Scoping of Lateral Loading Study
Lower Duwamish Waterway, WA

Previous Studies and Existing Data

Prepared for

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List of Acronyms

BEHP	bis(2-ethylhexyl)phthalate
cPAH	carcinogenic PAH
CSO	combined sewer overflow
DBA	dibenzo(a,h)anthracene
DEQ	Department of Environmental Quality
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
FP	fluorescent particles
GDWQA	Green-Duwamish Watershed Water Quality Assessment
GIS	geographic information systems
HDPE	high-density polyethylene
HSPF	Hydrologic Simulation Program-Fortran
LDW	Lower Duwamish Waterway
LWG	Lower Willamette Group
ML	mass load
OC	organic carbon
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SAIC	Science Applications International Corporation
SMS	Sediment Management Standards
SOP	Standard Operating Procedure
SPU	Seattle Public Utilities
SSC	suspended solids concentration
SWMM	Stormwater Management Model
TOC	total organic carbon
TSS	total suspended solids
WASP	Water Quality Analysis Simulation Program

1.0 Introduction and Purpose

Science Applications International Corporation (SAIC) has been asked by the Washington State Department of Ecology (Ecology) to assist with the development of a study to measure contaminant concentrations and estimate lateral sediment loading from significant municipal storm drain outfalls in the Lower Duwamish Waterway (LDW).

The objectives of this work assignment are to assist with scoping of the lateral loading study by identifying and recommending storm drain outfall sampling locations, reviewing existing stormwater and storm drain solids data for these sampling locations, summarizing the methodology used in similar studies to calculate sediment loading, and developing a sampling and analysis plan for conducting stormwater and solids sampling at the selected outfall locations.

This report was prepared for Task 3 of this work assignment to compile available data for stormwater and storm drain solids (from catch basins, in-line storm drains, and sediment traps) for the outfalls identified during Task 2 (Site Reconnaissance), and to review and summarize existing information about stormwater loading studies conducted in other locations and other relevant documents. Where possible, SAIC has described and summarized the models used to conduct stormwater mass loading calculations, and has identified input required by these models for incorporation into the Sampling and Analysis Plan (Task 4).

Stormwater discharges have the potential to contribute to the recontamination of LDW sediments after cleanup has been completed, particularly near outfalls. To predict whether recontamination to levels above the Washington Sediment Management Standards (SMS) or other approved cleanup goals is likely to occur, estimates of stormwater loads are needed for input into fate and transport estimation tools and models. These models require estimates of the chemical mass load (e.g., kilograms per month) from each type of chemical source, including stormwater, groundwater, and upstream sediments.

In general, estimation of stormwater pollutant mass loading requires information about the chemical concentration in stormwater and the volume of stormwater discharged. These terms can either be measured directly or estimated through indirect means. The specific approach selected depends on the objectives of the sampling effort; these objectives may include providing input to risk assessment, estimating river-wide stormwater loads for input to fate and transport models, estimating outfall-specific stormwater loads for input to fate and transport models (e.g., Slip 4), developing appropriate sediment cleanup levels, identifying upland contaminant sources, or identifying and evaluating upland control actions.

Section 2.0 of this report describes recent studies that were identified as most relevant to the estimation of chemical loading to the LDW from lateral storm drain lines. Section 3.0 provides a brief summary and identifies issues to be addressed as part of the lateral loading study. Section 4.0 identifies readily available existing data from sediment traps, catch basins, and inline solids samples for basins with stormwater discharge to the LDW via the outfalls recommended for sampling in *Scoping of Lateral Loading Study, Lower Duwamish Waterway, WA, Site Reconnaissance Report* (SAIC 2009). Section 5.0 lists the references cited in this report.

2.0 Review of Chemical Loading Studies

2.1 Portland Harbor Superfund Site

As part of the Remedial Investigation/Feasibility Study (RI/FS) for the Portland Harbor Superfund Site, a Stormwater Technical Team (including representatives of the U.S. Environmental Protection Agency [EPA], Oregon Department of Environmental Quality [DEQ], and the Lower Willamette Group [LWG]) was convened to develop the framework for a stormwater sampling plan. The Stormwater Technical Team evaluated a range of stormwater data collection technical approaches and made selections based on the ability to meet objectives for data use, schedule, cost, and feasibility (Anchor 2008). Samples were initially collected during the 2006/2007 wet weather season; a second round of sampling was conducted in late 2007/early 2008.

LWG outlined the framework for analyzing the stormwater and sediment data and calculating stormwater loads to the Site in a draft report: *Portland Harbor RI/FS Stormwater Loading Calculation Methods*, May 16, 2008 (Anchor 2008). The objective of the loading evaluation was to evaluate potential sediment recontamination from stormwater discharges to the river, and to support the RI risk evaluation (specifically to understand stormwater contribution to in-river fish tissue chemical burdens). The draft report includes a preliminary data analysis using the first round of composite stormwater data collected by the LWG plus data collected by the Port of Portland between March and June 2007.

Initial loading estimates were conducted for a subset of 10 analytes: five polychlorinated biphenyls (PCB) congeners (PCB18, PCB66, PCB118/106, PCB153, PCB194), two polycyclic aromatic hydrocarbons (PAHs) (benzo[a]pyrene, acenaphthene), arsenic, lead, and total suspended solids (TSS).

Because the purpose of the stormwater sampling effort was to provide sufficient data for an RI/FS-level evaluation of stormwater loads and contributions to potential recontamination for the entire Site (rather than for individual outfalls or upland sources), direct measurement of stormwater loads was determined to be infeasible due to the “unreasonably large number” of samples that would be required. Instead, the stormwater sampling rationale was designed to use estimate “representative” stormwater chemical concentrations for various land use types, and then extrapolate these concentrations to the entire Site.

Two types of samples were selected to estimate long-term stormwater loads: stormwater composite samples and sediment trap samples. These two types of samples provide data to support two independent means of estimating stormwater chemical loads. It was anticipated that these two methods (composite water and sediment traps) would result in different predictions of chemical mass loading at most locations, because each method has intrinsic measurement artifacts that will lead to varying load estimates (Anchor 2008). The advantages and disadvantages of each method were believed to be complementary, and the two estimates would provide a better overall sense of the potential range of chemical loads.

Two rounds of stormwater sampling were conducted: Round 3A (February through July 2007), and Round 3B (November 2007 through February 2008). Preliminary stormwater loading calculations (for water samples only) were conducted during preparation of the *Stormwater Loading Calculation Methods* document (Anchor 2008); complete loading estimates and calculations for the full data set will be published as part of the RI and were not available for review at the time this report was prepared.

To estimate loading based on stormwater samples, chemical concentrations were multiplied by the volume of water discharging at a location over a set time to yield a chemical load in mass/time. To estimate loading based on suspended sediment collected in sediment traps, chemical concentrations in solids were multiplied by TSS concentrations measured in water samples and the volume of water discharging at the location over a set time to again yield a chemical load in mass/time.

2.1.1 Stormwater Discharge Volume Calculations

Calculating chemical loading from stormwater data requires the measurement or estimation of runoff volumes. At the Portland Harbor Superfund Site, runoff volumes were calculated using the City of Portland Bureau of Environmental Services GRID model for each section of the river. In addition, runoff volumes for "unique" sites were calculated separately. The GRID model (City of Portland 2006) is a geographic information systems (GIS)-based reconnaissance-level pollutant model developed by the City of Portland Bureau of Environmental Services to calculate stormwater runoff volumes and TSS loading rates. The GRID model was used to develop runoff flow volumes. Precipitation, pervious/impervious area, and land use data were compiled for each 100-foot by 100-foot parcel for five "typical" flow years. With these data, runoff volumes for each land use type were calculated using a series of equations known as the "Simple Method" (Schueler 1987). The runoff volume was calculated as follows:

$$R \text{ (cm/month)} = P \text{ (cm)} \times Pj \times Rv / 12 \text{ months} \tag{1}$$

Where: R = Annual runoff per unit area (cm/month)
P = Annual rainfall (cm)
Pj = Fraction of monthly rainfall events that produce runoff (usually 0.9)
Rv = Runoff coefficient (unitless)

Runoff R was then converted to volume of discharge V using the following equation:

$$V \text{ (L/month)} = R \text{ (cm/month)} \times A \text{ (cm}^2\text{)} \tag{2}$$

Where: V = Volume of discharge from an outfall or site per month (L/month)
R = Annual runoff per unit area (cm/month)
A = Drainage area to outfall or site (cm^2)

Discharge volume was calculated on a monthly basis, because this is the smallest unit of time expected to require differentiation of loads for input to the fate and transport model. It was generally chosen so that seasonal variations in stormwater loads can be accounted for in the fate and transport model (e.g., little, if any, stormwater loading would be expected during the summer months).

The flow years used in the GRID model were selected to match the years planned for use in the fate and transport model for the Portland Harbor Superfund Site, and included 95th, 75th, 50th, 25th, and 5th percentile flow years. Monthly runoff volumes were calculated for each of the five storm years. Monthly loads were calculated for each of the five precipitation years using the following equation:

$$L\ (g/month) = C_w\ (\mu g/L) \times V\ (L/month) \times 10^{-9}\ kg/\mu g \qquad (3)$$

Where: L = Contaminant load (grams/month)
C_w = Measured contaminant concentration in stormwater (µg/L)
V = Volume of discharge from an outfall or site per month (L/month)

2.1.2 Chemical Concentrations Based on Stormwater Data

Chemical concentrations in stormwater were measured based on flow-weighted composite water samples (using automated ISCO samplers) from three storm events at a total of 36 locations (Anchor and Integral 2008b). Whole water samples were collected for analysis of organic compounds, and filtered/unfiltered sample pairs were collected for metals analysis (Anchor and Integral 2007a). An additional set of grab stormwater samples was collected at 10 of the 31 sampling locations of filtered/unfiltered pairs for analysis of selected organic compounds to obtain partitioning data that could be used to validate fate and transport model algorithms. Samples from a subset of locations were analyzed for phthalates due to logistical difficulties involved with avoiding phthalate contamination from field sampling equipment and laboratory analysis. Continuous flow monitoring was implemented at each sampling location for the duration of the sampling effort.

To prevent sampling of river water, stormwater sampling stations were chosen at locations/elevations unlikely to experience a backup of river water in to the junction or adjoining pipes (Anchor and Integral 2008b). The gage height of the Willamette River was obtained from the U.S. Geological Survey on a half-hour basis for the duration of the stormwater sampling.

2.1.3 Chemical Concentrations Based on Sediment Trap Data

The *Stormwater Loading Calculation Methods* document (Anchor 2008) presented methods for calculating stormwater loads using sediment trap data. However, no preliminary calculations were performed because sediment trap data were unavailable. The proposed methods are described below.

Measured TSS data from the composite stormwater sampling are used to convert chemical concentrations measured in sediment to chemical loads. In general, sediment traps were installed at the same locations that stormwater samples were collected (Anchor and Integral 2007a). In addition, sediment traps were generally installed over the same sampling period as stormwater sample collection. In cases where sufficient stormwater samples were collected during the first round of sampling, only sediment traps were installed during the second round and no composite stormwater samples were collected. Therefore, there are some instances when the collection period for TSS data in stormwater does not completely match the collection period for sediment trap data. In these cases, TSS data from the first round of stormwater sampling are used.

In addition, TSS data collected during the stormwater sampling efforts were compared to TSS data from other studies to assess if the study data were typical or unusual (Anchor 2008).

Loading is calculated using the following equations:

$$L\ (\text{g/month}) = C_s\ (\text{mg/kg}) \times TSS\ (\text{mg/L}) \times V\ (\text{L/month}) \times 10^{-6}\ \text{kg/mg} \times 10^{-3}\ \text{g/mg} \quad (4)$$

Where: L = Contaminant Load (grams/month)
C_s = Measured contaminant concentration in solids (µg/L)
TSS = total suspended solids in stormwater (mg/L)
V = Volume of discharge from an outfall or site per month (L/month)

In addition, loads can be calculated on an organic carbon (OC)-normalized basis by substituting total organic carbon (TOC) concentration for TSS, as follows:

$$L\ (\text{g/month-OC}) = C_s\ (\text{mg/kg-OC}) \times TOC\ (\text{mg/L}) \times V\ (\text{L/month}) \times 10^{-6}\ \text{kg/mg} \times 10^{-3}\ \text{g/mg} \quad (5)$$

Where: L = Contaminant Load, OC-normalized (g/month-OC)
C_s = Measured contaminant concentration in solids, OC-normalized (mg/kg-OC)
TOC = total organic carbon in stormwater (mg/L)
V = Volume of discharge from an outfall or site per month (L/month)

Sediment trap chemical concentration data are pooled by land use category. Flow volumes are calculated using the methods described in Section 2.1.1.

2.1.4 Comparison of Stormwater-Based Loads to Sediment Trap-Based Loads

Estimated loads based on stormwater data will be compared to estimated loads based on sediment trap data. It was expected that results would be different depending on the data on which they were based. Comparisons between results from one sediment trap with results from another are also expected to differ, due to the different flow regimes and trap configurations at each outfall. Similarly, collection methodology can affect the TSS component of the stormwater sample and thereby provide differing results.

Another reason for expected variation between loads from the two measurements is that total (unfiltered) stormwater concentrations include both dissolved and particulate concentrations. Sediment trap concentrations, on the other hand, represent particulate concentrations only. The divergence is expected to be greater for less hydrophobic chemicals such as metals. For metals data, stormwater loads will be calculated using both dissolved and total metals concentrations.

The LWG believed that by using two approaches, the advantages and disadvantages of each method can be better understood and the two loading estimates compared to provide a better overall sense of the potential range of chemical loads.

Results were unavailable at the time this report was prepared.

Additional information on stormwater and sediment trap sampling for the Portland Harbor RI/FS are available in the following documents:

- Anchor and Integral. 2007a. Portland Harbor RI/FS Round 3A Stormwater Sampling Rationale. February 7, 2007.
- Integral, Windward, Kennedy/Jenks, and Anchor. 2007. Portland Harbor RI/FS, Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report. February 21, 2007.
- Anchor and Integral. 2007b. Portland Harbor RI/FS Round 3A Field Sampling Plan, Stormwater Sampling. March 1, 2007.
- Integral. 2007. Portland Harbor RI/FS, Round 2 Quality Assurance Project Plan, Addendum 8: Round 3A Stormwater Sampling. March 1, 2007.
- Anchor. 2008. Portland Harbor RI/FS Stormwater Loading Calculation Methods. May 16, 2008.
- Integral. 2007. Portland Harbor RI/FS, Round 3A Low-Flow and Stormwater-Impacted Surface Water Data Report. May 21, 2007.
- Anchor and Integral. 2008a. Portland Harbor RI/FS, Round 3B Upland Stormwater Sampling Field Sampling Report. June 13, 2008.
- Anchor and Integral. 2008b. Portland Harbor RI/FS Round 3A and 3B Stormwater Data Report. September 30, 2008.

2.2 Thea Foss Waterway (Tacoma)

Remediation of sediments at the Thea Foss and Wheeler-Osgood Waterways in Tacoma, Washington, was completed in 2006 under EPA's Superfund Program. Under an Administrative Order (9/30/2002) and Consent Decree (5/9/2003) with EPA, the City of Tacoma has implemented a stormwater monitoring and source control program for the municipal storm drains entering the Thea Foss and Wheeler-Osgood Waterways, to help provide long-term protection of sediment quality in these waterways (City of Tacoma 2007).

Long-term outfall monitoring has been conducted for over five years as part of this effort, and modeling of stormwater chemical loads and sediment recontamination have been conducted. The history of these efforts, including discussions between the City of Tacoma and EPA regarding methodology and assumptions, is complex and not well documented from readily available sources. A summary of available information regarding stormwater chemical loading for the Thea Foss Waterway is provided below.

Whole-water samples of municipal stormwater were collected between 2001 and 2006 as part of the City's National Pollutant Discharge Elimination System monitoring program. Data were used to estimate base flow and stormwater loading for phenanthrene, pyrene, dibenzo(a,h)anthracene (DBA), and bis(2-ethylhexyl)phthalate (BEHP). For phenanthrene, pyrene, and BEHP, 10 storm events per year were targeted for sampling in the seven largest stormwater outfalls. In addition, four base flow events per year were targeted in the four outfalls with measurable base flow. For DBA, stormwater mass loads were estimated from sediment trap data rather than whole-water data. Due to its hydrophobic characteristics, DBA was not detected in most whole-water samples but was more easily measured in the suspended particulates captured in sediment traps. The dissolved DBA load was estimated using chemical partitioning equations.

The City of Tacoma uses EPA's Water Quality Analysis Simulation Program (WASP) to evaluate stormwater chemical loading and contaminant transport, and to predict sediment concentrations in the waterway (City of Tacoma 2007). During pre-remedial design, the WASP model for Thea Foss Waterway was custom-coded in a DOS platform by one of the model developers, Dr. James Martin. This was deemed necessary to include enhanced capabilities that were not available in the public domain program. In 2006, the custom-coded DOS WASP model was reconfigured to run in the current EPA-supported Windows platform (version 7.2). The WASP model was validated by comparing model predictions to the first two years of post-construction sediment monitoring data. In general, WASP model predictions agreed well with measured sediment concentrations.

Chemical mass loading estimates for stormwater and base flow were calculated using a representative average chemical concentration (arithmetic mean concentration) multiplied by the flow rate of the discharge. Average stormwater concentrations for phenanthrene, pyrene, DBA, and BEHP were calculated based on sampling of 10 storm events in the seven largest stormwater outfalls discharging to the Thea Foss Waterway over the period 2001 to 2006. Average base flow concentrations were calculated during four base flow events from the four outfalls with measurable base flow, using five years of monitoring data. Storm flow and base flow discharge rates for the two largest municipal outfalls were derived from in-situ flow measurements. Flow rates for the five other major outfalls were modeled using EPA's Stormwater Management Model (SWMM) by comparing hydrologic characteristics and land use patterns in neighboring watersheds.

For DBA, stormwater mass loads were estimated from the solids concentrations measured in sediment traps and multiplied by the sediment load as determined from TSS and flow measurements. The dissolved load was estimated using chemical partitioning equations.

Contaminant loads from private unregulated storm drains and overland runoff were estimated using average stormwater concentrations from one of the monitored drainages with comparable land use. Flows were estimated using the Rational Method with standard literature values for runoff coefficients (City of Tacoma 2007).

The basic equation for flow estimation using the Rational Method is the following:

$$Q = C \times i \times A \tag{6}$$

Where:

Q = Peak rate of runoff
C = Dimensionless runoff coefficient
i = Average rainfall intensity
A = catchment area

A detailed description of loading calculation methods is reportedly provided in the 2003–2004 Stormwater Source Control Report, Appendix E. However, SAIC was not able to obtain this document prior to submittal of this report.

2.3 City of Seattle Stormwater and City-Owned CSO Lateral Loading Analysis

Seattle Public Utilities (SPU) conducted an analysis of stormwater and City combined sewer overflow (CSO) discharges to the LDW for use in the sediment transport model and recontamination evaluation for the LDW RI (SPU 2007, 2008). The analysis estimated annual discharge volume and TSS loads for both stormwater and CSO discharges, and compiled available data from source sampling efforts to estimate chemical concentrations associated with the particulates discharged from these outfalls. Chemical mass loads from storm drain and CSO discharges are referred to as "lateral loads."

2.3.1 Stormwater Discharge Volume Calculations

The annual volume of stormwater discharged to the LDW was estimated from land use, soil type, slope, and rainfall using a simplified Hydrologic Simulation Program-Fortran (HSPF) model. This model calculates runoff volumes per unit area for individual land use, slope, and soil combinations based on regional Puget Sound input parameters and local rainfall data (NHC 2007).

Drainage basins were delineated by SPU based on City GIS utility and topographic data supplemented with site-specific drainage plans, if available. Land use was determined based on parcel data from King County. Land uses within the LDW drainage area were assigned to one of six categories: industrial (29%), right-of-way (26%), single family residential (20%), open space/park (15%), commercial (6%), or multi-family residential (3%).

Soil conditions were characterized using surficial geology maps developed by the University of Washington. Individual geologic deposits were grouped into the following categories: alluvium, till, outwash, and wetland soil.

The LDW drainage basin was divided into four major areas: areas served by municipal storm drains in Seattle (61%); areas served by municipal storm drains outside of Seattle (21%); areas served by private storm drains and waterfront discharges in Seattle (12%); and areas served by private storm drains and waterfront discharges outside of Seattle (6%). These four areas were then divided into smaller subbasins corresponding to major storm drain outfalls along the LDW. These storm drain outfalls are:

Subbasin	Outfall Location	Outfall Type	Drainage Area (acres)
West Side of Waterway			
Diagonal Avenue S CSO/SD	Diagonal Avenue S CSO/SD	Public	2,620
Norfolk CSO/SD	Norfolk CSO/EOF/SD	Public	826
Slip 4	Discharges from KCIA SD#3/PS44 EOF, Georgetown Flume, I-5 storm drain, NBF storm drain, and 10 private drains along the side of Slip 4 were modeled as a single discharge located at the head of Slip 4	Public/private	495
KCIA SD#2	KCIA SD#2 (former Slip 5)	Public	236
KCIA SD#1	KCIA SD#1 (Slip 6)	Public	64
Waterfront Areas – East side	Five waterfront areas, delineated based on the location and distribution of storm drains along the LDW	Private	471
East Side of Waterway			
S 96th Street SD	S 96th Street SD	Public	996
Hamm Creek	Hamm Creek	Public	721
SW Idaho Street	SW Idaho Street	Public	655
SW Highland Park Drive	SW Highland Park Drive SD	Public	491
1st Avenue S channel	1st Avenue S channel	Public	328
South Park/7th Avenue S SD	7th Avenue S SD	Public	232
SW Kenny/Glacier Bay	SW Kenny Street SD	Public	164
Waterfront Areas – West side	Six waterfront areas, delineated based on the location and distribution of storm drains along the LDW	Private	412

The land use and soil type information were compiled for each stormwater discharge subbasin above for input into the HSPF model. Flow volume estimates were completed for a typical wet year (2002), dry year (1993), and average year (1986) based on rainfall records for 1979 to 2005 from SPU's rain gage at East Marginal Way S and 13th Avenue S. Because a large portion of the Seattle-owned drainage system in the LDW is partially separated (i.e., storm water may be discharged to separated storm drains or to the combined sewer system), it is difficult to accurately determine which areas are connected to which system. SPU initially assumed that right-of-way areas are connected to the storm drain system and approximately 35% or areas outside the right-of-way are connected to the storm drain system. This was subsequently increased to 45% for consistency with King County estimates.

SPU has been monitoring discharges from the two City-owned CSOs (S Brighton Street and Diagonal Way S) since 1999. The S Brighton Street CSO has not overflowed since that time. Measured CSO volumes for the Diagonal CSO were used in the loading calculations.

Total runoff volumes for LDW storm drainage were estimated at 3,096 million gallons for a low water year, 4,065 million gallons for a medium water year, and 5,328 million gallons for a high water year.

2.3.2 Chemical Concentrations in Stormwater

None of the storm drains or City CSOs discharging to the LDW have been sampled for TSS. To estimate loads, data from 500 stormwater samples collected at 24 locations in Seattle, Bellevue, Tacoma, Issaquah, and Everett were compiled to determine representative TSS concentrations in urban stormwater (Herrera 2007). Samples included analyses for TSS using both the Standard Method 2540D and suspended solids concentration (SSC) analyses using ASTM D3977.[1]

The total suspended solids load to the LDW was calculated as 878 tons per year during a low water year, 1,224 tons per year during a medium water year, and 1,600 tons per year during a high water year (SPU 2008).

Chemical concentrations in stormwater and CSO discharges were also calculated. The chemicals of concern that were evaluated in this study included arsenic, mercury, zinc, PCBs, BEHP, phenanthrene, chrysene, fluoranthene, and carcinogenic PAHs (cPAH). Available data from all source sediment samples collected in areas draining to the LDW were compiled for this analysis. Data were grouped into the following categories: Tully's/brewery, North Boeing Field, Boeing Plant 2, and all remaining sample data. Available data included sediment trap, catch basin (including onsite and right-of-way locations), and inline sediment data.

Calculations were run for base case scenarios involving all available data for a given chemical, as well as excluding samples that contained less than specified concentrations of the chemical. This was intended to reflect various levels of source control effectiveness. For example, for PCBs, summary statistics (mean, median, 25^{th} percentile, 75^{th} percentile, and 90^{th} percentile) were calculated using all available data in each of the four data groups (base case), using only samples that contained less than 20 mg/kg, using only samples that contained less than 10 mg/kg, and using only samples that contained less than 5 mg/kg. A weighting factor was applied to the chemical concentrations based on the estimated annual runoff volume to determine the overall average PCB concentrations in storm drain sediment within the LDW.

