38	14000 - 76000	22368	9971
Total dissolved solids	43/43	90000 - 480000	143488	62369
Total organic carbon	44/44	2000 - 61000	6539	8969
Ammonia and Anions				
Ammonia	34/45	30 - 1000	136	226
Bromide	2/42	140 - 200	170	—
Chloride	43/43	3600 - 167000	10940	24465
Cyanide	33/43	1 - 70	16.5	19.7
Fluoride	43/43	300 - 1100	636	151
Nitrate	43/43	300 - 33000	6065	7855
Nitrite	2/35	110 - 130	120	—
Phosphate	31/43	212 - 81700	7077	14622
Sulfate	43/43	10000 - 47900	19251	5797
Sulfides	12/38	200 - 400	235	64
Metals				
Aluminum	43/44	22 - 630	147	159
Arsenic	5/44	2 - 3	2.4	0.5
Barium	44/44	17 - 48	29	6
Beryllium	1/44	—	0.19	—
Cadmium	2/44	—	3.4	—
Calcium	44/44	16000 - 43000	23568	6274
Chromium	6/44	4.3 - 22	12.5	8.0
Copper	44/44	9.5 - 930	50.8	136.9
Iron	42/44	18 - 460	85	78
Lead	36/44	0.6 - 17	2.5	2.8

Table D.11. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Magnesium	44/44	3900 - 18000	5536	2155
Manganese	35/44	1 - 16	3.4	3.3
Mercury	11/44	0.055 - 0.17	0.096	0.036
Nickel	2/44	16 - 17	17	—
Potassium	43/44	940 - 12000	3410	2536
Selenium	5/44	0.95 - 2	1.49	0.51
Silicon	2/2	3000 - 3200	3100	—
Silver	2/44	3.6 - 7.1	5.35	—
Sodium	44/44	3300 - 110000	13270	16563
Strontium	3/3	93 - 110	101	9
Thallium	4/44	0.58 - 1.1	0.83	0.21
Tin	5/44	24 - 110	71	31
Vanadium	6/44	2 - 7.8	4.3	2.6
Zinc	44/44	22 - 230	67	39
Volatile Organic Compounds				
1,1,1-Trichloroethane	1/66	—	2.1	—
2-Butanone	3/66	51 - 170	103	61
Acetone	15/66	5.6 - 1800	138.2	460.0
Acetonitrile	1/26	—	430	—
Bromodichloromethane	16/34	0.5 - 9.8	2.27	2.26
Bromoform	1/34	—	26	—
Chlorobenzene	1/26	—	0.39	—
Chloroform	66/66	3.1 - 33	11.4	6.5
Dibromochloromethane	6/34	0.7 - 11	2.7	4.1
Ethanol	5/66	8.3 - 47	20.5	15.4
Hexone	4/66	1.9 - 19	11.1	9.2
Isopropyl alcohol	1/66	—	19	—
Methylene chloride	43/66	0.4 - 4.8	1.2	0.9
Tetrahydrofuran	2/66	0.52 - 3	1.76	—
Toluene	4/66	0.22 - 0.86	0.53	0.26

Table D.11. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Trichloroethene	3/66	0.51 - 0.91	0.77	0.23
Xylenes (total)	3/66	1.4 - 2.4	1.8	0.5
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Benzyl alcohol	3/15	4.1 - 34	22.03	15.82
Bis(2-ethylhexyl) phthalate	8/46	1 - 6.4	3.7	2.3
Decane	1/32	—	37	—
Di-n-butylphthalate	4/14	2 - 3.6	2.5	0.8
Kerosene	1/14	—	9.5	—
Phenol	4/46	1 - 4.9	2.5	1.8
Semivolatile Organic Compounds (Pesticides)				
4,4'-DDE	3/40	0.0017 - 0.72	0.2417	0.4142
Aldrin	1/40	—	0.011	—
Alpha-BHC	3/40	0.0036 - 0.0073	0.0057	0.0019
Beta-BHC	4/40	0.0099 - 0.026	0.0170	0.0083
Delta-BHC	10/40	0.0017 - 0.033	0.0112	0.0088
Dieldrin	1/40	—	0.0032	—
Endosulfan I	6/40	0.0018 - 0.005	0.0032	0.0010
Endrin	2/40	0.0025 - 0.0066	0.0046	—
Endrin aldehyde	1/40	—	0.012	—
Gamma-BHC (Lindane)	5/40	0.0023 - 0.0038	0.0029	0.0007
Methoxychlor	1/40	—	0.019	—
Radiological Parameters				
Gross alpha	19/47	0.905 - 8.34	2.988	0.467
Gross beta	27/47	2.09 - 15.4	5.22	0.58
Tritium	1/2	—	330	—

(a) Number of samples with detectable concentrations/total number of samples analyzed.

