Insurance Auto Auctions, Inc.

STORMWATER SYSTEM INVESTIGATION – FINAL REPORT

INSURANCE AUTO AUCTIONS
8801 E MARGINAL WAY S
TUKWILA, WASHINGTON

For submittal to:

Washington State Department of Ecology
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May 20, 2011

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List of Acronyms

Acronym	Definition
AES	atomic emission spectrometry
AP	Analytical Perspectives
ARI	Analytical Resources, Inc.
BBP	butyl benzyl phthalate
BEHP	bis(2-ethylhexyl) phthalate
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CVAA	cold vapor atomic absorption
DL	detection limit
dw	dry weight
ECD	electron capture detection
Ecology	Washington State Department of Ecology
EDL	estimated detection limit
EMPC	estimated maximum possible concentration
EPA	US Environmental Protection Agency
GC	gas chromatography
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD	heptachlorodibenzo-*p*-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-*p*-dioxin
HxCDF	hexachlorodibenzofuran
HR	high resolution
IAA	Insurance Auto Auctions, Inc.
ICP	inductively coupled plasma
ID	identifier
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDW	Lower Duwamish Waterway
LPAH	low-molecular-weight polycyclic aromatic hydrocarbons
MCH	Merril Creek Holdings, LLC
MS	mass spectrometry
MS/MSD	matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
OCDD	octachlorodibenzo-*p*-dioxin
OCDF	octachlorodibenzofuran

Acronym	Definition
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PeCDD	pentachlorodibenzo-*p*-dioxin
PeCDF	pentachlorodibenzofuran
PSEP	Puget Sound Estuary Program
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SIM	selected ion monitoring
SMS	Washington State Sediment Management Standards
SVOC	semivolatile organic compound
SWPPP	stormwater pollution prevention plan
TCDD	tetrachlorodibenzo-*p*-dioxin
TCDF	tetrachlorodibenzofuran
TEF	toxic equivalency factor
TEQ	toxic equivalent
TOC	total organic carbon
WAC	Washington Administrative Code
WHO	World Health Organization
Windward	Windward Environmental LLC

1 Introduction

In 2004, Insurance Auto Auctions, Inc. (IAA) began operating a branch in Tukwila, Washington, on property it leases from Merrill Creek Holdings, LLC (MCH). This property, located at 8801 East Marginal Way South (referred to hereafter as the "8801 Parcel"), was formerly owned and operated by PACCAR Inc. (PACCAR). The property has a long and documented history of contamination pre-dating IAA's tenancy. The Washington State Department of Ecology (Ecology) has entered into a consent agreement with PACCAR and MCH under the Model Toxics Control Act (MTCA) to clean up the site.

In addition to complying with the requirements of the Washington State industrial stormwater general permit (Ecology 2009) and implementing the pollution control measures outlined in the site-specific stormwater pollution prevention plan (SWPPP) (Windward 2010b), IAA regularly performs drainage system preventive maintenance and upgrades, and conducts other source control activities at the site. In 2007, IAA had end-of-pipe stormwater treatment systems installed for all drainage systems on the 8801 Parcel; these treatment systems are regularly inspected and cleaned. The complete northern and central treatment systems were most recently cleaned out in June 2010. In addition, the northern and central system StormFilter™ units were cleaned out and new filter cartridges installed in September 2010. The next filter cartridge replacement and cleanout of the StormFilter™ units is planned for the summer of 2011. Source control measures at the site are supported by IAA's full-time on-site stormwater coordinator, who oversees day-to-day source control activities at the site. These activities are supplemented by Windward Environmental LLC (Windward).

This document presents the results from the four quarters of attempted sampling under the stormwater system investigation plan (referred to hereafter as the "Plan") implemented by IAA as required by Ecology (Windward 2010c). In addition, preliminary sampling of the stormwater treatment system solids was conducted by Ecology staff on October 6, 2009. The quarterly sample collection events pursuant to the Ecology-approved stormwater system investigation plan (Windward 2010c) were conducted on May 21 and 24, 2010; August 19, 2010; November 19, 2010; and March 22, 2011. The first three quarterly status reports were submitted to Ecology on August 27, 2010; November 16, 2010; and February 7, 2011. The Plan's prescribed survey and collection methods consists of the following tasks:

1. Conduct field reconnaissance to determine the locations and quantities of those solids that can be sampled within each catch basin, interceptor maintenance hole, and treatment system structure on the 8801 Parcel.
2. In both treatment systems, obtain grab samples of solids from the primary settling chambers of the Vortechs™ units, the filter cartridge ("middle")

chambers of the StormFilter™ units, and the post-filtration chambers of the StormFilter™ units.

3. Obtain in-line solids grab samples from up to 10 preselected maintenance hole structures.
4. Collect solids samples from catch basin inserts within areas similar to those sampled by Kennedy/Jenks in 2004 (AMEC 2006). Solids from at least three and up to seven catch basins will be composited to form a single sample for each area.
5. Obtain solids samples from both the inserts and floors of six catch basins that are near areas of potential concern for soil and groundwater, and that have been identified during previous inspections as having potential soil and/or groundwater infiltration.

This data report is the final report to Ecology documenting the results of the tasks performed in accordance with the Plan. Table 1 provides a summary of the sampling program and the samples collected.

Table 1. Summary of IAA stormwater solids sampling

Solids Sampling Location	Type of Sampling	Maximum Number of Samples	Analytes	Samples Collected				
				October 2009	May 2010	August 2010	November 2010	March 2011
Stormwater treatment systems	In both treatment systems, single discrete grab samples were targeted for collection from the primary settling chambers, filter chambers, and post-filtration chambers.	up to 6 discrete samples, 1 per chamber for both treatment systems	priority pollutant metals[a], PCBs (as Aroclors), SVOCs, butyltins, dioxins/furans, TOC, total solids	1 sample from central system Vortechs™ unit 1 sample from northern system StormFilter™ unit filter chamber	1 sample from central system StormFilter™ unit filter chamber	none	none	none
In-line interceptors	Single discrete grab samples were targeted for collection from up to 10 interceptors (maintenance holes).	up to 10 discrete samples	SMS metals[b], PCBs (as Aroclors), SVOCs, TOC, total solids	none	3 maintenance hole samples from the northern drainage system	none	none	none
Catch basin inserts from Areas 1 – 7	Single composite samples were targeted for collection from at least 3 and up to 7 catch basin grab samples from each area. Material from each discrete catch basin insert sample was archived.	up to 7 composite samples (with up to 49 discrete archive samples)	SMS metals[b], PCBs (as Aroclors), SVOCs, TOC, total solids	none	1 composite sample each (and associated archived discrete samples) from Areas 2, 3, 5, 6, and 7	1 composite sample each (and associated archived discrete samples) from Areas 1 and 4	none; sampling goals previously met	none; sampling goals previously met
Discrete catch basins	Discrete grab samples were targeted for collection from up to 6 catch basin inserts and floors.	up to 12 discrete samples (2 per catch basin)	SMS metals[b], PCBs (as Aroclors), SVOCs, TOC, total solids	none	none	1 discrete sample from the insert and 1 discrete sample from the floor of a single catch basin	none	1 discrete sample from the insert and 1 discrete sample from the floor of a single catch basin

[a] Priority pollutant metals include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc.
[b] SMS metals include arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc.
IAA – Insurance Auto Auctions, Inc.
PCB – polychlorinated biphenyl
SMS – Washington State Sediment Management Standards
SVOC – semivolatile organic compound
TOC – total organic carbon

2 Methods

The methods and procedures used to collect and analyze the samples are described briefly in this section and in more detail in the investigation plan (Windward 2010c).

2.1 Sample Collection and Processing

Field activities were conducted on October 6, 2009; May 21 and 24, 2010; August 19, 2010; November 19, 2010; and March 22, 2011, by Windward. Sample types collected included discrete catch basin insert solids grabs, discrete catch basin solids grabs, catch basin insert solids composites, maintenance hole in-line solids grabs, and treatment system solids grabs. The catch basin insert solids grabs were collected directly from the insert using a stainless steel spoon. The maintenance hole in-line solids grabs, treatment system solids grabs, and discrete catch basin solids grabs were collected using a stainless steel cup attached to a telescopic pole. The general procedure for collecting solids grabs and compositing samples is described in greater detail in Section 4.2.2 of the investigation plan (Windward 2010c).

2.2 Field Equipment Decontamination

To prevent cross-contamination between samples, all sample collection and homogenizing equipment, including the mixing bowl, stainless steel implements, and collection cup/pole, were decontaminated before the first sample was collected and between samples. The detailed decontamination procedures are outlined in the investigation plan (Windward 2010c).

2.3 Sample Identification Scheme

The two initial treatment system samples collected on October 6, 2009, were assigned alphanumeric sample identifiers based on the site and date of collection. The first characters are "IAA" to designate the samples as from the site operated by IAA, followed by "100610," the date of collection. The last characters are consecutive numbers, assigned based on the order of collection, beginning with "01." For example, the first sample, collected from the central treatment system Vortechs™ unit, is identified as "IAA-100610-01."

Each subsequent sample was also assigned a unique alphanumeric identifier. The first characters are "IAA," to designate the samples as from the site operated by IAA, followed by "SSN" or "SSC" to designate stormwater system northern or stormwater system central, respectively. The next characters, "TS," "MH," "CB," or "CBC," designate sample type: treatment system, maintenance hole, catch basin, or catch basin composite sample, respectively. The sample type is followed by a consecutive number beginning with "01." For example, the first maintenance hole sample collected from the northern drainage network is identified as "IAA-SSN-MH01."

The co-located discrete catch basin sump solids grab and catch basin insert grab samples have an additional letter following the number to designate whether the sample is from the catch basin sump or the catch basin insert. The catch basin sump solids grab sample is designated by an "A," and the catch basin insert solids grab is designated by a "B." The exception to this are samples IAA-SSC-CB12 and IAA-SSC-CB13, which are from the same catch basin location. IAA-SSC-CB12 is from the catch basin insert and IAA-SSC-CB13 is from the catch basin sump.