The SPU study did not calculate mass chemical loading to the LDW; its purpose was to develop input data for use in the sediment transport model for the LDW RI. This included stormwater flow volumes, suspended solids loads, and chemical concentrations in source sediment samples, but not chemical mass loads.

[1] Herrera 2003 found that TSS and SSC results were comparable, and therefore all data were combined.

2.4 Green-Duwamish Watershed Statistical and Pollutant Loadings Analysis

As part of the Green-Duwamish Watershed Water Quality Assessment (GDWQA), King County assessed and analyzed surface water quality data collected for the GDWQA during water years 2002 and 2003 (Herrera 2007b). The assessment included evaluation of surface water sampling approaches, comparison of base flow and storm flow data, correlations among water quality parameters and between water quality and hydrologic parameters, a pollutant loading rate analysis, correlations between pollutant loadings and land use/cover categories, and other data analyses. Information relevant to Ecology's lateral loading study is summarized below.

The study is based on surface water sampling results from 13 base flow events and 13 storm events between 2001 and 2003. Base flow sampling targeted periods during which no precipitation had occurred within at least a 2- to 3-day period, depending on the site. Storm flow sampling targeted wet periods during which at least 0.5 inches of precipitation occurred within a 12-hour period. Depending on the site, base flow and storm flow samples were collected by grab sampling, auto-sequential sampling (i.e., series of discrete samples), and auto-composite sampling.

For auto-sequential sampling, multiple discrete samples were collected using ISCO 3700 series autosamplers. During storm events, a sample was collected every 4 hours for a period ranging from 24 to 40 hours, depending on the duration of elevated stream flow. During base flow, a sample was collected every 4 to 8 hours for up to 24 hours. For auto-composite sampling, flow-weighted composite samples were collected during storm and base flow events using an ISCO 3700 series autosampler that filled one 15-liter high-density polyethylene (HDPE) sample carboy. A unit sample volume was then collected for each incremental unit of stream flow during the event.

Herrera (2007b) analyzed data for the following parameters: dissolved oxygen, pH, specific conductance, alkalinity, hardness, TSS, turbidity, ammonia nitrogen, nitrate+nitrite nitrogen, orthophosphate phosphorus, total phosphorus, fecal coliform bacteria, and total and dissolved iron, copper, zinc, and mercury.

Significant differences in water quality between base flow and storm flow conditions were found. Metals concentrations were consistently higher in storm flow than base flow, indicating the importance of storm flow in metals loading and transport. Other parameters, such as dissolved oxygen and pH, did not vary significantly between base flow and storm flow. A TSS first flush effect was observed in 54 percent of the storms analyzed, and TSS tended to increase with increasing discharge during the rising limb of the storm hydrograph. In highly-developed drainage basins (such as most of the LDW), dissolved and total copper and zinc concentrations were correlated with the antecedent dry period, indicating that these metals accumulate during dry weather and then wash off at high concentrations during subsequent storms. TSS concentrations were correlated with total metals concentrations (but not dissolved metals concentrations) in stormwater in highly developed basins and low- to medium-density development basins.

The study found that those land use characteristics most consistently associated with increased pollutant loading include commercial/industrial, high-density residential, agriculture, and effective impervious area.

Loading for base flow conditions was calculated by multiplying the sample concentration by the average discharge rate associated with the same sampling period to generate an instantaneous loading rate. The instantaneous loading rates for each base flow sample were summed and divided by the sum of the average discharge rates that were associated with each sample. The result was a flow-weighted average annual base flow concentration. This value was multiplied by the base flow volume measured between November 1, 2001, and October 31, 2003, then divided by two to generate the annual base flow loading rate.

For runoff conditions (i.e., during storm events), the storm event mean concentrations were multiplied by the average storm discharge rate associated with the sample to generate an instantaneous loading rate for that individual storm. The average annual base flow concentration (as calculated above) was then multiplied by the average base flow discharge rate for the same storm to generate a base flow instantaneous loading rate. The base flow instantaneous loading rate was subtracted from the total storm instantaneous loading rate to generate the runoff instantaneous loading rate for that individual storm. The process was repeated for each storm event. The resultant runoff instantaneous loading rates for each storm event were summed and divided by the sum of the average runoff discharge rates that were associated with each sample to generate a flow-weighted average annual runoff concentration. Finally, the annual runoff loading was calculated by multiplying the flow-weighted average annual runoff concentration by the runoff flow volume measured between November 1, 2001, and October 31, 2003, then divided by two to generate the annual runoff loading rate.

Annual total loading was estimated by adding the annual runoff loading and annual base flow loading. Loading was subsequently estimated for different land use/cover categories. Estimates of effective impervious surface were assigned to each of 10 land use/cover categories by intersecting land use and land cover GIS data layers with the subbasin layers to determine the total area of each land use/cover category per subbasin. The land use/cover areas were then weighed against the total subbasin area to calculate a percent coverage for each land use/cover category; these were subsequently used to develop loading estimates by land use. Land use/cover categories and percent impervious area are listed below for categories of interest in the LDW:

Land Use/Cover Category	Percent Impervious Area
Commercial/industrial	90
Roads	85
High-density residential	35
Low-density residential	10
Bare ground/shoreline	85
Agriculture/forest/grass/dry/wetlands	0

Areal TSS runoff loading (storm events only) for high-density development areas was estimated at 144.6 kg/ha/year; for low- to medium-density development, TSS loading was 142.9 kg/ha/year. Areal loadings by land use/cover categories were also developed for the other parameters evaluated during the study, including total and dissolved mercury, copper, and zinc.

Herrera (2007b) summarized the advantages and disadvantages of the various sampling methods used during the study. Their observations include:

- Autosamplers are expensive to operate and maintain
- Grab sampling is inexpensive, but rigorous storm sampling is needed
- Sequential (rather than composite) sampling results in high analytical costs but a more accurate representation of water quality
- Composite sampling reduces the number of samples while still characterizing the mean concentration of a storm event
- Composite sampling does not quantify peak concentrations

2.5 Other Studies and Reports

2.5.1 Estimating Loading of Contaminants and Tracking Fluorescent Particles (FP) from the Green River into the LDW (In Progress)

Ecology is currently conducting a study to estimate chemical loading from suspended sediments in the Green River to the LDW; to compare estimates of contaminant loading based on particle size (fine-grained vs. sandy); and to identify transport pathways and measure short-term deposition patterns for suspended sediments that enter the LDW from the Green River (Ecology 2008).

Comparing chemical concentrations and loading associated with fine-grained suspended sediments and sandy suspended sediments will be useful in evaluating stormwater mass loading based on different sample collection methods that have different particle size distributions.

2.5.2 Standard Operating Procedure (SOP) for Calculating Pollutant Loads for Stormwater Discharges (Draft)

Ecology's Environmental Assessment Program is currently developing an SOP for calculating pollutant loads in stormwater discharges. Total annual mass load (ML) for a chemical constituent is calculated as follows:

$$
\begin{aligned}
ML &= \text{Base Load} + \text{Storm Load} \\
&= [(V_{bd} \times C_b) + (V_{bw} \times C_b)] + [(V_{sd} \times C_s) + (V_{sw} \times C_s)] \qquad (6)
\end{aligned}
$$

Where:

V_{bd} = base flow volume during dry season
V_{bw} = base flow volume during wet season
C_b = average annual flow-weighted base flow concentration
V_{sd} = storm flow during dry season
V_{sw} = storm flow during wet season
C_s = average annual flow-weighted stormwater concentration

The draft SOP includes the following steps:

- Determine base flows and volumes for wet and dry seasons
- Collect water quality from base flow discharges for wet and dry seasons
- Calculate seasonal base flow volumes (V_{bw} and V_{bd}) and annual base flow volume
- Calculate flow-weighted mean base flow concentration (C_b)
- Estimate base flow mass load
- Determine storm flows and volumes for wet and dry seasons
- Separate storm flow and base flow volumes in sampled storm events
- Calculate storm flow event mean concentration (flow-weighted concentration) for each sampled storm event
- Calculate annualized flow-weighted mean storm flow concentration (C_s)
- Estimate storm flow mass load
- Estimate rainfall-runoff relationship for each monitoring site using flow record and rainfall records; create a regression model to fit to this relationship so that runoff volumes may be predicted from rainfall records
- Evaluate seasonal differences in base flow and stormwater quality

Once finalized, this SOP should be reviewed and incorporated into the lateral loading study methodology.

3.0 Summary and Recommendations

Stormwater pollutant mass loading studies are currently being conducted for Portland Harbor and the Thea Foss Waterway in Tacoma. Preliminary work on a stormwater pollutant loading analysis for the LDW has been conducted by SPU. These efforts, as well as other relevant information, were summarized in Section 2.

These studies have attempted to quantify (1) the chemical concentration in stormwater discharges, and (2) the stormwater discharge volume. In addition, if chemical concentrations were estimated based on stormwater solids measurements, then TSS data are required.

3.1 General Equations for Loading Calculations

In general, to estimate stormwater loads, the chemical concentration in stormwater and the volume of stormwater discharge are needed. These terms can either be measured directly or estimated through indirect means. Ideally, estimation of long-term loads would involve a large number of water samples collected over the course of many years and many types of storms, pollutant sources, and runoff conditions. The specific approach selected depends on the objectives of the sampling effort; these objectives may include providing input to risk assessment, estimating river-wide stormwater loads for input to fate and transport models, estimating outfall-specific stormwater loads for input to fate and transport models (e.g., Slip 4), developing appropriate sediment cleanup levels, identifying upland contaminant sources, or identifying and evaluating upland control actions. Depending on the objectives, the level of uncertainty that is acceptable and therefore the number and types of samples needed may vary considerably.

For stormwater, the general equation for estimating loading is the following:

$$L\ (\text{g/month}) = C_w\ (\mu\text{g/L}) \times V\ (\text{L/month}) \times 10^{-9}\ \text{kg}/\mu\text{g} \tag{7}$$

Where: L = Contaminant Load (grams/month)
C_w = Measured contaminant concentration in stormwater (µg/L)
V = Volume of discharge from an outfall or site per month (L/month)

For suspended sediment, the general equation for estimating loading is the following:

$$L\ (\text{g/month}) = C_s\ (\text{mg/kg}) \times TSS\ (\text{mg/L}) \times V\ (\text{L/month}) \times 10^{-6}\ \text{kg/mg} \times 10^{-3}\ \text{g/mg} \tag{8}$$

Where: L = Contaminant Load (grams/month)
C_s = Measured contaminant concentration in solids (µg/L)
TSS = total suspended solids in stormwater (mg/L)
V = Volume of discharge from an outfall or site per month (L/month)

In addition, loads can be calculated on an OC-normalized basis by substituting TOC concentration for TSS, as follows:

$$L\ (g/month\text{-}OC) = C_s\ (mg/kg\text{-}OC) \times TOC\ (mg/L) \times V\ (L/month) \times 10^{-6}\ kg/mg \times 10^{-3}\ g/mg \quad (9)$$

Where: L = Contaminant Load, OC-normalized (g/month-OC)
C_s = Measured contaminant concentration in solids, OC-normalized (mg/kg-OC)
TOC = total organic carbon in stormwater (mg/L)
V = Volume of discharge from an outfall or site per month (L/month)

3.2 Chemical Concentrations in Stormwater

Estimation of chemical mass load from stormwater requires an understanding of the chemical concentrations in stormwater. Stormwater chemical concentrations are widely variable depending on factors including (Anchor and Integral 2007a):

- Specific chemical sources which may vary over time and location within a drainage basin;
- Characteristics of the storms and their associated runoff (e.g., dry periods, storm volume, storm intensity and duration, collection system characteristics, and condition of source controls);
- How and where the stormwater is sampled;
- When the samples are collected during a specific storm (e.g., first flush, rising limb, falling limb).

Stormwater chemical concentrations can be measured in several ways, each of which has advantages and disadvantages. These were discussed by Anchor and Integral (2007a) and others, and are summarized below.

Sampling Type	Advantages	Disadvantages
Whole-water grab samples	Provides a direct measure of chemical concentrations in water that can be converted to a load in one step (multiplying by volume discharged per unit time).	Captures one small condition in time. Preferentially captures only the fines portion of the particulate load. Cannot provide concentrations for the particulate fraction unless a very large sample volume is available. Analytical detection limits may not be adequate to detect chemicals present in stormwater at very low concentrations, particularly for hydrophobic chemicals.
Whole-water composite samples	Provides a direct measure of chemical concentrations in water that can be converted to a load in one step (multiplying by volume discharged per unit time).	Preferentially captures only the fines portion of the particulate load. Cannot provide concentrations for the particulate fraction unless a very large sample volume is available. Analytical detection limits may not be adequate to

Sampling Type	Advantages	Disadvantages
	Samples a large portion of a runoff event.	detect chemicals present in stormwater at very low concentrations, particularly for hydrophobic chemicals. Samples are collected over a relatively short period of time (hours or days).
Sediment Traps	If left in place long enough, can accumulate a large enough sediment sample to reduce the likelihood of analytical limitations. Integrate the particulate-associated chemical loading over a relatively long period of time (4 to 7 months). Can avoid the need for large numbers of water chemistry samples. Provide data for the stormwater particulate load that may recontaminate river sediments. Logistically simple to implement.	Do not measure dissolved load. Preferentially capture only portions of the coarser fraction of the particulate load. Provide a much less direct measurement of the overall stormwater chemical load. Grain size data would be useful, however sample volumes are frequently too low to allow for grain size analysis. Samples are collected under somewhat turbulent conditions, therefore are likely to contain a smaller percentage of fine-grained particles (fine silt, clay) than stormwater.
High Volume Water Filtering Techniques (e.g., Filter Bags)	Method can be used in locations where sediment traps cannot be installed. Samples will likely contain a higher percentage of fine-grained particles and will be more representative of the suspended particulate load in stormwater.	Sampling is labor intensive. Samples are collected over a relatively short period of time (hours or days) and therefore have the same time integration limitations as composite stormwater sampling.
Sediment Grab Samples	Logistically easy and inexpensive to collect.	Grab samples from storm drain structures such as catch basins and manholes tend to contain a smaller percentage of fine-grained particles (fine silt, clay) than stormwater, thus may not be representative of chemical concentrations in stormwater.

3.3 Volume of Discharge

The studies described in Section 2 have focused on basin-wide pollutant loading, rather than pollutant loading from specific outfalls and subbasins. For this purpose, stormwater flow models that are intended for use over large spatial scales are appropriate. However, these models may not be appropriate for a localized area. Simple methods of estimating discharge volume, such as the Rational Method, may provide more accurate results for small subbasins than use of a model intended for large spatial scales (personal communication, D. Deleon, 6/29/2009). Simpler calculation methods rely on site-specific information about land use, impervious surfaces, and rainfall to estimate the stormwater discharge volume.

Continuous measurement of flow over the course of one or more representative years would provide the most accurate means of determining stormwater discharge volume from a specific basin or subbasin.

Methods used to model stormwater discharge volume and chemical loading in the studies reviewed are summarized below:

Study	Stormwater Discharge Volume	Chemical Concentrations in Stormwater	Total Suspended Solids
Portland Harbor RI/FS	GRID Model (City of Portland)	Composite whole-water samples, flow-weighted, 3 storm events Some whole water grab samples Sediment traps, one round of sampling Some sediment grab samples (if insufficient volume in sediment trap)	Measured in whole water samples
Thea Foss Waterway	SWMM (EPA): intended for use over large spatial scales, not localized area	Whole-water samples, average concentrations, 10 storm events/year during 2001-2006 Sediment traps, arithmetic average concentrations 2001-2006	Measured in whole water samples
SPU Lateral Load Analysis	HSPF Model (stormwater): intended for use over large spatial scales, not localized area Measured flow volumes, 1999-2005 (CSOs)	Sediment traps Onsite catch basins Right-of-way catch basins Inline grab samples	Average values compiled from various sources, weighted by land use

3.4 Recommendations

To estimate stormwater pollutant mass loading to the LDW from lateral storm drain lines, flow-weighted composite whole water samples are recommended because they provide the most direct measure of stormwater contaminant concentrations. Samples collected should be representative of base flow and storm conditions during both dry and wet seasons. This type of sampling tends to be resource- and labor-intensive. In addition, whole water sampling does not capture the coarser particle size fractions of the particulate load and therefore is likely to underestimate the total stormwater pollutant load.

It is therefore recommended that in addition to whole water sampling, sediment traps and/or high volume water filtering be employed to collect solids with a particle size distribution that includes coarser particle sizes, and therefore complements the stormwater data.

No information is currently available regarding correlations between chemical concentrations at a given location and time as measured by various sampling types. Ideally, several types of samples should be collected concurrently for one or more storm events at a given location. Comparisons between the sample results could then be made and an assessment of correlation or lack thereof could be made. However, even if such correlations could be made, it is not clear whether and how the results would be applicable to other locations or stormwater flow conditions.

Significant uncertainties are also introduced into the chemical loading calculations due to uncertainties in the estimates of stormwater flow volume. Continuous measurement of flow over the course of one or more representative years would provide the most accurate means of determining stormwater discharge volume from a specific basin or subbasin.

Because of the limitations associated with the measurement of chemical concentrations in stormwater flow and the estimation of stormwater flow volume, the level of uncertainty associated with stormwater pollutant loading estimates is high. A probabilistic uncertainty evaluation would provide useful information on the potential range of chemical loads from a given location, and would allow selection of a range of chemical loading estimates for input to the LDW sediment transport model.

4.0 Existing LDW Data

Recommended sampling locations were summarized and described in *Scoping of Lateral Loading Study, Lower Duwamish Waterway, WA, Site Reconnaissance Report* (SAIC 2009); existing storm drain solids data for the recommended sampling locations are provided as Appendix A. Maps showing sample locations within the drainage basins for the recommended sampling locations are also included.

These available chemical data have been collected from sediment traps, catch basin solids, and inline solids samples. In general, stormwater TSS and TOC concentrations are unavailable, making it difficult to apply the chemical data to site-specific stormwater loading calculations.

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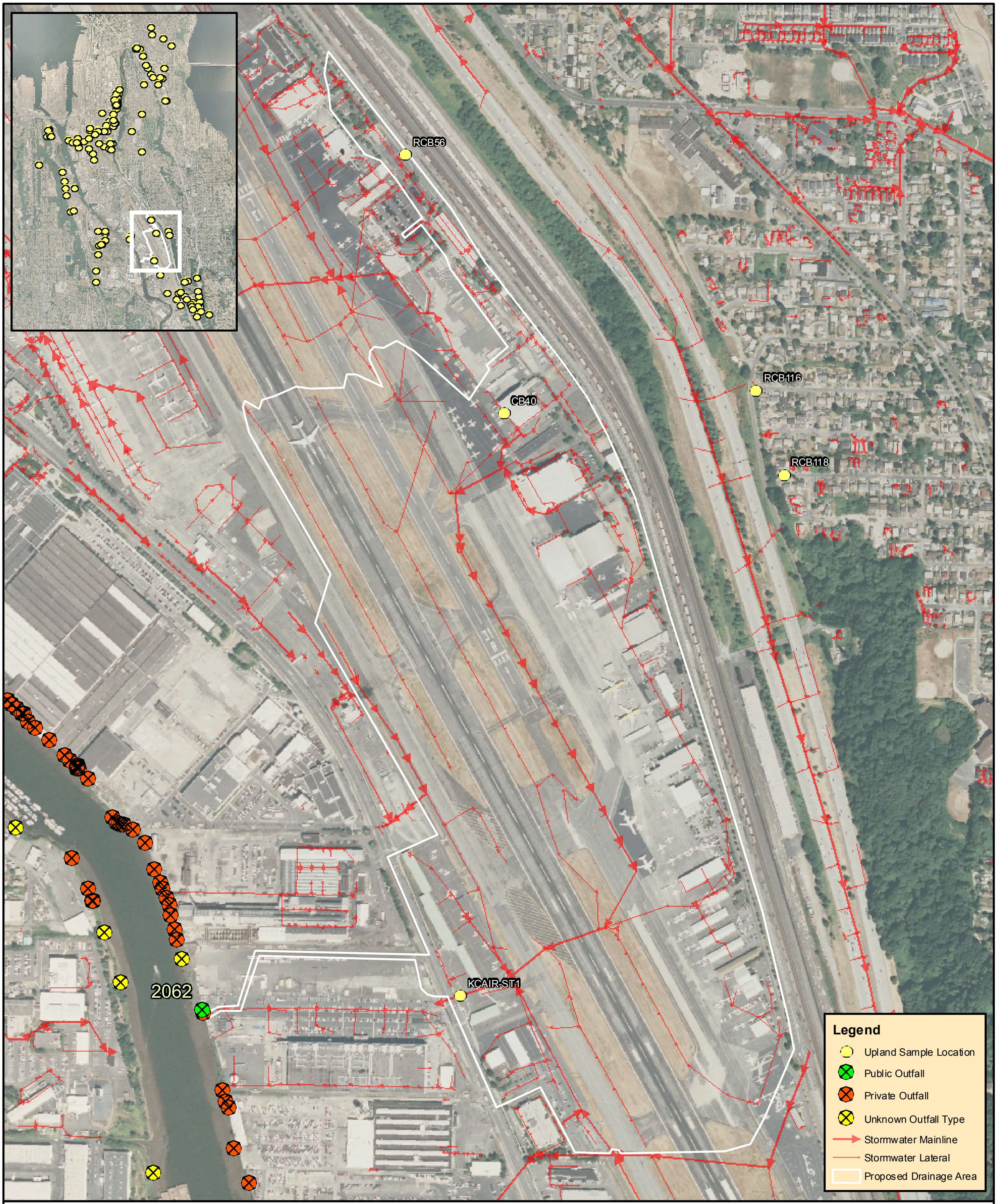
Appendix A
Available Stormwater and Storm Drain Solids Data



Upland sample sites for storm drain solids in the King County Airport #2 storm drain basin (2062)

1 inch = 717 feet

DEPARTMENT OF ECOLOGY State of Washington

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Drainage Basin			2062		2062		2062	
Station ID			CB40		KCAIR-ST1		RCB56	
Type			CB		Inline		RCB	
Sewer			SD				SD	
Date	**LAET**	**LAET2**	**8/4/04**	**Q**	**9/25/08**	**Q**	**5/31/06**	**Q**
Conventionals								
Total Organic Carbon (% DW)	—	—	2.97		12.3		9.69	
Grain Size								
Gravel	—	—			0.3			
Very coarse sand	—	—			12.3			
Coarse Sand	—	—			18.1			
Medium Sand	—	—			18			
Fine Sand	—	—			12.7			
Very fine sand	—	—			7.4			
Coarse Silt	—	—			2.9			
Medium Silt	—	—			3.5			
Fine Silt	—	—			3.5			
Very fine silt	—	—			3.9			
8-9 Phi Clay	—	—			3			
9-10 Phi Clay	—	—			4.4			
> 10 Phi Clay	—	—			10.2			
Total Fines	—	—			31.3			
Metals in mg/kg DW								
Arsenic	57	93	6	U	**140**	U	8	U
Copper	390	390	92		16		84.7	
Lead	450	530	90		50	U	70	
Mercury	0.41	0.59	**0.61**		0.3	U	0.14	
Zinc	410	960	271		330		329	
LPAH in ug/kg DW								
Naphthalene	2100	2400	850	U	20	U	1,900	U
Acenaphthylene	1300	1300	850		20	U	**1,900**	U
Acenaphthene	500	730	**850**		20	U	**1,900**	U
Fluorene	540	1000	**1,000**		20	U	**1,900**	U
Phenanthrene	1500	5400	**19,000**		61		**1,900**	
Anthracene	960	4400	**2,200**		20	U	**1,900**	U
Total LPAH	5200	1300	**23900**		61		1900	
HPAH in ug/kg DW								
Fluoranthene	1700	2500	**33,000**		140		**3,600**	
Pyrene	2600	3300	**24,000**		120		**3,400**	
Benzo(a)anthracene	1300	1600	**12,000**		35		**1,900**	
Chrysene	1400	2800	**21,000**		94		**2,200**	
Benzo(b)fluoranthene	—	—	25,000		140		1,900	
Benzo(k)fluoranthene	—	—	8,800		85		1,900	U
Benzofluoranthenes	3200	3600	**33800**		225		1900	
Benzo(a)pyrene	1600	3000	**14,000**		60		**1,900**	U
Indeno(1,2,3-cd)pyrene	600	690	**9,200**		92		**1,900**	U
Dibenz(a,h)anthracene	230	540	**1,400**		32		**1,900**	U
Benzo(g,h,i)perylene	670	720	**7,200**		98		**1,900**	U
Total HPAH	1200	1700	**155600**		896		**13000**	