(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.

(c) Two times the standard error of the mean for radiological parameters.

Table D.12. Constituents Detected in Building 331 Background Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	5/5	45000 - 50000	48200	2049
Chemical Oxygen Demand	2/5	7000 - 8000	7500	—
Conductivity	4/4	155 - 180	167	11
pH	4/4	3.3 - 7.64	6.44	2.10
Total carbon	5/5	13000 - 15000	13800	837
Total dissolved solids	5/5	90000 - 120000	102000	10954
Total organic carbon	5/5	2000 - 3000	2400	548
Ammonia and Anions				
Ammonia	3/5	23 - 30	28	4
Bromide	1/5	—	110	—
Chloride	5/5	4700 - 6800	6060	847
Cyanide	2/5	2 - 8	5.0	—
Fluoride	5/5	600 - 800	700	71
Nitrate	5/5	300 - 2700	1200	1005
Phosphate	1/5	—	2200	—
Sulfate	5/5	17000 - 21000	19000	1871
Sulfides	1/5	—	300	—
Metals				
Aluminum	5/5	56 - 81	70	11
Antimony	1/5	—	42	—
Barium	5/5	28 - 33	30	2
Calcium	5/5	19000 - 21000	20000	1000
Copper	5/5	9.6 - 36	20.3	13.0
Iron	4/5	23 - 65	39	19
Lead	3/5	0.66 - 1.5	1.05	0.42
Magnesium	5/5	4300 - 5000	4700	292
Manganese	1/5	—	2.6	—
Potassium	4/5	1000 - 2000	1400	432
Selenium	1/5	—	2.0	—

Table D.12. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Silver	2/5	3.4 - 4.2	3.8	—
Sodium	5/5	3200 - 7200	4140	1714
Tin	1/5	—	33	—
Zinc	5/5	42 - 79	58	15
Volatile Organic Compounds				
Acetone	1/10	—	67	—
Bromodichloromethane	6/8	1.2 - 9.5	3.2	3.2
Bromoform	1/8	—	15	—
Chloroform	10/10	8.6 - 26	16.9	5.3
Dibromochloromethane	2/8	1.7 - 11	6.3	—
Hexone	1/10	—	38	—
Methylene chloride	10/10	0.37 - 1.1	0.82	0.27
Toluene	2/10	0.37 - 0.52	0.45	—
Xylenes (total)	2/10	0.32 - 1.9	1.11	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	1/5	—	3.6	—
Semivolatile Organic Compounds (Pesticides)				
Aldrin	1/5	—	0.0042	—
Delta-BHC	1/5	—	0.017	—
Endosulfan I	1/5	—	0.0055	—
Gamma-BHC (Lindane)	1/5	—	0.0047	—
Radiological Parameters				
Gross alpha	3/5	0.877 - 12.8	4.87	3.97
Gross beta	1/5	—	2.68	—
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				
(c) Two times the standard error of the mean for radiological parameters.				

Table D.13. Constituents Detected in Building 3720 Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	43/43	30000 - 120000	55744	14821
Chemical Oxygen Demand	27/36	3000 - 51000	11552	10584
Conductivity	36/36	123 - 467	197	95
pH	36/36	2.37 - 12.2	7.75	1.51
Total carbon	35/35	12000 - 30000	17800	4269
Total dissolved solids	41/41	80000 - 190000	106341	22667
Total organic carbon	42/42	1000 - 16000	2876	2539
Ammonia and Anions				
Ammonia	7/43	30 - 100	63	35
Chloride	40/40	2200 - 32000	5911	4559
Cyanide	5/40	1 - 10	4.4	3.5
Fluoride	40/40	200 - 1000	506	161
Nitrate	40/40	400 - 32000	3513	5635
Phosphate	2/40	598 - 800	699	—
Sulfate	40/40	8500 - 28000	15733	3206
Sulfides	11/34	200 - 300	231	37
Metals				
Aluminum	40/43	21 - 190	70	33
Antimony	1/43	—	33	—
Arsenic	1/43	—	2.0	—
Barium	43/43	14 - 66	29	8
Beryllium	1/43	—	0.18	—
Cadmium	3/43	—	4.0	0.0
Calcium	43/43	16000 - 43000	21674	4664
Chromium	7/43	4.7 - 27	11.4	8.6
Cobalt	1/43	—	6.9	—
Copper	43/43	4.3 - 170	19.7	30.6
Iron	43/43	27 - 230	96	43
Lead	32/43	1.1 - 20	3.4	3.4