2.4 Sample Documentation Procedures

A field logbook was used to note the date, time, and location of sampling stations, as well as additional parameters recorded in the field (see Appendix A). The following data were recorded in the field logbook:

- Names of person(s) collecting and logging the samples
- Unique sample and location identifiers
- Date and time of collection
- Observations made during sample collection, including weather conditions, complications, and other details associated with sampling equipment or procedures

2.5 Chain of Custody and Sample Transport Procedures

Chain of custody forms were used to track sample custody. Completed forms are included in Appendix A. Samples collected in the field were placed in a cooler with ice and hand delivered to Analytical Resources, Inc. (ARI), in Tukwila, Washington.

2.6 Analytical Methods

Laboratory analyses of all parameters except dioxins/furans were conducted by ARI. Dioxins/ furans analyses were conducted by Analytical Perspectives (AP) in Wilmington, North Carolina. Table 2 summarizes the specific methods used to analyze the samples; these are standard test methods for these parameters.

Table 2. Summary of analytical methods

Parameter	Method	Source
SVOCs	GC/MS	EPA Method 8270D/ 8270D-SIM
PCBs as Aroclors	GC/ECD	EPA Method 8082
Mercury	CVAA	EPA Method 7471A
Other metals[a]	ICP-AES or ICP-MS	EPA Method 6010B or EPA Method 200.8
Butyltins	GC/MS-SIM	Krone et al. (1989)

Parameter	Method	Source
Dioxins/furans	HRGC/HRMS	EPA Method 1613B
TOC	combustion	Plumb (1981)
Total solids	oven-dried	EPA Method 160.3
Grain size	sieve/pipette	PSEP (1986)

[a] For treatment system samples: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc. For all other samples: arsenic, cadmium, chromium, copper, lead, silver, and zinc.

AES – atomic emission spectroscopy
CVAA – cold vapor atomic absorption
ECD – electron capture detection
EPA – US Environmental Protection Agency
GC – gas chromatography
HR – high resolution
ICP – inductively coupled plasma
MS – mass spectrometry
PCB – polychlorinated biphenyl
PSEP – Puget Sound Estuary Program
SIM – selected ion monitoring
SVOC – semivolatile organic compound
TOC – total organic carbon

3 Results

This section describes the results from all samples collected in October 2009, May 2010, August 2010, and March 2011. No samples were collected after the November 2010 solids survey due to a lack of sufficient accumulated solids in the targeted locations.

3.1 Solids Surveys

A full survey of solids in the drainage system structures (i.e., all catch basins, all maintenance holes, and all treatment systems) was conducted on May 20 and 21, 2010. The inspection was conducted to determine which targeted sampling locations could be sampled as part of the first quarterly sampling event under the plan, and to meet SWPPP requirements for stormwater drainage system inspections. Subsequent solids surveys, limited to the targeted locations that were not sampled during the previous sampling events, were conducted on August 19, 2010; November 19, 2010; and March 22, 2011.The detailed results of the solids surveys are included in Appendix B, and notes from the surveys are included in Appendix A. Results of the solids surveys are summarized in Section 3.2.

3.2 Sampling Locations and Sample Compositing

This section describes the observations made at the targeted sampling locations during the October 2009 sampling event and the solids surveys and sampling events in May, August, and November 2010 and March 2011. The locations that were targeted for sampling are presented in the investigation plan (Windward 2010c). The location description and coordinates for every sample collected are provided in Table 3.

Table 3. Sample locations

Sample	Location	Component Locations	Latitude	Longitude
IAA09-100609-1	central system Vortechs™ unit	na	47.521529	-122.306237
IAA09-100609-2	northern system StormFilter™ vault	na	47.522928	-122.306774
IAA-SSC-CBC01	Composite Area 3	IAA-SSC-CB01	47.521560	-122.306179
		IAA-SSC-CB02	47.522004	-122.305436
		IAA-SSC-CB03	47.521434	-122.305433
		IAA-SSC-CB04	47.521329	-122.305066
		IAA-SSC-CB05	47.521618	-122.305024
		IAA-SSC-CB06	47.521756	-122.305206

Sample	Location	Component Locations	Latitude	Longitude
IAA-SSC-CBC02	Composite Area 6	IAA-SSC-CB07	47.521399	-122.303239
		IAA-SSC-CB08	47.521397	-122.304125
		IAA-SSC-CB09	47.521431	-122.302785
		IAA-SSC-CB10	47.521009	-122.301967
		IAA-SSC-CB11	47.521005	-122.301512
IAA-SSC-TS01	central system StormFilter™ vault	na	47.521463	-122.306327
IAA-SSN-CBC01	Composite Area 2	IAA-SSN-CB01	47.522294	-122.306097
		IAA-SSN-CB02	47.522233	-122.305404
		IAA-SSN-CB03	47.521982	-122.304078
		IAA-SSN-CB04	47.522180	-122.304074
IAA-SSN-CBC02	Composite Area 5	IAA-SSN-CB05	47.521752	-122.301694
		IAA-SSN-CB06	47.521748	-122.302011
		IAA-SSN-CB07	47.521747	-122.302394
		IAA-SSN-CB08	47.521822	-122.303750
IAA-SSN-CBC03	Composite Area 7	IAA-SSN-CB09	47.522889	-122.301604
		IAA-SSN-CB10	47.522623	-122.301330
		IAA-SSN-CB11	47.522616	-122.301049
		IAA-SSN-CB12	47.522445	-122.301532
		IAA-SSN-CB13	47.522060	-122.300737
		IAA-SSN-CB14	47.521917	-122.301217
		IAA-SSN-CB15	47.52201	-122.300941
IAA-SSN-MH01	northern system maintenance hole, Area 2	na	47.522195	-122.305866
IAA-SSN-MH02	northern system maintenance hole near water tower	na	47.522679	-122.303973
IAA-SSN-MH03	northern system maintenance hole inside large building	na	47.522206	-122.302712
IAA-SSN-CB16A	northern system, Area 2 catch basin floor	na	47.522004	-122.305436
IAA-SSN-CB16B	northern system, Area 2 catch basin insert	na	47.522004	-122.305436
IAA-SSN-CBC04	Composite Area 4	IAA-SSN-CB17	47.522893	-122.302801
		IAA-SSN-CB18	47.522899	-122.303023
		IAA-SSN-CB19	47.522888	-122.303638
		IAA-SSN-CB20	47.522891	-122.303893
		IAA-SSN-CB21	47.522905	-122.304086

Sample	Location	Component Locations	Latitude	Longitude
		IAA-SSN-CB22	47.522876	-122.304221
IAA-SSN-CBC05	Composite Area 1	IAA-SSN-CB23	47.522697	-122.304418
		IAA-SSN-CB24	47.522921	-122.305223
		IAA-SSN-CB25	47.522575	-122.306032
IAA-SSC-CB12	central system, Area 3 catch basin insert	na	47.521671	-122.305898
IAA-SSC-CB13	central system, Area 3 catch basin floor	na	47.521671	-122.305898

Note: Coordinates provided are geographic coordinates using the North American Datum of 1983.
na – not applicable

3.2.1 Treatment system solids

Stormwater drainage from the entire 8801 Parcel flows through the northern and central treatment systems, which, as part of the treatment process, collect and filter out solids from the stormwater. Solids samples from the northern and central treatment systems (Outfalls 1 and 3) were collected in October 2009 by IAA at Ecology's request. These samples were then analyzed for metals, semivolatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs) by Ecology at Manchester Environmental Laboratory in Port Orchard, Washington. The sample from the northern treatment system was collected from the filter chamber of the StormFilter™ unit. The sample from the central treatment system was composited from solids collected from the outlet chamber and the primary settling chamber of the Vortechs™ unit. As shown in Figure 1, samples from both the northern and central treatment systems were collected from the middle of the treatment system, before treatment was complete. Split samples from this sampling event that were archived by IAA, analyzed for butyltins by ARI, and sent to AP for analysis of dioxins/furans. Laboratory reports from Manchester Environmental Laboratory are included in Appendix C. The analytical results from ARI and AP are presented in Section 3.3.

One solids sample was collected from the central system StormFilter™ unit filter chamber in May 2010. The primary settling chamber of the Vortechs™ unit in the northern drainage system and the post-filtration chambers of the StormFilter™ units in the northern and central drainage systems were also examined for solids accumulation during the May 2010 solids survey. However, not enough solids had accumulated in these chambers for samples to be collected in accordance with the volume requirements specified in the Plan.

The Vortechs™ primary settling chamber of the northern drainage system and the post-filtration chambers of the StormFilter™ units of the northern and central drainage systems were subsequently examined for solids accumulation during the August and November 2010 and March 2011 solids surveys. However, not enough solids had