Phthalate Esters in ug/kg DW								
Butylbenzylphthalate	63	900	**5,100**	J	20	U	**1,900**	U
bis(2-Ethylhexyl)phthalate	1300	1900	**5,500**		88		**13,000**	U
Phenols in ug/kg DW								
Phenol	420	1200	**850**	U	20	U	**1,900**	U
2,4-Dimethylphenol	29	29	**850**	U	20	U	**1,900**	U
Total Petroleum Hydrocarbons in ug/kg DW								
Diesel Range Organics	—	—	600		320		970	
Oil Range Organics	—	—	2,300		1500		6,100	
PCBs in ug/kg DW								
Aroclor-1016	—	—	20	U	20	U	19	U
Aroclor-1221	—	—	20	U	20	U	19	U
Aroclor-1232	—	—	58		20	U	19	U
Aroclor-1242	—	—	39		20	U	19	U
Aroclor-1248	—	—	200		31		19	U
Aroclor-1254	—	—	3,000		40		19	U
Aroclor-1260	—	—	3,600		21		19	U
Total PCBs	130	1000	**6,600**		92		19	U

Notes:
LAET = lowest apparent effects threshold
2LAET = second lowest apparent effects threshold
Bold text indicates results that exceed either LAET or 2LAET values
Blank cells indicate parameter not analyzed
U = Analyte was not detected at or above the reported result
J = Estimated concentration
UJ = Analyte was not detected at or above the reported estimate
B = Analyte detected is sample and method blank

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N

Upland sample sites for storm drain solids in the King County Airport storm drain basin (2080)

1 inch = 400 feet

0 250 500 1,000 Feet

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Drainage Basin			2080	
Station ID			CB41b	
Type			CB	
Sewer			SD	
Date	**LAET**	**LAET2**	**9/10/04**	**Q**
Conventionals				
Total Organic Carbon (% DW)	—	—	5.79	
Grain Size				
Gravel	—	—		
Very coarse sand	—	—		
Coarse Sand	—	—		
Medium Sand	—	—		
Fine Sand	—	—		
Very fine sand	—	—		
Coarse Silt	—	—		
Medium Silt	—	—		
Fine Silt	—	—		
Very fine silt	—	—		
8-9 Phi Clay	—	—		
9-10 Phi Clay	—	—		
> 10 Phi Clay	—	—		
Total Fines	—	—		
Metals in mg/kg DW				
Arsenic	57	93	8	U
Copper	390	390	92	
Lead	450	530	232	
Mercury	0.41	0.59	0.17	
Zinc	410	960	**740**	
LPAH in ug/kg DW				
Naphthalene	2100	2400	1,400	U
Acenaphthylene	1300	1300	**1,400**	U
Acenaphthene	500	730	**1,400**	J
Fluorene	540	1000	**1,400**	U
Phenanthrene	1500	5400	1,400	U
Anthracene	960	4400	**1,400**	U
Total LPAH	5200	1300	1400	
HPAH in ug/kg DW				
Fluoranthene	1700	2500	1,400	U
Pyrene	2600	3300	1,400	U
Benzo(a)anthracene	1300	1600	**1,400**	U
Chrysene	1400	2800	1,400	U
Benzo(b)fluoranthene	—	—	1,400	U
Benzo(k)fluoranthene	—	—	1,400	U
Benzofluoranthenes	3200	3600	1400	U
Benzo(a)pyrene	1600	3000	1,400	U
Indeno(1,2,3-cd)pyrene	600	690	**1,400**	U
Dibenz(a,h)anthracene	230	540	**1,400**	U
Benzo(g,h,i)perylene	670	720	**1,400**	U
Total HPAH	1200	1700	**1400**	U

Phthalate Esters in ug/kg DW				
Butylbenzylphthalate	63	900	**2,600**	
bis(2-Ethylhexyl)phthalate	1300	1900	**41,000**	
Phenols in ug/kg DW				
Phenol	420	1200	**1,400**	U
2,4-Dimethylphenol	29	29	**2,400**	
Total Petroleum Hydrocarbons in ug/kg DW				
Diesel Range Organics	—	—	3,900	
Oil Range Organics	—	—	17,000	
PCBs in ug/kg DW				
Aroclor-1016	—	—	51	U
Aroclor-1221	—	—	51	U
Aroclor-1232	—	—	51	U
Aroclor-1242	—	—	51	U
Aroclor-1248	—	—	51	U
Aroclor-1254	—	—	51	U
Aroclor-1260	—	—	51	U
Total PCBs	130	1000	51	U

Notes:

LAET = lowest apparent effects threshold

2LAET = second lowest apparent effects threshold

Bold text indicates results that exceed either LAET or 2LAET values

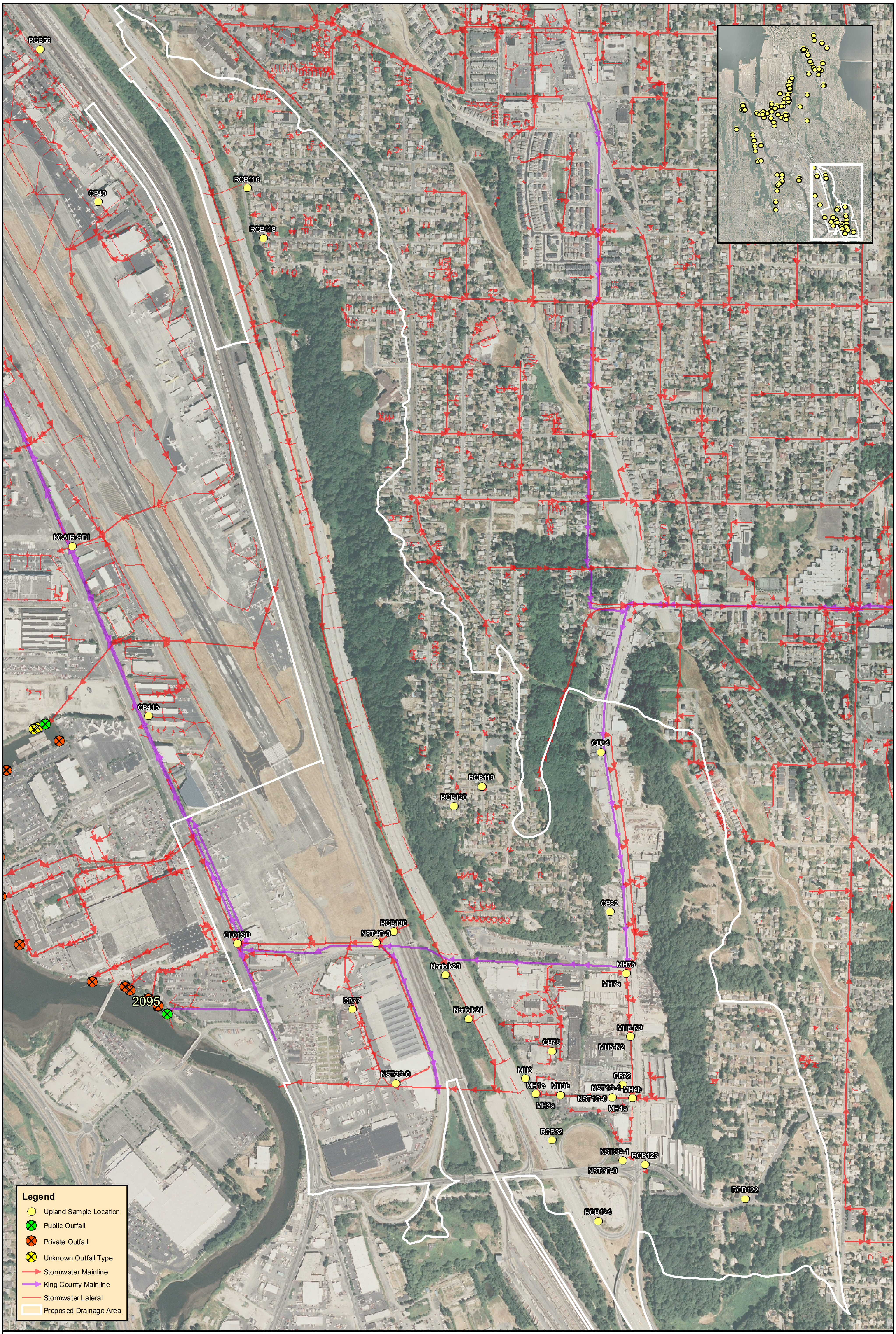
Blank cells indicate parameter not analyzed

U = Analyte was not detected at or above the reported result

J = Estimated concentration

UJ = Analyte was not detected at or above the reported estimate

B = Analyte detected is sample and method blank



Upland sample sites for storm drain solids in the Norfolk storm drain basin (2095)

DEPARTMENT OF ECOLOGY State of Washington

N

1 inch = 833 feet

0 550 1,100 2,200 Feet

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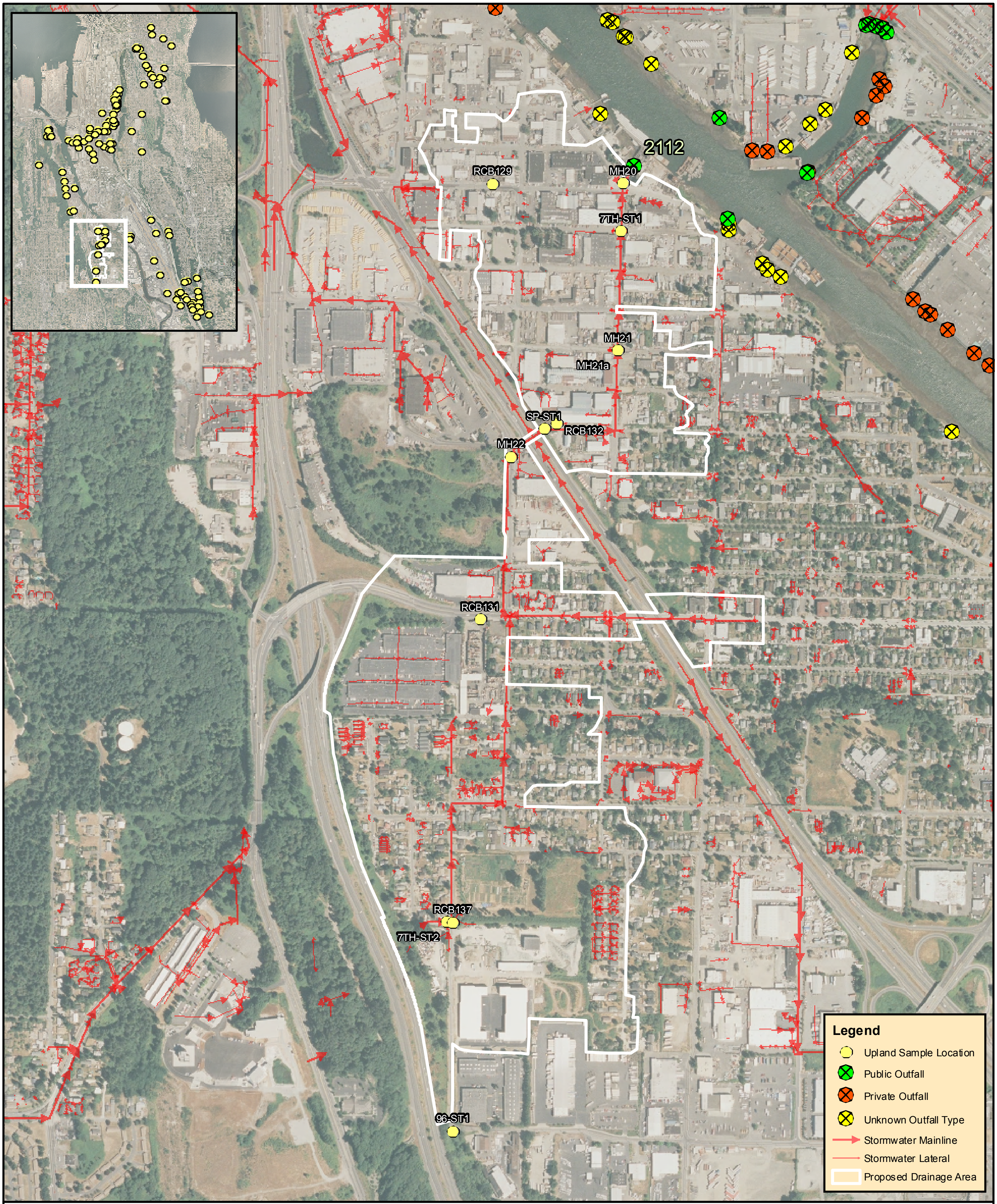
Drainage Basin			2095		2095		2095		2095		2095		2095	
Station ID			CB72		CB77		CB78		CB82		CB84		CF01SD	
Type			CB		CB		CB		CB		CB		inline	
Sewer			SD		SD		SD		SD		SD			
Date	LAET	LAET2	10/18/05	Q	11/8/05	Q	11/8/05	Q	11/23/05	Q	12/6/05	Q	HEC2006	Q
Conventionals														
Total Organic Carbon (% DW)	—	—	7.56		11.1		17.1		6.19		11.3			
Grain Size														
Gravel	—	—												
Very coarse sand	—	—												
Coarse Sand	—	—												
Medium Sand	—	—												
Fine Sand	—	—												
Very fine sand	—	—												
Coarse Silt	—	—												
Medium Silt	—	—												
Fine Silt	—	—												
Very fine silt	—	—												
8-9 Phi Clay	—	—												
9-10 Phi Clay	—	—												
> 10 Phi Clay	—	—												
Total Fines	—	—												
Metals in mg/kg DW														
Arsenic	57	93	11		7	U	10	U	8	U	17			
Copper	390	390	164		79		103		44		139			
Lead	450	530	49		23		124		61		295			
Mercury	0.41	0.59	0.07	U	0.07	U	0.20		0.06	U	0.17			
Zinc	410	960	**1,980**		**565**		**820**		121		378			
LPAH in ug/kg DW														
Naphthalene	2100	2400	460		95	U	180		180		**3,100**	J		
Acenaphthylene	1300	1300	130	U	95	U	350		160	U	**3,900**	U		
Acenaphthene	500	730	130	U	95	U	**1,100**		250		**3,900**			
Fluorene	540	1000	**600**		220		**2,600**		350		**2,000**	J		
Phenanthrene	1500	5400	1,400		510		**50,000**		**3,400**		**11,000**			
Anthracene	960	4400	130	U	95	U	**12,000**		690		**2,900**	J		
Total LPAH	5200	1300	2460		730		**66230**		4870		**22900**			
HPAH in ug/kg DW														
Fluoranthene	1700	2500	700		290		**130,000**		**6,100**		**12,000**			
Pyrene	2600	3300	890		690		**86,000**		**2,700**		**9,400**			
Benzo(a)anthracene	1300	1600	180		95	U	**56,000**		**1,700**		**5,100**			
Chrysene	1400	2800	450		290		**68,000**		**1,900**		**6,700**			
Benzo(b)fluoranthene	—	—	250		220	J	75,000		2,100		4,600			
Benzo(k)fluoranthene	—	—	300		220	J	59,000		1,400		4,000			
Benzofluoranthenes	3200	3600	550		440	J	**134000**		**3500**		**8600**			
Benzo(a)pyrene	1600	3000	250		100	J	**58,000**		**1,700**		**4,800**			
Indeno(1,2,3-cd)pyrene	600	690	130	U	95	U	**25,000**		**690**		**2,800**	J		
Dibenz(a,h)anthracene	230	540	130	U	95	U	**8,400**		**260**		**3,900**	U		
Benzo(g,h,i)perylene	670	720	170		200		**20,000**		640		**2,800**	J		
Total HPAH	1200	1700	**3190**		**2010**		**585400**		**19190**		**52200**			
Phthalate Esters in ug/kg DW														
Butylbenzylphthalate	63	900	130	U	**450**		**580**		**920**		**4,600**			
bis(2-Ethylhexyl)phthalate	1300	1900	**33,000**		**11,000**		**13,000**		**4,100**	B	**45,000**			
Phenols in ug/kg DW														
Phenol	420	1200	220		280		120		160	U	**3,900**	U		
2,4-Dimethylphenol	29	29	**400**		**1,200**		**380**	U	**180**		**3,900**	U		
Total Petroleum Hydrocarbons in ug/kg DW														
Diesel Range Organics	—	—			2,600		1,800		410		3,100			
Oil Range Organics	—	—			10,000		5,600		1,700		14,000			
PCBs in ug/kg DW														
Aroclor-1016	—	—	20	U	98	U	100	U	19	U	59	U	9800	U
Aroclor-1221	—	—	20	U	98	U	100	U	19	U	59	U	9800	U
Aroclor-1232	—	—	20	U	98	U	100	U	19	U	59	U	9800	U
Aroclor-1242	—	—	20	U	98	U	100	U	19	U	59	U	9800	U
Aroclor-1248	—	—	20	U	98	U	100	U	19	U	120	Y	18000	
Aroclor-1254	—	—	59	Y	98	U	100	U	27	Y	320		22000	
Aroclor-1260	—	—	40	Y	98	U	100	U	29	Y	120	Y	9800	U
Total PCBs	130	1000	40	Y	98	U	100	U	29	Y	**320**		**40000**	

Drainage Basin	2095		2095		2095		2095		2095		2095	
Station ID	MH1e		MH3a		MH3b		MH4a		MH4b		MH5-N2	
Type	Inline		Inline		Inline		Inline		Inline		Inline	
Sewer	SD		SD		SD		SD		SD		SD	
Date	10/1/03	Q	10/1/03	Q	3/16/05	Q	10/1/03	Q	3/16/05	Q	10/1/03	Q
Conventionals												
Total Organic Carbon (% DW)	7.4		8.1		6.4		4.7		4.96		4.6	
Grain Size												
Gravel												
Very coarse sand												
Coarse Sand												
Medium Sand												
Fine Sand												
Very fine sand												
Coarse Silt												
Medium Silt												
Fine Silt												
Very fine silt												
8-9 Phi Clay												
9-10 Phi Clay												
> 10 Phi Clay												
Total Fines												
Metals in mg/kg DW												
Arsenic	20		10		10		8		8	U	8	
Copper	147		153		131		55.7		74.8		73	
Lead	217		183		226		79		82		66	
Mercury	0.40		0.20		0.20		0.09		0.11		0.06	U
Zinc	**1,150**		**1,060**		**847**		**416**		**415**		357	
LPAH in ug/kg DW												
Naphthalene	930	U	480	U	640	U	120	U	300	U	190	
Acenaphthylene	930	U	480	U	640	U	120	U	300	U	170	U
Acenaphthene	**930**	U	480	U	**640**	U	120	U	490		170	U
Fluorene	**930**	U	480	U	**830**		200		**670**	U	170	U
Phenanthrene	930	U	**1,800**		**2,700**		**1,600**		**4,000**		490	
Anthracene	930	U	480	U	640	U	120	U	**1,900**		170	U
Total LPAH	930	U	1800		3530		1800		**6390**		680	
HPAH in ug/kg DW												
Fluoranthene	**1,800**		**2,800**		**3,300**		**2,600**		**8,200**		790	
Pyrene	2,200		**2,900**		**3,000**		1,700		**6,600**		820	
Benzo(a)anthracene	930	U	**1,400**		640	U	1,000		1,000		380	M
Chrysene	930	U	**1,700**		**2,700**		1,100		**6,500**		380	M
Benzo(b)fluoranthene	930		1,100		1,100		1,100		2,800		260	
Benzo(k)fluoranthene	930		1,100		1,500		1,100		2,900		260	
Benzofluoranthenes	1860		2200		2600		2200		**5700**		520	
Benzo(a)pyrene	1,000		960		**2,400**		1,200		**5,900**		240	
Indeno(1,2,3-cd)pyrene	**930**	U	**1,000**		**860**		**970**		**1,800**		200	
Dibenz(a,h)anthracene	**930**	U	**480**	U	**640**	U	230		**490**		170	U
Benzo(g,h,i)perylene	**1,000**		**1,200**		**1,100**		**910**		**1,600**		250	
Total HPAH	**7860**		**14160**		**15960**		**11910**		**37790**		**3580**	
Phthalate Esters in ug/kg DW												
Butylbenzylphthalate	**930**	U	**990**	M	**640**	U	**300**		**300**	U	**1,900**	
bis(2-Ethylhexyl)phthalate	**24,000**		**25,000**		**28,000**		**5,600**		**22,000**		**6,800**	
Phenols in ug/kg DW												
Phenol	**930**	U	**480**	U	**660**	B	120	U	300	U	170	U
2,4-Dimethylphenol	**930**	U	**480**	U	**640**	U	**120**	U	**300**	U	**170**	U
Total Petroleum Hydrocarbons in ug/kg DW												
Diesel Range Organics	2,300		2,200				1,400				1,800	
Oil Range Organics	5,300		5,000				2,900				3,600	
PCBs in ug/kg DW												
Aroclor-1016	20	U	20	U	73	U	19	U	20	U	20	U
Aroclor-1221	39	U	39	U	73	U	38	U	20	U	39	U
Aroclor-1232	20	U	20	U	73	U	19	U	20	U	20	U
Aroclor-1242	20	U	20	U	73	U	19	U	20	U	20	U
Aroclor-1248	59	Y	100	Y	73	U	19	U	20	U	20	U
Aroclor-1254	33		36		110		21	J	25		22	J
Aroclor-1260	46		46		200	Y	22		50	Y	21	J
Total PCBs	79		82		110		43	J	25		43	J

Drainage Basin	2095		2095		2095		2095		2095		2095		2095	
Station ID	MH5-N3		MH6		MH7a		MH7b		Norfolk20		Norfolk21		NST1G-0	
Type	Inline		Inline		Inline		Inline		Inline		Inline		Inline	
Sewer	SD		SD		SD		SD		SD		SD		SD	
Date	10/1/03	Q	10/1/03	Q	10/2/03	Q	3/16/05	Q	9/30/04	Q	9/30/04	Q	9/19/07	Q
Conventionals														
Total Organic Carbon (% DW)			7.7		2.2		1.21		5.34		1.65		2.22	
Grain Size														
Gravel														
Very coarse sand														
Coarse Sand														
Medium Sand														
Fine Sand														
Very fine sand														
Coarse Silt														
Medium Silt														
Fine Silt														
Very fine silt														
8-9 Phi Clay														
9-10 Phi Clay														
> 10 Phi Clay														
Total Fines														
Metals in mg/kg DW														
Arsenic	**120**		11		20	U	6	U	10		7		7	
Copper	**3960**		118		51.1		24.6		149		39.9		32.1	
Lead	**700**		198		51		16		245		38		49	
Mercury	0.04	U	0.33		0.05	U	0.05	U	0.18		0.06	U	0.07	U
Zinc	**9,980**		**627**		127		90		**651**		108		166	
LPAH in ug/kg DW														
Naphthalene					38	U	120	U	98	U	20	U	150	U
Acenaphthylene					38	U	120	U	98	U	20	U	150	U
Acenaphthene					70		120	U	98		20	U	150	U
Fluorene					95		120	U	98	U	20	U	150	U
Phenanthrene					930		130		190		20	U	1,200	
Anthracene					330		120	U	98		20	U	270	
Total LPAH					1425		130		386		20	U	1470	
HPAH in ug/kg DW														
Fluoranthene					1,100		230		450		20	U	**2,000**	
Pyrene					1,100		200		320		20	U	1,900	
Benzo(a)anthracene					250		120	U	200		20	U	760	
Chrysene					810		120		340		20	U	980	
Benzo(b)fluoranthene					260		120	U	400		20	U	790	
Benzo(k)fluoranthene					260		120	U	300		20	U	690	
Benzofluoranthenes					520		120	U	700		20	U	1480	
Benzo(a)pyrene					410		120	U	300		20	U	860	
Indeno(1,2,3-cd)pyrene					170		120	U	320		20	U	380	
Dibenz(a,h)anthracene					76	Y	120	U	98		20	U	150	U
Benzo(g,h,i)perylene					130		120	U	410		20	U	360	
Total HPAH					**4566**		550		**3138**		20	U	**8720**	
Phthalate Esters in ug/kg DW														
Butylbenzylphthalate					61		**120**	U	**120**	U	20	U	**370**	
bis(2-Ethylhexyl)phthalate					670		400		620		63		**7,500**	
Phenols in ug/kg DW														
Phenol					38	U	120	U	98	U	20	U	150	U
2,4-Dimethylphenol					**38**	U	**120**	U	**98**	U	20	U	**150**	U
Total Petroleum Hydrocarbons in ug/kg DW														
Diesel Range Organics			650		88				140		43		780	
Oil Range Organics			1,700		300				580		200		2,700	
PCBs in ug/kg DW														
Aroclor-1016					19	U	19	U	20	U	20	U	20	U
Aroclor-1221					38	U	19	U	20	U	20	U	20	U
Aroclor-1232					19	U	19	U	20	U	20	U	20	U
Aroclor-1242					19	U	19	U	20	U	20	U	20	U
Aroclor-1248					19	U	19	U	20	U	20	U	36	
Aroclor-1254					14	J	19	U	67		20	U	59	
Aroclor-1260					11	J	19	U	41		20	U	55	
Total PCBs					25	J	19	U	108		20	U	**150**	

