# Annual Stormwater Monitoring Report

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for

## Seattle-Tacoma International Airport

for the period July 1, 1998 through June 30, 1999



September 1999

Exh 428

AR 022516

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#### **1 EXECUTIVE SUMMARY**

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This Annual Stormwater Monitoring Report has been prepared pursuant to the NPDES permit for the Port of Seattle's Seattle-Tacoma International Airport (STIA). The Port took a total of 96 grab and 66 composite stormwater samples in the past year, bringing the 5-year totals to over 300 samples. A total of 23 storms were sampled, about two thirds of the total number occurring that met monitoring criteria. The Port complied with all sampling and reporting requirements.

In summary, STIA stormwater quality, especially airfield runoff continues to have pollutant concentrations lower than comparable regional studies. Results continue to demonstrate that typical constituent concentrations in airfield outfall discharges are much lower than from the landside subbasin outfalls. This difference is most likely due to the runoff from high vehicular use areas, including public roadways in the landside subbasins. Nonetheless, overall STIA results are generally lower than results from other studies for roadways and commercial areas.

Whole effluent toxicity (WET) testing was performed at four outfalls. Toxic conditions were not found in the stormwater discharges sampled at outfalls SDE4, SDS3, and SDN4. These results met performance standards for WET according to Ecology guidelines. Results from outfall SDN1 indicated conditions that warranted further investigation. Testing revealed that uncoated, galvanized metal rooftops are the most likely source of toxicity. This problem will be rectified and follow-on monitoring will verify the effectiveness. The Port submitted the required WET testing reports to Ecology. The final summary report will be submitted by mid November 1999.

Several drainage system improvements included adding a berm to prevent track-out of the rental canvash water from entering SDE4 and covering three drain inlets with solid lids to eliminate a small area of ramp drainage to SDS3 near the C-Concourse. Investigations also led to the identification of drainage connections that may require improvements, including a loading dock drain in SDN1 and a clogged IWS drain inlet that may overflow to the SDS3 storm drainage system.

Based on sampling results the following suggestions are recommended.

- Petition Ecology to eliminate sampling at outfalls SDS1 (003) and SDN2 (007) as allowed for in permit condition S2.B.4. The Port has satisfied the minimum number of sampling events at these two outfalls where the data verify the achievements of previous BMPs.
- 2. Continue to investigate possible sources of fecal coliforms in SDE4 discharges.
- 3. Investigate potential sources of stormwater contamination in subbasin SDS1,

- 4. Modify the SWPPP to address appropriate resolution of the following items:
  - an IWS drain inlet drainage backs up at structure IWS-563 near C-Concourse gate C8.
     Overflow from this inlet appears to drain to the next IWS slot drain, but may escape to the nearby and contiguous SDS3 subbasin, and
  - a loading dock drain that connects to the SDN1 system.

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The STIA stormwater monitoring program has been in place since 1993 pursuant to the National Pollutant Discharge Elimination System (NPDES) permit. The first permit was renewed and reissued on February 20, 1998, becoming effective March 1, 1998 (permit number WA-702465-1.) In early 1999, a major permit modification issued by Ecology reduced sampling frequency based upon a permit appeal settlement (WDOE 1999.)

The Port conducts the required monitoring activities according to the specific guidelines and criteria of the Procedure Manual for Stormwater Monitoring (POS, 1999a). This report summarizes and discusses results from the fifth year of sampling conducted in the past year (July 1998 through June 1999), the conclusions, and potential new initiatives to be undertaken. Results summarized in this report include data already submitted to Ecology In Discharge Monitoring Reports (DMRs) plus additional results from other samples unrelated to DMR reporting. The Port has previously submitted four Annual Reports (POS 1995, 1996, 1997a, 1998c.)

This report satisfies Special Condition S2.E of the National Pollutant Discharge Elimination System (NPDES) permit for the Port of Seattle's (Port) Sea-Tac International Airport (STIA). Special Condition S2.E of the permit states: "On or before October 1 of each year, the Permittee shall submit a report to the Department summarizing the results of the stormwater monitoring conducted pursuant to Special Condition S2.B or S3.E of this permit during the preceding twelve (12) month period from July 1 through June 30. The report shall present the analytical data, the Port's conclusions as to what is being learned from the data, and any new initiatives to be undertaken as part of the Stormwater Pollution Prevention Plan for Airport Operations required in Special Condition S12."

Additionally, the permit requires in Special Condition S2B that; "The permittee shall include the following data for each storm event in the Annual Stormwater Monitoring Summary Report...: date, duration, the number of dry hours preceding the storm event, total rainfall during the storm event (inches), maximum flow rate during the rain event (gallons per minute), and the total flow from the rain event (gallons). The permittee shall also include a monthly summary of daily rainfall..." This information appears in Appendix A.



#### 3 BACKGROUND

## 3.1 Sea-Tac International Airport

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Seattle-Tacoma International Airport (STIA) lies about mid way between the cities of Seattle and Tacoma, Washington. The airport was built in the 1940s and expanded throughout the years to become the 18<sup>th</sup> busiest airport in the U.S. The areas surrounding the airport urbanized as the airport grew and incorporated as the cities of Seatac, Des Moines, and Burien.

STIA storm drainage discharges through 14 individual outfalls, four that drain to Miller Creek, eight that drain to Des Moines Creek, and two that drain to a City of Seatac system. These outfalls drain a total of 963 acres which contain about 44% impervious surfaces. Another 370 acres, mostly the impervious surfaces of terminal gate and ramp areas, drain to the Industrial Waste System (IWS) and the Industrial Waste Treatment Plant (IWTP.) WTP sampling results are not included in this report.

#### 3.2 STIA Storm Drainage Subbasins

STIA storm drainage subbasin names are coded according to location, for example, "SDS1" means storm drain south number 1. The NPDES permit refers to outfalls by number, however, this report refers to subbasins and their outfalls by location names (see Table 2). The Port identifies all manholes according to an alphanumeric scheme, some of which are referred to in this report. For convenience and consistency, many of these locations will be renamed and renumbered next year. Drainage area estimates are included in Appendix A. Figure 1 shows the individual stormwater drainage subbasins and the STIA stormwater management boundaries.

STIA stormwater subbasins fall into the general categories listed in Table 2. These categories group subbasins together that have similar land use and other characteristics. These categories include "landside," "airfield," and other non-specific, low-activity areas. A previous report showed that sampling results were different for each of these categories (POS, 1997.)

Airfield subbasins SDS3, SDS4, SDN3, and SDN4 drain 626 acres (45% impervious) of the Aircraft Movement Area (AMA), which includes the airport runways, taxiways, and other open space of the "airfield." These four airfield subbasins represent approximately 65 percent of the total STIA storm drainage area. Previously an airfield outfall, SDN2 now discharges to the Industrial Waste System (IWS) via two pump stations constructed as BMPs in 1997.

Four subbasins (SDE4, SDN1, EY, and TY) compose the 165 acres (60% impervious) of "landside" areas of the airport, primarily public roads, parking, and passenger vehicle areas. Although 11 percent of the total impervious area of SDE4 drains portions of Taxiways A and B, the "landside" designation is appropriate because roads, parking, and other vehicle areas on the landside of the airport make up more than 50 percent of the total impervious area.