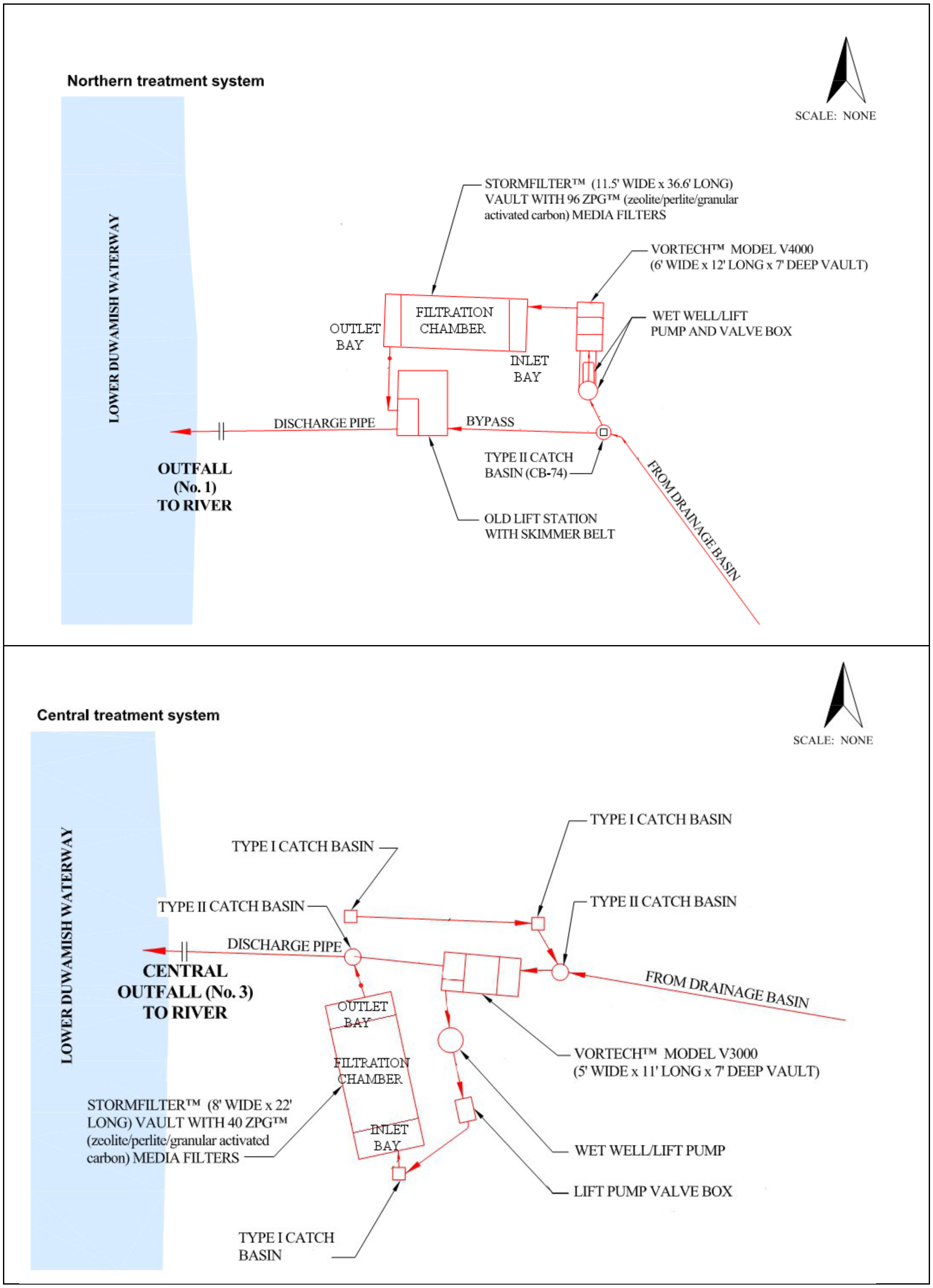
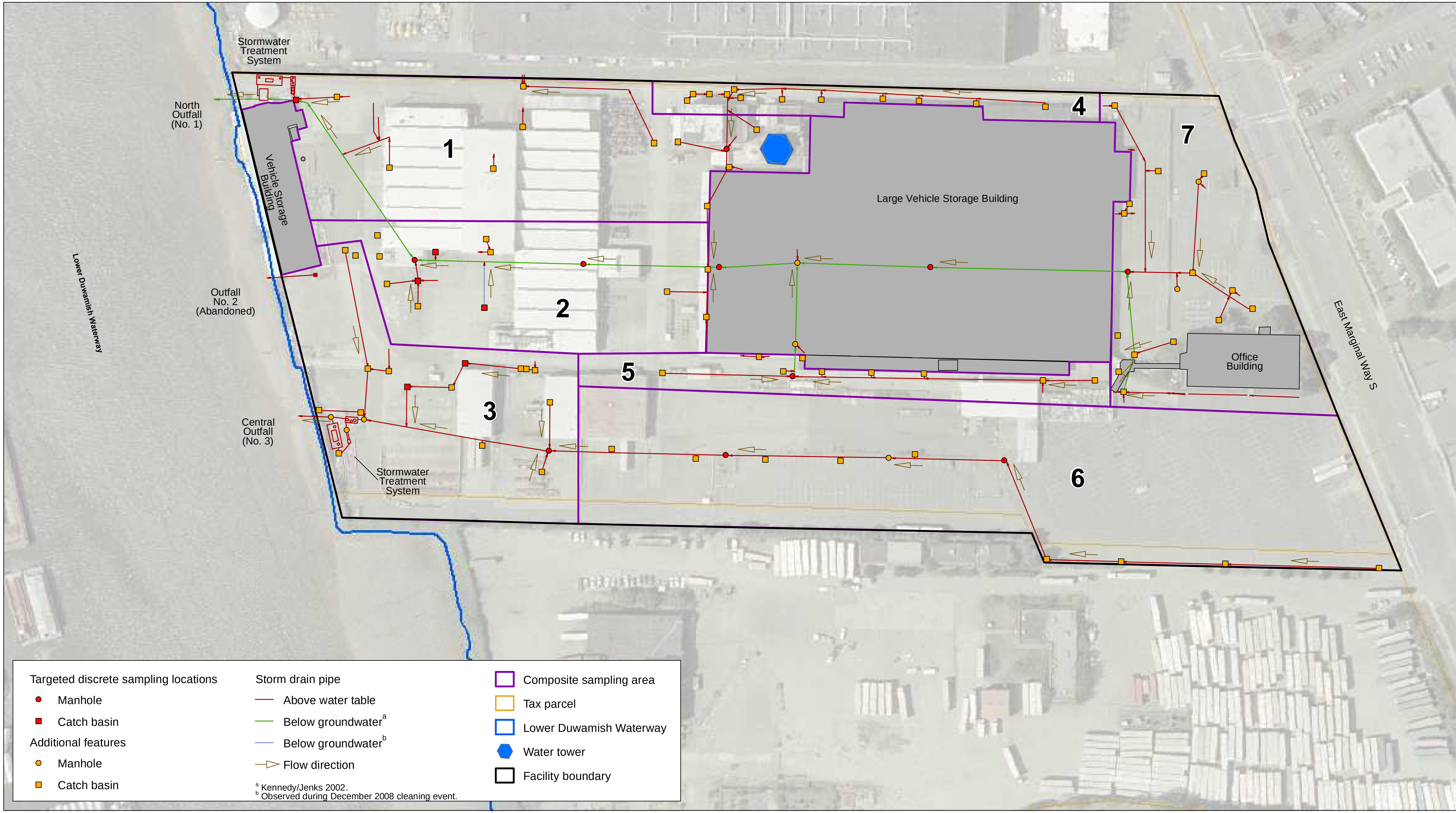


Figure 1. Configuration of northern and central treatment systems

accumulated for samples to be collected in accordance with the volume requirements specified in the Plan.

3.2.2 In-line solids

Solids from surface drainage and subsurface infiltration can accumulate in the drainage lines and maintenance holes of the drainage systems. Grab samples of in-line solids from the bottoms of 10 maintenance hole structures located on the principal drainage lines were targeted for sampling, as identified in Figure 2. During the May 2010 solids survey, three of these locations were identified as having material that could be sampled and were subsequently sampled during the May 2010 sampling event. During the August and November 2010 and March 2011 solids surveys, the remaining seven targeted locations were identified as either not having material that could be sampled, or were inaccessible for sampling, so sampling did not occur. The maintenance holes that lacked accumulated solids are designed as flow-through structures without sumps. The absence of solids accumulation in these structures indicates that the drainage lines and upstream BMPs are functioning as designed.



WindWard environmental LLC

N

0 200 400 Feet

0 50 100 Meters

Figure 2. IAA 8801 Parcel drainage system and targeted sampling locations

Prepared by CEH, 08/13/2010; MAP #3754; W:\Projects\IAA Tukwila Stormwater\Data\GIS\Sampling Event 2010

3.2.3 Solids retained in catch basin inserts

Grab samples of solids from the interiors of catch basin inserts were also targeted for sampling. Seven areas of the site, identified in Figure 2, were targeted for sampling under the Plan. At least three and up to seven grab samples per area were collected and composited to form a single sample for each area within the northern and central drainage networks. The catch basins contributing to each composite sample were selected randomly from among those catch basins with adequate quantities of material at the time of sampling, as determined by the most current solids monitoring survey. Additional material from each discrete sample that contributed to the composites was archived at ARI.

During the May 2010 solids survey, Areas 2, 3, 5, 6, and 7 were identified as each having at least three catch basin inserts with samplable volumes of material and were subsequently sampled during the May 2010 sampling event. During the August 2010 solids survey, Areas 1 and 4 were identified as each having at least three catch basin inserts with samplable volumes of material and were subsequently sampled during the August 2010 sampling event, completing the catch basin insert composite sampling under the Plan (Windward 2010c). The catch basins from which solids were collected for each area are shown on Figure 3.

The fact that sufficient solids could be collected from catch basins in all the targeted areas indicates that the catch basin inserts are working as designed. These inserts effectively trap solids, thereby preventing them from accumulating within the treatment system.