Notes:
LAET = lowest apparent effects threshold
2LAET = second lowest apparent effects threshold
Bold text indicates results that exceed either LAET or 2LAET values
Blank cells indicate parameter not analyzed
U = Analyte was not detected at or above the reported result
J = Estimated concentration
UJ = Analyte was not detected at or above the reported estimate
B = Analyte detected is sample and method blank

2095 NST1G-1 Inline SD **3/18/08**	**Q**	2095 NST2G-0 Inline SD **9/19/07**	**Q**	2095 NST3G-0 Inline SD **9/19/07**	**Q**	2095 NST3G-1 Inline SD **3/18/08**	**Q**	2095 NST4G-0 Inline SD **9/19/07**	**Q**	2095 RCB116 RCB SD **11/16/07**	**Q**	2095 RCB118 RCB SD **11/16/07**	**Q**	2095 RCB119 RCB CS **11/16/07**	**Q**	2095 RCB120 RCB CS **11/16/07**	**Q**	2095 RCB122 RCB SD **1/4/08**	**Q**	2095 RCB123 RCB SD **1/4/08**	**Q**	2095 RCB124 RCB SD **1/4/08**	**Q**	2095 RCB130 RCB SD **1/18/08**	**Q**	2095 RCB32 RCB SD **5/26/04**	**Q**
8.86		2.16		5.86		8.12		1.99		9.71		1.5		2.3		4.82		0.752		2.15		3.76		2.54		7.58	
10		20	U	9		10		7		8	U	7	U	8		7	U	10	U	6	U	10	U	7		10	U
109		52.3		102		90.7		20		44.2		53.2		28.9		38		52.6		54.9		80.9		42.4		97.5	
105		52		78		68		44		36		20		41		37		40		21		63		122		126	
0.10	U	0.09		0.13		0.10	U	0.05	U	0.06	U	0.05	U	0.05	U	0.06	U	0.04	U	0.05	U	0.08	U	0.05	U	0.09	U
650		282		**741**		**657**		94		161		73		86		96		93		233		**530**		144		305	
530	U	90	U	250	U	460	U	20	U	60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	110	U
530	U	90	U	250	U	460	U	20	U	60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	110	U
530	U	90	U	250	U	460	U	20	U	60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	110	U
530	U	90	U	250	U	460	U	20	U	60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	110	U
860		90	U	640		570		70		100		99		100	U	99	U	72		90		90	U	200		970	
530	U	90	U	250	U	460	U	20	U	60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	150	
860		90	U	640		570		70		100		99		100	U	99	U	72		90		90	U	200		1120	
2,400		130		**1,900**		1,700		230		140		99		100	U	99	U	130		220		130	U	380		1,300	
1,600		160		1,100		1,000		150		190		99	U	100	U	99	U	100		170		130		320		840	
610		90	U	480		360		52		60	U	99	U	100	U	99	U	60	U	71		90	U	130		280	
1,200		120		1,200		880		140		93		99	U	100	U	99	U	60	U	100		91		220		430	
1,300		90	U	1,500		1,200		220		73		99	U	100	U	99	U	60	U	150		110		200		430	
1,000		90	U	990		610		130		60	U	99	U	100	U	99	U	60	U	84		90	U	190		220	
2300		90	U	2490		1810		350		73		99	U	100	U	99	U	60	U	234		110		390		650	
800		90	U	860		510		92		60	U	99	U	100	U	99	U	60	U	90		90	U	150		360	
270		90	U	480		460		51		60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	220	
530	U	90	U	**250**	U	**460**	U	20	U	60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	110	U
300		90	U	490		240		36		60	U	99	U	100	U	99	U	60	U	59	U	90	U	68		220	
9480		410		**9000**		**6960**		1101		496		99		100	U	99	U	230		885		331		**1658**		**4300**	
530	U	**90**	U	**250**	U	**310**	U	20	U	**640**		**99**	U	**100**	U	**99**	U	60	U	**790**		**90**	U	**4,400**		**350**	
14,000		920		**5,000**		**13,000**		82		**2,700**		580		270		560		300		480		1,300		420		**21,000**	
530	U	90	U	250	U	**470**	0	20	U	60	U	99	U	100	U	99	U	60	U	59	U	90	U	59	U	**1,100**	
530	U	**90**	U	**250**	U	**4,400**	0	20	U	**60**	U	**99**	U	**100**	U	**99**	U	**60**	U	**59**	U	**90**	U	**59**	U	**110**	U
	U	410		470			U	68	U	180		64	U	64	U	160		56	U	59		210		49		150	
		1,600		4,300				180		1,500		620		360		1,000		570		740		1,800		450		690	
940	U	20	U	20	U	970	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	20	U	20	U	19	U
940	U	20	U	20	U	970	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	20	U	20	U	19	U
940	U	20	U	20	U	970	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	20	U	20	U	38	Y
940	U	20	U	20	U	970	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	20	U	20	U	19	U
940	U	20	U	20	U	970	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	20	U	20	U	19	U
940	U	37		25		970	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	46		20	U	86	
940	U	31		25		970	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	39	Y	22		52	
940	U	68		50		**970**	U	19	U	20	U	19	U	20	U	20	U	20	U	19	U	46		22		**138**	



Upland sample sites for storm drain solids in the 7th Ave S. storm drain basin (2112)

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Drainage Basin			2112		2112		2112		2112		2112		2112		2112		2112		2112		2112		2112		2112	
Station ID			7TH-ST1		7TH-ST2		96-ST1		MH20		MH21		MH21a		MH22		RCB129		RCB131		RCB132		RCB137		SP-ST1	
Type			Inline		Inline		Inline		Inline		Inline		Inline		Inline		RCB		RCB		RCB		RCB		Inline	
Sewer									SD		SD		SD		SD		SD		SD		SD		SD			
Date	**LAET**	**LAET2**	**9/10/08**	**Q**	**9/16/08**	**Q**	**12/11/08**	**Q**	**4/13/05**	**Q**	**4/13/05**	**Q**	**10/29/04**	**Q**	**4/13/05**	**Q**	**1/18/08**	**Q**	**2/15/08**	**Q**	**3/12/08**	**Q**	**3/25/08**	**Q**	**8/28/08**	**Q**
Conventionals																										
Total Organic Carbon (% DW)	—	—	6.46		0.417		1.3		7.74		8.9		4.16		6.27		3.57		3.42		3.09		2.75		5.29	
Grain Size																										
Gravel	—	—	2		89.9		4.7																		1.3	
Very coarse sand	—	—	4.1		3.1		4.2																		2.2	
Coarse Sand	—	—	2.9		1.4		21.8																		2.3	
Medium Sand	—	—	3.3		0.7		48.8																		2.6	
Fine Sand	—	—	3.5		0.2		11.3																		3.5	
Very fine sand	—	—	4.3		0.1		3.1																		5.4	
Coarse Silt	—	—	9.9		4.2		1.8																		9.3	
Medium Silt	—	—	13.1		0.1		1.2																		18.6	
Fine Silt	—	—	19.8		0.1		1.2																		23	
Very fine silt	—	—	19.8		0.1		1																		18.7	
8-9 Phi Clay	—	—	8.5		0.1		0.4																		6.8	
9-10 Phi Clay	—	—	5.2		0.1		0.3																		3.3	
> 10 Phi Clay	—	—	3.6		0.1		0.3																		3.1	
Total Fines	—	—	79.9		4.6		6.1																		82.8	
Metals in mg/kg DW																										
Arsenic	57	93	20		6	U	7		20		30		22		20		20	U	50		8.5		6		20	
Copper	390	390	251		19.2		28.9		175		148		269		129		135		166		**701**		9.1		159	
Lead	450	530	188		3		38		151		130		**4,910**		119		54		**548**		110		4		173	
Mercury	0.41	0.59	0.26		0.05	U	0.06	U	0.17		0.20		**1.75**		0.20		0.05	U	0.11		0.06	U	0.05	U	0.26	
Zinc	410	960	**735**		84		228		**547**		**515**		**463**		**575**		**3,650**		**827**		**1,650**		123		**654**	
LPAH in ug/kg DW																										
Naphthalene	2100	2400	140	U	19	U	20	U	350	U	290	U			240	U	250	U	60	U	350	U	34	U	20	U
Acenaphthylene	1300	1300	140	U	19	U	20	U	350	U	290	U			240	U	250	U	60	U	350	U	34	U	20	U
Acenaphthene	500	730	140	U	19	U	22		350	U	290	U			240	U	250	U	60	U	350	U	34	U	20	U
Fluorene	540	1000	140	U	19	U	25		350	U	290	U			240	U	250	U	60	U	350	U	34	U	20	U
Phenanthrene	1500	5400	240		19	U	260		350	U	290	U			590		310		700		350	U	34	U	110	
Anthracene	960	4400	140	U	19	U	54		350	U	290	U			240	U	250	U	160		350	U	34	U	20	U
Total LPAH	5200	1300	240		19	U	361		350	U	290	U			590		310		860		350	U	34	U	110	
HPAH in ug/kg DW																										
Fluoranthene	1700	2500	800		19	U	370		1,400		570				**1,900**		980		**2,500**		350	U	58	U	250	
Pyrene	2600	3300	1000		19	U	420		1,000		430				1,200		730		1,600		350	U	100	U	210	
Benzo(a)anthracene	1300	1600	240		19	U	160		390		290	U			560		250	U	1,200		350	U	34	U	89	
Chrysene	1400	2800	520		19	U	200		720		380				940		270		**1,600**		350	U	58	U	140	
Benzo(b)fluoranthene	—	—	410		19	U	180		870		460				1,100		250	U	2,800		350	U	34	U	220	
Benzo(k)fluoranthene	—	—	770		19	U	140		580		380				890		250	U	2,300		350	U	41	U	190	
Benzofluoranthenes	3200	3600	1180		19	U	320		1450		840				1990		250	U	**5100**		350	U	41	U	410	
Benzo(a)pyrene	1600	3000	420		19	U	160		500		310				760		250	U	**2,200**		350	U	34	U	140	
Indeno(1,2,3-cd)pyrene	600	690	190		19	U	53		350	U	290	U			240		250	U	**1,000**		350	U	34	U	47	
Dibenz(a,h)anthracene	230	540	140	U	19	U	20	U	**350**	U	**290**	U			**240**	U	**250**	U	**440**		**350**	U	34	U	20	U
Benzo(g,h,i)perylene	670	720	270		19	U	54		350	U	290	U			290		250	U	**800**		350	U	34	U	59	
Total HPAH	1200	1700	**4620**		19	U	**1737**		**5460**		**2530**				**7880**		**1980**		**16440**		350	U	100	U	**1345**	
Phthalate Esters in ug/kg DW																										
Butylbenzylphthalate	63	900	**270**		19	U	28		**350**	U	**290**	U			**680**		**250**		**130**		**540**		**170**		**100**	
bis(2-Ethylhexyl)phthalate	1300	1900	**3400**		19	U	920		**6,400**		**3,800**				**6,100**		**3,600**		310		**4,200**	B	**2,700**	B	510	
Phenols in ug/kg DW																										
Phenol	420	1200	140	U	19	U	20	U	350		290	U			240	U	250	U	60	U	350	U	34	U	20	U
2,4-Dimethylphenol	29	29	**140**	U	19	U	20	U	**350**	U	**290**	U			**240**	U	**250**	U	**60**	U	**350**	U	**34**	U	20	U

Total Petroleum Hydrocarbons in ug/kg DW																										
Diesel Range Organics	—	—	240		59	U	77		720		560		370		380		1,300		360		1,500		230		110	U
Oil Range Organics	—	—	1300		120	U	470		2,900		3,100		1,200		1,900		4,200		2,200		6,300		1,200		220	
PCBs in ug/kg DW																										
Aroclor-1016	—	—	270	U	20	U	20	U	270	U	42	U			20	U	20	U	20	U	20	U	20	U	20	U
Aroclor-1221	—	—	270	U	20	U	20	U	270	U	42	U			20	U	20	U	20	U	20	U	20	U	20	U
Aroclor-1232	—	—	270	U	20	U	20	U	270	U	42	U			20	U	20	U	20	U	20	U	20	U	20	U
Aroclor-1242	—	—	270	U	20	U	20	U	270	U	42	U			20	U	20	U	20	U	20	U	20	U	20	U
Aroclor-1248	—	—	270	U	20	U	20	U	270	U	42	U			20	U	20	U	20	U	24	Y	20	Y	20	U
Aroclor-1254	—	—	540	Y	20	U	39		270	U	84	J			55	P	24		49		51		20		59	
Aroclor-1260	—	—	2400		20	U	50		440		190				64		51		90		25		20		55	
Total PCBs	130	1000	**2400**		20	U	89		**440**		**274**	J			119	P	75		**139**		76		20		114	

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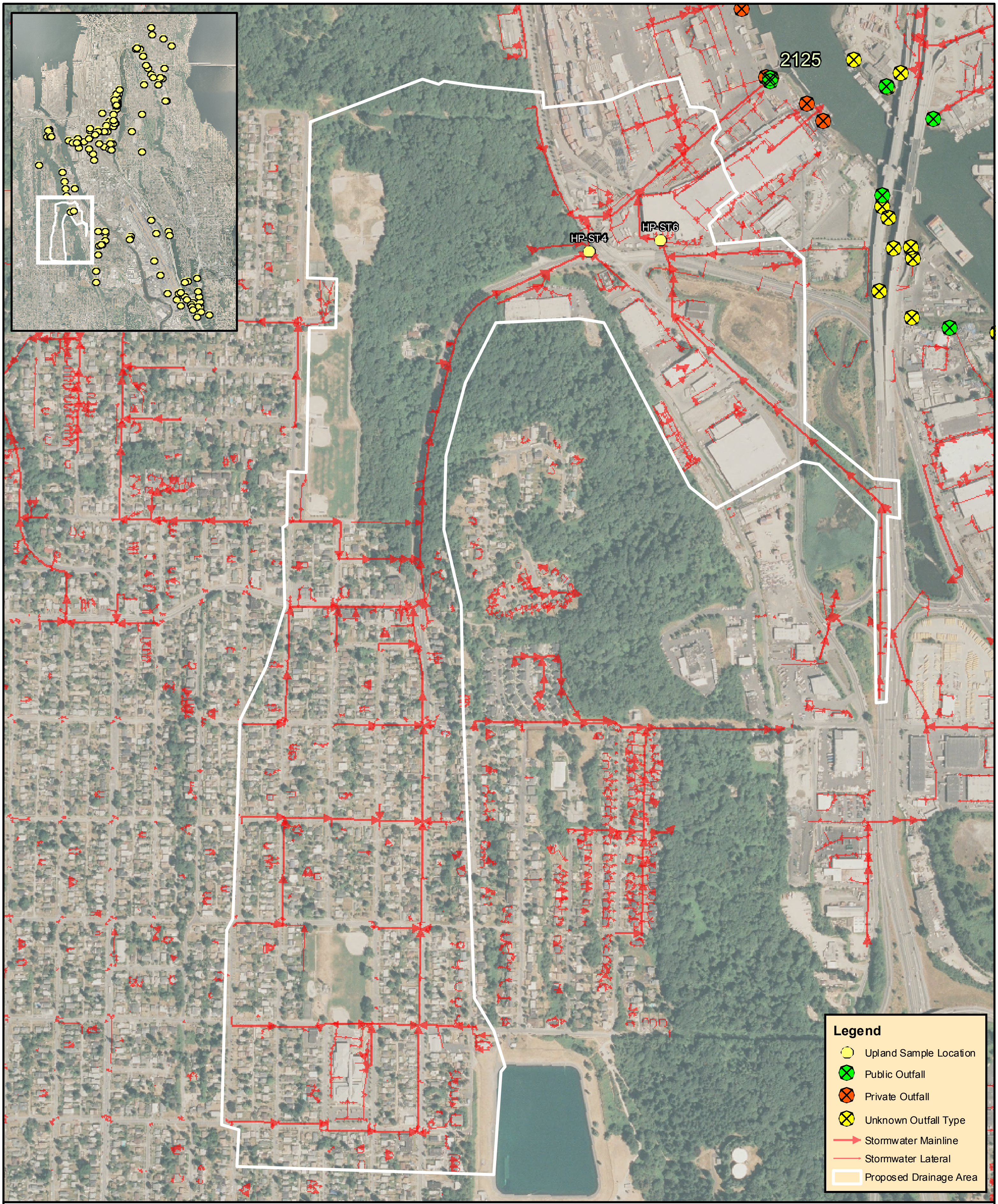

Upland sample sites for storm drain solids in the Highland Park storm drain basin (2125)

N

1 inch = 800 feet

0 495 990 1,980 Feet

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Drainage Basin			2125		2125	
Station ID			HP-ST4		HP-ST6	
Type			Inline		Inline	
Sewer						
Date	**LAET**	**LAET2**	**9/10/08**	**Q**	**9/25/08**	**Q**
Conventionals						
Total Organic Carbon (% DW)	—	—	0.708		6.64	
Grain Size						
Gravel	—	—	82.1		0.1	
Very coarse sand	—	—	10.7		2.1	
Coarse Sand	—	—	3.4		5.4	
Medium Sand	—	—	1.2		8.7	
Fine Sand	—	—	0.3		12.7	
Very fine sand	—	—	0.1		7.8	
Coarse Silt	—	—	1.7		7.7	
Medium Silt	—	—	0.1		16.5	
Fine Silt	—	—	0.1		14.4	
Very fine silt	—	—	0.2		11.4	
8-9 Phi Clay	—	—	0.1		3.7	
9-10 Phi Clay	—	—	0.1		2.9	
> 10 Phi Clay	—	—	0.1		6.6	
Total Fines	—	—	2.3		63.3	
Metals in mg/kg DW						
Arsenic	57	93	7		30	
Copper	390	390	36.3		144	
Lead	450	530	19		150	
Mercury	0.41	0.59	0.04	U	0.26	
Zinc	410	960	184		**876**	
LPAH in ug/kg DW						
Naphthalene	2100	2400	39	U	59	U
Acenaphthylene	1300	1300	39	U	59	U
Acenaphthene	500	730	39	U	59	U
Fluorene	540	1000	39	U	59	U
Phenanthrene	1500	5400	34	J	190	
Anthracene	960	4400	39	U	59	U
Total LPAH	5200	1300	34	J	190	
HPAH in ug/kg DW						
Fluoranthene	1700	2500	110		380	
Pyrene	2600	3300	81		400	
Benzo(a)anthracene	1300	1600	34	J	130	
Chrysene	1400	2800	55		290	
Benzo(b)fluoranthene	—	—	66		240	
Benzo(k)fluoranthene	—	—	45		180	
Benzofluoranthenes	3200	3600	111		420	
Benzo(a)pyrene	1600	3000	37	J	150	
Indeno(1,2,3-cd)pyrene	600	690	39	U	98	
Dibenz(a,h)anthracene	230	540	39	U	59	U
Benzo(g,h,i)perylene	670	720	39	U	140	
Total HPAH	1200	1700	428		**2008**	
Phthalate Esters in ug/kg DW						

Butylbenzylphthalate	63	900	39	U	**570**	
bis(2-Ethylhexyl)phthalate	1300	1900	290		**4500**	
Phenols in ug/kg DW						
Phenol	420	1200	39	U	72	
2,4-Dimethylphenol	29	29	**39**	U	**59**	U
Total Petroleum Hydrocarbons in ug/kg DW						
Diesel Range Organics	—	—	89		230	U
Oil Range Organics	—	—	540		470	U
PCBs in ug/kg DW						
Aroclor-1016	—	—	19	U	20	U
Aroclor-1221	—	—	19	U	20	U
Aroclor-1232	—	—	19	U	20	U
Aroclor-1242	—	—	19	U	20	U
Aroclor-1248	—	—	19	U	20	U
Aroclor-1254	—	—	19	U	20	U
Aroclor-1260	—	—	19	U	20	U
Total PCBs	130	1000	19	U	20	U

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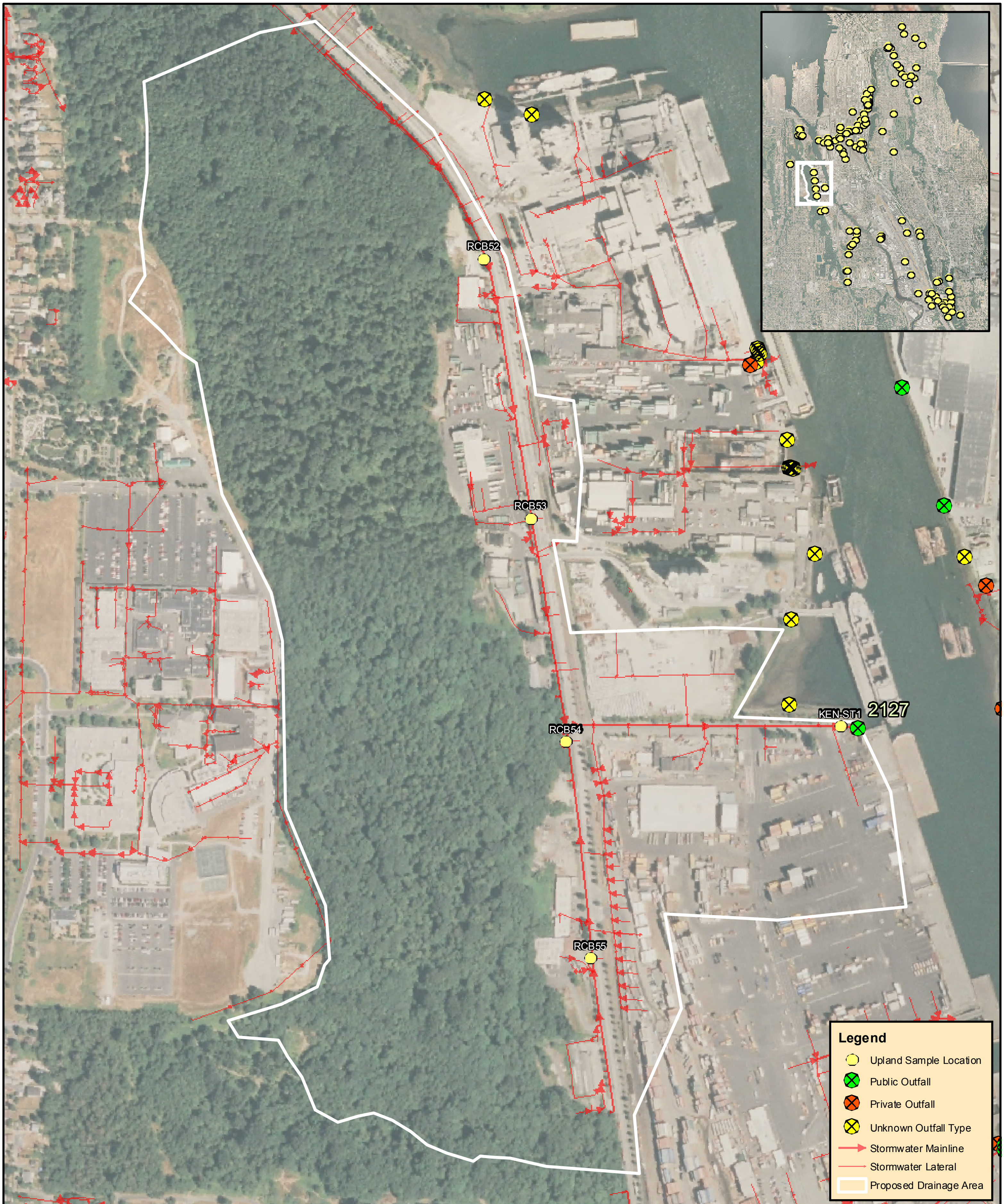