In previous reports, the SDS1 subbasin was included in the "terminal" category. However, several stormwater BMPs were undertaken in 1996-97 near the terminal, removing 1.5 acres of ramp areas from SDS1. Other BMPs disconnected yet more ramp area that occasionally drained to SDS1 when certain structures were surcharged during intense rainfall. As a result, SDS1 now drains mostly rooftops, plus a minor area of ramp. Therefore, the "terminal" category is no longer appropriate for SDS1. In addition, recently expanded drainage from South 188th Street was added to SDS1 in 1998-99, increasing the total offsite (non-Port) area to 5.1 acres, nearly 50% of the total SDS1 area.<sup>1</sup> Four other outfalls (SDS2, SDW3, B, and D) drain 110 acres, mostly open spaces (11% impervious) in the southwest portion of STIA.

#### 3.3 Sampling locations

The Port monitors stormwater discharges at 14 locations, one for each subbasin within the boundary of the permit. Figure 1 shows the location of the outfalls and monitoring locations.

Four monitoring locations (subbasins SDE4, SDN1, EY, and TY) are upstream from the final discharge point. Runoff contributions from other, non-STIA sources enter these storm drains and therefore necessitate monitoring at the first location, often a manhole, upstream of the majority of offsite inputs. Table 3 lists these offsite influences. Eliminating all offsite runoff is not possible for sampling stations in SDE4, SDS1, SDS2, and SDS3.

To remove unfavorable biases from highway SR518 runoff, the sampling location for SDN1 was moved upstream to its current location in 1997. Therefore, outfall SDN1 has two datasets, one for the period prior to January 1997 that includes results influenced by SR518 runoff, and the other for "SDN1up" for the ensuing period.

<sup>&</sup>lt;sup>1</sup> In 1998-99 the City of SeaTac added drainage area to SDS1 through the widening of about 800 linear feet of S. 188th Street, adding curb, gutter, piping and a number of storm drain inlets. This section of roadway previously drained sheetwise off the shoulder to grassed ditches. Prior to these improvements, only one inlet drained a much smaller portion of this public roadway outside the Port's jurisdiction.

#### 3.4 Storm sampling procedures and analytes

The Port's Procedure Manual for Stormwater Monitoring (Port 1999); describes the criteria for sampling storm events, and describes all relevant sampling, programming, and handling necessary to comply with requirements of the permit. Table 4 lists required sampling frequencies, pollutant analytes, methods, and detection limits. Only results from storms and samples that meet representativeness criteria are reported in DMRs. Results from samples not meeting these criteria, or those taken for other purposes are also included in this report. Using automatic samplers, the Port generally takes a grab then a flow-weighted composite sample during rain storms of 0.20 inches or greater.

Outfall Number in	Port	
Permit	Nomenclature	Category
002	SDE4	landside
003	SDS1	none
004	SDS2	none
005	SDS3	airfield
006	SDN1	landside
007	SDN2	Drains to IWS
. 800	SDN3	airfield
009	SDS4	airfield
010	SDW3	none
011	SDN4	airfield
012	EY	landside
013	TY	landside
014	В	none
015	D	none



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## Table 2 Offsite Influences in STIA Monitoring Locations(a)

Outfall (manhole)	Total Area (ac)	Offsite Area (ac)	Percent Offsite	Comment
SDE4 (SDE4-47)	149	0.6	<1%	Offsite area of SR99.
SDS1 (outfall)	10.7	5.1	47%	Offsite area of S. 188th St. includes area added by City in Fall 1998
SDS2 (outfall)	13.2	2.9+	21%	Offsite 16th Ave S., S. 188th St, and possible non-Port commercial area. Approximate offsite area of S. 188th
SDS3 (outfall)	462	3	<1%	St.
SDN1 (manhole SDN1-27)	24+	9.9+	>40%	Former SDN1 location includes public road runoff. Additional 49 acres enters below this point.
SDN1up (SDN1-22)	13.8	0	0%	Air cargo road is about 1/2 of SDN1.

(a) All area estimates are as of 27 October 1998 and subject to change.

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## Table 3 Analytes, Methods and Detection Limits

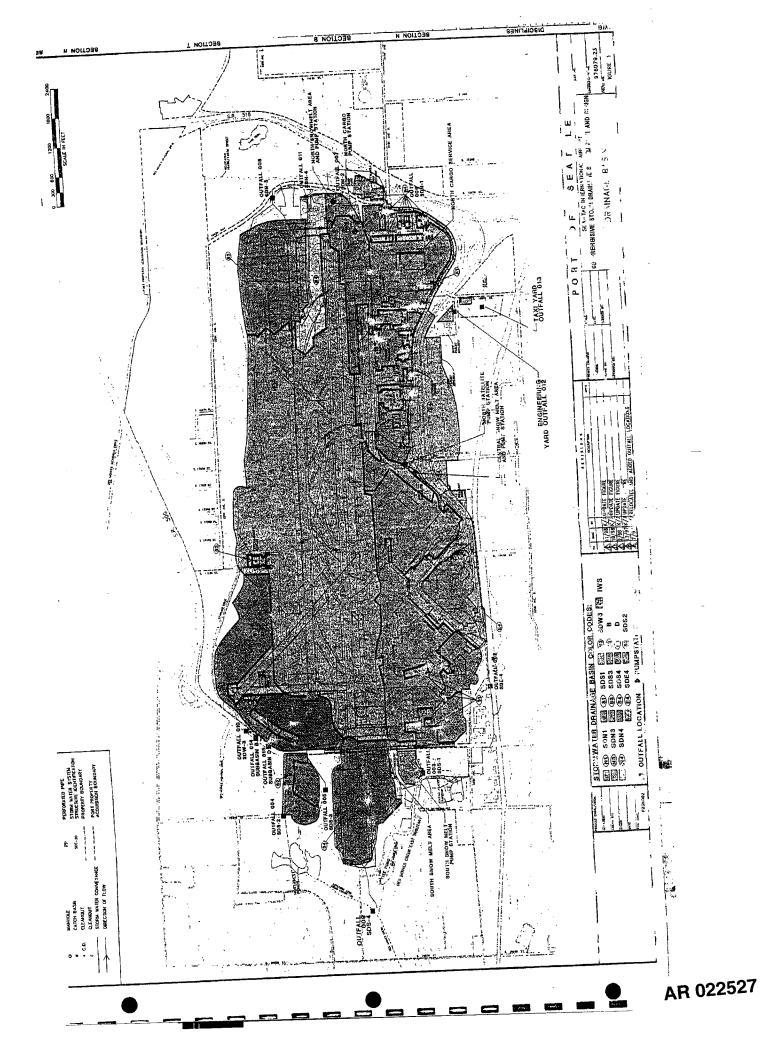
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		T	🤋 Subbasins						
Analyte	Method <sup>(a)</sup>	Detection limit (MDL) mg/l	SDE4, SDS3, SDN1, SDN4	EY TY, SDN2	SDS1, SDN2	SDS1, SDS2,SDN3, SDS4, SDW3, B, D			
рН	150.1	0.10	Х	X	X				
OG (Oil and Grease)	413.1	1.0	n/a	n/a	n/a	n/a			
TPH (IR)	418.1 mod <sup>(b)</sup>	1.0	n/a	n/a	n/a	n/a			
TPH (GC)	NWTPH-Dx	0.15	x	x	x	×			
Fecal coliforms (MPN)	9221 E	2	×			x			
TSS (total suspended solids)	160.2	0.50	x	X	x	x			
Turbidity	180.1	0.10	X		X	X			
BOD <sub>5</sub>	405.1	4.0	X		X				
Total Ammonia	350.2S	0.010	n/a	n/a	n/a	n/a			
Total Glycols <sup>(c)</sup>	GC FID	4	X		X	X			
Total Recoverable copper, lead, zinc <sup>63</sup>	200	Varies	x						
Surfactants	425.1	0.10	X*	X					

- (a) Method refers to EPA-600/4-79-020, March 1979. Fecal coliform method refers to 18th edition of Standard Methods for the Examination of Water and Wastewater (APHA, 1995), or as revised.
- (b) Washington State Department of Ecology method WTPH-418 1 Modified.
- (c) Analyzed by Gas Chromatograph, Flame Ionization Detector.
- (d) Lead by atomic absorption (AA) furnace, copper and zinc by ICP.

