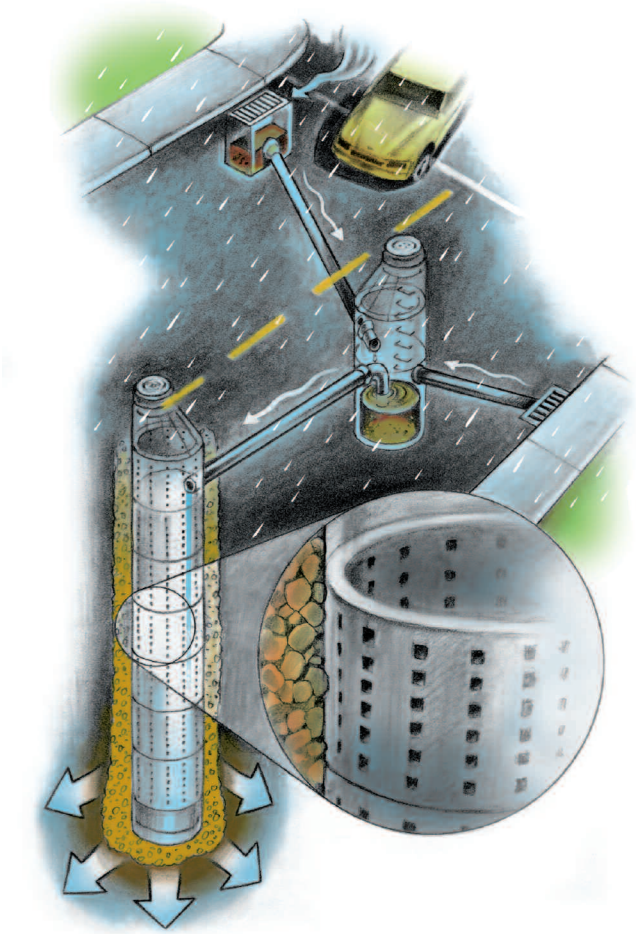
Annual Stormwater Discharge Monitoring Report

Year 4

October 2008 - May 2009



July 2009

Water Pollution Control Facilities (WPCF) Permit

Class V Stormwater Underground Injection Control Systems

DEQ Permit Number 102830

Prepared by

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

— CITY OF PORTLAND —
ENVIRONMENTAL SERVICES
1120 SW Fifth Avenue, Room 1000, Portland, Oregon 97204 ▪ Dan Saltzman, Commissioner ▪ Dean Marriott, Director

July 15, 2009

Mr. Rodney Weick
NWR Stormwater and Underground Injection Control Manager
Oregon Department of Environmental Quality
2020 Southwest Fourth Avenue, Suite 400
Portland, Oregon 97201

Subject: Permit Required Submittal – Annual Stormwater Discharge Monitoring Report No. 4
City of Portland Water Pollution Control Facilities Permit No. 102830

Dear Rodney:

In accordance with the Oregon Department of Environmental Quality's (DEQ) Water Pollution Control Facilities Permit (WPCF Permit #102830 issued on June 1, 2005) for Class V Stormwater Underground Injection Control Systems (UICs), the City of Portland's Bureau of Environmental Services (City) is pleased to provide DEQ with the following document *Annual Stormwater Discharge Monitoring Report: Year 4 – October 2008 – May 2009.*

This report presents the results of the Year 4 (October 1, 2008 through May 31, 2009) UIC Monitoring Program. Monitoring was implemented in accordance with the final *Stormwater Discharge Monitoring Plan* (SDMP), submitted to DEQ in August 2006. The monitoring program is representative of the estimated 9,000 City-owned UICs. Forty UIC locations were sampled in Year 4 including:

- Thirty UICs selected to implement the required Year 4 monitoring (*i.e.*, compliance monitoring network) described in the SDMP including: 15 rotating UIC locations (Panel 4) and 15 fixed UIC locations (Panel 6).
- Ten supplemental UICs located near drinking water wells.

The report provides details regarding the UIC sampling program (*e.g.*, UIC locations, sampling and analysis, data quality); individual sampling events; annual mean concentrations; preliminary trend analysis, response actions, and the identification of Category 4 UICs as required by the permit. However, no Category 4 UICs were identified in Year 4.

Permit compliance is demonstrated in this report by documenting that Year 4 sampling, analyses, data evaluation, and response actions are performed in accordance with the permit, SDMP, and UIC Management Plan (submitted to DEQ in December 2006).

If you have any questions or need additional information to complete your review of this document, please call me at 503 823-5737. We look forward to continuing to work with you on implementing the City's UIC Program.

Sincerely,

Barbara Adkins.
Bureau of Environmental Services
Underground Injection Control Program

Enclosures:

3 Copies: Annual Stormwater Discharge Monitoring Report – Year 4
(Note: Appendices and a full copy of the report are provided on a CD contained in the report)

Cc: UIC Program File
Mary Wahl, BES
Dave Kliewer, BES
Joel Bowker, BES
Jan Betz, City Attorney

City of Portland, Oregon

Water Pollution Control Facilities (WPCF) Permit For
Class V Stormwater Underground Injection Control Systems

Permit Number: 102830

Annual Stormwater Discharge Monitoring Report
Year 4 – October 2008 - May 2009

Underground Injection Control Systems
System Monitoring

July 2009

Prepared By:
City of Portland, Bureau of Environmental Services

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Executive Summary

The annual *Stormwater Discharge Monitoring* report is required by the Water Pollution Control Facilities (WPCF) permit issued to the City of Portland (City) in June 2005 by the Oregon Department of Environmental Quality (DEQ). The City is required to monitor stormwater entering City-owned Underground Injection Control (UIC) systems throughout the life of the permit and to submit this annual monitoring report.

Year 4 Monitoring Program: The City of Portland's UIC monitoring program was implemented in accordance with the final *Stormwater Discharge Monitoring Plan* (SDMP; City of Portland, 2006a), submitted to DEQ in August 2006 and approved by DEQ in November 2008. The program was designed to monitor UICs that are representative of the estimated 9,000 City-owned UICs using a statistically robust method to identify a subset of UICs for monitoring. Forty UIC locations were sampled in Year 4 (October 1, 2008 through May 31, 2009) including:

- Thirty UICs selected to implement the required Year 4 monitoring (*i.e.*, compliance monitoring) described in the SDMP:
  - Panel 4 (15 rotating UIC locations sampled in permit Years 4 and 10); and
  - Panel 6 (15 fixed UIC locations sampled in permit Years 1 through 10).
- Ten supplemental UICs located near drinking water wells (Supplemental Panel 3).

There were no carry over UIC locations from Year 3.

UIC monitoring network sample locations were selected on the basis of two traffic flow categories: <1,000 trips per day (TPD) and ≥1,000 TPD. Year 4 Panel locations (*i.e.*, Panels 4 and 6, Supplemental Panel 3) included 21 UIC locations in the <1,000 TPD category and 19 locations in the ≥1,000 TPD category.

Year 4 Results: Five sampling events were completed, as required, between October 2008 and May 2009. Stormwater discharge samples were analyzed for common pollutant and priority pollutant screen (PPS) analytes (*e.g.*, metals, volatile organic compounds, semivolatile organic compounds, and pesticides) as defined by the permit. Year 4 field and laboratory data collected met the SDMP data quality objectives.

All 14 common pollutants and six PPS analytes (antimony, barium, beryllium, 2,4-D, glyphosate, and mercury) were detected in Year 4. Twenty-eight ancillary pollutants (*i.e.*, analytes derived from the analytical methods for common pollutants) were detected at low concentrations. The 10 ancillary pollutants detected at the highest frequencies (between 50 percent and 92.5 percent) during the individual sampling events are polycyclic aromatic hydrocarbons (PAH). Of the PAHs detected, naphthalene had the highest concentration (2.24 micrograms per liter [µg/L]).

Maximum Allowable Discharge Limit (MADL) Exceedances: Four common pollutants (pentachlorophenol, di(2-ethylhexyl)phthalate [DEHP], benzo(a)pyrene, and lead) were detected in Year 4 at concentrations above their respective MADLs in at least

one sample. Detected concentrations of other common and PPS analytes were below their respective MADLs. The City reported MADL exceedances to DEQ, as required by the permit.

Annual Geometric Mean Concentrations: Annual geometric mean concentrations for five UIC locations (P6_1, P6_7, P6_14, SP3_6, and SP3_8) exceeded the MADL for pentachlorophenol (1.0 µg/L); annual geometric means for these locations ranged from 1.1 to 1.5 µg/L, slightly above the MADL. One site (SP3_8 also exceeded the MADL for lead (50 µg/L). Annual geometric mean concentrations for DEHP and benzo(a)pyrene were less than their respective MADLs. Annual geometric mean concentration for benzene was calculated for one UIC location (P6_12). The concentration at this location was 0.4 µg/L, significantly below the MADL of 5.0 µg/L. Annual geometric mean concentrations were calculated for antimony at three locations (P4_3, SP3_6, and SP3_8); annual geometric means for these locations range from 1.9 to 3.9 µg/L, well below the MADL (6.0 µg/L). Annual geometric mean concentrations were not calculated for other pollutants because their concentrations were <50 percent of the MADL and theoretically cannot exceed the MADL.

Preliminary Trend Analysis: In general, low concentrations of common pollutants were detected in Year 1 - Year 4 samples. Concentration ranges for pentachlorophenol, DEHP, and lead are similar for Years 1, 2, 3, and 4. Concentrations are generally within narrow ranges at individual UIC locations. Concentrations for the ≥1,000 TPD traffic category appear to be slightly higher than the <1,000 TPD traffic category in Years 1 - 4. Year 2 DEHP data suggest several data points may be outliers or result from laboratory contamination issues.

Year 4 Response Actions: Source investigations may be conducted when new data are inconsistent with previous results or observations. No specific source investigations were conducted in Year 4.

Category 4 UICs: The permit defines Category 4 UICs as those that become non-compliant by failing to meet the annual geometric mean MADL within one wet season after the initial exceedance. No Category 4 UICs were identified in Year 4. However, corrective actions were selected and implemented for a total of seven previously identified Category 4 UICs in accordance with the DEQ approved *Corrective Action Plan* (CAP; City of Portland, 2006f). The recommended corrective action for each of the Category 4 UICs was a Groundwater Protectiveness Demonstration (GWPD; ***i.e.,*** risk assessment) or No Further Action determination as allowed by the permit [Schedule C(11)(a)].

Site-specific GWPDs for Year 2 Category 4 UICs were submitted for DEQ review and approval in the spring of 2008 (GSI, 2008a; 2008b). DEQ issued No Further Action determinations for the four Year 2 Category 4 UICs in a letter dated May 30, 2008 (DEQ, 2008). Site-specific GWPDs for the three Year 3 Category 4 UICs were submitted to DEQ on March 30, 2009, for No Further Action. All Category 4 UICs identified to date have been addressed.

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List of Acronyms

BES	City of Portland, Bureau of Environmental Services
BMP	best management practice
City	City of Portland
C	Celsius
CDF	cumulative distribution function
COC	chain-of-custody
CSM	conceptual site model
DEHP	di(2-ethylhexyl)phthalate or bis(2-ethylhexyl)phthalate
DEM	digital elevation model
DEQ	Oregon Department of Environmental Quality
DFR	daily field report
DOC	dissolved organic carbon
DQO	data quality objective
EC	electrical conductivity
EOP	end-of-pipe
EPA	U.S. Environmental Protection Agency
EST	estimated value
F	Fahrenheit
FDS	field data sheet
FO	field operations
GIS	geographic information systems
GRTS	Generalized Random Tessellation Stratified
GWPD	Groundwater Protectiveness Demonstration
Gx	gasoline range
HYDRA	Hydrological Data Retrieval and Alarm System
IMS	BES Investigation and Monitoring Services
LCS	laboratory control sample
LIMS	BES Laboratory Information Management System
MADL	Maximum Allowable Discharge Limit
MDL	method detection limit
mg/kg	milligrams per kilogram
MRL	method reporting limit
MS	matrix spike
µmhos/cm	micromhos per centimeter
µg/L	micrograms per liter
NCA	North Creek Analytical

List of Acronyms (Continued)

PAH	polycyclic aromatic hydrocarbon
PDOT	City of Portland Department of Transportation
PPS	priority pollutant screen
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
ROW	right(s)-of-way
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SDMP	Stormwater Discharge Monitoring Plan
SOP	Standard Operating Procedures
SVOC	semi-volatile organic compound
TA	Test America
TPD	trips per day
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSS	total suspended solids
UIC	underground injection control
UICMP	UIC Management Plan
VOC	volatile organic compound
WPCF	Water Pollution Control Facility
WPCL	Water Pollution Control Laboratory

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Section 1

1 Introduction and Organization

1.1 Introduction and Purpose

This *Annual Stormwater Discharge Monitoring Report* presents the results of the fourth year of sampling, performed between October 1, 2008 and May 31, 2009, under the *Stormwater Discharge Monitoring Plan* (SDMP) (City of Portland, 2006a). This report is a requirement of the Water Pollution Control Facilities (WPCF) permit issued to the City of Portland (City) in June 2005 by the Oregon Department of Environmental Quality (DEQ; Permit Number 102830). The permit requires the City to monitor stormwater entering City-owned or operated (*i.e.*, public) underground injection control (UIC) structures throughout the life of the permit (10 years, or permit term) and to submit this annual report. For the purposes of this report, all references to "WPCF permit" or "permit" refer to this permit.

The City currently has an estimated 9,000 Class V UICs, which collect stormwater from public rights-of-way (ROW) and discharge it to the subsurface. UICs are an essential element of the City's comprehensive watershed strategy to use stormwater as a resource by infiltrating it back into the ground.

Underground Injection Control

UIC, as used in this document, means any Class V underground stormwater control system owned or operated by the City of Portland.

In the Portland area, groundwater serves as a backup drinking water supply to the Bull Run reservoirs. The WPCF permit establishes the UIC construction, operation, and maintenance requirements that the City must implement to protect groundwater for use as a drinking water resource. The permit is designed to protect groundwater by implementing a comprehensive stormwater management strategy to prevent, minimize, and control pollutants at the surface before stormwater is discharged to the ground.

The SDMP is a mandatory element of the permit and consists of the *Sampling and Analysis Plan* (SAP) (City of Portland, 2006b) and the *Quality Assurance Project Plan* (QAPP) (City of Portland, 2006c). Adherence to the SAP and QAPP ensures that the stormwater data collected are of known and acceptable quality and can be used to demonstrate permit compliance. The purpose of the SAP is to present the methodology for selecting representative sampling locations and procedures for collecting and analyzing stormwater samples. The purpose of the QAPP is to establish the laboratory and field data quality standards and measures and to ensure that project-specific data quality objectives (DQO) are met. The QAPP also presents the method for calculating annual geometric mean stormwater concentrations for each sample location for comparison to the Maximum Allowable Discharge Limits (MADL). The SDMP was submitted to DEQ in February 2006 and approved in January 2009 and much of the background information in this report is summarized from that document.

1.2 Permit Requirements

The WPCF permit contains specific monitoring and reporting requirements. These requirements and how they are met are presented in Table 1-1. The permit requires the City to submit an annual stormwater discharge monitoring report to DEQ by July 15 of each permit year. The annual report is intended to:

- Present the results of the previous year's wet season (October through May) stormwater monitoring results;
- Describe the storms sampled during each sampling event and any conditions that may affect the sampling results;
- Describe the UIC monitoring locations;
- Identify and discuss any individual or annual geometric mean MADL exceedances for common pollutants;
- Identify and discuss detected priority pollutant screen (PPS) analyte detections (required in Years 1, 4, and 9 only);
- Identify any ancillary pollutants detected; and
- Present the results of groundwater monitoring (if any).

In addition, the permit requires the City to submit an annual *UIC Management Plan* (UICMP) report by November 1 of each year. The annual UICMP report(s) will supplement this report and will include the following types of information related to the stormwater discharge monitoring results presented in this report:

- Identify traffic or land use changes that would modify sampling protocols or the sampling network;
- Evaluate trends in the cumulative monitoring data;
- Identify factors that strongly influence the quality of stormwater draining to public UICs to assist in enhancing protection of groundwater;
- Present a preliminary discussion of response actions; and
- Present action(s) taken in response to monitoring data.

1.3 Report Organization

This annual report presents the City's UIC monitoring data for the period between October 1, 2008 and May 31, 2009 (*i.e.,* the permit-defined wet season). This report includes sampling data collected during five sampling events, a summary of descriptive information for the UICs sampled (*e.g.,* location, surrounding land use), a description of individual storms comprising each sampling event, identification of MADL concentration exceedances, identification and discussion of common and ancillary pollutants detected, and a discussion of Year 4 response actions. This report is organized as follows:

- Section 1 Introduction and Organization;
- Section 2 Goals and Objectives;
- Section 3 UIC System Monitoring Design and Locations;
- Section 4 UIC SDMP Implementation;
- Section 5 Stormwater Discharge Monitoring Results;
- Section 6 Data Management and Validation;
- Section 7 Data Evaluation;
- Section 8 Response Actions;
- Section 9 Preliminary Trend Analyses;
- Section 10 Findings and Conclusions; and
- Section 11 References.

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Section 2

2 Goals and Objectives

2.1 Goals

The primary goal of the UIC monitoring program is to demonstrate that the quality of stormwater discharged into City-owned UICs meets permit conditions and is protective of groundwater quality (*i.e.*, all beneficial use). Permit compliance is demonstrated in this report by documenting that Year 4 sampling, analyses, and data evaluation were performed in accordance with the WPCF permit and SDMP, and results are statistically representative of the City's UIC system.

In addition, the results of the City's UIC monitoring program will be used to ensure UICs are constructed and operated in a manner that provides multiple watershed benefits and protects groundwater.

UICs are also an essential element of a comprehensive watershed strategy to use stormwater as a resource by infiltrating it back into the ground. Demonstrating permit compliance is important to the City to ensure that UICs continue to have an integral role in achieving the City's Bureau of Environmental Services' (BES) mission.

2.2 Objectives

The overall objectives of the UIC monitoring program are to demonstrate compliance with permit requirements and to protect groundwater. Compliance is demonstrated using data of known and acceptable quality that are representative of stormwater quality entering the City-owned UICs. The UIC monitoring program was designed to satisfy the following specific objectives, which are described in more detail in the SDMP:

- Monitor the quality of stormwater discharged into public UICs and demonstrate that groundwater is protected by meeting MADLs established in the WPCF permit (DEQ, 2005a, Table 1);
- Provide a high degree of confidence that the sampling design used for this program is representative of all UICs covered by the permit;
- Provide data that will be used to conduct trend analysis of the stormwater quality discharged into public UICs;
- Identify factors that strongly influence the quality of stormwater draining to public UICs to assist in enhancing groundwater protection;
- Evaluate the effectiveness of actions implemented to improve stormwater quality and meet MADLs; and
- Provide data that can be compared with data collected from previous investigations conducted by the City and/or split/duplicate samples collected by others.

In addition, the monitoring data inform decision making processes to identify actions that will protect groundwater quality, improve UIC management practices, and improve overall watershed health.

Section 3

3 UIC System Monitoring Design and Locations

This section summarizes the UIC system monitoring design and presents the Year 4 monitoring locations and their characteristics. The basis and details of the UIC monitoring program are presented in the SDMP.

3.1 Sample Design

It is not technically practicable or financially feasible to collect and analyze stormwater from each of the estimated 9,000 active City-owned UICs during every storm event (Figure 3-1). Therefore, a statistically robust method, the Generalized Random Tessellation Stratified (GRTS) survey design (Stevens and Olsen, 2004), was used to identify a representative subset of the City's UICs for monitoring. This method, which is described in detail in the SAP, provides a high degree of confidence that a monitored subset is reasonably representative of the entire system. This allows the characteristics of the entire UIC population to be estimated using the measured results of a representative sampling subset.

3.1.1 Sample Size

Forty UIC locations were sampled in Year 4 including:

- Thirty UICs selected to implement the required Year 4 monitoring (*i.e.*, compliance monitoring) described in the SDMP:
  - Panel 4 (15 rotating UIC locations sampled in Years 4 and 10[1]);
  - Panel 6 (15 fixed UIC locations sampled in Years 1 through 10);
- Ten supplemental UICs located near drinking water wells (Supplemental Panel 3; see Section 3.2.4).

There were no carry-over UIC locations from Year 3.

The sample size, "n", for the UIC monitoring locations is described in detail in the SDMP and was selected to be representative of the City's UIC system. The sample size is based on a specified confidence level, interval width, and the estimated proportion of UICs exceeding the MADL (definitions of these measurements are provided in the *Annual Stormwater Discharge Monitoring Report - Year 1*; City of Portland, 2006e). To limit the amount of uncertainty around the estimated proportion of exceedances, the confidence interval was set at a 90 percent confidence level and a half-width of 12 percent, as described in the SAP.

[1] The permit requires the PPS analytes to be sampled in Years 1, 4, and 9. The sequence of Panels 4 and 5 will be reversed in Years 9 and 10 so that Panel 4 is not sampled twice for PPS analytes, which will result in a more robust data set by adding an additional 15 discrete locations for 45 total locations for PPS analytes.

The proportion of UICs exceeding a MADL was estimated from stormwater discharge data collected during a pre-permit pilot study (described in the SAP). This study indicated that the proportion of all City-owned UICs estimated to exceed the pentachlorophenol MADL was 8.1 percent. Using the 90 percent confidence interval and a 12 percent precision half-width, 30 UIC locations were selected to be representative of the City's UIC population. The upper confidence limit on the number of UICs that may exceed the pentachlorophenol MADL was estimated to be 20.1 percent.

The results from Years 1 through 4 were consistent with the pre-permit pilot study results. As in the pre-permit pilot study, pentachlorophenol was the most frequently detected pollutant above its MADL of 1 microgram per liter (µg/L). The proportion of UICs exceeding the pentachlorophenol MADL ranged between 7.5 percent (three UICs) and 20 percent (eight UICs) during individual Year 4 sampling events (see Section 7.1). These results are consistent with the proportions estimated during the pre-permit pilot study and with the assumptions used to estimate the sample size.

3.1.2 Stratification

The permit requires that the sampled UIC population be divided into two traffic volume-based sub-populations, which are assumed to be associated with different stormwater qualities. These two traffic volume categories are identified in Table 2 of the WPCF permit and are presented in Table 3-1. The lower traffic volume category (<1,000 trips per day [TPD]) is presumed to be associated with lower pollutant concentrations. The higher traffic volume category (≥1,000 TPD) is presumed to be associated with higher pollutant concentrations. After the sample size was determined, the sampling design was stratified in accordance with the two identified traffic volume categories.

As explained in the SAP, preliminary work by the City determined that approximately 57 percent of active City-owned UICs are in the <1,000 TPD category and 43 percent are in the ≥1,000 TPD category. To ensure that there were enough data points in each traffic category for statistical analysis, initially 50 percent of the sample locations were selected from the <1,000 TPD category, and 50 percent of the sample locations were selected from the ≥1,000 TPD category. Because the majority of active UICs is in the <1,000 TPD category, which are predominantly in residential areas, the sample design is considered conservative. The Year 4 sampling program selected 15 locations in the <1,000 TPD category and 15 locations in the ≥1,000 TPD category, for a total of 30 locations.

UIC locations for Year 5 monitoring (*i.e.*, Panel 5) will be submitted to DEQ by September 1, 2009.

3.1.3 Carry Over Locations from Previous Year MADL Exceedances

Geometric mean stormwater concentrations were calculated in Years 1 through 3 for those analytes and locations where the individual analyte was detected in at least one sampling event at a concentration ≥50 percent of the analyte's respective MADL. If the annual geometric mean concentration exceeded the MADL at a given UIC, the UIC was sampled again (*i.e.*, carried over to) the following year.

There were no MADL exceedances in Panel 3 or the Supplemental Panel for Year 3. Therefore, no Panel 3 or Supplemental Panel 2 UIC locations were carried over from Year 3 for monitoring in Year 4.

In Panel 6, annual geometric mean concentrations of pentachlorophenol exceeded the MADL for the third consecutive year in two UIC locations in Panel 6 (P6_1 and P6_14) and for the second consecutive year in three UIC locations (P2_5, P2_13, and P2_14). At the end of Year 2, P6_1 and P6_14 were identified as Category 4 UICs and have received a No Further Action determination from DEQ (DEQ, 2008). At the end of Year 3, P2_5, P2_13, and P2_14 were determined to be Category 4 UICs and the *Category 4 UIC Corrective Actions Groundwater Protectiveness Demonstration* was applied (GSI, 2008a). As part of (fixed) Panel 6, each of these locations will be sampled again in Year 5.

3.2 UIC Sampling Locations and Characteristics

To perform long-term trend analysis and evaluate permit compliance during the 10-year permit term, a sufficient number of UICs needed to be sampled to assess the spatial and temporal range of data. Therefore, the UIC sampling network consists of six sampling panels that are divided into two primary types: stationary and rotating. Each sampling panel consists of 15 UIC locations. Panel 6 locations are stationary (*i.e.,* fixed) and the same locations will be sampled annually for 10 years. The other five panels of locations are rotated, so that each panel will be sampled twice during the 10-year permit term; once in Years 1 through 5, and once in Years 6 through 10. After 5 years, 75 rotating locations (five different panels *x* 15 locations per panel) will have been sampled once and after 10 years they will have been sampled twice. Using this process, a total of 90 unique locations will be monitored during the permit term (15 stationary + 75 rotating locations).

Sampling locations were randomly selected and then stratified on the basis of traffic category (<1,000 TPD and ≥1,000 TPD). This approach also randomizes information for multiple factors that may affect stormwater quality (including older and newer industrial/ commercial office buildings versus commercial salvage yards, etc.). Locations were identified using the GRTS survey design (Stevens and Olsen, 2004). In accordance with the SAP, each selected UIC sampling location was inspected in August and September 2008 before sampling to confirm UIC information (*e.g.*, location, type of construction) and to determine suitability for sampling (*e.g.,* accessibility, potential health and safety concerns). Characteristics of UIC monitoring locations sampled in Year 4 are

summarized in Table 3-2 (Panel 4) and Table 3-3 (Panel 6). Year 4 sampling locations are shown in Figure 3-2. The UIC sampling design is described in detail in the SAP.

3.2.1 Stationary Panel (Panel 6)

Fifteen randomly selected UICs in the stationary panel (Panel 6) were sampled during five storm events throughout the 2008-2009 wet season. These UIC locations also were sampled in Years 1 through 3, and will continue to be sampled throughout the term of the permit (*i.e.,* 10 years). Panel 6 includes eight UICs with traffic counts <1,000 TPD and seven UICs with traffic counts ≥1,000 TPD[2].

Appendix A provides detailed maps showing individual Panel 6 UIC locations. Table 3-3 presents location information, characteristics, and maintenance information for each UIC in Panel 6.

3.2.2 Rotating Panel (Panel 4)

Fifteen new randomly selected UICs in the rotating panel (Panel 4) also were sampled during five storm events throughout the 2008-2009 wet season. This panel will be resampled in Year 10 (2014 – 2015) of the permit. Panel 4 includes eight UICs with traffic counts <1,000 TPD and seven UICs with traffic counts ≥1,000 TPD.

Appendix A provides detailed maps showing individual Panel 4 UIC locations. Table 3-2 presents location information, characteristics, and maintenance information for each UIC in Panel 4.

3.2.3 Oversample Panel

An oversample panel of 85 alternate locations was previously generated as described in the SAP in order to develop Panels 4 and 6. This panel was used to find replacements for three of the randomly selected Panel 4 UIC monitoring locations that were submitted to DEQ in August 2008. These three UICs were determined to be unsuitable because of sampling difficulties, and were replaced during Event 1. Further information about the rationale for replacement is included in Appendix B. Unsuitable UICs are replaced by selecting the next location on the oversample panel list with a site in a similar traffic categorization.

[2] A change in the TPD estimation methodology in Year 1 resulted in recategorizing traffic volume from ≥1,000 TPD to <1,000 TPD at three UIC locations: P6_2, P6_10, and P6_12. New UIC locations in the ≥1,000 TPD traffic category were randomly selected before Year 2 to replace the three UIC locations, and sample location codes were retained. See the Year 2 or Year 3 annual reports for more information.

3.2.4 Supplemental Monitoring Near Drinking Water Wells

The City performed voluntary sampling at 10 additional UIC locations in Year 4 to assess the quality of stormwater discharged to UICs located near domestic[3] or public drinking water wells; and/or within the 2-year time of travel[4] of a public water well. Supplemental monitoring also was performed in Years 2 and 3, with 10 unique UICs sampled each year for 3 years, for a total of 30 UICs.

Supplemental monitoring locations were taken from the list of the City-owned UICs in the *Systemwide Assessment* report (City of Portland, 2006d) that are estimated to be located within 500 feet of a domestic well, 500 feet of a public water well that does not have a determined time of travel, or the 2-year time of travel of a public water well. Locations were randomly selected from this list using the GRTS method described in the SDMP, and stratified by traffic category. The final list of supplemental monitoring locations consisted of five UICs with estimated traffic counts of <1,000 TPD and five locations with estimated traffic counts of ≥1,000 TPD. Locations for Year 4 were inspected in August and September 2008 to determine whether they were suitable for sampling and representative of the associated traffic categories. Supplemental monitoring locations were sampled during all five Year 4 storm events. Sampling and analyses were performed in accordance with the SDMP.

The statistical basis of the supplemental monitoring is presented in Section 3.3. Information on the supplemental sampling locations is presented in Table 3-4, and locations are shown in Figure 3-2.

3.3 Supplemental UIC Monitoring Statistical Basis

The supplemental UIC monitoring program was initiated in Year 2 and completed in Year 4 with 10 unique UICs sampled each year. The supplemental UIC monitoring program was intended to selectively monitor a UIC subset. UICs selected for the supplemental monitoring program were located within a 2-year time of travel or within 500 feet of a potential drinking water well. The objectives of the supplemental monitoring were to:

- Assess the quality of stormwater discharged to UICs located near domestic or public drinking water wells;
- Demonstrate that the results of the citywide annual compliance monitoring program (described in the SDMP) are representative of stormwater discharging to UICs located within 500 feet of a domestic well, 500 feet of a public water well, and the 2-year time of travel of a public water well; and

[3] Domestic well means a water supply well used to serve no more than three residences with water for drinking, culinary, or household use. Domestic wells include irrigation wells because irrigation wells can be used as drinking water wells unless there is an enforceable regulatory mechanism that prevents this. Public water well means a water supply well serving a public water system for human consumption. For the purposes of this document, both domestic and public wells are referred to as "drinking water wells."

[4] Time of travel means the amount of time it takes groundwater to flow within an aquifer to a given public well. Time of travel is not designated for domestic wells.

- Demonstrate through the compliance monitoring and supplemental monitoring programs that discharges to public UICs within 500 feet of domestic and irrigation wells or within a 2-year time of travel of public drinking water wells meet permit MADLs and are protective of groundwater quality.

As stated in the *Annual Stormwater Discharge Monitoring Report: Year 3*, the supplemental monitoring program was designed to achieve the 12 percent confidence interval half width for a 90 percent confidence interval specified in the SDMP. This was accomplished through sampling 10 UICs each year for 3 years for a final sample size of 30 UICs.

Using the stormwater monitoring results from the supplemental UIC locations sampled in Years 2, 3 and 4, it was determined that the supplemental UIC monitoring program meets the statistical goals and objectives presented above. For pentachlorophenol, the calculated half width is 12 percent, while for lead, the calculated half width is 11 percent. These results indicate the expected precision was achieved.

The analytes detected and the concentration ranges observed in the supplemental and compliance UIC monitoring locations are similar (see Sections 9 and 10). Therefore, it was concluded that the monitoring results from the compliance monitoring program can be used to represent stormwater discharging to UICs near drinking water wells.

The City also performed a Groundwater Protectiveness Demonstration (GWPD) for the UICs located near drinking water wells in 2008 to determine whether City-owned UICs that are located within permit-specific setbacks from drinking water wells are protective of groundwater quality in accordance with Oregon Administrative Rules (OAR) 340-040. The results were submitted to DEQ in a report titled: *UICs within Permit-Specified Well Setbacks - Groundwater Protectiveness Demonstration – No Further Action Request* (City of Portland, 2008c). DEQ approval and No Further Action determination were obtained on October 6, 2008.

Section 4

4 UIC Stormwater Discharge Monitoring Plan Implementation

This section describes how key elements of the SDMP were implemented in Year 4. The Year 4 *Data Usability Report*, prepared by the City's Water Pollution Control Lab (WPCL), is presented in Appendix B. The report summarizes weather conditions, describes field and laboratory quality assurance/quality control (QA/QC) procedures and samples collected, describes Year 4 QA/QC issues and their resolution, and provides copies of field sampling documentation. Field and laboratory data validation also are discussed in Section 6.

4.1 Sampling Staff

BES personnel performed Year 4 UIC sampling. At a minimum, the sampling staff included the Storm Event Coordinator and Event Sampling Teams. The Storm Event Coordinator was responsible for tracking weather patterns, directing sampling activities, and selecting the storm events to initiate sampling.

Multiple Event Sampling Teams were used during single stormwater sampling events to decrease the length of field time and the number of individual storms needed to collect samples from all 30 UIC locations designated by the SDMP and the 10 supplemental UICs located near drinking water wells. Event Sampling Teams were composed primarily of the City's Field Operations' (FO) staff and were supplemented by other WPCL or BES personnel as needed. Sampling Teams were primarily two-person teams, and at least one person was an experienced FO staff member. Individual samplers were used, on occasion, if no traffic control was required.

4.2 Storm Event Targeting

The Storm Event Coordinator worked directly with the City's contract weather forecasting service, Extended Range Forecasting Company, Inc., to obtain the weather forecasts, and to decide whether to proceed with a stormwater sampling event. To the extent practicable, staff adhered to target storm criteria to help ensure that stormwater runoff would be adequate for sample collection, representative of stormwater runoff, and consistent between sampling events. Before initiating a sampling event, the storm forecast was evaluated against the following three target storm criteria:

- Predicted rainfall amount of $\geq$0.2 inch per storm;
- Predicted rainfall duration of $\geq$6 hours; and
- Antecedent dry period of $\geq$6 hours (as defined by <0.1 inch of precipitation during the previous 6 hours).

Storms meeting these criteria were expected to provide the volume of runoff necessary to implement sampling. These criteria were used as general guidance to determine when forecasted storms should be targeted for sampling during this project. Some sampled storms may not have met the criteria when the sampling event was completed. Storm characteristics for the five required sampling events are documented in the *Data Usability Report* (Appendix B) and are further discussed in Section 5.2.

4.3 Field Sampling Procedures

Field sample collection procedures described in the SDMP were followed, to the extent practicable, to assure data of known and acceptable quality. The *Data Usability Report* and Section 6.4.2 describe field-sampling issues encountered during Year 4 monitoring events. Field data validation is described in Section 6.3.

4.4 Sample Collection Documentation

Field data were recorded on project-specific paperwork during each sampling event, in accordance with the procedures described in the SDMP. Each Event Sampling Team completed three separate forms while sampling: Daily Field Reports (DFR), Field Data Sheets (FDS), and Chain-of-Custody (COC) forms. Copies of the DFR, FDS, and WPCL COC forms are included in the *Data Usability Report* (see Appendix B). Copies of the Test America[5] (TA) COC forms are included with the analytical data reports presented in Appendix C. Field data management is discussed in Section 6.1 and data validation is discussed in Section 6.3.

4.5 Year 4 Analytical Schedule

Forty UIC locations were sampled during five storm events between October 1, 2008 and May 31, 2009 (Year 4), and measured for the analytes listed in Table 4-1 in accordance with the SDMP. Sample locations for common pollutants included 30 UIC compliance monitoring locations (Panels 4 and 6) and 10 supplemental UIC locations (Supplemental Panel 3) near drinking water wells. Twenty-five of these sample locations, Panel 4 and Supplemental Panel 3, were analyzed for PPS analytes. Nine PPS analytes were detected by U.S. Environmental Protection Agency (EPA)-approved analytical methods for the common pollutants and therefore were reported for all 40 UIC locations. Monitoring was conducted, to the extent practicable, in accordance with EPA-approved test methods, standard of industry practices, or use of best available technology.

4.5.1 Common Pollutants

Common pollutants were measured at all UIC monitoring locations during each stormwater sampling event. All samples required by the permit and by the SAP were

[5] Test America (TA) acquired North Creek Analytical (NCA) in February 2006. The Year 1 annual report and the SDMP use the acronym "NCA." The Year 2 report uses "TA."

collected in Year 4. Analytical laboratories, analytical methods, method detection limits (MDL), method reporting limits (MRL), and MADLs for common pollutants are listed in Table 4-2. Analytical results are presented in Section 5 and data validation is presented in Section 6.

4.5.2 Priority Pollutant Screen Analytes

PPS analytes were measured at all Panel 4 and Supplemental Panel 3 UIC monitoring locations in Event 1. Table 4-3 also includes analytical laboratories, analytical methods, MDLs, MRLs, and MADLs for PPS analytes. If PPS analytes were detected in Event 1, the remaining four stormwater sampling events were analyzed in accordance with the permit. Specifically, the following PPS analytes were tested for five events in Year 4 in accordance with the methods presented in Table 4-3:

- Antimony;
- Barium;
- Beryllium;
- Glyphosate;
- Mercury; and
- 2,4-D.

In addition, nine PPS analytes were detected during analysis of the common pollutants and therefore also are reported for Panel 6 UIC locations and at all sampling locations in Events 2 through 5. These analytes are listed in Table 4-3. Analytical results are presented in Section 5 and data validation is presented in Section 6.

4.5.3 Ancillary Pollutants

The permit requires that analytes detected by any of the laboratory methods used in the stormwater monitoring program be reported. Ancillary pollutants are those analytes that are detected during the required monitoring for common pollutant or PPS analytes using EPA-approved analytical methods. Tables 4-2 and 4-3 provide a list of analytical methods run in Year 4. Appendix B of the QAPP contains lists of analytes detected by each method and their respective MRLs.

4.5.4 Additional Testing

The City performed additional stormwater characterization testing in Year 4 including:

- Field parameters, including pH (EPA Method SM4500-HB), conductivity (EPA Method SM2510B), and temperature (EPA Method SM2550B), were measured at all UIC monitoring locations during each sampling event.
- Total suspended solids (TSS) were measured at all UIC monitoring locations during each sampling event, using EPA Method SM2540D.

- For each sampling event, dissolved arsenic, cadmium, chromium, copper, lead, zinc, antimony, barium, beryllium, selenium, and thallium were measured at all 40 UIC monitoring locations. Samples were:
    - Collected during each sampling event at end of pipe (EOP) for dissolved metal analyses;
    - Transported to the WPCL at the end of the sampling day;
    - Filtered by WPCL staff within 24 hours of collection using a 0.45 micron filter;
    - Preserved using nitric acid (pH < 2) before analyses; and
    - Analyzed using the EPA methods specified in the SDMP for metals.

Results are discussed in Section 5.

4.6 Year 4 – Field Audit

As required by the project QAPP, field audits of stormwater sampling procedures were performed. The primary objectives of the audits were to ensure that stormwater data were being collected in accordance with the SDMP and, if necessary, to identify any areas requiring changes in field procedures or practices.

The audits were conducted and documented by City personnel not directly involved in Year 4 field sampling activities. At a minimum, the auditor:

- Inspected field sampling equipment before use to ensure that it was in proper working order;
- Observed stormwater sample collection procedures;
- Observed field sample labeling and storage procedures; and
- Reviewed available field sampling forms (*e.g.*, COCs, FDSs) to assess if they were properly and completely filled out.

Audit results are discussed in Section 6.

Section 5

5 Stormwater Discharge Monitoring Results

This section describes the data (*e.g.*, storm event, field parameters, and analytical results) collected in accordance with the permit and SDMP during the 2008–2009 wet season *(i.e.,* Year 4). Five stormwater samples were collected from each of the designated UIC sampling locations required by the permit (Panels 4 and 6) and from the supplemental UIC locations near drinking water wells during five storm events occurring between October 1, 2008 and May 31, 2009.

5.1 Year 4 Monitoring Results

Year 4 monitoring results are presented in this report in various tables, figures, and appendices. Tables and figures included in this report draw from, present, or summarize the raw data presented in Appendices B and C. Data sources are referenced as appropriate. Section 6 describes the management and validation of field and laboratory data generated in Year 4. The appendices contain the following information:

- **Data Usability Report** (Appendix B). This report draws from, presents, or summarizes the following information:
  - Storm data and general weather conditions (additional information described in Section 5.2 of this report);
  - UIC locations (described in Section 3 of this report);
  - QA/QC sample results and identification and resolution of QA/QC issues (further described in Section 6 of this report);
  - Analytical data summary (described in detail in Sections 5 and 7 of this report);
  - Identification of individual sampling event MADL exceedances (described in Section 7.1 of this report); and
  - Copies of event DFR, FDS, and COC forms.
- **Analytical Laboratory Data Reports** (Appendix C). These reports present the results of UIC sample analyses, QA/QC samples, and any data flags. Copies of the COC forms also are included.
- **Field Audit Documentation** (Appendix D). Field audits of stormwater sampling procedures were performed as required by the QAPP. The primary objectives of the audits were to ensure that stormwater data were being collected in accordance with the SDMP and, if necessary, to identify any areas requiring changes in field procedures or practices.
- **Stormwater Discharge Monitoring Data** (Appendix E). Analytical data and key UIC location characteristics (*e.g.,* traffic category, land use) are provided

in a Microsoft Access© Database file on CD. Key fields in this database include:

- Permit Year;
- Event;
- Panel Identification;
- Sample Identification;
- Panel Number and Sample Location Number;
- Hansen Database Node Number;
- Street Address;
- Traffic Category;
- Predominant Land Use;
- Sample Type;
- Sample Date and Time;
- Analytical Method;
- Analytes;
- Result;
- Data Qualifier;
- Units; and
- MRL.

- **Summary Data Tables** (Appendix F). Table F-1 presents summary field parameter data. Table F-2 presents summary common pollutant data. Table F-3 presents summary PPS analyte data.

5.2 Storm Event Data

As described in Section 4.2, the Storm Event Coordinator worked directly with the City's contract weather forecasting service to initiate and complete storm-sampling activities for individual storms that, to the extent practicable, meet SAP-defined criteria. Storms meeting the target storm criteria were expected to provide the volume of runoff necessary for sampling.

5.2.1 Year 4 Storm Events

After a sampling event was completed, the characteristics of the storm or individual storms comprising the sampling event were evaluated using data from the City's Hydrological Data Retrieval and Alarm (HYDRA) system rain gage network. Rain gage data are available at http://or.water.usgs.gov/non-usgs/bes/raingage_info/. The website also provides a map of rain gage locations. Precipitation data from the following 13 rain

gages across Portland were averaged and used to characterize individual storms for Years 1 through 4:

HYDRA (Rain gage) Station	Address
Station # 1: Airport Way #2 P.S.	14614 NE Airport Way
Station # 2: Arleta School	5109 SE 66th Ave.
Station # 3: Astor School	5601 N Yale
Station # 4: Beaumont School	4043 NE Fremont
Station # 5: Cascade PCC_02	705 N Killingsworth St.
Station # 6: Holgate	4507 SE 136th Ave.
Station # 7: Kelly School	9030 SE Cooper
Station # 8: Mallory	8030 NE Mallory Ave.
Station # 9: Open Meadows School	7602 N Emerald Ave.
Station # 10: PDX Post Office	7660 NE Airport Way
Station # 11: Swan Island	2600 N Going St.
Station # 12: Vernon School	2044 NE Killingsworth
Station # 13: WPCL	6543 N Burlington

Sampling staff attempted to sample all locations that were scheduled for the 2008-2009 season during discrete storms; however, if rainfall ceased before the collection of all required samples, the sampling event was extended over additional storms (*i.e.*, sample collection period), as necessary. Each of the five Year 4 stormwater sampling events was comprised of several storms or sample collection periods. Dates of individual sample collection periods for each event are listed below:

- Event 1: 10/3/08, 10/9/08, 11/3/08
- Event 2: 11/12/08, 11/20/08, 12/12/08, 1/7/09
- Event 3: 1/7/09, 2/9/09, 2/10/09, 2/23/09
- Event 4: 2/23/09, 3/5/09, 3/9/09, 3/16/09
- Event 5: 3/17/09, 3/23/09, 3/25/09, 4/1/09, 4/13/09, 4/17/09, 4/27/09, 4/28/09

Hourly "average" precipitation records are summarized for each storm event in Tables 5-1 through 5-5 and hydrographs are provided for each storm event in Figures 5-1 though 5-5. Additional information regarding forecasted rainfall for individual storms in a storm event is provided in the *Data Usability Report*, provided in Appendix B.

Information presented in Tables 5-1 through 5-5 and Figures 5-1 though 5-5 was used to estimate the duration, intensity, and the antecedent dry period for each sample collection period in each storm event. These storm characteristics are summarized for Event 1 through Event 5 in Table 5-6. The duration of an individual sample collection period was defined as a continuous rainfall event, preceded and followed by 0.0 inch of rain in an hour (*i.e.*, a dry hour). The intensity of an individual sample collection period was defined as the amount of precipitation recorded for the duration of the event. The

antecedent dry period for each sample collection period was defined as the number of "dry" hours before the first measured rainfall in the sampling event.

The first predicted storm during the 2008-2009 wet season was targeted for sampling to investigate water quality differences that may be associated with the first significant rainfall of the fall season. The remaining monitoring events (Events 2 through 5) were distributed throughout the monitoring season as storms occurred that met the target storm event criteria, presented in Section 4.2.

5.2.2 Year 4 Regional Precipitation and Temperature Records

A summary of long-term (30-year) and Years 1 through 4 precipitation and temperature records for the Portland area is provided in Table 5-7. The permit-defined wet-season months are shaded. Precipitation totals for these time periods are depicted graphically in Figure 5-6. Year 1 had approximately 5.69 inches more precipitation than the long-term average, which was recalculated to include the Year 1 data. In contrast, Year 2 received approximately 2.67 inches less precipitation than the long-term average, and Year 3 received approximately 3.14 inches less precipitation than the long-term average. During the eight wet-season months of Year 3, only October 2007 and December 2007 were above the long-term average mean monthly precipitation. Year 4 received approximately 27.2 inches, which was 9.88 inches less precipitation than the long-term average. With the exception of May, all other months of the permit-defined wet-season months (October – May) of Year 4 had less than the long-term average monthly precipitation.

5.3 Field Parameters

Field data were collected to aid in the interpretation of analytical results. Three field parameters (pH, specific conductivity, and temperature) were measured at all UIC locations during each stormwater sampling event. Measurements are included in the Access© Database in Appendix E. Appendix F (Table F-1) presents a summary of Year 4 field parameters. Summary statistics for field parameters are reported in Table 5-8.

pH. pH measurements ranged from 5.6 to 8.7 in stormwater discharge during Year 4. The mean pH readings for individual events ranged from 6.6 to 6.9.