Table D.13. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Magnesium	43/43	3600 - 9100	4728	879
Manganese	41/43	0.98 - 13	3.90	2.54
Mercury	27/41	0.05 - 0.87	0.19	0.17
Nickel	4/43	15 - 18	17	1
Potassium	36/43	700 - 2800	1325	507
Selenium	6/43	0.65 - 2	1.18	0.57
Silicon	2/2	2600 - 2700	2650	—
Sodium	43/43	2700 - 13000	5216	2196
Strontium	4/4	88 - 110	96	10
Thallium	7/43	0.58 - 2	1.03	0.48
Tin	6/43	34 - 65	47	14
Vanadium	2/43	2.5 - 3.7	3.1	—
Zinc	43/43	16 - 470	65	77
Volatile Organic Compounds				
1,1,2-Trichloroethane	1/56	—	0.75	—
1,2-Dichloroethylene	7/56	0.44 - 1.1	0.68	0.27
Acetone	30/63	5.3 - 530	72.9	128.2
Acetonitrile	3/29	7.1 - 2400	1075	1217
Benzene	1/63	—	0.51	—
Bromodichloromethane	13/34	0.5 - 2	1.2	0.4
Carbon disulfide	1/56	—	2.5	—
Chloroform	61/63	2.5 - 32	12.9	5.9
Dibromochloromethane	1/34	—	1.7	—
Ethanol	6/63	5.5 - 26	14.1	8.7
Ethylbenzene	3/34	0.45 - 0.89	0.63	0.23
Hexone	6/63	1.4 - 37	13.3	13.8
Isopropyl alcohol	12/63	5.2 - 46	15.8	12.5
Methylene chloride	41/63	0.36 - 9.7	1.36	1.50
Tetrahydrofuran	10/63	3.4 - 406	53.4	124.3
Toluene	7/63	0.14 - 410	69.39	150.77

Table D.13. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Trichloroethene	61/63	0.66 - 2.1	1.28	0.35
Xylenes (total)	4/63	2.1 - 2.9	2.3	0.4
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	14/42	0.72 - 8.6	3.18	2.47
Di-n-butylphthalate	4/13	1.9 - 3.6	2.5	0.8
Diethylphthalate	3/14	35 - 170	81	77
Phenol	1/42	—	3.8	—
Tributyl phosphate	5/42	1.3 - 9.8	4.66	3.44
Radiological Parameters				
Gross alpha	41/47	0.997 - 44.6	12.07	1.21
Gross beta	28/47	2.64 - 17.6	5.31	0.54
Uranium-234	1/1	—	7.96	—
Uranium-235	1/1	—	0.346	—
Uranium-238	1/1	—	6.5	—

(a) Number of samples with detectable concentrations/total number of samples analyzed.

(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.

(c) Two times the standard error of the mean for radiological parameters.