Surfactants





### 4 SAMPLING RESULTS

#### 4.1 General

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Data are discussed separately for results from grab samples, composite samples, and deicing event (glycol) samples because of the differences in sampling protocols (i.e., grab samples versus composite samples) and because some rainfall events sampled did not meet the "storm" criteria.

The required hydraulic and hydrologic data are included in Appendix A. Sampler were validated according to the representativeness criteria described in the Port's Procedure Manual for Stormwater Monitoring (Port 1998a). Analytical results are tabulated and summarized for each outfall in Appendix B. Data previously submitted to Ecology in the monthly discharge monitoring reports (DMRs) represent samples collected from strictly those storms and sampling routines that fully met the criteria of the Procedure Manual. This report summarizes all data collected at storm drain outfalls.

## 4.2 Method of Data Presentation and Comparisons

This report compares the Port's stormwater data to others' stormwater data listed as reference comparators in Table 5. In general, the reference comparator used was selected as the more conservative (1995) of two City of Bellevue studies because they were comprehensive, local studies, and had similar sampling protocols. However, the samples in the 1995 Bellevue study were taken at instream stations and therefore reflect receiving water conditions, as opposed to outfall discharges. Nonetheless, contrasting STIA *outfall* discharges to this *instream* comparator should result in more conservative conclusions. The Portland NPDES data for copper better represents commercial and industrial outfall discharges before mixing with receiving waters.

These comparators and outfall sampling results appear on box plots that illustrate the central tendency, spread, and skew of the Port's data. The bold line within a box represents the median value, while the bottom and top of a box show the 25th and 75th percentiles, respectively. In other words, the interquartile range (central 50 percent) of the data fall within values highlighted. by the box. SPSS software was used to generate the box plots (SPSS 1999).

When summarizing data to compare typical values, outliers usually represent unusual conditions, atypical of what one could expect under usual circumstances. In a box plot, the "whiskers" show the largest values that are not considered outliers. SPSS box plots show two types of outliers:

those more than 1.5 box-lengths from the 75th percentile plotted with the symbol "o", and those more than 3.0 boxlengths with a star symbol ( "\*". )

	· · · · · · · · · · · · · · · · · · ·				Study			
Pollutant	Units	NURP, 1983	BURP, 1984	Metro, 1982	Bellevue, 1995 <sup>(b)</sup>	Highway Runoff <sup>(ci</sup> 1981	Portland NPDES <sup>(d)</sup> 1993	WA State Standard <sup>(e)</sup>
pH	std units		5.2 - 7.4		7.2 - 7.8			6.5 - 8.5
трн	mg/l				3.7		6.5	no standard
Fecal coliforms	mpn per 100 ml	1000 to 21000	980		201			100
BOD <sub>5</sub>	mg/l	9	6,6				20	no standard
TSS	mg/l	100	50		82.3	106	119	no standard
Turb	mg/l		19		- 29.4			based on background
glycols	mg/l		not	analyzed	in any of the	se studies	-	no standard
Cu (TR) <sup>(7)</sup>	µg/l	34		20	10.4	43	39	5,3 <sup>(1)</sup>
Pb (TR) <sup>(1)</sup>		144	170	210	26.3	466	36	16 <sup>(1)</sup>
Zn (TR) <sup>(1)</sup>	1	160	120	110	161.4	638	253	40 <sup>(1)</sup>
statistic re		median	mean <sup>(g)</sup> ,	mean	log-normal	mean	mean	metals standards <sup>(t)</sup> at
	,		median		median			hardness =28 mg/l

#### Table 4 Stormwater Quality Comparators(a)

(a) Comparative Values in bold. Blank space means no data available, reported, or applicable.

(b) Bellevue, 1995 data are for instream samples from the "Sturtevant Creek, downstream" site.

(c) Highway runoff from an 15 location in Seattle with 57,000 ADT, 43 to 54 storm samples in 1980-81 (Chui, Mar, and Homer, 1982).

(d) City of Portland 1993 NPDES Part 2 Municipal Application, data from NW Yeon Blvd.

(e) Standards are for class A waters, see WAC 173-201A.

(f) Total recoverable metals. WA State acute standards expressed as total recoverable, calculated at 28 mg/l hardness using Ecology's "TSDCALC6.XLW" spreadsheet. The hardness value is the 10th percentile for the streams sampled in the Stormwater Receiving Environment Study (POS, 1997c.)

(g) For Turb, Cu, Pb, and Zn, BURP 1984 data was mean of grab samples, therefore Bellevue, 1995 data are more representative comparators because they represent median of composite samples.

#### 4.3 Storm events sampled

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The 1998-99 sampling season began in July 1998 during the "El Nino" dry weather pattern and progressed into the very wet "La Nina" pattern from October 1998-March 1999. During this unusually wet period, about 40 inches of rain fell at STIA, which is a typical total annual amount, and was 12 inches more than typical in just this 6 month wet season. Rainfall in November 1998 set a new monthly record at 11.6 inches, breaking a previous record by almost an inch.

In the past 12 months ending June 1999, rainfall meeting "storm" critena<sup>2</sup> occurred on 33 occasions. The Port sampled 23 (two thirds) of these "storms" where rainfall ranged from 0.2 to over 3 inches preceded by up to 23 days of dry weather. In August, September, and December 1998, only one event met criteria existing at the time<sup>3</sup>. One month, Juty 1998, had no rainfall that qualified as a storm. Extra samples were taken in October 1998 to make up for those taken, but which failed to meet sample criteria during the single "storm" sampling opportunity in September 1998 (POS 1998a.) Appendix A summarizes daily rainfall on a monthly basis graphically and in tabular form.

In the past year, there were four storm events generally associated with higher than typical sample results experienced at several outfalls. Two of these were due to late summer thunderstorms on August 16 and September 24, 1998 where intense rainfall of greater than 0.25 inches per hour fell after protracted dry periods of up to more than a month. These factors resulted in the unusual condition of a lengthy accumulation period combined with high scour potential from the intense rainfall. Two other storms on November 3 and December 24, 1998 had similar characteristics. The product of maximum rainfall intensity and length of the antecedent dry period, termed the "load factor", was much higher for these four events than for the 25 other events sampled (See Appendix A.) These facts are important to take into account when examining the sample results in the following sections.