DEPARTMENT OF ECOLOGY State of Washington

Upland sample sites for storm drain solids in the SW Kenny St. storm drain basin (2127)

SAIC From Science to Solutions

Drainage Basin			2127		2127		2127		2127		2127	
Station ID			KEN-ST1		RCB52		RCB53		RCB54		RCB55	
Type			Inline		RCB		RCB		RCB		RCB	
Sewer					SD		SD		SD		SD	
Date	**LAET**	**LAET2**	**9/10/08**	**Q**	**3/26/06**	**Q**	**3/26/06**	**Q**	**3/26/06**	**Q**	**3/26/06**	**Q**
Conventionals												
Total Organic Carbon (% DW)	—	—	4.48		1.43		5.22		2.23		1.02	
Grain Size												
Gravel	—	—	4.1									
Very coarse sand	—	—	3.8									
Coarse Sand	—	—	2.4									
Medium Sand	—	—	2.6									
Fine Sand	—	—	3.4									
Very fine sand	—	—	4.3									
Coarse Silt	—	—	8.4									
Medium Silt	—	—	21.4									
Fine Silt	—	—	23.6									
Very fine silt	—	—	11.3									
8-9 Phi Clay	—	—	4.6									
9-10 Phi Clay	—	—	4.5									
> 10 Phi Clay	—	—	5.6									
Total Fines	—	—	79.4									
Metals in mg/kg DW												
Arsenic	57	93	30		20		11		10		7	
Copper	390	390	147		183		99		55.4		35.9	
Lead	450	530	223		38		402		24		11	
Mercury	0.41	0.59	0.4		0.05	U	0.09		0.06	U	0.05	U
Zinc	410	960	**707**		370		**635**		260		78	
LPAH in ug/kg DW												
Naphthalene	2100	2400	75	U	120	U	460	U	430	U	120	U
Acenaphthylene	1300	1300	75	U	120	U	460	U	430	U	120	U
Acenaphthene	500	730	75	U	120	U	460	U	430	U	120	U
Fluorene	540	1000	75	U	120	U	290	J	430	U	120	U
Phenanthrene	1500	5400	85		69	J	**2,500**		400	J	120	U
Anthracene	960	4400	75	U	120	U	530		430	U	120	U
Total LPAH	5200	1300	85		69	J	3320		400	J	120	U

HPAH in ug/kg DW											
Fluoranthene	1700	2500	420		180	J	**5,700**		460	J	120	U
Pyrene	2600	3300	290		140		**4,200**		370	J	120	U
Benzo(a)anthracene	1300	1600	91		78	J	**2,400**		430	U	120	U
Chrysene	1400	2800	210		220		**4,900**		270	J	120	U
Benzo(b)fluoranthene	—	—	310		290		5,700		430	U	120	U
Benzo(k)fluoranthene	—	—	300		120		3,300		430	U	120	U
Benzofluoranthenes	3200	3600	610		410		**9000**		430	U	120	U
Benzo(a)pyrene	1600	3000	150		120	J	**2,900**		430	U	120	U
Indeno(1,2,3-cd)pyrene	600	690	83		130		**3,300**		430	U	120	U
Dibenz(a,h)anthracene	230	540	75	U	120	U	**620**		**430**	U	120	U
Benzo(g,h,i)perylene	670	720	93		160		**3,500**		430	U	120	U
Total HPAH	1200	1700	**1947**		**1438**		**36520**		1100	J	120	U
Phthalate Esters in ug/kg DW												
Butylbenzylphthalate	63	900	**75**	U	**140**		**510**		**1,100**		**120**	U
bis(2-Ethylhexyl)phthalate	1300	1900	830		900		**3,800**		1,100		190	
Phenols in ug/kg DW												
Phenol	420	1200	75	U	110	J	**460**	U	**430**	U	120	U
2,4-Dimethylphenol	29	29	**75**	U	**120**	U	**460**	U	**430**	U	**120**	U
Total Petroleum Hydrocarbons in ug/kg DW												
Diesel Range Organics	—	—	130		59	U	330		210		91	
Oil Range Organics	—	—	660		370		1,700		1,200		630	
PCBs in ug/kg DW												
Aroclor-1016	—	—	20	U	19	U	20	U	20	U	20	U
Aroclor-1221	—	—	20	U	19	U	20	U	20	U	20	U
Aroclor-1232	—	—	20	U	19	U	20	U	20	U	20	U
Aroclor-1242	—	—	20	U	19	U	20	U	20	U	20	U
Aroclor-1248	—	—	68		19	U	39	Y	20	U	20	U
Aroclor-1254	—	—	130		43		58		20	U	20	U
Aroclor-1260	—	—	100		19	U	39	Y	20	U	20	U
Total PCBs	130	1000	**298**		43		58		20	U	20	U

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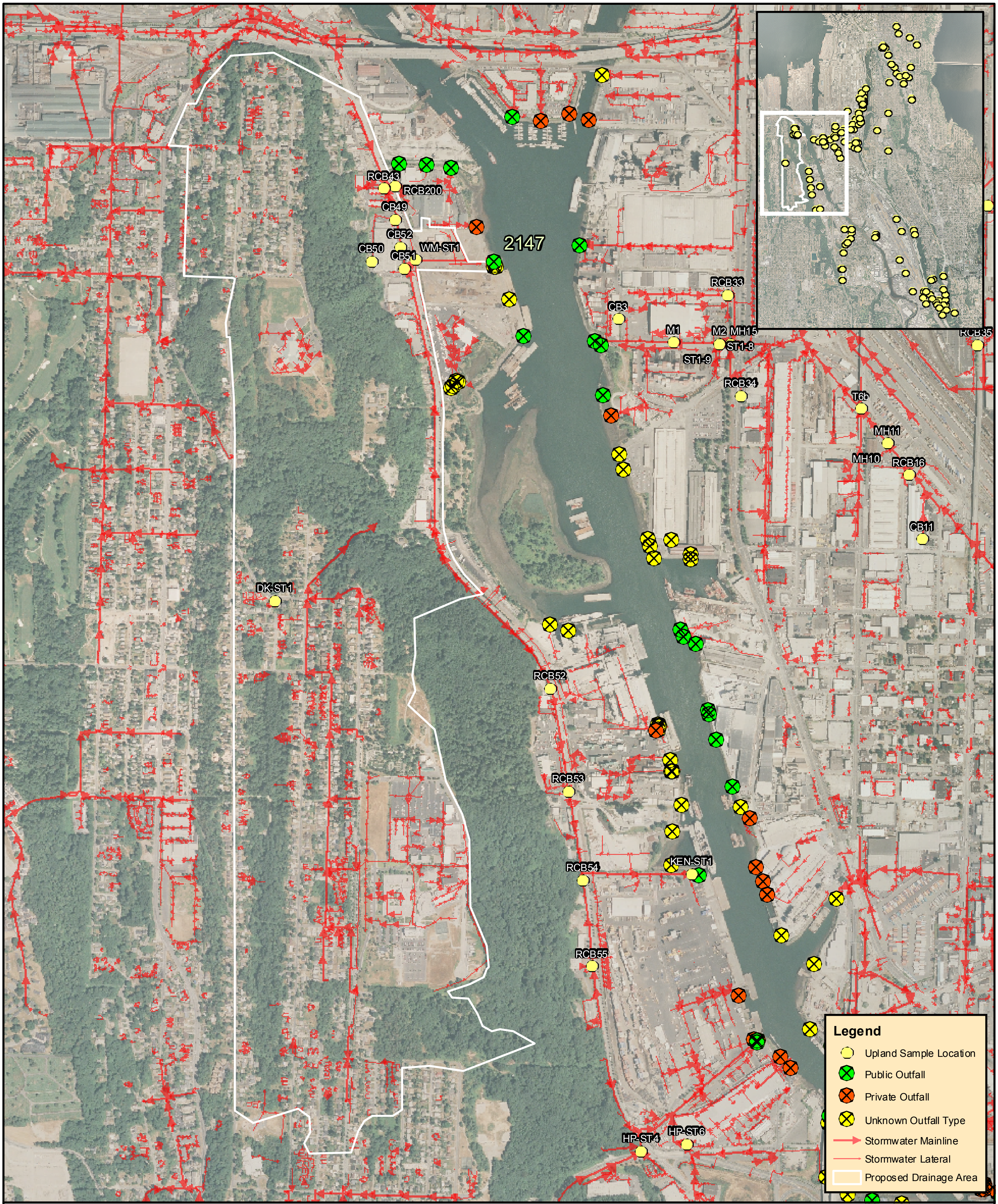

Upland sample sites for storm drain solids in the SW Idaho St. storm drain basin (2147)

DEPARTMENT OF ECOLOGY State of Washington

N

1 inch = 1,250 feet

0 750 1,500 3,000 Feet

SAIC From Science to Solutions

Drainage Basin			2147		2147		2147		2147		2147		2147		2147		2147	
Station ID			CB49		CB50		CB51		CB52		DK-ST1		RCB200		RCB43		WM-ST1	
Type			CB		CB		CB		CB		Inline		RCB		RCB		Inline	
Sewer			SD		SD		SD		SD						SD			
Date	**LAET**	**LAET2**	**2/4/05**	**Q**	**2/4/05**	**Q**	**2/4/05**	**Q**	**2/4/05**	**Q**	**9/16/08**	**Q**	**8/28/08**	**Q**	**2/4/05**	**Q**	**9/5/08**	**Q**
Conventionals																		
Total Organic Carbon (% DW)	—	—	3.58		9.25		4.79		5.13		3.63		4.72		4.57		0.359	
Grain Size																		
Gravel	—	—									75.4		10.8				2.4	
Very coarse sand	—	—									4.8		16.6				3.2	
Coarse Sand	—	—									3.3		29.3				8.3	
Medium Sand	—	—									4.2		32.5				16.2	
Fine Sand	—	—									3.1		7.6				18.4	
Very fine sand	—	—									2.7		0.6				36.4	
Coarse Silt	—	—									1.2		0				7.7	
Medium Silt	—	—									1.9		0				1.5	
Fine Silt	—	—									1.5		0				1.4	
Very fine silt	—	—									1		0				0.5	
8-9 Phi Clay	—	—									0.4		0				0.9	
9-10 Phi Clay	—	—									0.2		0				1	
> 10 Phi Clay	—	—									0.2		0				2.1	
Total Fines	—	—									6.4		2.6				15.1	
Metals in mg/kg DW																		
Arsenic	57	93	7	U	10	U	10		11		10		30		20	U	6	U
Copper	390	390									26.3		101				17.4	
Lead	450	530	36		47		99		127		33		112		118		10	
Mercury	0.41	0.59	0.06	U	0.09	U	0.12		0.13		0.08		0.04	U	0.09		0.06	U
Zinc	410	960									170		**424**				74	
LPAH in ug/kg DW																		
Naphthalene	2100	2400							120	U	19	U	19	U	140	J	20	U
Acenaphthylene	1300	1300							120	U	19	U	19	U	75	U	20	U
Acenaphthene	500	730							120	U	19	U	19	U	75	U	20	U
Fluorene	540	1000							120	U	19	U	19	U	75	U	20	U
Phenanthrene	1500	5400							680		19	U	100		200	J	67	
Anthracene	960	4400							120	U	19	U	27		757	U	20	U
Total LPAH	5200	1300							680		19	U	127		340	J	67	
HPAH in ug/kg DW																		
Fluoranthene	1700	2500							1,200		19	U	320		350	J	200	
Pyrene	2600	3300							750		19	U	260		210	J	170	
Benzo(a)anthracene	1300	1600							270		19	U	120		100	J	69	
Chrysene	1400	2800							650		19	U	180		210	J	190	
Benzo(b)fluoranthene	—	—							530		19	U	200		120	J	180	
Benzo(k)fluoranthene	—	—							440		21		170		120	J	310	
Benzofluoranthenes	3200	3600							970		21		370		240	J	490	
Benzo(a)pyrene	1600	3000							310		19	U	150		150	J	110	
Indeno(1,2,3-cd)pyrene	600	690							120	U	19	U	32		80	J	120	
Dibenz(a,h)anthracene	230	540							120	U	19	U	19	U	75	U	20	

Benzo(g,h,i)perylene	670	720							160		19	U	33		91	J	120	
Total HPAH	1200	1700							**4310**		21		**1465**		**1431**	J	**1489**	
Phthalate Esters in ug/kg DW																		
Butylbenzylphthalate	63	900							**1,300**		19	U	28		**520**	J	13	J
bis(2-Ethylhexyl)phthalate	1300	1900							**7,300**		63		880		1,000	J	130	
Phenols in ug/kg DW																		
Phenol	420	1200							120	U	19	U	19	U	75	U	20	U
2,4-Dimethylphenol	29	29							**160**		19	U	19	U	**75**	U	20	U
Total Petroleum Hydrocarbons in ug/kg DW																		
Diesel Range Organics	—	—							250		56	U	110		190		65	U
Oil Range Organics	—	—							1,700		270		330		1,100		130	U
PCBs in ug/kg DW																		
Aroclor-1016	—	—							19	U	19	U	20	U	19	U	20	U
Aroclor-1221	—	—							19	U	19	U	20	U	19	U	20	U
Aroclor-1232	—	—							19	U	19	U	20	U	19	U	20	U
Aroclor-1242	—	—							19	U	19	U	20	U	19	U	20	U
Aroclor-1248	—	—							70		19	U	30		28		20	
Aroclor-1254	—	—							89		19	U	68		66		20	U
Aroclor-1260	—	—							64		19	U	35		64	J	20	U
Total PCBs	130	1000							**223**		19	U	**133**		**158**	J	20	

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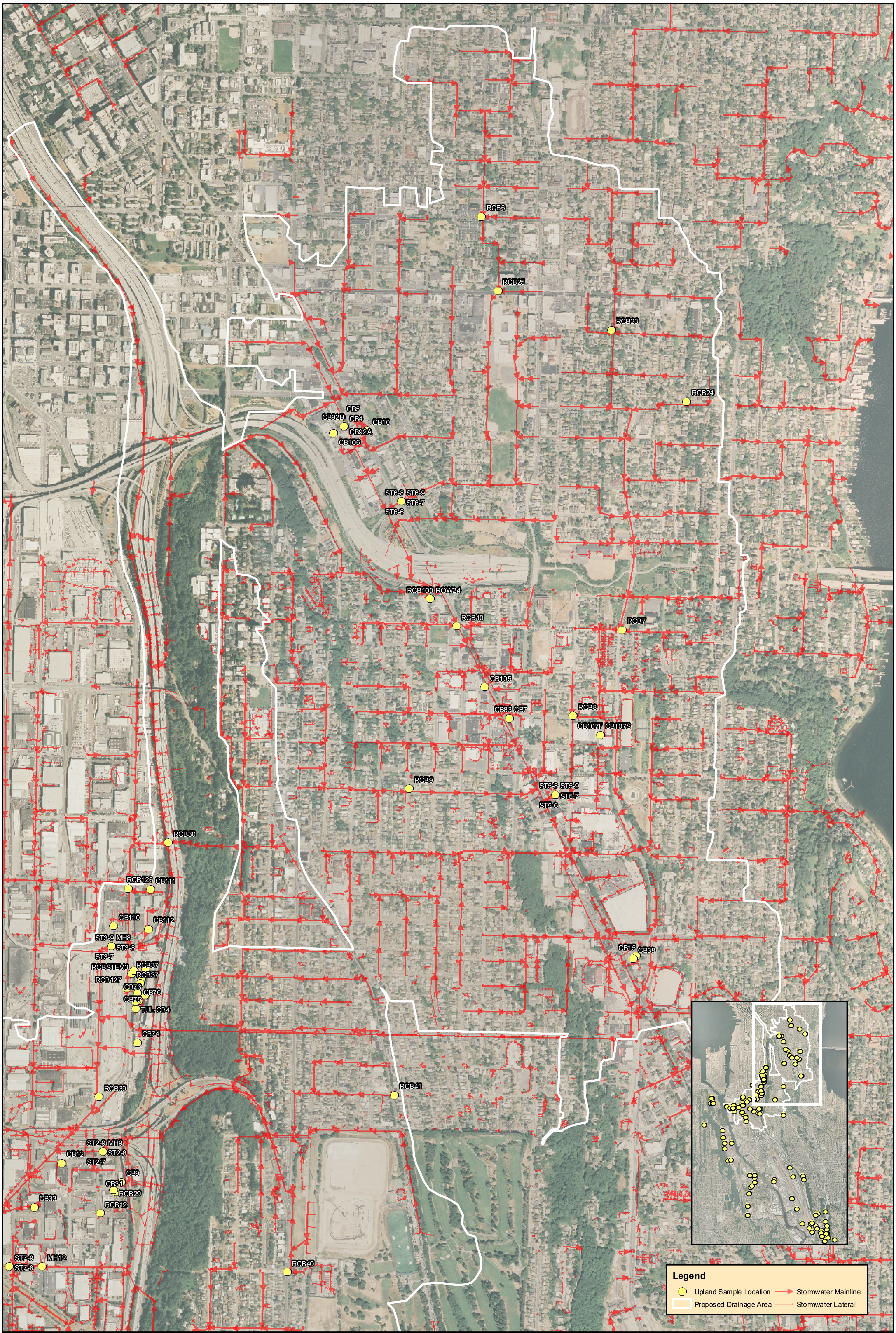
B = Analyte detected is sample and method blank



Upland sample sites for storm drain solids in the East Diagonal storm drain basin (2155)

DEPARTMENT OF ECOLOGY State of Washington

N

1 inch = 1,000 feet

0 750 1,500 3,000 Feet

SAIC From Science to Solutions

Drainage Basin			2155		2155		2155		2155		2155		2155	
Station ID			CB10		CB105		CB106		CB107F		CB107S		CB110	
Type			CB		CB		CB		CB		CB		CB	
Sewer			SD		SD		SD		SD		SD		SD	
Date	**LAET**	**LAET2**	**1/22/04**	**Q**	**8/13/07**	**Q**	**10/18/07**	**Q**	**10/18/07**	**Q**	**10/18/07**	**Q**	**12/5/07**	**Q**
Conventionals														
Total Organic Carbon (%	—	—	15		5.97		11.9		1.41		4.86		3.91	
Grain Size														
Gravel	—	—												
Very coarse sand	—	—												
Coarse Sand	—	—												
Medium Sand	—	—												
Fine Sand	—	—												
Very fine sand	—	—												
Coarse Silt	—	—												
Medium Silt	—	—												
Fine Silt	—	—												
Very fine silt	—	—												
8-9 Phi Clay	—	—												
9-10 Phi Clay	—	—												
> 10 Phi Clay	—	—												
Total Fines	—	—												
Metals in mg/kg DW														
Arsenic	57	93	8	U	13		10	U	7	U	20	U	6	U
Copper	390	390	87		358		107		360		177		46	
Lead	450	530	96		341		29		15		106		20	
Mercury	0.41	0.59	0.07		0.24	U	0.08		0.05	U	0.20	U	0.05	U
Zinc	410	960	250		**787**		**790**		108		**628**		200	
LPAH in ug/kg DW														
Naphthalene	2100	2400	240	U	1,700		280	U	130	U	330	U	99	U
Acenaphthylene	1300	1300	300		1,200	U	280	U	130	U	330	U	99	U
Acenaphthene	500	730	**1,400**		**1,200**	U	430		130	U	330	U	99	U
Fluorene	540	1000	**1,800**		**1,200**	U	350		130	U	330	U	99	U
Phenanthrene	1500	5400	**9,500**		1,500		**2,800**		550		**3,400**		100	
Anthracene	960	4400	**6,300**		**1,200**	U	450		130	U	370		99	U
Total LPAH	5200	1300	**19300**		**3200**		**4030**		550		**3770**		100	
HPAH in ug/kg DW														
Fluoranthene	1700	2500	**50,000**		1,300		**4,800**		1,200	U	**6,600**		120	
Pyrene	2600	3300	**32,000**		1,400		**4,600**		960		**5,100**		180	
Benzo(a)anthracene	1300	1600	**27,000**		1,200	U	**1,800**		360		**1,600**		99	U
Chrysene	1400	2800	**26,000**		1,200		**3,600**		660	U	**4,100**		110	
Benzo(b)fluoranthene	—	—	40,000		1,200	U	3,100		540		4,100		99	U
Benzo(k)fluoranthene	—	—	17,000		1,200	U	3,300		720		3,000		99	U
Benzofluoranthenes	3200	3600	**57000**		1200	U	**6400**		1260		**7100**		99	U
Benzo(a)pyrene	1600	3000	**30,000**		1,200	U	**3,000**		530		**3,100**		99	U
Indeno(1,2,3-cd)pyrene	600	690	**16,000**		**1,200**	U	**780**		240		**1,300**		99	U
Dibenz(a,h)anthracene	230	540	**6,800**		**1,200**	U	**280**	U	130	U	**360**		99	U
Benzo(g,h,i)perylene	670	720	**12,000**		**1,200**	U	540		160		**880**		99	U
Total HPAH	1200	1700	**313800**		**3900**		**31920**		**4770**		**37240**		410	
Phthalate Esters in ug/kg DW														
Butylbenzylphthalate	63	900	**240**	U	**16,000**		**17,000**	U	**150**	U	**330**		**150**	U
bis(2-Ethylhexyl)phthalate	1300	1900	**1,500**		**68,000**	B	**67,000**	B	**6,000**	B	**17,000**	B	**6,700**	
Phenols in ug/kg DW														
Phenol	420	1200	240	U	**1,200**	U	**820**		160		**690**		99	U
2,4-Dimethylphenol	29	29	**240**	U	**1,200**	U	**9,900**		**670**		**330**	U	**99**	U
Total Petroleum Hydrocarbons in ug/kg DW														
Diesel Range Organics	—	—	930		12,000		1,900		1,400		2,500		480	
Oil Range Organics	—	—	2,000		42,000		11,000		1,600		4,600		3,300	
PCBs in ug/kg DW														
Aroclor-1016	—	—	17	U	200	U	20	U	20	U	20	U	20	U
Aroclor-1221	—	—	17	U	200	U	20	U	20	U	20	U	20	U
Aroclor-1232	—	—	17	U	200	U	20	U	20	U	20	U	20	U
Aroclor-1242	—	—	17	U	200	Y	30	U	20	U	20	U	20	U
Aroclor-1248	—	—	17	U	200	U	20	Y	29	U	40	Y	20	U
Aroclor-1254	—	—	17	U	210		35	Y	29	U	40	Y	20	
Aroclor-1260	—	—	17	U	200	Y	40	Y	39	U	200	Y	20	U
Total PCBs	130	1000	17	U	**210**		35	Y	39	U	**200**	Y	20	

Notes:
LAET = lowest apparent effects threshold
2LAET = second lowest apparent effects threshold
Bold text indicates results that exceed either LAET or 2LAET values
Blank cells indicate parameter not analyzed
U = Analyte was not detected at or above the reported result
J = Estimated concentration
UJ = Analyte was not detected at or above the reported estimate
B = Analyte detected is sample and method blank