Field Parameter Definitions

pH: The pH of a water sample is a measure of the concentration of hydrogen ions. The pH of water determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.).

Conductivity: (Specific conductivity; electrical conductivity [EC]) estimates the amount of total dissolved solids, or the total amount of dissolved ions in the water. Conductivity is measured and reported in units of micromhos per centimeter (µmhos/cm).

Temperature: Temperature is important because of its potential influence on water chemistry. The rate of chemical reactions generally increases at higher temperature. Temperature is reported in degrees Celsius (^{o}C). Stormwater temperature is related to seasonal air temperatures and daily weather variations.

Conductivity. Conductivity measurements ranged from 8 to 198 µmhos/cm in stormwater discharge during Year 4. The mean conductivity readings for individual sampling events ranged from 27.6 to 57.6 µmhos/cm.

Temperature. Temperature measurements ranged from 1.4 to 17.9 ^{o}C in stormwater discharge during Year 4. The mean temperature measurements for individual sampling events ranged from 6 to 14.2 ^{o}C.

5.4 Year 4 Analytical Testing Results

5.4.1 Common Pollutants

All 14 common pollutants listed in Table 4-1 were detected during Year 4. Appendix F (Table F-2) presents the Year 4 common pollutant sample concentrations for each UIC location by storm event. Table 5-9 provides a summary of the information in Table F-2 and includes the number of detections (*i.e.*, ≥MRL), number of samples analyzed, frequency of detection, range of Year 4 concentrations, and maximum percent of the MADL detected (*i.e.*, maximum concentration/MADL *x* 100) during Year 4. Table 5-10 provides a summary of the frequency of detection values for common pollutants and PPS analytes during this period. Common pollutants detected in Panels 4, 6, and Supplemental Panel 3 (200 samples total) are discussed below.

Arsenic. Arsenic was detected in all 200 samples. Sample concentrations ranged from 0.059 µg/L to 2.06 µg/L. All Year 4 concentrations are below the 10 µg/L MADL for arsenic.

Cadmium. Cadmium was detected in 85 of 200 samples. Sample concentrations ranged from the QAPP target MRL of 0.1 µg/L to 0.75 µg/L. All Year 4 concentrations are well below the 5.0 µg/L MADL for cadmium.

Chromium. Chromium was detected in 175 of 200 samples. Sample concentrations ranged from below the QAPP target MRL of 0.4 µg/L to 16.9 µg/L. All Year 4 concentrations are well below the 100 µg/L MADL for chromium.

Copper. Copper was detected in all 200 samples. Sample concentrations ranged from 1.46 µg/L to 64.1 µg/L. All Year 4 concentrations are well below the 1,300 µg/L MADL for copper.

Lead. Lead was detected in all 200 samples. Sample concentrations ranged from 0.18 µg/L to 129 µg/L. Eight sample concentrations exceeded the 50 µg/L MADL for lead, in Events 2 though 5.

Zinc. Zinc was detected in all 200 samples. Sample concentrations ranged from 3.39 µg/L to 419 µg/L. All Year 4 concentrations are well below the 5,000 µg/L MADL for zinc.

Nitrate-Nitrogen. Nitrate-nitrogen was detected in 72 of 200 samples. Concentrations ranged from the QAPP target MRL of 0.1 mg/L to 0.3 mg/L. All Year 4 concentrations are well below the 10,000 µg/L MADL for nitrate-nitrogen.

Pentachlorophenol. Pentachlorophenol was detected in 168 of 200 samples. Detected concentrations ranged from the QAPP target MRL of 0.04 µg/L to 6.29 µg/L. Twenty-five primary sample concentrations (*i.e.*, not duplicate or resampled concentrations) exceeded the 1.0 µg/L MADL for pentachlorophenol in all five storm events.

Benzene. Benzene was detected in 1 of 200 samples. The sample concentration was 4.31 µg/L, which is below the 5 µg/L MADL for benzene.

Ethylbenzene. Ethylbenzene was detected in 1 of 200 samples. The sample concentration was 1.68 µg/L, which is well below the 700 µg/L MADL for ethylbenzene.

Toluene. Toluene was detected in 104 of 200 samples. Values ranged from the QAPP target MRL of 0.5 µg/L to 252 µg/L. All concentrations were well below the 1,000 µg/L MADL for toluene. As identified in Section 4, the MDL and the MRL in the QAPP were reversed. The QAPP target MRL listed in Table 4-2 represents the correct value.

Xylenes. The permit identifies xylenes as a common pollutant. Total xylenes are the sum of the analytical concentrations measured for m,p-xylene and o-xylene. With three exceptions, all total xylene sample concentrations were below 1.5 µg/L. The highest of these concentrations, 14.51 µg/L, is well below the 10,000 µg/L MADL.

Benzo(a)pyrene. Benzo(a)pyrene was detected in 74 of 200 samples. Concentrations ranged from less than 0.00962 to 0.245 µg/L. The one sample concentration at the high end of this range exceeded the 0.2 µg/L MADL.

DEHP. Di(2-ethylhexyl)phthalate (DEHP) was detected in 114 of 200 samples. Concentrations ranged from less than 0.962 µg/L to 14.9 µg/L at location P6_11 (Event 5). Twelve sample concentrations exceeded the 6.0 µg/L MADL for DEHP during Events 3, 4, and 5.

5.4.2 Priority Pollutant Screen Analytes

PPS analytes were monitored at all Panel 4 and Supplemental Panel 3 UIC locations during the first sampling event. Where PPS analytes were detected during the analysis of the common pollutants, they also are measured for Panel 6, and in Panel 4 and

Supplemental Panel 3 UICs for Events 2 through 5. Six of the 27 PPS analytes, listed in Table 4-1, were detected during Year 4. Only those PPS analytes detected in Event 1 were sampled for all five storm events. Table F-3 (Appendix F) presents these monitoring results for all UIC locations by storm event. Tables 5-9 and 5-10 provide a summary of common pollutants and PPS analytes detected and not detected in Year 4, respectively. These tables include the number of detections (*i.e.*, $\geq$ MRL), the number of samples including duplicates analyzed, the frequency of detection, concentration range of detected values, and the maximum percent of the MADL detected (*i.e.*, maximum concentration/MADL *x* 100). Table 5-11 provides a summary of the frequency of detection for common pollutants and PPS analytes in Year 4. PPS analytes detected during Year 4 are discussed in this section.

During Event 1, MRLs for four PPS analytes [bis(2-chloroisopropyl)ether, bis(2-chloroethyl)ether, alachlor, and atrazine] exceeded the MADL in some, but not all, samples analyzed (see Table 5-11). The QAPP noted that it was expected that the MRL would exceed the MADL on occasion for certain analytes because of method limitations and matrix interferences in the samples. In these cases, MDLs were relied upon where possible. MDLs slightly exceeded the MADL for these analytes at one location, SP3_7, for bis(2-chloroisopropyl)ether and bis(2-chloroethyl)ether. Because these two analytes were not detected in any of the samples collected for PPS analyses during Event 1, this was judged not to affect the analyte presence/absence assessment and no additional sampling was performed for these analytes and no action was taken. The decision not to continue PPS monitoring is consistent with the approach used in Year 1 when the MDL also exceeded the MADL for these pollutants at a limited number of locations. DEQ was notified of this exceedance and of the decision to not continue monitoring these analytes in a UIC Priority Pollutant Screen Result Notification letter for Event 1 dated January 7, 2009.

Antimony. Antimony was detected in 124 of 125 samples in Panel 4 and Supplemental Panel 3. Antimony concentrations ranged from the QAPP target MRL of 0.1 µg/L to 5.41 µg/L, which are below the 6 µg/L MADL.

Barium. Barium was detected in all 125 samples in Panel 4 and Supplemental Panel 3. Sample concentrations ranged from 4.13 µg/L to 171 µg/L, which are well below the 2,000 µg/L MADL.

Beryllium. Beryllium was detected in 3 of 33 samples in Panel 4 and Supplemental Panel 3. Sample concentrations ranged from the QAPP target MRL of 0.1 µg/L to 0.26 µg/L, which are below the 4 µg/L MADL.

2,4-D. 2,4-D was detected in 45 of 200 samples in Panels 4, 6, and Supplemental Panel 3. Sample concentrations ranged from the QAPP target MRL of 0.1 µg/L to 1.66 µg/L. All Year 4 concentrations are well below the 70.0 µg/L MADL.

Glyphosate. Glyphosate was detected in 1 of 37 samples collected from Panel 4 and Supplemental Panel 3. Sample concentrations ranged from below the QAPP target MRL of 6 µg/L to 27 µg/L. This concentration is well below the 700 µg/L MADL.

Mercury. Mercury was detected in 122 of 125 samples in Panel 4 and Supplemental Panel 3. Sample concentrations ranged from the QAPP target MRL of 0.005 µg/L to 0.062 µg/L, which are below the 2 µg/L MADL.

5.4.3 Ancillary Pollutants

The permit requires that all analytes detected by any of the laboratory methods used in the stormwater monitoring program be reported. Ancillary pollutants are those analytes that are detected in addition to required monitoring for common pollutant or PPS analytes using EPA-approved analytical methods. Table 5-12 provides a list of ancillary pollutants detected in Year 4, as well as the analytical method, sampling event number, number of samples analyzed, number of detections, frequency of detection, and minimum and maximum concentrations. Appendix C contains the laboratory data sheets and Appendix E contains an Access© Database file containing the monitoring results.

Table 5-13 summarizes the individual sampling event frequencies of detection for ancillary pollutants in Year 4. All pollutants were analyzed for all five sampling events, except 3,4-methylphenol and benzyl alcohol, which are associated with priority pollutants that were not detected during the first sampling event. Twenty-eight ancillary pollutants were detected in Year 4. Eleven of these were detected at a maximum frequency of less than or equal to 4 percent and seven were detected at maximum frequencies between 7 percent and 50 percent. The 10 pollutants that were detected at the highest frequencies (>50 percent) during the individual sampling events are PAHs: benzo(a)anthracene, benzo(k)fluoranthene, chrysene, ideno(1,2,3-cd)pyrene, phenanthrene, napthalene, pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, and fluoranthene.

The detection of PAH compounds was an expected result because of the presence of numerous sources in an urban environment. PAH sources include, but are not limited to, fresh and used petroleum products (*e.g.*, gasoline, diesel, motor oil, used oil), petroleum and coal combustion, motor vehicle exhaust, tire wear, wood ash, asphalt, insecticides, wood preservatives, used cigarette filters, and air deposition. PAHs tend to adhere to sediment particles rather than dissolve in water.

PAHs will continue to be analyzed and reported as ancillary pollutants in future sampling events for UICs in the monitoring network, along with the common pollutant benzo(a)pyrene. Benzo(a)pyrene was detected, as discussed in Section 5.4.1, with a frequency of detection ranging between 25 percent and 58 percent during individual sampling events.

5.4.4 Additional Testing

Dissolved Metals. Table 5-14 presents a summary of dissolved and total common pollutant and PPS metal analyses performed in Year 4. Table 5-14 includes the number of samples analyzed; number of detected values; average (*i.e.*, arithmetic mean) concentration; geometric mean, minimum and maximum concentrations; and ratio of the dissolved average concentration to the total average concentration. Dissolved arsenic, cadmium, chromium, copper, lead, zinc, antimony, barium, beryllium, selenium, and thallium were detected in most samples at concentrations well below the respective MADLs for these metals. Only total lead concentrations exceeded the lead MADL. The ratios of dissolved to total metal concentrations for $\geq$1,000 TPD traffic category ranged from 4 percent (lead) to 100 percent (selenium and thallium) and from 7 percent (lead) to 100 percent (selenium and thallium) for <1,000 TPD. For individual metals, the ratio of dissolved to total metal concentrations is generally lower for the high traffic category. Results indicate that lead concentrations are strongly correlated to stormwater particulates.

Total Suspended Solids. Table 5-15 presents the summary statistics for TSS results. TSS in stormwater was analyzed for each UIC location during each of the five sampling events. TSS concentrations ranged from 2 mg/L (<1,000 TPD) to a maximum concentration of 562 (<1,000 TPD) mg/L. The mean TSS concentration for UICs with <1,000 TPD was 31 mg/L, and the mean concentration for UICs with $\geq$1,000 TPD was 75 mg/L.

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Section 6

6 Data Management and Validation

This section summarizes the types of information managed and maintained during Year 4 of the Stormwater Discharge Monitoring Program. It also summarizes the results of data validation conducted in the field and analytical laboratory data collected during the 2008-2009 wet season (*i.e.*, Year 4). Specific procedures for data management and data validation are described in the QAPP.

6.1 Data Management

Technical data that were collected during the 2008-2009 wet season and used in this report include the following:

- Field data (described below);
- Analytical laboratory data (described below);
- UIC construction data (provided in Section 3);
- UIC locations (described in Section 3);
- Sedimentation manhole depth to sediment measurements (described in Section 3);
- Traffic volume data (described in Section 3);
- Land use (described in Section 3);
- Sampling event data (described in Section 4); and
- Calculated or manipulated data (described in Section 7).

There were no deviations from specific data management procedures described in the QAPP during the 2008-2009 wet season.

Additional technical data types are identified in the QAPP, but not specifically presented in this report. This information will be presented and discussed in other reports as appropriate.

6.1.1 Field Data

Field data were recorded on project-specific paperwork, as described in the SAP and in Sections 4.4 and 5.1 of this report. BES maintains field records in both hard copy and electronic (pdf file) formats. The *Data Usability Report* (see Appendix B) contains copies of the DFRs and FDSs. WPCL COC forms are included with the *Data Usability Report* and the TA COCs are included with the analytical laboratory data packages (see below).

6.1.2 Laboratory Data

Analytical laboratory data (sample information and analytical results from both the WPCL and TA) were manually entered into the BES Laboratory Information Management System (LIMS), which functions as the BES database for data storage, sample tracking, and reporting. A WPCL chemist checked analytical data sheets and results of laboratory QC samples to ensure that the QC statistics were within control limits and that appropriate corrective actions were taken if control limits were exceeded. The WPCL chemist also flagged or provided comments on results that did not strictly meet QC criteria. The WPCL applied an "EST," which means estimated value, to qualify results. TA used customized flags to communicate detailed QC issues; these flags are included on the TA analytical laboratory reports.

WPCL staff verified the accuracy of data entry into the LIMS system and did not release data until the data validation process was complete. The LIMS system was backed up on a daily basis. Appendix C contains electronic copies of the TA and WPCL analytical data reports.

The WPCL maintains project files containing any records necessary to reconstruct the analytical events associated with this project. All procedures for storage of hard copy and electronic data comply with the *WPCL Quality Manual* (City of Portland, 2005). Records related to analytical laboratory data that are maintained include:

- COC forms (copies included in analytical laboratory reports presented in Appendix C);
- Instrument calibration and tuning records (as applicable);
- Analytical standards preparation logs;
- Method Standard Operating Procedures (SOP);
- Analytical QC results (including method blanks, internal standards, surrogates, replicates, spikes, and spike duplicate results, as applicable);
- Raw data, specifically instrument printouts;
- Bench worksheets and/or quantification reports;
- Corrective action reports (if any); and
- Details of the QA/QC program in place at the time that the project analyses were conducted.

Laboratory data were extracted from the LIMS system to generate Year 4 summary tables, in an electronic format, by UIC location and analytical constituent. A copy of the Access© Database containing a compilation of Year 1 through Year 4 monitoring data is included in Appendix E. Tables were checked against copies of the original final data sheets before data analyses. Data are tabulated as they are shown on the original data sheets. However, specific data flags by TA are not included in the Access© Database.

Noteworthy laboratory QC issues are included in the comments section of the spreadsheet.

6.1.3 Management Data

Management data collected during the 2008-2009 wet season included information that must be tracked to monitor, manage, and document the performance of the UIC program; such as schedules, cost estimates, and project reports. All original data, calculations, drawings, etc., were systematically filed as they were collected for easy reference, and are maintained by BES.

6.1.4 Data Storage

All technical and management data described above will be retained indefinitely and no other records will be destroyed without prior permission of the City's UIC Program Manager and notification of the DEQ UIC Permit Manager, as specified in the QAPP.

6.2 Data Quality Objectives

DQOs are defined for environmental sampling and laboratory activities as qualitative and quantitative statements that specify the quality of the data required to support the project objectives. DQOs provide the driving force for the level of QC required for any particular sampling or analytical task. The key DQOs for the City's UIC monitoring program are to provide environmental data that are of known and acceptable quality, are scientifically defensible, and demonstrate compliance with the WPCF permit. The quality of data is known when all components associated with data generation are thoroughly documented. Data are of acceptable quality when a rigorous QA/QC program is implemented and the QC indicators fall within predefined limits of acceptability. The project QAPP describes the methods of data documentation and the mechanisms to be used in attaining data of acceptable quality.

Table 6-1 summarizes the project DQOs for analytical data. DQOs for Year 1 were carried forward into Years 2 through 4 without change. Additional information on DQOs can be found in the QAPP.

6.3 Data Validation

This section summarizes the procedures used to review field and analytical data. The purpose of this review was to ensure that data collection and evaluation were conducted according to procedures specified in the SDMP. Deficiencies in field or analytical data, if any, are noted, as are the cause of these deficiencies. If these deficiencies required a corrective action, it is described in Section 6.4 of this report.

6.3.1 Field Data

Deviations from field procedures outlined in the SAP are noted in this section. Field data were collected in general accordance with the procedures described in the SDMP during the 2008-2009 wet season. The following paragraphs describe key components of the field program used to validate field data. All field data were determined to be valid and of acceptable quality.

Sample Locations. Pre-sampling investigations were conducted to determine whether any of the Panel 4, Panel 6, or Supplemental Panel 3 UIC locations located near drinking water wells that were proposed for sampling during the 2008-2009 wet season were unsuitable for sampling. The factors used in this evaluation are described in the SAP. As a result of these investigations, five Panel 4 locations and three proposed supplemental locations were determined to be unsuitable for sampling. Except for the locations listed below, these substitutions were made before initiating Year 4 storm event sampling. The sites listed below were changed during the first storm sampling event.

Site	Final Location	Original Location	Rationale for Replacement
P4_2	5903 N Houghton St.	15740 SE Powell Blvd.	Manhole paved over; 1st replacement site (7132 NE Prescott St.) had leaking sedimentation manhole
P4_3	6302 SE Foster Pl.	2927 NE 7th Ave.	Traffic control issues; 1st replacement site (2348 SE 130th St.) had traffic control issues
P4_5	6615 SE Lambert St.	4615 SE 71st Ave.	Minimal flow into sump (observed during first Event 1 sampling attempt)

Sample Stratification. UIC monitoring locations are stratified by traffic category ($\geq$1,000 or <1,000 TPD). Sample stratification in Year 4 meet the traffic criteria identified in the SDMP, the *Annual Stormwater Discharge Monitoring Report – Year 2* (City of Portland, 2007), and Section 3.1.2 of this report.

Precipitation Events. Five sampling events were successfully completed during the 2008-2009 wet season, associated with precipitation events between October 2008 and May 2009. The precipitation events sampled are described in more detail in Section 5 of this report and in the *Data Usability Report* (see Appendix B). Storms targeted for sampling met the criteria identified in the SAP to the extent practicable and were determined to be acceptable.

Sample Collection Procedures. No issues associated with sample collection procedures occurred during the 2008-2009 wet season.

Field Data Documentation. Field data were recorded on project-specific paperwork, as described in the SAP. Field documentation is reviewed by both the BES Field Leader and the Monitoring Coordinator to ensure that sample collection was conducted

according to procedures specified in the SDMP and that documentation is complete. The Year 4 field records document:

- Adherence to SAP protocols;
- Field corrective actions tracking and inherent data uncertainties;
- Field procedures do not affect samples (*i.e.*, collection of appropriate QC samples); and
- Safe work practices are followed (*i.e.,* adherence to the Health and Safety Plan).

Specific field records maintained by BES in Year 4 include the following:

- DFRs, FDSs, and COC forms;
- Health and Safety Plan;
- Field meter calibration and maintenance records (as applicable);
- Sample collection standard operating procedures;
- Storm event information; and
- Sampling event summaries.

Field data documentation for sampling met the objectives identified in the SAP to the extent practicable and was determined to be acceptable.

6.3.2 Laboratory Data

Year 4 analytical data validation included, but was not limited to, a review of the following:

- **Timeliness.** Verified laboratory analyses were performed within the recommended analytical holding times. Samples not extracted or tested with the specified period were noted or flagged.
- **Detection Limits**. Verified analytic detection limits for each analysis met the project specific limits. Except as noted in the *Data Usability Report* (Appendix B), Sample MRLs were less than the MADLs specified in the permit and met the MRLs proposed in the QAPP.
- **Chain-of-Custody**. Verified COC procedures were followed by the laboratory.
- **Reagent Blanks/Trip Blanks**. Verified blanks did not contain any analytes. Analytes detected in the reagent blank indicate laboratory-introduced contamination that can be identified and flagged or separated from the sample results.
- **Matrix Spikes and Matrix Spike Duplicates**. Verified the percent recoveries between the spike quantity recovered and the known spike value were

acceptable. The relative percent difference (RPD) was calculated using the duplicate analyses results.

- **Surrogate Spike Analyses**. Verified the percent recoveries were within the acceptable range for the analytical laboratories database.
- **Blind Duplicates**. Verified the RPD between the original sample and the blind duplicate was acceptable.
- **Equipment Blanks/Field Decontamination Blanks**. Verified blanks did not contain any analytes. Analytes detected in the blank indicate introduced contamination from field or decontamination processes that can be identified and flagged.

Year 4 analytical data were determined to meet the DQOs described in Section 6.2 and to be of acceptable quality. All planned data were collected and analyzed and all data were considered usable. Year 4 monitoring efforts resulted in a data completeness, which exceeded the 95 percent goal set in the QAPP. Data QA/QC issues identified during the data validation process are summarized in Table 6-2 as described below. Appendices B, C, and E include the following information used for data validation:

- WPCL Laboratory Analysis Reports;
- TA Laboratory Analysis Reports;
- *Data Usability Report;* and
- Year 4 Analytical Data (*e.g.*, Access© Database, City of Portland Janus database).

Validation occurred throughout the sample collection and analytical process. Initial validation was performed during sample receipt and log-in and included the following steps: examination of the integrity of sample containers and labels, including suitability of containers for requested analyses; examination of the COC form for the presence of all required information and signatures; and verification of sample container identification numbers against those listed on the COC form.

Laboratory data validation also occurred during sample analysis and was carried out at the instrument by the analyst. This phase of validation involved performing and maintaining instrument calibration and assessing precision and accuracy of the data via the analysis of the appropriate QC checks by the individual laboratories. The analyst ensured that the QC statistics were within control limits and took appropriate corrective actions during analysis if control limits were exceeded.

Laboratory data validation also included checking the data reduction and transcription/ data entry operations used to calculate final results. An analyst or chemist other than the one who conducted the analysis, but who is fully knowledgeable about the analysis, performed this validation. Results were verified against the raw data, including checking

calculations, use of correct units and/or conversion factors, and use of correct sample preparation conditions. The technical reviewer also confirmed that all relevant previous validation checks were applied correctly and that QC statistics were within control limits.

Results that do not meet quality criteria were flagged by the TA, WPCL, WPCL QA Coordinator, or BES Investigation and Monitoring Services (IMS). Selected samples were flagged by the WPCL QA Coordinator using "EST," which means estimate, to qualify the results; the reason for the "EST" flag is described in the comments section of the WPCL Laboratory Analysis Reports and database. TA used customized flags to communicate QC issues. Definitions for these data flags are included in the TA data reports (see Appendix C). Data qualifiers were assigned through project data validation and are defined in the *Data Usability Report* (see Appendix B). Most laboratory-assigned flags were carried through using project-specific data qualifiers, and additional qualifiers were assigned through data usability assessment.

The analytical data were entered into BES LIMS and hard copies of the entered data were checked for data entry errors. After sample results (TA and WPCL) had undergone technical and data entry review, the WPCL QA Coordinator electronically marked the sample in LIMS. The mark indicates that all analyses for that sample are complete and have been checked for errors. At that point, the data were released to the UIC Program for use.

Table 6-2 presents a summary of all laboratory QC issues identified during the 2008-2009 wet season. The WPCL QA and Monitoring Coordinators reviewed all QC issues. Only noteworthy QC issues are included in Table 6-2. These issues are discussed in the comments section of the WPCL Laboratory Analysis Reports (see Appendix C). Additional detailed flags may be found on the TA Laboratory Analysis Reports (Note: this information is not transferred to the WPCL Laboratory Analysis Reports comment section or database if it does not affect interpretation of the data). Intermittent DEHP QC issues were encountered during Year 4, though these issues were not nearly as pervasive as in Year 2 (see *Annual Stormwater Discharge Monitoring Report – Year 2* [City of Portland, 2007]). DEHP QC issues consisted primarily of method blank contamination or elevated LCS and MS/MSD recoveries resulting from laboratory-introduced contamination. These QC issues typically resulted in DEHP analytical results that were biased high. DEHP QC issues and associated data qualifiers are described in the *Data Usability Report* (see Appendix B) and in Table 6-2.

6.4 Monitoring Program Corrections

Any unusual condition that occurred during a monitoring event that could affect the monitoring results was noted and, if necessary, corrected. These conditions may be classified as a deviation, nonconformance, or occurrence (see Section 6.4.1). Conditions or issues related to field sampling activities are discussed in Section 6.4.2. Conditions or issues related to activities in the laboratory are discussed in Section 6.4.3.

6.4.1 Deviations, Nonconformance, and Occurrences

A deviation is a planned or unplanned departure from a procedure deemed reportable and tracked by the City's UIC Program Manager. Nonconformance is a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. An occurrence is any condition or event that could affect the health and safety of the public, have an adverse effect on the environment, endanger the health and safety of workers, affect the operations and intended purpose of a facility, or result in loss or damage of property.

No deviations, nonconformance, or occurrences were noted during the 2008-2009 wet season.

6.4.2 Field Corrective Actions

A field corrective action was initiated if problems associated with field measurements or field sampling equipment were observed. These problems and associated corrective actions are documented in *Corrective Action Reports* (Appendix G). No corrective action was taken during the 2008-2009 wet season.

6.4.3 Laboratory Corrective Actions

The QAPP requires that a laboratory corrective action be initiated if problems associated with laboratory procedures or equipment are observed. These problems and associated corrective actions are documented on a corrective action report specific to the laboratory in question.

No issues requiring laboratory corrective action were noted during the 2008-2009 wet season.

Section 7

7 Data Evaluation

This section presents the evaluation of stormwater data collected from UICs during the 2008-2009 wet season (*i.e.,* permit Year 4). Requirements for the data evaluation are specified in the WPCF permit and described in the QAPP.

To achieve the objectives described in the SDMP, the following data evaluation tasks were performed:

- Comparison of individual sampling event results to MADLs;
- Calculation of annual geometric mean analyte concentrations for permit compliance;
- Trend analysis to evaluate changes in analyte concentrations over time;
- Comparison of data obtained in the two traffic categories to assess potential differences in analyte concentrations as associated with the two traffic categories; and
- Evaluation of analyte concentrations relative to factors that may have influenced stormwater quality.

7.1 Individual Sampling Event MADL Exceedances

7.1.1 Common Pollutants

The permit requires that detected concentrations of common pollutants in each individual sampling event be compared to their respective MADLs. Table 7-1 summarizes the comparison of individual detected concentrations to MADL values for common pollutants. Four common pollutants [benzo(a)pyrene, pentachlorophenol, DEHP, and lead] were detected in Year 4 at concentrations above their MADLs in at least one sample, as shown on the following table:

Pentachlorophenol	**DEHP**	**Lead**
P4_2 (Events 2, 3, 4)	P4_6 (Event 1)	P6_5 (Event 3)
P4_3 (Events 1, 3)	P6_1 (Event 3)	P6_11 (Event 4)
P6_1 (Event 2, 4, 5)	P6_5 (Event 3)	SP3_2 (Event 2)
P6_2 (Event 3)	P6_11 (Event 5)	SP3_6 (Event 3)
P6_6 (Event 2)	P6_14 (Event 4)	SP3_8 (Events 2, 3, 4, 5)
P6_7 (Events 3, 4)	SP3_2 (Events 4, 5)	
P6_9 (Event 2)	SP3_6 (Events 3, 4)	**Benzo(a)pyrene**
P6_14 (Events 1, 3, 4)	SP3_8 (Events 3, 4)	SP3_6 (Event 3) *(continued)*

Pentachlorophenol	**DEHP**
SP3_4 (Events 2, 3)	SP3_9 (Event 4)
SP3_6 (Events 2, 3, 4, 5)	SP3_10 (Event 4)
SP3_8 (Events 1, 3, 4, 5)	

Pentachlorophenol. Eleven Year 4 UIC sample locations exceeded the MADL of 1.0 µg/L, with between one and four exceedances per location. Of these, seven were UICs categorized as ≥1,000 TPD, and four were UICs categorized as <1,000 TPD. By sampling event, the fewest number of exceedances (three) occurred during Events 1 and 5 and the greatest number of exceedances (eight) occurred during Event 3.

DEHP. Ten Year 4 UIC sample locations exceeded the MADL of 6.0 µg/L for DEHP. Of these, seven UICs were categorized as ≥1,000 TPD, and three UICs were categorized as <1,000 TPD. Exceedances occurred during Events 1, 3, 4, and 5. By sampling event, the fewest number of exceedances (zero) occurred during Event 2 and the greatest number of exceedances (six) occurred during Event 4.

Lead. Five Year 4 UIC sample locations exceeded the MADL of 50.0 µg/L for lead. Of these, four UICs were categorized as ≥1,000 TPD. Exceedances occurred during Events 2, 3, 4, and 5.

Benzo(a)pyrene. One Year 4 UIC sample location exceeded the MADL of 0.2 µg/L for benzo(a)pyrene. This location is categorized as ≥1,000 TPD. The exceedance occurred during Event 3.

As required by the permit, the City reported observed MADL exceedances of common pollutants from each individual sampling event to DEQ within 7 days following the receipt of validated analytical data. Exceedances were reported to DEQ in the following correspondence:

- MADL Exceedance Notification Year 4 – Event 1 – letter dated December 1, 2008, Revised December 26, 2009;
- MADL Exceedance Notification Year 4 – Event 2 – letter dated March 19, 2009;
- MADL Exceedance Notification Year 4 – Event 3 – letter dated April 6, 2009;
- MADL Exceedance Notification Year 4 – Event 4 – letter dated May 6, 2009; and
- MADL Exceedance Notification Year 4 – Event 5 – letter dated June 11, 2009.

Causes of the MADL exceedances are largely unknown. All compounds detected at concentrations greater than the MADL appear ubiquitous at low concentrations. Potential sources are identified below:

- **Pentachlorophenol**. Leaching from treated wood utility poles (*i.e.*, wood treatment). Poles have been observed near all UIC locations with pentachlorophenol exceedances. A utility pole pathway analysis was conducted during the 2007-2008 storm year and presented in Appendix G of the *Annual Stormwater Discharge Monitoring Report – Year 3*. That analysis demonstrated that the utility poles could account for most, if not all, of the pentachlorophenol present in stormwater entering the UICs. Other potential sources include: common pesticide (*e.g.*, lindane, hexachlorobenzene) breakdown products, insecticides, fungicides, herbicides, preservatives (*e.g.*, in laundry starch), glues, paper coatings, inks, incineration of chlorine containing wastes, etc.
- **DEHP**. Auto exhaust, tires, auto belts, used oil, brake pads, vinyl upholstery, air deposition, packing peanuts, used oil, paints, leaching and/or incineration from flexible plastic, etc.
- **Lead**. Auto batteries, tires, tire weights, etc.
- **Benzo(a)pyrene**. Incomplete combustion of organic material (*e.g.,* fuel from vehicles, wood and oil burning furnaces, and incinerators), component of coal tar, tobacco smoke, charbroiled food.

Section 8 describes City actions taken in response to MADL exceedances.

7.1.2 Priority Pollutant Screen Analytes

The permit requires that detected PPS analyte concentrations are reported and that concentrations from each individual sampling event are compared to their respective MADLs in Years 1, 4, and 9. Six PPS analytes were detected in Event 1 of Year 4 and monitored for all five sampling events:

- Antimony;
- Barium;
- Beryllium;
- 2,4-D;
- Glyphosate; and
- Mercury.

As described in Section 5.4.2, nine of 27 PPS analytes are analyzed as part of the routine monitoring of common pollutants during each sampling event. Of these compounds, only 2,4-D was detected (see Section 5).

The causes of the PPS analyte detections are largely unknown. No PPS analytes were detected at concentrations exceeding their respective MADLs. With the exception of antimony, the concentrations of these analytes are significantly (<50 percent) less than their respective MADLs for all sampling events. Table 5-9 presents the maximum percent of the MADL detected for PPS analytes. Because the concentrations of PPS analytes are significantly (<50 percent) less than their respective MADLs, response actions or source investigations have not been conducted. This is consistent with the PPS Action Levels, defined in the permit and presented in Table 7-2.

7.2 Calculation of Annual Mean

7.2.1 Method for Calculating Annual Mean Concentrations

The permit requires that the annual mean MADL concentration be met at the EOP discharge point after any pretreatment best management practices (BMP) or structural controls. DEQ considers using either a lognormal or geometric mean calculation to determine the "annual mean concentration" to be appropriate methodologies (DEQ, 2005b). The method used to calculate the geometric mean is described in the QAPP. Based on the considerations outlined in the QAPP, half of the MRL was used to address non-detected values in calculating the geometric mean. In general, all data were used. No individual data points were identified as outliers and omitted from the calculations.

The annual geometric mean concentration was calculated for pollutants detected in at least one sampling event or individual sampling location at a concentration >50 percent of their respective MADLs. The annual geometric mean concentration cannot exceed the MADL for analytes detected at concentrations <50 percent of the MADL. Annual geometric mean concentrations were calculated for the following pollutants in Year 4:

- Pentachlorophenol;
- DEHP;
- Benzo(a)pyrene;
- Lead;
- Benzene; and
- Antimony.

The Year 4 annual geometric mean concentration estimates for DEHP, benzo(a)pyrene, lead, pentachlorophenol, benzene, and antimony are presented in Table 7-3. Table 7-3 also presents pollutant MADLs, and the arithmetic mean (average), geometric mean, minimum, and maximum concentrations for reference and comparison. It should be noted that the arithmetic mean can be biased toward higher pollutant concentrations by outlier data points. Because stormwater data usually does not conform to a normal distribution and outlier data may bias the mean, using an arithmetic mean may be inappropriate (DEQ, 2005b).

7.2.2 Common Pollutants

Benzo(a)pyrene. The annual geometric mean concentration for benzo(a)pyrene was calculated for two UIC locations, P6_1 and SP3_6. Concentrations at these locations were 0.05 and 0.04 µg/L respectively. Both concentrations are ≤50 percent of the MADL of 0.2 µg/L.

Lead. The annual geometric mean concentration for total lead was calculated for 12 UIC locations where the concentration was ≥50 percent of the MADL (50.0 µg/L) in at least one sampling event. The annual geometric means for these locations range from 3.5 to 62.9 µg/L. The geometric means at 10 locations were <50 percent of the MADL. The geometric mean at one UIC location, P6_5, was >50 percent (32.2 µg/L) of the MADL, but below the MADL. The geometric mean at one UIC location, SP3_8, exceeded the MADL in Year 4.

Pentachlorophenol. The annual geometric mean concentrations for pentachlorophenol was calculated for 19 UIC locations where the concentration was ≥50 percent of the MADL (1.0 µg/L) in at least one sampling event. The geometric mean concentration for five UIC locations (P6_1, P6_14, P6_7, SP3_6, and SP3_8) exceeded the MADL in Year 4. The annual geometric means for these locations range from 1.1 to 1.4 µg/L, slightly exceeding the MADL. Three of these locations, P6_1, P6_7, and P6_14, were previously identified as Category 4 UICs in the *Annual Stormwater Discharge Monitoring Report – Year 2* (City of Portland, 2007). GWPDs for Category 4 UICs were conducted on these UICs as a corrective action in May 2008 (GSI 2008a, 2008b). DEQ concluded that the analyses for these UICs demonstrated that pentachlorophenol concentrations are attenuated by subsurface soils, and that stormwater discharges to these UICs are protective of beneficial uses of groundwater, public health, and the environment. A No Further Action letter for these UICs was issued May 30, 2008 (DEQ, 2008).

DEHP. The annual geometric mean concentration was calculated for 19 locations where the DEHP concentration was ≥50 percent of the MADL in at least one sampling event using the results of the event samples and duplicate samples. The annual geometric means for these locations ranged from 1.4 to 5.1 µg/L, less than the MADL of 6.0 µg/L.

Benzene. The annual geometric mean concentration for benzene was calculated for one UIC location, P6_12. The concentration at this location was 0.4 µg/L, significantly below the MADL of 5.0 µg/L.

7.2.3 Priority Pollutant Screen Analytes

Antimony. The annual geometric mean concentration for antimony was calculated for three UIC locations, P4_3, SP3_6, and SP3_8. Concentrations at these locations were 2.8, 1.9, and 3.5 µg/L respectively, all less than the MADL of 6.0 µg/L.

7.3 Evaluation of Year 4 Results

This section evaluates Year 4 data using statistical and graphical methods to look for potential differences or similarities between sample panels, sampling events, and traffic categories. These methods are described in the following sections. Analytical results for Year 4 are introduced in Section 5.

7.3.1 Box Plots

Box plots were selected to present the results of selected analytes. Box plots are an effective way to convey information that otherwise might require multiple graphs (such as contaminant concentration as a function of sampling location and traffic category). The statistical distribution of a given data set can be illustrated through use of a box plot. In general, box plots are a convenient way to graphically depict the range of stormwater concentrations, percentiles (25th, 50th, 75th), skewness, and identify outliers. Figure 7-1 illustrates and defines the components of a box plot.

Presenting box plots side-by-side allows both the general magnitude of the observations (*i.e.*, stormwater concentrations) in each plot to be ascertained and general comparisons to be made regarding the data sets.

Box plots were prepared only for analytes detected in Year 4 where the stormwater concentration in at least one sampling event was detected at a concentration $\geq$50 percent of the MADL or that were presented in the *Annual Stormwater Discharge Monitoring Report – Year 3* (City of Portland, 2008b) for comparison. As identified previously in this section, five pollutants were detected in Year 4 at concentrations $\geq$50 percent the MADL: pentachlorophenol, lead, benzo(a)pyrene, DEHP, and antimony. Arsenic, cadmium, and chromium did not exceed the MADL in any samples in Year 4 and are provided for comparison to previous annual data and general information. TSS box plot results are provided only for general information.

Box plots showing the pollutant concentrations by traffic category were prepared using Year 4 stormwater discharge data, including non-detect values. Concentrations reported as non-detect (<MRL) used the MRL to generate the box plots. Figures were prepared to illustrate analyte concentrations by traffic category (*i.e.*, <1,000 TPD, $\geq$1,000 TPD). Box plots of the following pollutants were prepared:

- Pentachlorophenol (Figure 7-2);
- Total lead (Figure 7-3);
- Dissolved lead (Figure 7-4)
- Benzo(a)pyrene (Figure 7-5);
- DEHP (Figure 7-6);
- Arsenic (Figure 7-7);
- Cadmium (Figure 7-8);
- Chromium (Figure 7-9);

- TSS (Figure 7-10); and
- Antimony (Figure 7-11).

The following general observations are made regarding these figures:

- Pentachlorophenol, cadmium, chromium, lead, benzo(a)pyrene, and DEHP concentrations generally appear to be lognormally distributed. However, several plots are skewed by the nondetect values (*e.g.*, pentachlorophenol, dissolved lead, chromium, benzo(a)pyrene, DEHP).
- The ≥1,000 TPD traffic category has a slightly higher mean and median concentration than the <1,000 TPD category for the pollutants evaluated.
- The means and geometric means of the pollutants evaluated are, in general, <50 percent of their respective MADLs.
- Some individual event concentrations detected above their respective MADLs are identified as potential outliers by the box plot methodology (*e.g.*, pentachlorophenol, lead, benzo(a)pyrene, DEHP).

Box plots of Year 4 for total lead (Figure 7-3) and dissolved lead (Figure 7-4) indicate lead occurs in narrow concentration ranges. The mean and geometric mean for dissolved lead is approximately an order of magnitude less than for total lead, suggesting lead is associated with stormwater particulates. This is consistent with the known behavior of lead in the environment and its strong affinity to sorb to soil.

A box plot of Year 4 TSS concentrations is presented in Figure 7-10. The average and geometric mean were calculated for Year 4 TSS data by traffic category. The ≥1,000 TPD traffic category average and geometric mean concentrations were more than two times higher than the concentrations in the <1,000 TPD traffic category.

7.3.2 Individual UIC Location Concentration Data by Sampling Event

Dot plots (*i.e.*, Trellis Displays) were prepared for:

- Pentachlorophenol (Figure 7-12);
- Total lead (Figure 7-13);
- Dissolved lead (Figure 7-14);
- Benzo(a)pyrene (Figure 7-15);
- DEHP (Figure 7-16);
- Arsenic (Figure 7-17);
- Chromium (Figure 7-18);
- TSS (Figure 7-19); and
- Antimony (Figure 7-20).

These plots depict the concentration for each UIC sampling location in Year 4 by sampling event and traffic category. The UIC locations on these plots are ordered according to increasing average concentration along the *x*-axis. These plots show the concentration of pollutant at an individual UIC for each sampling event (*i.e.*, Event 1 and Event 2). Concentrations reported as non-detect (<MRL) were plotted at the MRL. The following general observations are made regarding these plots:

- The majority of individual sample concentrations (by event and by location) is below the applicable MADLs.
- Concentrations at most individual UIC locations are within a narrow concentration range.
- Concentrations appear slightly higher in UICs categorized as ≥1,000 TPD.
- Benzo(a)pyrene was frequently not detected. Benzo(a)pyrene was detected only in one sample (P3_6) at a concentration greater than the MADL.
- Eight UIC discharge sample concentrations exceeded the MADL for lead (50 µg/L) in Year 4. Exceedances were observed in four monitoring events and five UIC locations.

Figure 7-14 presents the concentration for each UIC sampling location in Year 4 by sampling event and traffic category for dissolved lead. Similar to observations made based on the box plots, dissolved concentrations are significantly less than the MADL for total lead and the total lead concentrations depicted in Figure 7-13.

Figure 7-19 presents the TSS concentration for each UIC sampling location in Year 4 by sampling event and traffic category. Supporting the observations based on the box plots, TSS has higher concentrations on high traffic streets. In addition, the dot plots figure shows that for many UIC monitoring locations, the TSS concentrations were highest in the third and fourth sampling events.

7.3.3 Year 4 Concentration Data by Sampling Event

Box plot showing the concentrations of pentachlorophenol (Figure 7-21), total lead (Figure 7-23), DEHP (Figure 7-25), arsenic (Figure 7-27), and antimony (Figure 7-29) by sampling event were prepared using Year 4 stormwater discharge data, including non-detect values. These box plots for the four common pollutants were generated using data from 40 UIC monitoring locations for each sampling event. The box plot for the PPS analyte, antimony, was generated using data from 25 UIC monitoring locations for each sampling event. Concentrations reported as non-detect (<MRL) used the MRL to generate the box plot. The following general observations are made regarding these plots:

- Event concentrations generally appear to be lognormally distributed or skewed.
- With the exception of DEHP, pollutant concentration ranges and distributions among Year 4 sampling events are similar.

- The majority of individual sample concentrations (by event and by location) is below the MADL.

7.3.4 Year 4 Concentration Data by Sampling Panel

Box plots showing the concentrations of pentachlorophenol (Figure 7-22), total lead (Figure 7-24, DEHP (Figure 7-26), arsenic (Figure 7-28), and antimony (Figure 7-30) by sampling panel were prepared using Year 4 stormwater discharge data, including non-detect values. These box plots were generated using data from each sampling event. The following general observations were made regarding these plots:

- Panel concentrations generally appear to be lognormally distributed or skewed.
- DEHP concentration distributions are skewed by the non-detect values with elevated detection limits.
- With the exception of DEHP, pollutant concentration ranges and distributions among Year 4 sampling panels are similar.

7.4 UIC Stormwater Infiltration Volumes

The permit requires that the annual stormwater discharge monitoring report provide information on the total volume of recharge (*i.e.*, stormwater infiltration) to the subsurface (*i.e.*, aquifer) from City-owned UICs. This section describes the methods used to estimate the volume of water infiltrated to City-owned UICs.

BES estimated the catchment area (*i.e.*, basin drainage area) and impervious surface area (*e.g.*, roofs, parking lots, streets) for each known and active City-owned UIC. The impervious portion is the area of the UIC basin area assumed to provide stormwater runoff to the UIC. It was conservatively assumed that all of the impervious areas identified directed stormwater only to the subject UIC (*i.e.*, no infiltration into pavement, no infiltration into unpaved or curbless areas).

The equation used to calculate infiltration volume for each UIC is:

Infiltration Volume (cubic feet) = AP x (1ft/12 inches) x IA x LE (1)

Where:

AP = Annual Precipitation (inches)
IA = Impervious Area within UIC catchment (square feet)
LE = Loss to evaporation (1.0 – ELF)

Where:

ELF = Evaporative loss factor assumed to be 26 percent (0.26) (Snyder *et al.*, 1994)

Table 7-4 summarizes the total estimated stormwater infiltration volumes calculated for the City-owned UIC system for Years 1 through 4.

The total volume of stormwater infiltration was estimated using precipitation measurements from the Portland International Airport. Precipitation measurements for the periods between June 1 and May 30 for Year 1 (2005-2006), Year 2 (2006-2007), Year 3 (2007-2008), and Year 4 (2008-2009) and the estimated long-term annual precipitation total are presented in Section 5.2. The total precipitation totals for these periods were 42.77, 34.41, 33.94, and 27.2 inches, respectively (see Table 5-7).

UIC drainage (*i.e.*, catchment) areas were estimated using a geographic information system (GIS), as described in Year 1 – 3 reports. A number of the delineated drainage areas contained more than one UIC. When this was the case, the effective drainage area was assigned to an individual sump and the other sumps were removed from the calculation. Approximately 699 UIC sumps (~8 percent of City-owned UICs) were identified and removed from this category.

Based on these calculations, the City-owned UICs drain a total area of approximately 629,800,000 square feet (14,500 acres), of which approximately 223,500,000 square feet (5,130 acres) is impervious. Using these values, approximately 35 percent of the drainage area is considered impervious. The average area drained by a UIC system in the City of Portland was estimated to be approximately 81,500 square feet (1.9 acres), of which an average 35 percent or 28,900 square feet (0.7 acre) is impervious. The stormwater infiltration volumes for the City's UIC system were estimated to be approximately:

- 589 million cubic feet (4.4 billion gallons) in Year 1 (June 1, 2005 through May 30, 2006);
- 474 million cubic feet (3.5 billion gallons) in Year 2 (June 1, 2006 through May 30, 2007).
- 467 million cubic feet (3.5 billion gallons) in Year 3 (June 1, 2007 through May 30, 2008).
- 421 million cubic feet (3.1 billion gallons) in Year 4 (June 1, 2008 through May 30, 2009).