The change in the criterion for the duration of the antecedent dry period provided, as intended, two to three more sampling opportunities per month<sup>3</sup>. Yet because total rainfall from a particular event can be highly unpredictable, six potential sampling events failed to fruit to the 0.20-inch

<sup>&</sup>lt;sup>3</sup> A minor permit modification became effective in 1999 allowing the Port to reduce the criteria for the duration of the antecedent dry period from 48 hours to 24 hours. This change was intended to allow more storm events for sampling than the prior definition.



 $<sup>^{2}</sup>$  A "storm" event is defined as having total rainfall of at least 0.20 inch, separated by more than 12 hours of dry weather from past or subsequent events, and preceded by a period of 24 hours with no more than 0.10 inch rainfall from discrete events.

minimum rainfall, and hence resulted in false starts, or "non-storm" samples. Despite the incomplete and therefore non-representative composite samples that resulted (which were usually discarded), the grab samples were still considered representative and comparable<sup>4</sup> to those taken from "storms." The Procedure Manual was revised in 1998 to allow for this comparability (POS, 1998b). Data from all such grab samples were included on DMRs beginning in January 1999.

#### 4.4 Grab Sample Results

The following discussion includes results from 96 grab samples collected in the past year. The entire five-year data set for grab sample results comprises 322 samples from "storms", plus 26 samples from other rainfall events (non-storms) that did not reach the minimum rainfall criterion of 0.20 inches.

## 4.4.1 Total Petroleum Hydrocarbons (TPH)

The results from the current year presented in Figures 2 and 3 continue to demonstrate that concentrations of petroleum-type pollutants in STIA stormwater are consistently less than in stormwater from other urban areas. The following bulleted items present a discussion of these results.

The TPH method was changed from an infrared absorbance (IR) method (WTPH 418.1) to a gaschromatographic (GC) method (NWTPH-Dx.) in 1998. Only results from the new method are discussed below. The previous Annual Report (POS, 1998c) demonstrated that data from the old and new methods were comparable however.

 STIA stormwater overall continues to have less petroleum-type pollutants than typical urban runoff. During the past year, more than 90 percent of the 93 STIA results were less than the Bellevue, 1995 median (instream samples) of 3.7 milligrams per liter (mg/l). The overall STIA TPH median is 0.4 mg/l, and was 0.27 mg/l for the past year. On the whole, TPH was not detected above 0.15 mg/l in 44 (36%) of a total of 121 samples taken since March 1998.

<sup>&</sup>lt;sup>4</sup> These "non-storm" grab samples were collected on the same basis as grab samples taken from true "storms". Therefore, given the consistent sampling protocol, all grab sample results can be aggregated regardless of total rainfall.

- Airfield stormwater (SDS3, SDS4, SDN3, and SDN4) contains far less TPH concentrations than runoff from the landside subbasins (SDE4, SDN1, and TY.) TPH was not detected in 31 (67 percent) of the 46 airfield outfall samples analyzed by the new method in the past two years. The maximum TPH value of these 46 airfield outfall samples was 0.5 mg/l. Current results are similar. See Figure 2.
- Most of the TPH detected in landside runoff is likely attributable to cars and trucks. Figure 2 shows that motor oil represents the majority of the TPH at these outfalls (SDE4, SDN1, and TY.)
- The IWS effectively isolates aviation-related fuel spills and drips from the storm drains. TPH concentrations are generally low in stormwater from subbasin SDE4 and are generally not detectable in SDS3 samples. More than 85% of the 24 samples from SDE4 had TPH less than the 3.7 mg/l comparative value for urban areas. These 2 subbasins are contiguous with aircraft service (IWS) areas.

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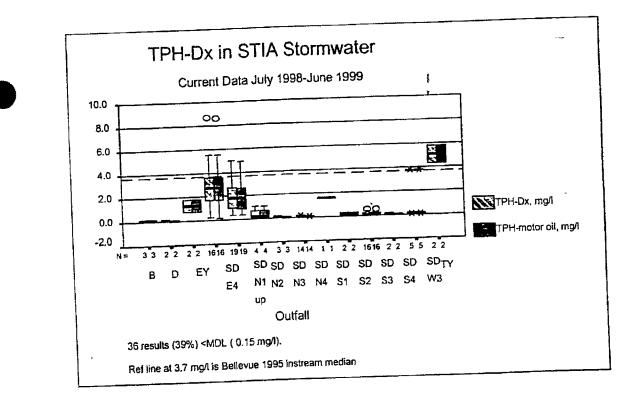


Figure 2 TPH for current year

#### 4.4.2 Fecal Coliforms

Overall, the median value for fecal coliforms in 268 samples to date is 50 per 100 ml, with two thirds of the results less than 200 per 100 ml. Relative to the comparative values (Table 4), these overall results indicate that STIA stormwater contains fewer fecal coliforms than typical urban stormwater. More than 79 percent of the airfield subbasin samples showed fecal coliforms less than the comparative value of 201 per 100 ml (Bellevue, 1995.) See Figure 3.

There are numerous sources of fecal coliforms: birds and all mammals. Small animals and birds inhabit many of the respective drainage areas and are believed to be the sources of these infrequent findings. Urban stormwater often contains fecal coliforms in elevated numbers, and sanitary sewage is not always implicated.

In past reports, the Port showed that fecal coliforms were found principally in the landside subbasin SDE4. Current results for six of 16 SDE4 samples showed elevated results greater than 500 per 100 ml. However, another six of the 16 samples showed fecal coliforms less than 240 per 100 ml. Nonetheless, the Port is continuing to conduct a source tracing study intended to identify potential sources of contamination. Preliminary results, included in Section 4.6, do not indicate sanitary sewage as a source in storm or baseflows. Uncontaminated baseflow samples indicate that there is no continuous source of fecal coliform bacteria. Investigations are ongoing and results will be presented in subsequent Annual Stormwater Monitoring Reports.

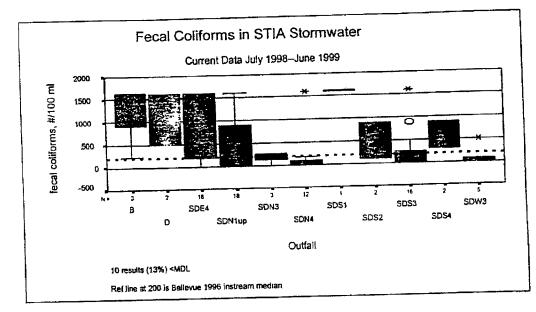


Figure 3 Fecal Coliforms for Current year

## 4.5 Composite Sample Results

In the past year, the Port took a total of 66 flow-weighted composite samples, bringing the five year total to 317. The discussion of these composite sample results are segregated from grab samples because the latter represent only instantaneous values. Composite sample results, especially those from samples that comprise the entire hydrograph, represent an average value over a longer time period.