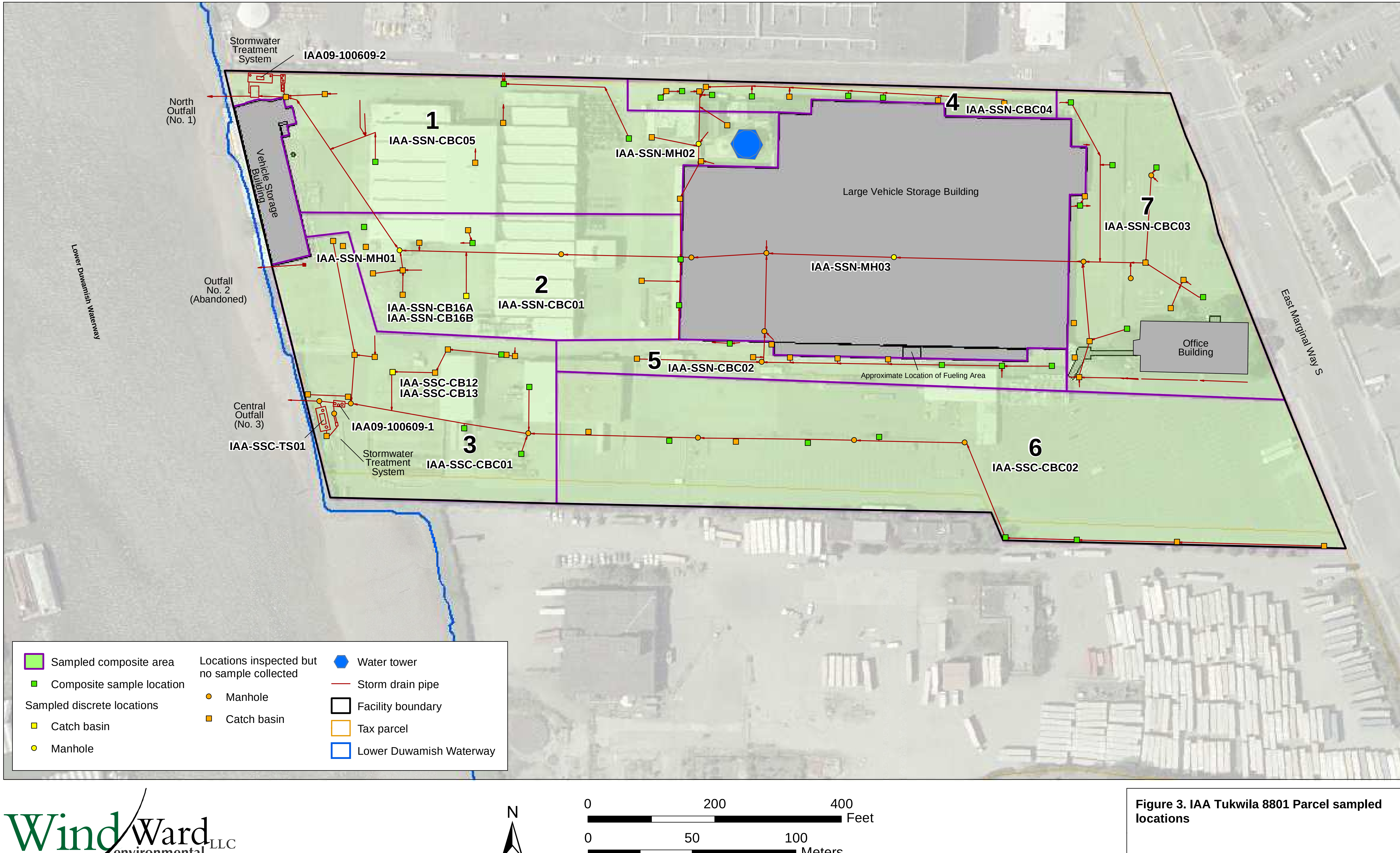


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Figure 3. IAA Tukwila 8801 Parcel sampled locations

Prepared by craigh, 4/22/2011; W:\Projects\IAA Tukwila Stormwater\Data\GIS\Sampling Event 2010\Fig 2 4337 Sampled locations.mxd

3.2.4 Discrete catch basin solids

Solids samples from the bottoms of the six catch basins that have been identified as possible soil or groundwater pathways during previous inspection activities and are in the vicinity of areas of historical soil or groundwater contamination were targeted for sampling under the Plan. For comparison, co-located contemporaneous discrete solids samples from the catch basin inserts at these locations were also targeted for sampling. The six targeted sampling locations are shown on Figure 2. During the May 2010 solids survey, none of these targeted catch basin locations had enough accumulated material in the bottoms of the catch basins or in the inserts for adequate volumes of material to be collected. During the August 2010 solids survey, one of the catch basin locations was identified as having adequate accumulated solids for samples to be collected from the catch basin sump and catch basin insert; samples were subsequently collected from this catch basin location during the August 2010 sampling event. During the November 2010 solids survey, none of the targeted catch basin locations had enough accumulated material in the bottoms of the catch basins or in the inserts for adequate volumes of material to be collected. During the March 2011 solids survey, one of the catch basin locations was identified as having adequate accumulated solids for samples to be collected from the catch basin sump and catch basin insert; samples were subsequently collected from this catch basin location during the March 2011 sampling event. The locations of the sampled discrete catch basins are presented on Figure 3.

3.3 CHEMISTRY

All chemistry results have undergone summary-level data validation (Stage 2B) using current US Environmental Protection Agency (EPA) guidance (EPA 2005, 2008, 2010) and are of good quality and acceptable for all project uses, as qualified. Analytical results for chemistry of the stormwater solids samples collected in October 2009 and May 2010 are presented in Table 4. Analytical results for chemistry of the stormwater solids samples collected in August 2010 and March 2011 are presented in Table 5.

Table 4. October 2009 and May 2010 chemistry results for stormwater solids samples

Chemical	Unit	Collected on 10/6/2009		Collected on 5/21/2010					Collected on 5/24/2010			
		IAA09-100609-1	IAA09-100609-2	IAA-SSC-CBC01	IAA-SSC-CBC02	IAA-SSN-CBC01	IAA-SSN-MH01	IAA-SSN-MH02	IAA-SSC-TS01	IAA-SSN-CBC02	IAA-SSN-CBC03	IAA-SSN-MH03
		Central System Vortechs™ Unit	North System StormFilter™ Vault	Composite Area 3	Composite Area 6	Composite Area 2	North System, Area 2	North System Near Water Tower	Central System StormFilter™ Vault	Composite Area 5	Composite Area 7	North System Inside Large Building
Metals												
Antimony	mg/kg dw	na	na	na	na	na	na	na	40 UJ	na	na	na
Arsenic	mg/kg dw	na	na	10 UJ	9 UJ	10 J	10 J	20 UJ	12	10 U	10 U	7 U
Beryllium	mg/kg dw	na	na	na	na	na	na	na	0.7 U	na	na	na
Cadmium	mg/kg dw	na	na	10.8	1.4	31.0	9.2	11.7	8	12.6	4.2	0.9
Chromium	mg/kg dw	na	na	168 J	66.4 J	193 J	192 J	152 J	108	92	84	36.8
Copper	mg/kg dw	na	na	679 J	141 J	1,040 J	310 J	410 J	335	254	139	76.3
Lead	mg/kg dw	na	na	1,160 J	858 J	632 J	677 J	705 J	740	454	380	91
Mercury	mg/kg dw	na	na	0.06 J	0.08 J	0.61 J	0.32 J	1.76 J	0.2	0.19	0.11	0.06
Nickel	mg/kg dw	na	na	na	na	na	na	na	60	na	na	na
Selenium	mg/kg dw	na	na	na	na	na	na	na	4 U	na	na	na
Silver	mg/kg dw	na	na	0.7 UJ	0.5 UJ	0.7 UJ	1.5 J	3 J	2 U	0.7 U	0.7 U	0.4 U
Thallium	mg/kg dw	na	na	na	na	na	na	na	1 U	na	na	na
Zinc	mg/kg dw	na	na	2,220	514	2,570	1,370	3,360	1,820	2,230	1,150	214
Butyltins												
Monobutyltin as ion	µg/kg dw	45	12	na	na	na	na	na	220	na	na	na
Dibutyltin as ion	µg/kg dw	53	110	na	na	na	na	na	1,400	na	na	na
Tributyltin as ion	µg/kg dw	21	3.8 U	na	na	na	na	na	160	na	na	na
PAHs												
1-Methylnaphthalene	µg/kg dw	na	na	520 U	410 U	660 U	150	440	1,100 U	240 U	380 U	39 U
2-Chloronaphthalene	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
2-Methylnaphthalene	µg/kg dw	na	na	520 U	410 U	660 U	240	510	1,100 U	120 J	210 J	39 U
Acenaphthene	µg/kg dw	na	na	520 U	410 U	480 J	310	780	1,100 U	330	620	36 J
Acenaphthylene	µg/kg dw	na	na	520 U	410 U	660 U	130 U	250	1,100 U	240 U	520	39 U
Anthracene	µg/kg dw	na	na	300 J	800	930	740	1,500	1,100 J	950	3,100	150
Benzo(a)anthracene	µg/kg dw	na	na	800	1,100	1,800	1,600	2,400	2,400	2,400	14,000	430
Benzo(a)pyrene	µg/kg dw	na	na	830	4,300	2,400	3,300	3,000	6,100	3,200	21,000	830
Benzo(b)fluoranthene	µg/kg dw	na	na	820	5,700	2,200	3,500	2,000	7,800	3,800	22,000	960
Benzo(g,h,i)perylene	µg/kg dw	na	na	430 J	1,800	1,200	1,400	830	2,300	1,200	7,900	310
Benzo(k)fluoranthene	µg/kg dw	na	na	820	5,700	2,200	3,500	2,000	7,800	3,800	22,000	960
Total benzofluoranthenes	µg/kg dw	na	na	1,640	11,400	4,400	7,000	4,000	15,600	7,600	44,000	1,920
Chrysene	µg/kg dw	na	na	1,200	8,100	3,400	5,500	3,800	11,000	5,200	27,000	1,200
Dibenzo(a,h)anthracene	µg/kg dw	na	na	520 U	520	330 J	360	340	700 J	360	3,000	120
Dibenzofuran	µg/kg dw	na	na	520 U	410 U	420 J	320	680	1,100 U	380	590	35 J
Fluoranthene	µg/kg dw	na	na	2,300 J	8,500 J	6,900 J	7,800 J	7,800 J	14,000 J	9,800 J	48,000 J	2,100 J
Fluorene	µg/kg dw	na	na	520 U	410 U	410 J	390	710	1,100 U	380	780	40
Indeno(1,2,3-cd)pyrene	µg/kg dw	na	na	370 J	2,000	1,000	1,200	730	2,300	1,200	7,800	330
Naphthalene	µg/kg dw	na	na	520 U	410 U	640 J	330	680	1,100 U	170 J	350 J	22 J
Phenanthrene	µg/kg dw	na	na	1,800	2,500	5,500	4,100	7,700	6,700	5,000	23,000	760
Pyrene	µg/kg dw	na	na	1,900	6,100	4,400	5,700	6,200	9,500	6,200	37,000	1,400
Total HPAHs	µg/kg dw	na	na	9,500 J	43,800 J	25,800 J	33,900 J	29,100 J	64,000 J	37,200 J	210,000 J	8,600 J
Total LPAHs	µg/kg dw	na	na	2,100 J	3,300	8,000 J	5,900	11,600	7,800 J	6,800 J	28,000 J	1,010 J
cPAH TEQ - half DL	µg/kg dw	na	na	1,200 J	6,000	3,300 J	4,500	3,900	8,500 J	4,500	29,000	1,200