The simplified method for calculating runoff used in this report assumes that all rain that falls on impervious areas becomes runoff and all rain that falls on pervious areas does not. *The method used to estimate stormwater volume described above is believed to yield a conservative estimate of stormwater infiltration volumes*. There are a number of uncertainties inherent in both the underlying information and method used to estimate the stormwater infiltration volume at each UIC. Uncertainties in the estimates also may be the result of one or more of the following assumptions:

- All stormwater runoff from identified impervious areas is assumed to enter the UIC. This assumption overestimates the recharge volume.
- The evaporative loss factor was assumed to be constant. This value may vary as the result of weather conditions (ambient air temperature, impervious surface temperature, rainfall intensity, rainfall duration, land surface topography, impervious surface type and condition).
- Annual precipitation was based on data collected at the Portland International Airport. Total rainfall amounts are known to vary across the Portland metropolitan area. A constant precipitation rate may result in either an overestimate or underestimate of stormwater infiltration volume.
- Storm duration and intensity (longer storms will have a higher runoff percentage, as will more intense storms; storm intensity in the Portland area usually is not very high).
- Antecedent conditions (there will be more runoff if the ground/pavement is already saturated).
- Vegetative cover was not included in the stormwater infiltration estimates and therefore infiltration volumes may be overestimated. The effects of vegetative cover would vary seasonally (*e.g.*, summer versus winter) and spatially (*e.g.*, areas with high density of evergreen trees, areas with significant tree cover over roads, neighborhoods with no mature trees).
- Topography (flat areas generally will retain more water than steep slopes).

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Section

8

8 Response Actions

This section presents a summary of the actions taken during the Year 4 wet season (October 2008 – May 2009) to further understand pollutant sources, to prevent pollutants of concern from exceeding respective MADLs, and to respond to conditions identified during implementation of the Stormwater Discharge Monitoring Program.

8.1 Source Investigations

Source investigations may be conducted when new data are inconsistent with previous results or observations. No specific source investigations were conducted in Year 4.

8.2 Pentachlorophenol Response Actions

No specific response actions were conducted in Year 4; however, corrective actions were selected and implemented for previously identified Category 4 UICs (no Category 4 UICs were identified in Year 4). The permit defines Category 4 UICs as those that become non-compliant by failing to meet the annual geometric mean MADL within one wet season after the initial exceedance.

Pentachlorophenol was detected above the MADL in Years 1 and 2 of the UIC Stormwater Discharge Monitoring Program. Annual geometric mean concentrations at four locations (P1_1, P6_1, P6_7, and P6_14) exceeded the MADL in two consecutive years. These four UICs were identified in *Annual Stormwater Discharge Monitoring Report –Year 2* (City of Portland, 2007) as noncompliant Category 4 UICs, based on the results of the Year 2 stormwater monitoring data. Year 2 had three additional locations that exceeded the annual geometric mean concentrations and were rolled over for monitoring in Year 3 (P2_5, P2_13, and P2_14). The annual geometric mean pentachlorophenol concentration exceeded the MADL at six UIC locations (P6_1, P6_4, P6_14, P2_5, P2_13, and P2_14) in Year 3. These exceedances resulted in three additional Category 4 UICs (P2_5, P2_13, and P2_14), which were identified in *Annual Stormwater Discharge Monitoring Report –Year 3* (City of Portland, 2008b).

The recommended corrective actions for the Category 4 UICs were identified and evaluated in accordance with the DEQ approved *Corrective Action Plan* (CAP; City of Portland, 2006f). The recommended corrective action for each Category 4 UIC was a groundwater protectiveness demonstration (*i.e.,* risk assessment) or No Further Action determination as allowed by the permit [Schedule C(11)(a)].

The City developed the *Decision Making Framework for Groundwater Protectiveness Demonstrations* (Framework, City of Portland, 2008a). The purpose of the Framework is to

provide a consistent, streamlined decision making framework for evaluating the potential impacts (*i.e.,* risks) to groundwater quality associated with the discharge of urban ROW stormwater into permitted City-owned UICs. The Framework includes a groundwater protectiveness tool for assessing the potential "risk" to groundwater posed by the discharge of urban stormwater runoff into City-owned UICs. The Framework was submitted to DEQ in June 2008 and approved by DEQ in October 2008.

Scope of Analyses. GWPDs were performed by the City in accordance with the protocols defined in the CAP and Section 10 of the Framework. The GWPDs evaluated the fate and transport of pentachlorophenol in stormwater discharged to Category 4 UICs using a one-dimensional mathematical fate and transport equation and site-specific parameter values (*e.g.*, soil type, contaminant concentration). The analyses evaluated whether stormwater pollutant concentrations entering the UIC are reduced to levels protective of drinking water at the point the infiltrated stormwater reaches groundwater. Specific activities included:

- Preparing a conceptual site model (CSM) of potential transport pathways for pentachlorophenol discharge to a UIC; and
- Assessing the fate and transport of pentachlorophenol in unsaturated soil under a range of geologic conditions and under a range of stormwater discharge concentrations.

Results. Results of fate and transport analyses demonstrated that unsaturated subsurface soil attenuates (*i.e.,* treatment/removal) pentachlorophenol in stormwater discharges to the subject UICs to levels protective of beneficial uses of groundwater and public health and the environment as required by OAR 340-040.

The UIC monitoring data for Years 1, 2, 3 and 4 indicate pentachlorophenol is generally present at low concentrations and within a narrow concentration range (between 0.04 and 6.29 µg/L). The analyses indicated that beneficial uses of groundwater are protected. Pentachlorophenol concentrations are not expected to increase significantly in the future because the source is strongly suspected to be leaching or weathering of treated wood utility poles as demonstrated in the pentachlorophenol pathway analysis presented in Appendix G of the *Annual Stormwater Discharge Monitoring Report – Year 3*.

The site-specific GWPDs for Year 2 Category 4 UICs were submitted for DEQ review and approval in the spring of 2008 (GSI, 2008a; 2008b). DEQ issued No Further Action determinations for the four Year 2 Category 4 UICs in a letter dated May 30, 2008 (DEQ, 2008). Site-specific GWPDs for the three Year 3 Category 4 UICs were submitted to DEQ on March 30, 2009 for No Further Action.

8.3 UIC System Cleaning

No observations during pre-sampling inspections or during stormwater event sampling warranted the City's UIC program requesting that the City's Bureau of Maintenance crews or

the City's response contractor clean selected UICs. General UIC cleaning activities were performed in general accordance with the *Surface Stormwater Facilities Maintenance Management Manual* (prepared for BES by Brown and Caldwell, 1997) and UICMP, submitted to DEQ in December 2006.

Recent cleaning and/or maintenance activities performed on Year 4 UIC sampling locations are identified in Tables 3-2 through 3-4.

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Section 9

9 Preliminary Trend Analyses

9.1 General

This section presents Years 1, 2, 3, and 4 stormwater discharge monitoring data using statistical and graphical methods to identify potential differences or similarities between permit years, traffic categories, and monitoring panels. Analytical results for Year 4 are introduced in Section 5. Years 1 through 3 results are presented in their respective annual stormwater discharge monitoring reports (City of Portland, 2006e, 2007, 2008b).

Box plots were prepared to present the results of selected analytes for Years 1, 2, 3, and 4. These box plots are presented side-by-side to allow both the general magnitude of stormwater concentrations and distribution in each plot to be viewed and to allow general comparisons to be made regarding the data sets.

In general, plots were prepared for pollutants where the stormwater concentration in at least one sampling event was detected at a concentration ≥MADL, with the exception of antimony, which was detected at concentrations greater than half the MADL. Box plots were generated using data from all four permit years, including values reported by the analytical laboratories as "non-detect" and flagged data. Concentrations reported as non-detect (<MRL) were replaced with a value equal to the MRL in order to generate the box plots.

Additional data evaluation and analysis may be conducted and discussed in the annual UICMP report, as appropriate. The annual UICMP report is submitted to DEQ in November of each permit year.

9.2 Permit Year

Box plots were prepared for Panel 6 (fixed panel) to allow the comparison of stormwater discharge concentrations of selected analytes by permit year. Figures 9-1 through 9-6 present the box plot comparisons for pentachlorophenol, lead, benzo(a)pyrene, DEHP, TSS, and dissolved lead, respectively. The following general observations are made regarding these figures:

- Pentachlorophenol, DEHP, benzo(a)pyrene, antimony, lead, and TSS concentrations appear lognormal and are skewed.
- Concentration ranges and distributions are very similar among Years 1, 2, 3, and 4.
- Annual geometric mean concentrations of the compounds evaluated are, in general, <50 percent of their respective MADLs for all four years.
- Potential outliers are present in benzo(a)pyrene and DEHP data for all four years.

9.3 Traffic Categories

Box plots were prepared to compare the concentrations of selected analytes by traffic category (*i.e.*, <1,000 TPD, ≥1,000 TPD) for Years 1, 2, 3, and 4. Figures 9-7 through 9-10 present the box plots for pentachlorophenol, lead, benzo(a)pyrene, and DEHP, respectively. The following general observations are made regarding these figures:

- Box plot patterns for both traffic categories have similar concentration ranges from permit year to permit year.
- Distributions of DEHP and BAP are consistent with a lognormal model that has been truncated at the detection limit (i.e., data are skewed by the non-detect values).
- Annual median and geometric mean concentrations of the compounds evaluated are, in general, <50 percent of their respective MADLs.
- The ≥1,000 TPD traffic category has higher geometric mean and median concentrations than the <1,000 TPD category for the compounds evaluated.

9.4 Monitoring Panels

Box plots were prepared to compare the concentrations of selected analytes by monitoring panel. Years 1, 2, 3, and 4 UIC monitoring locations are as follows:

Year 1	**Year 2**	**Year 3**	**Year 4**
• Panel 6 (15 fixed UICs)	• Panel 6 (15 fixed UICs)	• Panel 6 (15 fixed UICs)	• Panel 6 (15 fixed UICs)
• Panel 1 (15 rotating UICs)	• Panel 2 (15 different rotating UICs)	• Panel 3 (15 different rotating UICs)	• Panel 4 (15 different rotating UICs)
	• P1_1 (carried over from Year 1)	• P1_1, P2_5, P2_7, P2_13, and P2_14 (carried over from Year 2)	• Supplemental Panel 3 (10 different UICs near drinking water wells)
	• Supplemental Panel 1 (10 UICs near drinking water wells)	• Supplemental Panel 2 (10 different UICs near drinking water wells)	

Figures 9-11 through 9-14 present box plots by panel for pentachlorophenol, lead, DEHP, and benzo(a)pyrene, respectively. The following general observations are made regarding these figures:

- In general, panels show similar concentration ranges and have similar concentration distributions.
- The median and geometric mean concentrations of the four compounds evaluated are, in general, <50 percent of their respective MADLs. The concentrations of UIC Panels 1 and 2 carry-over locations P1_1 (Years 2 and 3), and P2_5, P2_7, P2_13, and P2_14 (Year 3), are higher because these locations were determined to have annual average concentrations >MADL in Years 1 and/or 2.

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Section

10

10 Findings and Conclusions

This section presents the findings and conclusions for Year 4 of the UIC monitoring program.

10.1 Year 4 Monitoring Program

The UIC monitoring program was implemented in accordance with the SDMP. It demonstrates permit compliance by documenting sampling procedures, analyses, results, data evaluation, and reporting in accordance with the SDMP.

The monitoring program was designed to be representative of the estimated 9,000 active City-owned and/or operated UICs. It is based on a statistically valid and robust method for identifying a representative subset of UIC locations for monitoring. This method provides a high level of confidence that the monitoring network is representative of the City's UIC population. Forty UIC locations were sampled in Year 4. Sample locations are stratified on two traffic categories: <1,000 TPD and ≥1,000 TPD. No significant land use or zoning changes were noted by BES that would be expected to result in modifications to traffic volumes during the 2008-2009 monitoring season.

10.2 Year 4 Sampling Results

Five sampling events were completed between October 2008 and May 2009, as required by the permit. Sampling events often consisted of multiple storms. Storms targeted for sampling met the criteria identified in the SAP to the extent practicable and were determined to be acceptable.

Stormwater samples from selected UIC locations were analyzed for both common pollutants and PPS analytes defined in the permit. PPS analytes were analyzed for Panel 4 and Supplemental Panel 3 sample locations in Event 1, and, if detected, sampled again in Events 2 through 5. PPS analytes were sampled for Panel 6 in Year 1. In addition to the required monitoring, the City also measured the following:

- TSS at all UIC monitoring locations during each sampling event;
- Dissolved copper, lead, zinc, and mercury at all UIC monitoring locations during each sampling event; and
- Dissolved antimony, arsenic, barium, beryllium, cadmium, chromium, and selenium at Panel 4 and Supplemental Panel 3 locations during sampling Event 1.

Field and laboratory data collected during Year 4 were determined to meet the DQOs described in the QAPP and to be of known and acceptable quality. All data are considered useable (see Appendix B for details).

10.2.1 Common Pollutants

All 14 common pollutants defined by the permit were detected during Year 4. The permit requires that detected concentrations of common pollutants in each individual sampling event be compared to their respective MADLs. Four common pollutants [pentachlorophenol, DEHP, benzo(a)pyrene, and lead] were detected in Year 4 at concentrations above their MADLs in at least one sample.

10.2.2 Priority Pollutant Screen Analytes

Six of the 27 PPS analytes (antimony, barium, beryllium, 2,4-D, glyphosate, and mercury) were detected during Year 4, Event 1. These analytes were analyzed during Events 2 through 5 in the selected UICs to obtain a total of five samples as required by the permit. The permit requires that detected concentrations of PPS analytes be reported and that concentrations from each individual sampling event be compared to their respective MADLs. No individual detected concentrations of the PPS analytes exceeded the MADL; with the exception of antimony, concentrations were less than 50 percent of the MADL.

10.2.3 Ancillary Pollutants

The permit requires that all analytes detected by any of the laboratory methods used in the stormwater monitoring program be reported. Ancillary pollutants are those analytes that are detected in addition to required monitoring for common pollutants or PPS analytes using EPA-approved analytical methods. Twenty-eight ancillary pollutants were detected in Year 4. Eleven of these were detected at a maximum frequency $\leq$4 percent of the samples and seven were detected at maximum frequencies between 7 percent and 50 percent of the samples. The 10 remaining pollutants detected at the highest frequencies (>50 percent) during the individual sampling events are PAHs. PAHs detected above 50 percent included: chrysene, phenanthrene, napthalene, pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, fluoranthene, indeno(1,2,3-cd)pyrene, benzo(a)anthracene, and benzo(k)fluoranthene. Of these, naphthalene had the highest concentration with a maximum of 2.24 µg/L.

10.3 Individual Sampling Event MADL Exceedances

Four common pollutants exceeded MADL concentrations during individual sampling events in Year 4 including:

Pentachlorophenol. Twenty-six sample concentrations from 11 UIC locations exceeded the MADL of 1.0 µg/L. Exceedances occurred during all five sampling events.

DEHP. Thirteen sample concentrations from 10 UIC locations exceeded the MADL of 6.0 µg/L for DEHP. Exceedances occurred during Events 1, 3, 4, and 5.

Lead. Eight sample concentrations from five UIC locations exceeded the MADL of 50.0 µg/L for lead. Exceedances occurred during Events 2, 3, 4, and 5.

Benzo(a)pyrene. One sample concentration from one UIC location exceeded the MADL of 0.2 µg/L for benzo(a)pyrene. The exceedance occurred during Event 3.

As required by the permit, the City reported the observed MADL exceedances to DEQ within 7 days following the receipt of validated analytical data.

The causes of the MADL exceedances are largely unknown. All compounds detected at concentrations greater than the MADLs appear ubiquitous at low concentrations across the sampling locations.

10.4 Calculation of Annual Mean

As required by the permit and described in the QAPP, annual geometric mean concentrations were calculated for pentachlorophenol, lead, benzo(a)pyrene, DEHP, benzene, and antimony.

- **Pentachlorophenol**. Year 4 annual geometric mean concentrations for five UIC locations (P6_1, P6_7, P6_14, SP3_6, and SP3_8) exceeded the MADL for pentachlorophenol. The annual geometric means for these locations ranges from 1.1 to 1.5 µg/L, slightly above the MADL of 1.0 µg/L.
- **Lead**. The Year 4 annual geometric mean concentration for lead (62.9 µg/L) in UIC location SP3_8 also exceeded the MADL (50 µg/L).
- **Benzo(a)pyrene**. Year 4 annual geometric mean concentrations for benzo(a)pyrene were <50 percent of their MADL for individual UIC locations.
- **DEHP**. Year 4 annual geometric mean concentrations for DEHP ranged between 1.4 and 5.1 µg/L, all less than 90 percent of the MADL.
- **Benzene**. The annual geometric mean concentration for benzene was 0.4 µg/L, significantly below the MADL of 5.0 µg/L.
- **Antimony**. The annual geometric mean concentration for antimony was calculated for three UIC locations: P4_3, SP3_6, and SP3_8. The annual geometric mean for these locations ranges from 1.9 to 3.5 µg/L, respectively, all less than the MADL of 6.0 µg/L.

10.5 Preliminary Trend Analysis – Traffic Categories

Years 1 through 4 pollutant concentration data were compared using box plots. Box plots were prepared to identify potential differences in pollutant concentrations between:

- Permit years (Year 1,Year 2, Year 3, Year 4);

- Traffic categories (*i.e.*, <1,000 TPD; ≥1,000 TPD); and
- Sample panels (*e.g.*, Panels 1-4, Panel 6, Supplemental Panels 1-3).

In general, in the box plots prepared for Years 1 through 4, data are similar for each variable. For most pollutants evaluated, the concentration ranges were generally narrow and geometric means were well below their respective MADL (*i.e.*, <50 percent). Pollutant concentrations appear to be higher in the ≥1,000 TPD traffic category than in the <1,000 TPD category and similar between sample panels.

10.6 Analysis of Factors that Affect Stormwater

One of the goals of the permit and the SDMP is to identify factors that have a substantive effect on the quality of stormwater entering City-owned UICs. To identify these factors, the potential associations and relationships between stormwater quality, potential sources of pollution, traffic category, land use, etc. could be evaluated. As data are collected in successive years, and a larger data set becomes available, additional analysis will be considered, if needed (*e.g.*, detailed trend analysis, correlations, or logistic regression). As appropriate, this type of evaluation and analyses, if performed, will be included in the annual UICMP report(s), which are submitted to DEQ by November 1 of each year. Types of analyses that may be performed include:

- Investigate potential relationships between:
  - TSS and selected pollutants;
  - Presence of treated wood utility poles and pentachlorophenol;
  - Traffic volume (*i.e.*, TPD) and selected pollutants;
  - Pollutants (*e.g.*, lead and arsenic, lead and antimony, DEHP and PAHs, lead and PAHs).
- Comparison of data groups to determine if they are statistically different (*i.e.*, concentrations between traffic categories).

10.7 Category 4 UICs

The WPCF permit requires the City to identify UICs at which the annual geometric mean concentration exceeds the MADL for two consecutive years as Category 4[6] UICs. No new Category 4 UICs were identified in Year 4.

The Year 4 annual geometric mean concentration of pentachlorophenol exceeded the MADL in five UICs (P6_1, P6_7, P6_14, SP3_6, and SP3_8). The annual geometric mean lead concentration in SP3_8 also exceeded the MADL (50 µg/L). Three of these UICs (P6_1, P6_7, and P6_14) were previously identified in Year 2 as non-compliant Category 4 UICs. Three additional UICs (P2_5, P2_13, and P2_14) also exceeded annual geometric mean concentrations in Year 2 for pentachlorophenol. These UICs were

[6] Category 4 UICs are those UICs that become non-compliant by failing to meet the annual geometric mean MADL within one wet season after the exceedance or failing to satisfy any groundwater protection conditions of Schedule A of the permit.

sampled again in Year 3, as required by the permit. In Year 3, three UICs (P2_5, P2_13, and P2_14) were identified as Category 4 UICs.

Corrective actions for the Category 4 UICs identified in Years 2 and 3 were selected and completed in compliance with the permit conditions and schedule. The corrective actions were site-specific GWPDs performed in accordance with the DEQ-approved Framework (City of Portland, 2008a), as discussed in Section 8.2.

SP3_6 and SP3_8 will be sampled again in Year 5.

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Section 11

11 References

Brown and Caldwell. 1997. *Surface Stormwater Facilities Maintenance Management Manual.* Prepared for City of Portland Bureau of Environmental Services. April 1997.

City of Portland, Bureau of Environmental Services. 2005. *WPCL Quality Manual.* Revision 6. April 2005.

City of Portland, Bureau of Environmental Services. 2006a. *Stormwater Discharge Monitoring Plan, consists of Sampling and Analysis Plan and Quality Assurance Project Plan.* February 2006. Version: 1.

City of Portland, Bureau of Environmental Services. 2006b. *Sampling and Analysis Plan – Stormwater Underground Injection Control System Monitoring*. February 2006. Version 1.

City of Portland, Bureau of Environmental Services. 2006c. *Quality Assurance Project Plan – Stormwater Underground Injection Control System Monitoring.* February 2006. Version 1.

City of Portland, Bureau of Environmental Services. 2006d. *Systemwide Assessment.* July 2006.

City of Portland, Bureau of Environmental Services. 2006e. *Annual Stormwater Discharge Monitoring Report – Year 1 – October 2005 – May 2006*. July 2006.

City of Portland, Bureau of Environmental Services. 2006f. *Corrective Action Plan*. July 2006f.

City of Portland, Bureau of Environmental Services. 2006g. *Underground Injection Control Management Plan*. December 2006.

City of Portland, Bureau of Environmental Services. 2007. *Annual Stormwater Discharge Monitoring Report – Year 2 – October 2006 – May 2007*. July 2007.

City of Portland, Bureau of Environmental Services. 2008a. *Decision Making Framework for Groundwater Protectiveness Demonstrations*. June 2008.

City of Portland, Bureau of Environmental Services. 2008b. *Annual Stormwater Discharge Monitoring Report – Year 3 – October 2007 – May 2008*. July 2008.

City of Portland, Bureau of Environmental Services. 2008c. *UICs within Permit-Specified Well Setbacks - Groundwater Protectiveness Demonstration – No Further Action Request*.

DEQ. 2005a. Water Pollution Control Facilities Permit for Class V Stormwater Underground Injection Control Systems, Permit No. 102830. June 1, 2005.

DEQ. 2005b. Permit Evaluation Report. June 1, 2005

DEQ. 2008. No Further Action Determination, Category 4 UICs – Corrective Action. City of Portland, DEQ Water Pollution Control Facilities Permit No. 102830. May 30, 2008.

GSI Water Solutions, Inc. 2008a. Category 4 UIC Corrective Actions Groundwater Protectiveness Demonstrations- Updated. Prepared for: City of Portland Bureau of Environmental Services UIC Program. May 2008.

GSI Water Solutions, Inc. 2008b. Category 4 UIC Corrective Actions- Updated Groundwater Protectiveness Demonstrations (GWPD). Prepared for: City of Portland Bureau of Environmental Services UIC Program, April.

Kincaid, T.M. 2000. Testing for differences between cumulative distribution functions from complex environmental sampling surveys. In *2000 Proceeding of the Section on Statistics and the Environment*, American Statistical Association, Alexandria, VA.

O'Callaghan, J. F., and D. M. Mark. 1984. The Extraction of Drainage Networks from Digital Elevation Data. Computer Vision, Graphics and Image Processing 28:323-344.

Snyder, D.T., D.S. Morgan, and T.S. McGrath. 1994. Estimation of ground-water recharge from precipitation, runoff into drywells, and on-site waste disposal systems in the Portland Basin, Oregon and Washington. Water Resources Investigations Report WRIR 92-4010. http://or.water.usgs.gov/pubs_dir/orrpts.html#HDR6

Stevens, D.L., Jr., and A.R. Olsen. 2004. Spatially-balanced sampling of natural resources. *Journal of the American Statistical Association*. 99: 262-278.

Table 1-1: WPCF Permit Annual Monitoring Report Requirements[1]

7. **Monitoring Reporting**. The Permittee must submit to the Department annual monitoring reports in accordance with Schedule C.19. At a minimum, each annual monitoring reports must address the following conditions [2]:	**Report Section**
a. Provide a summary of the monitoring data for the preceding wet season being reported. At a minimum, the summary must include:	
i. Data pertinent to each storm event sampled, including but not limited to:	Section 5 Tables 5-1 through 5-7 Appendix B
(1) A description of the date and duration of storm event sampled;	
(2) Precipitation estimates of the storm event;	
(3) Duration and intensity of the storm event; and	
(4) The duration in days between storm events sampled and the previous storm event;	
ii. A summary table for the injection systems being sampled that includes, but not limited to:	
(1) DEQ ID number for the public UIC;	Table 3-2 - Year 4 Panel 4 Table 3-3 - Year 4 Panel 6 Table 3-4 Supplemental Panel 3
(2) Latitude and longitude of each sample location;	
(3) Street location;	
(4) The traffic volume, traffic pattern and type of land use in accordance with Table 2 for each public UIC injection system sampled;	
(5) Type of pretreatment, if any, for the public UIC sampled;	Table 3-2 - Year 4 Panel 4 Table 3-3 - Year 4 Panel 6 Table 3-4 Supplemental Panel 3
(6) Depth to groundwater from ground surface based on USGS estimated depths to groundwater. Site specific data shall be used if available;	
(7) Date of the last maintenance and type of maintenance performed;	Table 3-2 - Year 4 Panel 4 Table 3-3 - Year 4 Panel 6 Table 3-4 Supplemental Panel 3 Section 8
(8) Date of last maintenance and inspection;	
(9) The level of the sediment in a sediment manhole, if the injection system has a sediment manhole as part of the pretreatment. If no sediment manhole is present, report the sediment level in the associated catch basins and in the bottom of the public UIC.	Table 3-2 - Year 4 Panel 4 Table 3-3 - Year 4 Panel 6 Table 3-4 Supplemental Panel 3
(10) The estimated total volume of recharge to the aquifer by public UICs.	Section 7 Table 7-4

Table 1-1: WPCF Permit Annual Monitoring Report Requirements[1]

iii. A map showing the location of the public UIC injection systems sampled in relation to the Permittee's other public UIC systems authorized by this permit and any domestic wells and public water system wells;	Figures 3-1 and 3-2 Appendix A Systemwide Assessment Report (July 2006)
iv. A map of sufficient scale that clearly shows the location of the specific public UIC being sampled;	Appendix A
v. Identification and discussion of any exceedance of an individual storm event MADL and any annual mean MADL concentration, including:	Section 7 Tables 7-1, 7-3 and 7-4
(1) A discussion of any potential cause of the exceedance, to the extent practicable and if known, and	Appendix B Section 7
(2) Actions taken during the wet season to reduce the concentration of the pollutant of concern;	Section 8
vi. Identification and discussion of any detected PPS pollutant during a PPS screen sampling event, including:	Sections 5 and 7
(1) The pollutant concentration:	Tables 5-9, 5-10, and 5-11 Appendices C, E , and F
(2) The public UIC at which the detection occurred;	
(3) A discussion of the cause of the detection, if known; and	Section 7
(4) actions taken; and	Section 8
vii. A discussion of compliance response actions taken to correct a MADL annual mean exceedance.	Section 8
b. Provide a summary table of all laboratory monitoring data for the reporting period wet season, including:	Appendices C, E, and F
i. Ancillary pollutants derived from the approved analytical method;	Tables 4-2 and 4-3 Section 5 Tables 5-12 and 5-13 Appendices C, E, and F
ii. MRLs; and	
iii. Analytical method used.	
c. Discuss any unusual conditions that occurred during a monitoring event that may impact the monitoring results.	Appendix B Sections 6 and 7

Table 1-1: WPCF Permit Annual Monitoring Report Requirements[1]

d. Include an analysis of the trends in the cumulative monitoring data, including water quality improvements or degradations for each annual report after the first year of reporting.	Section 9
e. Explain any outliers in the data used to determine the annual mean MADL concentration. If the outlier data was not used in the mean annual MADL concentration, provide an explanation of why the data was omitted from the determination.	No outliers identified (Section 7)
f. Include a statement that sampling and measurements taken as required herein are representative of the traffic volume and traffic patterns of the monitored discharge weighted or stratified in accordance with the Department-approved SDMP.	Sections 3 and 6
g. Discuss any annual mean MADL exceedance in accordance with Schedule C.10.	Sections 7 and 10
h. Discuss, in accordance with Schedule C.8, any PPS pollutant detection during a PPS sampling event. This condition applies to the 1st, 4th and 9th year PPS sampling events, or whenever the Permittee samples for the presence of PPS pollutants.	Sections 5 and 7 Tables 5-9, 5-10, 5-11
i. In the event conditions occur beyond the reasonable control of the Permittee as identified in Schedule B.3, the Permittee must explain the circumstances in the annual monitoring report. The explanation must include why the sampling event or sample analysis was missed and (if applicable) any corrective actions to prevent the occurrence from happening again.	Not applicable for Year 4 (Note: Five events sampled in accordance with permit)
j. For Category 4 public UICs, as defined in Schedule D.11, the Permittee must report in the annual monitoring report the following:	Section 10 Category 4 UICs are defined as public UICs that become non-compliant by failing to meet the annual mean MADL within one wet season after the exceedance, or fails to satisfy any groundwater protection conditions of Schedule A of the permit. (Continued on next page)
i. Provide a list of the Category 4 public UICs;	
ii. A brief description of the public UICs;	
iii. The location of the public UIC at which the non-compliant condition occurred, including traffic volume and the nature of land uses that may drain to the public UIC;	
iv. The nature and concentration of the pollutant that exceeded the annual mean MADL concentration;	
v. The vertical separation distance to groundwater;	
vi. The proposed corrective action, which may include a risk assessment that meets Department risk assessment protocols;	
vii. Discuss the corrective action(s) completed;	
viii. Discuss on-going corrective action(s), or corrective actions to be implemented, including but not limited to:	
(1) The type of corrective action;	
(2) Implementation date;	

Table 1-1: WPCF Permit Annual Monitoring Report Requirements[1]

(3) Completion date; and	(Continued from previous page)
(4) Other pertinent information regarding the public UIC or its corrective action obtained during the reporting period.	
k. In the event the Permittee undertakes groundwater monitoring, the Permittee must provide the following:	Not applicable for Year 4. Groundwater monitoring was not performed in Year 4.
i. Monitoring well locations with street location and latitude and longitude in decimal degrees;	
ii. Water level measurements and gradient;	
iii. As-built monitoring well construction details for any monitoring well installed during the reporting period;	
iv. The pollutant(s) being monitored;	
v. All groundwater monitoring data and other data pertinent to groundwater monitoring;	
vi. Any other pertinent data to groundwater monitoring obtained during the reporting period;	
vii. A discussion of the following:	
(1) Monitoring data;	
(2) Pollutant concentrations, including concentrations at background and compliance monitoring wells;	
(3) Compliance with Table 1 for groundwater;	
(4) Actions taken or to be taken by the Permittee with respect to groundwater monitoring;	
(5) An analyses of the data; and	
(6) Conclusions with respect to potential or demonstrated groundwater contamination from public UICs; and	
viii. If applicable, a discussion of any Department-approved groundwater corrective actions, including, but not limited to:	Not applicable for Year 4. Need for groundwater Corrective Action was not identified in Year 4.
(1) Nature of the action(s);	
(2) Status of the action(s);	
(3) All laboratory results related to the action;	
(4) Analyses of the data with respect to achieving the corrective action goal; and	
(5) Milestones reached.	
8. **Permittee Monitoring Responsibility**. The Permittee is responsible to protect groundwater quality while operating its public UICs. At a minimum, the Permittee must:	
a. Ensure data and information acquired through implementation of the SDMP is representative of the Permittee's entire public UIC system;	SDMP (August 2006) Section 3
b. Ensure the results of the system-wide assessment, required under Schedule D.8, are incorporated into the SDMP as appropriate;	SDMP (August 2006)
c. Notify the Department in the annual monitoring report of significant land use changes which change traffic volume or patterns which may affect public UICs in the SDMP. Significant land use changes include, but are not limited to:	Sections 3 and 10

Table 1-1: WPCF Permit Annual Monitoring Report Requirements[1]

i. Zoning changes that result in an increase of 1,000 trips per day or more;	None
ii. A change in type of traffic, i.e. increase in truck traffic; or	None
iii. A change that may cause or causes an adverse impact to a BMP such that the BMP no longer performs as intended to meet the conditions of this permit;	None
d. Notify the Department when information or data indicates additional pollutants should be added to Table 1;	SDMP (August 2006)
e. Implement modifications to the permit, including the addition of pollutants that the Department deems necessary to incorporate into the SDMP or other actions under this permit as directed by the Department; and	SDMP (August 2006)
f. Ensure other verifiable data or information, which may indicate a potential that groundwater may be endangered by stormwater injection, is reported in a timely manner to the Department.	SDMP (August 2006)

Notes:

[1] The report section provides a reference to the sections, tables, or figures in the annual SDM report that best address given requirements.

[2] Conditions taken verbatim from Section B(7) of DEQ issued "Water Pollution Control Facilities Permit for Class V Stormwater Underground Injection Control Systems." [DEQ Permit (No. 102830), issued June 1, 2005].

Table 3-1: Vehicle Trips per Day and Predominant Land Use

Vehicle Trips per Day (TPD)	Predominant Land Use
< 1,000	Residential Streets; Small Parking Lot
≥ 1,000	Residential Feeder Streets; Commercially Zoned Areas; Transportation Corridors; Industrial Areas

Table 3-2: UIC Summary Information - Rotating Panel, Year 4, Panel 4

Location Code	Approximate Address [a]	Estimated Trips per Day (TPD)	Traffic Category (TPD)	Predominant Land Use [b]	DEQ UIC ID	BES UIC ID [c]	Latitude	Longitude	UIC Depth (feet)	Pretreatment System [d]	Separation Distance [e]	Distance to Nearest Well (ft) [f]	Within Two-year Time of Travel from public drinking water well?	Date of Last Maintenance	Maintenance Performed	Sediment Level (ft) [g]
P4_01	4924 SE 113TH AVE	450	<1000	SFR	10102-5875	ADW243	45.48627	-122.54717	20	No Sed MH	13	504	No	3/8/2001	Cleaned UIC	8
P4_02	5903 N HOUGHTON	1,012	≥1000	SFR	10102-1331	ADN392	45.58648	-122.72666	30	Sed MH	74	4342	No	5/18/2008	Cleaned UIC & Sed MH	4
P4_03	6304 SE FOSTER	25,775	≥1000	MFR	10102-5278	ADW310	45.47634	-122.54132	20	No Sed MH	18	1499	No	2/13/2008	Cleaned UIC & Sed MH	9.5
P4_04	3250 NE GOING ST	317	<1000	SFR	10102-3377	ADQ124	45.55628	-122.63190	31	Sed MH	169	3,471	No	8/29/2005	Cleaned UIC & Sed MH	2.9
P4_05	6615 SE LAMBERT	334	<1000	SFR	10102-4919	ADV909	45.46736	-122.59543	30	Sed MH	72	2892	No	4/30/2008	Cleaned UIC & Sed MH	5.2
P4_06	14137 SE MILL ST	2,404	≥1000	SFR	10102-7232	ADS361	45.51026	-122.51764	29	Sed MH	47	1,060	No	8/2/2004	Cleaned UIC & Sed MH	4
P4_07	4311 SE 51ST AVE	545	<1000	SFR	10102-681	ADS886	45.49176	-122.61003	30.5	Sed MH	99	3,330	No	6/29/2004	Cleaned UIC & Sed MH	2
P4_08	5945 NE 11TH AVE	9,339	≥1000	SFR	10102-1886	ADP681	45.56618	-122.65411	31	Sed MH	119	4,914	No	9/29/2007	Cleaned UIC & Sed MH	2
P4_09	8330 SE RAMONA ST	597	<1000	MFR	10102-5352	ADV070	45.48064	-122.57707	35	Sed MH	31	2,968	No	7/22/2001	Cleaned UIC & Sed MH	4
P4_10	11228 SE PINE CT	101	<1000	SFR	10102-8215	ADR960	45.52042	-122.54803	22	Sed MH	110	1,736	No	6/10/2009	Cleaned UIC & Sed MH	1
P4_11	5109 NE 11TH AVE	588	<1000	SFR	10102-3261	ADQ011	45.56013	-122.65457	28	Sed MH	151	7,091	No	12/11/2008	Cleaned UIC & Sed MH	2
P4_12	7315 N DENVER AVE	5,097	≥1000	SFR	10102-2623	ADP211	45.57609	-122.68735	30	Sed MH	72	5,328	No	8/23/2008	Cleaned UIC & Sed MH	5
P4_13	1305 SE CLATSOP ST	2,873	≥1000	MFR	10102-4784	ADU203	45.46078	-122.65276	30	Sed MH	17	2,971	No	5/15/2008	Cleaned UIC & Sed MH	1.7
P4_14	916 NE 153RD AVE	310 [h]	<1000 [h]	SFR	10102-8465	ADR809	45.52956	-122.50518	30.2	Sed MH	116	1,910	No	11/9/2007	Cleaned UIC & Sed MH	4.9
P4_15	5838 NE KILLINGSWORTH ST	10,916	≥1000	SFR	10102-1795	ADQ291	45.56270	-122.60244	30	Sed MH	79	2,692	No	5/14/2008	Cleaned UIC & Sed MH	4

Notes:

a Addresses should not be considered precise location information and are subject to change as City staff better describe the physical UIC locations relative to nearby properties. UIC Street addresses are assigned relative to nearby properties for general locating purposes. Latitude and longitude should be relied upon for accurate locating of UICs.

b COM - commerical; POS = Parks and Open Space; SFR = Single Family Residential; MFR = Multifamily Residential; IND = Industrial

c BES UIC ID number is obtained from the BES Hansen database.

d Sed MH = Sedimentation manhole

e The estimated separation distance is defined as the approximate depth in feet from the bottom-most perforation in the UIC to the approximate seasonal-high groundwater level. The bottom-most perforation is defined as the bottom of the UIC – 2 feet. Two feet were added to all separation distance calculations to account for the standard depth of the sediment trap ring on standard City UIC design. This information is reported to DEQ by the City as "Depth to groundwater" (UIC Database Report) for inclusion in DEQ's UIC database. Reported to nearest foot. Separation distances are based on December 2008 USGS depth to groundwater data (Snyder, D.T., 2008, Estimated depth to ground water and configuration of the water table in the Portland, Oregon area: U.S. Geological Survey Scientific Investigations Report 2008-5095, 40p. (Available at http://pubs.usgs.cov/sir/2008/5059).

f Horizontal distance to nearest groundwater drinking water well (e.g., muncipal, domestic, irrigation).

g Sediment level represents "feet of sediment removed" from UIC as measured prior to cleaning.

h No traffic count available. Value estimated from nearby street(s).

i UIC depth is not reported in Hansen. Therefore, UIC is assumed to be 30-ft based on standard BES UIC design.

Table 3-3: UIC Summary Information – Stationary Panel, Year 4, Panel 6

Location Code	Approximate Address [a]	Estimated Trips per day (TPD)	Predominant Land Use	DEQ UIC ID	BES UIC ID [b]	Latitude	Longitude	UIC Depth (feet)	Pretreatment System	Separation Distance [c]	Date of Last Maintenance	Maintenance Performed	Sediment Level (feet) [d]
P6_1	3500 SE 112th Ave.	25,838	COM	6707	ADW577	45.49676	-122.54801	23	Sed MH[e]	58	04/26/08	Cleaned UIC & Sed MH	5
P6_2 [g]	3740 SE 104th Avenue	2,354	POS	662	ADT394	45.49511	-122.55601	29	Sed MH	62	10/09/07	Cleaned UIC & Sed MH	3
P6_3	4541 NE 80th Ave.	130 [h]	SFR	3192	ADQ337	45.55605	-122.58071	30	Sed MH	80	04/20/07	Raise UIC/sed system to grade (approx.8")	18
P6_4	9090 SE Claybourne St.	393	SFR	5070	ADT961	45.47471	-122.56991	30	Sed MH	12	09/30/00	Cleaned UIC & Sed MH	NA [f]
P6_5	2513 SE 153rd Ave.	36,904	MFR	6590	ADS740	45.5041	-122.50598	30	Sed MH	25	08/05/04	Cleaned UIC & Sed MH	3.1
P6_6 [i]	5201 N. Emerson Dr.	<100 [h]	SFR	3311	ADV395	45.56048	-122.69658	19	No Sed MH	18	01/09/06	Cleaned UIC	6
P6_7 [j]	640 NE 87th Ave.	729	MFR	256	AMU771	45.52784	-122.57361	30	Sed MH	143	04/23/07	Cleaned UIC & Sed MH	12
P6_8	10064 SE Woodstock Blvd.	795	IND	5448	ADV169	45.57613	-122.56014	26	Sed MH	5	03/24/06	Cleaned UIC & Sed MH	2
P6_9	3617 SE 168th Ave.	557	SFR	6117	ADT531	45.49604	-122.48968	30	Sed MH	31	11/24/03	Cleaned UIC & Sed MH	3.2
P6_10 [g]	5502 NE 13th Ave.	12,028	MFR	3074	ADP732	45.56285	-122.65206	31	Sed MH	139	03/18/07	Cleaned UIC & Sed MH	3.3
P6_11	1406 NE Skidmore St.	648	SFR	3605	AAU014	45.5544	-122.65157	30	Sed MH	156	03/07/02	Cleaned UIC & Sed MH	NA
P6_12 [g]	550 SE 130th Ave.	3,536	SFR	7667	ADT061	45.51824	-122.52998	29	Sed MH	82	10/17/05	Cleaned UIC & Sed MH	4.8
P6_13	14350 NE Knott St.	291	SFR	4296	ADW213	45.45245	-122.5143	20	No Sed MH	97	03/25/00	Cleaned UIC	9.6
P6_14	4289 NE Prescott St.	8,100	COM	3510	ADQ252	45.55559	-122.61931	31	Sed MH	155	09/14/07	Cleaned UIC & Sed MH	2
P6_15	13500 NE Glisan St.	19,380	POS	8422	ADR767	45.52646	-122.52461	29	Sed MH	101	03/01/06	Cleaned UIC & Sed MH	5.5

Notes:

a Addresses should not be considered precise location information and are subject to change as City staff better describe the physical UIC locations relative to nearby properties. UIC Street addresses are assigned relative to nearby properties for general locating purposes. Latitude and longitude should be relied upon for accurate locating of UICs.

b The BES UIC number is the node number and is obtained from the BES Hansen database.

c The estimated separation distance is defined as the approximate depth in feet from the bottom-most perforation in the UIC to the approximate seasonal-high groundwater level. The bottom-most perforation is defined as the bottom of the UIC – 2 feet. Two feet were added to all separation distance calculations to account for the standard depth of the sediment trap ring on standard City UIC design. This information is reported to DEQ by the City as "Depth to groundwater" (UIC Database Report) for inclusion in DEQ's UIC database. Reported to the nearest foot. Separation distances are based on April 2007 USGS depth to groundwater data (Snyder, in press).

d Sediment level represents "feet of sediment removed" as measured prior to cleaning.

e Sed MH = Sedimentation manhole

f NA = Information not available

g Indicates UIC was replaced for Year 2 sampling. Three Panel 6 locations were replaced due to reestimation of the traffic category during Year 1 sampling activities. See Section 4.2 of the SAP (August 2006) for additional information.

h No traffic count available. Value estimated from nearby street(s).

i A sedimentation manhole (ANS741) was added to this sump system in November 2007. A second UIC sump (ANS742) was installed between the new sedimentation manhole and the original sump (ADV395). The new sump was installed to a depth of 30 feet. The new sump (ANS742) is designed to overflow into the original sump (ADV395). The sampling point was moved to the new sump after installation.

j UIC (ADV645) was decommissioned and converted to a sedimentation manhole in the summer of 2007. The sedimentation manhole retained the ADV645 label. A new UIC (AMU771) was installed to a total depth of 30 feet. The depth of the former UIC sump (ADV645) prior to conversion was 21 feet. The sedimentation manhole (ADV645) provides pretreatment to the new UIC (AMU771).

TPD = Trips per day MFR = Multifamily residental SFR = Single family residential

IND = Industrial COM = Commercial POS = Parks & open space

Table 3-4: UIC Summary Information - Supplemental Panel 3, Year 4

Location Code	Approximate Address [a]	Estimated Trips per Day (TPD)	Traffic Category (TPD)	Predominant Land Use [b]	DEQ UIC ID	BES UIC ID [c]	Latitude	Longitude	UIC Depth (feet)	Pretreatment System [d]	Separation Distance [e]	Distance to Nearest Well (ft) [f]	Within Two-year Time of Travel from public drinking water well?	Date of Last Maintenance	Maintenance Performed	Sediment Level (ft) [g]
SP3_01	3350 NE 163RD PL	195 [h]	<1000 [h]	SFR	10102-417	AMW360	45.54816	-122.49444	25	Sed MH	16	370	No	12/18/2006	Cleaned UIC & Sed MH	2
SP3_02	5409 NE ALAMEDA ST	2,269	≥1000	MFR	10102-4064	ADN506	45.54228	-122.60742	30	Sed MH	193	400	No	9/21/2005	Cleaned UIC & Sed MH	3
SP3_03	12707 SE MILL ST	1,254	≥1000	SFR	10102-7210	ADS336	45.51023	-122.53234	31	Sed MH	69	93	No	5/28/2008	Cleaned UIC & Sed MH	1.5
SP3_04	14522 SE RACHEL LN	717 [h]	<1000 [h]	SFR	10102-408	AMX627	45.49439	-122.51346	30	Sed MH	30	482	Yes	9/30/2008	Cleaned UIC & Sed MH	0
SP3_05	4644 NE ALBERTA CT	722	<1000	SFR	10102-1790	ADQ234	45.55824	-122.61503	30	Sed MH	139	270	No	6/30/2007	Cleaned UIC & Sed MH	2
SP3_06	490 NE 133RD AVE	19,700	≥1000	SFR	10102-8052	ADS048	45.52618	-122.52604	29.4	Sed MH	97	301	No	5/26/2007	Cleaned UIC & Sed MH	3
SP3_07	13010 SE TESSA ST	3,615	≥1000	MFR	10102-7214	ADS339	45.50535	-122.52968	30	Sed MH	48	155	No	6/5/2009	Cleaned UIC & Sed MH	3
SP3_08	12198 SE HOLGATE BLVD	14,463	≥1000	COM	10102-5882	ADW251	45.48959	-122.53791	21	No Sed MH	8	429	No	2/16/2008	Cleaned UIC	3
SP3_09	2545 SE 89TH AVE	594	<1000	COM	10102-6997	ADU168	45.50375	-122.57173	30	Sed MH	94	267	No	7/13/2008	Cleaned UIC & Sed MH	2.5
SP3_10	13690 NE HANCOCK ST	212	<1000	SFR	10102-8767	ADR375	45.53642	-122.52221	30.5	Sed MH	111	350	No	6/13/2009	Cleaned UIC & Sed MH	2

Notes:

a Addresses should not be considered precise location information and are subject to change as City staff better describe the physical UIC locations relative to nearby properties. UIC Street addresses are assigned relative to nearby properties for general locating purposes. Latitude and longitude should be relied upon for accurate locating of UICs.

b COM - commerical; POS = Parks and Open Space; SFR = Single Family Residential; MFR = Multifamily Residential; IND = Industrial

c BES UIC ID number is obtained from the BES Hansen database.

d Sed MH = Sedimentation manhole

e The estimated separation distance is defined as the approximate depth in feet from the bottom-most perforation in the UIC to the approximate seasonal-high groundwater level. The bottom-most perforation is defined as the bottom of the UIC – 2 feet. Two feet were added to all separation distance calculations to account for the standard depth of the sediment trap ring on standard City UIC design. This information is reported to DEQ by the City as "Depth to groundwater" (UIC Database Report) for inclusion in DEQ's UIC database. Reported to nearest foot. Separation distances are based on December 2008 USGS depth to groundwater data (Snyder, D.T., 2008, Esitimated depth to ground water and configuration of the water table in the Portland, Oregon area: U.S. Geological Survey Scientific Investigations Report 2008-5095, 40p. (Available at http://pubs.usgs.cov/sir/2008/5059)).

f Horizontal distance to nearest groundwater drinking water well (e.g., muncipal, domestic, irrigation).

g Sediment level represents "feet of sediment removed" from UIC as measured prior to cleaning.

h No traffic count available. Value estimated from nearby street(s).