## 4.5.1 Suspended Solids and Turbidity

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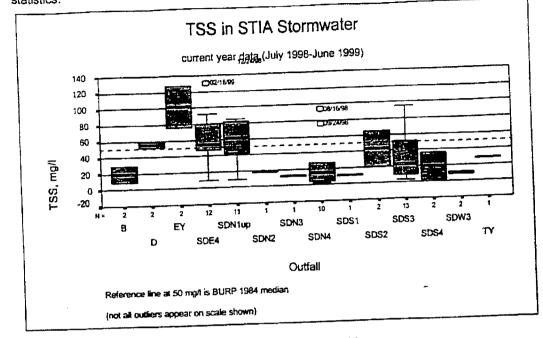
STIA outfalls continue to discharge typically less total suspended solids (TSS) and turbidity than urban areas. In the 5 year sampling history at STIA, more than 80 percent of the 293 TSS samples and 250 turbidity samples were below the comparative values of 50 mg/l, and 29 NTUs, respectively. As shown in Figure 4 and Figure 5 the majority of results for the past year continue to be consistently low.

The four airfield outfalls (SDS3, SDS4, SDN3, and SDN4) continue to produce less TSS and turbidity than the two principal landside subbasins (SDE4 and SDN1). In the past 5 years, 95 percent of the 97 TSS results from the airfield outfalls were less than one-half the regional comparative median value<sup>5</sup>. Because these airfield outfalls represent about 61 percent of the total SDS area, the data show that the majority of STIA runoff is much lower in suspended material than runoff from comparable regional urban areas.

In the past year, there were 4 storm events generally associated with higher than typical TSS and turbidity experienced at several outfalls. These results are considered outliers because they were new maxima and atypical based on the abundance of data for the particular outfalls. Samples from these storms were associated with the unusual condition of a lengthy dry period prior to the event combined with high scour potential of intense rainfall. As a result, samples from these storms that coincided with certain construction activity showed higher TSS and turbidity in late summer and fall of 1998. See Figure 6. A number of construction BMPs became effective after these first storms of the wet season. In the late fall as work ceased and sites stabilized, TSS and turbidity rapidly returned to typical values at outfalls SDS3, SDN4, and SDN1. See Figure 6 which illustrates typical results for these three outfalls. Outlying TSS and turbidity results for SDE4 and SDN1 for the December 24, 1998 storm were associated with sand applied to

<sup>5</sup> This is the case where 9 results considered outliers or from unusual storm conditions are trimmed from the dataset.

roadways during a snow event. Trimming these outliers reduces the maximum, 95<sup>th</sup> and 75<sup>th</sup> percentile values, but has little effect on median values<sup>6</sup>. Appendix B lists these trimmed statistics.





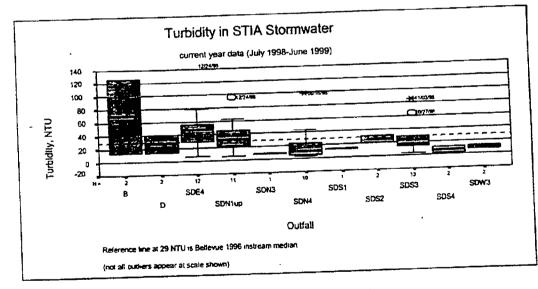


Figure 5 Turbidity for Current Year

<sup>6</sup> Trimming is a statistical approach that deals with the influence of outlying data that are not representative or otherwise not comparable with other data. Trimming outliers yields summary statistics that better represent typical results.

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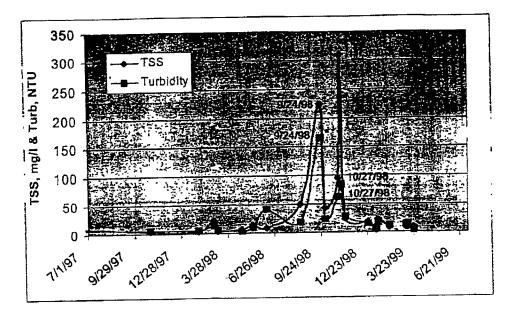


Figure 6 TSS and Turbidity peak and return for SDS3

#### 4.5.2 Biochemical Oxygen Demand (BOD<sub>5</sub>)

Results for the past year continue to indicate overall low levels of  $\beta$ OD<sub>5</sub> in STIA stormwater. In 55 samples analyzed in the past year, the median BOD<sub>5</sub> was 5.5 mg/l, and 60 percent were below the 6.6 mg/l regional urban comparator (BURP, 1984, see Table 4). Excluding 7 samples where the BOD<sub>5</sub> was attributable to runway deicing events, the 95 percent of the 48 sample results in the last year were less than 18 mg/l. See Figure 7. Trimming these outliers reduces the maximum, 95<sup>th</sup> and 75<sup>th</sup> percentile values, but has little effect on median values. Appendix B lists these trimmed statistics.

Principal sources of elevated BOD<sub>5</sub> concentrations in the past were associated primarily with major winter weather episodes and the accompanying deicing events. Acetate-based ground surface deicers were the primary sources of BOD<sub>5</sub>, with isolated indications of aircraft deicing glycols. All known direct sources of glycols have been eliminated from the storm drains.

In the past year, two limited periods of winter weather (December 24-25, 1998 and February 8, 1999) occurred where the Port applied chemicals to ground surfaces (primarily runways and taxiways.) Storms following both events were sampled at various outfalls. Compared to past years, snowfall and chemical usage, including aircraft glycols, was less (POS 1998c, POS 1997b.) During the December event, BOD<sub>5</sub> results ranged from 116 to 450 mg/l at the five

outfalls sampled. Because glycol concentrations were generally low (15 to 44 mg/l) in these samples, the elevated BOD<sub>5</sub> concentrations were attributable to the acetate-based runway (ground) deicing chemicals. There were no discharges from outfall SDN2 during these events<sup>7</sup>.

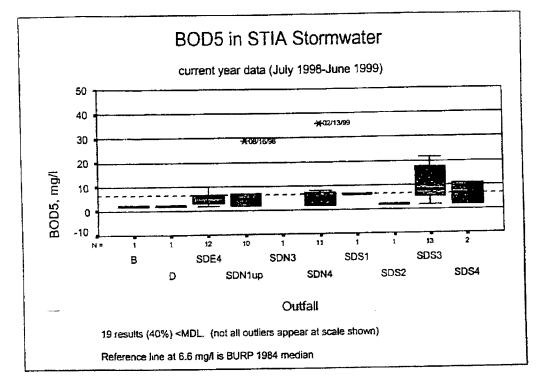


Figure 7 BOD<sub>5</sub> for Current Year

#### 4.5.3 Metals

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All data reported below are for total recoverable metals. It is important to note that Washington State Water Quality Standards (WAC 173-201A) apply to the receiving waters, not to the discharges from a particular outfall. Stormwater discharges are mixed in receiving waters. Therefore, it is inappropriate to compare outfall sample results directly with Ecology or other receiving water standards without accounting for mixing.

The Washington water quality standards for copper, lead, and zinc are based on the dissolved fraction of the metal. The dissolved fraction is generally used to determine potential toxicity, an

<sup>&</sup>lt;sup>7</sup> The entire drainage area of outfall SDN2 was re-routed to the IWS in 1997 as a result of two BMPs.

approximation of what is actually available (i.e., the bioavailable fraction for uptake by aquatic organisms). Limited results for dissolved metals analyzed in source tracing studies appear in Appendix F.

#### General Results.

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Samples from airfield outfalls continue to contain less lead and zinc concentrations than typical urban sources. In the five-year permit sampling history, over 97 percent of the results for lead and zinc in airfield outfalls were below the median for comparable regional data for commercial areas. This is important given that the commercial/industrial comparators cited (see Table 4) are the most conservative and, these reflect *instream* sample concentrations after outfall discharges mixed with receiving waters. Current results continue these patterns, See Figure 9 and Figure 10.