Chemical	Unit	Collected on 10/6/2009		Collected on 5/21/2010					Collected on 5/24/2010			
		IAA09-100609-1	IAA09-100609-2	IAA-SSC-CBC01	IAA-SSC-CBC02	IAA-SSN-CBC01	IAA-SSN-MH01	IAA-SSN-MH02	IAA-SSC-TS01	IAA-SSN-CBC02	IAA-SSN-CBC03	IAA-SSN-MH03
		Central System Vortechs™ Unit	North System StormFilter™ Vault	Composite Area 3	Composite Area 6	Composite Area 2	North System, Area 2	North System Near Water Tower	Central System StormFilter™ Vault	Composite Area 5	Composite Area 7	North System Inside Large Building
Total PAHs	µg/kg dw	na	na	11,600 J	47,100 J	33,800 J	39,700 J	40,700 J	72,000 J	44,000 J	238,000 J	9,600 J
Phthalates												
BEHP	µg/kg dw	na	na	7,400	17,000	20,000	11,000	2,500	37,000	10,000	17,000	1,200
BBP	µg/kg dw	na	na	1,200	3,300	20,000	5,200	380	1,200	1,600	1,600	97
Diethyl phthalate	µg/kg dw	na	na	120 U	54 U	120 U	31 U	21 U	280 U	46 U	48 U	15 U
Dimethyl phthalate	µg/kg dw	na	na	1,100	190	580	4,700	160	500	220 J	250	21
Di-n-butyl phthalate	µg/kg dw	na	na	520 U	410 U	840	580	96 U	1,100 U	400	1,100	76
Di-n-octyl phthalate	µg/kg dw	na	na	490 J	4,100	1,000	620	160	3,500	680	1,000	63
Other SVOCs												
1,2,4-Trichlorobenzene	µg/kg dw	na	na	50 U	22 U	48 U	12 U	15	110 U	18 U	19 U	5.9 U
1,2-Dichlorobenzene	µg/kg dw	na	na	50 U	22 U	48 U	12 U	13	110 U	18 U	19 U	5.9 U
1,3-Dichlorobenzene	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
1,4-Dichlorobenzene	µg/kg dw	na	na	50 U	22 U	48 U	21	14	110 U	18 U	19 U	5.9 U
2,4,5-Trichlorophenol	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
2,4,6-Trichlorophenol	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
2,4-Dichlorophenol	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
2,4-Dimethylphenol	µg/kg dw	na	na	50 U	22 U	58	40	8.5	110 UJ	18 UJ	19 UJ	5.9 UJ
2,4-Dinitrophenol	µg/kg dw	na	na	5,200 U	4,100 U	6,600 U	1,300 U	960 U	11,000 U	2,400 U	3,800 U	390 U
2,4-Dinitrotoluene	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
2,6-Dinitrotoluene	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
2-Chlorophenol	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
2-Methylphenol	µg/kg dw	na	na	50 U	22 U	48 U	12 U	18	110 U	18 U	19 U	5.9 U
2-Nitroaniline	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
2-Nitrophenol	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
3,3′-Dichlorobenzidine	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
3-Nitroaniline	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
4,6-Dinitro-o-cresol	µg/kg dw	na	na	5,200 U	4,100 U	6,600 U	1,300 U	960 U	11,000 U	2,400 U	3,800 U	390 U
4-Bromophenyl phenyl ether	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
4-Chloro-3-methylphenol	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
4-Chloroaniline	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
4-Chlorophenyl phenyl ether	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
4-Methylphenol	µg/kg dw	na	na	12,000	2,400	5,300	14,000	64 J	14,000	1,100	2,700	77
4-Nitroaniline	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
4-Nitrophenol	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
Aniline	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
Benzoic acid	µg/kg dw	na	na	1,600 J	990 J	1,400 J	880 J	960 U	11,000 U	2,400 U	3,400 J	390 U
Benzyl alcohol	µg/kg dw	na	na	3,100	110 U	1,800	210	30 U	560 U	92 U	97 U	30 U
bis(2-chloroethoxy)methane	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
bis(2-chloroethyl)ether	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
bis(2-chloroisopropyl)ether	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
Carbazole	µg/kg dw	na	na	520 U	680	660	570	480	1,200	820	5,500	160
Hexachlorobenzene	µg/kg dw	na	na	50 U	22 U	48 U	12 U	6.1 U	110 U	18 U	19 U	5.9 U
Hexachlorobutadiene	µg/kg dw	na	na	50 U	22 U	48 U	12 U	6.1 U	110 U	18 U	19 U	5.9 U
Hexachlorocyclopentadiene	µg/kg dw	na	na	2,600 U	2,000 U	3,300 U	650 U	480 U	5,600 U	1,200 U	1,900 U	200 U
Hexachloroethane	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U

Chemical	Unit	Collected on 10/6/2009		Collected on 5/21/2010					Collected on 5/24/2010			
		IAA09-100609-1	IAA09-100609-2	IAA-SSC-CBC01	IAA-SSC-CBC02	IAA-SSN-CBC01	IAA-SSN-MH01	IAA-SSN-MH02	IAA-SSC-TS01	IAA-SSN-CBC02	IAA-SSN-CBC03	IAA-SSN-MH03
		Central System Vortechs™ Unit	North System StormFilter™ Vault	Composite Area 3	Composite Area 6	Composite Area 2	North System, Area 2	North System Near Water Tower	Central System StormFilter™ Vault	Composite Area 5	Composite Area 7	North System Inside Large Building
Isophorone	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
n-Nitroso-di-n-propylamine	µg/kg dw	na	na	250 U	110 U	240 U	62 U	30 U	560 U	92 U	97 U	30 U
n-Nitrosodimethylamine	µg/kg dw	na	na	250 U	110 U	240 U	62 U	30 U	560 U	92 U	97 U	30 U
n-Nitrosodiphenylamine	µg/kg dw	na	na	60 U	22 U	48 U	12 U	15 U	160 U	18 U	19 U	5.9 U
Nitrobenzene	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
Pentachlorophenol	µg/kg dw	na	na	250 U	9,600	240 U	62 U	30 U	560 U	92 U	2,000 J	30 U
Phenol	µg/kg dw	na	na	520 U	410 U	660 U	130 U	96 U	1,100 U	240 U	380 U	39 U
PCBs												
Aroclor-1016	µg/kg dw	na	na	20 U	32 U	110 U	160 U	98 U	84 U	47 U	41 U	20 U
Aroclor-1221	µg/kg dw	na	na	20 U	32 U	110 U	160 U	98 U	84 U	47 U	41 U	20 U
Aroclor-1232	µg/kg dw	na	na	20 U	32 U	110 U	160 U	98 U	84 U	47 U	41 U	20 U
Aroclor-1242	µg/kg dw	na	na	20 U	32 U	110 U	160 U	98 U	84 U	47 U	41 U	20 U
Aroclor-1248	µg/kg dw	na	na	20 U	32 U	110 U	160 U	340 U	130 U	240 U	62 U	20 U
Aroclor-1254	µg/kg dw	na	na	39	88	240	650	710	430	940	160	45
Aroclor-1260	µg/kg dw	na	na	23	65 U	150	260	390 U	84 U	250	100 U	20 U
Aroclor-1262	µg/kg dw	na	na	20 U	32 U	110 U	160 U	98 U	84 U	47 U	41 U	20 U
Aroclor-1268	µg/kg dw	na	na	20 U	32 U	110 U	160 U	98 U	84 U	47 U	41 U	20 U
Total PCBs	µg/kg dw	na	na	62	88	390	910	710	430	1,190	160	45
Dioxins/furans												
2,3,7,8-TCDD	ng/kg dw	3.97	2.97	na	na	na	na	na	2.47 J	na	na	na
1,2,3,7,8-PeCDD	ng/kg dw	32.1	16.3	na	na	na	na	na	30.0	na	na	na
1,2,3,4,7,8-HxCDD	ng/kg dw	71.7	28.4	na	na	na	na	na	93.3	na	na	na
1,2,3,6,7,8-HxCDD	ng/kg dw	169	78.3	na	na	na	na	na	180	na	na	na
1,2,3,7,8,9-HxCDD	ng/kg dw	147	66.3	na	na	na	na	na	176	na	na	na
1,2,3,4,6,7,8-HpCDD	ng/kg dw	4,410	1,900	na	na	na	na	na	5,440 J	na	na	na
OCDD	ng/kg dw	30,000 J	15,800	na	na	na	na	na	33,300 J	na	na	na
2,3,7,8-TCDF	ng/kg dw	18.5	44.9	na	na	na	na	na	10.4	na	na	na
1,2,3,7,8-PeCDF	ng/kg dw	13.1	11.3 J	na	na	na	na	na	9.35	na	na	na
2,3,4,7,8-PeCDF	ng/kg dw	26.0	33.0	na	na	na	na	na	18.3	na	na	na
1,2,3,4,7,8-HxCDF	ng/kg dw	65.2	30.1	na	na	na	na	na	85.3	na	na	na
1,2,3,6,7,8-HxCDF	ng/kg dw	71.7	29.9	na	na	na	na	na	90.4	na	na	na
1,2,3,7,8,9-HxCDF	ng/kg dw	1.68 U	0.983 U	na	na	na	na	na	1.55 U	na	na	na
2,3,4,6,7,8-HxCDF	ng/kg dw	82.7	39.0	na	na	na	na	na	108	na	na	na
1,2,3,4,6,7,8-HpCDF	ng/kg dw	1,850	623	na	na	na	na	na	2,800	na	na	na
1,2,3,4,7,8,9-HpCDF	ng/kg dw	107	33.7	na	na	na	na	na	165	na	na	na
OCDF	ng/kg dw	4,520	2,050	na	na	na	na	na	6,560	na	na	na
Dioxin/furan TEQ - (half DL)	ng/kg dw	181 J	92.2 J	na	na	na	na	na	209 J	na	na	na