2155		2155		2155		2155		2155		2155		2155		2155		2155
CB111		CB112		CB12		CB15		CB31		CB33		CB38		CB4		CB5
CB		CB		CB		CB		CB		CB		CB		CB		CB
SD		SD		SD		SD		SD		SD		SD		SD		SD
12/5/07	**Q**	**12/5/07**	**Q**	**1/23/04**	**Q**	**2/9/04**	**Q**	**5/6/04**	**Q**	**5/24/04**	**Q**	**6/25/04**	**Q**	**9/8/03**	**Q**	**9/10/03**
2.04		4.57		6.7		4		3.69		11.4		6.4		3.4		15
10	U	8	U	10	U	9		20	U	20		7	U	20	U	20
241		303		181		142	J	186		118		66		135		147
97		117	U	97		**476**	J	231		82		54		47		51
0.04	U	0.06		0.10		0.06	U	0.12		0.09		0.08		0.08	U	0.20
190		**465**		**603**		98		**590**		**924**		209		360		**412**
98	U	180		49	U	82	U	59	U	320	U	460		95	U	**2,800**
98	U	99	U	49	U	82	U	59	U	320	U	210	U	95	U	**2,800**
98	U	420		49	U	82	U	59	U	320	U	**2,600**		95	U	**2,800**
98	U	**690**		49	U	82	U	59	U	320	U	**3,400**		410		**1,900**
300		**4,700**		95		82	U	67		660		**32,000**		990		**3,500**
98	U	**1,300**		49	U	82	U	59	U	320	U	**6,400**		95	U	**2,800**
300		**7290**		95		82	U	67		660		**44860**		**1400**		**5400**
480		**5,500**	U	270		82	U	150		820		**43,000**		250		710
560		**9,900**		340		170		160		610		**32,000**		450		2,200
160		**2,400**		120		82	U	59	U	320	U	**13,000**		95	U	**2,800**
240		**3,200**	U	240		150		80		430		**14,000**		140		320
210		2,500		200		82	U	74		570		16,000		95	U	2,800
180		3,300		200		82	U	59	U	320	U	5,400		95	U	2,800
390		**5800**		400		82	U	74		570		**21400**		95	U	2800
160		**2,400**		130		82	U	59	U	320	U	**11,000**		95	U	**2,800**
98	U	**1,100**		69		82	U	59	U	320	U	**4,900**		95	U	**2,800**
98	U	**250**		49	U	82	U	59	U	**320**	U	**1,700**		95	U	**2,800**
98	U	**1,200**		84		82	U	59	U	400		**3,800**		95	U	**2,800**
2380		**28850**		**2053**		320		538		**3400**		**166200**		840		**3230**
98		**430**	U	**240**		**82**	U	59	U	**320**	U	**240**		**1,000**		**10,000**
1,900		**64,000**		**6,600**		380		460		**9,900**		**5,000**		**32,000**		**67,000**
98	U	200	U	80	U	82	U	59	U	320	U	210	U	**1,200**		**620**
98	U	**390**	U	**58**		**82**	U	**59**	U	**1,300**		**1,200**		**95**	U	**2,800**
46,000		2,000		41		380		200		900		960		1,800		2,600
250,000		5,800		270		3,900		670		3,100		3,300		6,300		9,200
20	U	39	U	18	U	19	U	19	U	20	U	19	U	19	U	20
20	U	39	U	18	U	19	U	19	U	20	U	19	U	38	U	40
20	U	39	U	18	U	19	U	19	U	20	U	19	U	19	U	20
20	U	39	U	18	U	19	U	19	U	20	U	19	U	19	U	20
20	Y	58	U	18	U	19	U	55		20	U	19	U	19	U	20
47		130	U	23		19	U	47		30		19	U	19	U	20
20		120	U	18	J	19	U	26		28		220		19	U	20
47		**250**	U	41	J	19	U	128		58		**220**		38	U	40

	2155		2155		2155		2155		2155		2155		2155		2155	
	CB7		CB73		CB74		CB75		CB76		CB83		CB9		CB92A	
	CB		CB		CB		CB		CB		CB		CB		CB	
	SD		SD		SD		SD		SD		SD		CS		SD	
Q	**10/15/03**	**Q**	**10/19/05**	**Q**	**10/19/05**	**Q**	**10/19/05**	**Q**	**10/19/05**	**Q**	**12/5/05**	**Q**	**1/22/04**	**Q**	**7/10/06**	**Q**
	17		0		12		0		0		8.25		2.7		6.29	J
U	10	U			30	U					20		20		20	U
	647				362						145		177		111	
	1,220				430						**5,830**		105		42	
U	0.10	U			**1.51**						**2.05**		0.06	U	0.07	
	1,150				**1,810**						**432**		294		**547**	
U	**3,100**				**2,500**						**6,100**		40	U	180	U
U	1,100	U			44	U					230	J	40	U	180	U
U	**1,100**	U			44	U					340	U	40	U	180	U
J	**1,100**	U			81						500		40	U	180	
J	**2,300**				870						**1,900**		140		880	J
U	**1,100**	U			44	U					250	J	39	J	180	U
J	**5400**				**3451**						**8980**		179		1060	
J	1,100	U			920						**2,300**		360		520	
J	**4,800**				490						2,000		200		460	
U	1,100	U			190						610		140		180	U
J	1,100	U			280						880		270		340	
U	1,100	U			200						610		410		180	U
U	1,100	U			170						550		240		180	U
U	1100	U			370						1160		650		180	U
U	1,100	U			98						380		180		180	U
U	**1,100**	U			44						240	J	86		180	U
U	**1,100**	U			44	U					**340**	U	40	U	180	U
U	**1,100**	U			44	UJ					370		66		180	U
	4800				**2806**						**9100**		**2602**		**1320**	
J	**1,100**	U			**1,000**						**3,000**		**410**		**280**	
	140,000				**13,000**						**24,000**		**2,200**		**8,900**	
J	**1,100**	U			**1,900**						350		89	U	**3,200**	
U	**2,100**				**17,000**						**340**	U	**40**	U	**1,200**	
	9,900				740						7,900		50	U	1,600	
	13,000				3,400						23,000		300		7,000	
U	20	U	150,000	U	180	U	31,000	U	26,000	U	290	Y	18	U	40	U
U	40	U	150,000	U	180	U	31,000	U	26,000	U	780	Y	18	U	40	U
U	20	U	150,000	U	180	U	31,000	U	260,000	U	680	Y	18	U	40	U
U	20	U	150,000	U	180	U	31,000	U	26,000	U	290	Y	18	U	120	Y
UJ	20	U	150,000	U	2,900		31,000	U	26,000	U	290	Y	18	U	40	U
UJ	22		800,000		8,800		96,000		1,200,000		380		52		76	
UJ	26		540,000		8,100		79,000		1,000,000		220	Y	45		130	
UJ	48		**1,340,000**		**19,800**		**175,000**		**2,200,000**		**380**		97		**206**	

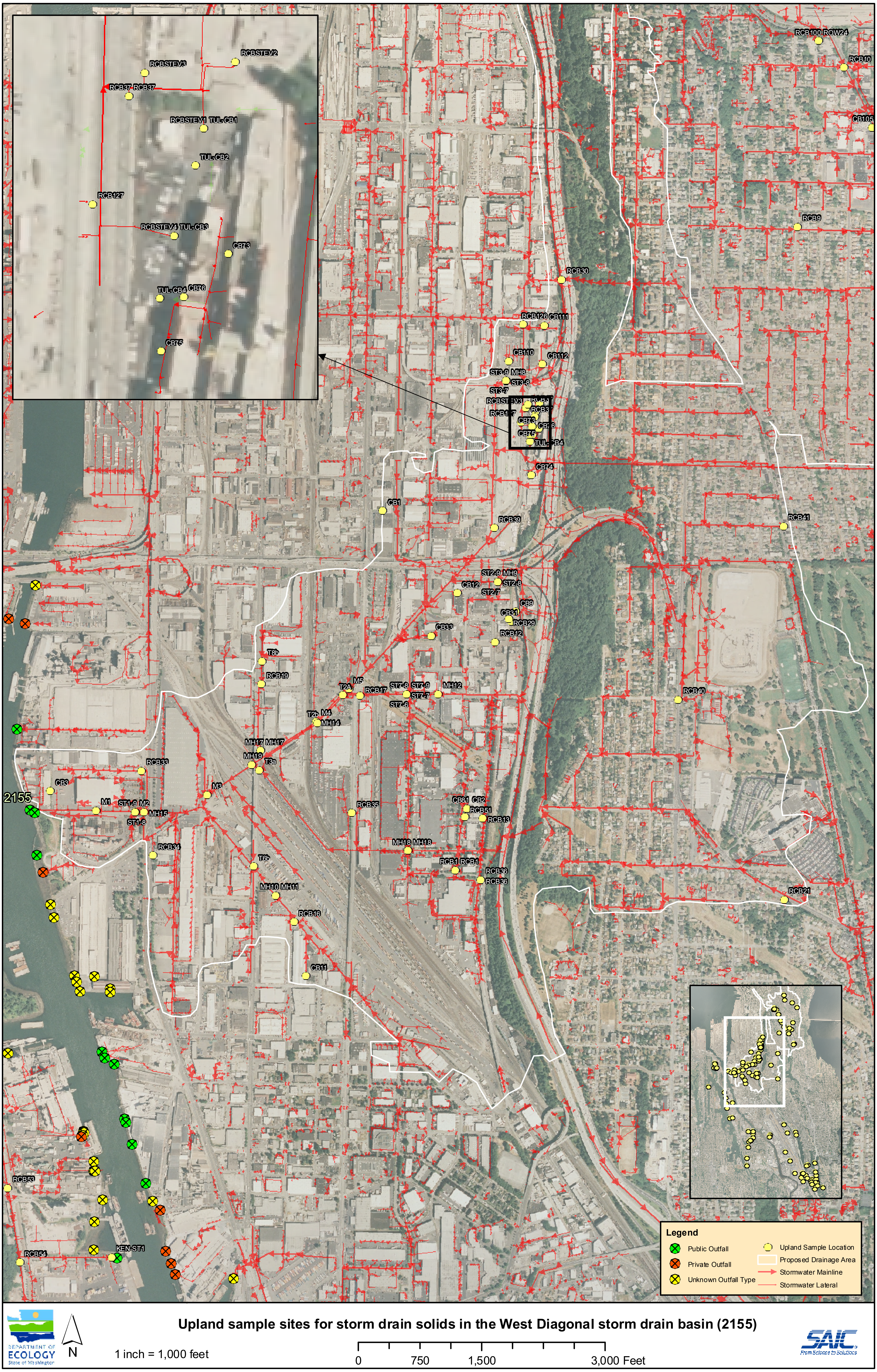
2155		2155		2155		2155		2155		2155		2155		2155		2155
CB92B		MH12		MH8		MH9		RCB10		RCB100		RCB12		RCB126		RCB127
CB		Inline		Inline		Inline		RCB		RCB		RCB		RCB		RCB
SD		SD		SD		SD		SD		SD		SD		SD		SD
8/23/07	**Q**	**10/27/03**	**Q**	**10/13/03**	**Q**	**10/13/03**	**Q**	**3/15/04**	**Q**	**11/14/06**	**Q**	**4/7/04**	**Q**	**1/11/08**	**Q**	**1/11/08**
6.17		1.2		0.38		0.42		10		2.71		5.83		9.79		10.9
20	U	6	U	13	U	30	U	10	U	7	U	10	U	20	U	20
129		126		56		220		183		66.9		112		153		127
39		28		120		50		109		28		77		74		65
0.07		0.05	U	0.33	U	0.05	U	0.10	U	0.05	U	0.10	U	0.20		0.20
578		286		410		192		**589**		174		384		**793**		**674**
500	U	39	U	39	U	39	U	**4,600**	U	300	U	160	U	650	U	660
500	U	39	U	39	U	39	U	**4,600**	U	300	U	160	U	650	U	660
500	U	39	U	39	U	39	U	**4,600**	U	300	U	160	U	**650**	U	**660**
500	U	39	U	39	U	39	U	**4,600**	U	420		160	U	**650**	U	**660**
1,100		340		39	U	100		**4,600**	U	680		660		650		660
500	U	84		39	U	39	U	**4,600**	U	300	U	160	U	650	U	660
1100		424		39	U	100		**4600**	U	1100		660		650		660
500	U	540		82		220		**4,600**	U	300		**1,800**		1,000		1,100
500	U	440		72		170		**4,600**	U	350		970		1,100		1,200
500	U	110		39	U	72		**4,600**	U	300	U	530		650	U	660
500	U	280		49		110		**4,600**	U	300	U	730		650		670
500	U	150		30	J	63		4,600	U	300	U	540		650	U	660
500	U	150		30	J	63		4,600	U	300	U	460		650	U	660
500	U	300		60	J	126		**4600**	U	300	U	1000		650	U	660
500	U	250		29	J	68		**4,600**	U	300	U	400		650	U	660
500	U	120		39	U	56		**4,600**	U	300	U	200		**650**	U	**660**
500	U	39	U	39	U	39	U	**4,600**	U	**300**	U	160	U	**650**	U	**660**
500	U	110		39	U	55		**4,600**	U	300	U	180		650	U	660
500	U	**2450**		352		1003		**4600**	U	650		**6810**		**2750**		**2970**
18,000		**66**		50		48		**4,600**	U	**300**	U	**220**		**1,400**		**660**
7,900		**1,400**		790		740		**28,000**	J	**6,200**		**5,600**		**11,000**		**20,000**
500	U	39	U	39	U	39	U	**4,600**	U	300	U	**2,000**		**650**	U	**660**
500	U	**39**	U	**39**	U	**39**	U	**4,600**	U	**300**	U	**160**	U	**650**	U	**660**
3,300		66		33		49		6,300		3,800		540				
20,000		250		150		190		14,000		9,500		3,000				
20	U	20	U	19	U	20	U	20	U	20	U	20	U	20	U	20
20	U	39	Y	39	U	40	U	20	U	20	U	20	U	20	U	20
20	U	20	U	19	U	20	U	20	U	39	Y	20	U	20	U	20
39	Y	20	U	19	U	20	U	20	U	20	U	20	U	20	U	20
20	U	20	U	19	U	20	U	42	Y	20	U	20	U	49	Y	20
39	Y	22		20	J	20	U	54		23		30		81		98
140		20	U	19	U	20	U	20	U	20	U	20	J	100		54
140		22		20	J	40	U	54		23		50	J	**181**		**152**

Q	2155 RCB23 RCB SD **4/21/04**	Q	2155 RCB24 RCB SD **4/21/04**	Q	2155 RCB25 RCB SD **4/21/04**	Q	2155 RCB29 RCB CS **5/7/04**	Q	2155 RCB30 RCB SD **5/26/04**	Q	2155 RCB37 RCB SD **6/30/04**	Q	2155 RCB37 RCB SD **1/11/08**	Q	2155 RCB39 RCB SD **6/30/04**	Q
	10.8		7.45		5.66		4.43		3		5.44		5.44		4.57	
U	10	U	8	U	7	U	9	U	10	U	7	U	7		7	U
	81.6		41.4		53.1		134		46.2		58.8		58.8		113	
	180		316		25		106		20		62		62		61	
U	0.12		0.31		0.07		0.26		0.06	U	0.06	U	0.06		0.06	U
	277		226		120		334		171		189		189		213	
U	250	U	180		82		60	U	80	U	70		70	U	61	U
U	250	U	150		82		60	U	80	U	56	U	56	U	61	U
U	250	U	130	U	82	U	60	U	80	U	78		78	U	61	U
U	250	U	130	U	82	U	60	U	80	U	120		120	U	100	
	350		**1,600**		82		220		230		1,000		1,000	U	570	
U	250	U	130	U	82	U	60	U	80	U	180		180	U	80	
	350		**1930**		246		220		230		**1448**		1000	U	750	
	580		1,700		120		240		340		1,700		1,700	U	640	
	650		1,400		150		250		330		1,600		1,600		700	
U	250	U	420		82		60		120		520		520	U	180	
	400		870		99		130		180		750		750		360	
U	250	U	540		82		90		140		820		820	U	320	
U	250	U	540		82		60	U	80	U	520		520	U	270	
U	250	U	1080		164		90		140		1340		820	U	590	
U	250	U	600		82		63		110		420		420	U	160	
U	250	U	320		82		60	U	85		140		140	U	61	U
U	**250**	U	130		82		60	U	80	U	56	U	56	U	61	U
U	250	U	300		82		60	U	94		130		130	U	63	
	1630		**7900**		1107		923		**1539**		**7940**		**2350**		**3283**	
	300		**130**	U	**100**	U	**140**		**390**		**410**		**410**		**280**	
	8,700		1,100		**1,900**		**1,400**		**3,200**		**8,300**		**8,300**		**4,400**	
U	250	U	130	U	82	U	60	U	80	U	56	U	56	U	61	U
U	**250**	U	**130**	U	**82**	U	**60**	U	**80**	U	**56**	U	**56**	U	**61**	U
	690		400		290		130	J	130		220		220		640	
	2,500	J	1,400		1,200		480	J	630		1,200		1,200		3,500	
U	20	U	19	U	19	U	20	U	19	U	130	U	130	U	20	U
U	20	U	19	U	19	U	20	U	19	U	130	U	130	U	20	U
U	20	U	19	U	19	U	20	U	19	U	130	U	130	U	20	U
U	20	U	19	U	19	U	20	U	19	U	130	U	130	U	20	U
U	20	U	19	U	19	U	44		19	U	130	U	130	U	29	
0	24		25		19		24		19	U	11,000		11,000		74	
0	21	J	19	U	19	U	20	U	19	U	6,500		6,500		57	
0	45	J	25		19		68		19	U	**17,500**		**17,500**		**160**	

2155		2155		2155		2155		2155		2155		2155		2155		2155
RCB40		RCB41		RCB6		RCB7		RCB8		RCB9		RCBSTEV3		ROW24		ST2-7
RCB		RCB		RCB		RCB		RCB		RCB		RCB		RCB		Trap
SD		SD		CS		SD		SD		SD		SD		SD		SD
6/30/04	**Q**	**6/30/04**	**Q**	**3/3/04**	**Q**	**3/3/04**	**Q**	**3/3/04**	**Q**	**3/3/04**	**Q**	**8/31/04**	**Q**	**1/14/05**	**Q**	**9/5/06**
2.79		10.5		4.7		2.4		7.8		4.7				4.63		6.64
5	U	8	U	10	U	6		9	U	10	U			20	U	8
70.4		83.2		161		55.1		75.3		42.5				84.4		99.4
99		120		125		374		54		53				19		130
0.04	U	0.07	U	0.30	U	0.06	U	0.07	U	0.04	U			0.06	U	0.07
207		223		**1,100**		142		223		151				185		357
36	U	160		620	U	39	U	83		39	U			2,000	U	360
36	U	54	U	620	U	39	U	68	U	39	U			**2,000**	U	360
36	U	54	U	**620**	U	39	U	68	U	39	U			**2,000**	U	360
36	U	54	U	**620**	U	39	U	68	U	39	U			**3,000**		360
87		120		1,100		70		130		57				**5,900**		520
36	U	120		620	U	39	U	68	U	39	U			**2,000**	U	360
87		400		1100		70		213		57				**8900**		520
180		180		1,600		120		220		100				**2,000**		1,000
190		150		1,200		100		200		100				2,000	U	800
70		54	U	620		39	U	68	U	42				**2,000**	U	370
140		130		710		63		230		86				**2,000**	U	560
170		160		1,900		40		140		69				2,000	U	360
110		100		620		41		140		69				2,000	U	400
280		260		2520		81		280		138				2000	U	400
79		100		620		39	U	110		59				**2,000**	U	360
36	U	54	U	**1,100**	U	39	U	68	U	39	U			**2,000**	U	360
36	U	54	U	**630**	U	39	U	68	U	39	U			**2,000**	U	**360**
45		54	U	620	U	39	U	72		39	U			**2,000**	U	360
1264		1080		**7270**		364		1112		525				**2000**		**3130**
60		**8,100**		**1,900**		**80**		**130**		39	U			**2,000**	U	**1,400**
980		**2,800**		**19,000**		**2,100**		**8,600**		970				**18,000**		**8,900**
36	U	54	U	**650**	U	39	U	68	U	39	U			**2,000**	U	360
36	U	**54**	U	**620**	U	**39**	U	**68**	U	**39**	U			**2,000**	U	**360**
140		260				210		320		160				6,400		440
850		1,200			J	1,600		3,000		1,900				14,000		2,900
20	U	20	U	20	U	20	U	19	U	20	U	19	U	58	U	19
20	U	20	U	39	U	20	U	19	U	20	U	19	U	58	U	19
20	U	20	U	20	U	20	U	19	U	20	U	19	U	58	U	19
20	U	20	U	20	U	20	U	19	U	20	U	19	U	58	U	76
20	U	20	J	20	U	20	U	19	U	20	U	19	U	58	U	19
20	U	62		160	U	20	U	19	U	20	U	130		58	U	51
20	U	51		20	U	20	U	19	U	20	U	71		58	U	86
20	U	**133**	J	**160**	U	20	U	19	U	20	U	**201**		58	U	**213**

	2155		2155		2155		2155		2155		2155	
	ST2-8		ST2-9		ST3-7		ST3-8		ST3-9		ST5-6	
	Trap		Trap		Trap		Trap		Trap		Trap	
	SD		SD		SD		SD		SD		SD	
Q	**3/22/07**	**Q**	**8/22/07**	**Q**	**9/5/06**	**Q**	**3/22/07**	**Q**	**8/22/07**	**Q**	**3/28/06**	**Q**
	3.16		4.95		3.02		3.86		2.87		2.79	
U	8	U	8	U	7	U	7	U	7	U	9	
	61.4		120		214		95.8		80.5		66.4	
	195		59		74		73		86		71	
U	0.06	U	0.07	U	0.05	U	0.07	U	0.06		0.07	
	275		277		408		394		392		341	
U	91	UJ	90	U	240	U	180	J	88	U	410	U
U	91	UJ	90	U	240	U	88	UJ	88	U	410	U
U	91	UJ	90	U	240	U	65	J	88	U	410	U
U	91	UJ	90	U	240	U	66	J	88	U	410	U
	200	J	590		270		560	J	410		220	J
U	91	UJ	110		240	U	72	J	88	U	410	U
	200	J	700		270		943	J	410		220	J
	530	J	1,400		570		680	J	910		270	J
	260	J	790		410		380	J	520		240	J
	170	J	400		240	U	190	J	260		410	U
	260	J	570		280		300	J	400		230	J
U	180	J	450		240	U	210	J	330		410	U
	180	J	520		240	U	240	J	280		410	U
	360	J	970		240	U	450	J	610		410	U
U	160	J	410		240	U	160	J	270		410	U
U	57	J	140		240	U	51	J	100		410	U
U	91	UJ	90	U	**240**	U	88	UJ	88	U	**410**	U
U	78	J	160		240	U	74	J	130		410	U
	1966	J	**4840**		**1260**		**2373**	J	**3200**		740	J
	250	J	**150**		**840**		**500**	J	**1,800**		**410**	U
B	**6,200**	J	**4,300**		**4,700**	B	**4,600**	J	**4,300**		**2,900**	
U	91	UJ	93		240	U	88	UJ	88	U	410	U
U	**91**	UJ	**90**	U	**240**	U	**88**	UJ	**88**	U	**410**	U
	300		460		250		240		330		520	
	1,400		2,100		1,600		1,200		1,900		2,600	
U	20	U	20	U	20	U	39	U	97	U	100	U
U	20	U	20	U	50	Y	39	U	97	U	100	U
U	20	U	20	U	20	U	39	U	97	U	100	U
	20	U	110		20	U	39	U	97	U	100	U
U	68		20	U	20	U	58	Y	97	U	100	U
	34		49		110		200		160		2,900	
	20	UJ	20		54		110	J	200	Y	350	
	102		**179**		**164**		**310**		**160**		**3,250**	

2155 ST5-7 Trap SD **9/5/06**	**Q**	2155 ST5-8 Trap SD **3/22/07**	**Q**	2155 ST5-9 Trap SD **8/22/07**	**Q**	2155 ST6-6 Trap SD **3/28/06**	**Q**	2155 ST6-7 Trap SD **9/5/06**	**Q**	2155 ST6-8 Trap SD **3/22/07**	**Q**	2155 ST6-9 Trap SD **8/22/07**	**Q**	2155 ST7-8 Trap SD **3/22/07**	**Q**	2155 ST7-9 Trap SD **8/22/07**	**Q**	2155 TUL-CB4 CB SD **1/9/08**	**Q**
18.1		7.82		9.55		10.7		11.4		7.08		8.12		3.57		2.62			
10	U	8	U	10	U	7	U	10	U	8	U	10	U	7	U	9	U		
146		42.9		110		64.5		155		57.6		120		74.6		104			
112		37		111		79		123		71		92		60		98			
0.20		0.07	U	0.12		0.06		0.20		0.06	U	0.11		**1.28**		0.13			
650		194		**466**		284		**881**		237		**591**		283		401			
490	U	95	UJ	300	U	1,400		440	U	110	UJ	430	U	120	UJ	170	U		
490	U	95	UJ	300	U	420	U	440	U	110	UJ	430	U	120	UJ	170	U		
490	U	95	UJ	300	U	420	U	440	U	110	UJ	430	U	120	UJ	170	U		
490	U	95	UJ	300	U	420	U	440	U	110	UJ	430	U	120	UJ	170	U		
490	U	180	J	740		**4,100**		**4,400**		1,200	J	**2,200**		470	J	310			
490	U	95	UJ	300	U	590		580		160	J	430	U	110	J	170	U		
490	U	95	UJ	740		**6090**		**4980**		**1360**	J	**2200**		580	J	310			
780		300	J	900		**6,300**		**11,000**		**3,400**	J	**4,600**		1,400	J	630			
530		180	J	620		**3,400**		**5,500**		1,400	J	**2,700**		860	J	430			
490	U	91	J	300	U	**2,300**		**2,900**		840	J	**1,400**		400	J	180			
490	U	170	J	480		**3,000**		**4,200**		1,200	J	**2,000**		700	J	340			
490	U	140	J	420		1,500		3,400		1,100	J	1,500		670	J	290			
490	U	130	J	300	U	2,300		3,400		960	J	1,500		500	J	230			
490	U	270	J	420		**3800**		**6800**		2060	J	3000		1170	J	520			
490	U	99	J	300	U	**1,700**		**3,500**		760	J	1,400		350	J	210			
490	U	95	UJ	300	U	**1,000**		**1,200**		150	J	**620**		87	J	170	U		
490	U	95	UJ	**300**	U	**420**	U	**470**		110	UJ	**430**	U	120	UJ	170	U		
490	U	95	UJ	300	U	**1,200**		**1,200**		170	J	**680**		100	J	170	U		
1310		**1395**	J	**2420**		**22700**		**36770**		**10090**	J	**16400**		**5187**		**2310**			
650		**360**	J	**300**	U	**420**	U	**540**		**180**	J	**430**	U	**1,100**	J	**180**			
13,000	B	**6,900**	J	**8,300**		**4,900**		**11,000**	B	**5,700**	J	**9,900**		**8,800**	J	**5,900**			
490	U	95	UJ	300	U	420	U	**440**	U	160	UJ	**430**	U	**810**	UJ	170	U		
490	U	**95**	UJ	**300**	U	**420**	U	**440**	U	**110**	UJ	**430**	U	**120**	UJ	**170**	U		
510		540		1,200		970		1,100		460		1,100		540		1,200			
2,800		1,600		4,800		3,900		6,000		2,000		5,000		2,100		6,000			
20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	460	U
20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	460	U
20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	460	U
20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U	460	U
20	U	20	U	660		20	U	20	U	66		20	U	95		58		460	U
120		27		230		45		79		73		64		120		88		9,500	
34		20	UJ	20	U	20	U	48		20	UJ	37		84	J	52		8,300	
154		27		**890**		45		127		**139**		101		**299**		**198**		**17,800**	