Much of the airfield outfall lead and zinc data are below water quality standards. Nearly all lead results in the past five years are below the standard calculated at the very low hardness listed in Table 4. In fact, lead was not detected in 42% of the total of these 104 samples. Airfield zinc was similar in that more than half the results are less than the standard. And when the total zinc standard is calculated as 0.071 mg/l at 56 mg/l hardness<sup>8</sup>, more than 70% of the STIA airfield results are less.

It should also be noted that lead and zinc concentrations measured in airfield outfall samples were far lower in lead and zinc than the landside outfall samples. The overall median lead and zinc values for landside outfalls SDE4 and SDN1 were nearly 5 times or more those from the airfield samples. See Figure 9 and Figure 10. This difference is likely due to the amount of passenger vehicle usage in the landside areas, much of which is beyond the Port's jurisdiction. The landside subbasins experience considerable vehicle traffic where tire wear is a likely source of zinc (EPA 1993). Roads and parking areas constitute more than 50 percent of the impervious surfaces draining to SDE4 and SDN1.

Overall, in 225 samples in the past five years the median copper value was 0.027 mg/l. Airfield and landside outfall data in this case are similar, with medians ranging from 0.023 to 0.038 mg/l. See Figure 8. This similarity is likely related to the considerable vehicle activity within SDE4 and SDN1. Nonetheless, STIA data are generally less than, but comparable to the 0.039 mg/l median

<sup>&</sup>lt;sup>8</sup> In two storms in 1999, hardness values in seven Miller and Des Moines Creek instream composite samples ranged from 41 to 74 mg/l with a median of 56 mg/l.

for copper from the City of Portland's sampling results (City of Portland, 1993.) This comparison is more representative of outfall discharges than the Bellevue, 1995 median of 0.01 mg/l for *instream* stormwater samples.

As indicated for TSS and turbidity, there were several outliers for primarily copper and zinc results obtained in the past year. Again, the causes are attributable to unusual storm events that coincided with certain construction projects in subbasins SDS3 and SDN1. The outlying metals results were correlated to outlying TSS and/or turbidity results and were new maxima. Subsequent samples showed a rapid return to typical ranges as discussed under section 4.5.1. Trimming these outliers reduces the maximum, 95<sup>th</sup> and 75<sup>th</sup> percentile values, but has little effect on median values. Appendix B lists these trimmed statistics.

A prior data entry error for a copper value for an SDS3 sample was discovered and corrected in the fall of 1998 (POS 1998e.) The correct value of 0.0388 mg/l for the November 23, 1996 sample was erroneously entered as 0.388 mg/l, an order of magnitude higher. The error did not effect DMRs because the data was transcribed correctly during DMR preparation. The error occurred only during data entry into the Port's database. In the past two annual reports, only the 75<sup>th</sup> and 95<sup>th</sup> percentile statistics reported are affected, but not the medians. Boxplots are affected only slightly. Table 5 below shows the pertinent changes required to correct the error.

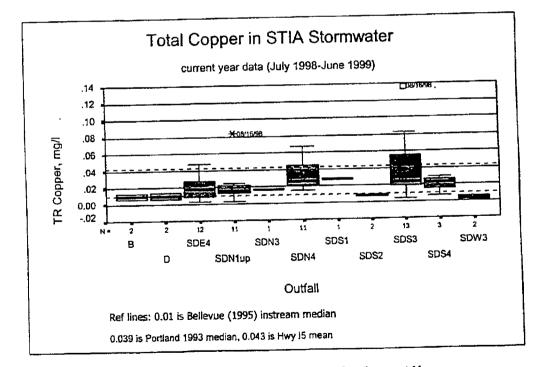
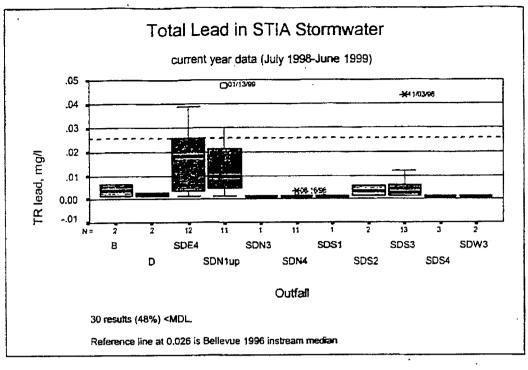


Figure 8 Total Recoverable Copper for Current Year





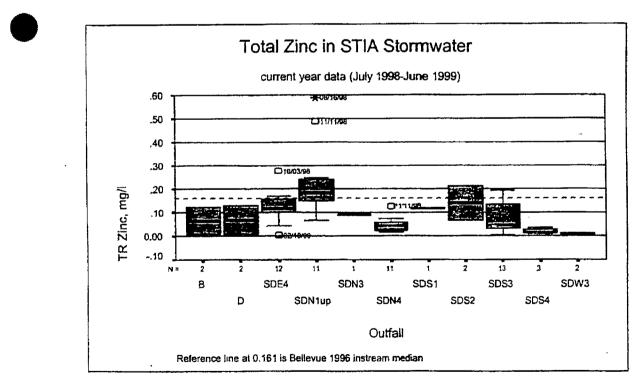


Figure 10 Total Recoverable Zinc for Current Year

Table 5 Correction	ons to Total Reco	verable eter	1998 Annua	Report	
ſ	1997 Annu		1998 Allina		
		Change To	Change From	Change To	
'All Data"	Change From		0.445	0.102	
95 <sup>th</sup> percentile	No change	No change	0.115		
1	0.042	0.041	0.045	0.042	
75 <sup>th</sup> percentile	0.042		Change From	Change To	
"SDS3"	Change From	Change To		0.086	
	0.170	0.093	0.109		
95 <sup>th</sup> percentile		0.046	0.068	0.054	
75 <sup>th</sup> percentile	0.053		Change From	Change To	
"All Airfield"	Change From	Change To	Change From		
		n/a	0.101	0.089	
95 <sup>th</sup> percentile	n/a		No change	No change	
75 <sup>th</sup> percentile	n/a	n/a	, to unany -		

## Total Recoverable Copper Data Summaries in Past Reports\*

\*all values in mg/l

Copper and zinc in SDN1 samples continue to show lower values attributable to removing the bias imparted by SR 518 runoff that was inextricably combined in samples from the previous location<sup>9</sup>. Therefore, the current station provides results more representative of STIA discharges, and prior data must be considered to contain a high bias. Data for the two stations have been segregated and discussed separately in this report and the past two Annual Reports (POS 1998c,

1997a.)

#### **Deicing Event Samples** 4.6

## 4.6.1 Background.

The permit requires sampling and analysis for glycols during "deicing events" The Port conducts this sampling according to the Procedure Manual (POS, 1999a.) The glycol data discussed below encompass mostly composite samples collected during periods of aircraft deicing, representing average values during a storm event discharge.

<sup>&</sup>lt;sup>9</sup> In October 1996, the Port changed the sampling location for SDN1 from manhole SDN1-27 to manhole SDN1-22, upgradient from public road runoff. Past annual reports compare data from both locations.