BBP – butyl benzyl phthalate
BEHP – bis(2-ethylhexyl) phthalate
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DL – detection limit
dw – dry weight
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD – heptachlorodibenzo-*p*-dioxin
HpCDF – heptachlorodibenzofuran
HxCDD – hexachlorodibenzo-*p*-dioxin
HxCDF – hexachlorodibenzofuran
J – estimated concentration
LPAHs – low-molecular-weight polycyclic aromatic hydrocarbons
na – not analyzed
PAH – polycyclic aromatic hydrocarbon
OCDD – octachlorodibenzo-*p*-dioxin
OCDF – octachlorodibenzofuran
PCB – polychlorinated biphenyl
PeCDD – pentachlorodibenzo-*p*-dioxin
PeCDF – pentachlorodibenzofuran
SVOC – semivolatile organic compound
TCDD – tetrachlorodibenzo-*p*-dioxin
TCDF – tetrachlorodibenzofuran
TEQ – toxic equivalent
U – not detected at given concentration

Table 5. August 2010 and March 2011 chemistry results for stormwater solids samples

Chemical	Unit	Collected on 8/19/2010				Collected on 3/22/2011	
		IAA-SSN-CB16A	IAA-SSN-CB16B	IAA-SSN-CBC04	IAA-SSN-CBC05	IAA-SSC-CB12	IAA-SSC-CB13
		North System, Area 2 Catch Basin Floor	North System, Area 2 Catch Basin Insert	Composite Area 4	Composite Area 1	Central System Area 3 Catch Basin Insert	Central System Area 3 Catch Basin Floor
Metals							
Arsenic	mg/kg dw	20 U	10 U	10 U	9.0	10 U	10
Cadmium	mg/kg dw	26.3	10.0	11.4	11.2	4.6	12.7
Chromium	mg/kg dw	242 J	189 J	204 J	148 J	62	137
Copper	mg/kg dw	369	1,050	371	252	264	1,210
Lead	mg/kg dw	960	799	1,050	623	430	1,080
Mercury	mg/kg dw	0.12	0.08	0.18	0.11	0.05 U	0.11
Silver	mg/kg dw	0.9 U	0.8 U	0.8 U	0.5	14	2.1
Zinc	mg/kg dw	2,400	1,640	2,110	1,170	1,100	2,290
PAHs							
1-Methylnaphthalene	µg/kg dw	520 J	330	150 J	170 J	490	410
2-Chloronaphthalene	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
2-Methylnaphthalene	µg/kg dw	780	620	200 J	250 J	910	830
Acenaphthene	µg/kg dw	340 J	110 J	420	520	290 U	160 J
Acenaphthylene	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
Anthracene	µg/kg dw	530 J	160	840	1,000	290 U	330
Benzo(a)anthracene	µg/kg dw	1,200	270	1,800	1,400	430	830
Benzo(a)pyrene	µg/kg dw	2,100	580	2,400	2,300	500	900
Benzo(g,h,i)perylene	µg/kg dw	2,200	600	2,000	1,800	460	960
Total benzofluoranthenes	µg/kg dw	3,200	1,040	4,000	4,000	1,100	2,000
Chrysene	µg/kg dw	3,000	930	3,900	3,400	880	1,400
Dibenzo(a,h)anthracene	µg/kg dw	330 J	170	720	630	290 U	170 J
Dibenzofuran	µg/kg dw	370 J	110 J	360	390	290 U	170 J
Fluoranthene	µg/kg dw	4,800	1,400	6,300	5,100	1,600	2,600
Fluorene	µg/kg dw	460 J	92 J	380	460	290 U	250 J
Indeno(1,2,3-cd)pyrene	µg/kg dw	1,300	320	1,500	1,300	360	640
Naphthalene	µg/kg dw	1,300	610	360	520	260 J	490
Phenanthrene	µg/kg dw	4,400	1,200	5,300	4,900	1,100	2,100
Pyrene	µg/kg dw	3,800	1,100	4,600	4,200	1,400	2,400

Chemical	Unit	Collected on 8/19/2010				Collected on 3/22/2011	
		IAA-SSN-CB16A	IAA-SSN-CB16B	IAA-SSN-CBC04	IAA-SSN-CBC05	IAA-SSC-CB12	IAA-SSC-CB13
		North System, Area 2 Catch Basin Floor	North System, Area 2 Catch Basin Insert	Composite Area 4	Composite Area 1	Central System Area 3 Catch Basin Insert	Central System Area 3 Catch Basin Floor
Total HPAHs	µg/kg dw	21,900 J	6,400	27,200	24,100	6,700	11,900 J
Total LPAHs	µg/kg dw	7,000 J	2,200 J	7,300	7,400	1,400 J	3,300 J
cPAH TEQ –- half DL	µg/kg dw	2,800 J	820	3,500	3,300	710	1,280 J
Total PAHs	µg/kg dw	29,000 J	8,600 J	34,500	31,500	8,100 J	15,200 J
Phthalates							
BEHP	µg/kg dw	35,000	5,800	14,000	8,000	8,200	16,000
BBP	µg/kg dw	3,100	2,500	3,400	3,400	7,000	2,500
Diethyl phthalate	µg/kg dw	150 U	46 U	63 U	71 U	110	78 U
Dimethyl phthalate	µg/kg dw	1,300	740	590	300	240	880
Di-n-butyl phthalate	µg/kg dw	320 J	380	970	300 U	1,200	740
Di-n-octyl phthalate	µg/kg dw	610 U	150 U	250 U	300 U	820	610
Other SVOCs							
1,2,4-Trichlorobenzene	µg/kg dw	61 U	18 U	25 U	28 U	72 U	72 U
1,2-Dichlorobenzene	µg/kg dw	61 U	18 U	25 U	28 U	72 U	72 U
1,3-Dichlorobenzene	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
1,4-Dichlorobenzene	µg/kg dw	61 U	18 U	25 U	28 U	72 U	72
2,4,5-Trichlorophenol	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
2,4,6-Trichlorophenol	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
2,4-Dichlorophenol	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
2,4-Dimethylphenol	µg/kg dw	61 U	18 U	46	40	72 U	72 U
2,4-Dinitrophenol	µg/kg dw	6,100 U	1,500 U	2,500 U	3,000 U	3,100 U	3,100 U
2,4-Dinitrotoluene	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
2,6-Dinitrotoluene	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
2-Chlorophenol	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
2-Methylphenol	µg/kg dw	580 U	18 U	25 U	40	72 U	72 U
2-Nitroaniline	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
2-Nitrophenol	µg/kg dw	610 U	150 U	250 U	300 U	1,400 U	1,400 U
3,3′-Dichlorobenzidine	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
3-Nitroaniline′	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
4,6-Dinitro-o-cresol	µg/kg dw	6,100 U	1,500 U	2,500 U	3,000 U	2,900 U	2,900 U
4-Bromophenyl phenyl ether	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U

Chemical	Unit	Collected on 8/19/2010				Collected on 3/22/2011	
		IAA-SSN-CB16A	IAA-SSN-CB16B	IAA-SSN-CBC04	IAA-SSN-CBC05	IAA-SSC-CB12	IAA-SSC-CB13
		North System, Area 2 Catch Basin Floor	North System, Area 2 Catch Basin Insert	Composite Area 4	Composite Area 1	Central System Area 3 Catch Basin Insert	Central System Area 3 Catch Basin Floor
4-Chloro-3-methylphenol	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
4-Chloroaniline	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
4-Chlorophenyl phenyl ether	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
4-Methylphenol	µg/kg dw	1,000	98 J	1,400	440	4,200	1,600
4-Nitroaniline	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
4-Nitrophenol	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
Aniline	µg/kg dw	610 U	150 U	250 U	300 U	1,900 U	1,900 U
Benzoic acid	µg/kg dw	1,700 J	1,500 U	11,000	2,700 J	5,200	2,900 U
Benzyl alcohol	µg/kg dw	780 J	5,000 J	440 J	420 J	330	150
bis(2-chloroethoxy)methane	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
bis(2-chloroethyl)ether	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
bis(2-chloroisopropyl)ether	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
Carbazole	µg/kg dw	610 U	97 J	370	340	290 U	230 J
Hexachlorobenzene	µg/kg dw	61 U	18 U	25 U	28 U	72 U	72 U
Hexachlorobutadiene	µg/kg dw	61 U	18 U	25 U	28 U	72 U	72 U
Hexachlorocyclopentadiene	µg/kg dw	3,100 U	770 U	1,300 U	1,500 U	1,400 U	1,400 U
Hexachloroethane	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
Isophorone	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
n-Nitroso-di-n-propylamine	µg/kg dw	310 U	92 U	130 U	140 U	72 U	72 U
n-Nitrosodimethylamine	µg/kg dw	310 U	92 U	130 U	140 U	360 U	360 U
n-Nitrosodiphenylamine	µg/kg dw	61 U	26 U	63 U	28 U	120	130
Nitrobenzene	µg/kg dw	610 U	150 U	250 U	300 U	290 U	290 U
Pentachlorophenol	µg/kg dw	310 UJ	370 J	130 UJ	140 UJ	360 U	360 U
Phenol	µg/kg dw	610 U	150 U	250 U	300 U	790	560
PCBs							
Aroclor-1016	µg/kg dw	65 U	26 U	62 U	54 U	20 U	20 U
Aroclor-1221	µg/kg dw	65 U	26 U	62 U	54 U	20 U	20 U
Aroclor-1232	µg/kg dw	65 U	26 U	62 U	54 U	20 U	20 U
Aroclor-1242	µg/kg dw	65 U	26 U	62 U	54 U	20 U	20 U
Aroclor-1248	µg/kg dw	130 U	78 U	120 U	95 U	24 U	48
Aroclor-1254	µg/kg dw	360	220	350	310	62	69

Chemical	Unit	Collected on 8/19/2010				Collected on 3/22/2011	
		IAA-SSN-CB16A	IAA-SSN-CB16B	IAA-SSN-CBC04	IAA-SSN-CBC05	IAA-SSC-CB12	IAA-SSC-CB13
		North System, Area 2 Catch Basin Floor	North System, Area 2 Catch Basin Insert	Composite Area 4	Composite Area 1	Central System Area 3 Catch Basin Insert	Central System Area 3 Catch Basin Floor
Aroclor-1260	µg/kg dw	170	88	150	160	47	27
Aroclor-1262	µg/kg dw	65 U	26 U	62 U	54 U	20 U	20 U
Aroclor-1268	µg/kg dw	65 U	26 U	62 U	54 U	20 U	20 U
Total PCBs	µg/kg dw	530	310	500	470	109	144

BBP – butyl benzyl phthalate
BEHP – bis(2-ethylhexyl) phthalate
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DL – detection limit
dw – dry weight
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
J – estimated concentration
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TEQ – toxic equivalent
U – not detected at given concentration

3.4 CONVENTIONALS

Analytical results for conventional parameters for the stormwater solids samples collected in October 2009, May and August 2010, and March 2011 are presented in Table 6.