Table D.14. Constituents Detected in Building 3720 Background Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	5/5	40000 - 70000	51200	11189
Conductivity	5/5	122 - 146	136	9
pH	5/5	5.31 - 8.32	7.32	1.16
Total carbon	5/5	11000 - 17000	13800	2168
Total dissolved solids	5/5	90000 - 100000	96000	5477
Total organic carbon	5/5	1000 - 3000	1800	837
Ammonia and Anions				
Ammonia	1/5	—	23	—
Chloride	5/5	1900 - 5800	4100	1409
Fluoride	5/5	200 - 800	560	219
Nitrate	5/5	500 - 1000	720	192
Sulfate	5/5	15000 - 40000	20600	10877
Sulfides	3/5	200 - 300	267	58
Metals				
Aluminum	5/5	42 - 77	55	16
Barium	5/5	15 - 28	24	5
Cadmium	1/5	—	3.3	—
Calcium	5/5	19000 - 21000	19600	894
Copper	5/5	6.6 - 13	9.5	3.2
Iron	5/5	44 - 84	63	14
Lead	4/5	0.95 - 3.3	1.91	0.99
Magnesium	5/5	4100 - 4300	4200	100
Manganese	3/5	1.5 - 3.3	2.1	1.0
Mercury	4/5	0.11 - 0.26	0.17	0.06
Potassium	2/5	1000 - 1300	1150	—
Silver	1/5	—	4.7	—
Sodium	5/5	2700 - 3400	2860	305
Thallium	1/5	—	2.0	—
Tin	1/5	—	24	—

Table D.14. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Zinc	5/5	15 - 49	34	13
Volatile Organic Compounds				
1,2-Dichloroethylene	3/10	0.41 - 0.63	0.50	0.12
Acetone	1/10	—	37	—
Bromodichloromethane	1/6	—	2.0	—
Chlorobenzene	1/6	—	0.66	—
Chloroform	10/10	5.8 - 40	14.9	10.2
Methylene chloride	10/10	0.34 - 1.3	0.83	0.40
Tetrahydrofuran	1/10	—	7.0	—
Toluene	2/10	0.23 - 0.64	0.44	—
Trichloroethene	10/10	0.84 - 1.6	1.13	0.26
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	1/5	—	1.5	—
Radiological Parameters				
Gross alpha	5/5	7.41 - 28	16.66	3.47
Gross beta	4/5	4.05 - 10.6	6.29	1.47
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				
(c) Two times the standard error of the mean for radiological parameters.				

Table D.15. Constituents Detected in End-of-Pipe Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	34/34	40000 - 140000	59618	19920
Chemical Oxygen Demand	24/34	4700 - 84000	13421	15834
Conductivity	36/36	125 - 5110	488	1141
pH	37/37	4.63 - 9.13	7.97	0.82
Total carbon	34/34	13000 - 42000	17882	5370
Total dissolved solids	32/32	80000 - 730000	142813	136694
Total organic carbon	46/46	1000 - 36000	3470	5054
Ammonia and Anions				
Ammonia	13/43	23 - 100	45	22
Bromide	2/40	100 - 200	150	—
Chloride	41/41	2500 - 190000	11369	28900
Cyanide	9/45	1 - 5	2.7	1.2
Fluoride	40/41	200 - 940	545	159
Nitrate	41/41	200 - 110000	6105	18180
Nitrite	1/34	—	200	—
Phosphate	10/41	383 - 1860	777	493
Sulfate	41/41	10000 - 36900	18402	4372
Sulfides	8/32	200 - 400	283	63
Metals				
Aluminum	46/47	40 - 410	92	64
Arsenic	2/46	2 - 3	2.5	—
Barium	47/47	15 - 130	31	18
Beryllium	3/47	0.19 - 0.68	0.40	0.25
Cadmium	2/47	1 - 2.3	1.6	—
Calcium	47/47	14000 - 100000	24085	14059
Chromium	6/47	3.8 - 20	12.0	6.0
Copper	47/47	7.9 - 49	17.9	10.3
Iron	47/47	23 - 250	97	48
Lead	39/46	0.7 - 5.9	2.4	1.1