As of June 1997, all ramp areas where aircraft are routinely deiced drain to the IWS. Prior to this date, drainage from several aircraft service areas of limited extent flowed to the SDS. As a result, the Port completed necessary Stormwater Pollution Prevention-Plan (SWPPP, POS 1998f) actions by implementing seven BMPs that rerouted this drainage to the IWS from the four affected SDS subbasins (SDE4, SDS1, SDS3, and SDN2.)

The Port's Annual Glycol Reports (Port 1996, 1997c, 1998b) detail the history of glycol application airport-wide. These reports summarize data reported by the airlines for the volumes of both ethylene and propylene glycol applied and number of aircraft treated each day. The Federal Aviation Administration (FAA) authorizes only ethylene and propylene glycols for aircraft deicing and anti-icing. Port tenants perform all glycol application at STIA (applied by airlines or their ground service providers). However, to ensure public safety, aircraft pilots make the ultimate decision on whether to apply glycols or not.

#### 4.6.2 Results

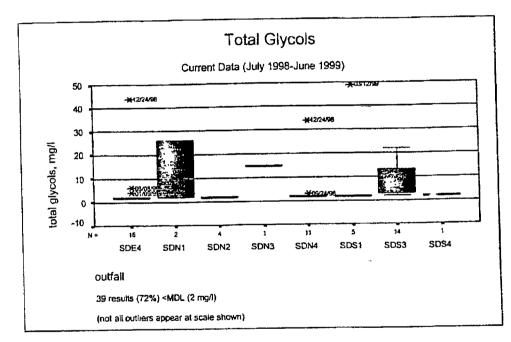
In the past year, glycols were analyzed in a total of 54 samples from eight cutfalls. The majority of samples were collected at the regular sampling locations (SDE4, SDS3, and SDN4.) Total glycol concentrations ranged from non-detectable to a maximum of 158 mg/l. The majority of these results (72 percent) were below the detection limits. The total number of aircraft deiced in the dry period before sampling events ranged from 2 to 373, with a median of 15. Data appear in Figure 11 and are summarized in tabular form in Appendix C.

In the past year, two limited periods of winter weather occurred: December 24-25, 1998 and February 8, 1999. During the December event, the minor snowfall of 2 to 3 inches did not require plowing because it melted rapidly with the ensuing rainfall. During the February event, no snowfall accumulated, yet the melted precipitation froze on ground surface during clear night skies. These were the only periods where the Port applied chemicals to ground surfaces (primarily runways and taxiways.) Storms following both events were sampled at various outfalls. In addition to this NPDES sampling, both of these events were also monitored for the Dissolved Oxygen Study (POS, 1999b.) Because of the limited snowfall, the snow storage areas were not used.

Compared to past years, snowfall and chemical usage, including aircraft glycols, was less (POS 1998d, POS 1997cb) During the December event, glycol results ranged from 15 to 113 mg/l at the five outfalls sampled (SDE4, SDS3, SDN1, SDN3, and SDN4.) Because glycol concentrations were generally low in these samples, the elevated BOD<sub>5</sub> concentrations were

attributable to the acetate-based runway (ground) deicing chemicals. There were no discharges from outfall SDN2 during either of these events<sup>10</sup>.

Results for samples from SDS3 and SDS1 may warrant further investigation to determine if direct glycol sources can be further stemmed. An IWS drain structure (IWS-563) at a slot drain terminus near Concourse C, gate C8 seems to be capable of overflowing to the SDS3 drainage area, yet most of any overflow would probably run to the next IWS slot drain in the series. The cause of the overflow should be investigated to determine if a repair is appropriate. Several SDS3 drain inlets under the C- Concourse overhang were covered with solid lids in early 1999, therefore these possible source areas were eliminated. Because of several drainage re-route BMPs in SDS1, there should be little or no glycol detected in SDS1 samples. However, the source of the March 12, 1999 glycol result of 49 mg/l should be investigated.



#### Figure 11 Glycol results for Current Year

The Port has completed sampling of at least four deicing events at outfalls SDS1 (003) and SDN2 (007) since the permit became effective on March 1, 1998. According to permit condition S2.B.4, footnote (a), the Port is eligible to petition Ecology for elimination of further monitoring at these two outfalls. Sampling results demonstrate effective abatement of glycol attributable to several

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<sup>&</sup>lt;sup>10</sup> The entire drainage area of outfall SDN2 was re-routed to the IWS in 1997 as a result of two BMPs.

BMPs implemented in the past few years in these two subbasins. In the 5 deicing event samples taken at SDS1, glycols were not detected in 3 samples, and minor amounts (7 and 49 mg/l) were detected in two samples. These samples were taken from runoff preceded by dry periods during which up to 154 aircraft were deiced. In the past, as little as a single aircraft deicing could result in much higher glycols in SDS1 runoff. Glycols were not detected in four samples of the limited duration discharges to SDN2 caused by storms that exceeded operating designs for the two IWS pump stations built as BMPs in 1997. Therefore, the data indicate that the BMPs have been effective and the intent of this monitoring requirement is satisfied.

#### 4.7 Other Results

The following results were obtained from samples taken for purposes other than to satisfy permit condition S2B.

#### 4.7.1 WET samples

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As required by permit condition S10, The Port completed two rounds of whole effluent toxicity (WET) testing at the four principal outfalls in the past year. Two outfalls were sampled on additional occasions to corroborate results from the first two tests. The Port submitted the required WET testing reports to Ecology within 60 days of each sampling date. The final summary report summarizing all results will be submitted by main November 1999.

WET testing bioassays used the two required aquatic test species; *Daphnia pulex* (a daphnid or waterflea), and *Pimephales promelas* (fathead minnow.) Results did not indicate toxic conditions in the stormwater discharges sampled at outfalls SDE4, SDS3, and SDN4. Furthermore these results exceeded the performance standards for WET according to Ecology guidelines<sup>11</sup>. In contrast, results from outfall SDN1 exhibited toxicity that appears to be attributable to metals leaching from uncoated galvanized metal rooftops. The Port is currently verifying the source of toxicity so that this problem can be rectified in a timely manner.

Table 6 summarizes WET testing results and Appendix D lists all accompanying data. Analyses for supplemental parameters indicated that these samples were representative of typical conditions based upon past sampling history. The average percent rank value for each parameter shows these results were within the ranges of historical data for each outfall.