Table 6. Conventional parameter results for stormwater solids samples

Sample	Location	TOC (% dw)	Total Solids (% ww)	Total Gravel (% dw)	Total Sand (% dw)	Total Silt (% dw)	Total Clay (% dw)
IAA09-100609-1	central system Vortechs™ unit	na	42.7	na	na	na	na
IAA09-100609-2	northern system StormFilter™ vault	na	38.5	na	na	na	na
IAA-SSC-CBC01	composite Area 3	13.6	42.00 J	na	na	na	na
IAA-SSC-CBC02	composite Area 6	11.6	59.50 J	na	na	na	na
IAA-SSC-TS01	central system StormFilter™ vault	16.5	13.30	na	na	na	na
IAA-SSN-CBC01	composite Area 2	10.8	41.00 J	na	na	na	na
IAA-SSN-CBC02	composite Area 5	12.7	44.17	na	na	na	na
IAA-SSN-CBC03	composite Area 7	11.4	42.90	na	na	na	na
IAA-SSN-MH01	northern system maintenance hole, Area 2	9.31	38.23 J	na	na	na	na
IAA-SSN-MH02	northern system maintenance hole near water tower	2.75	62.00 J	na	na	na	na
IAA-SSN-MH03	northern system maintenance hole inside large building	2.10	72.80	na	na	na	na
IAA-SSN-CB16A	northern system, Area 2 catch basin floor	8.16 J	18.57	1.6	50.3	44.5	3.5
IAA-SSN-CB16B	northern system, Area 2 catch basin insert	7.19 J	96.00	4.4	79.3	15.8	0.6
IAA-SSN-CBC04	composite Area 4	8.77 J	38.30	5.3	70.7	20.9	3.2
IAA-SSN-CBC05	composite Area 1	11.3 J	61.20	5.4	72.4	19.3	3.0
IAA-SSC-CB12	central system, Area 3 catch basin insert	14.8	43.7	5.2	77.4	16.2	1.3
IAA-SSC-CB13	central system, Area 3 catch basin floor	11.0	39.27	3.1	65.7	29.4	1.9

dw – dry weight
J – estimated concentration
na – not analyzed
TOC – total organic carbon
ww – wet weight

4 Data Quality Review

Data quality objectives and laboratory quality control (QC) procedures are discussed in Sections 6 and 8, respectively, of the Plan (Windward 2010c). The stormwater solids samples collected on October 6, 2009, were submitted to ARI for butyltin analysis and to AP for dioxins/furans analysis. The samples were analyzed by ARI in sample delivery group (SDG) QV75 and by AP in SDG P2228. The stormwater solids samples collected on May 21 and 24, 2010, were submitted to ARI and analyzed in SDGs QX60 and QX80, respectively. In addition, material from sample IAA-SSC-TS01, collected on May 24, 2010, was submitted to AP for dioxin/furan analysis in SDG P2271. The stormwater solids samples collected on August 19, 2010, and March 22, 2011, were submitted to ARI and analyzed in SDGs RJ74 and SO21, respectively. Results from the analyses of the August 2010 and March 2011 samples, as well as all dioxin/furan results, have undergone summary-level data validation (Stage 2B) by EcoChem, Inc., using current EPA guidance (EPA 2005, 2008, 2010). Data validation reports are included in Appendix D. All other results from the October 2009 and May 2010 sampling events have undergone summary-level data validation by Windward, also using current EPA guidance (EPA 2005, 2008, 2010). The data validation encompassed a review of all QC summary forms, including initial and continuing calibration, internal standard, surrogate, laboratory control sample (LCS), laboratory control sample duplicate (LCSD), matrix spike/ matrix spike duplicate (MS/MSD), and interference check sample summary forms. The majority of the data did not require qualification, or were as an estimated concentration (J-qualified). The specified completeness goal of 95% was met.

Based on the information reviewed, the overall data quality was considered acceptable for use as qualified. Issues that resulted in the qualification of data are as follows:

- Twenty results for arsenic, lead, mercury, and silver, and five results for total solids from SDG QX60, were J-qualified as estimated because the associated laboratory duplicate sample indicated a lack of sample homogeneity with a relative percent difference (RPD) value higher than the control limits.
- Five results for chromium from SDG QX60 were J-qualified as estimated because the associated laboratory duplicate sample indicated a lack of sample homogeneity with an RPD value higher than the control limit of 20% and a matrix spike recovery higher than the control limit of 125%.
- Five results for copper from SDG QX60 were J-qualified as estimated because the associated matrix spike sample had a recovery higher than the control limit of 125%.

- Nine results for fluoranthene from SDG QX60 and QX80 were J-qualified as estimated because the percent recovery for the continuing calibration verification sample was below control limits.
- All four results for 2,4-dimethylphenol from SDG QX80 were UJ-qualified as estimated and not detected at given concentration because the associated LCS/LCSD samples had recoveries below the control limit.
- One result for antimony from SDG QX80 was UJ-qualified as estimated and not detected at given concentration because the matrix spike sample recovery was below the control limit.
- All four results for total organic carbon (TOC) and chromium from SDG RJ74 were J-qualified as estimated because the associated matrix spike sample had a recovery below the control limit of 75%.
- All four results for 2,4-dimethylphenol, pentachlorophenol, and benzyl alcohol from SDG RJ74 were J-qualified as estimated because the associated LCS/LCSD samples had recoveries below the control limit.
- The percent recovery values for nitrobenzene-d5 and p-terphenyl-d14 were greater than the upper control limits in sample IAA-SSN-CB16B from SDG RJ74. The positive result for dimethylphthalate was J-qualified as estimated to indicate a potential high bias.
- One result for octachlorodibenzo-*p*-dioxin (OCDD) from SDG P2228 was J-qualified as estimated because the result was over the calibration range.
- Two results for OCDD and one result for 1234678-heptachlorodibenzo-*p*-dioxin (HpCDD) from SDG P2271 were J-qualified as estimated because the results were above the calibration range.
- In addition, the analytical laboratories flagged many other results with J-qualifiers, indicating the reported results were detected at less than the reporting limit; these values are treated as estimated.
- Both results for 2-nitrophenol, 2,4-dinitrophenol, and 2,4-dinitro-2-methylphenol from SDG SO21were UJ-qualified as estimated and not detected at given concentration because the continuing calibration recoveries were outside of the control limits.
- One result for diethylphthalate from SO21 was U-qualified as not detected at the given concentration because of contamination in the method blank.
- One result for Aroclor 1248 from SDG SO21 was U-qualified as not detected at the given concentration because of non-target background interference.
- Both copper results from SDG SO21 were J-qualified as estimated because the associated matrix spike recovery was above the control limit of 125%.

- Both silver results from SDG SO21 were J-qualified as estimated because the associated laboratory duplicate sample indicated a lack of sample homogeneity with a RPD value higher than the control limit.

5 Discussion

Ecology has required IAA to complete this evaluation of stormwater solids as part of Ecology source control efforts. Structures such as catch basins are intended to capture solid material that might otherwise be discharged to adjacent water bodies. Chemical analyses of this solid material can be helpful in identifying chemical sources. Because there are no regulatory standards that apply to stormwater solids, a comparison to regional data collected in a similar fashion provides the appropriate context for interpreting the data. Chemical concentrations that are within the range of the regional data are indicative of typical urban signatures for these chemicals.

The Lower Duwamish Waterway (LDW) remedial investigation report (Windward 2010a) summarized several datasets of stormwater solids. The most relevant dataset for comparison to the IAA stormwater solids data was collected from the Diagonal Ave S stormwater drainage basin. Stormwater from this basin is discharged to the LDW, as is stormwater from the 8801 facility. The Diagonal dataset includes 40 samples collected from on-site catch basins, 36 samples collected from right-of-way catch basins, and 32 samples collected from in-line drainage pipes throughout the Diagonal drainage basin. On-site catch basin samples were primarily collected during City of Seattle business inspections from catch basins located on private commercial and industrial properties. Right-of-way catch basin samples were collected from catch basins located on public streets. In-line drainage pipe samples were collected from the bottoms of maintenance holes associated with the stormwater drainage system trunk lines. Data from the Rainier Commons site, which was a significant source of PCBs to the Diagonal drainage system, were excluded from the Diagonal dataset (Windward 2010a).

The chemicals for which data summaries were prepared are those commonly analyzed and detected in stormwater solids, including metals (i.e., copper, lead, zinc, mercury, and arsenic), phthalates (i.e., bis(2-ethylhexyl) phthalate [BEHP] and butyl benzyl phthalate [BBP]), polycyclic aromatic hydrocarbons (PAHs), and PCBs. The maximum concentrations of chemicals in the stormwater solids samples collected under the Plan are lower than the maximum concentrations in samples collected from the Diagonal drainage basin (Figures 4, 5, and 6). This comparison indicates that the concentrations of these chemicals found in IAA stormwater solids are typical of concentrations found in similar urban environments in the LDW drainage basin.