Table D.15. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Magnesium	47/47	3400 - 24000	5528	3346
Manganese	47/47	1.5 - 9.3	3.39	1.68
Mercury	18/43	0.019 - 0.48	0.154	0.114
Nickel	2/47	16 - 18	17	—
Potassium	44/47	580 - 5000	1545	783
Selenium	7/46	0.97 - 2.2	1.61	0.49
Silicon	2/2	2400 - 2500	2450	—
Sodium	47/47	3200 - 230000	18000	39632
Strontium	5/5	88 - 100	95	5
Thallium	4/46	1.2 - 2	1.6	0.4
Tin	8/47	26 - 68	41	16
Vanadium	8/47	2 - 4.6	2.9	0.9
Zinc	47/47	19 - 110	41	19
Volatile Organic Compounds				
1,1,1-Trichloroethane	1/61	—	1.4	—
Acetone	17/61	5.9 - 63	24.1	17.3
Acetonitrile	1/24	—	76	—
Bromodichloromethane	16/31	0.5 - 3.2	1.9	0.8
Bromoform	2/31	0.54 - 0.86	0.70	—
Chloroform	61/61	3.4 - 21	11.0	4.5
Dibromochloromethane	7/31	1 - 2.2	1.6	0.4
Ethylbenzene	1/31	—	0.22	—
Hexone	4/61	1.7 - 20	8.5	8.5
Isopropyl alcohol	2/61	110 - 575	342	—
Methylene chloride	39/61	0.2 - 1.6	0.9	0.4
Tetrachloroethene	1/61	—	2.0	—
Tetrahydrofuran	2/61	7.4 - 9.4	8.4	—
Toluene	1/61	—	1.4	—
Trichloroethene	7/61	0.32 - 0.7	0.52	0.12
Trichlorofluoromethane	3/25	1.4 - 4.4	2.4	1.7

Table D.15. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Xylenes (total)	6/61	0.49 - 2	1.23	0.53
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	13/45	0.44 - 38	19.83	11.36
Butylbenzylphthalate	1/12	—	7.6	—
Di-n-butylphthalate	4/12	2.6 - 5.7	3.9	1.3
Tributyl phosphate	1/45	—	6.4	—
Semivolatile Organic Compounds (Pesticides)				
4,4'-DDE	2/29	0.004 - 0.024	0.014	—
Beta-BHC	1/29	—	0.0017	—
Delta-BHC	7/29	0.002 - 0.014	0.007	0.005
Endosulfan I	2/29	0.0045 - 0.0051	0.0048	—
Endosulfan sulfate	1/29	—	0.036	—
Gamma-BHC (Lindane)	1/29	—	0.0029	—
Heptachlor	3/29	0.0078 - 0.0099	0.0087	0.0011
Radiological Parameters				
Gross alpha	34/44	1.44 - 13.3	4.06	0.50
Gross beta	20/44	2.11 - 12.5	4.02	0.53
Tritium	1/11	—	423	—

(a) Number of samples with detectable concentrations/total number of samples analyzed.

(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.

(c) Two times the standard error of the mean for radiological parameters.

Table D.16. Constituents Detected in End-of-Pipe Background Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation [c]
General Chemical Parameters				
Alkalinity	6/6	40000 - 70000	54500	12550
Chemical Oxygen Demand	1/6	—	9000	—
Conductivity	4/4	125 - 162	145	16
pH	4/4	6.26 - 8.3	7.50	0.87
Total carbon	5/5	12000 - 17000	13800	1924
Total dissolved solids	5/5	90000 - 100000	92000	4472
Total organic carbon	6/6	2000 - 3000	2167	408
Ammonia and Anions				
Ammonia	1/6	—	60	—
Chloride	6/6	2200 - 6100	4650	1909
Fluoride	6/6	200 - 800	517	256
Nitrate	6/6	500 - 900	733	186
Sulfate	6/6	10000 - 20000	15667	4179
Sulfides	2/5	—	200	—
Metals				
Aluminum	6/6	36 - 89	62	19
Arsenic	1/6	—	2.0	—
Barium	6/6	16 - 31	25	7
Cadmium	1/6	—	3.4	—
Calcium	6/6	19000 - 22000	20333	1366
Copper	6/6	9.3 - 15	11.12	2.15
Iron	6/6	55 - 90	76	13
Lead	5/6	1.3 - 3	2.1	0.8
Magnesium	6/6	4300 - 4600	4500	126
Manganese	5/6	1.4 - 3.5	2.2	0.8
Nickel	1/6	—	24	—
Potassium	6/6	940 - 1700	1357	323
Sodium	6/6	3200 - 4100	3533	403
Tin	1/6	—	100	—