Table 4-1: UIC Stormwater Analytes

Common Pollutants	Benzene Toluene Ethylbenzene Xylenes[2]	Pentachlorophenol Di(2-ethylhexyl)phthalate[1] Benzo(a)pyrene	Arsenic (Total) Cadmium (Total) Chromium (Total) Copper (Total) Lead (Total) Zinc (Total) Nitrate-nitrogen
Priority Pollutant Screen	Antimony (Total) Barium (Total) Beryllium (Total) Cyanide (Total) Mercury (inorganic) Selenium Thallium	Alachlor Atrazine Carbofuran **Carbon Tetrachloride** Chlordane **Chlorobenzene** **2,4-D** Dalapon **o-Dichlorobenzene[3]** **p-Dichlorobenzene[4]** **1,3-Dichlorobenzene**	Bis(2-chloroisopropyl)ether Bis(2-chloroethyl)ether **Dinoseb** Diqat Endothall Glyphosate Lindane **Picloram** **1,2,4-Trichlorobenzene**

Notes:
[1] Di(2-ethylhexyl)phthalate is also known as bis(2-ethylhexyl)phthalate or DEHP.
[2] Xylenes is equal to o-xylene + m,p-xylene.
[3] o-Dichlorobenzene is also known as 1,2-dichlorobenzene.
[4] p-Dichlorobenzene is also known as 1,4-dichlorobenzene.
Bold indicates PPS analytes analyzed during Year 4 as part of routine common pollutant testing and reporting.

Table 4-2: Stormwater Quality Analytes – Common Pollutant Analyses

Analyte	Analytical Laboratory	Method	Method Detection Limit	Method Reporting Limit	MADL
Benzene	WPCL[1]	EPA 8260B	0.04 µg/L [7]	0.2 µg/L	5.0 µg/L
Toluene	WPCL	EPA 8260B	0.04 µg/L [7]	0.5 µg/L [a]	1,000 µg/L
Ethylbenzene	WPCL	EPA 8260B	0.05 µg/L [7]	0.5 µg/L	700 µg/L
Xylenes	WPCL	EPA 8260B	0.12 µg/L [7]	1.0 µg/L	10,000 µg/L
Pentachlorophenol	TA[2]	EPA 515.3[3]	0.014 µg/L [7]	0.04 µg/L	1.0 µg/L
Di(2-ethylhexyl) phthalate	TA	EPA 8270-SIM[4]	0.5 µg/L [7]	1.0 µg/L [7]	6.0 µg/L
Benzo(a)pyrene	TA	EPA 8270-SIM[4]	0.01 µg/L	0.01 µg/L	0.2 µg/L
Total Arsenic	WPCL	EPA 200.8[5]	0.00134 µg/L	0.045 µg/L	10.0 µg/L
Total Cadmium	WPCL	EPA 200.8[5]	0.00078 µg/L	0.1 µg/L	5.0 µg/L
Total Chromium	WPCL	EPA 200.8[5]	0.00963 µg/L	0.4 µg/L	100 µg/L
Total Copper	WPCL	EPA 200.8[5]	0.00179 µg/L	0.2 µg/L	1300 µg/L
Total Lead	WPCL	EPA 200.8[5]	0.00045 µg/L	0.1 µg/L	50.0 µg/L
Total Zinc	WPCL	EPA 200.8[5]	0.00424 µg/L	0.5 µg/L	5000 µg/L
Nitrate-Nitrogen	WPCL	EPA 300.0[6]	0.0041 mg/L	0.1 mg/L	10 mg/L

Notes:

[a] Values are corrected from QAPP –Table 5-1.

[1] WPCL indicates BES Water Pollution Control Laboratory.

[2] TA indicates Test America. (North Creek Analytical, identified in the SDMP, was acquired by Test America in early 2006).

[3] Preparation: Adjust pH of a 40 milliliter sample to 12 with sodium hydroxide. Let stand for 1 hour. Acidify the sample with sulfuric acid and extract with MTBE. Derivitize the sample with diazomethane. Remove the diazomethane with nitrogen. Analyze the extract using GC/ECD.

[4] Preparation: Sample is extracted with DCM and taken to final volume. The extract is analyzed using GC/MS.

[5] Preparation: hot block digestion.

[6] Preparation: sample filtered by WPCL using a 0.45 micron filter.

[7] Method and/or limits changed from QAPP, see PY 4 Data Usability Report in Appendix B.

Table 4-3: Stormwater Quality Analytes – Priority Pollutant Screen Analyses

Analyte	Analytical Laboratory	Method	Method Detection Limit	Method Reporting Limit	MADL
Total Antimony	WPCL[1]	EPA 200.8[2]	0.00111 µg/L	0.1 µg/L	6.0 µg/L
Total Barium	WPCL	EPA 200.8[2]	0.00575 µg/L	0.1 µg/L	2000 µg/L
Total Beryllium	WPCL	EPA 200.8[2]	0.00210 µg/L	0.1 µg/L	4.0 µg/L
Total Selenium	WPCL	EPA 200.8[2]	0.0127 µg/L	0.5 µg/L	50.0 µg/L
Total Thallium	WPCL	EPA 200.8[2]	0.00099 µg/L	0.1 µg/L	2.0 µg/L
Total (inorganic) Mercury	WPCL	WPCL SOP M-10.02[4]	0.0009 µg/L	0.002 µg/L [5]	2.0 µg/L
Total Cyanide	WPCL	SM 4500-CN-E[5]	0.01 mg/L	0.01 mg/L	0.2 mg/L
Alachlor	TA[3]	EPA 8270C	0.01 µg/L [5]	0.5 µg/L [5]	2.0 µg/L
Atrazine	TA	EPA 8270C	0.2 µg/L [5]	0.5 µg/L [5]	3.0 µg/L
Carbofuran	TA	EPA 531.1[5]	0.026 µg/L [5]	0.9 µg/L [5]	40.0 µg/L
Carbon Tetrachloride*	WPCL	EPA 8260B	0.05 µg/LL [5]	0.2 µg/L	5.0 µg/L
Chlordane (tech)	TA	EPA 8081	0.5 µg/L	1.0 µg/L	2.0 µg/L
Chlorobenzene*	WPCL	EPA 8260B	0.05 µg/L [5]	0.2 µg/L	100 µg/L
2,4-D*	TA	EPA 515.3	0.05 µg/L	0.1 µg/L	70.0 µg/L
Dalapon	TA	EPA 552.2	0.36 µg/L [5]	1.0 µg/L	200 µg/L
o-Dichlorobenzene*	WPCL	EPA 8260B	0.06 µg/L [5]	0.5 µg/L [5]	600 µg/L
p-Dichlorobenzene*	WPCL	EPA 8260B	0.06 µg/L [5]	0.5 µg/L [5]	75.0 µg/L
1,3-Dichlorobenzene*	WPCL	EPA 8260B	0.04 µg/L [5]	0.5 µg/L [5]	5.5 µg/L
Bis(2-chloroisopropyl) ether	TA	EPA 8270C	0.1 µg/L [5]	0.5 µg/L [5]	0.80 µg/L
Bis(2-chloroethyl) ether	TA	EPA 8270C	0.1 µg/L [5]	0.5 µg/L [5]	0.30 µg/L
Dinoseb*	TA	EPA 515.3	0.08 µg/L [5]	0.1 µg/L	7.0 µg/L
Diquat	TA	EPA 549.2	0.37 µg/L [5]	0.4 µg/L	20.0 µg/L
Endothall	TA	EPA 548.1	2.0 µg/L [5]	9.0 µg/L [5]	100 µg/L
Glyphosate	TA	EPA 547	1.2 µg/L [5]	6.0 µg/L [5]	700 µg/L
Lindane	TA	EPA 8081	0.05 µg/L	0.1 µg/L	0.2 µg/L
Picloram*	TA	EPA 515.3	0.08 µg/L [5]	0.4 µg/L	500 µg/L
1,2,4-Trichlorobenzene*	WPCL	EPA 8260B	0.04 µg/L [5]	0.5 µg/L [5]	70.0 µg/L

Notes:

* Indicates PPS pollutants analyzed during Year 4 as part of routine common pollutant testing and reporting.

[1] WPCL indicates BES Water Pollution Control Laboratory.

[2] Preparation: hot block digestion.

[3] TA indicates Test America. (North Creek Analytical, identified in the SDMP, was acquired by Test America in early 2006).

[4] Preparation: WPCL SOP M-05.01; Analysis performed under alternative test procedure as described in PY 4 Data Usability Report in Appendix B.

[5] Method and/or limits changed from QAPP, see PY 4 Data Usability Report in Appendix B.

Table 5-1: City of Portland HYDRA Rain Gage [1] Data Year 4, Event 1

Date	Hours																							Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
9/29/2008	[2]																								0.00
9/30/2008																									0.00
10/1/2008																									0.00
10/2/2008								0.01										0.02	0.01						0.05 [3]
10/3/2008		0.01					0.02			0.02			0.04	0.04	0.01	0.02	0.03	0.05	0.09	0.05	0.02	0.01			0.42
10/4/2008		0.01	0.02	0.1	0.07	0.08	0.01						0.04		0.01				0.02						0.38
10/5/2008										0.02	0.02	0.02	0.02			0.01	0.01	0.01		0.01					0.12
10/6/2008					0.01																	0.05	0.03	0.04	0.15
10/7/2008	0.03	0.01							0.01			0.01	0.05												0.10
10/8/2008																									0.00
10/9/2008														0.02	0.03	0.04	0.04		0.01		0.01	0.01			0.15
10/10/2008																									0.00
10/11/2008																									0.00
10/12/2008																									0.00
10/13/2008																									0.00
10/14/2008																									0.00
10/15/2008																								0.01	0.01
10/16/2008																									0.00
10/17/2008																									0.00
10/18/2008				0.01																					0.02
10/19/2008																									0.00
10/20/2008								0.01	0.1	0.01			0.02									0.01			0.15
10/21/2008																									0.00
10/22/2008																									0.01
10/23/2008																									0.00
10/24/2008																									0.00
10/25/2008																									0.00
10/26/2008																									0.00
10/27/2008																									0.00
10/28/2008																									0.00
10/29/2008																									0.00
10/30/2008																									0.00
10/31/2008							0.04	0.05	0.02	0.04	0.02	0.01													0.19
11/1/2008												0.02	0.02				0.02					0.09	0.01		0.18
11/2/2008	0.09	0.01		0.01	0.03	0.04						0.02													0.20
11/3/2008		0.01	0.03	0.09	0.02	0.01										0.01	0.04	0.06	0.09	0.11	0.09	0.05	0.04	0.1	0.77

Notes:

Sample Collection Period

[1] Average of 13 rain gages in N, NE, and SE Portland, reported in inches

[2] Blank cells indicate less than one rain gage bucket tip per hour. One bucket tip = 0.01 inches of rainfall.

[3] Gage data for each hour has been reported to the nearest hundredth of an inch. Daily totals may not reflect the sum of hourly data due to rounding.

Table 5-10: Summary [1] of Non-Detect Priority Pollutant Screen Analytes - Year 4

Analyte	MADL (µg/L)	Event	MRL Exceeds MADL	Number of Non-Detections	Number of Samples	Minimum MRL (µg/L)	Maximum MRL (µg/L)
Priority Pollutant Screen [2,3]							
Selenium	50.0	1	0	25	25 [4]	0.5	0.5
Thallium	2.0	1	0	25	25	0.1	0.1
Dinoseb	7.0	1	0	40	40 [4]	0.1	0.1
		2	0	40	40	0.1	0.1
		3	0	40	40	0.1	0.4
		4	0	40	40	0.1	0.4
		5	0	40	40	0.1	0.4
Picloram	500	1	0	40	40	0.4	0.4
		2	0	40	40	0.4	0.4
		3	0	40	40	0.4	1.6
		4	0	40	40	0.4	1.6
		5	0	40	40	0.4	1.6
Carbofuran	40.0	1	0	25	25	0.9	0.9
Endothall	100.0	1	0	25	25	9	9
Diquat	20.0	1	0	25	25	0.4	1.2
Dalapon	200.0	1	0	25	25	1	1
Chlordane (alpha)	NA	1	NA	25	25	0.0952	0.105
Chlordane (gamma)	NA	1	NA	25	25	0.0952	0.105
Chlordane (tech)	2.0	1	0	25	25	0.952	1.05
Gamma-BHC(Lindane)	0.2	1	0	25	25	0.0952	0.105
1,2,4-Trichlorobenzene	70.0	1	0	40	40	0.5	0.5
		2	0	40	40	0.5	0.5
		3	0	40	40	0.5	0.5
		4	0	40	40	0.5	0.5
		5	0	40	40	0.5	0.5
1,3-Dichlorobenzene	5.5	1	0	40	40	0.5	0.5
		2	0	40	40	0.5	0.5
		3	0	40	40	0.5	0.5
		4	0	40	40	0.5	0.5
		5	0	40	40	0.5	0.5
Carbon tetrachloride	5.0	1	0	40	40	0.2	0.2
		2	0	40	40	0.2	0.2
		3	0	40	40	0.2	0.2
		4	0	40	40	0.2	0.2
		5	0	40	40	0.2	0.2

Table 5-10: Summary [1] of Non-Detect Priority Pollutant Screen Analytes - Year 4

Analyte	MADL (µg/L)	Event	MRL Exceeds MADL	Number of Non-Detections	Number of Samples	Minimum MRL (µg/L)	Maximum MRL (µg/L)
Chlorobenzene	100	1	0	40	40	0.2	0.2
		2	0	40	40	0.2	0.2
		3	0	40	40	0.2	0.2
		4	0	40	40	0.2	0.2
		5	0	40	40	0.2	0.2
o-Dichlorobenzene [5]	600	1	0	40	40	0.5	0.5
		2	0	40	40	0.5	0.5
		3	0	40	40	0.5	0.5
		4	0	40	40	0.5	0.5
		5	0	40	40	0.5	0.5
p-Dichlorobenzene [6]	75.0	1	0	40	40	0.5	0.5
		2	0	40	40	0.5	0.5
		3	0	40	40	0.5	0.5
		4	0	40	40	0.5	0.5
		5	0	40	40	0.5	0.5
Alachlor	2.0	1	1 (0) [7]	25	25	0.49	5
Atrazine	3.0	1	1 (0) [7]	25	25	0.49	5
Bis(2-chloroethyl) ether	0.3	1	25 (1) [7]	25	25	0.49 (0.097) [7]	5
Bis(2-chloroisopropyl) ether	0.8	1	4 (1) [7]	25	25	0.49 (0.2) [7]	5
Cyanide (total)	0.2	1	0	25	25	0.01	0.01

Notes:

[1] This table summarizes the results of the original UIC stormwater samples for each event. This table includes the results of Panel 4, Panel 6, and Supplemental Panel No. 3. This table does not include the results of duplicate samples or laboratory reanalyses.

[2] Table 5-9 provides a summary of common pollutants and PPS analytes detected in Year 4.

[3] Table 4-3 provides a complete list of PPS analytes. PPS analytes are those detected by analytical methods used for the required common pollutant monitoring. Full PPS testing is required by the WPCF permit in Years 1, 4, and 9.

[4] PPS analytes are monitored at Panel 4 and Supplemental Panel 3 UIC locations. Where PPS analytes are detected by common pollutant analytical methods, they are also measured for Panel 6 UIC locations.

[5] o-Dichlorobenzene is also known as 1,2-dichlorobenzene.

[6] p-Dichlorobenzene is also known as 1,4-dichlorobenzene.

[7] MDLs were used where MRLs exceeded MADLs. Number in parentheses indicates MDL or number of MDL exceedences of the MADL.

Table 5-11: Summary of Frequency of Detection for Common Pollutants and Priority Pollutant Screen Analytes[1] – Year 4

> 75 %	> 50 - 75 %	≤ 50 %
Common Pollutants		
Arsenic (100%)	**B(a)P** (22.5 – 57.5 %) [2]	Benzene (0-2.5%) [3]
Chromium (77.5 - 95%)	Cadmium (35 – 52.5%)	Ethylbenzene (0-2.5%)
Copper (100%)	Toluene (42.5 – 70%)	Total Nitrogen (15 - 45%)
DEHP (27.5 – 82.5%)		Xylenes (0 – 2.5%)[2]
Lead (100%)		
Pentachlorophenol (75 – 92.5%)		
Zinc (100%)		
Priority Pollutants		
Antimony (96-100%)	2,4-D (2.5-55%)	Beryllium (0-50%)
Barium (100%)		Glyphosate (0-4%)
Mercury (96-100%)		

Notes:

[1] This table summarizes the results of the original UIC stormwater samples for each event. This table includes the results of Panel 4, Panel 6, and Supplemental Panel No. 3 for common pollutants, and Panel 4 and Supplemental Panel No. 3 for the PPS pollutants, except where PPS pollutants are detected by analytical methods used for the required common pollutant monitoring (i.e., 2,4-D). This table does not include the results of duplicate samples or laboratory reanalyses.

[2] Bolded values exceed MADL in at least one sampling event (see Section 7.1).

[3] Pollutants are grouped by the maximum frequency of detection observed during the five sampling events. The range of frequency of detection is shown in parentheses. A value of zero indicates the pollutant was not detected.

Table 5-12: Summary of Detected Ancillary Pollutants [1] - Year 4

Analyte	Method	Event	Number of Detections	Number of Samples	Frequency of Detection (%)	Minimum Concentration [2] (µg/L)	Maximum Concentration (µg/L)
Ancillary Pollutants Detected by Required Analyses							
Dicamba	EPA 515.3	1	0	40	0	< 0.2 [3]	< 0.2
		2	1	40	2.5	< 0.2	0.25
		3	0	40	0	< 0.2	< 0.8
		4	0	40	0	< 0.2	< 0.8
		5	1	40	2.5	< 0.2	< 0.8
1,2,4-Trimethylbenzene	EPA 8260	1	0	40	0	< 0.5	< 0.5
		2	1	40	2.5	< 0.5	4.99
		3	0	40	0	< 0.5	< 0.5
		4	1	40	2.5	< 0.5	13.2
		5	0	40	0	< 0.5	< 0.5
1,3,5-Trimethylbenzene	EPA 8260	1	0	40	0	< 0.5	< 0.5
		2	1	40	2.5	< 0.5	1.11
		3	0	40	0	< 0.5	< 0.5
		4	1	40	2.5	< 0.5	3.57
		5	0	40	0	< 0.5	< 0.5
2-Butanone	EPA 8260	1	1	40	2.5	< 5	7.2
		2	0	40	0	< 5	< 5
		3	1	40	2.5	< 5	14.6
		4	0	40	0	< 5	< 5
		5	0	40	0	< 5	< 5
2-Chlorotoluene	EPA 8260	1	0	40	0	< 0.5	< 0.5
		2	0	40	0	< 0.5	< 0.5
		3	0	40	0	< 0.5	< 0.5
		4	1	40	2.5	< 0.5	1.29
		5	0	40	0	< 0.5	< 0.5
4-Isopropyltoluene	EPA 8260	1	6	40	15	< 0.5	2.65
		2	2	40	5	< 0.5	0.69
		3	2	40	5	< 0.5	0.74
		4	1	40	2.5	< 0.5	0.77
		5	0	40	0	< 0.5	< 0.5
Acetone	EPA 8260	1	2	40	5	< 20	21.3
		2	0	40	0	< 20	< 20
		3	2	40	5	< 20	20.8
		4	0	40	0	< 20	< 20
		5	0	40	0	< 20	< 20
Chloroform	EPA 8260	1	1	40	2.5	< 0.2	0.25
		2	0	40	0	< 0.2	< 0.2
		3	0	40	0	< 0.2	< 0.2
		4	0	40	0	< 0.2	< 0.2
		5	0	40	0	< 0.2	< 0.2
n-Propylbenzene	EPA 8260	1	0	40	0	< 0.5	< 0.5
		2	0	40	0	< 0.5	< 0.5
		3	0	40	0	< 0.5	< 0.5
		4	1	40	2.5	< 0.5	0.74
		5	0	40	0	< 0.5	< 0.5
3-,4-Methylphenol	EPA 8270	1	1	25 [4]	4	< 4.9	< 50
Benzyl alcohol	EPA 8270	1	1	25 [4]	4	< 9.7	< 100

Table 5-12: Summary of Detected Ancillary Pollutants [1] - Year 4

Analyte	Method	Event	Number of Detections	Number of Samples	Frequency of Detection (%)	Minimum Concentration [2] (µg/L)	Maximum Concentration (µg/L)
Acenaphthylene	EPA 8270M-SIM	1	11	40	27.5	< 0.0192	< 0.08
		2	8	40	20	< 0.0192	0.1
		3	6	40	15	< 0.0192	< 0.0784
		4	3	40	7.5	< 0.0192	< 0.0444
		5	2	40	5	< 0.019	< 0.0388
Anthracene	EPA 8270M-SIM	1	1	40	2.5	< 0.0192	< 0.118
		2	0	40	0	< 0.0192	< 0.136
		3	4	40	10	< 0.0192	< 0.0784
		4	1	40	2.5	< 0.0192	< 0.0444
		5	0	40	0	< 0.019	< 0.0388
Benzo(a)anthracene	EPA 8270M-SIM	1	13	40	32.5	< 0.00962	0.0675
		2	11	40	27.5	< 0.00962	0.0493
		3	20	40	50	< 0.00962	0.216
		4	22	40	55	< 0.00962	0.0737
		5	13	40	32.5	< 0.00952	0.0414
Benzo(b)fluoranthene	EPA 8270M-SIM	1	14	40	35	< 0.00962	0.0906
		2	13	40	32.5	< 0.00962	0.0608
		3	22	40	55	< 0.00962	0.355
		4	32	40	80	< 0.00962	0.123
		5	19	40	47.5	< 0.00952	0.0536
Benzo(ghi)perylene	EPA 8270M-SIM	1	9	40	22.5	< 0.0192	0.138
		2	10	40	25	< 0.0192	0.0897
		3	20	40	50	< 0.0192	0.327
		4	24	40	60	< 0.0192	0.158
		5	18	40	45	< 0.019	0.0921
Benzo(k)fluoranthene	EPA 8270M-SIM	1	8	40	20	< 0.00962	0.0567
		2	9	40	22.5	< 0.00962	< 0.0686
		3	20	40	50	< 0.00962	0.205
		4	25	40	62.5	< 0.00962	0.237
		5	12	40	30	< 0.00952	0.0389
Chrysene	EPA 8270M-SIM	1	29	40	72.5	< 0.00962	0.164
		2	25	40	62.5	< 0.00962	0.123
		3	37	40	92.5	0.01	0.521
		4	37	40	92.5	< 0.0098	0.188
		5	28	40	70	< 0.00962	0.105
Di-n-octyl phthalate	EPA 8270M-SIM	1	0	40	0	< 0.962	< 1
		2	0	40	0	< 0.962	< 2.91
		3	0	40	0	< 0.962	< 20.8
		4	2	40	5	< 0.962	< 3.85
		5	5	40	12.5	< 0.952	2.35
Dibenzo(a,h)anthracene	EPA 8270M-SIM	1	2	40	5	< 0.00962	0.0611
		2	2	40	5	< 0.00962	< 0.0388
		3	8	40	20	< 0.00962	0.0733
		4	11	40	27.5	< 0.00962	0.0376
		5	4	40	10	< 0.00952	< 0.0194
Diethyl phthalate	EPA 8270M-SIM	1	1	40	2.5	< 0.962	1.09
		2	0	40	0	< 0.962	< 1
		3	0	40	0	< 0.962	< 2.97
		4	0	40	0	< 0.962	< 3.85
		5	1	40	2.5	< 0.952	1.87

Table 5-12: Summary of Detected Ancillary Pollutants [1] - Year 4

Analyte	Method	Event	Number of Detections	Number of Samples	Frequency of Detection (%)	Minimum Concentration [2] (µg/L)	Maximum Concentration (µg/L)
Dimethyl phthalate	EPA 8270M-SIM	1	6	40	15	< 0.962	3.58
		2	0	40	0	< 0.962	< 1
		3	1	40	2.5	< 0.962	< 2.97
		4	1	40	2.5	< 0.962	< 3.85
		5	1	40	2.5	< 0.952	< 1
Fluoranthene	EPA 8270M-SIM	1	14	40	35	< 0.0192	0.192
		2	21	40	52.5	< 0.0192	0.206
		3	31	40	77.5	< 0.0192	1.44
		4	33	40	82.5	< 0.0194	0.365
		5	19	40	47.5	< 0.019	0.193
Fluorene	EPA 8270M-SIM	1	3	40	7.5	< 0.0192	< 0.08
		2	2	40	5	< 0.0192	< 0.0583
		3	7	40	17.5	< 0.0192	< 0.0784
		4	4	40	10	< 0.0192	< 0.0444
		5	1	40	2.5	< 0.019	0.0495
Indeno(1,2,3-cd)pyrene	EPA 8270M-SIM	1	11	40	27.5	< 0.00962	0.0805
		2	10	40	25	< 0.00962	0.0414
		3	20	40	50	< 0.00962	0.183
		4	22	40	55	< 0.00962	0.0592
		5	12	40	30	< 0.00952	0.0402
Naphthalene	EPA 8270M-SIM	1	26	40	65	< 0.0192	0.186
		2	13	40	32.5	< 0.0192	2.24
		3	29	40	72.5	< 0.0192	0.142
		4	27	40	67.5	< 0.0192	0.235
		5	18	40	45	< 0.019	0.267
Phenanthrene	EPA 8270M-SIM	1	21	40	52.5	< 0.0192	0.122
		2	22	40	55	< 0.0192	< 0.136
		3	37	40	92.5	0.0205	0.643
		4	37	40	92.5	< 0.0196	0.206
		5	25	40	62.5	< 0.019	0.147
Pyrene	EPA 8270M-SIM	1	22	40	55	< 0.0192	0.209
		2	24	40	60	< 0.0192	0.137
		3	30	40	75	< 0.0192	0.463
		4	34	40	85	< 0.0194	0.269
		5	32	40	80	< 0.0194	0.225

Notes:

[1] This table summarizes the results of the original UIC stormwater samples for each event. This table includes the results of Panel 4, Panel 6, and Supplemental Panel No. 3. This table does not include the results of duplicate samples or laboratory reanalyses.

[2] Concentrations reported with a minimum and maximum concentration range of <x to <y may indicate all concentrations were below MRLs or may indicate a concentration is below the maximum MRL. See Appendix F, Table F-3, for actual values.

[3] "<" Indicates laboratory reporting limit.

[4] 3-,4-Methylphenol and Benzyl alcohol were sampled 25 times because they are ancillary pollutants associated with priority pollutants that were not detected in the first storm event.

Table 5-13: Summary of Frequency of Detection for Ancillary Pollutants[1] – Year 4

Analyte	Frequency of Detection[2] (%)	Maximum Individual Sampling Event Frequency of Detection				
		>75%	>50 - ≤75%	>25 - ≤50%	>10 - ≤25%	≤10%
Ancillary Pollutants Detected by Required Analyses						
1,2,4-Trimethylbenzene	0-2.5% [3]					x
1,3,5 -Trimethylbenzene	0-2.5%					x
2-Butanone	0-2.5%					x
2-Chlorotoluene	0-2.5%					x
3,4 - Methylphenol	4%					x
4-Isopropyltoluene	0-15%				x	
Acenaphthylene	5-27.5%			x		
Acetone	0-5%					x
Anthracene	0-10%					x
Benzo(a)anthracene	27.5-55%		x			
Benzo(b)fluoranthene	32.5-80%	x				
Benzo(ghi)perylene	22.5-60%		x			
Benzo(k)fluoranthene	20-62.5%		x			
Benzyl alcohol	4%					x
Chloroform	0-2.5%					x
Chrysene	62.5-92.5%	x				
Dibenzo(a,h)anthracene	5-27.5%			x		
Dicamba	0-2.5%					x
Diethyl phthalate	0-2.5%					x
Dimethyl phthalate	0-15%				x	
Di-n-octyl phthalate	0-12.5%				x	
Fluoranthene	35-82.5%	x				
Fluorene	2.5-17.5%				x	
Indeno(1,2,3-cd) pyrene	25-55%		x			
Naphthalene	32.5-72.5%		x			
n-Propylbenzene	0-2.5%					x
Phenanthrene	52.5-92.5%	x				
Pyrene	55-85%	x				

Notes:

[1] This table summarizes the results of the original UIC stormwater samples for each event. This table includes the results of Panel 4, Panel 6, and Supplemental Panel No. 3. This table does not include the results of duplicate samples or laboratory reanalyses.

[2] Range of frequency of detections for individual sampling events

[3] "0" Indicates concentrations less than laboratory reporting limit.

Table 5-14: Summary of Total and Dissolved Metal Results - Year 4

Metal	MADL (ug/L)	Traffic Category (TPD)	Number of Samples	Number of Detections	Total (ug/L) Average [1] (ug/L)	Geometric Mean [1] (ug/L)	Minimum (ug/L)	Maximum	Ratio of Dissolved Average/Total Average	
Common Pollutants										
Arsenic (total)	10.0	<1000	100	100	0.41	0.33	0.06	1.42		
		≥1000	95	95	0.60	0.46	0.06	2.06	<1000	39%
Arsenic (dissolved)	NA	<1000	13	13	0.16	0.14	0.08	0.33	>1000	33%
		≥1000	12	12	0.20	0.17	0.09	0.51		
Cadmium (total)	5.0	<1000	100	24	0.12	0.11	< 0.1	0.69		
		≥1000	95	60	0.19	0.16	< 0.1	0.75	<1000	87%
Cadmium (dissolved)	NA	<1000	13	2	0.11	0.11	< 0.1	0.19	>1000	53%
		≥1000	12	1	0.10	0.10	< 0.1	0.12		
Chromium (total)	100	<1000	100	80	1.45	0.94	< 0.4	9.6		
		≥1000	95	90	3.07	1.94	0.33	16.9	<1000	49%
Chromium (dissolved)	NA	<1000	13	6	0.71	0.56	< 0.4	3.09	>1000	17%
		≥1000	12	5	0.51	0.49	< 0.4	1.11		
Copper (total)	1300	<1000	100	100	7.01	5.41	1.46	60.2		
		≥1000	95	95	16.17	12.42	2.69	64.1	<1000	44%
Copper (dissolved)	NA	<1000	100	100	3.05	2.48	0.79	13.9	>1000	32%
		≥1000	95	95	5.10	4.35	0.418	12.7		
Lead (total)	50.0	<1000	100	100	4.78	2.37	0.18	62.6		
		≥1000	95	95	15.56	8.26	0.67	129	<1000	7%
Lead (dissolved)	NA	<1000	100	65	0.35	0.21	< 0.1	2.91	>1000	4%
		≥1000	95	92	0.61	0.40	< 0.1	5.96		
Zinc (total)	5000	<1000	100	100	35.99	23.90	3.39	256		
		≥1000	95	95	87.83	62.59	12.9	419	<1000	42%
Zinc (dissolved)	NA	<1000	100	100	15.23	10.98	1.66	62.2	>1000	29%
		≥1000	95	95	25.63	21.93	4.82	68.6		

Table 5-14: Summary of Total and Dissolved Metal Results - Year 4

Metal	MADL (ug/L)	Traffic Category (TPD)	Number of Samples	Number of Detections	Total (ug/L) Average [1] (ug/L)	Geometric Mean [1] (ug/L)	Minimum (ug/L)	Maximum	Ratio of Dissolved Average/Total Average	
Priority Pollutant Screen										
Antimony (total)	6.0	<1000	65	64	0.48	0.40	< 0.1	2.3		
		≥1000	60	60	1.30	0.93	0.22	5.41	<1000	58%
Antimony (dissolved)	NA	<1000	65	59	0.28	0.24	< 0.1	0.74	>1000	45%
		≥1000	60	60	0.58	0.47	0.11	1.81		
Barium (total)	2000.0	<1000	65	65	21.97	16.00	4.13	171		
		≥1000	60	60	41.98	30.08	9.84	169	<1000	48%
Barium (dissolved)	NA	<1000	65	65	10.65	7.44	1.99	77.2	>1000	32%
		≥1000	60	60	13.33	11.03	3.43	40.8		
Beryllium (total)	4.0	<1000	17	1	0.11	0.10	< 0.1	0.21		
		≥1000	16	2	0.11	0.11	< 0.1	0.26	<1000	94%
Beryllium (dissolved)	NA	<1000	17	0	0.10	0.10	< 0.1	< 0.1	>1000	88%
		≥1000	16	0	0.10	0.10	< 0.1	< 0.1		
Selenium (total)	50.0	<1000	13	0	0.50	0.50	< 0.5	< 0.5		
		≥1000	12	0	0.50	0.50	< 0.5	< 0.5	<1000	100%
Selenium (dissolved)	NA	<1000	13	0	0.50	0.50	< 0.5	< 0.5	>1000	100%
		≥1000	12	0	0.50	0.50	< 0.5	< 0.5		
Thallium (total)	2.0	<1000	13	0	0.10	0.10	< 0.1	< 0.1		
		≥1000	12	0	0.10	0.10	< 0.1	< 0.1	<1000	100%
Thallium (dissolved)	NA	<1000	13	0	0.10	0.10	< 0.1	< 0.1	>1000	100%
		≥1000	12	0	0.10	0.10	< 0.1	< 0.1		

Note:

[1] All data were used in calculation of the mean and geometric mean. No outliers were omitted. Values reported at <MRL were included at 50% of the MRL for estimation of the mean and geometric mean. Duplicate sample results were not included.

Table 5-15: Summary of Total Suspended Solids (TSS) Results [1] - Year 4

	Number of Samples	Total (mg/L)			
		Average	Geometric Mean	Minimum	Maximum
<1,000 Trips per Day (TPD)					
TSS	105	31	17	2	562
≥ 1,000 TPD					
TSS	95	75	42	4	450

Note:

[1] This table summarizes the results of the original UIC stormwater samples for each event. This table includes the results of Panel 4, Panel 6, and Supplemental Panel No. 3. This table does not include the results of duplicate samples or laboratory reanalyses.

Table 5-2: City of Portland HYDRA Rain Gage [1] Data Year 4, Event 2

Date	Hours																							Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
11/8/2008	0.01	[2]		0.01						0.03	0.05	0.07	0.01												0.2 [3]
11/9/2008						0.01																			0.02
11/10/2008							0.01	0.04	0.02																0.07
11/11/2008		0.01	0.06	0.06	0.09	0.05	0.05	0.04	0.01								0.04	0.04	0.04	0.07	0.03				0.58
11/12/2008					0.01	0.01	0.02	0.06	0.04	0.01	0.01	0.05	0.02	0.03	0.08	0.11	0.16	0.18	0.1	0.06	0.06	0.1	0.01		1.11
11/13/2008					0.01																				0.01
11/14/2008																									0.00
11/15/2008																									0.00
11/16/2008																									0.00
11/17/2008																									0.00
11/18/2008																									0.00
11/19/2008																									0.00
11/20/2008							0.01	0.11	0.08	0.04	0.04	0.04	0.01	0.08		0.01	0.03	0.03							0.49
11/21/2008																				0.02	0.01	0.01	0.01		0.06
11/22/2008																									0.00
11/23/2008																									0.00
11/24/2008																									0.00
11/25/2008												0.01	0.03	0.04	0.01										0.09
11/26/2008																									0.00
11/27/2008													0.01	0.02	0.02				0.01	0.01	0.01		0.01		0.08
11/28/2008																									0.01
11/29/2008																									0.01
11/30/2008																									0.00
12/1/2008																	0.01	0.01	0.01	0.01	0.07			0.05	0.16
12/2/2008	0.03	0.05	0.03																						0.11
12/3/2008																									0.00
12/4/2008																									0.01
12/5/2008																									0.00
12/6/2008																									0.00
12/7/2008													0.09	0.09	0.01										0.20
12/8/2008																									0.01
12/9/2008																									0.00
12/10/2008																									0.00
12/11/2008																									0.00
12/12/2008											0.05	0.1	0.01	0.04		0.04	0.03	0.06	0.01	0.01	0.01	0.01		0.01	0.37
12/13/2008										0.01	0.02			0.01		0.02	0.01								0.09
12/14/2008																									0.00
12/15/2008																									0.00
12/16/2008																									0.00
12/17/2008													0.02	0.02	0.02	0.01	0.02	0.04	0.03	0.01	0.01		0.01	0.01	0.22
12/18/2008						0.01				0.01	0.03	0.05	0.01												0.13
12/19/2008											0.01	0.01													0.02
12/20/2008																									0.00
12/21/2008																									0.00
12/22/2008																									0.00
12/23/2008														0.01	0.01										0.02
12/24/2008													0.03	0.07	0.08	0.18	0.07	0.03	0.02	0.04	0.05	0.02	0.01	0.01	0.62

12/25/2008	0.01	0.01	0.01				0.01	0.01	0.01	0.02	0.03	0.03	0.03	0.02	0.05	0.03									0.27
12/26/2008										0.01	0.02	0.01	0.01	0.04	0.05	0.03	0.02			0.01	0.01				0.21
12/27/2008		0.01	0.05	0.07	0.02	0.01	0.01				0.01	0.01	0.01	0.01	0.01			0.02						0.01	0.25
12/28/2008	0.03	0.04										0.01													0.10
12/29/2008	0.01	0.01	0.02	0.01	0.01	0.04	0.15	0.16	0.12	0.01		0.01	0.05		0.01	0.02		0.01	0.01						0.66
12/30/2008																						0.05	0.04	0.02	0.11
12/31/2008	0.01	0.01	0.01	0.01													0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.13
1/1/2009	0.01	0.02	0.04	0.09	0.08	0.09	0.14	0.14	0.13	0.09	0.06	0.06	0.09	0.07	0.06	0.05	0.04	0.07	0.08	0.13	0.18	0.23	0.2	0.2	2.37
1/2/2009	0.18	0.02	0.04	0.04	0.04	0.02	0.02	0.01	0.02	0.05	0.06	0.05	0.02	0.02		0.01	0.02								0.62
1/3/2009																									0.00
1/4/2009																		0.02	0.03	0.01	0.01	0.03	0.09	0.06	0.25
1/5/2009	0.11	0.01																						0.01	0.13
1/6/2009	0.04			0.02	0.01	0.01										0.01	0.01								0.12
1/7/2009			0.01	0.02	0.01						0.01	0.04	0.05	0.05	0.02								0.01	0.04	0.28

Notes:

Sample Collection Period

[1] Average of 13 rain gages in N, NE, and SE Portland, reported in inches

[2] Blank cells indicate less than one rain gage bucket tip per hour. One bucket tip = 0.01 inches of rainfall.

[3] Gage data for each hour has been reported to the nearest hundredth of an inch. Daily totals may not reflect the sum of hourly data due to rounding.

Table 5-3: City of Portland HYDRA Rain Gage [1] Data Year 4, Event 3

Date	Hours																							Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
1/3/2009	[2]																								0.00
1/4/2009																		0.02	0.03	0.01	0.01	0.03	0.09	0.06	0.25 [3]
1/5/2009	0.11	0.01																						0.01	0.13
1/6/2009	0.04			0.02	0.01	0.01										0.01	0.01								0.12
1/7/2009			0.01	0.02	0.01						0.01	0.04	0.05	0.05	0.02								0.01	0.04	0.28
1/8/2009	0.06	0.09	0.09	0.04	0.01				0.01		0.02			0.01											0.33
1/9/2009																									0.00
1/10/2009																								0.02	0.02
1/11/2009	0.02	0.02	0.01						0.01	0.01	0.01												0.01	0.01	0.11
1/12/2009	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01																	0.10
1/13/2009																									0.00
1/14/2009																									0.00
1/15/2009																									0.01
1/16/2009																									0.00
1/17/2009																									0.00
1/18/2009																									0.00
1/19/2009																									0.00
1/20/2009																									0.00
1/21/2009																									0.00
1/22/2009																									0.00
1/23/2009																									0.00
1/24/2009																									0.01
1/25/2009										0.01	0.05	0.04	0.01												0.12
1/26/2009																									0.00
1/27/2009												0.09	0.04			0.01		0.01							0.17
1/28/2009																0.01									0.01
1/29/2009																									0.01
1/30/2009																									0.01
1/31/2009																									0.01
2/1/2009																									0.00
2/2/2009																									0.00
2/3/2009																									0.00
2/4/2009																									0.00
2/5/2009																									0.00
2/6/2009		0.01	0.03	0.01	0.01	0.01	0.01	0.02	0.01	0.01															0.12
2/7/2009																									0.00
2/8/2009																	0.01	0.03	0.01						0.05
2/9/2009															0.01	0.01									0.02
2/10/2009						0.01	0.01	0.01	0.01	0.01			0.02	0.07	0.06	0.03	0.01								0.25
2/11/2009																									0.00
2/12/2009																									0.00
2/13/2009	0.02	0.01	0.01																						0.04
2/14/2009																									0.01
2/15/2009								0.04	0.02																0.06
2/16/2009																									0.00
2/17/2009																									0.00
2/18/2009																									0.01

2/19/2009																								0.00
2/20/2009																								0.00
2/21/2009																								0.00
2/22/2009																0.02								0.03
2/23/2009				0.01	0.04		0.04	0.01	0.02	0.11	0.08	0.02							0.01	0.06	0.01			0.42

Notes:

Sample Collection Period

[1] Average of 13 rain gages in N, NE, and SE Portland, reported in inches

[2] Blank cells indicate less than one rain gage bucket tip per hour. One bucket tip = 0.01 inches of rainfall.

[3] Gage data for each hour has been reported to the nearest hundredth of an inch. Daily totals may not reflect the sum of hourly data due to rounding.

Table 5-4: City of Portland HYDRA Rain Gage [1] Data Year 4, Event 4

Date	Hours																							Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
2/19/2009	[2]																								0
2/20/2009																									0
2/21/2009																									0
2/22/2009																0.02									0.03 [3]
2/23/2009								0.01	0.04		0.04	0.01	0.02	0.11	0.08	0.02						0.01	0.06	0.01	0.42
2/24/2009		0.04	0.03	0.03	0.02	0.01						0.01	0.01			0.01	0.02	0.06	0.04	0.04	0.04	0.02	0.02	0.02	0.43
2/25/2009	0.01		0.01		0.01								0.01								0.03	0.02		0.01	0.13
2/26/2009	0.02	0.01	0.01					0.01	0.02	0.01															0.08
2/27/2009																									0
2/28/2009																									0
3/1/2009												0.01	0.02	0.04											0.08
3/2/2009			0.11	0.03																					0.15
3/3/2009	0.08	0.13			0.02	0.03																			0.26
3/4/2009																	0.04								0.05
3/5/2009					0.01	0.02		0.03	0.01					0.01			0.04		0.03						0.16
3/6/2009																									0
3/7/2009										0.01									0.01			0.01	0.01		0.05
3/8/2009	0.02	0.01	NA				0.01		0.01				0.02				0.01								NA
3/9/2009									0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.01							0.13
3/10/2009																									0
3/11/2009																									0
3/12/2009																									0
3/13/2009																									0
3/14/2009									0.03	0.01	0.01					0.07	0.07	0.02			0.02	0.01	0.1	0.07	0.41
3/15/2009	0.05	0.05	0.06	0.07	0.05	0.06	0.04	0.03	0.05	0.03	0.01		0.03	0.01							0.01				0.58
3/16/2009					0.02				0.02	0.02	0.06		0.02	0.01	0.01		0.02					0.02		0.01	0.21

Notes:

Sample Collection Period

[1] Average of 13 rain gages in N, NE, and SE Portland, reported in inches

[2] Blank cells indicate less than one rain gage bucket tip per hour. One bucket tip = 0.01 inches of rainfall.

[3] Gage data for each hour has been reported to the nearest hundredth of an inch. Daily totals may not reflect the sum of hourly data due to rounding.