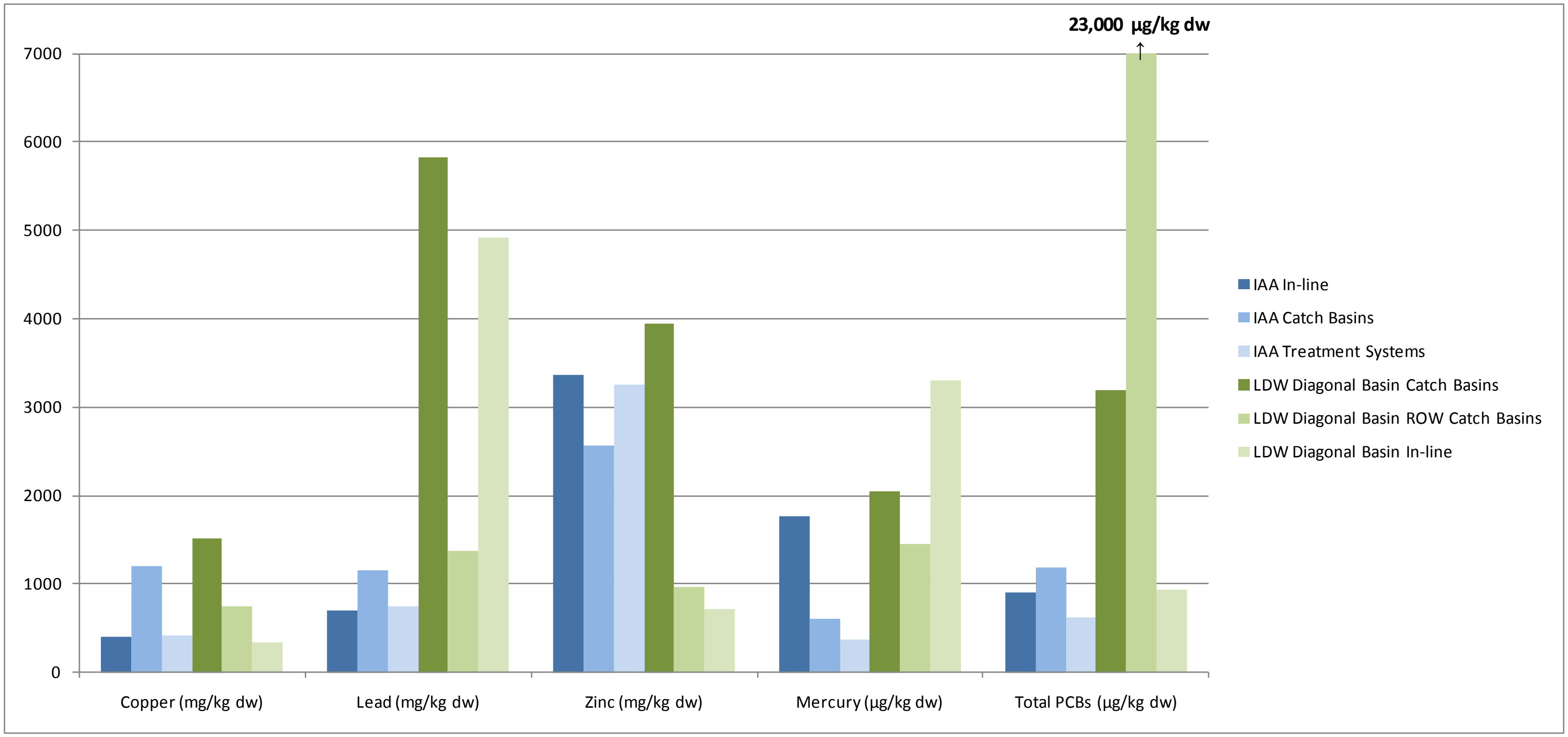

Figure 4. Comparison of maximum copper, lead, zinc, mercury, and PCB concentrations in stormwater solids

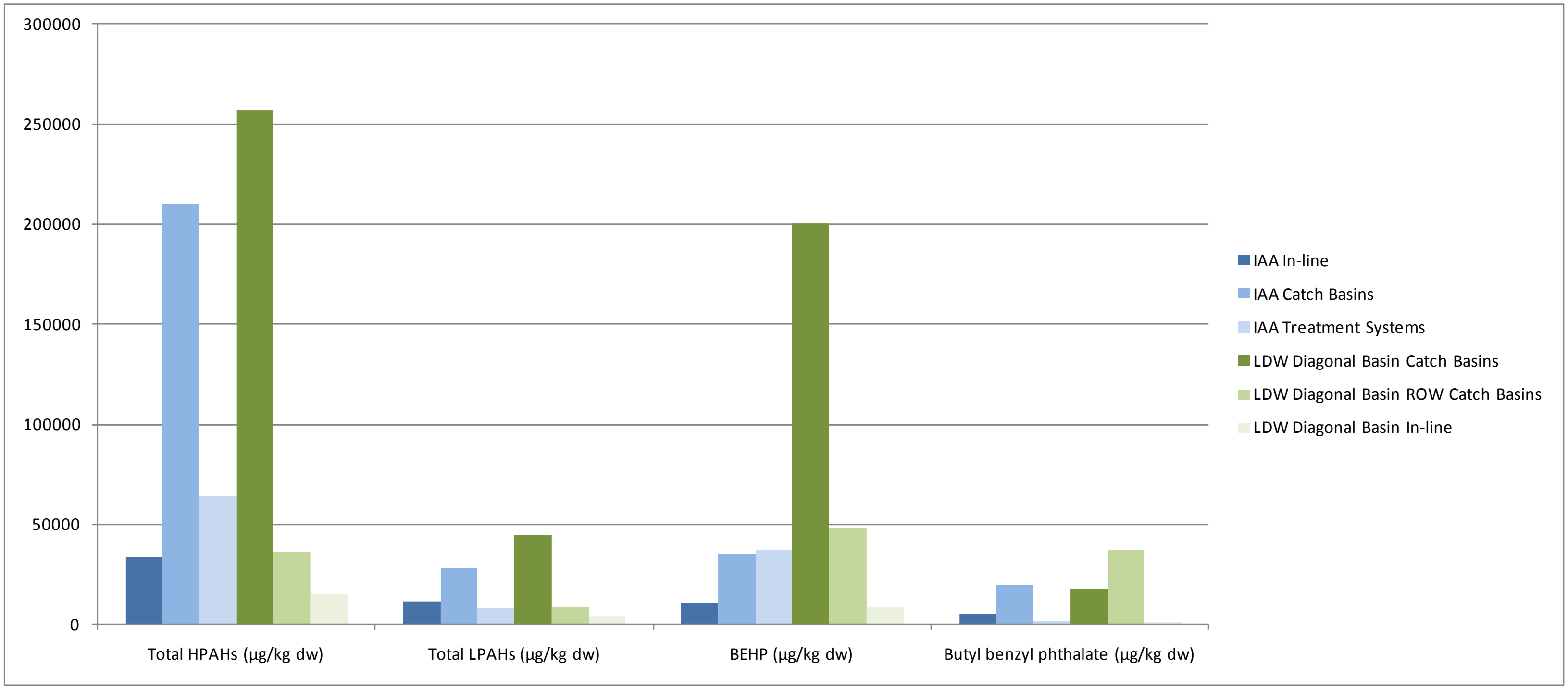

Figure 5. Comparison of maximum HPAH, LPAH, BEHP, and BBP concentrations in stormwater solids

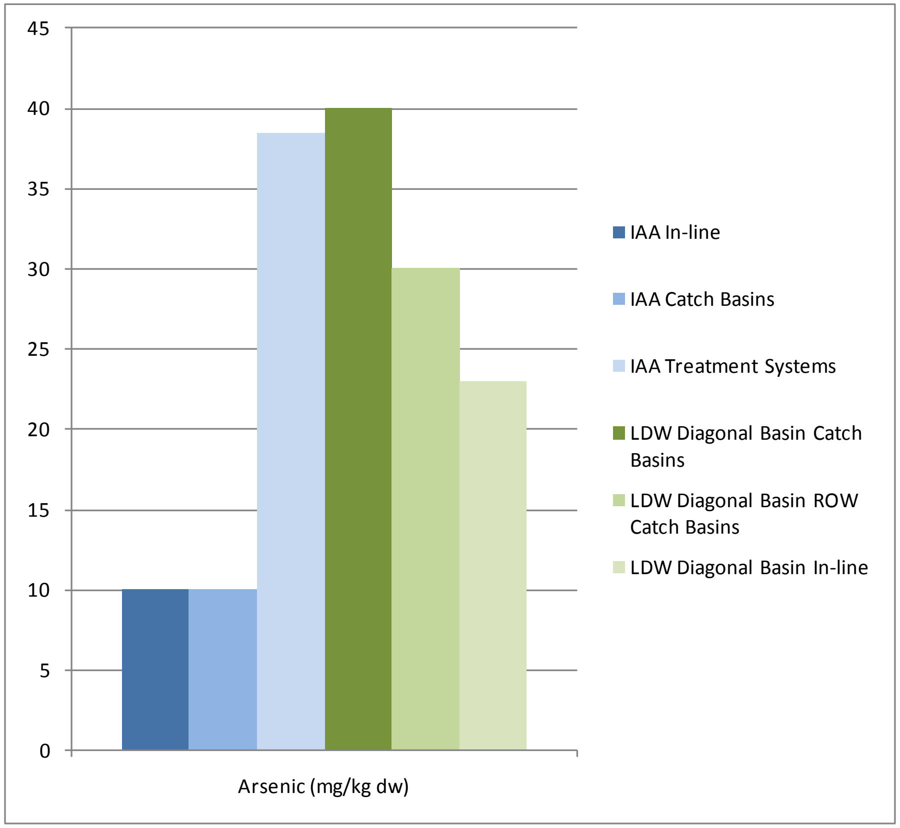

Figure 6. Comparison of maximum arsenic concentrations in stormwater solids

Dioxins/furans were also analyzed in three treatment system samples from the 8801 facility, but no comparable data were collected within the Diagonal drainage basin. The highest dioxin/furan toxic equivalent (TEQ) from the 8801 facility (209 ng/kg) was associated with a TOC concentration of 16.5%, which was the highest TOC concentration found in this investigation (Table 6). Organic chemicals with high octanol-water partition coefficients, such as dioxins/furans, will preferentially concentrate in organic-rich solid material that is typically found within stormwater treatment systems. As described in the introduction to this report, such accumulated material is periodically removed from the treatment systems at the 8801 facility so that it will not be discharged to the LDW.

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