Table D.16. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Zinc	6/6	18 - 52	33	15
Volatile Organic Compounds				
Acetone	1/12	—	33	—
Acetonitrile	2/12	260 - 400	330	—
Bromodichloromethane	3/6	1.8 - 3.3	2.4	0.8
Bromoform	1/6	—	1.7	—
Chloroform	12/12	3.1 - 18	9.1	4.8
Dibromochloromethane	2/6	1 - 2.7	1.9	—
Hexone	1/12	—	33	—
Methylene chloride	12/12	0.34 - 1.4	0.67	0.44
Tetrachloroethene	1/12	—	0.52	—
Trichloroethene	1/12	—	0.84	—
Trichlorofluoromethane	2/6	1.7 - 4.2	3.0	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Bis(2-ethylhexyl) phthalate	2/6	21 - 31	26	—
Semivolatile Organic Compounds (Pesticides)				
Heptachlor	1/5	—	0.013	—
Radiological Parameters				
Gross alpha	6/6	1.29 - 4.39	2.21	0.47
Gross beta	3/6	2.23 - 2.72	2.41	0.15
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm and radiological parameters are pCi/L.				
(c) Two times the standard error of the mean for radiological parameters.				

Table D.17. Constituents Detected in Untreated Influent Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation
General Chemical Parameters				
Alkalinity	4/4	48000 - 60000	52000	5416
Chemical Oxygen Demand	1/1	—	9000	—
Conductivity	3/3	103 - 125	116	12
pH	3/3	6.66 - 7.27	6.94	0.31
Total carbon	5/5	16000 - 21000	18200	2280
Total dissolved solids	4/4	80000 - 90000	82500	5000
Total organic carbon	5/5	3000 - 7000	4400	1517
Ammonia and Anions				
Chloride	4/4	1000 - 1200	1075	96
Fluoride	4/4	100 - 400	225	126
Nitrate	3/4	200 - 300	267	58
Sulfate	4/4	8500 - 10000	9000	707
Sulfides	1/1	—	300	—
Metals				
Aluminum	5/5	36 - 260	93	94
Arsenic	2/5	—	2.0	—
Barium	5/5	27 - 33	29	2
Calcium	5/5	17000 - 21000	18600	1517
Chromium	1/5	—	13	—
Cobalt	1/5	—	6.6	—
Copper	3/5	4.4 - 35	15.2	17.2
Iron	5/5	56 - 530	160	207
Lead	5/5	0.62 - 8.1	2.43	3.19
Magnesium	5/5	4100 - 5100	4440	397
Manganese	5/5	4.5 - 16	7.2	4.9
Potassium	3/5	1200 - 1400	1267	115
Sodium	5/5	2300 - 3000	2600	292
Tin	1/5	—	69	—
Zinc	3/5	10 - 110	44	57

Table D.17. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Volatile Organic Compounds				
Chloroform	1/10	—	6.2	—
Methylene chloride	10/10	1 - 1.7	1.3	0.2
Tetrahydrofuran	1/10	—	3.6	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Phenol	2/5	3.2 - 3.4	3.3	—
Semivolatile Organic Compounds (Pesticides)				
Delta-BHC	2/5	0.0026 - 0.004	0.0033	—
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm.				

Table D.18. Constituents Detected in Treated Influent Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation
General Chemical Parameters				
Alkalinity	4/4	40000 - 60000	50000	11547
Chemical Oxygen Demand	1/1	—	10000	—
Conductivity	3/3	116 - 133	126	9
pH	3/3	6.31 - 7.22	6.70	0.47
Total carbon	5/5	13000 - 19000	15800	2588
Total dissolved solids	4/4	80000 - 90000	82500	5000
Total organic carbon	5/5	3000 - 5000	3800	837
Ammonia and Anions				
Chloride	5/5	4000 - 5700	4740	709
Fluoride	5/5	500 - 600	540	55
Nitrate	4/5	100 - 500	325	171
Sulfate	5/5	16000 - 17000	16200	447
Metals				
Aluminum	4/4	51 - 93	75	19
Barium	4/4	27 - 30	28	1
Calcium	4/4	17000 - 19000	18250	957
Copper	2/4	3.1 - 3.7	3.4	—
Iron	2/4	23 - 69	46	—
Lead	3/4	0.74 - 1.2	0.91	0.25
Magnesium	4/4	4100 - 4500	4275	206
Manganese	1/4	—	1.1	—
Potassium	2/4	1100 - 1500	1300	—
Sodium	4/4	2600 - 2800	2675	96
Tin	2/4	61 - 62	62	—
Zinc	3/4	4.8 - 11	8.9	3.6
Volatile Organic Compounds				
Benzene	1/10	—	0.71	—
Bromodichloromethane	8/9	0.91 - 2.5	1.40	0.51
Chlorobenzene	1/9	—	2.3	—