Table 5-5: City of Portland HYDRA Rain Gage [1] Data Year 4, Event 5

Date	Hours																							Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
3/13/2009	[2]																								0.00
3/14/2009									0.03	0.01	0.01					0.07	0.07	0.02			0.02	0.01	0.1	0.07	0.41 [3]
3/15/2009	0.05	0.05	0.06	0.07	0.05	0.06	0.04	0.03	0.05	0.03	0.01		0.03	0.01							0.01				0.58
3/16/2009					0.02				0.02	0.02	0.06		0.02	0.01	0.01		0.02					0.02		0.01	0.21
3/17/2009					0.01	0.02	0.01			0.01		0.01	0.01	0.02	0.01		0.02	0.02							0.14
3/18/2009																									0.00
3/19/2009																									0.01
3/20/2009	0.01		0.01																	0.01					0.04
3/21/2009														0.01	0.01										0.01
3/22/2009									0.01	0.01			0.03			0.01									0.07
3/23/2009															0.01	0.02	0.04	0.03	0.01	0.01					0.13
3/24/2009																0.01									0.02
3/25/2009			0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01														0.13
3/26/2009																									0.00
3/27/2009																									0.00
3/28/2009							0.02	0.02	0.05	0.06	0.07	0.04	0.02	0.01			0.05	0.04	0.03						0.42
3/29/2009														0.01											0.02
3/30/2009																									0.00
3/31/2009			0.03	0.01							0.01	0.04	0.01												0.10
4/1/2009							0.01	0.02	0.01	0.01	0.03	0.04	0.03	0.02		0.01	0.02	0.01	0.01				0.01	0.02	0.26
4/2/2009	0.04	0.05	0.01	0.02	0.01	0.04	0.06						0.01	0.01											0.25
4/3/2009					0.01	0.01	0.01																		0.04
4/4/2009																									0.00
4/5/2009																									0.00
4/6/2009																									0.00
4/7/2009																									0.00
4/8/2009																									0.00
4/9/2009			0.01	0.01	0.01	0.02														0.02	0.09	0.07	0.04	0.04	0.30
4/10/2009	0.03	0.01	0.01	0.01	0.01																				0.07
4/11/2009																									0.00
4/12/2009								0.02	0.02							0.02	0.07	0.08	0.03	0.02					0.27
4/13/2009				0.01								0.01	0.02	0.04							0.01	0.02	0.01		0.14
4/14/2009																									0.01
4/15/2009																									0.00
4/16/2009																									0.00
4/17/2009				0.04	0.04	0.03	0.03	0.03	0.03							0.01									0.21
4/18/2009																									0.00
4/19/2009																									0.00
4/20/2009																									0.00
4/21/2009																									0.00
4/22/2009																									0.00
4/23/2009														0.01											0.01
4/24/2009																									0.00
4/25/2009																									0.00
4/26/2009																									0.00
4/27/2009																			0.06	0.04	0.08	0.08	0.04	0.01	0.31
4/28/2009			0.01		0.01	0.02	0.05	0.05	0.15	0.08	0.02	0.01	0.01	0.01											0.44

Notes:

Sample collection period

[1] Average of 13 rain gages in N, NE, and SE Portland, reported in inches

[2] Blank cells indicate less than one rain gage bucket tip per hour. One bucket tip = 0.01 inches of rainfall.

[3] Gage data for each hour has been reported to the nearest hundredth of an inch. Daily totals may not reflect the sum of hourly data due to rounding.

Table 5-6: Year 4 Storm Event Rainfall Data Summary

Event	Start date of sampled storm	Daily		Individual sampled storm			
		Predicted rainfall [1] (inches)	Actual daily rainfall total[2] (inches)	Antecedent dry period [3] (hours)	Actual storm rainfall total[2] (inches)	Duration (hours)	Intensity (inches[2] per hour)
1	10/3/2008	0.57 - 0.88 +	0.42	> 72	0.39	13	0 - 0.09
	10/9/2008	0.05 - 0.13 +	0.15	59	0.15	9	0 - 0.04
	11/3/2008	0.79 - 0.92 +	0.77	10	0.84 [4]	13	0.01 - 0.11
2	11/12/2008	0.77 - 1.02 +	1.11	9	1.11	19	0.01 - 0.18
	11/20/2008	0.29 - 0.42 +	0.49	> 72	0.49	12	0 - 0.11
	12/12/2008	0.52 - 0.77 +	0.37	> 72	0.37	12	0 - 0.10
2/3[5]	1/7/2009	1.04 - 1.45 +	0.28	28	0.17	5	0.01 - 0.05
3	2/9/2009	0.21 - 0.34 +	0.02	> 72	0.02	2	0.01
	2/10/2009	0.27 - 0.42 +	0.25	> 72	0.25	12	0 - 0.07
3/4[5]	2/23/2009	0.37 - 0.48 +	0.42	> 72	0.34	9	0 - 0.11
4	3/5/2009	0.09 - 0.21 +	0.16	49	0.16	15	0 - 0.04
	3/9/2009	0.09 - 0.16 +	0.13	> 72	0.13	10	0.01 - 0.02
	3/16/2009	0.18 - 0.33 +	0.21	20	0.16	9	0 - 0.06
5	3/17/2009	0.08 - 0.13 +	0.14	18	0.14	14	0 - 0.02
	3/23/2009	0.21 - 0.32 +	0.13	> 72	0.13	6	0 - 0.04
	3/25/2009	0.23 - 0.32 +	0.13	35	0.13	9	0.01 - 0.02
	4/1/2009	0.31 - 0.48 +	0.26	> 72	0.23	13	0.01 - 0.04
	4/13/2009	0.22 - 0.51 +	0.14	13	0.07	3	0.01 - 0.04
	4/17/2009	0.04 - 0.11 +	0.21	> 72	0.2	6	0.03 - 0.04
	4/27/2009	trace - 0.03	0.31	> 72	0.31	6	0.01 - 0.08
	4/28/2009	0.07 - 0.19 +	0.44	6	0.44	12	0 - 015

Notes:

[1] Predicted rainfall from Extended Range Forecasting, Inc. daily reports

[2] Rainfall totals average of 13 rain gages (see Section 3.0, Year 3 Data Usability Report presented in Appendix B)

[3] Antecedent dry period = < 0.1" in 6 hours

[4] Storm event total may include rainfall from more than one calendar day.

[5] Next UIC sampling event was started the same day previous sampling event was finished (see Data Usability Report).

Table 5-7: Climate Data Summary - Years 1, 2, 3, 4 and Long-term Average

Long-term Average			Year 1 Data				Year 2 Data				Year 3 Data				Year 4 Data			
Month	Mean Average Temperature (F)[1]	Mean Monthly Precipitation (inches)[2]	Month	Average Temperature (F)[3]	Monthly Precipitation (inches)[3]	Difference in Precipitation (Permit Year - Monthly Mean) (inches)[4]	Month	Average Temperature (F)[3]	Monthly Precipitation (inches)[3]	Difference in Precipitation (Permit Year - Monthly Mean) (inches)[4]	Month	Average Temperature (F)[3]	Monthly Precipitation (inches)[3]	Difference in Precipitation (Permit Year - Monthly Mean) (inches)[4]	Month	Average Temperature (F)[3]	Monthly Precipitation (inches)[3]	Difference in Precipitation (Permit Year - Monthly Mean) (inches)[4]
June	63.3	1.59	Jun-05	62.0	2.21	0.62	Jun-06	66.4	0.93	-0.66	Jun-07	62.8	1.08	-0.51	Jun-07	61.8	1.00	-0.59
July	68.1	0.72	Jul-05	70.3	0.41	-0.31	Jul-06	71.0	0.47	-0.25	Jul-07	70.7	0.55	-0.17	Jul-07	68.8	0.29	-0.43
August	68.5	0.93	Aug-05	70.7	1.05	0.12	Aug-06	69.2	0.10	-0.83	Aug-07	68.3	0.46	-0.47	Aug-07	69.6	1.23	0.30
September	63.2	1.65	Sep-05	62.5	1.71	0.06	Sep-06	65.2	0.86	-0.79	Sep-07	62.4	2.04	0.39	Sep-07	65.2	0.48	-1.17
October	54.5	2.88	Oct-05	56.3	3.40	0.52	Oct-06	54.0	1.40	-1.48	Oct-07	53.1	3.26	0.38	Oct-07	53.5	1.74	-1.14
November	46.1	5.62	Nov-05	44.0	4.98	-0.64	Nov-06	47.4	11.92	6.30	Nov-07	44.8	4.25	-1.37	Nov-07	49.2	4.15	-1.47
December	40.2	5.71	Dec-05	39.8	7.52	1.81	Dec-06	40.0	5.86	0.15	Dec-07	40.9	7.57	1.86	Dec-07	37.5	3.52	-2.19
January	39.6	5.07	Jan-06	45.5	10.92	5.85	Jan-07	38.1	2.74	-2.33	Jan-08	38.8	4.71	-0.36	Jan-08	40	4.50	-0.57
February	43.4	4.18	Feb-06	42.0	2.15	-2.03	Feb-07	44.2	3.47	-0.71	Feb-08	44.9	2.19	-1.99	Feb-08	41.3	1.36	-2.82
March	47.3	3.71	Mar-06	46.1	2.96	-0.75	Mar-07	50.1	3.20	-0.51	Mar-08	45.4	3.71	0.00	Mar-08	45.3	3.36	-0.35
April	50.9	2.64	Apr-06	53.1	2.46	-0.18	Apr-07	51.7	2.01	-0.63	Apr-08	48.5	2.09	-0.55	Apr-08	52.3	2.31	-0.33
May	57.1	2.38	May-06	59.8	3.00	0.62	May-07	58.6	1.45	-0.93	May-08	58.9	2.03	-0.35	May-08	60.1	3.26	0.88
Year	53.5	37.08	Year	54.3	42.77	5.69	Year	54.7	34.41	-2.67	Year	53.3	33.94	-3.14	Year	53.7	27.2	-9.88

Notes:

[1] Mean Monthly temperatures at Portland Airport from www.ocs.oregonstate.edu/index.html

[2] Monthly Totals/Averages. Portland International Airport. Period 1971 - 2000. From NOWData - NOAA Online Weather Data at http://nowdata.rcc-acis.org/PQR/pubACIS_results.

[3] Preliminary Local Climatological Data - Portland Oregon. From http://www.weather.gov/climate/index.php?wfo=pqr

[4] A positive values indicates that the measured precipitation total for that month exceeds the monthly mean.

Shaded area indicates permit "wet season"

Table 5-8: Field Parameter Summary Statistics [1] - Year 4

Field Parameter	Units	Event	Number of Samples	Minimum	Median	Mean	Maximum
Conductivity - specific	umhos/cm	1	40	9	36	46.2	198
		2	40	8	23.5	27.6	68
		3	40	9	45.9	57.6	157
		4	40	9	33.8	38.8	103
		5	40	13	35	39.2	114
pH	Units	1	40	5.6	6.6	6.6	8.7
		2	40	5.9	6.7	6.7	7.4
		3	40	6.1	6.9	6.9	7.5
		4	40	6.0	6.8	6.9	8.1
		5	40	6.2	6.8	6.8	7.4
Temperature	°C	1	40	10.2	13.8	14.2	17.9
		2	40	5.9	12	12.4	15.5
		3	40	1.4	5.2	6	11.4
		4	40	2.8	6.3	6.6	9.6
		5	40	6.3	8.5	8.7	13.1

Note:

[1] This table summarizes the results of the original UIC stormwater samples for each event. This table includes the results of Panel 4, Panel 6, and Supplemental Panel No. 3. This table does not include the results of duplicate samples or laboratory reanalyses.

Table 5-9: Frequency of Detected [1] Common and Priority Pollutant Screen Analytes [2] - Year 4

Analyte	MADL (µg/L)	Event	Exceedances of MADL [2]	Number of Detections [2]	Number of Samples [2]	Frequency of Detection (%)	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Maximum Percent of MADL Detected [Maximum concentration / MADL] (%)
Common Pollutants									
Arsenic (total)	10.0	1	0	40	40	100	0.059	0.957	10%
		2	0	40	40	100	0.109	1.63	16%
		3	0	40	40	100	0.194	1.85	19%
		4	0	40	40	100	0.137	2.06	21%
		5	0	40	40	100	0.132	1.3	13%
Cadmium (total)	5.0	1	0	21	40	52.5	< 0.1 [3]	0.75	15%
		2	0	14	40	35	< 0.1	0.49	10%
		3	0	16	40	40	< 0.1	0.75	15%
		4	0	20	40	50	< 0.1	0.61	12%
		5	0	14	40	35	< 0.1	0.36	7%
Chromium (total)	100	1	0	34	40	85	0.33	9.73	10%
		2	0	31	40	77.5	< 0.4	10.7	11%
		3	0	38	40	95	< 0.4	14.6	15%
		4	0	38	40	95	< 0.4	16.9	17%
		5	0	34	40	85	< 0.4	8.14	8%
Copper (total)	1300	1	0	40	40	100	1.89	60.2	5%
		2	0	40	40	100	1.75	47.9	4%
		3	0	40	40	100	2.55	64.1	5%
		4	0	40	40	100	1.46	49	4%
		5	0	40	40	100	1.87	28.8	2%
Lead (total)	50.0	1	0	40	40	100	0.26	36.1	72%
		2	**2** [4]	40	40	100	0.26	**68.4**	**137%**
		3	**3**	40	40	100	0.55	**91.4**	**183%**
		4	**2**	40	40	100	0.23	**129**	**258%**
		5	**1**	40	40	100	0.18	**65**	**130%**
Zinc (total)	5000	1	0	40	40	100	5.7	320	6%
		2	0	40	40	100	4.92	193	4%
		3	0	40	40	100	10.1	419	8%
		4	0	40	40	100	6.62	291	6%
		5	0	40	40	100	3.39	240	5%

Table 5-9: Frequency of Detected [1] Common and Priority Pollutant Screen Analytes [2] - Year 4

Analyte	MADL (µg/L)	Event	Exceedances of MADL [2]	Number of Detections [2]	Number of Samples [2]	Frequency of Detection (%)	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Maximum Percent of MADL Detected [Maximum concentration / MADL] (%)
Total Nitrogen	10000	1	0	18	40	45	< 0.1	0.5	0%
		2	0	6	40	15	< 0.1	0.3	0%
		3	0	16	40	40	< 0.1	0.55	0%
		4	0	17	40	42.5	< 0.1	0.37	0%
		5	0	15	40	37.5	< 0.1	0.86	0%
Pentachlorophenol	1.0	1	**3**	35	40	87.5	< 0.04	**1.54**	**154%**
		2	**6**	37	40	92.5	< 0.04	**5.2**	**520%**
		3	**8**	33	40	82.5	< 0.04	**6.29**	**629%**
		4	**5**	30	40	75	< 0.04	**4.4**	**440%**
		5	**3**	33	40	82.5	< 0.04	**1.52**	**152%**
Benzene	5.0	1	0	0	40	0	< 0.2	< 0.2	4%
		2	0	1	40	2.5	< 0.2	4.31	86%
		3	0	0	40	0	< 0.2	< 0.2	4%
		4	0	0	40	0	< 0.2	< 0.2	4%
		5	0	0	40	0	< 0.2	< 0.2	4%
Ethylbenzene	700	1	0	0	40	0	< 0.5	< 0.5	0%
		2	0	1	40	2.5	< 0.5	1.68	0%
		3	0	0	40	0	< 0.5	< 0.5	0%
		4	0	0	40	0	< 0.5	< 0.5	0%
		5	0	0	40	0	< 0.5	< 0.5	0%
Toluene	1000	1	0	28	40	70	< 0.5	252	25%
		2	0	17	40	42.5	< 0.5	15.8	2%
		3	0	22	40	55	< 0.5	63	6%
		4	0	19	40	47.5	< 0.5	7.54	1%
		5	0	18	40	45	< 0.5	25.5	3%
Xylenes	10000	1	0	0	40	0	< 1.5	< 1.5	0%
		2	0	1	40	2.5	< 1.5	14.51	0%
		3	0	1	40	2.5	< 1.5	2.05	0%
		4	0	0	40	0	< 1.5	< 1.5	0%
		5	0	1	40	2.5	< 1.5	1.61	0%

Table 5-9: Frequency of Detected [1] Common and Priority Pollutant Screen Analytes [2] - Year 4

Analyte	MADL (µg/L)	Event	Exceedances of MADL [2]	Number of Detections [2]	Number of Samples [2]	Frequency of Detection (%)	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Maximum Percent of MADL Detected [Maximum concentration / MADL] (%)
Benzo(a)pyrene	0.2	1	0	9	40	22.5	< 0.00962	0.077	39%
		2	0	10	40	25	< 0.00962	0.0537	27%
		3	**1**	19	40	47.5	< 0.00962	**0.245**	**123%**
		4	0	23	40	57.5	< 0.00962	0.0887	44%
		5	0	13	40	32.5	< 0.00952	0.0408	20%
Di(2-ethylhexyl) phthalate	6.0	1	0	11	40	27.5	< 0.962	4.2	70%
		2	0	16	40	40	< 0.962	4.06	68%
		3	**4**	24	40	60	< 0.962	**12.2**	**203%**
		4	**6**	33	40	82.5	< 0.962	**11.7**	**195%**
		5	**2**	30	40	75	< 0.952	**14.9**	**248%**
Priority Pollutant Screen									
Antimony	6.0	1	0	25	25 [5]	100	0.16	4.53	76%
		2	0	24	25	96	< 0.1	4.09	68%
		3	0	25	25	100	0.21	5.41	90%
		4	0	25	25	100	0.24	3.26	54%
		5	0	25	25	100	0.17	2.38	40%
Barium	2000.0	1	0	25	25	100	7.76	171	9%
		2	0	25	25	100	4.15	96.2	5%
		3	0	25	25	100	7.63	169	8%
		4	0	25	25	100	4.13	163	8%
		5	0	25	25	100	5.32	93.6	5%
Beryllium	4.0	1	0	2	25	8	< 0.1	0.21	5%
		2	0	0	2	0	< 0.1	< 0.1	3%
		3	0	1	2	50	< 0.1	0.26	7%
		4	0	0	2	0	< 0.1	< 0.1	3%
		5	0	0	2	0	< 0.1	< 0.1	3%
2,4-D	70.0	1	0	22	40	55	< 0.1	1.48	2%
		2	0	12	40	30	< 0.1	0.315	0%
		3	0	1	40	2.5	< 0.1	< 0.4	1%
		4	0	2	40	5	< 0.1	< 0.4	1%
		5	0	8	40	20	< 0.1	1.66	2%

Table 5-9: Frequency of Detected [1] Common and Priority Pollutant Screen Analytes [2] - Year 4

Analyte	MADL (µg/L)	Event	Exceedances of MADL [2]	Number of Detections [2]	Number of Samples [2]	Frequency of Detection (%)	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Maximum Percent of MADL Detected [Maximum concentration / MADL] (%)
Glyphosate	700.0	1	0	1	25	4	< 6	27	4%
		2	0	0	3	0	< 6	< 6	1%
		3	0	0	3	0	< 6	< 6	1%
		4	0	0	3	0	< 6	< 6	1%
		5	0	0	3	0	< 6	< 6	1%
Mercury	2.0	1	0	25	25	100	0.0024	0.0561	3%
		2	0	24	25	96	< 0.002	0.062	3%
		3	0	24	25	96	< 0.002	0.038	2%
		4	0	25	25	100	0.0021	0.039	2%
		5	0	24	25	96	< 0.002	0.022	1%

Notes:

[1] This table includes only those common or priority pollutants that were detected in one or more samples.

[2] This table summarizes the results of the original UIC stormwater samples for each event. This table includes the results of Panel 4, Panel 6, and Supplemental Panel No. 3. This table does not include the results of duplicate samples or laboratory reanalyses.

[3] "<" Indicates the laboratory reporting limit.

[4] **Bold**, shaded text indicate pollutant concentration exceeds the MADL.

[5] PPS analytes are monitored in Panel 4 and Supplemental Panel 3 UIC locations. Where PPS analytes are detected by common pollutant analytical methods, they are also measured for Panel 6 UIC locations.

Table 5-11 provides summary of non-detect priority pollutant stormwater monitoring data.

Table 6-1: Overall Data Quality Objectives

Compound Class	Precision	Accuracy	Completeness
Volatile Organic Compounds (VOCs)	± 25%	Per method/per analyte	95%
Polynuclear Aromatic Hydrocarbons (PAHs)	± 50%	Per method/per analyte	95%
Semivolatile Organic Compounds (SVOCs)	± 50%	Per method/per analyte	95%
Herbicides/Pesticides	± 30%	± 30%	95%
Total Metals	± 20%	± 25%	95%
Conventionals	± 20%	± 25%	95%

Table 6-2: Laboratory QC Issues for Permit Year 4
UIC WPCF Permit Monitoring

Event	Method	Issue	Affected Samples	Cause	Comments, Actions Taken	Usability
1	200.8	Field duplicate RPD failures: P6_13 arsenic 0.063/0.083 (27.4%) and copper 3.43/4.3 (22.5%) and P4_6 barium 36.1/29 (21.8%)	P6_13 (copper), P4_6 (barium)	Non-homogeneous samples, low concentrations	P6_13 copper and P4_6 barium values qualified with "J"; P6_13 arsenic values < 5x MRL, no other action taken	Usable with qualifiers
	8260	Methylene chloride detected in trip blank at 2.22 ug/l	None	Unknown	Not detected in associated sample, no action taken	Usable
	8260	Chlorobenzene detected in trip blank at 0.21 ug/l	None	Unknown	Not detected in associated sample, no action taken	Usable
	8270-SIM	Benzo(a)pyrene field duplicate RPD failed [0.048/0.0169 ug/l (96.0%)].	None	Non-homogenous samples, low concentrations	Values less than 5x MRL, no action taken	Usable
	8270-SIM	DEHP field duplicate RPD failed [0.852/7.39 ug/l (158.7%)].	P4_6	Lab contamination?	No other QC issues, high value qualified with "JH', low value qualified with "J"	Usable with qualifiers
	8270-SIM	Anthracene LCS (126%) recovery greater than upper acceptance limit for batch 8100340	None	Analytical difficulties	Analyte not detected in associated samples, no action taken	Usable
	8270-SIM	Anthracene MSD (125%) recovery greater than upper acceptance limit for batch 8100340	None	Analytical difficulties, matrix effects	Analyte not detected in associated samples, no action taken	Usable
	8270C	2,4,6-Tribromophenol (23%), 2-fluorobiphenyl (33%), 2-fluorophenol (8%), nitrobenzene-d5 (29%), phenol-d6 (6%) surrogate recoveries less than lower acceptance limits	P4_12	Analytical difficulties	Detects qualified with "JL" for estimated, possible low bias, non-detects qualified with "UJ", for reporting limits approximate or imprecise	Usable with qualifiers
	8270C	4-Chloro-3-methylphenol and hexachlorocyclopentadiene LCS/LCSD RPDs (28%, 31%) failed in batch 8J10092.	None	Analytical difficulties	No other QC issues, analytes not detected, no action taken.	Usable
	8270C	Benzoic acid (133%), 4-chloroaniline (28%, ND), 3,3'-dichlorobenzidine (ND, ND), 2,4-dimethylphenol (6%, 4%), 4,6-dinitro-2-methylphenol (127%, 125%), 2,4-dinitrophenol (130%, 135%), 2,6-dinitrotoluene (121%), 3,4-methylphenol (25%), 3-nitroaniline (4%, 6%), 4-nitroaniline (16%, 19%), nitrobenzene (128%), 4-nitrophenol (135%, 132%), phenol (137%) MS/MSD recoveries outside acceptance limits for batch 8K08043. All RPDs acceptable except for 2,4-dimethylphenol (49%), 3,4-dimethylphenol (86%), and 3-nitroaniline (41%).	None	Analytical difficulties, matrix effects	No other QC issues, most analytes not detected, no action taken.	Usable
	515.3	Picloram LCS (227%) and MS/MSD (241%/218%) recoveries greater than upper acceptance limits for batch 8100229	None	Analytical difficulties, matrix effects	Analyte not detected in associated samples, MS/MSD RPD acceptable, no action taken.	Usable
	515.3	Pentachlorophenol MS/MSD (64.7%/66.7%) recoveries less than lower acceptance limit for batch 8100229	None	Matrix effects	RPD acceptable, no other QC issues, no action taken.	Usable
	515.3	2,4-D (132%), 2,4-DB (157%, 157%), picloram (184%, 183%), and 2,4,5-T (132%) MS/MSD recoveries greater than upper acceptance limits for batch 8100231.	None	Matrix effects	MS/MSD RPDs acceptable; either no other QC issues, or analyte not detected in associated samples. No action taken.	Usable
	515.3	Picloram LCS (144%) recovery greater than upper acceptance limit for batch 8100689	None	Analytical difficulties, matrix effects	Analyte not detected in associated samples, MS/MSD RPD acceptable, no action taken.	Usable
	515.3	2,4-DB (154%), 3,5-dichlorobenzoic acid (132%), and picloram (150%, 131%) MS/MSD recoveries greater than upper acceptance limits for batch 8100689. 2,4-DB RPD failed (35%).	None	Matrix effects	Other MS/MSD RPDs acceptable; either no other QC issues, or analyte not detected in associated samples. No action taken.	Usable
	515.3	2,4-DB (140%, 143%) and 3,5-Dichlorobenzoic acid (144%, 146%) MS/MSD recoveries greater than upper acceptance limits in batch 8110399.	None	Matrix effects	RPDs acceptable, no other QC issues, analyte not detected in associated samples. No action taken.	Usable
	531.1	Carbofuran LCS/LCSD (119%, 121%) recoveries greater than upper acceptance limit for batch C8J1109	None	Analytical difficulties	Analyte not detected in associated samples, RPD acceptable, no action taken.	Usable
	531.1	Carbofuran LCS (127%) greater than upper acceptance limit for batch C8K0724	None	Analytical difficulties	Analyte not detected in associated samples, RPD acceptable, no action taken.	Usable
	548.1	Endothall MS recovery (13%) less than lower acceptance limit in batch C8J0382.	None	Matrix effects	Analyte not detected in associated samples, no action taken	Usable
	548.1	Endothall MS recovery (19%) less than lower acceptance limit in batch C8J0815.	None	Matrix effects	Analyte not detected in associated samples, no action taken	Usable
	548.1	Endothall MS recovery (13%) less than lower acceptance limit in batch C8J1004.	None	Matrix effects	Analyte not detected in associated samples, no action taken	Usable

Table 6-2: Laboratory QC Issues for Permit Year 4
UIC WPCF Permit Monitoring

Event	Method	Issue	Affected Samples	Cause	Comments, Actions Taken	Usability
	548.1	Endothall MS recovery (41%) less than lower acceptance limit in batch C8J1502.	None	Matrix effects	Analyte not detected in associated samples, no action taken	Usable
	548.1	Endothall MS recovery (20%) less than lower acceptance limit in batch C8K0704.	None	Matrix effects	Analyte not detected in associated samples, no action taken	Usable
	549.2	Diquat LCSD recovery (127%) greater than upper acceptance limit, RPD failed (24%) for batch C8J0930	None	Analytical difficulties	Analyte not detected in associated samples, no action taken	Usable
	549.2	Diquat LCS/LCSD recoveries (117%, 120%) greater than upper acceptance limit for batch C8J0931	None	Analytical difficulties	RPD acceptable, analyte not detected in associated samples, no action taken	Usable
	549.2	Diquat MS1/MS2/MSD1 recoveries (164%, 21%, 110%) outside acceptance limits, RPD failed (39%) for batch C8J0930	None	Matrix effects, analytical difficulties	Analyte not detected in associated samples, LCS/LCSD results high (see above), no action taken	Usable
	549.2	Diquat MS1/MS2/MSD1 recoveries (ND, 41%, ND) less than lower acceptance limit, RPD failed (not reportable due to ND results) for batch C8J0931	None	Matrix effects, analytical difficulties	Analyte not detected in associated samples, LCS/LCSD results high (see above), no action taken	Usable
	549.2	Diquat MS recovery (36%) less than lower acceptance limit for batch C8J1424	None	Matrix effects, analytical difficulties	Analyte not detected in associated samples, no action taken	Usable
	549.2	Diquat MS1 recovery (10%) less than lower acceptance limit for batch C8K0727	None	Matrix effects, analytical difficulties	Attributed to matrix effects, analyte not detected, LCS/LCSD/MS2 recoveries acceptable, no action taken.	Usable
	552.2	Dalapon surrogate recoveries (134-173%) greater than upper acceptance limits for some samples in batch 8100787	None	Matrix effects	MS/MSD RPD acceptable, dalapon not detected, no action taken	Usable
	552.2	Dalapon surrogate (143%) recovery greater than upper acceptance limit for one sample in batch 8100293	None	Matrix effects	RPD acceptable, dalapon not detected, no action taken	Usable
	552.2	Dalapon surrogate (139, 144%) recoveries greater than upper acceptance limit for some samples in batch 8100294	None	Matrix effects	Dalapon not detected, no action taken	Usable
2	200.8	Field duplicate RPD failure; lead 1.24/1.01 (21.2%)	P6_6	Non-homogeneous samples, low concentrations	Lead values qualified with “J”. No other QC issues, no other action taken.	Usable with qualifiers
	8270-SIM	Several PAHs detected below MRL in method blank (batch 8110478). No action taken.	None	Laboratory contaminant	Sample reanalyzed within hold time with no detects in method blank. Phthalates reported from original batch, PAHs reported from re-analyses.	No action taken
	8270-SIM	Pyrene-d10 surrogate recovery (152%) greater than upper acceptance limit for batch 8110478 method blank.	None	Analytical difficulties	Samples re-extracted within hold time due to low-level method blank contamination, PAHs reported from reanalysis, no action taken	Usable
	515.3	For sample P6_15, initial run within hold time, surrogate recovery failed. Sample reanalysis performed 14 days past extraction hold time.	None	Analytical difficulties	Reanalysis results similar, all other initial run QC acceptable, reanalysis used only for comparison.	Usable
	515.3	Picloram LCS (139%) recovery greater than upper acceptance limit for batch 8110667	None	Analytical difficulties, matrix effects	Analyte not detected in associated samples, MS/MSD RPD acceptable, no action taken.	Usable
	515.3	Pentachlorophenol MS (67.2%) recovery less than lower acceptance limit for batch 8110667	None	Matrix effects	MSD and RPD acceptable, no other QC issues, no action taken.	Usable
	515.3	Picloram LCS (139%) recovery greater than upper acceptance limit for batch 8110667	None	Analytical difficulties	Analyte not detected in associated samples, MS/MSD RPD acceptable, no action taken.	Usable
	515.3	2,4-D (1180%), 2,4-DB (139%), and picloram (139%) LCS recoveries greater than upper acceptance limits for batch 8110810. Calibration verfication recoveries exceeded method control limits.	P6_2, P6_4, P6_4 DUP, P6_5, P6_6, P6_6 DUP, P6_8, P6_9, P6_10, P6_11, P6_12	Analytical difficulties	2,4-D MS/MSD recoveries outside control limits, all detects qualified with "JH' for estimated, potential high bias. Other analytes not detected, no other action taken.	Usable with qualifiers
	515.3	Acifluorfen (142%, 133%, 139%, 135%), 2,4-D (168%, 156%, 163%, 159%), 2,4-DB (208%, 202%, 191%, 203%), and picloram (217%, 203%, 203%, 209%) MS1/MS2/MSD1/MSD2 recoveries greater than upper acceptance limits for batch 8110810.	None	Matrix effects	No RPD failures, no other QC issues, most analytes not detected, no action taken.	Usable
	515.3	Pentachlorophenol MS2/MSD2 (15.7%, 6.95%) recoveries less than lower acceptance limit for batch 8110810	None	Matrix effects	RPD acceptable, no other QC issues, no action taken.	Usable

Table 6-2: Laboratory QC Issues for Permit Year 4
UIC WPCF Permit Monitoring

Event	Method	Issue	Affected Samples	Cause	Comments, Actions Taken	Usability
	515.3	Acifluorfen (46.7%, 47.4%), Bentazon (140%), 2,4-D (131%), Dinoseb (52.1%, 53.0%), pentachlorophenol (35.7%, 35.3%), picloram (136%), and 2,4,5-TP (65.3%, 65.2%) MS/MSD recoveries outside acceptance limits for batch 8110668.	None	Matrix effects	No RPD failures, no other QC issues, except for pentachlorophenol, most analytes not detected, no action taken.	Usable
	515.3	Picloram LCS (138%) and MS/MSD (134%, 135%) recoveries greater than upper acceptance limits for batch 8120569	None	Analytical difficulties	Analyte not detected in associated samples, MS/MSD RPD acceptable, no action taken.	Usable
	515.3	2,4-D field duplicate RPD failed 0.144/0.197 ug/l (31.1%)	P6_6	Non-homogenous samples, low concentrations	Values < 5x MRL, no action taken	Usable
	515.3	Pentachlorophenol field duplicate RPD failed 5.2/< 0.04 ug/l (196.9%)	P6_6	Non-homogenous samples, lab issues?	Gross RPD failure, sample and duplicate "out of control". P6_6 pentachlorophenol value qualified with "M" for estimated, sample and duplicate “out of control”, and P6_6 DUP value qualified with "UM" for not detected, detection limit may be inaccurate or imprecise.	Qualified, use with caution
2/3*	515.3	3,5-Dichlorobenzoic acid MS/MSD (134%, 133%) recoveries greater than upper acceptance limit for batch 9010482	None	Matrix effects	Analyte not detected in associated samples, MS/MSD RPD acceptable, no action taken.	Usable
	515.3	For batch 9020110, MS/MSD (135%, 140%) surrogate recoveries and 2,4-D (154%, 160%), 2,4-DB (212%, 229%), 3,5-dichlorobenzoic acid (131%), and picloram (178%, 190%) MS/MSD recoveries greater than upper acceptance limits. No RPD failures.	None	Matrix effects	No RPD failures, batch was only for single sample reanalysis, results used only for comparison. No action taken.	Usable
	547	Glyphosate LCS/LCSD RPD failed (14%) in batch C9A1401	None	Analytical difficulties	Recoveries acceptable, analyte not detected in associated samples, no action taken	Usable
3	200.8	Field duplicate RPD failure; chromium 2.79/5.53 (65.9%)	P4_6	Non-homogeneous samples, low concentrations	Chromium values qualified with “J”. No other QC issues, no other action taken.	Usable with qualifiers
	8270-SIM	Di-n-octyl phthalate MSD (158%) recovery greater than upper acceptance limit for batch 9020459.	None	Matrix effects	MS recovery and RPD acceptable, no other QC issues, no action taken.	Usable
	515.3	2,4-D (146%, 151%), 2,4-DB (195%, 208%), 3,5-dichlorobenzoic acid (136%, 143%), and picloram (148%, 153%) MS/MSD recoveries greater than upper acceptance limits for batch 9020602.	None	Matrix effects	RPDs acceptable, most analytes not detected, no action taken.	Usable
	515.3	Pentachlorophenol MS/MSD (66.4%, 65.8%) recoveries less than lower acceptance limit for batch 9020603	None	Matrix effects	RPD acceptable, no other QC issues, no action taken.	Usable
	515.3	Acifluorfen (140%, 138%) and picloram (146%, 143%) MS/MSD recoveries greater than upper acceptance limits for batch 9020848. No RPD failures.	None	Matrix effects	Analytes not detected, no action taken.	Usable
	547	Glyphosate MS (118%) recovery greater than upper acceptance limit in batch C9B1613	None	Matrix effects	RPD acceptable, no other QC issues, analyte not detected in associated samples, no action taken.	Usable
3/4*	515.3	Acifluorfen (148%, 148%), 2,4-DB (140%, 138%) and picloram (163%, 159%) MS/MSD recoveries greater than upper acceptance limits for batch 9020849. No RPD failures.	None	Matrix effects	Analytes not detected, no action taken.	Usable
	547	Glyphosate detected at 1.55 ug/l in method blank, slightly above MDL	None	Laboratory contamination	Analyte not detected, no action taken.	Usable
4	8270-SIM	Di-n-octyl phthalate MS (154%) recovery greater than upper acceptance limit for batch 9030570.	None	Matrix effects	MSD recovery and RPD acceptable, no other QC issues, no action taken.	Usable
	8270-SIM	DEHP (-8.46%, -29.2%) MS/MSD recoveries greater than upper acceptance limit (sample value 7.89 ug/l, spike amount 4.21 ug/l; 7.53, 6.72 ug/l recovered), RPD failed (110%) in batch 9030570.	SP3_10	Matrix effects, lab contamination?	RPD failed, no other QC issues for this batch. Original sample value qualifed with "JH" for estimated, potential high bias.	Usable with qualifiers
	8270-SIM	Di-n-octyl phthalate (170%, 185%) MS/MSD recoveries greater than upper acceptance limit for batch 9030671.	None	Matrix effects	RPD acceptable, no other QC issues, analyte not detected in associated samples, therefore, no action taken.	Usable

Table 6-2: Laboratory QC Issues for Permit Year 4
UIC WPCF Permit Monitoring

Event	Method	Issue	Affected Samples	Cause	Comments, Actions Taken	Usability
	515.3	Picloram (150%, 146%) MS/MSD recoveries greater than upper acceptance limit for batch 9030500. No RPD failures.	None	Analytical difficulties	No other QC issues, no action taken.	Usable
	515.3	3,5-Dichlorobenzoic acid (142%, 139%) and picloram (142%, 140%) MS/MSD recoveries greater than upper acceptance limit for batch 9030502. No RPD failures.	None	Analytical difficulties	No other QC issues, no action taken.	Usable
	515.3	Pentachlorophenol field duplicate RPD failed 0.289/0.162 ug/l (56.3%)	P4_9	Non-homogenous samples, low concentrations	Values < 5x MRL, no action taken	Usable
	547	Glyphosate detected at 1.6 ug/l in field decon blank, slightly above MDL	None	Field/laboratory contamination?	Analyte not detected in associated samples, no action taken.	Usable
	547	LCS/LCSD RPD failed (19%) in batch C9C2006	None	Analytical difficulties	Recoveries acceptable, no other QC issues, no action taken	Usable
5	200.8	Field duplicate RPD failure; lead 22.1%	SP2_1	Non-homogeneous samples, low concentrations	Lead values qualified with “J”, no other QC issues, no other action taken.	Usable with qualifiers
	8270-SIM	DEHP (158%) and di-n-octyl phthalate (154%) MSD recoveries greater than upper acceptance limit for batch 9030908.	None	Matrix effects	MS recoveries and RPDs acceptable, no other QC issues, no action taken.	Usable
	8270-SIM	Field duplicate RPD failure; DEHP 72.3%	P4_5	Lab contamination?	Sample value qualified with “JH” for estimated, potential high bias, duplicate value qualified with "J", no other action taken.	Usable with qualifiers
	8270-SIM	Naphthalene method blank contamination at slightly > 1/2 MRL (MRL = MDL) in batch 9030837.	P4_6, P4_11, P6_5, P6_11, P6_12, SP3_7	Laboratory contaminant	Reanalysis extractions performed seven days after extraction holding time expired. Reanalysis results comparable to original sample results but generally lower; reanalysis results used only for comparison. Associated samples with concentrations < 10 x blank value qualified with "JB" for estimated.	Usable with qualifiers
	8270-SIM	Anthracene and phenanthrene method blank contamination at slightly > 1/2 MRL (MRL = MDL) in batch 9040803.	None	Laboratory contaminant	Anthracene not detected in associated samples. Reanalysis extractions performed three days after extraction holding time expired. Reanalysis results comparable to original sample results; reanalysis results used only for comparison. No action taken.	Usable
	8270-SIM	Naphthalene method blank contamination at 0.0213 ug/l in batch 9040665.	None	Laboratory contaminant	Analyte not detected in associated samples, no action taken.	Usable
	515.3	Acifluorfen (132%), 2,4-D (133%), 2,4-DB (133%, 133%, 149%, 158%), picloram (154%, 151%, 163%, 170%), 2,4,5-T (131%, 131%, 133%, 137%) MS1/MSD1/MS2/MSD2 recoveries greater than upper acceptance limits for batch 9040052.	None	Matrix effects	No RPD failures. Except for 2,4-D, analytes not detected. No other QC issues, no action taken.	Usable
	515.3	2,4-D (134%, 135%), 3,5-dichlorobenzoic acid (134%), and picloram (179%, 181%) MS/MSD recoveries greater than upper acceptance limits in batch 9040301.	None	Matrix effects	Except for 2,4-D, analytes not detected. No other QC issues, no action taken.	Usable
	515.3	2,4-DB (134%, 136%) and picloram (174%, 172%) MS/MSD recoveries greater than upper acceptance limits in batch 9040609.	None	Matrix effects	Analytes not detected, no other QC issues, no action taken.	Usable
	515.3	2,4,5-T (267%) MSD recovery greater than upper acceptance limit in batch 9050114, RPD (72.4%) failed.	None	Matrix effects	Analyte not detected, no other QC issues, no action taken.	Usable

Notes: * = Some samples from separate Events analyzed as part of the same analytical batches by TA
Batch numbers are included in Laboratory Reports presented in Appendix C of the *Annual Stormwater Discharge Monitoring Report – Year 4* , July 2009.
DEHP = di(2-ethylhexyl)phthalate
DUP = field duplicate
LCS/LCSD = laboratory control sample/laboratory control sample duplicate
MDL = method detection limit
MRL = method reporting limit
MS/MSD = matrix spike/matrix spike duplicate
QC = quality control
RPD = relative percent difference
TA = TestAmerica

Table 7-1: Summary of Year 4 MADL Exceedances - Common Pollutants

Analyte	Location Code	Traffic Category (TPD)	MADL (ug/L)	Event [concentration (µg/L)] [1]				
				1	2	3	4	5
Benzo(a)pyrene	SP3_6	≥1000	0.2	<0.00962	0.0293, 0.0303 [2]	**0.245** [3]	0.0276	0.0354
Di(2-ethylhexyl) phthalate	P4_6	≥1000	6.0	**7.39**, <0.962	<0.971	1.11, 1.05	1.77	1.21
	P6_1	≥1000		1.3, 1.28	4.06	**9.11**	5.14	3.4
	P6_11	<1000		<0.98	<0.971	1.03	1.27	**14.9**
	P6_14	≥1000		1.47	2.32	2.03	**9.74**	1.83
	P6_5	≥1000		1.5	1.52	**8.58**	3.91	3.78
	SP3_10	<1000		<0.962	<0.962	<1.05	**7.89**	<1
	SP3_2	≥1000		<0.962	<1	1.47	**7.26**	**7.47**
	SP3_6	≥1000		1.16	2.54, 2.39	**11.2**	**11.7**	4.42
	SP3_8	≥1000		4.2	1.91	**12.2**	**10**	3.64
	SP3_9	<1000		<0.962	1.23	2.27	**9.19**	2.49, 3.66
Lead (total)	P6_11	<1000	50.0	6.71	4.66	14.8	**62.6**	7.1
	P6_5	≥1000		26.5	22.2	**91.4**	26.4	24.3
	SP3_2	≥1000		5.55	**68.4**	9.21	7.67	5.49
	SP3_6	≥1000		14.6	16.4, 16.6	**53.2**	14.6	9.94
	SP3_8	≥1000		26	**51.6**	**87.4**	**129**	**65**
Pentachlorophenol	P4_2	≥1000	1.0	0.184	**1.17, 1.26**	**1.01**	**1.09**, 0.809	0.631
	P4_3	≥1000		**1.12**	0.679	**1.01**	0.705	0.564
	P6_1	≥1000		0.61, 0.693	**3.79**	0.692	**1.55**	**1.08**
	P6_14	≥1000		**1.15**	1	**1.22**	**1.25**	0.848
	P6_2	≥1000		0.488	0.561	**1.11**	0.586	0.334
	P6_6	<1000		0.0506	<0.04, **5.2**	<0.04	<0.04	<0.04
	P6_7	<1000		0.743	0.866	**6.29**	**1.32**	0.586
	P6_9	<1000		<0.04	**1.11**	<0.04	<0.04	<0.04
	SP3_4	<1000		0.18	**1.09**	**1.2**	0.423	0.539
	SP3_6	≥1000		0.673	**2.86, 2.27**	**1.5**	**1.4**	**1.09**
	SP3_8	≥1000		**1.54**	0.416	**1.17**	**4.4**	**1.52**

Notes:

[1] This table includes only those analytes detected at concentrations ≥ the MADL during at least one sampling event.

[2] Duplicate samples reported as: sample concentration, duplicate concentration.

[3] Bolded numbers exceed the MADL.

Table 7-2: Priority Pollutant Screen Analyte Action Levels

Annual Mean Concentration Action Level	Compliance Response Action
≤ 50 % MADL	No further action. Return to PPS sampling frequency specified in the permit.
> 50 % MADL, but < MADL	Continue monitoring UIC at frequency of 5 sampling events per wet season, or request permit modification to return to normal PPS sampling frequency specified in permit
≥ MADL	Implement compliance response in accordance with permit

Table 7-3: Year 4 Annual Mean Concentrations - Common and Priority Pollutant Screen Analytes

Analysis	MADL (µg/L)	Location Code [1]	Traffic Category (TPD)	Average [2] (µg/L)	Geometric Mean [2] (µg/L)	Minimum [3] (µg/L)	Maximum [3] (µg/L)
Common Pollutants							
Benzene	5.0	P6_12	≥1000	1.0	0.4	< 0.2	4.31
Benzo(a)pyrene	0.2	P6_1	≥1000	0.1	0.05	0.0163	0.139
		SP3_6	≥1000	0.1	0.04	< 0.00962	0.245
Di(2-ethylhexyl) phthalate	6.0	P4_11	<1000	1.6	1.4	< 1	3.19
		P4_3	≥1000	3.1	2.8	< 1	3.86
		P4_9	<1000	1.7	1.4	< 0.962	3.99
		P6_1	≥1000	4.6	3.8	1.28	9.11
		P6_10	≥1000	2.1	1.7	< 0.98	5.14
		P6_11	<1000	3.8	1.8	< 0.971	14.9
		P6_12	≥1000	2.9	2.2	1	5.63
		P6_13	<1000	1.7	1.6	< 0.99	3.28
		P6_14	≥1000	3.5	2.6	1.47	9.74
		P6_15	≥1000	2.7	2.2	< 0.99	5.39
		P6_5	≥1000	3.9	3.1	1.5	8.58
		P6_7	<1000	2.6	2.1	< 0.971	5.13
		P6_8	<1000	2.5	2.2	< 0.971	4.73
		SP3_1	<1000	1.9	1.6	< 0.962	4.46
		SP3_10	<1000	2.4	1.5	< 0.962	7.89
		SP3_2	≥1000	3.6	2.4	< 0.962	7.47
		SP3_6	≥1000	6.2	4.4	1.16	11.7
		SP3_8	≥1000	6.4	5.1	1.91	12.2
		SP3_9	<1000	3.5	2.5	< 0.962	9.19
Lead (total)	50.0	P4_1	<1000	8.9	3.5	1.01	35
		P4_15	≥1000	14.3	11.2	3.43	28.3
		P4_3	≥1000	19.5	12.5	2.88	40.2
		P6_1	≥1000	27.5	20.1	4.2	46.5
		P6_10	≥1000	11.7	9.1	3.11	28.7
		P6_11	<1000	19.2	11.6	4.66	62.6
		P6_12	≥1000	12.1	9.9	4.56	28.2
		P6_14	≥1000	11.6	9.1	4.03	25.7
		P6_5	≥1000	38.2	32.2	22.2	91.4
		SP3_2	≥1000	19.3	10.8	5.49	68.4
		SP3_6	≥1000	21.8	18.0	9.94	53.2
		SP3_8	≥1000	71.8	**62.9**	26	129

Table 7-3: Year 4 Annual Mean Concentrations - Common and Priority Pollutant Screen Analytes

Analysis	MADL (µg/L)	Location Code [1]	Traffic Category (TPD)	Average [2] (µg/L)	Geometric Mean [2] (µg/L)	Minimum [3] (µg/L)	Maximum [3] (µg/L)
Pentachlorophenol	1.0	P4_15	≥1000	0.6	0.578	0.344	0.826
		P4_2	≥1000	0.8	0.7	0.184	1.26
		P4_3	≥1000	0.8	0.8	0.564	1.12
		P4_6	≥1000	0.2	0.1	0.0532	0.818
		P4_9	<1000	0.3	0.3	0.133	0.529
		P6_1	≥1000	1.6	**1.2**	0.692	3.79
		P6_12	≥1000	0.4	0.404	0.287	0.576
		P6_14	≥1000	1.1	**1.1**	0.848	1.25
		P6_15	≥1000	0.5	0.388	0.206	0.974
		P6_2	≥1000	0.6	0.6	0.334	1.11
		P6_4	<1000	0.3	0.2	0.0728	0.655
		P6_5	≥1000	0.3	0.3	0.11	0.565
		P6_6	<1000	1.1	0.1	< 0.04	5.2
		P6_7	<1000	2.0	**1.3**	0.586	6.29
		P6_9	<1000	0.3	0.078	< 0.04	1.11
		SP3_4	<1000	0.7	0.6	0.18	1.2
		SP3_6	≥1000	1.4	**1.3**	0.673	2.27
		SP3_7	≥1000	0.3	0.3	0.112	0.538
		SP3_8	≥1000	1.8	**1.4**	0.416	4.4
Priority Pollutant Screen							
Antimony (total)	6.0	P4_3	≥1000	3.2	2.8	1.37	5.41
		SP3_6	≥1000	2.1	1.9	1.19	3.98
		SP3_8	≥1000	3.6	3.5	2.38	4.21

Notes:

[1] Table includes only those UIC monitoring locations where the concentration was ≥50% of the MADL in at least one sample.