Upland sample sites for storm drain solids in the West Diagonal storm drain basin (2155)

Drainage Basin			2155		2155		2155		2155		2155		2155
Station ID			CB1		CB11		CB2		CB3		CB81		M1
Type			CB		CB		CB		CB		CB		Inline
Sewer			CS		CS		SD		SD		SD		SD
Date	**LAET**	**LAET2**	**8/21/03**	**Q**	**1/23/04**	**Q**	**8/21/03**	**Q**	**9/5/03**	**Q**	**11/22/05**	**Q**	**1/25/02**
Conventionals													
Total Organic Carbon (%	—	—	7.8		6.2		26		0.47		11.6		0.379
Grain Size													
Gravel	—	—											
Very coarse sand	—	—											
Coarse Sand	—	—											
Medium Sand	—	—											
Fine Sand	—	—											
Very fine sand	—	—											
Coarse Silt	—	—											
Medium Silt	—	—											
Fine Silt	—	—											
Very fine silt	—	—											
8-9 Phi Clay	—	—											
9-10 Phi Clay	—	—											
> 10 Phi Clay	—	—											
Total Fines	—	—											
Metals in mg/kg DW													
Arsenic	57	93	10	U	40		40	U	6	U	30		12
Copper	390	390	161		325		**1,520**		30		**686**		39
Lead	450	530	125		445		**1,110**		10		**473**		37
Mercury	0.41	0.59	0.30		**0.68**		**0.50**		0.05	U	0.15		0.31
Zinc	410	960	**1,100**	J	**3,940**		**2,720**		55		**1,550**		250
LPAH in ug/kg DW													
Naphthalene	2100	2400	620	U	71	U	**9,500**		19	U	1,200	U	78
Acenaphthylene	1300	1300	620	U	71	U	**2,100**	U	19	U	1,200	U	78
Acenaphthene	500	730	**620**	U	71	U	**2,100**	U	19	U	**1,200**	U	91
Fluorene	540	1000	**620**	U	71	U	**2,300**		19	U	**720**	J	92
Phenanthrene	1500	5400	1,100		310		**7,600**		19	U	**2,000**		660
Anthracene	960	4400	620	U	71	U	**2,100**	U	19	U	**1,200**	U	150
Total LPAH	5200	1300	1100		310		**19400**		19	U	**2720**		993
HPAH in ug/kg DW													
Fluoranthene	1700	2500	1,600		610		**5,000**		19	U	1,700		820
Pyrene	2600	3300	1,200		580		**6,100**		19	U	1,700		630
Benzo(a)anthracene	1300	1600	620	U	200		**2,100**	U	19	U	1,200	U	340
Chrysene	1400	2800	710		480		**2,800**		19	U	1,200		380
Benzo(b)fluoranthene	—	—	1,900		360		6,800	Y	19	U	800	J	300
Benzo(k)fluoranthene	—	—	620	U	360		2,100	U	19	U	620	J	360
Benzofluoranthenes	3200	3600	1900		720		**6800**		19	U	1420	J	660
Benzo(a)pyrene	1600	3000	620	U	250		**2,200**	Y	19	U	1,200	U	330
Indeno(1,2,3-cd)pyrene	600	690	**1,100**		140		**3,900**	Y	19	U	**1,200**	U	160
Dibenz(a,h)anthracene	230	540	**630**		71	U	**2,100**	U	19	U	**1,200**	U	78
Benzo(g,h,i)perylene	670	720	620	U	160		**2,100**	U	19	U	620	J	140
Total HPAH	1200	1700	9040		**3860**		**33600**		19	U	**8060**		**4120**
Phthalate Esters in ug/kg DW													
Butylbenzylphthalate	63	900	**1,900**	J	**360**		**7,800**		20		**5,000**		**78**
bis(2-Ethylhexyl)phthalate	1300	1900	**19,000**	B	**6,200**		**200,000**	B	130		**91,000**		1,000
Phenols in ug/kg DW													
Phenol	420	1200	**650**		71	U	**5,700**		19	U	**1,200**	U	160
2,4-Dimethylphenol	29	29	**620**	U	**71**	U	**14,000**		19	U	**8,100**		**78**
Total Petroleum Hydrocarbons in ug/kg DW													
Diesel Range Organics	—	—			370	J	34,000		15		7,200		77
Oil Range Organics	—	—			2,100	J	71,000		52		26,000		420
PCBs in ug/kg DW													
Aroclor-1016	—	—	20	U	17	U	19	U	19	U	98	UJ	62
Aroclor-1221	—	—	39	U	17	U	38	U	39	U	98	UJ	62
Aroclor-1232	—	—	20	U	17	U	19	U	19	U	98	UJ	62
Aroclor-1242	—	—	20	U	17	U	19	U	19	U	98	UJ	62
Aroclor-1248	—	—	20	U	30		19	UJ	19	U	98	UJ	62
Aroclor-1254	—	—	160		130		210	UJ	19	U	430	J	62
Aroclor-1260	—	—	20	U	95	J	19	UJ	19	U	390	UJ	62
Total PCBs	130	1000	**160**		**255**	P	**210**	UJ	39	U	**430**	J	62

Notes:
LAET = lowest apparent effects threshold
2LAET = second lowest apparent effects threshold
Bold text indicates results that exceed either LAET or 2LAET values
Blank cells indicate parameter not analyzed
U = Analyte was not detected at or above the reported result
J = Estimated concentration
UJ = Analyte was not detected at or above the reported estimate
B = Analyte detected is sample and method blank

Q	2155 M2 Inline SD **1/25/02**	Q	2155 M3 Inline SD **1/28/02**	Q	2155 M4 Inline SD **1/25/02**	Q	2155 M5 Inline SD **1/28/02**	Q	2155 MH10 Inline SD **10/13/03**	Q	2155 MH11 Inline SD **10/13/03**	Q	2155 MH14 Inline SD **2/18/04**	Q	2155 MH15 Inline SD **2/18/04**	Q
	0.537		0.538		0.383		0.628		7.3		3.5		0.63		1.3	
U	13	U	12	U	12	U	12	U	10	U	8	U	7	U	6	U
	43		33		34		24		134		70.2		28.9	J	32.7	J
	140		33		18		47		318		117		119		15	
U	0.31	U	0.30	U	0.30	U	0.29	U	0.20		0.12		0.05	U	0.05	U
	240		200		170		280		**637**		334		119	J	155	J
U	78	U	79	U	78	U	77	U	1,700	U	99	U	78	U	79	U
U	78	U	79	U	78	U	77	U	**1,700**	U	99	U	78	U	79	U
	78	U	79	U	78	U	77	U	**1,700**	U	99	U	78	U	43	J
	78	U	79	U	78	U	77	U	**1,700**	U	99	U	78	U	53	J
	360		79	U	78	U	77	U	**4,000**		140		78	U	560	
	89		79	U	78	U	77	U	**1,700**	U	99	U	78	U	53	J
	449		79	U	78	U	77	U	**4000**		140		78	U	709	
	900		150		78	U	130		**4,100**		530		52	J	810	
	810		160		78	U	130		**4,200**		450		49	J	490	
	770		79	U	78	U	77	U	1,300	J	130		78	U	220	
	1,100		100		78	U	94		**2,300**		230		42	J	280	
	1,500		82		78	U	110		1,100	J	110		78	U	230	
	1,300		86		78	U	85		1,100	J	110		78	U	200	
	2800		168		78	U	195		2200	J	220		78	U	430	
	1,700		79	U	78	U	77	U	1,200	J	120		78	U	200	
	1,000		79	U	78	U	77	U	**1,700**	U	92	J	78	U	110	
U	210		79	U	78	U	77	U	**1,700**	U	99	U	78	U	79	U
	900		79	U	78	U	77	U	**1,700**	U	96	J	78	U	83	
	12990		746		78	U	744		**17500**		**2088**		143		**3053**	
U	**78**	U	**79**	U	**78**	U	**77**	U	**1,700**	U	**99**	U	**78**	U	**530**	
	5,100		670		330		710		**8,100**		580		390		630	
U	160	U	160	U	160	U	150	U	**1,700**	U	99	U	78	U	79	U
U	**180**		**79**	U	**78**		**77**	U	**1,700**	U	**99**	U	**78**	U	**79**	U
	63		82		37		28	U	7,300		120		62		85	
	560		420		360		470		9,100		260		380		390	
U	63	U	60	U	59	U	56	U	20	U	20	U	20	U	19	U
U	63	U	60	U	59	U	56	U	40	U	40	U	20	U	19	U
U	63	U	60	U	59	U	56	U	20	U	20	U	20	U	19	U
U	63	U	60	U	59	U	56	U	92	P	20	U	20	U	19	U
U	63	U	60	U	59	U	56	U	20	U	20	U	20	U	19	U
U	63	U	60	U	59	U	56	U	59		20	U	20	U	19	U
U	63	U	60	U	59	U	56	U	71		20	U	20	U	19	U
U	63	U	60	U	59	U	56	U	**222**	P	40	U	20	U	19	U

2155 MH17 Inline 11/25/08	Q	2155 MH17 Inline SD 2/20/04	Q	2155 MH18 Inline 11/25/08	Q	2155 MH18 Inline SD 2/20/04	Q	2155 MH19 Inline SD 7/30/04	Q	2155 RCB1 RCB 11/25/08	Q	2155 RCB1 RCB SD 2/2/04	Q	2155 RCB13 RCB SD 4/7/04	Q
2.4		4.1		3.43		9.5		3.76		14.7		10		9.63	
4.4				1.5						13.6					
12.6				1.9						16.9					
26				1.6						18.1					
39.1				5.2						17.8					
12.9				20.2						11.5					
1.6				28.3						6.2					
0				15.6						0					
0				8.6						0					
0				7.5						0					
0				6						0					
0				1.7						0					
0				0.7						0					
0				1.2						0					
3.4				41.3						15.9					
6	U	7	U	34		9		20	U	30	U	9		20	
109		94.9	J	387		152	J	340		162		112		172	
51		70	J	**461**		**538**	J	**752**		220		**1,370**		163	
0.06		0.08		**0.48**		**1.02**		**3.30**		0.2		**0.87**		0.17	
183		296	J	**534**		293	J	**718**		**1330**		364		**567**	
19	U	50	J	27	J	41	J	230	U	59	J	520		350	U
19	U	79	U	32	U	79	U	230	U	96	U	490	U	350	U
13	J	120		54		140		230	U	100		**770**		350	U
19	U	81		53		140		230	U	140		**1,500**		350	U
100		210		520		1,400		430		**2800**	0	**3,200**		**2,700**	
18	J	79	U	290		250		230	U	330		680		350	U
131		461		944		**1971**		430		**3429**		**6670**		**2700**	
200		470		**1800**		**2,100**		800		**6000**		**1,900**		**6,000**	
170		340		1500		1,600		900		**4700**		1,700		**2,900**	
73		110		840		750		340		**2400**		510		**1,500**	
110		200		880		950		510		**3400**		880		**2,500**	
87		180		950		740		240		3600		630		2,000	
82		120		820		840		400		2100		540		1,800	
169		300		1770		1580		640		**5700**		1170		**3800**	
77		130		860		730		380		**2800**		480	J	1,400	
29		60	J	280		280		230	U	**1200**		270	J	**670**	
19	U	79	U	100		79	U	230	U	**510**		**490**	U	**350**	U
37		61	J	270		230		230	U	**1200**		280	J	600	
1034		**1971**		**10070**		**9800**		**4210**		**33610**		**8360**		**23170**	
100		**73**	J	32	U	**230**		**230**	U	**1600**		**700**		**450**	
670		**2,500**		**3200**		**3,100**		**1,700**		**4900**		**46,000**		**17,000**	
19	U	79	U	22	J	170	U	230	U	96	U	**490**	U	390	
19	U	**79**	U	**32**	U	**7,500**	U	**230**	U	**96**	U	**490**	U	**350**	U
97		310		800		390				410		3,500		1,200	
560		1,500		2300		1,900				2500		4,000		7,800	
20	U	20	U	60	U	19	U	350	Y	20	U	19	U	20	U
20	U	20	U	60	U	19	U	69	U	20	U	19	U	20	U
20	U	20	U	60	U	19	U	1,000	Y	20	U	19	U	20	U
20	U	20	U	60	U	19	U	1,000	Y	20	U	19	U	20	U
20	U	20	U	150		290	Y	480	Y	20	U	240		35	
20	U	20	U	200		180		1,000	Y	20	U	280		77	
20	U	20	U	110		73		480	Y	20	U	150		49	
20	U	20	U	**460**		**253**		**1,000**	Y	20	U	**670**		**161**	

2155		2155		2155		2155		2155		2155		2155		2155	
RCB16		RCB17		RCB19		RCB21		RCB33		RCB34		RCB35		RCB36	
RCB		RCB		RCB		RCB		RCB		RCB		RCB		RCB	
SD		SD		SD		CS		SD		SD		SD		SD	
4/7/04	**Q**	**4/16/04**	**Q**	**4/16/04**	**Q**	**4/16/04**	**Q**	**6/30/04**	**Q**	**6/30/04**	**Q**	**6/30/04**	**Q**	**6/30/04**	**Q**
7.09		7.6		4.32		6.11		2.37		10.5		9.55		9.57	
12		9		7	U	7	U	10	U	8	U	8	U	15	
154		137		71.9		38.4		149	J	134		120		**751**	
105		146		64		39		60	J	89		193		152	
0.19		0.15		0.05	U	0.07	U	0.06	U	0.08		0.10		**1.17**	
698		**534**		252		132		**674**		**488**		358		**505**	
210	U	240	U	120	U	120	U	29	U	150	U	97	U	320	
210	U	240	U	120	U	120	U	29	U	150	U	97	U	160	U
210	U	240	U	120	U	120	U	29	U	150	U	97	U	160	U
210	U	260		120	U	120	U	29	U	150	U	170		260	
1,100		**2,800**		460		140		150		850		**1,600**		1,400	
210	U	400		120	U	120	U	29	U	150	U	220		200	
1100		**3460**		460		140		150		850		**1990**		**2180**	
2,100		**5,500**		600		220		310		1,400		**2,700**		1,500	
1,300		**4,600**		550		250		300		1,000		2,000		900	
460		**1,700**		170		120	U	120		360		660		280	
1,100		**3,100**		310		160		170		680		1,300		540	
610		2,000		130		120	U	190		670		1,700		700	
610		2,000		130		120	U	160		510		1,100		560	
1220		**4000**		260		120	U	350		1180		2800		1260	
360		**2,200**		140		120	U	140		380		820		350	
210	U	**1,300**		120	U	120	U	74		150	U	360		160	U
210	U	**590**		120	U	120	U	29	U	150	U	97	U	160	U
290		**1,300**		120	J	120	U	83		160		280		170	
8050		**28290**		**2410**		630		**1897**		**6340**		**13720**		**6260**	
870		**2,100**		**970**		**180**		**210**		**290**		**700**		**37,000**	
14,000		**12,000**		**5,900**		**4,300**		740		**16,000**		**8,000**		**48,000**	
210	U	240	U	120	U	120	U	29	U	**150**	U	120		**640**	
210	U	**240**	U	**120**	U	**120**	U	29	U	150	U	**97**	U	**160**	U
1,400		1,400		470		390		190		1,200		420		1,800	
8,000		7,200		2,600		2,500		1,100		6,100		2,100		6,000	
20	U	19	U	19	U	19	U	19	U	19	U	20	U	77	Y
20	U	19	U	19	U	19	U	19	U	19	U	20	U	39	Y
20	U	19	U	19	U	19	U	19	U	19	U	20	U	190	Y
20	U	19	U	19	U	19	U	19	U	19	U	20	U	190	Y
73		91		19	U	19	U	19	U	27		40		96	Y
130		79		39		19	U	29		48		63		290	Y
90		61		25		19	U	24		39		39		120	Y
293		**231**		64		19	U	53		114		**142**		**290**	Y

2155 RCB36 RCB **11/25/08**	**Q**	2155 RCB51 RCB SD **3/2/06**	**Q**	2155 RCBSTEV1 RCB SD **8/31/04**	**Q**	2155 RCBSTEV2 RCB SD **8/31/04**	**Q**	2155 RCBSTEV4 RCB SD **8/31/04**	**Q**	2155 ST1-040908G Inline SD **4/9/08**	**Q**	2155 ST1-1 Trap SD **8/18/03**	**Q**	2155 ST1-2 Trap SD **2/18/04**	**Q**
5.29		15	J							3.51		17		10	
16.9															
15.8															
23															
22.7															
11															
4.3															
2.8															
1.3															
1.2															
0.6															
0.2															
0.1															
0.1															
6.3															
20	U	10								6	U	10	U	10	U
126		166								51.5		298		120	
46		412								29		244		121	
0.26		0.20								0.05	U	0.30		0.20	
292		**966**								250		**1,050**		**445**	
110		1,600	U							22	U	1,800	U	98	U
38	U	**1,600**	U							19	U	**1,800**	U	98	U
72		**1,600**	U							19	U	**1,800**	U	55	J
520		**1,600**	U							19	U	**1,800**	U	77	J
2000		**1,700**								36		**3,200**		590	U
3000		**1,600**	U							19	U	**1,800**	U	75	J
5702		**1700**								36		**3200**		207	
1700		**3,800**								86		**5,900**		1,100	
1100		**3,200**								120		**5,500**		950	
300		1,300	J							31		**1,800**	U	340	
1200		**2,300**								58		**3,100**		610	
470		1,800	J							39		2,400		630	
610		1,400	J							39		2,300		340	
1080		3200	J							78		**4700**		970	
700		1,400	J							34		**1,900**		370	
190		**920**	J							16	U	**1,800**	U	170	
54		**1,600**	U							19	U	**1,800**	U	98	U
240		**1,200**	J							19		**1,800**	U	160	
7644		**20520**								426		**21100**		**4670**	
1600		**1,300**	J							44	U	**2,900**		**390**	
14000		**20,000**								930		**67,000**		**8,700**	
440		**1,600**	U							34	U	**1,800**	U	290	0
38	U	**1,600**	U							**69**		**1,800**	U	**98**	U
650		2,300								140		620			
2700		12,000								710		1,100			
20	U	20	U	1,600	U	420	U	1,100	U	19	U	20	U	20	U
20	U	20	U	1,600	U	420	U	1,100	U	19	U	40	U	20	U
20	U	20	U	1,600	U	420	U	1,100	U	19	U	20	U	20	U
20	U	89	Y	1,600	U	420	U	1,100	U	19		20	U	20	U
39	Y	79	Y	1,600	U	420	U	1,100	U	19	U	20	U	20	U
68		350	J	9,000		1,500		12,000		19	J	85		240	
33		120	Y	8,000		1,100		11,000		19	U	20	U	630	
101		**350**	J	**17,000**		**2,600**		**23,000**		19	J	85		**870**	

2155		2155		2155		2155		2155	ST1-	2155		2155		2155	
ST1-3		ST1-4		ST1-5		ST1-6		ST1-7		ST1-8		ST1-9		ST1-grab1	
Trap		Trap		Trap		Trap		Trap		Trap		Trap		Inline	
SD		SD		SD		SD		SD		SD		SD		SD	
7/30/04	**Q**	**3/14/05**	**Q**	**11/7/05**	**Q**	**3/28/06**	**Q**	**9/5/06**	**Q**	**3/22/07**	**Q**	**8/22/07**	**Q**	**3/31/06**	**Q**
7.81		8.17		12.5		10.4		6.97		5.84		15.5		1.17	
20	U	10		12		12		20		7	U	10		5	U
215		144		181		116		196		89.8		160		36.4	
160		126		164		97		154		72		124		105	
0.20		0.27		0.24		0.17		0.30		0.11		0.28		0.05	U
638		**435**		**682**		400		**683**		282		**620**		150	
200	U	61	U	410	U	680	U	450	U	92	UJ	150	U	120	U
200	U	61	U	410	U	680	U	450	U	92	UJ	150	U	120	U
200	U	61	U	240	J	**680**	U	450	U	92	UJ	150	U	120	U
200	U	61	U	270	J	**680**	U	450	U	92	UJ	150	U	120	U
1,700		90		**2,200**		**2,100**		1,000		390	J	440		77	J
220		61	U	350	J	490	J	450		87	J	150	U	120	U
1920		90		**3060**		**2590**		**1450**		477	J	440		77	J
2,300		190		**4,600**		**2,300**		**2,000**		740	J	900		110	J
2,400		150		**3,900**		1,800		1,600		430	J	860		140	
830		59	J	**1,700**		860		590		250	J	270		120	U
1,800		100		**2,600**		1,100		1,200		390	J	550		64	J
1,200		44	J	4,400		610	J	890		260	J	500		120	U
1,200		85		2,800		710		820		260	J	430		120	U
2400		129		**7200**		1320		1710		520	J	930		120	U
1,000		60	J	**2,400**		690		790		230	J	310		120	U
660		50	J	520		430		450	U	79	J	150	U	120	U
220		61	U	**410**	U	**680**	U	**450**	U	92	UJ	150	U	120	U
710		62		580		570	J	**720**		110	J	170		120	U
12320		800		**23500**		**9070**		**8610**		**2841**	J	**3990**		314	
1,800		61	U	**1,200**		**680**	U	**450**	U	**130**	J	**370**		**120**	U
23,000		1,000	B	**33,000**		**8,900**		**22,000**	B	**4,900**	J	**12,000**		330	
200	U	91	B	410	U	**680**	U	**450**	U	140	UJ	**1,100**		120	U
200	U	**61**	U	**410**	U	**680**	U	**450**	U	**92**	UJ	**150**	U	**120**	U
840		94		1,500		1,300		1,100		560		1,300		220	
3,200		380		5,700		5,400		5,300		2,100		7,000		810	
20	U	20	U	99	U	20	U	120	Y	20	U	20	U	19	U
20	U	20	U	99	U	20	U	39	Y	20	U	20	U	19	U
20	U	20	U	99	U	20	U	160	Y	20	U	20	U	19	U
20	U	20	U	99	U	63		120	Y	20	U	20	U	19	U
20	U	72	Y	99	U	20	U	120	Y	53	Y	64	U	19	U
66		200		370		140		310		83		92		19	U
81		190		150		69		230		66	J	79		19	U
147		**390**		**520**		**272**		**540**		**149**		**171**		19	U