Table D.18. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Chloroform	10/10	15 - 41	22	7
Methylene chloride	10/10	1.1 - 1.6	1.3	0.2
Tetrahydrofuran	2/10	3.7 - 8.6	6.2	—
Toluene	2/10	0.13 - 0.36	0.25	—
Semivolatile Organic Compounds (Acids/Bases/Neutrals)				
Di-n-butylphthalate	1/5	—	1.9	—
Semivolatile Organic Compounds (Pesticides)				
Aldrin	1/5	—	0.016	—
Alpha-BHC	1/5	—	0.0032	—
Delta-BHC	1/5	—	0.0065	—
Heptachlor epoxide	1/5	—	0.0016	—
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm.				

Table D.19. Constituents Detected in Alternate Influent Samples

Constituent	Frequency [a]	Concentration (µg/L)[b]		
		Range	Average	Standard Deviation
General Chemical Parameters				
Alkalinity	1/1	—	70000	—
Conductivity	4/4	160 - 187	172	13
pH	4/4	7.03 - 8.15	7.80	0.52
Total carbon	1/1	—	17000	—
Total dissolved solids	4/4	90000 - 110000	97500	9574
Total organic carbon	4/4	1500 - 2700	2100	497
Ammonia and Anions				
Ammonia	1/4	—	30	—
Chloride	4/4	1800 - 2900	2550	507
Fluoride	4/4	200 - 300	225	50
Nitrate	4/4	400 - 700	593	142
Sulfate	4/4	8500 - 14000	12125	2462
Metals				
Barium	4/4	12 - 25	21	6
Calcium	4/4	21000 - 22000	21250	500
Copper	3/4	2.5 - 34	13.6	17.7
Iron	3/4	20 - 31	24	6
Lead	2/4	2.3 - 4.2	3.3	—
Magnesium	4/4	4300 - 4400	4350	58
Manganese	3/4	0.86 - 1.4	1.04	0.31
Potassium	4/4	1000 - 1300	1125	126
Silicon	2/2	2600 - 2700	2650	—
Sodium	4/4	2700 - 2900	2750	100
Strontium	3/3	93 - 100	97	4
Tin	1/4	—	47	—
Vanadium	1/4	—	2.9	—
Zinc	4/4	9 - 200	137.3	88.2
Volatile Organic Compounds				
Chloroform	5/5	5.6 - 22	13.5	7.3

Table D.19. (continued)

Constituent	Frequency	Concentration (µg/L)		
		Range	Average	Standard Deviation
Hexone	1/5	—	2.6	—
Methylene chloride	2/5	0.45 - 0.47	0.46	—
Trichloroethene	1/5	—	0.79	—
Xylenes (total)	1/5	—	2.0	—
(a) Number of samples with detectable concentrations/total number of samples analyzed.				
(b) Conductivity units are µmhos/cm.				

Appendix E

Procedure Used to Calculate Facility and End-of-Pipe Rankings

Appendix E

Procedure Used to Calculate Facility and End-of-Pipe Rankings

For each class of constituents, the ranking of constituent releases at facilities and end-of-pipe was facilitated by calculating a normalized significance value for each location. The significance value statistic was designed to have relatively high values (i.e., near 1) for those locations that had frequent detection and/or above average concentrations of constituents as listed in the waste acceptance criteria or U.S. Environmental Protection Agency maximum contaminant levels. The following six-step procedure was used to calculate normalized significance values.

1. Determine the average concentration of each constituent at each location (i.e., facility or end-of-pipe). These values are designated location averages.

2. For each constituent, calculate the average of the location averages. These values are designated overall averages.

3. Divide each location average by its associated overall average. These values are designated normalized location averages.

4. For each constituent, multiply the normalized location averages by the detection frequency (i.e., number of times the constituent was detected divided by the number of samples analyzed). These values are designated constituent weights.

5. For each location, add all of the constituent weights. This sum is designated the location's total significance.

6. Divide the total significance value at each location by the maximum total significance value observed. These values are the normalized significance values.

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