[2] Most concentrations are rounded to one decimal place.

[3] Minimum concentrations may be either MRL or MDL values (i.e., < symbol not shown).

[4] Bold, shaded text indicates pollutant concentration geometric mean exceeds the MADL.

Table 7-4: UIC Stormwater Discharge Volume[a]

Ownership	Total of UICs [b]	Sum of Total UIC Catchment Area [c] (ft^2)	Sum of Total Impervious Area Drainage[c] (ft^2)	Sum of Total UIC Catchment Area[c] (acre)	Sum of Total Impervious Area Drainage[c] (acre)	Adjusted Sum of Total UIC Catchment Area[f] (ft^2)	Adjusted Sum of Impervious Area Drainage[f] (ft^2)	Adjusted Sum of Total UIC Catchment Area [f] (acre)	Adjusted Sum of Impervious Area Drainage[f] (acre)	Year 1 Annual Infiltration Volume [h,i] (ft^3)	Year 2 Annual Infiltration Volume[h,i] (ft^3)	Year 3 Annual Infiltration Volume[h,i] (ft^3)	Year 4 Annual Infiltration Volume[h,i] (ft^3)
BES	9,176	717,968,479	284,192,231	16,441	6,508	616,698,216	250,996,836	14,122	5,748	661,999,970	532,602,735	525,328,010	421,005,359
BGS	20	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]
Fire	21	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]
Parks	189	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]	-[d]
Water	37	-[d]	37,150	-[d]	0.9	-[d]	37,150	-[d]	0.9	97,983	78,830	77,754	62,313
Sum	9,443	717,968,479	284,229,381	16,441	6,509	616,698,216	251,033,986	14,122	5,749	662,097,953	532,681,566	525,405,764	421,067,672
Average per UIC[e]	-	89,111	35,277	2.0	0.8	-	-	-	-	NA	NA	NA	NA
Adjusted Average per UIC	-	-	-	-	-	80,091	31,153	1.75	0.71	82,165	66,104	65,201	52,253

Notes:

[a] The volume of stormwater infiltrated estimated to discharge into the City's UIC is based on unverified subcatchment delineations. These delineations are likely to change due to refined mapping or modeling, or due to changes in the field.

[b] Approximately 520 BES UICs are identified in the UIC database to have a service status of "ABAN" (Abandoned); these were not included in the catchment/impervious area calculation or discharge volume estimation.

[c] Non-BES UICs with "Unknown" or "N/A" impervious/catchment drainage areas were given values of zero. In addition, 783 BES UICs were not included in calculation because they were identified as being inside a catchment area with at least one other UIC (e.g., UICs constructed in series).

[d] Denotes no UIC Catchment Area/Impervious Area Drainage reported for this classification of UIC.

[e] Average values for UICs with reported catchment areas > 0.

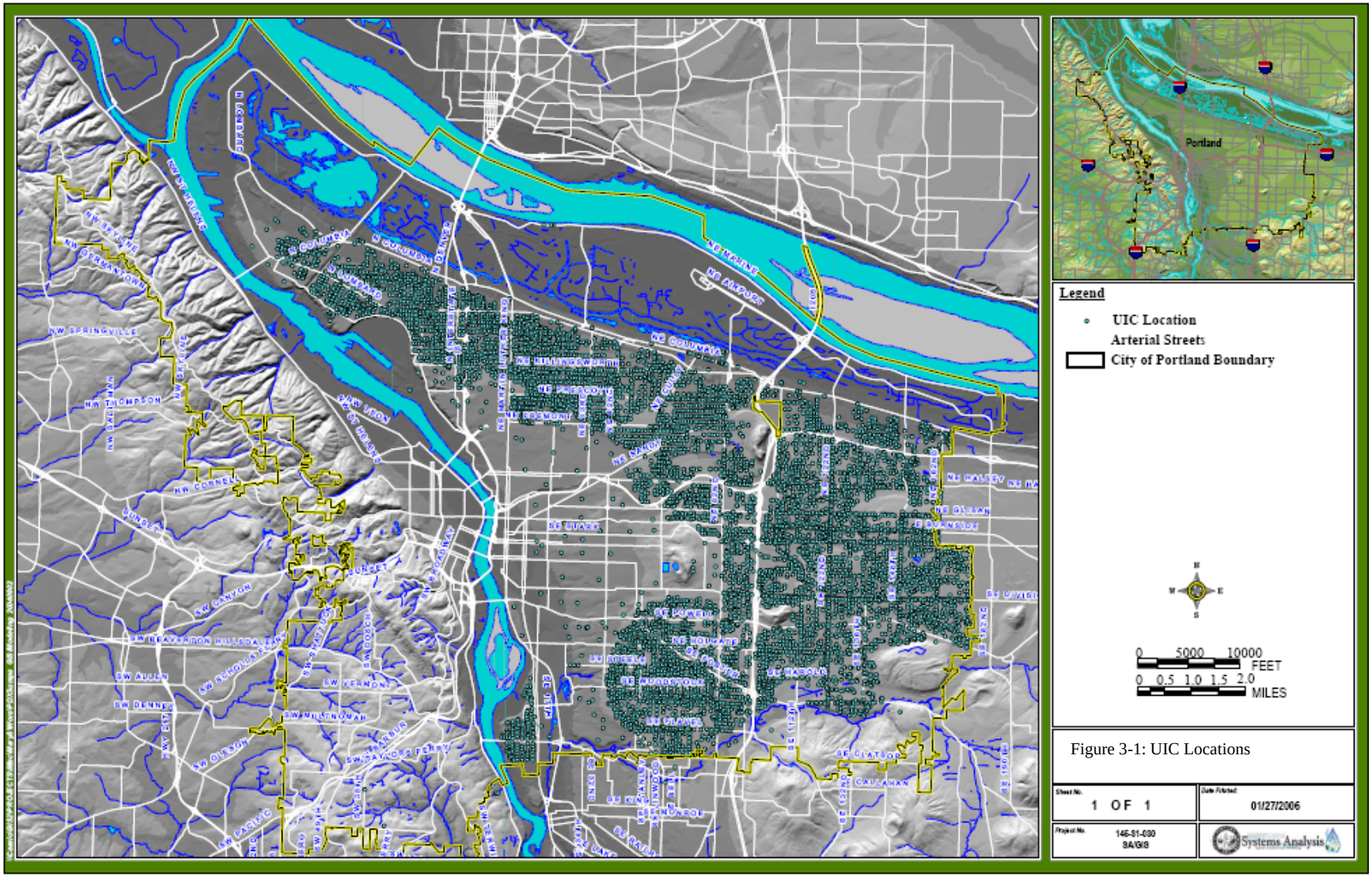
[f] Adjusted average values calculated by inserting "average" catchment areas for those reported as 0. In addtion, several UIC catchment areas and impervious area outlier values appeared anomalous (> +2 standard deviations). These values were also changed to average values: 89,111 and 35,277 square feet, respectively.

[g] Infiltration volume = Annual Precipitation (inches) * 1ft/12in *Imprevious Area (ft^2)*(1-Evaporative Loss Factor).

[h] Based on estimated Permit Year precipitation totals (See Table 5-7). Preliminary monthly National Weather Service climatological for Portland International Airport see http://www.weather.gov/climate/index.php?wfo=pqr.

[i] Infiltration volume calculation assumes that 26 percent of precipitation falling on impervious surfaces is lost to evaporation and 74 percent drains to the UIC (Snyder, D.T. and Others, 1994).

Figure 3-1: City of Portland UIC Locations



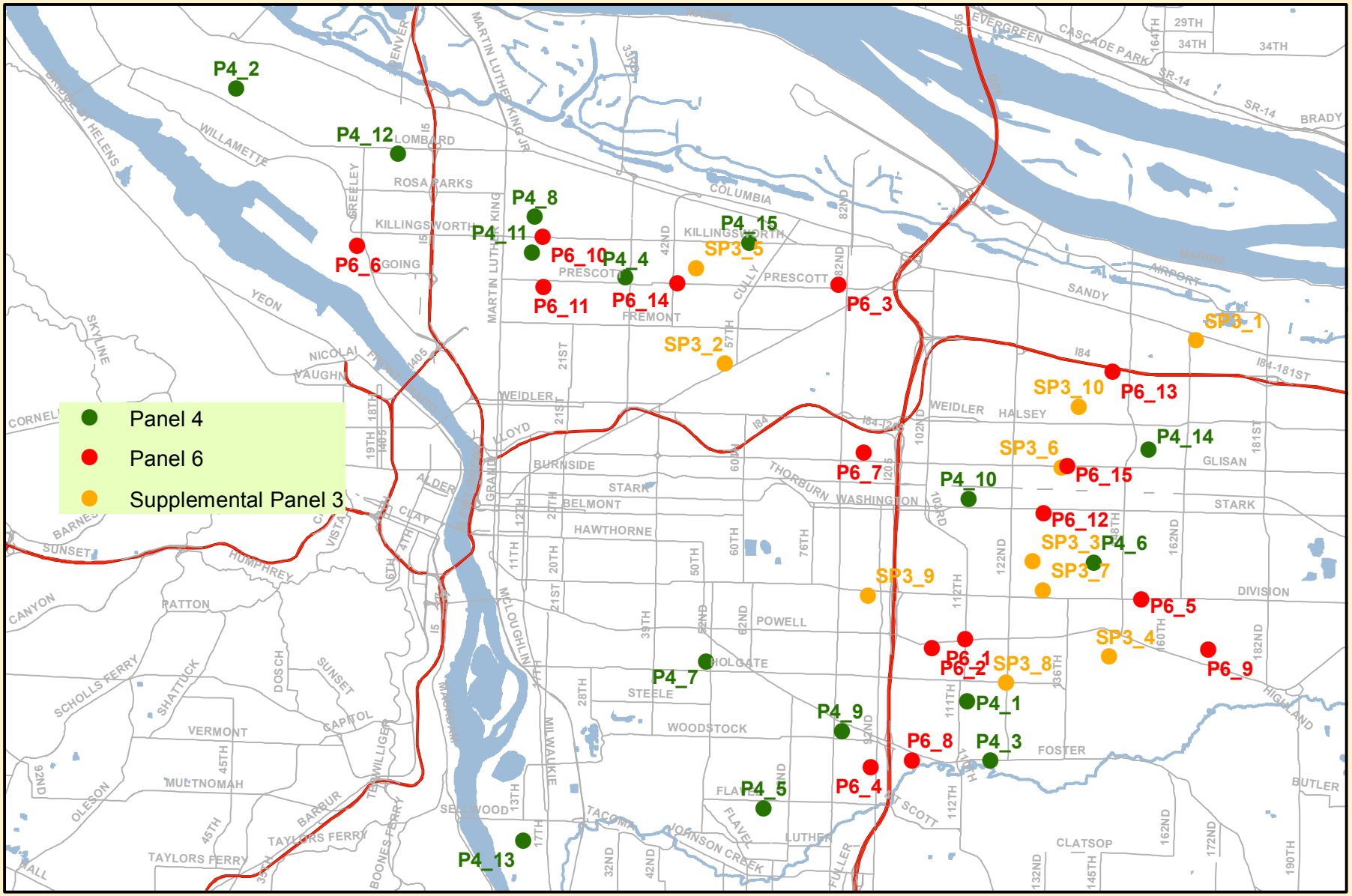


Figure 3-2
2008-09 (Year 4) UIC Monitoring Locations

Investigations & Monitoring Services
Bureau of Environmental Services

Source: ESRI Data & Maps CD
Created in ArcGIS 9.2 using ArcMap

Figure 5-1: Year 4 Event 1 Rain Gage Data

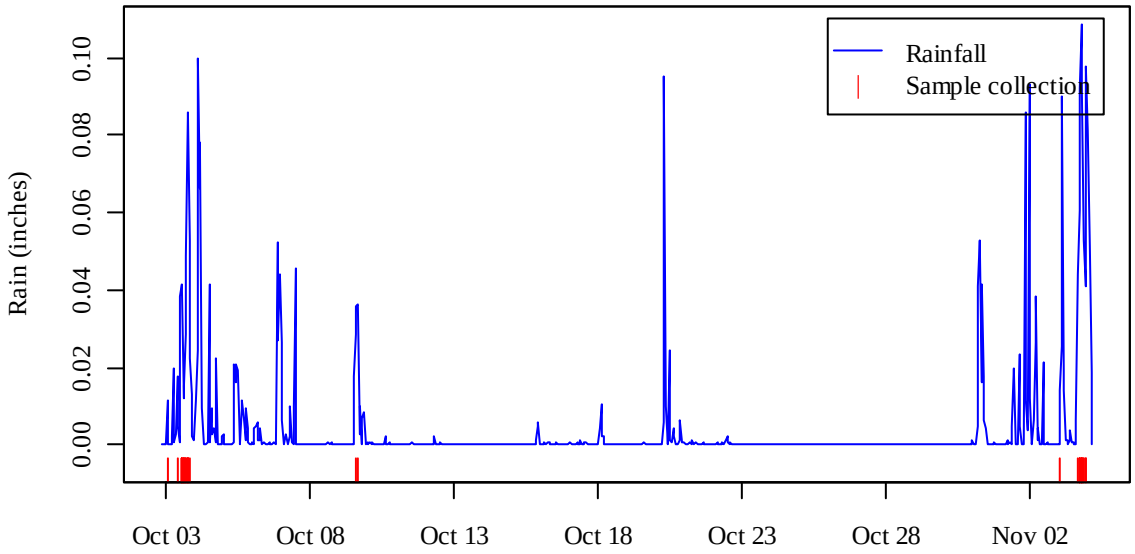


Figure 5-2: Year 4 Event 2 Rain Gage Data

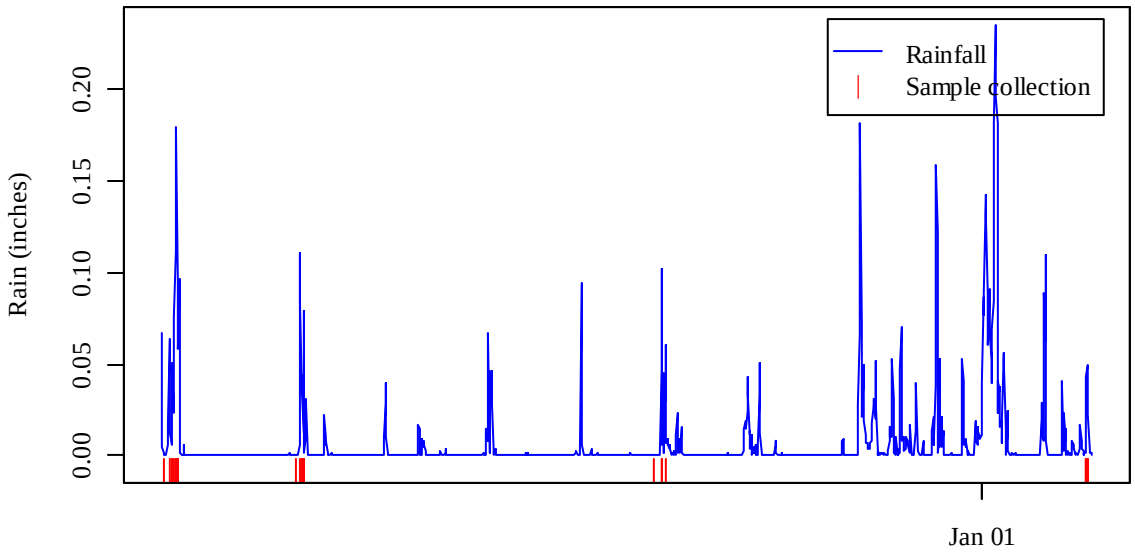


Figure 5-3: Year 4 Event 3 Rain Gage Data

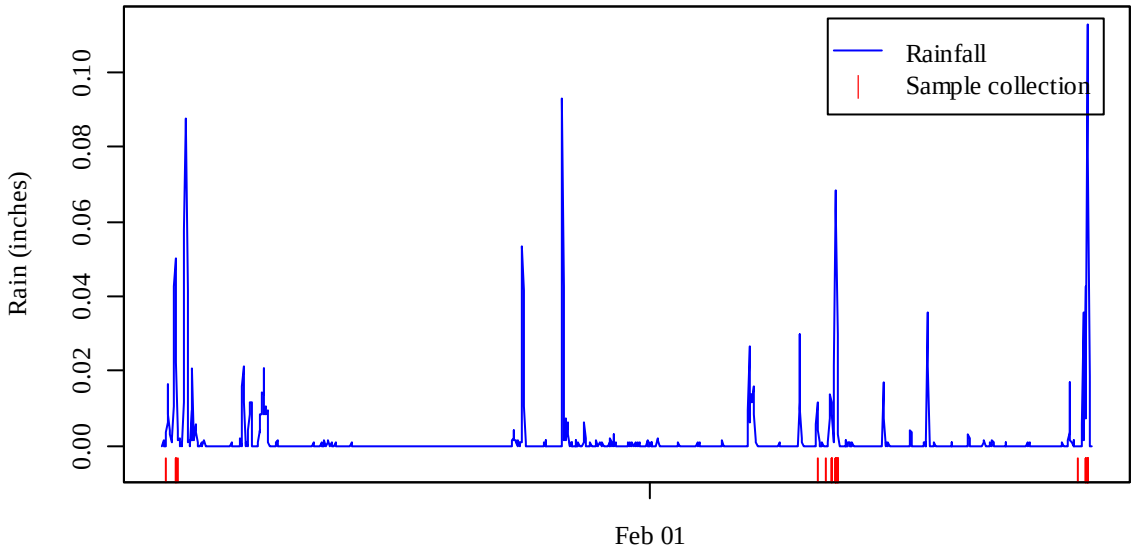


Figure 5-4: Year 4 Event 4 Rain Gage Data

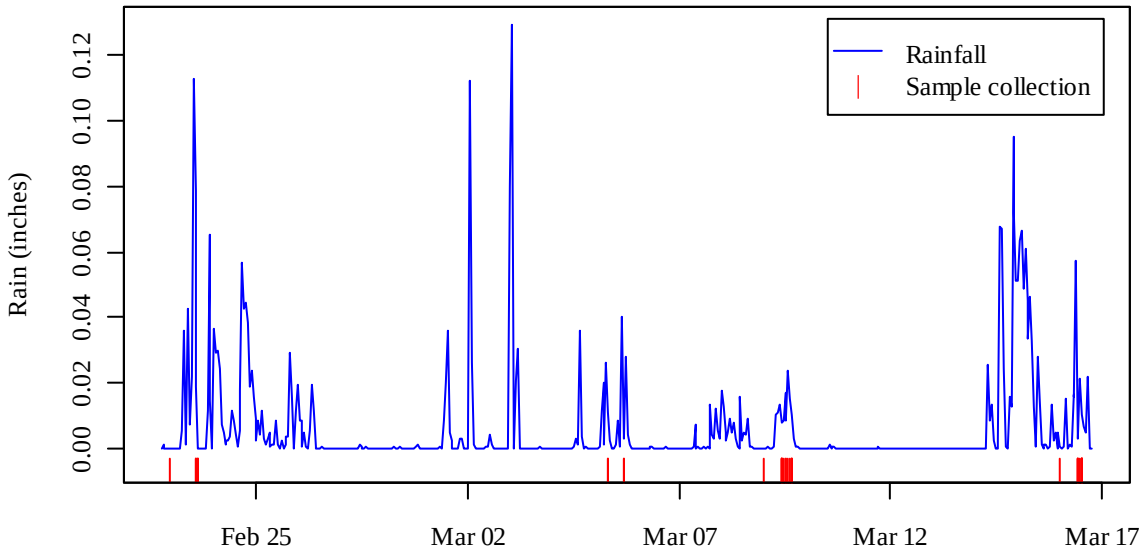


Figure 5-5: Year 4 Event 5 Rain Gage Data

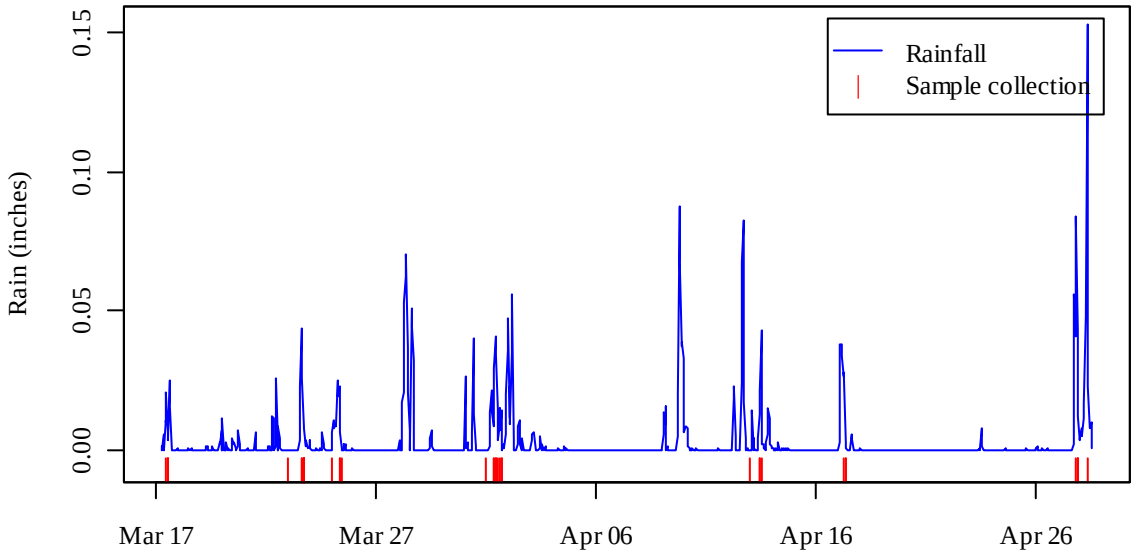
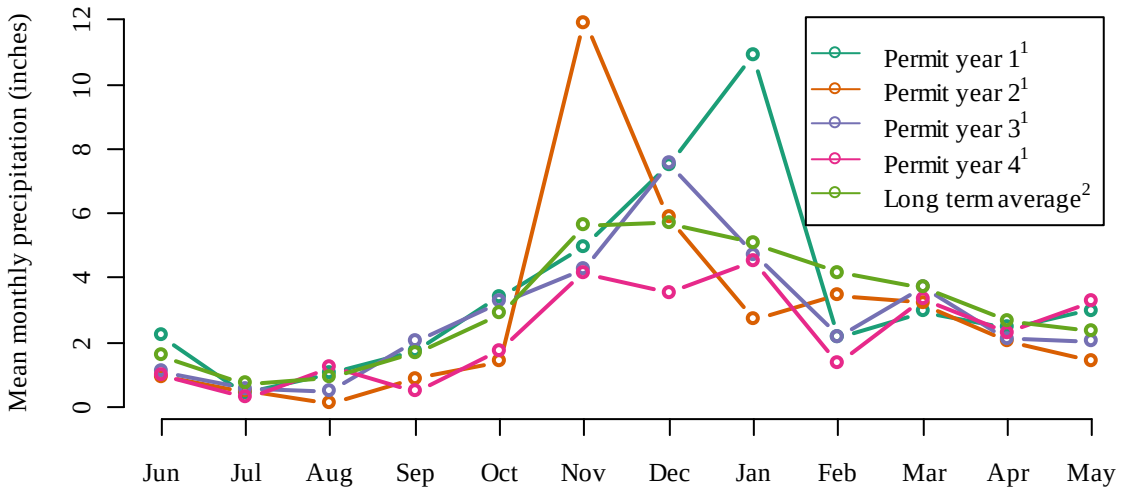


Figure 5-6: Regional Precipitation Data



1) Data source: Local Climatological Data - Portland Oregon.
From http://www.weather.gov/climate/index.php?wfo=pqr
2) Data source: Portland International Airport. Period 1971 - 2000.
From NOWData - NOAA Online Weather Data at http://nowdata.rcc-acis.org/PQR/pubACIS_results

Figure 7-1: Definition of a Box Plot

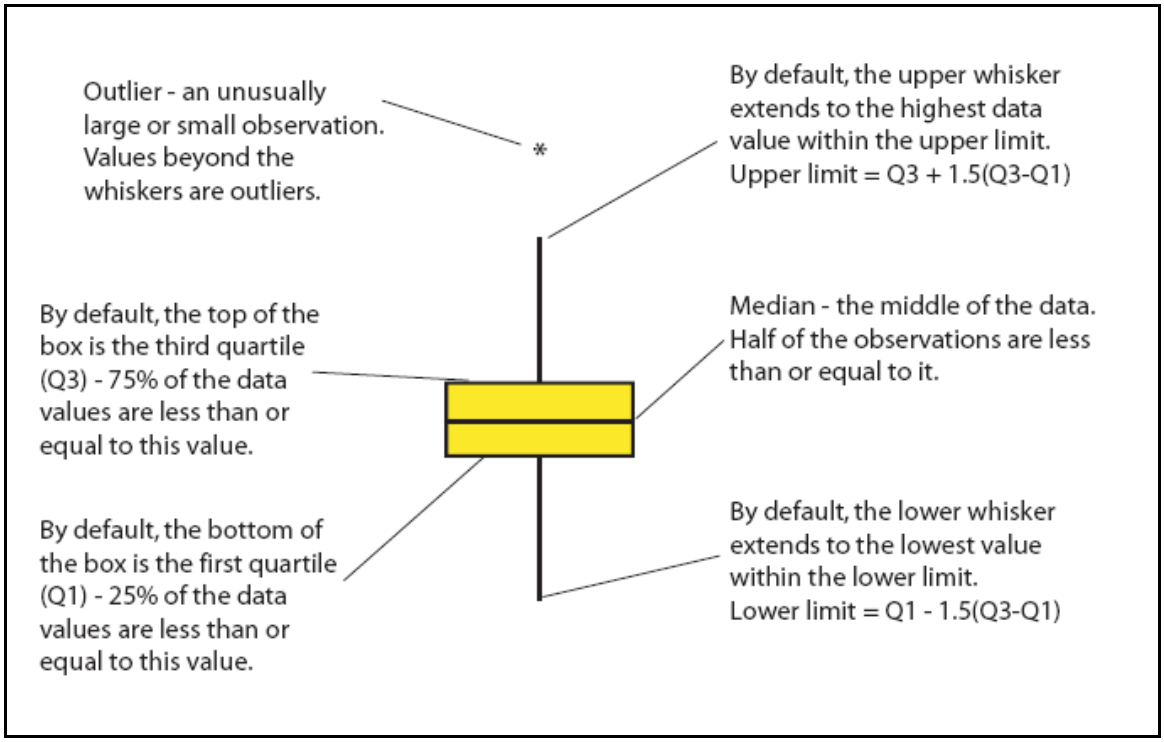


Figure note:
From Minitab®, version 14, 2006

Figure 7-10: Year 4 Total Suspended Solids Concentrations by Traffic Category

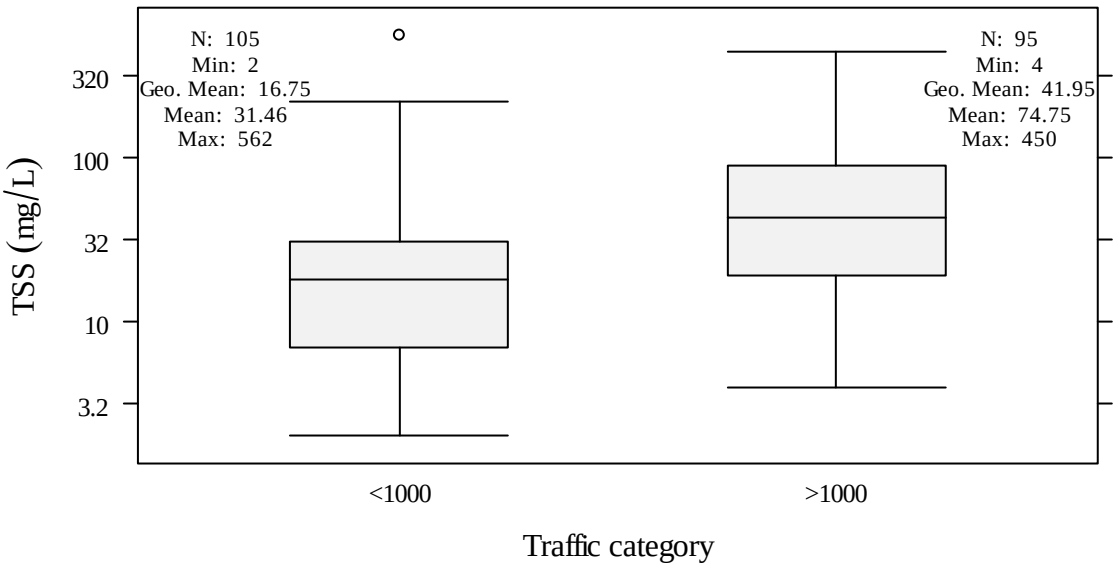
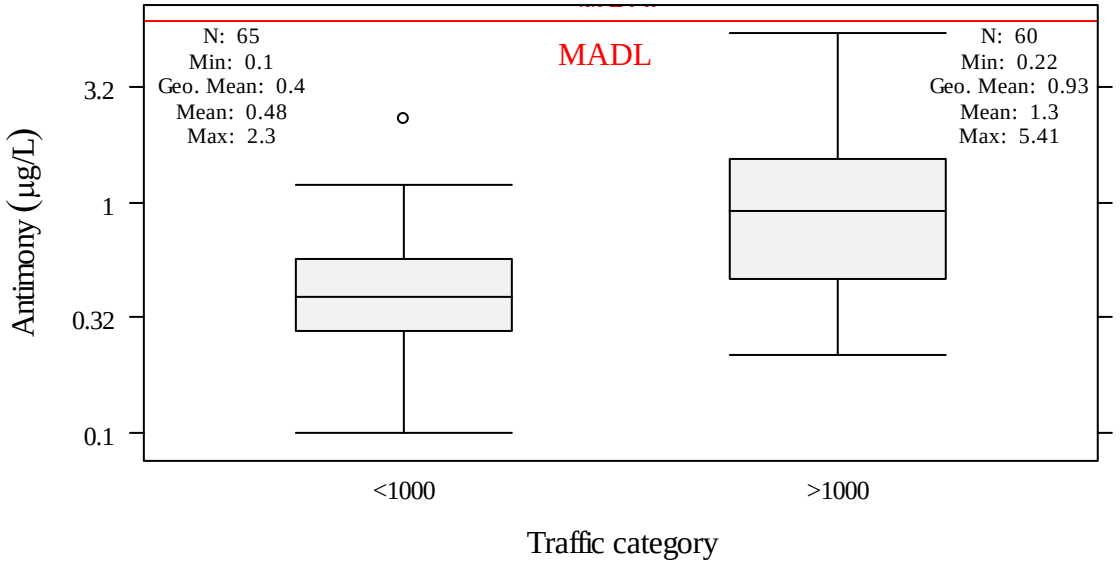


Figure 7-11: Year 4 Antimony Concentrations by Traffic Category

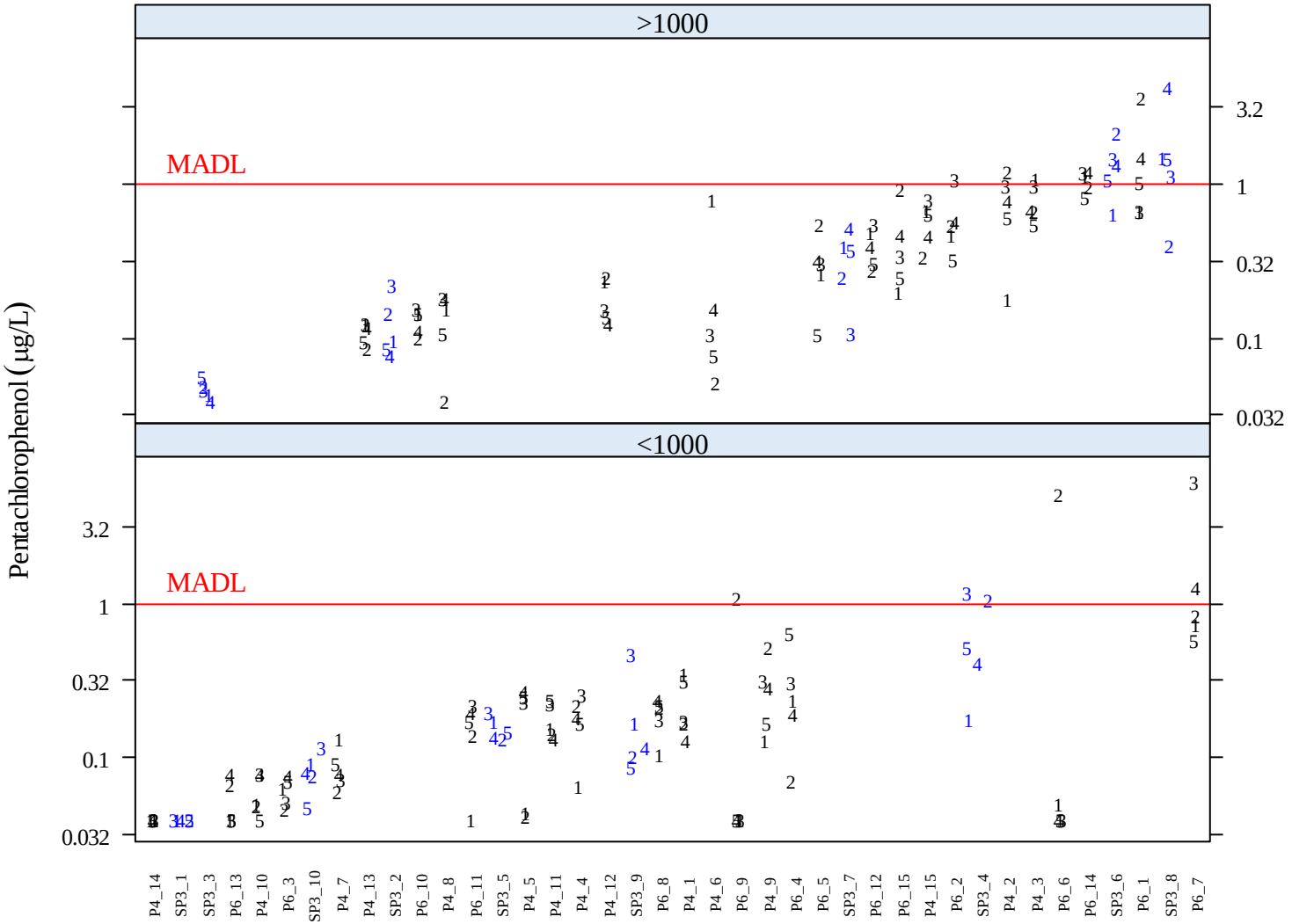


Notes:

These figures:

1) Summarize the results of the original UIC stormwater samples collected in Year 4;
2) Include the results of Panel 4, Panel 6, and Supplemental Panel 3;
3) Do not include duplicate sampling results; and
4) Plot sample concentrations < MRL at the MRL.

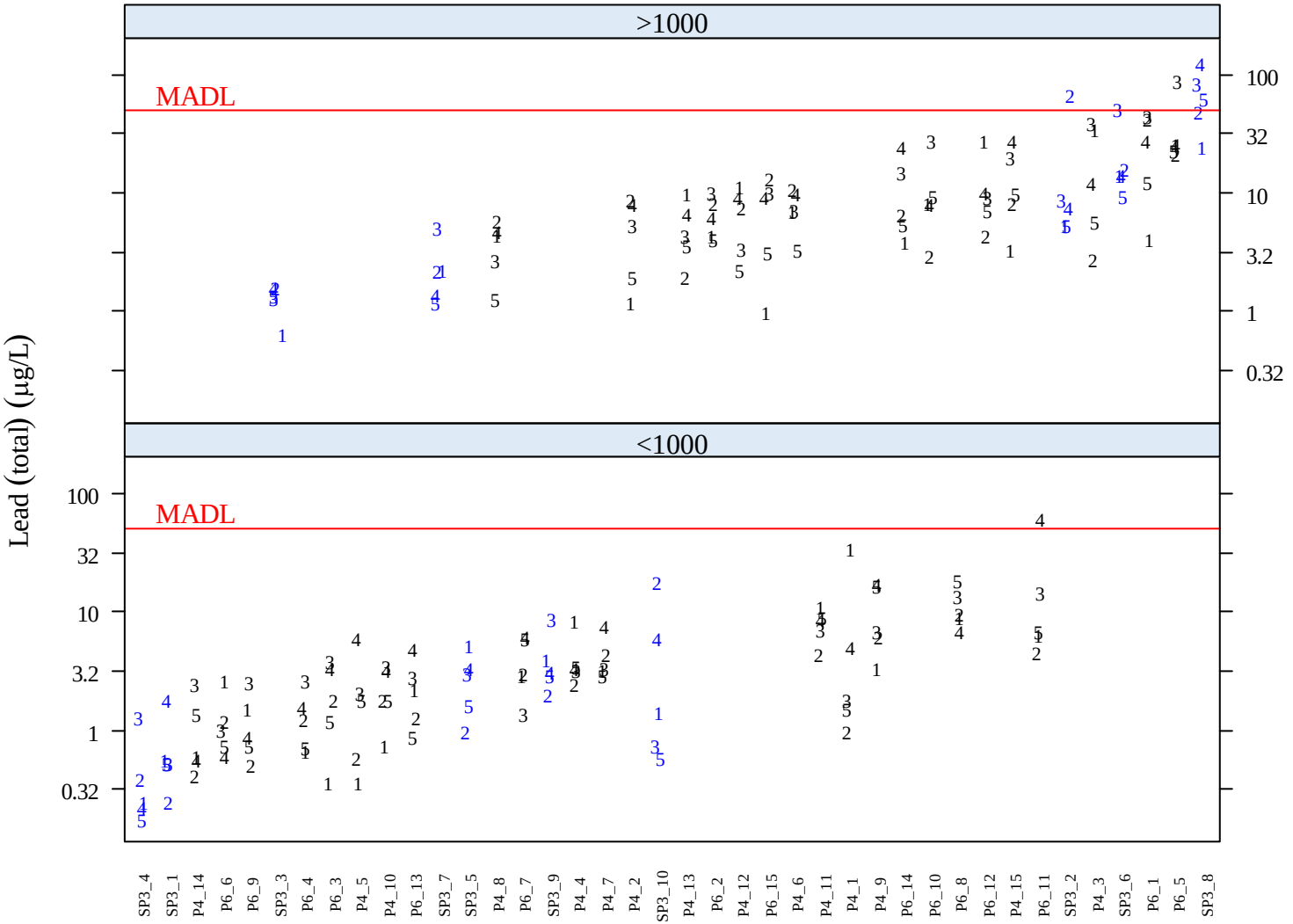
Figure 7-12: Year 4 Pentachlorophenol Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

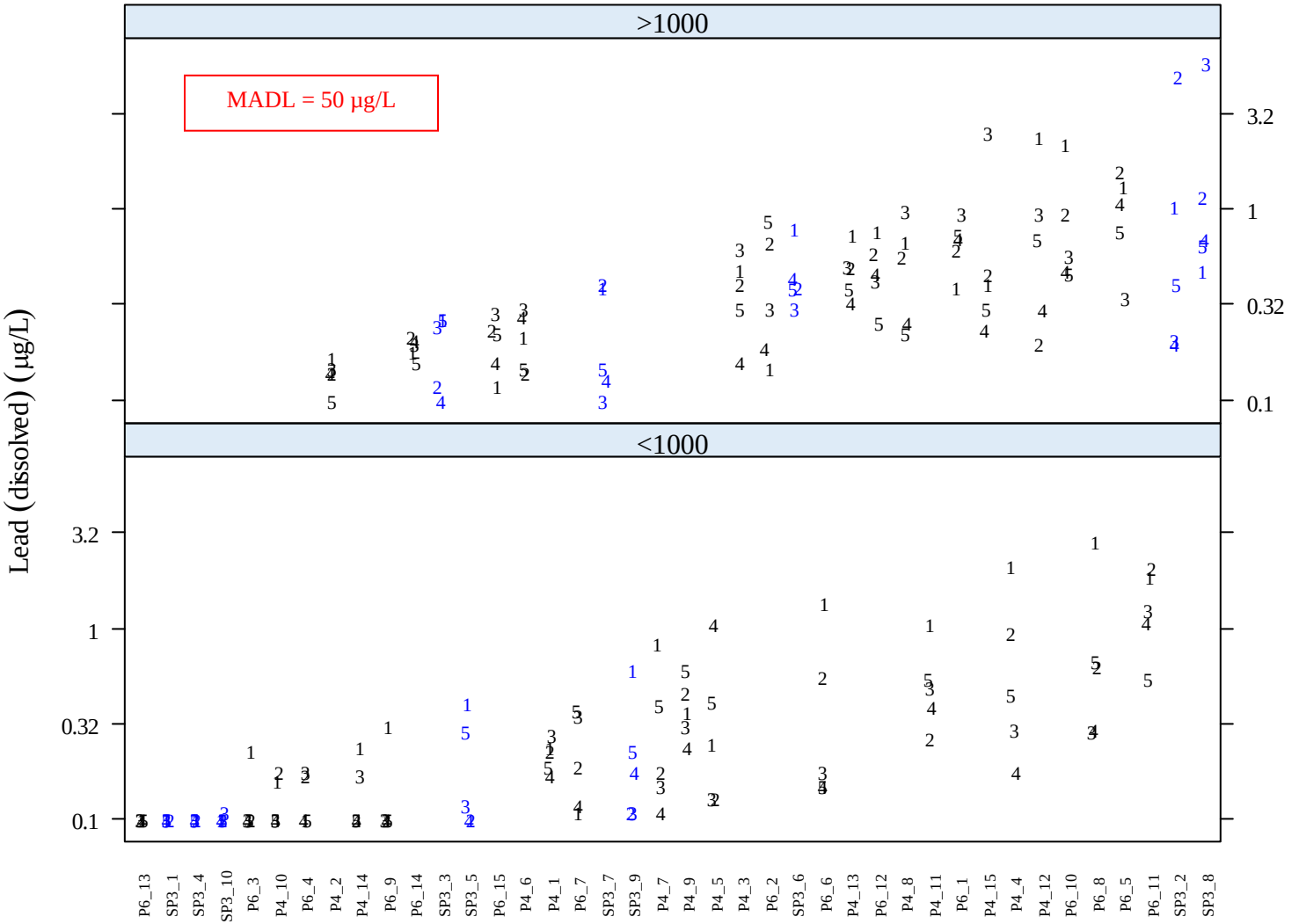
Figure 7-13: Year 4 Total Lead Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

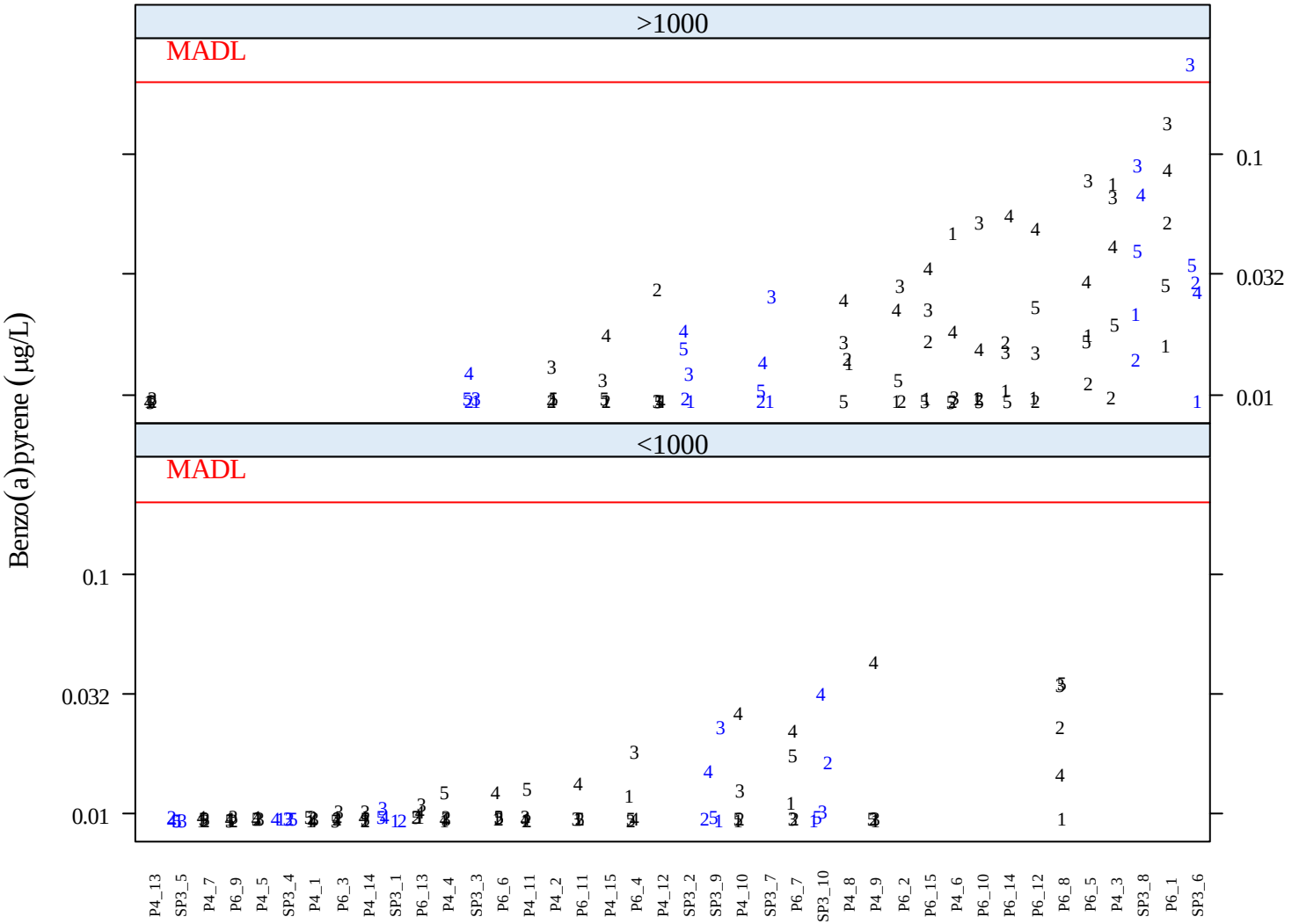
Figure 7-14: Year 4 Dissolved Lead Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