2155 ST1-grab2 Inline SD **9/6/06**	**Q**	2155 ST1-grab3 Inline SD **3/22/07**	**Q**	2155 ST1-grab4 Inline SD **8/13/07**	**Q**	2155 ST2-040908g Inline SD **4/9/08**	**Q**	2155 ST2-1 Trap SD **8/18/03**	**Q**	2155 ST2-3 Trap SD **8/5/04**	**Q**	2155 ST2-4 Trap SD **3/9/05**	**Q**	2155 ST2-5 Trap SD **8/26/05**	**Q**
1.2		1.64		3.3		1.03		4.5		7.46		8.42		7.2	
6	U	6	U	6	U	10	U	7	U	10	U	9	U	10	U
51.2		45		43.6		191		89.9		136		93.2		**597**	
28		24		22		63		76		41		111		123	
0.05	U	0.04	U	0.05	U	0.05	U	0.06	U	0.10	U	0.08	U	0.10	U
169		227		161		168		282		184		465		**874**	
33	U	20	U	100	U	20	U	79	U	68	U	170	U	59	U
33	U	20	U	100	U	20	U	79	U	68	U	180	U	59	U
45		40		100		20	U	79	U	68	U	**800**		59	U
57	U	54	U	100	U	20	U	96		68	U	**730**		59	U
620		81		170		17		**1,600**		1,300		**7,000**		260	
160		200		100		20	U	290		180		**1,900**		75	U
825		321		370		17		**1986**		**1480**		**10430**		260	
1,000		**2,600**		330		38		**2,700**		**2,000**		**12,000**		520	
710		1,200		240		37		2,400		1,600		**8,500**		410	
360		780		100		13		1,100		730		**4,700**		190	
430		1,000		150		31		1,300		1,100		**5,600**		220	
350		920		100		26		1,800		790		4,100		150	
310		1,000		160		23		1,800		790		2,700		200	
660		1920		260		49		**3600**		1580		**6800**		350	
360		850		100		17		1,100		720		**3,800**		130	
150		130		100		20	U	230		410		**2,000**		59	U
79		26		100		20	U	79	U	68	U	**440**		59	U
150		140		100		11		150		360		**1,900**		59	U
3899		**8646**		**1480**		196		**12580**		**8500**		**45740**		**1820**	
33	U	**640**	U	**100**	U	14	U	**1,200**		**68**	U	**660**		59	U
820		920		**1,600**		1,100		**18,000**		**8,400**		**9,900**		820	
33	0	20	U	100	U	20	U	79	U	240		180	U	59	U
33	0	20	U	**100**	U	20		**79**	U	**68**	U	**180**	U	**59**	U
85		240		180		67		88		32		52		760	
400		1,500		1,000		490		230		120		290		1,300	
39	Y	20	Y	20	Y	20	U	24	U	20	U	20	U	19	U
19	U	20	U	20	U	20	U	49	U	20	U	20	U	19	U
19	U	20	U	20	U	20	U	24	U	20	U	20	U	19	U
19	U	20	U	110		20		24	U	20	U	20	U	19	U
19	J	20	U	20	U	20	U	24	U	20	U	75		35	
29		25		38		20	J	96		22		80		79	
19	U	20	Y	22		20	U	24	U	20	U	93	Y	37	Y
48	J	25		**170**		20	J	96		22		**155**		114	

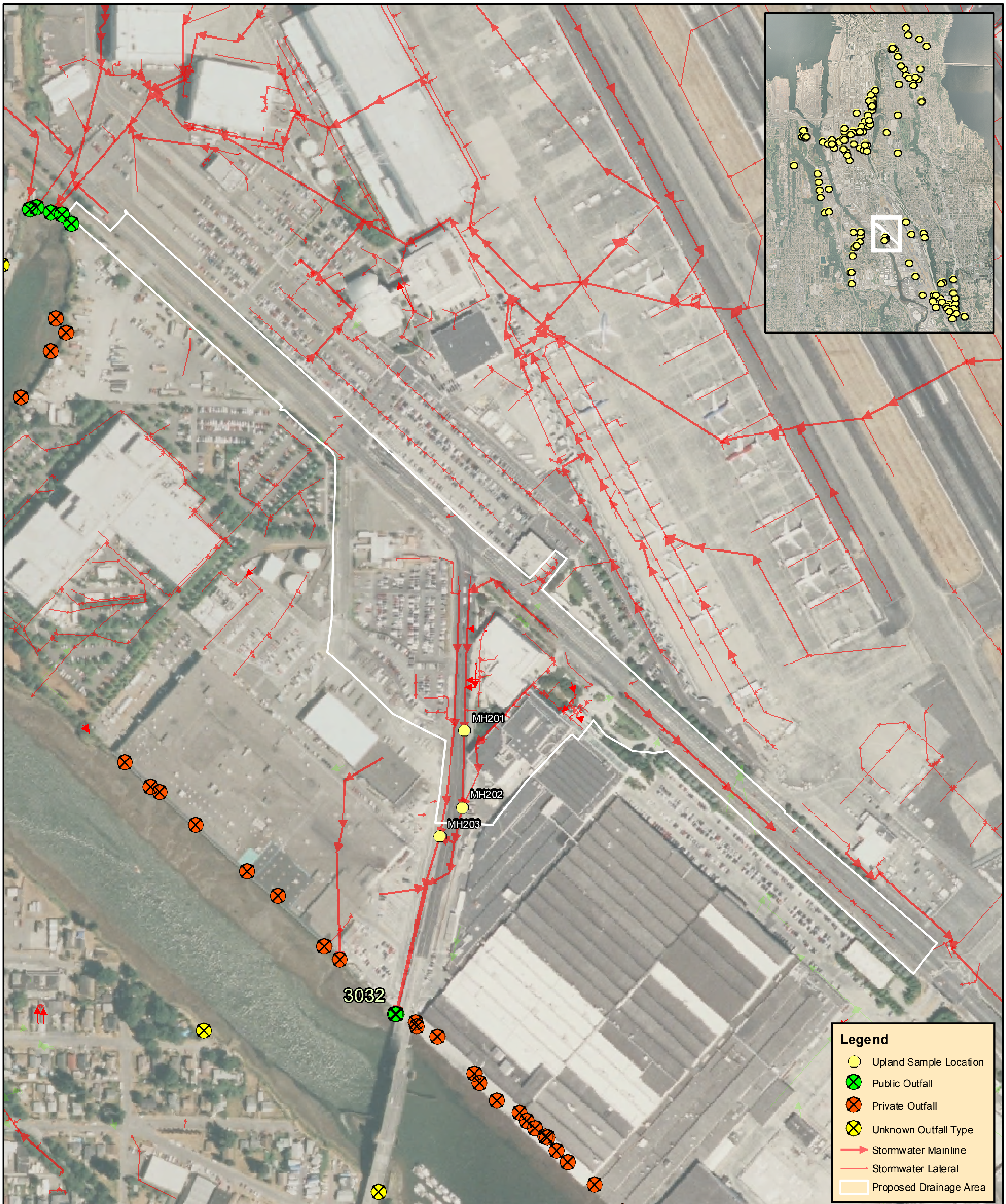
2155 ST2-6 Trap SD **3/28/06**	**Q**	2155 ST2A-2 Trap SD **3/11/04**	**Q**	2155 ST2B-2 Trap SD **3/11/04**	**Q**	2155 ST2-grab1 Inline SD **8/21/03**	**Q**	2155 ST2-grab2 Inline SD **8/26/05**	**Q**	2155 ST2-grab3 Inline SD **3/28/06**	**Q**	2155 ST2-grab4 Inline SD **9/5/06**	**Q**	2155 ST2-grab5 Inline SD **3/22/07**	**Q**
9.98		4.6		3.5		2.1		2.46		1.2		1.49		0.639	
11		50	U	8	U	30	U	20	U	10	U	20	U	6	U
100		146		34.1		78		64.6		54.7		66.3		22.4	
92		210		39		100		30		117		45		41	
0.07		0.40	U	0.07	U	0.02	U	0.07	U	0.05	U	0.05	U	0.05	U
428		**735**		162		159		151		**480**		364		93	
280	U	220	U	89	U	39	U	59	U	59	U	33	U	20	U
280	U	220	U	89	U	39	U	59	U	59	U	33	U	20	U
280	U	220	U	89	U	39	U	59	U	59	U	33	U	20	U
280	U	220	U	89	U	39	U	59	U	59	U	33	U	20	U
640		1,000		410		130		260		74		82		32	
280	U	220	U	89	U	39	U	75	U	59	U	33	U	20	U
640		1000		410		130		260		74		82		32	
1,200		**3,000**		890		200		520		92		160		71	
830		1,400		450		220		410		85		130		47	
440		850		290		96		190		36	J	63		25	
700		1,400		430		130		220		60		96		40	
540		1,100		330		120		150		34	J	82		47	
350		1,100		300		100		200		59	U	55		32	
890		2200		630		220		350		34	J	137		79	
460		940		320		94		130		59	U	64		22	
200	J	440		210		41		59	U	59	U	33	U	20	U
280	U	220	U	89	U	39	U	59	U	59	U	33	U	20	U
230	J	460		180		39	U	59	U	31	J	49		20	
4950		**10690**		**3400**		1001		**1820**		338		699		304	
260	J	**480**		**140**		39	U	59	U	59	U	33	U	42	U
7,500		**13,000**		**1,400**		**2,800**		820		380		750		550	
280	U	220	U	89	U	160		59	0	59	U	33	0	20	U
280	U	**220**	U	**89**	U	**790**		**440**		**59**	U	**33**	0	20	0
600		370		87	U	50		890		75		55		77	
3,300		2,400		570		110		1,400		440		410		520	
20	U	20	U	20	U	19	U	19	U	19	U	20	U	19	U
98	U	20	U	20	U	38	U	19	U	19	U	20	U	19	U
98	U	20	U	20	U	19	U	19	U	19	U	20	U	19	U
20	U	20	U	20	U	19	U	19	U	19	U	29		19	
750		68	P	60	P	19	U	19	U	19	U	20	U	19	U
260		45		21	J	36		19	U	19	U	20	U	19	U
110		31		14	J	19	U	19	U	19	U	20	U	19	U
1,120		**144**	P	95	PJ	36		19	U	19	U	29		19	

2155 ST2-grab6 Inline SD **8/22/07**	**Q**	2155 ST3-1 Trap SD **8/18/03**	**Q**	2155 ST3-2 Trap SD **3/11/04**	**Q**	2155 ST3-4 Trap SD **3/14/05**	**Q**	2155 ST5-1 Trap SD **8/18/03**	**Q**	2155 ST5-4 Trap SD **3/10/05**	**Q**	2155 ST5-5 Trap SD **8/26/05**	**Q**	2155 ST6-1 Trap SD **8/21/03**	**Q**
0.528		6.7		1.8		8.28		13		1.97		16.6		12	
6	U	9	U	7	U	10	U	6	U	14		50	U	8	U
26.5		138		68.8		164		136		32.5		**532**		231	
20		128		102		156		175		29		360		200	
0.05	U	0.07		0.07	U	0.20		0.10		0.05	U	**2.80**		0.25	
90		**653**		**433**		**662**		**479**		164		**1,930**		**944**	
60	U	580		76	U	470	U	160	U	60	U			1,100	U
60	U	140	U	76	U	470	U	160	U	60	U			1,100	U
60	U	140	U	76	U	470	U	160	U	60	U			**1,100**	U
60	U	140	U	76	U	470	U	160	U	60	U			**1,100**	U
140		1,100		200		**2,600**		520		180				**5,900**	
60	U	200		76	U	470	U	160	U	60	U			**1,100**	U
140		**1880**		200		**2600**		520		180				**5900**	
320		1,600		390		**3,900**		990		350				**9,100**	
180		1,600		190		2,400		870		220				**8,200**	
95		730		110		690		350		100				**3,200**	
130		1,000		200		**1,500**		580		170				**5,000**	
130		420		120		860		730		100				4,700	
81		350		120		950		500		140				4,700	
211		770		240		1810		1230		240				**9400**	
98		140	U	110		840		470		110				**3,400**	
60	U	140	U	74	J	600		460		52	J			**1,900**	
60	U	140	U	76	U	**470**	U	160	U	60				**1,100**	U
60		140	U	83		640		290		54	J			**1,700**	
1094		**5700**		**1397**		**12380**		**5240**		**1356**				**41900**	
60	U	**2,000**		**120**		**1,000**		**410**		**200**				**3,400**	
480		**15,000**		**4,600**		**16,000**		**8,900**		1,100				**42,000**	
60	U	150	U	76	U	**470**	U	160	U	60	U			**1,100**	U
60	U	**140**	U	**76**	U	**470**	U	**160**	U	**60**	U			**1,100**	U
63		560		380		140		600		140		1,800			
420		1,400		1,200		640		1,200		750		7,300			
20	U	20	U	20	U	20	U	20	U	20	U	20	U	19	U
20	U	39	U	20	U	20	U	39	U	20	U	20	U	38	U
20	U	20	U	20	U	20	U	20	U	20	U	59	Y	19	U
20		20	U	20	U	20	U	20	U	20	U	40	Y	19	U
20	U	20	U	20	U	58	Y	20	U	64		59	Y	19	U
20	U	130		50		20	U	130		20	U	420		84	
20	U	20	U	23	J	20	U	20	U	20	U	40	Y	19	U
20		130		73	J	58	Y	130		64		**420**		84	

2155 ST6-4 Trap SD **3/11/05**	**Q**	2155 ST6-5 Trap SD **8/26/05**	**Q**	2155 ST7-2 Trap SD **2/18/04**	**Q**	2155 ST7-5 Trap SD **11/7/05**	**Q**	2155 ST7-6 Trap SD **3/28/06**	**Q**	2155 ST7-7 Trap SD **9/5/06**	**Q**	2155 ST7-grab1 Inline SD **9/5/06**	**Q**	2155 ST7-grab2 Inline SD **8/13/07**	**Q**
11.3		12.4		6.9		15.1		6.59		6.89		0.818		3.22	
10	U	20	U	9		8	U	7		8	U	20	U	6	U
100		182		6.6		89.9		91.2		102		77.5		40	
122		248		61		99		35		82		32		28	
0.13		0.20		0.06	U	0.10		0.05	U	0.09		0.05	U	0.05	U
399		**1,090**		262		400		255		387		271		163	
220	U	400	U	78	U	290	U	590	U	360	U	40	U	110	U
220	U	400	U	78	U	290	U	590	U	360	U	40	U	110	U
200	J	490		42	J	290	U	**590**	U	360	U	40	U	110	U
320		**960**		65	J	**2,900**	U	**590**	U	360	U	40	U	110	U
4,800		**16,000**		270		590		590	U	640		97		250	
720		**1,900**		78	U	290	U	590	U	360	U	40	U	110	U
6040		**19350**		377		590		590	U	640		97		250	
10,000		**30,000**		400		1,300		360	J	1,600		190		500	
6,300		**24,000**		290		900		360	J	940		140		320	
2,900		**10,000**		120		350		590	U	410		53		140	
4,000		**15,000**		190		640		590	U	650		99		240	
4,300		17,000		150		750		590	U	450		76		230	
3,000		15,000		140		540		590	U	410		51		130	
7300		**32000**		290		1290		590	U	860		127		360	
3,100		**10,000**		120		450		590	U	360		65		150	
1,400		**3,200**		68	J	290	U	590	U	360	U	40	U	110	U
310		**780**		78	U	**290**	U	**590**	U	**360**	U	40	U	110	U
1,100		**2,600**		71	J	290	U	590	U	360	U	47		110	
36410		**127580**		**1549**		**4930**		720	J	**4820**		721		**1820**	
1,000		**520**		**240**		**450**		**1,100**		**460**		40	U	**1,200**	U
13,000		**14,000**		**2,400**		**11,000**		**2,100**		**13,000**	B	1,200		**2,500**	
220	U	400	U	60	J	290	U	**1,000**		360	U	45	U	110	U
220	U	**400**	U	**78**	U	**290**	U	**590**	U	**360**	U	**490**		**110**	
140		1,200				1,900		450		480		94		250	
680		4,000				7,500		1,900		2,800		620		1,200	
20	U	19	U	19	U	97	U	20	U	48	Y	20	U	19	U
20	Y	19	U	19	U	97	U	20	U	19	U	20	U	19	U
20	Y	38	Y	19	U	97	U	20	U	77	Y	20	U	19	U
20	U	19	U	19	U	97	U	22	J	58	Y	48		19	
20	U	38	Y	19	U	97	U	20	U	58	Y	20	U	19	U
54	Y	94	P	98		180		190		140		19	J	25	J
160	Y	28	Y	19	U	97	U	230		80		20	U	29	U
160	Y	94	P	98		**180**		**442**	J	**220**		67	J	25	J

2155		2155		2155		2155		2155		2155		2155		2155	
T2A		T2b		T3a		T6b		T8b		TUL-CB1		TUL-CB2		TUL-CB3	
Inline		Inline		Inline		Inline		Inline		CB		CB		CB	
		SD		SD		SD		SD		SD		SD		SD	
11/25/08	**Q**	**2/28/02**	**Q**	**2/28/02**	**Q**	**2/28/02**	**Q**	**2/28/02**	**Q**	**1/9/08**	**Q**	**1/9/08**	**Q**	**1/9/08**	**Q**
5.27		2.64		7.33		5.7		1.98							
3.6															
5.3															
8.7															
12.4															
7															
4.9															
5.5															
13.1															
17.1															
11.4															
4.1															
3.1															
3.8															
58.1															
10		12		16	U	23		14	U						
158		30		81		280		94							
83		16		130		200		100							
0.15		0.30	U	0.40	U	**0.58**	U	0.36	U						
337		85		230		**460**		**580**							
34	U	110	U	290	U	230	U	98	U						
34	U	110	U	290	U	230	U	98	U						
34	U	110	U	290	U	230	U	98	U						
34	U	110	U	290	U	230	U	98	U						
77		470		910		790		490							
34	U	110	U	290	U	230	U	98	U						
77		470		910		790		490							
190		1,300		1,400		1,600		1,200							
200		810		1,400		980		680							
52		300		530		490		400							
160		590		880		810		590							
94		630		1,000		780		570							
130		410		840		660		630							
224		1040		1840		1440		1200							
86		410		670		550		470							
45		170		370		230	U	150							
34	U	110	U	**290**	U	230	U	98	U						
77		190		440		230	U	150							
1034		**4810**		**7530**		**5870**		**4840**							
95		**110**	U	**600**		**900**		**100**							
6500		**3,800**		**8,900**		**5,300**		**5,500**							
34	U	230	U	**570**	U	**470**	U	200	U						
34	U	**230**	U	**290**	U	**230**	U	**98**	U						
390		680		6,300		180	U	170	U						
1900		2,700		9,100		13,000		2,300							
20	U	79	U	120	U	72	U	67	U	580	U	110	U	24,000	U
20	U	79	U	120	U	72	U	67	U	580	U	110	U	24,000	U
20	U	79	U	120	U	72	U	67	U	580	U	110	U	24,000	U
20	U	79	U	120	U	72	U	67	U	580	U	110	U	24,000	U
20	U	79	U	120	U	370		67	U	580	U	110	U	24,000	U
34		620		220		72	U	67	U	10,000		4,800		110,000	
20	U	320		160		110		67	U	7,100		3,600		79,000	
34		**940**		**380**		**480**		67	U	**17,100**		**8,400**		**189,000**	

3032 MH201 Inline		3032 MH202 Inline		3032 MH203 Inline	
11/17/08	**Q**	**11/17/08**	**Q**	**11/17/08**	**Q**
5.82		9.79		7.81	
8		9		7.2	
6.5		10.7		13.3	
10.1		15.3		19.7	
20.9		25		19.4	
19.6		17.5		13.8	
11.9		8.7		10.7	
8.6		5.4		5.4	
5.3		3.6		3.2	
4.4		2.5		3.7	
2.8		1.4		2.4	
1.2		0.5		0.6	
0.5		0.1		0.2	
0.2		0.3		0.3	
23		13.8		15.8	
10		9.2		8	U
158		158		111	
281		260		116	
7.7		0.12		0.11	
1020		**1640**		**562**	
100	U	120	U	170	U
100	U	120	U	170	U
100	U	120	U	170	U
100	U	120	U	170	U
350		470		640	
100	U	120	U	170	U
350		470		640	
810		800		1500	
650		700		1300	
320		300		500	
450		510		770	
330		430		650	
480		410		760	
810		840		1410	
390		360		560	
210		170		260	
100	U	120	U	170	U
290		240		350	
3930		**3920**		**6650**	
480		**370**		**2600**	
13000		**44000**		**8300**	
410		**3500**		360	
100	U	**120**	U	**170**	U
220		330		780	
1400		1600		3900	
20	U	19	U	20	U
20	U	19	U	20	U
20	U	19	U	20	U
20	U	19	U	20	U
20	U	75		41	
71		100		82	
170		120		59	
241		**295**		**182**	



Upland sample sites for storm drain solids in the 16th Ave S. storm drain basin (3032)

N

1 inch = 400 feet

0 250 500 1,000 Feet

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Drainage Basin			3032		3032		3032	
Station ID			MH201		MH202		MH203	
Type			Inline		Inline		Inline	
Sewer								
Date	**LAET**	**LAET2**	**11/17/08**	**Q**	**11/17/08**	**Q**	**11/17/08**	**Q**
Conventionals								
Total Organic Carbon (% DW)	—	—	5.82		9.79		7.81	
Grain Size								
Gravel	—	—	8		9		7.2	
Very coarse sand	—	—	6.5		10.7		13.3	
Coarse Sand	—	—	10.1		15.3		19.7	
Medium Sand	—	—	20.9		25		19.4	
Fine Sand	—	—	19.6		17.5		13.8	
Very fine sand	—	—	11.9		8.7		10.7	
Coarse Silt	—	—	8.6		5.4		5.4	
Medium Silt	—	—	5.3		3.6		3.2	
Fine Silt	—	—	4.4		2.5		3.7	
Very fine silt	—	—	2.8		1.4		2.4	
8-9 Phi Clay	—	—	1.2		0.5		0.6	
9-10 Phi Clay	—	—	0.5		0.1		0.2	
> 10 Phi Clay	—	—	0.2		0.3		0.3	
Total Fines	—	—	23		13.8		15.8	
Metals in mg/kg DW								
Arsenic	57	93	10		9.2		8	U
Copper	390	390	158		158		111	
Lead	450	530	281		260		116	
Mercury	0.41	0.59	**7.7**		0.12		0.11	
Zinc	410	960	**1020**		**1640**		**562**	
LPAH in ug/kg DW								
Naphthalene	2100	2400	100	U	120	U	170	U
Acenaphthylene	1300	1300	100	U	120	U	170	U
Acenaphthene	500	730	100	U	120	U	170	U
Fluorene	540	1000	100	U	120	U	170	U
Phenanthrene	1500	5400	350		470		640	
Anthracene	960	4400	100	U	120	U	170	U
Total LPAH	5200	1300	350		470		640	
HPAH in ug/kg DW								
Fluoranthene	1700	2500	810		800		1500	
Pyrene	2600	3300	650		700		1300	
Benzo(a)anthracene	1300	1600	320		300		500	
Chrysene	1400	2800	450		510		770	
Benzo(b)fluoranthene	—	—	330		430		650	
Benzo(k)fluoranthene	—	—	480		410		760	
Benzofluoranthenes	3200	3600	810		840		1410	
Benzo(a)pyrene	1600	3000	390		360		560	
Indeno(1,2,3-cd)pyrene	600	690	210		170		260	
Dibenz(a,h)anthracene	230	540	100	U	120	U	170	U
Benzo(g,h,i)perylene	670	720	290		240		350	
Total HPAH	1200	1700	**3930**		**3920**		**6650**	

Phthalate Esters in ug/kg DW								
Butylbenzylphthalate	63	900	**480**		**370**		**2600**	
bis(2-Ethylhexyl)phthalate	1300	1900	**13000**		**44000**		**8300**	
Phenols in ug/kg DW								
Phenol	420	1200	410		**3500**		360	
2,4-Dimethylphenol	29	29	**100**	U	**120**	U	**170**	U
Total Petroleum Hydrocarbons in ug/kg DW								
Diesel Range Organics	—	—	220		330		780	
Oil Range Organics	—	—	1400		1600		3900	
PCBs in ug/kg DW								
Aroclor-1016	—	—	20	U	19	U	20	U
Aroclor-1221	—	—	20	U	19	U	20	U
Aroclor-1232	—	—	20	U	19	U	20	U
Aroclor-1242	—	—	20	U	19	U	20	U
Aroclor-1248	—	—	20	U	75		41	
Aroclor-1254	—	—	71		100		82	
Aroclor-1260	—	—	170		120		59	
Total PCBs	130	1000	**241**		**295**		**182**	

Notes:
LAET = lowest apparent effects threshold
2LAET = second lowest apparent effects threshold
Bold text indicates results that exceed either LAET or 2LAET values
Blank cells indicate parameter not analyzed
U = Analyte was not detected at or above the reported result
J = Estimated concentration
UJ = Analyte was not detected at or above the reported estimate
B = Analyte detected is sample and method blank