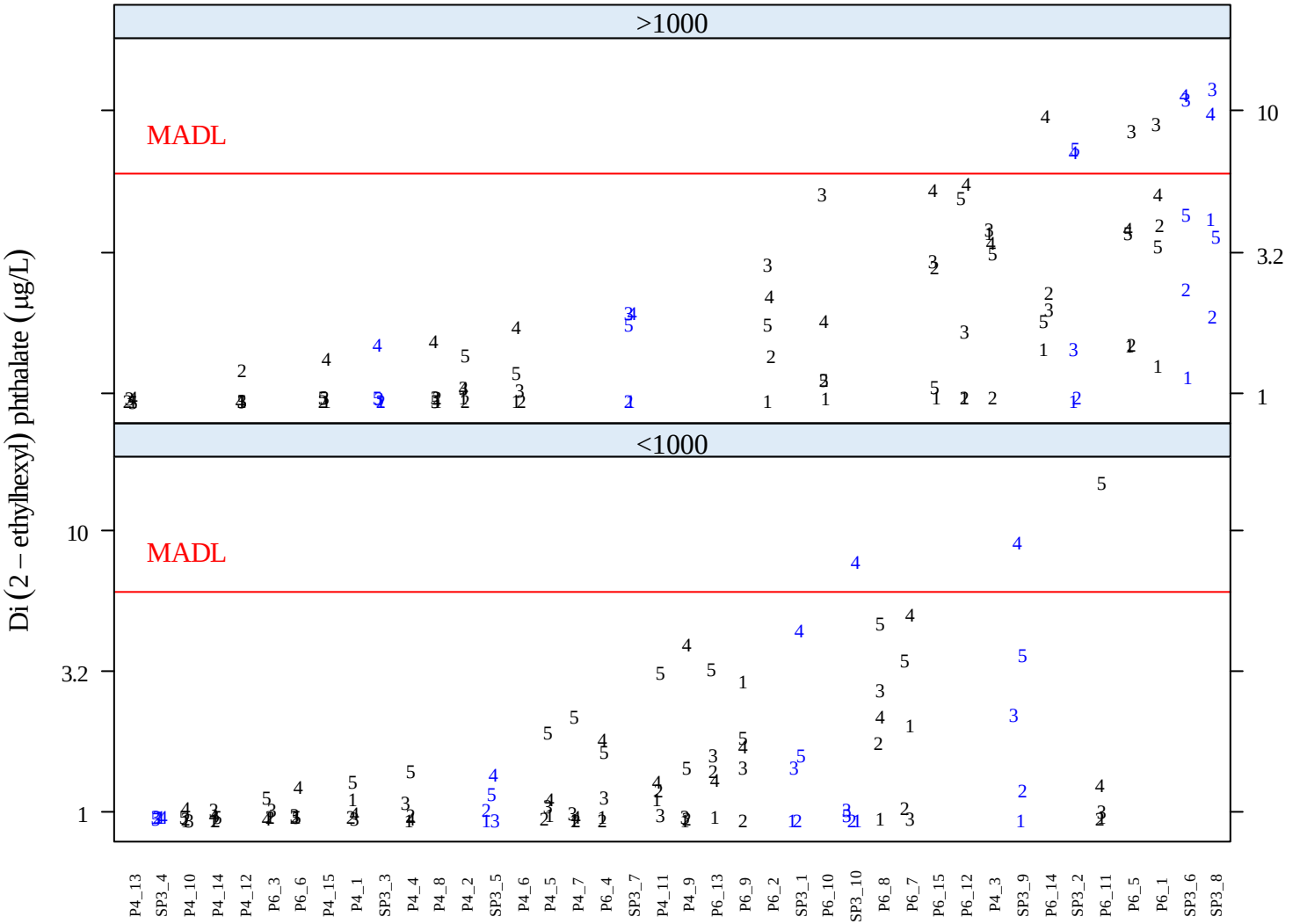
Figure 7-15: Year 4 Benzo(a)pyrene Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

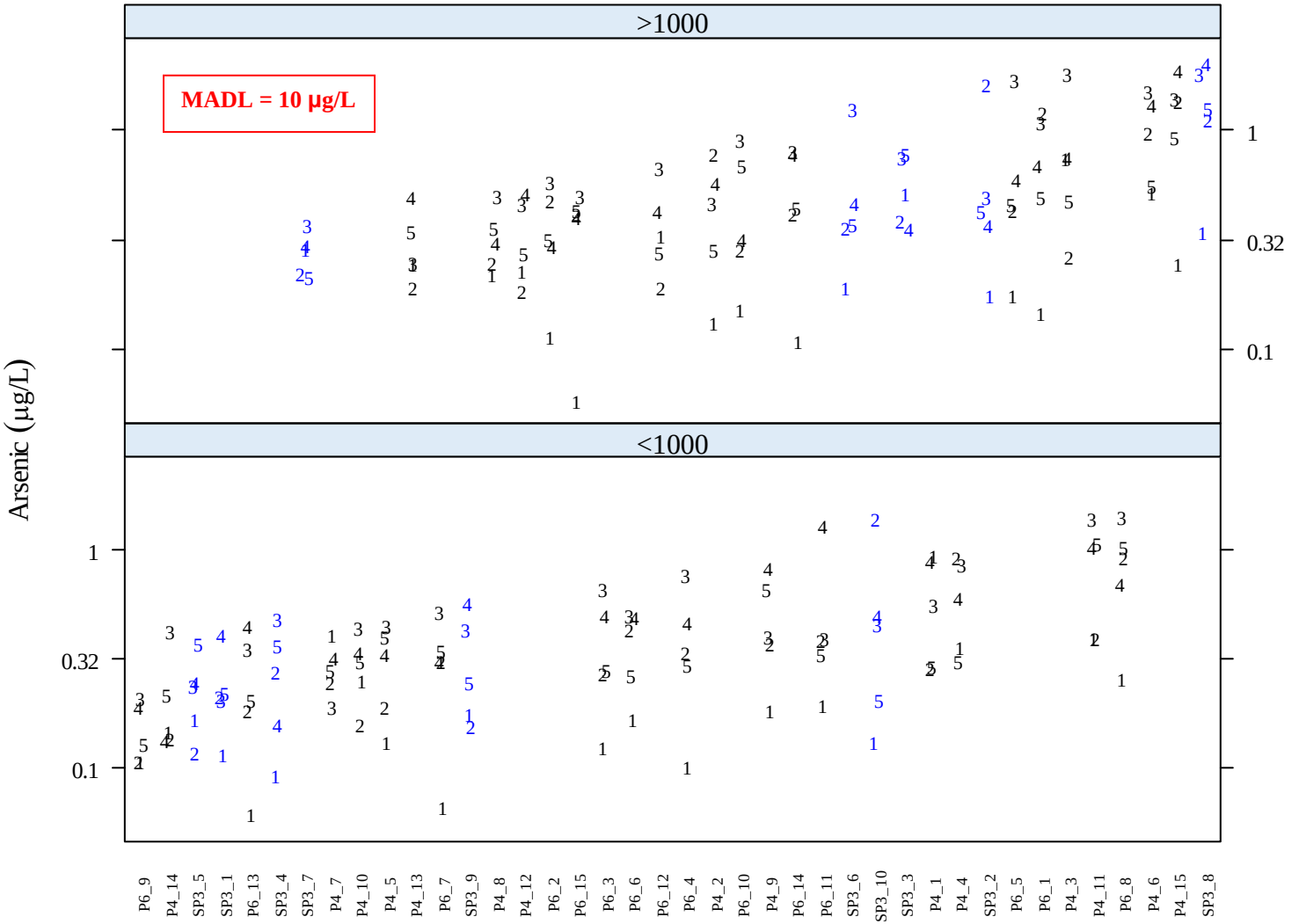
Figure 7-16: Year 4 Di(2-ethylhexyl)phthalate Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

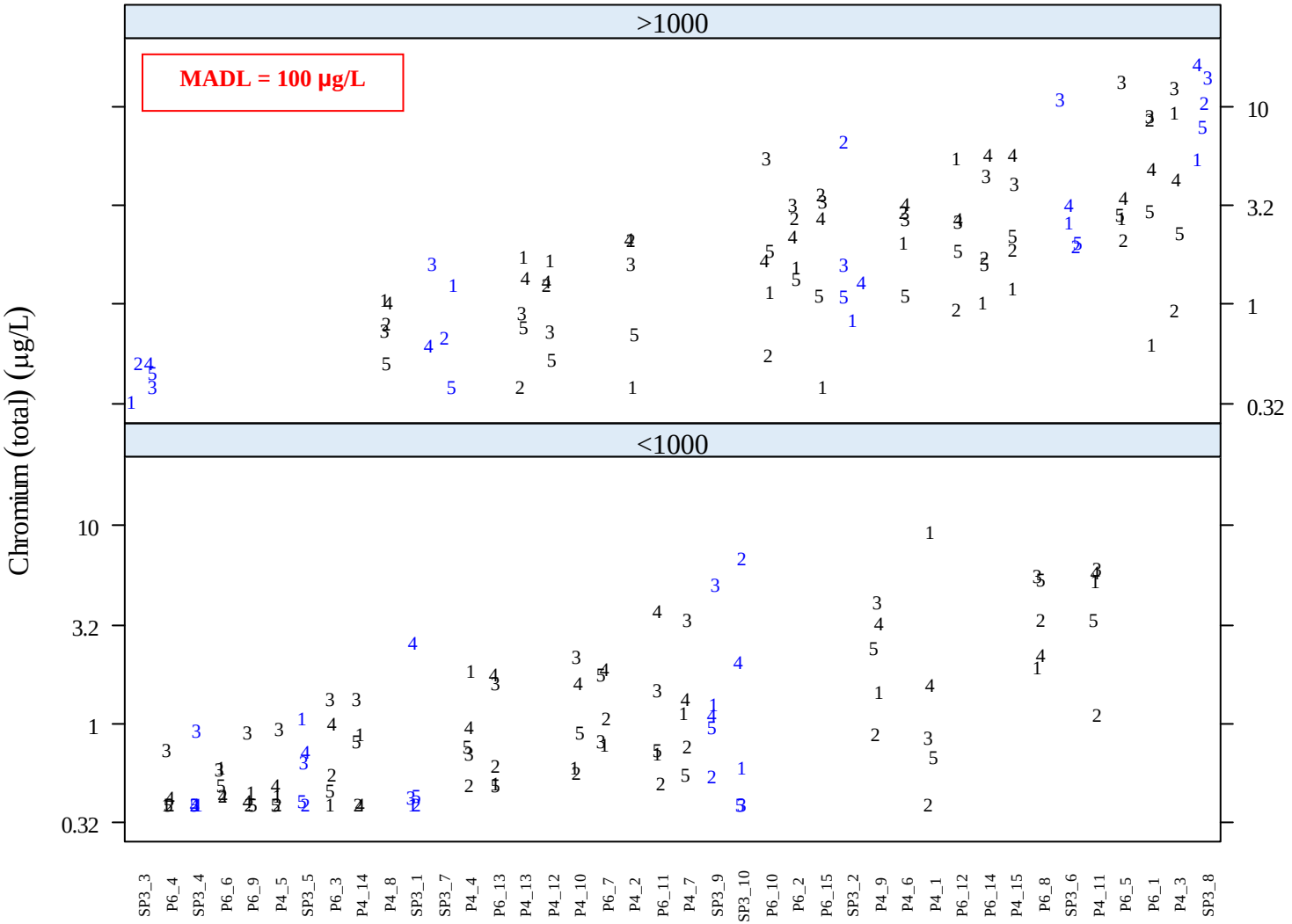
Figure 7-17: Year 4 Arsenic Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

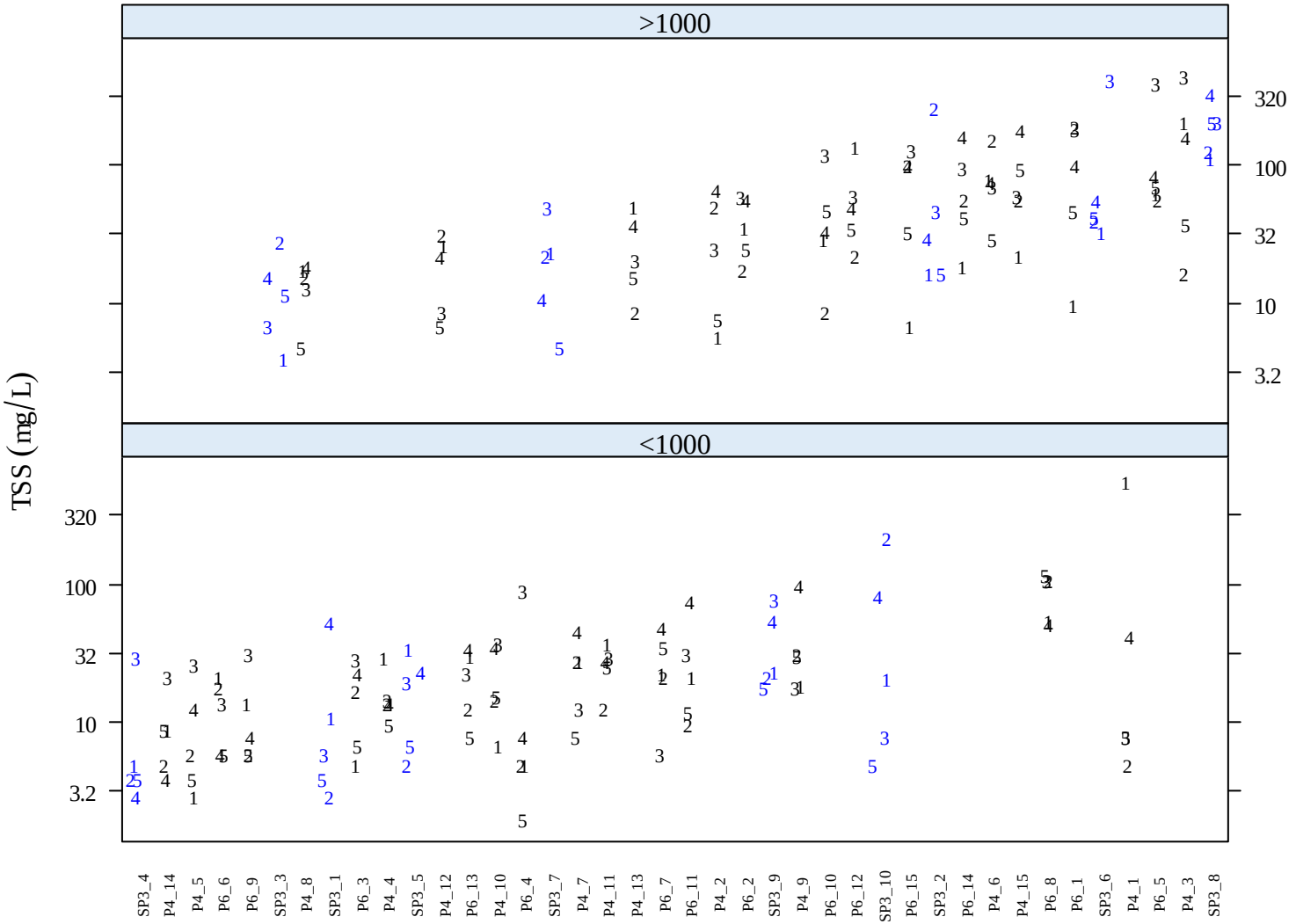
Figure 7-18: Year 4 Chromium Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

Figure 7-19: Year 4 Total Suspended Solids Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

Figure 7-2: Year 4 Pentachlorophenol Concentrations by Traffic Category

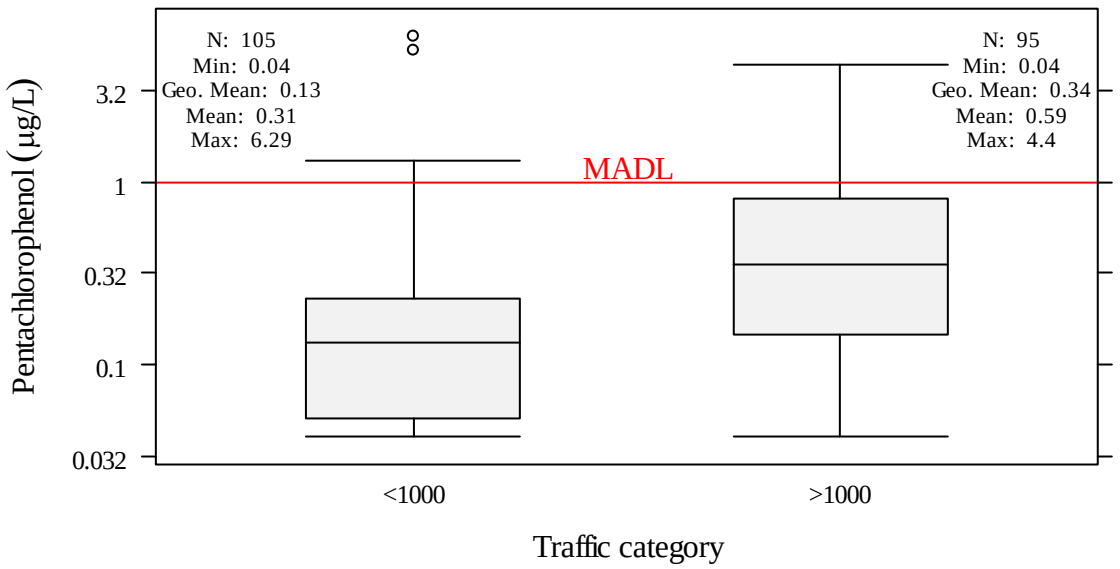
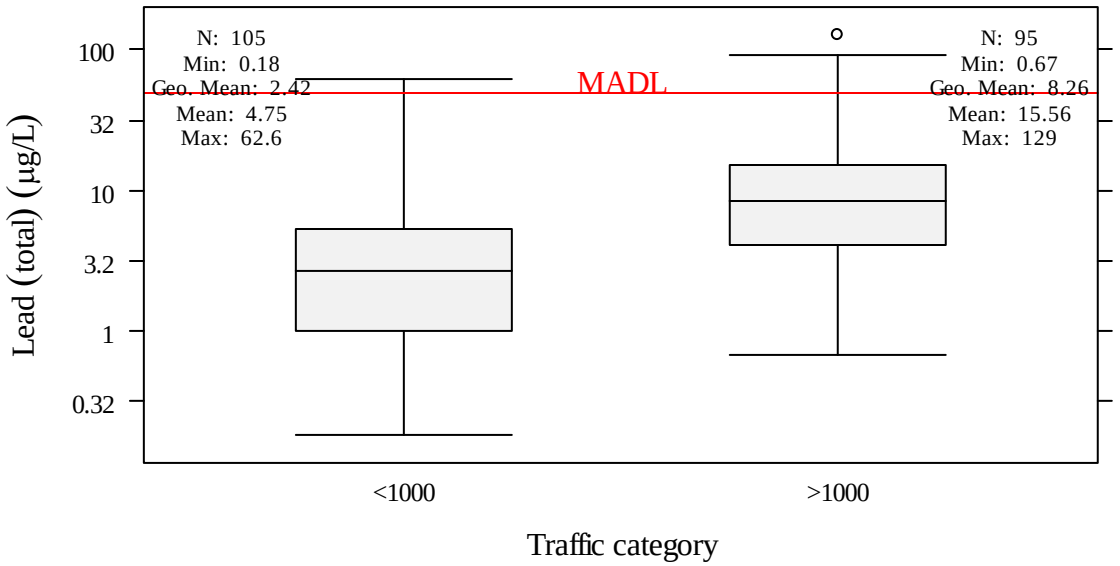


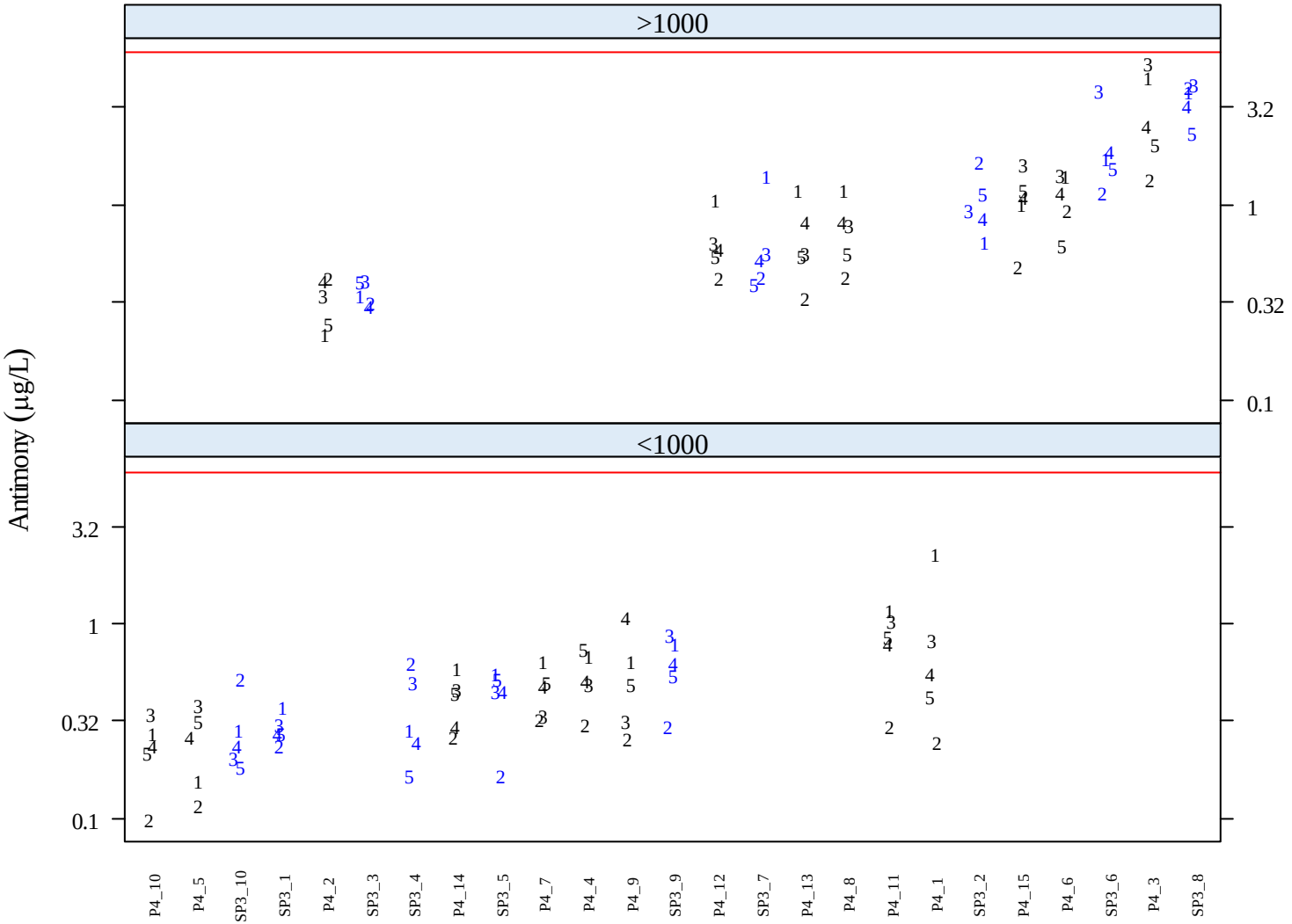
Figure 7-3: Year 4 Total Lead Concentrations by Traffic Category



Notes:
These figures:

1) Summarize the results of the original UIC stormwater samples collected in Year 4;
2) Include the results of Panel 4, Panel 6, and Supplemental Panel 3;
3) Do not include duplicate sampling results; and
4) Plot sample concentrations < MRL at the MRL.

Figure 7-20: Year 4 Antimony Concentrations by Sampling Event and Traffic Category



Notes:

(1, 2, 3, 4, 5) indicates Year 4 sampling event number.
<1000, >1000 indicates traffic category by estimated trips per day (TPD).
Concentrations are plotted on a logarithmic scale.
Data shown in blue are supplemental UIC monitoring locations.

Figure 7-21: Year 4 Pentachlorophenol Concentrations by Sample Event

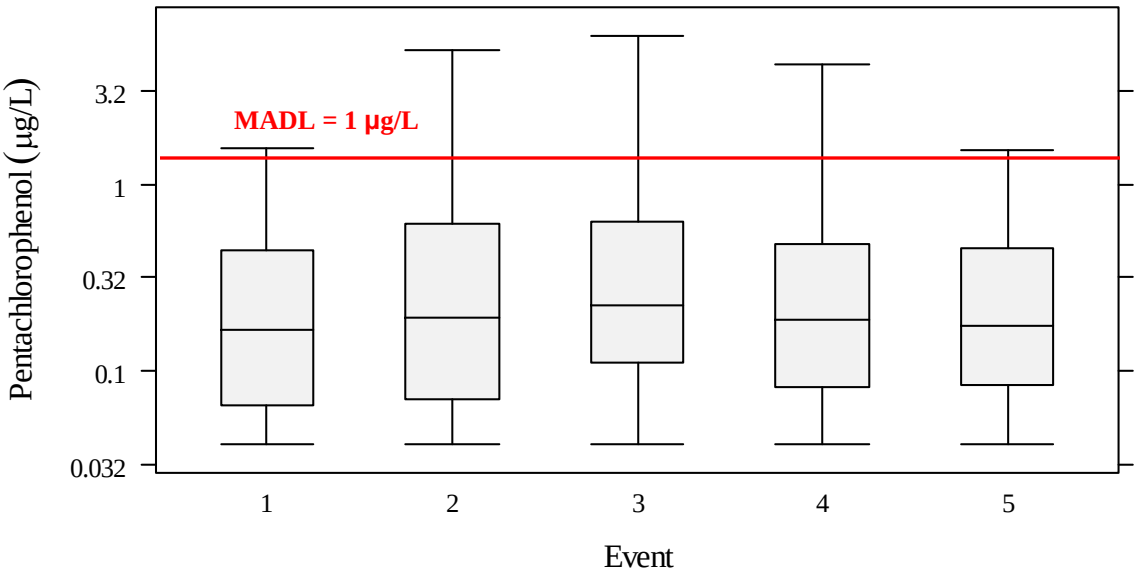


Figure 7-22: Year 4 Pentachlorophenol Concentrations by Sample Panel

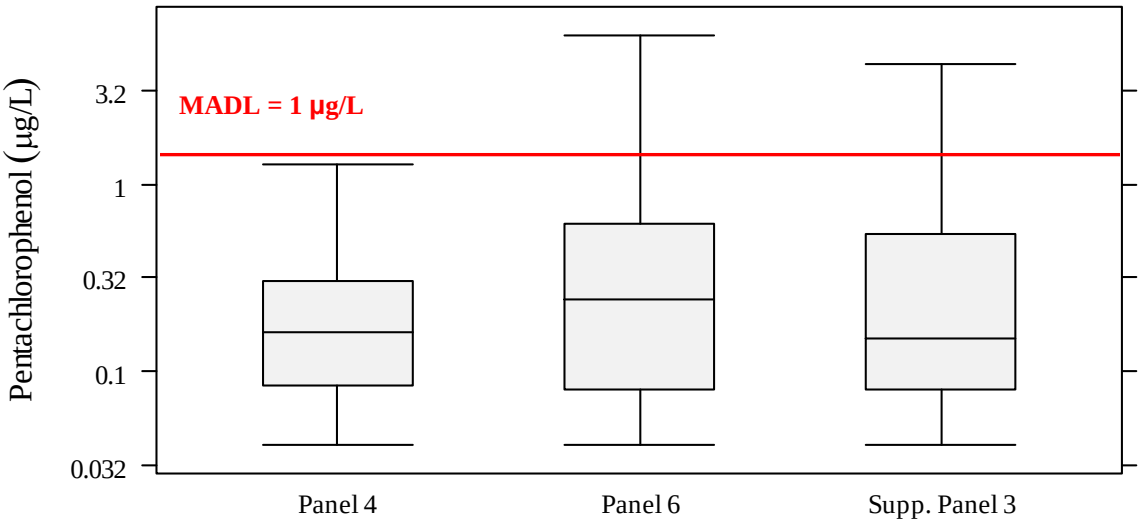


Figure 7-23: Year 4 Total Lead Concentrations by Sample Event

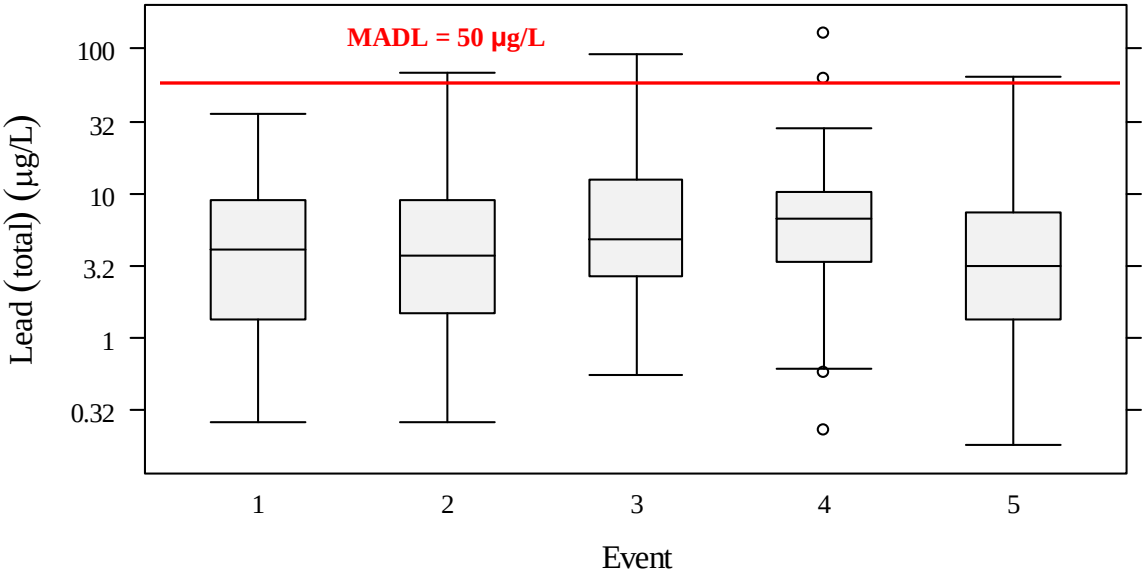


Figure 7-24: Year 4 Total Lead Concentrations by Sample Panel

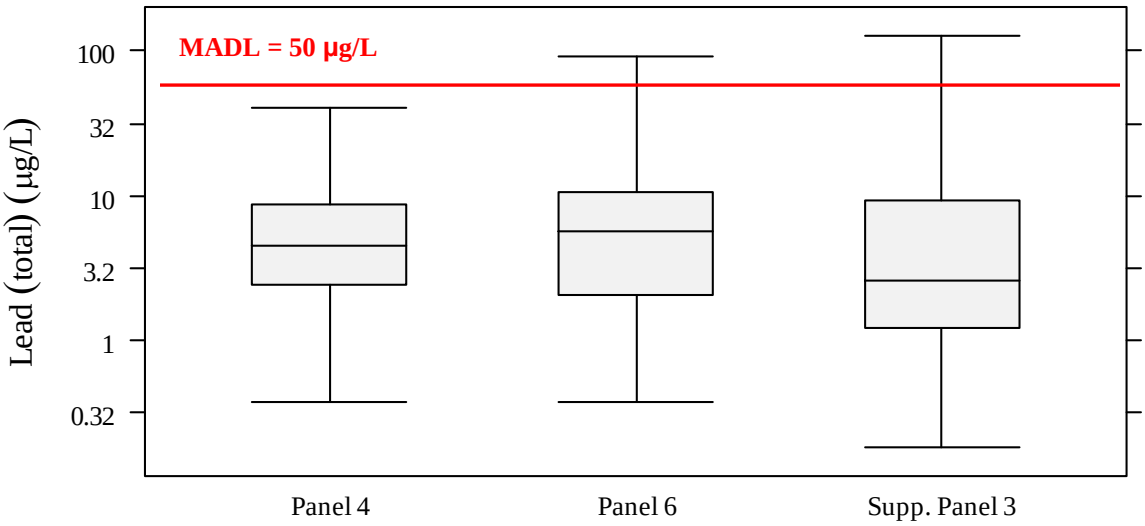


Figure 7-25: Year 4 Di(2-ethylhexyl)phthalate Concentrations by Sample Event

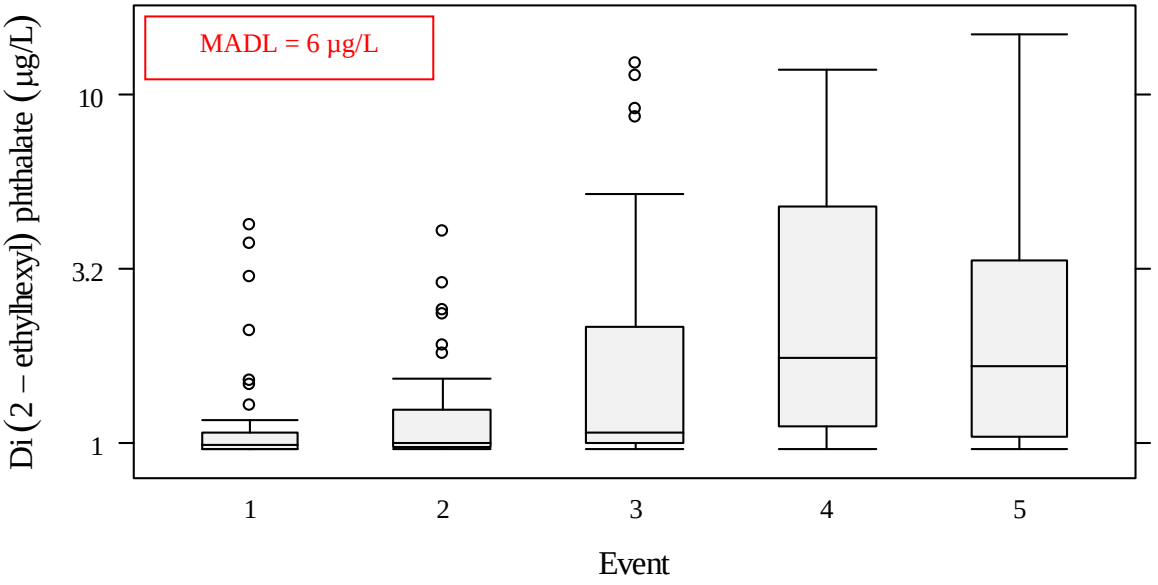


Figure 7-26: Year 4 Di(2-ethylhexyl)phthalate Concentrations by Sample Panel

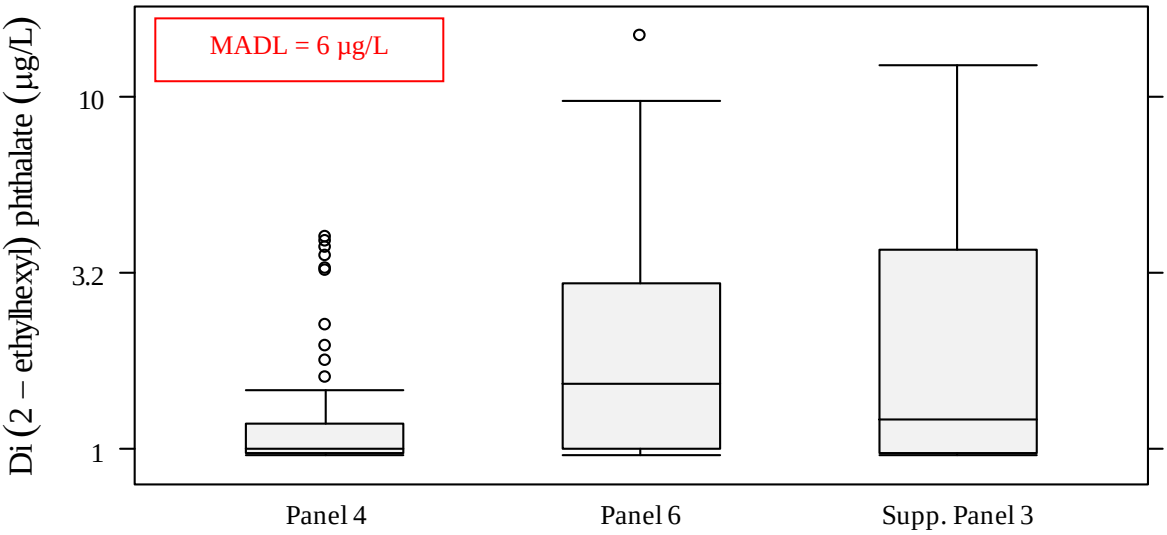


Figure 7-27: Year 4 Arsenic Concentrations by Sample Event

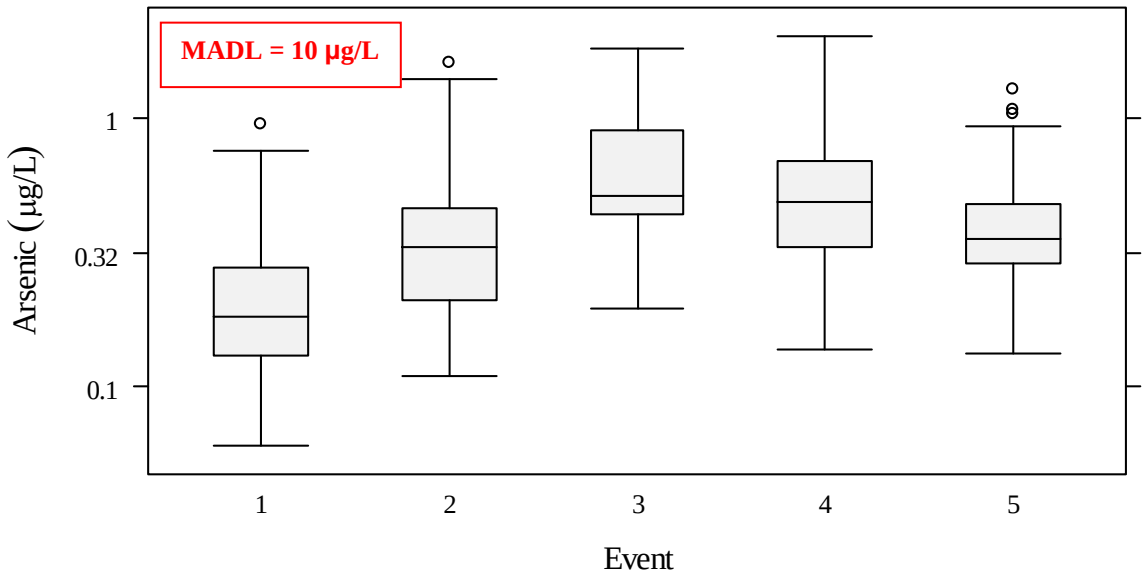


Figure 7-28: Year 4 Arsenic Concentrations by Sample Panel

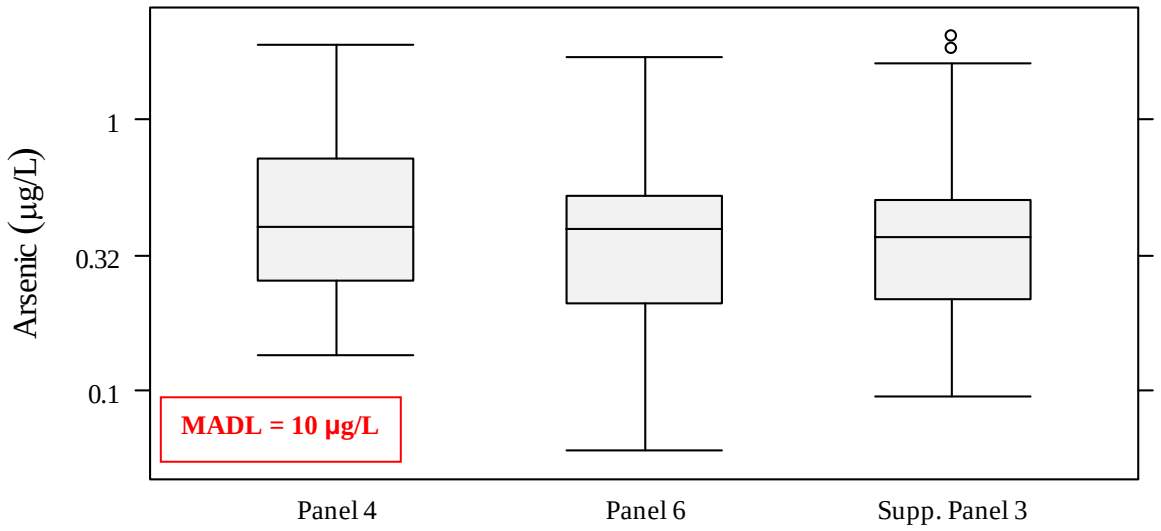


Figure 7-29: Year 4 Antimony Concentrations by Sample Event

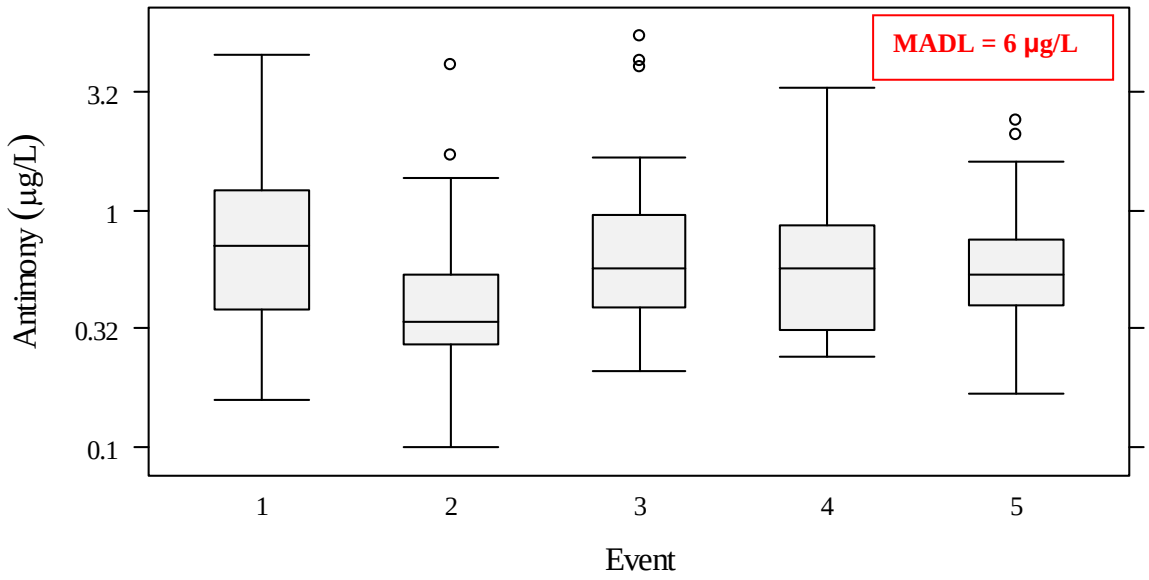


Figure 7-30: Year 4 Antimony Concentrations by Sample Panel

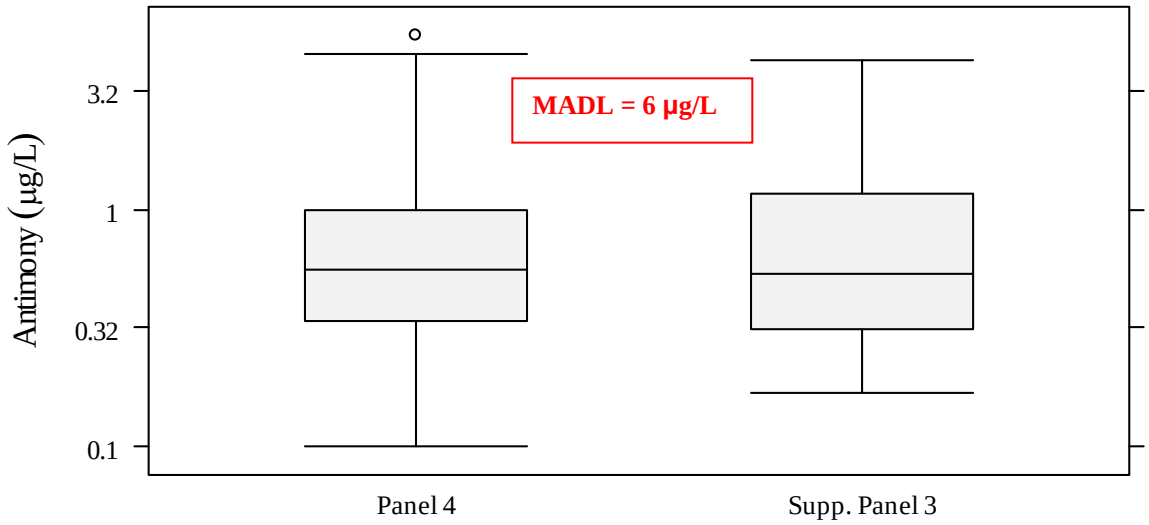


Figure 7-4: Year 4 Dissolved Lead Concentrations by Traffic Category

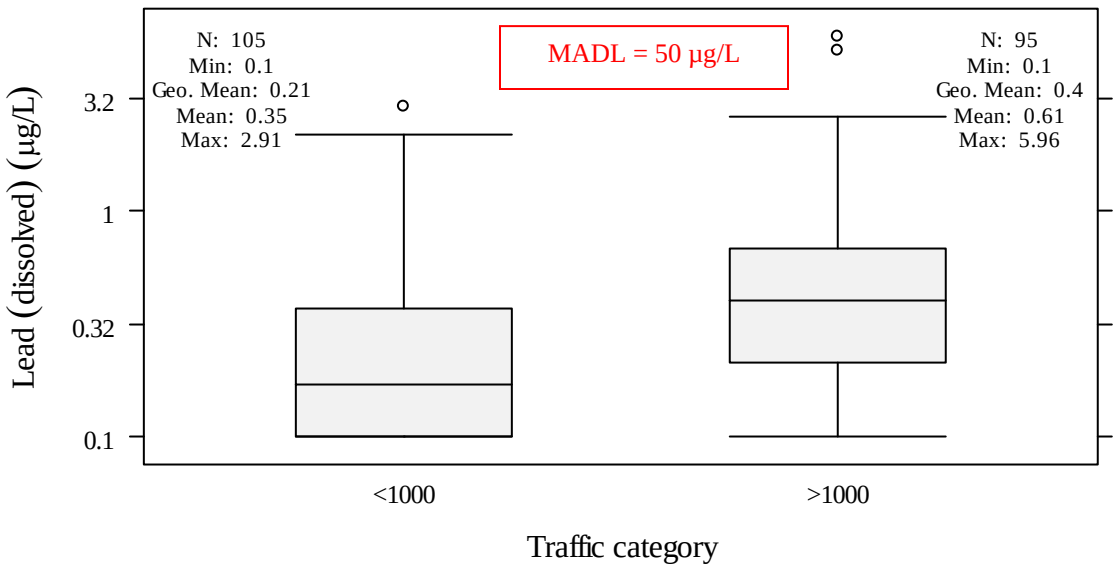
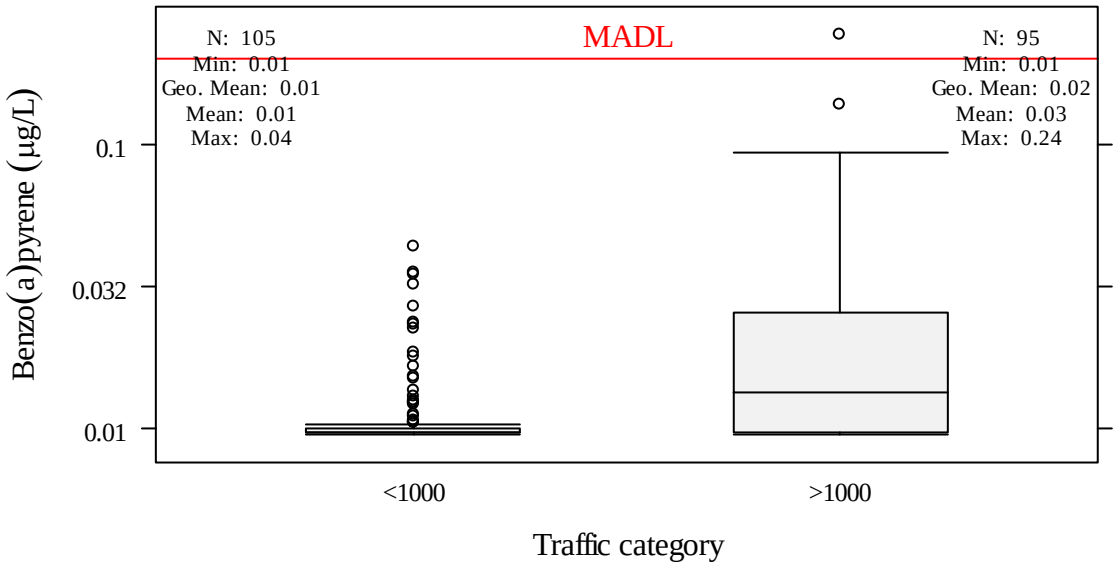


Figure 7-5: Year 4 Benzo(a)pyrene Concentrations by Traffic Category



Notes:

These figures:

1) Summarize the results of the original UIC stormwater samples collected in Year 4;
2) Include the results of Panel 4, Panel 6, and Supplemental Panel 3;
3) Do not include duplicate sampling results; and
4) Plot sample concentrations < MRL at the MRL.

Figure 7-6: Year 4 Di(2-ethylhexyl)phthalate Concentrations by Traffic Category

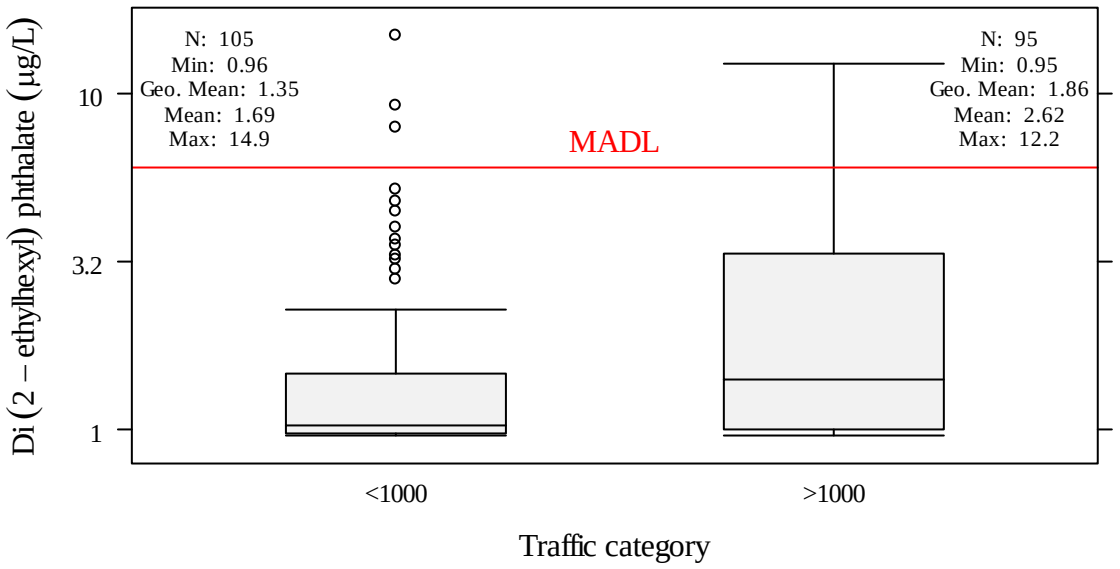
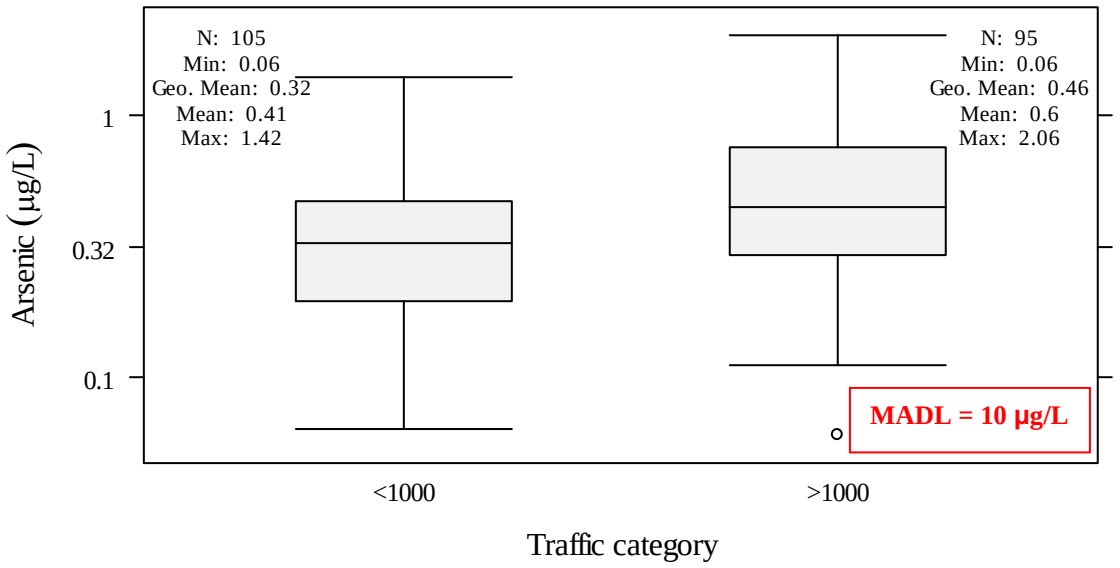


Figure 7-7: Year 4 Arsenic Concentrations by Traffic Category



Notes:
These figures:

1) Summarize the results of the original UIC stormwater samples collected in Year 4;
2) Include the results of Panel 4, Panel 6, and Supplemental Panel 3;
3) Do not include duplicate sampling results; and
4) Plot sample concentrations < MRL at the MRL.

Figure 7-8: Year 4 Cadmium Concentrations by Traffic Category

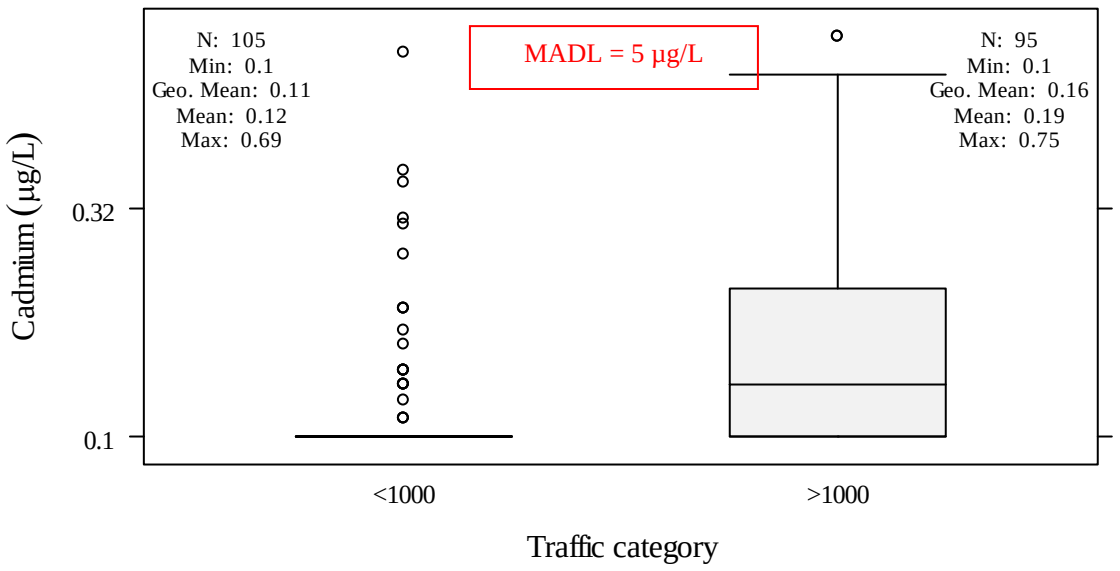
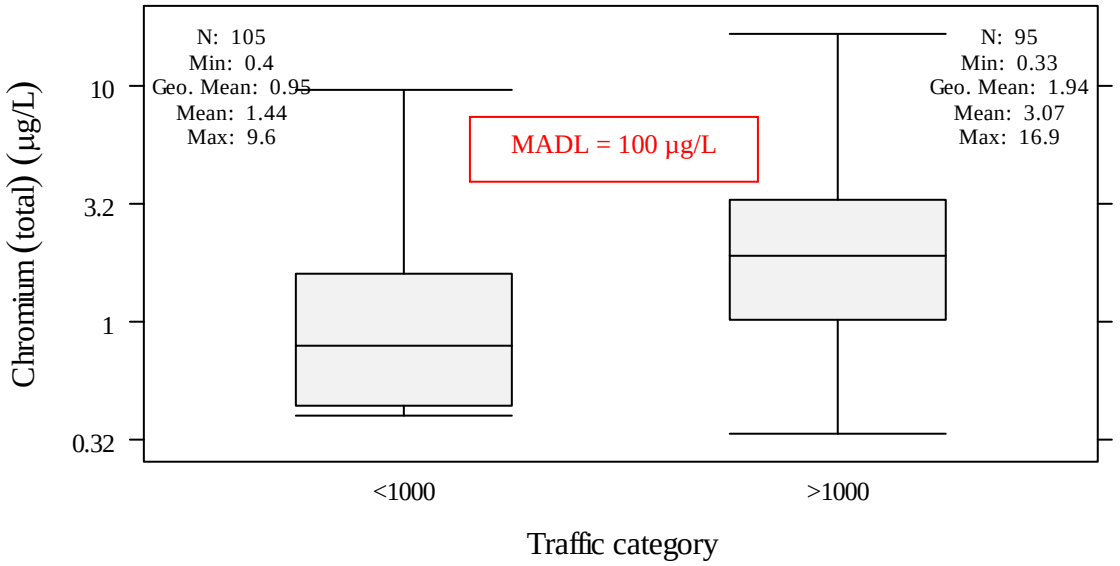


Figure 7-9: Year 4 Chromium Concentrations by Traffic Category



Notes:
These figures:

1) Summarize the results of the original UIC stormwater samples collected in Year 4;
2) Include the results of Panel 4, Panel 6, and Supplemental Panel 3;
3) Do not include duplicate sampling results; and
4) Plot sample concentrations < MRL at the MRL.

Figure 9-1: Comparison of Pentachlorophenol Concentrations for Years 1 – 4: Panel 6

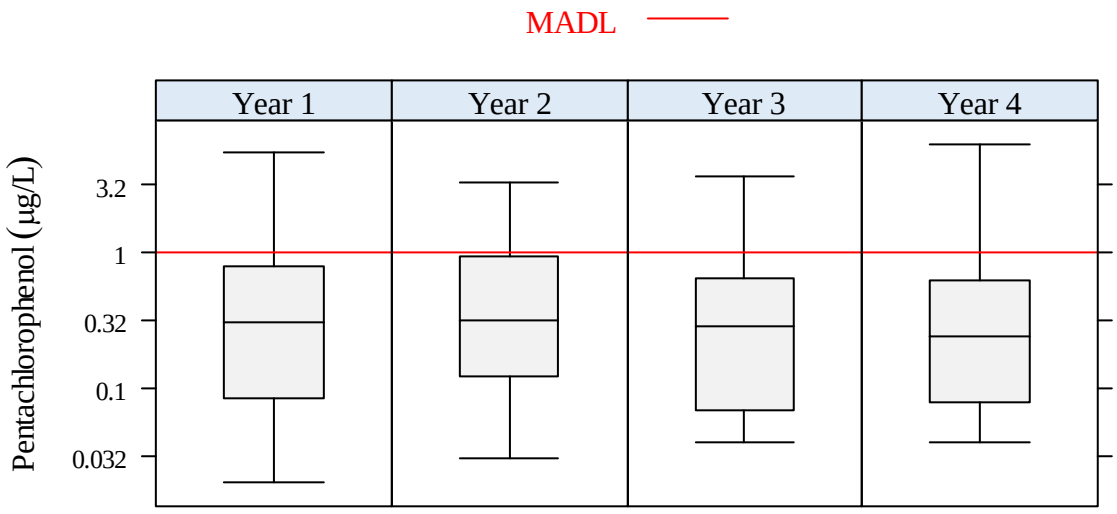


Figure 9-2: Comparison of Lead (Total) Concentrations for Years 1 – 4: Panel 6

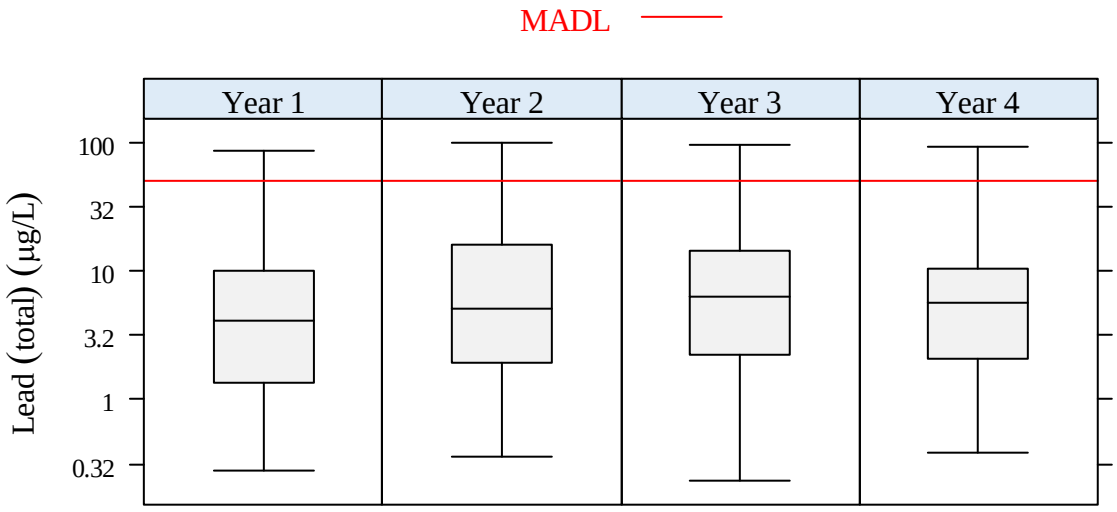
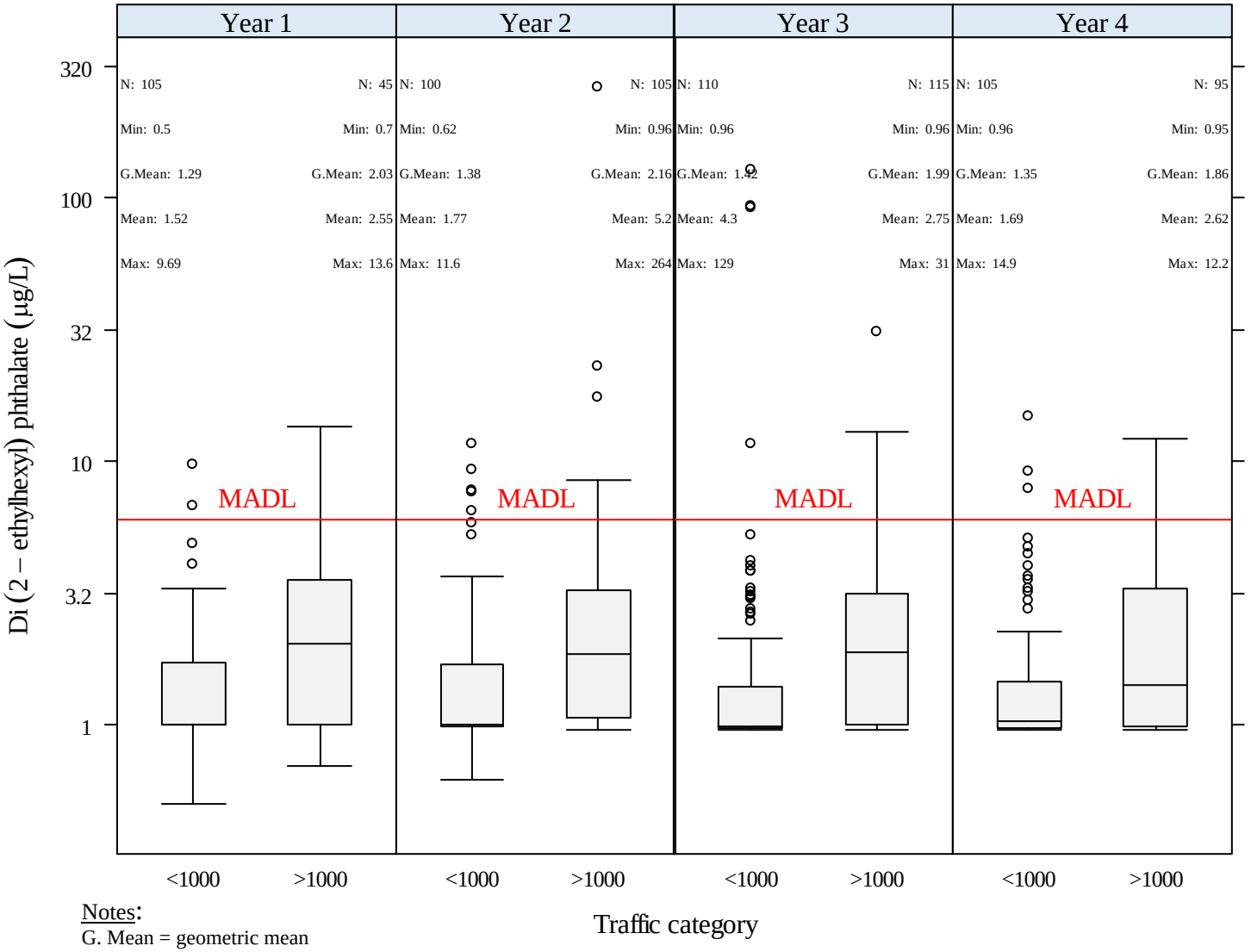


Figure 9-10: Comparison of Di(2-ethylhexyl)phthalate Concentrations by Year and Traffic Category



Notes:
G. Mean = geometric mean

Figure 9-11: Comparison of Pentachlorophenol Concentrations by Year and Sample Panel

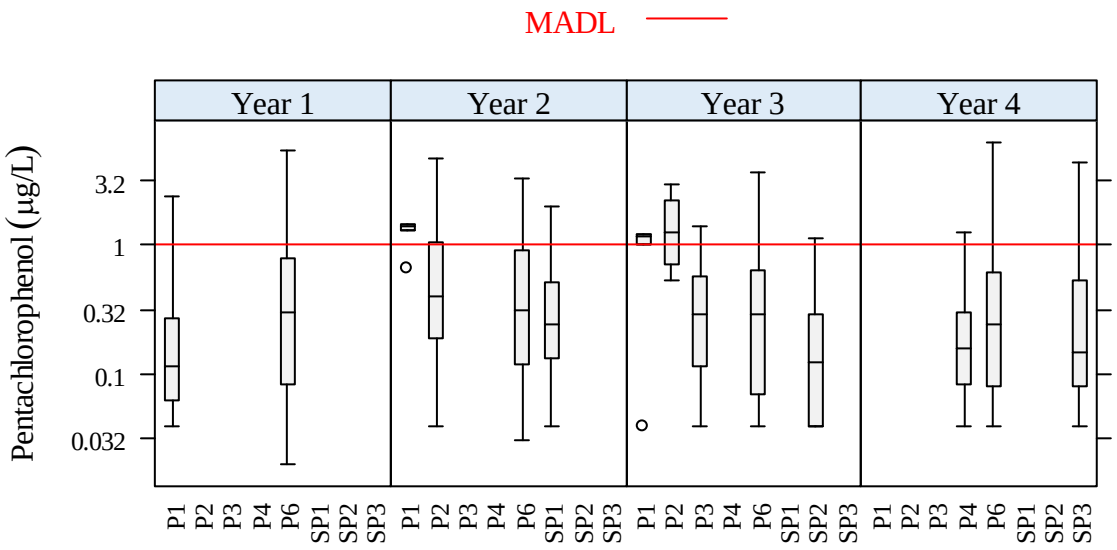


Figure 9-12: Comparison of Total Lead Concentrations by Year and Sample Panel

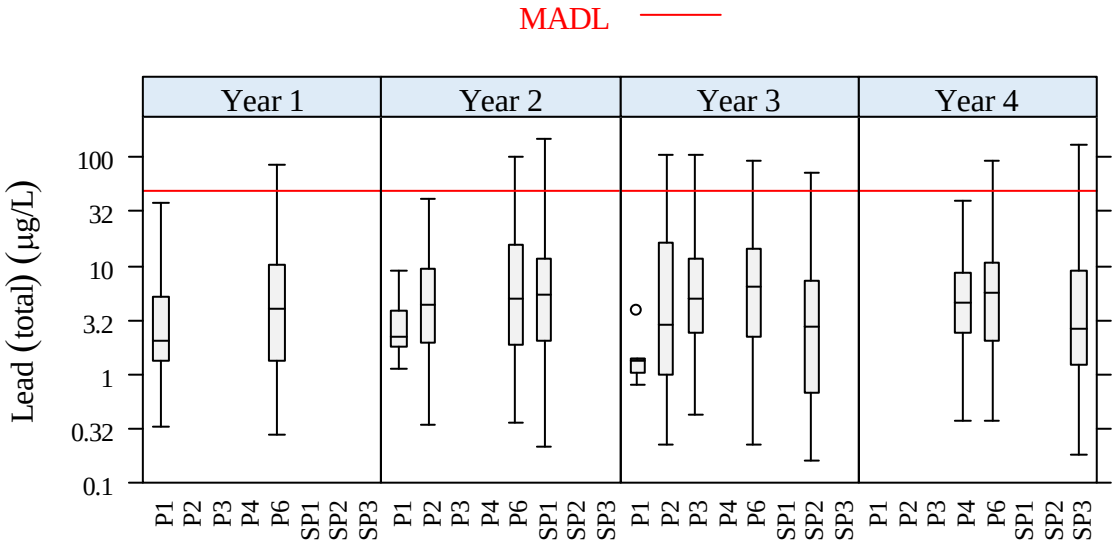


Figure 9-13: Comparison of Di(2-ethylhexyl)phthalate Concentrations by Year and Sample Panel

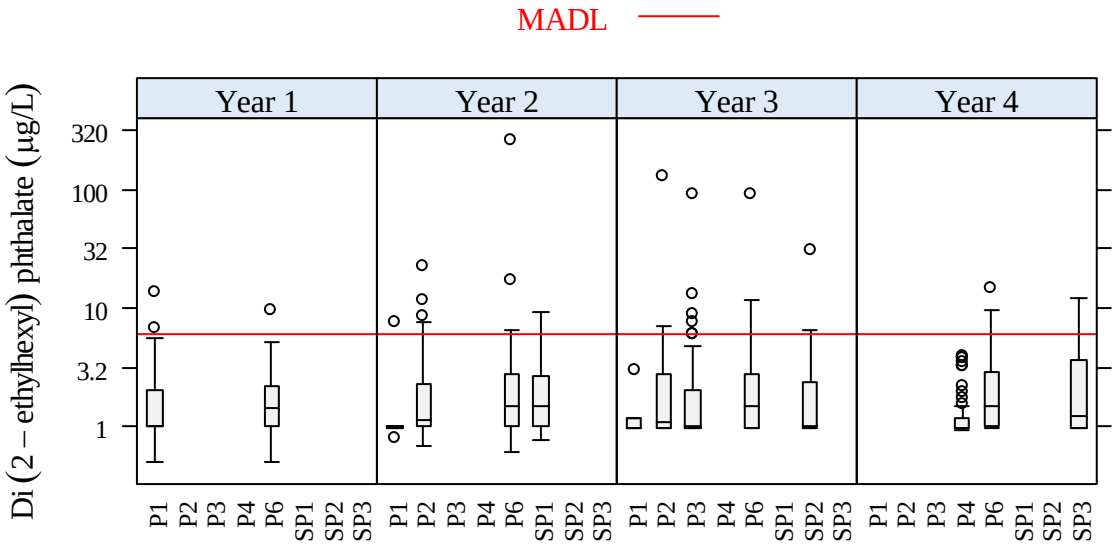


Figure 9-14: Comparison of Benzo(a)pyrene Concentrations by Year and Sample Panel

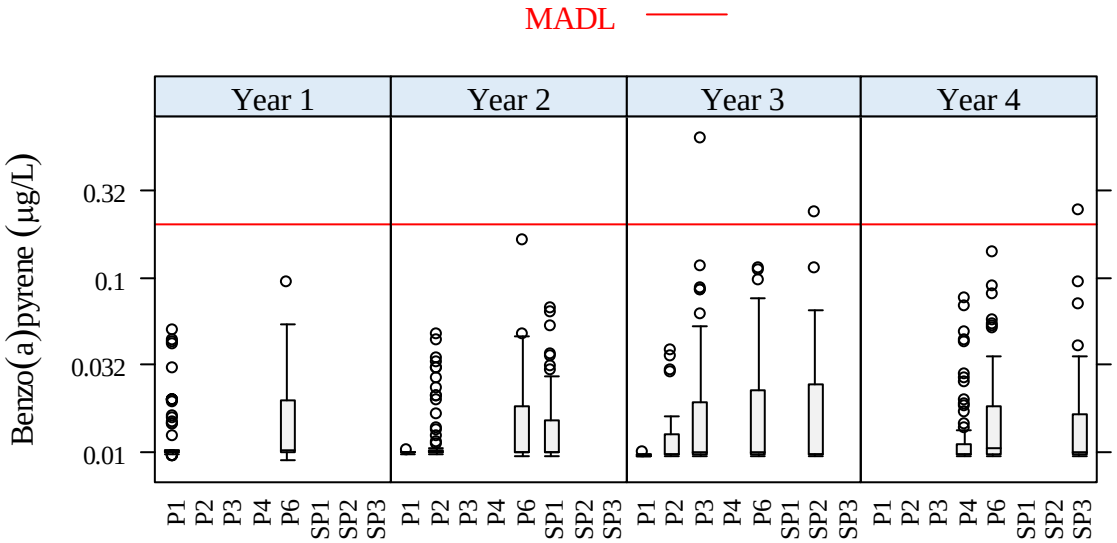


Figure 9-3: Comparison of Benzo(a)pyrene Concentrations for Years 1 – 4: Panel 6

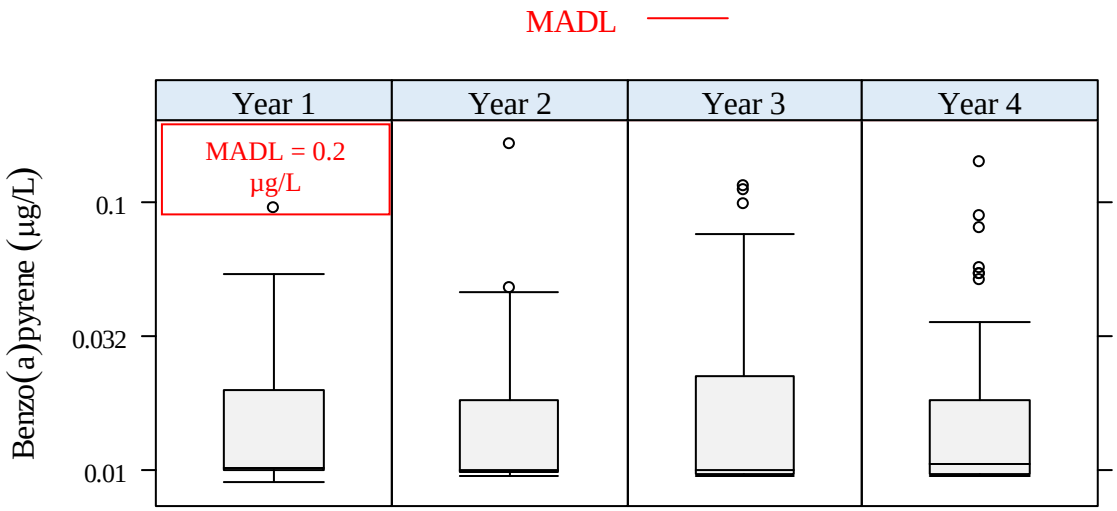


Figure 9-4: Comparison of Di(2-ethylhexyl)phthalate Concentrations for Years 1 – 4: Panel 6

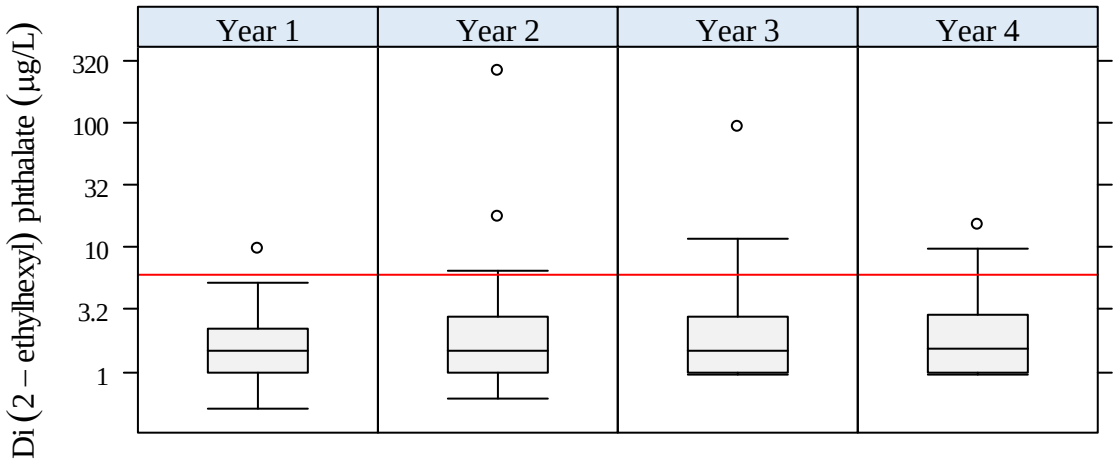


Figure 9-5: Comparison of Total Suspended Solids Concentrations for Years 1 – 4: Panel 6

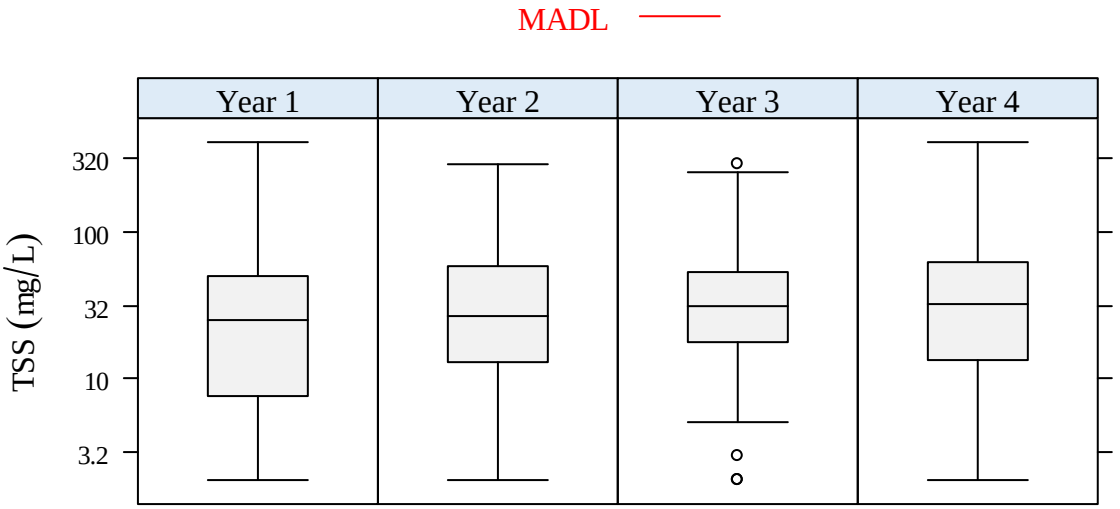


Figure 9-6: Comparison of Lead (Dissolved) Concentrations for Years 1 – 4: Panel 6

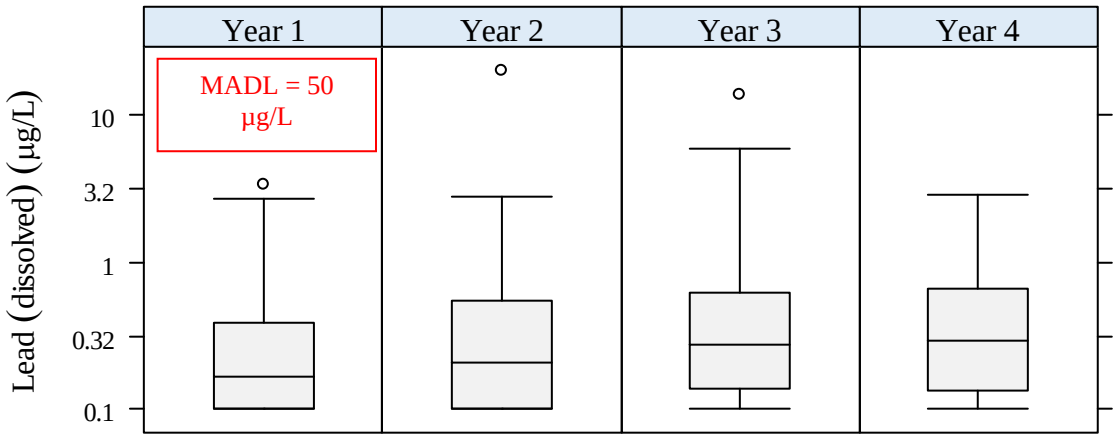
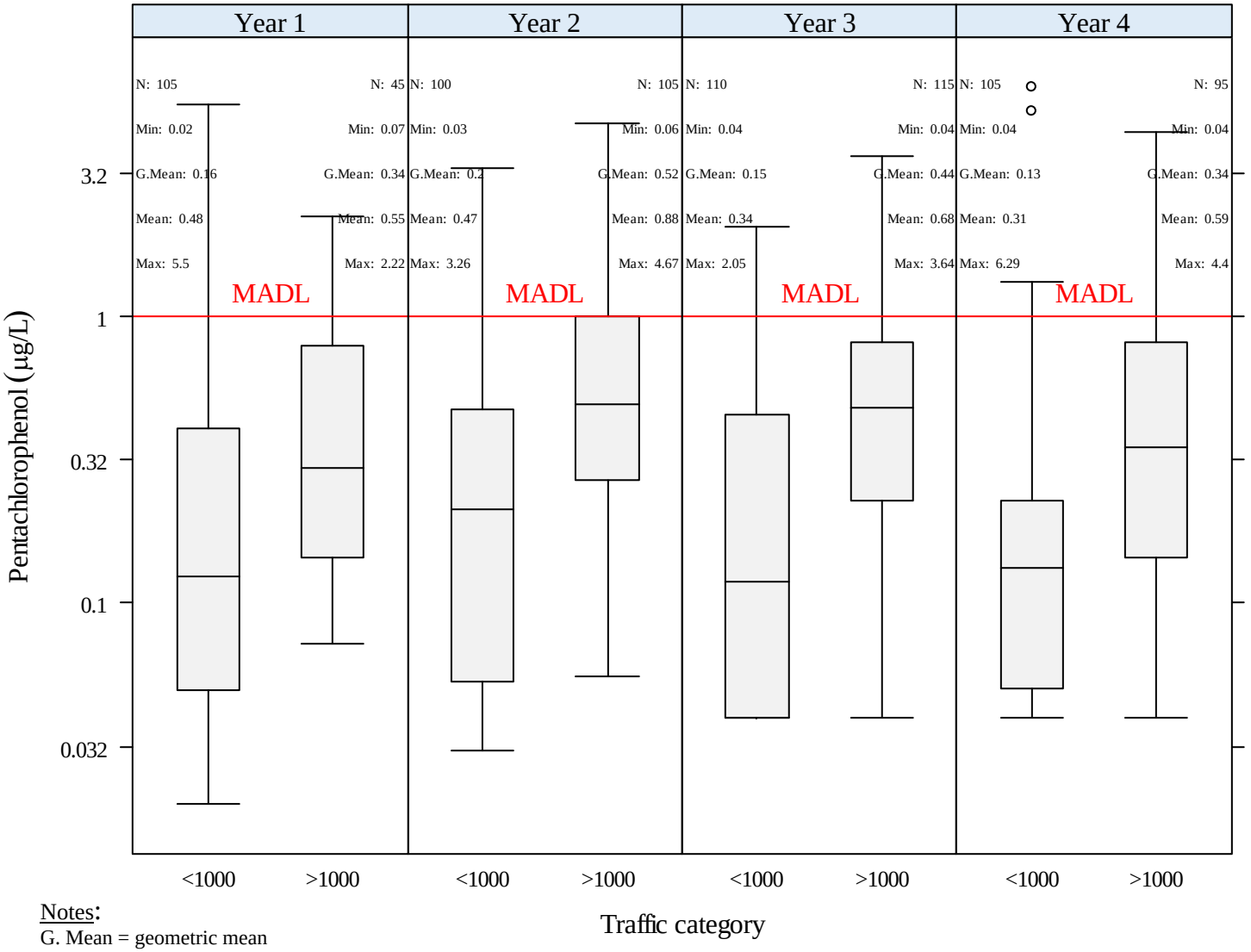
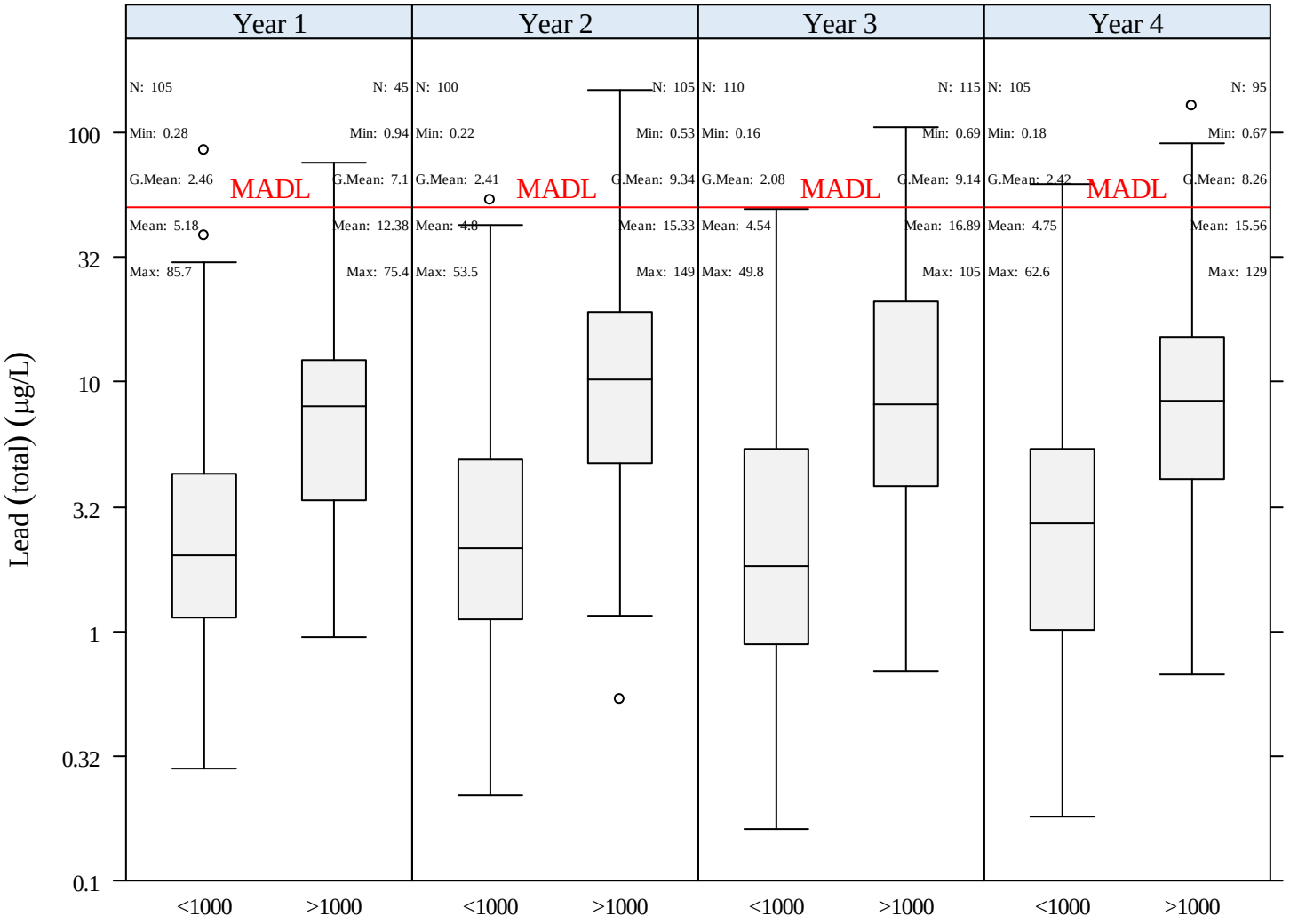


Figure 9-7: Comparison of Pentachlorophenol Concentrations by Year and Traffic Category



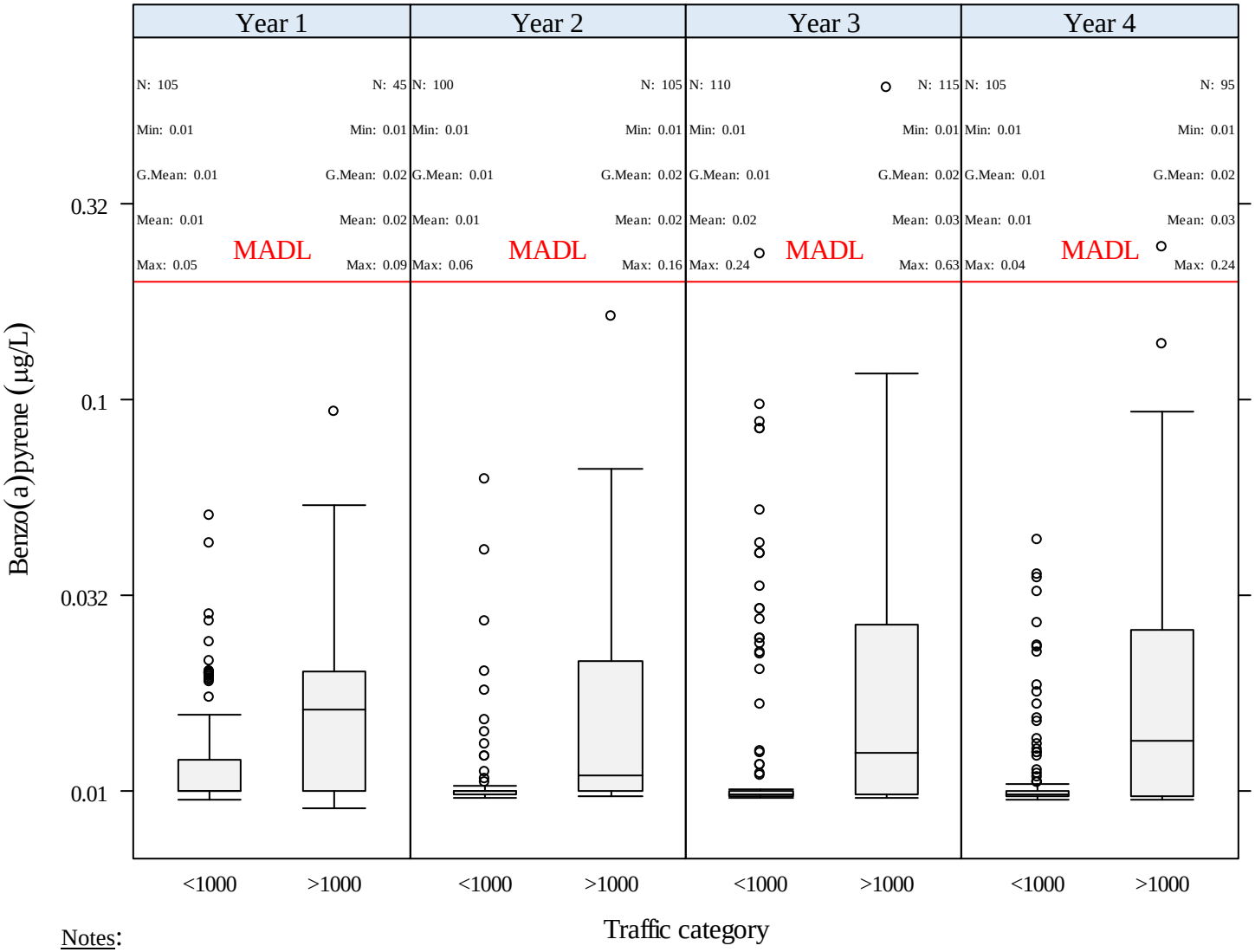
Notes:
G. Mean = geometric mean

Figure 9-8: Comparison of Total Lead Concentrations by Year and Traffic Category



Notes:
G. Mean = geometric mean

Figure 9-9: Comparison of Benzo(a)pyrene Concentrations by Year and Traffic Category



Notes:
G. Mean = geometric mean