<sup>&</sup>lt;sup>11</sup> Performance standards for acute WET tests: the average survival in 100% effluent must be at least 80%, and no single sample must have less than 65% survival (WAC 173-205)

				T		
	Г		WET, % 5	survival		
Outfall	Sample	avg rank*	daphnid	fathead	Comment	
	date		:	100		
SDE4	11/19/98	71%	90. i	100		
(002)	1/20/99	58%	100;	98		
	2/22/99	39%	1	63	L	
	3/24/99	43%		98		
	7/2/99	50%	100			
SDS3	11/13/98	79%	<b>9</b> 0	98	3	
(005)	1/13/99	58%	6 80	9	5	
SDN1		8 679	6 80	4	0	
(006)		9 619	% 30	7	8	
(000)	3/24/9		% 10	) 6	3	
<b> </b>	5/11/9	1	%	5 not teste		
	7/2/9		% not tested	1	33 2, 3	
SDN	4 11/13/9	65	% 7	5 1	00	
(007			% 10		00 ameter analy	

## Table 6 WET Testing Summary

\* Average rank is average of percent ranks for each supplemental parameter analyzed relative to the data history for the particular outfall.

comments:

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1. SDE4 Jan 20, 1999 sample: lab error on fathead test: was 48-hr instead of 96-hr

2. July 2, 1999 samples: control failed at 72.5% survival (performance standard is >90%)

3. July 2, 1999 SDN1 sample: insufficient # of organisms to start daphnid test.

4. May 11, 1999 SDN1 sample taken for source tracing (was a non-storm) only, not to explicitly satisfy permit condition S10

shaded results indicate exceedance of single value and/or averagestandard for survival

The Port conducted additional rounds of WET testing for SDN1 to verify results from the first two tests. Upstream sub-area drainage was also tested to determine where and under what conditions the problems occurred. Because stormwater from SDN1 exhibits historically higher zinc than other outfalls (see Figure 10), this metal was suspected as a potential source of toxicity. After removing metals in these samples with two different chelating agents test organisms had much higher survival. Based on the methods of Hockett and Mount (1996), this pattern of toxicity

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reduction following chelation confirmed that zinc was indeed the most likely source of toxicity<sup>12</sup>. Additional samples indicated that zinc originated from uncoated, galvanized metal rooftops on two cargo building rooftops (a total of 2.2 acres; 25% of the SDN1 subbasin impervious area). Other parameters analyzed, such as surfactants and ammonia were not correlated with survival. A final round of source tracing will be conducted this fall to verify these findings. The Port is currently investigating how to remedy this source of zinc.

## 4.7.2 Non-representative composites

As discussed in Section 4.3, some composite samples failed to meet representativeness criteria for the storm event itself, or for the resultant sampling routine. In addition, several samples were taken for other purposes, such as source tracing, where the compliance sampling criteria are not necessary. Because the Port strives for representative results for reporting and comparability to past NPDES reporting data, these 9 composite sample results are segregated and reported in Appendix E.

## 4.7.3 Field Quality Control Samples

The Port routinely collects duplicate and equipment blank samples during NPDES sampling events according to the Procedure Manual. Appendix E summarizes these results which continue to generally indicate effective sampling techniques.

## 4.7.4 Metals During Ground Deicing Event Runoff

A requested by Ecology, the Port analyzed metals in samples taken during the two ground deicing events in the past year. Cancilla (1998) suggested that glycols used for aircraft deicing can mobilize metals resulting in higher concentrations than might be expected during non-deicing event runoff. Airlines typically apply the most aircraft deicing glycol during these ground deicing/anti-icing events. Glycols are not used for ground surface deicing. Ecology also had a concern based upon what turned out to be an erroneous copper value incorrectly reported from the November 1996 deicing event and concurrent NPDES storm sample (see Section 4.5.3.)

<sup>&</sup>lt;sup>12</sup> These tests use EDTA (ethylenediaminetetraacetic acid) and sodium thiosulphate (STS) as chelating agents. EDTA and STS remove heavy metals from solution by binding them through the chelation reaction. Comparing bioassay results before and after adding these agents indicates if and to what degree metals influence toxicity. According to the method, strong toxicty removal by EDTA coupled with weak removal by STS indicates zinc as a likely source.

During both events monitored this past winter the Port analyzed metals in flow-weighted composite samples taken at four outfalls and in composite and discrete samples taken at select instream sampling stations. These samples were taken concurrently with those for the Dissolved Oxygen (DO) Study (POS, 1999b), where instream DO was monitored continuously *in situ* to determine if and to what extent ground deicing chemicals affect the streams. The tables below outline the samples and locations where they were taken. Because the December 1998 event also coincided with the only storm qualifying for monthly sampling for NPDES permit compliance (POS, 1999a), other outfalls (SDE4 and SDN1) were also sampled in addition to those targeted specifically for this study. Both storm events sampled met compliance sampling and reporting criteria (POS, 1999a). All flow-weighted composite samples taken by automatic sampler also met these criteria. Therefore, data from the two deicing events sampled are comparable to other NPDES samples in the Port's extensive stormwater database.

Overall, metal concentrations in outfall samples were within ranges typically measured during non-deicing events sampled during the past 4 or more years. Table 7 summarizes metals data for outfall samples and compares the data to the overall NPDES sampling history for each outfall. Only one value for total recoverable lead in the February 1999 SDN3 sample exceeded the historical maximum for this outfall. The result of 0.010 mg/l for this sample is less than one third of the water quality standard for total recoverable lead of 0.032 mg/l at 56 mg/l total hardness.

Table 8 summarizes total recoverable metals data for instream samples and compares results to water quality standards calculated at average hardness values measured during this study. In this table, "MC" stands for Miller Creek, and "NWP" stands for Northwest Ponds stations in Des Moines Creek. Metal concentrations were below standards at all locations sampled downstream of Port outfalls. In two cases, concentrations were lower downstream than up, indicating STIA runoff was cleaner than upstream samples.

Because virtually all metals data were within ranges recorded for non-deicing events, the Port believes that the metals measured during ground deicing events monitored this year are not atypical. Therefore, the theory that higher metals occur during these events was not manifested during the two events monitored.

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	total recoverable metals, mg/l							
outfall	event	Cui	rank,%	Pb	rank,%	Zn	rank,%	hard, mg/l
SDS3	Dec-98	0.047	65%	0.002	29%	0.134,	91%	í
SDS3 calc*	Dec-98	0.044	61%	0.004	62%	0,093	82%	
SDS3	Feb-99	0.049	66%	0.001	0%	0.074	76%	53.6
SDS4		only discret	e samples t	aken/analyz	ed, results c	alculated t	below	
SDS4 calc*	Dec-98			0,001	26%	0.063	95%	
SDS4 unit	Feb-99		0%	0.001	26%	0.036	77%	94.
SDN3	Dec-98		68%	0.001	28%	0.089	72%	2
SDN3 calc*	Dec-98		45%	0.002	61%	0.056	52%	
SDN3	Feb-99	0.020	84%	0.010	max	0.060	549	33.
SDN4	Dec-98		11%	0.001	32%	0.075	959	6
SDN4 caic*	Dec-98		0%	0.001	32%	0.034	75%	6 34
SDN4 Calc	Feb-99		48%	0.001	32%	0.026	619	6 55
SDIV4	Dec-98		1	0.006	11%	0.151	439	6
SDE4 3DN1	Dec-98		1		14%	0.122	129	6

## Table 7 Outfall Metals Samples During Ground Deicing Events

"flow-weighted average of multiple discrete grab samples, others are automatic flow-weighted composites.



Table 8 Instream	Metals Samples	During Ground D	eicing Events

nstream		total recov			
location	event	Cu	Pb	Zn	hard, mg/l
NWP in	Feb-99	0.003	0.001	0.035	58.7
NWP out	Feb-99	0.007	0.001	0.057	58.3
MC up	Feb-99	0.003	0,001	0.070	41.4
MC down	Feb-99	0.003	0.001	0.062	64.3
Acute*		0.011	0.032	0.071	55.7
NWP in	Dec-98	0.002	0.002	0.059	40.9
NWP at	Dec-98	0.005	0.001	0.032	74,5
MC up	Dec-98	0.008	0.017	0.147	46.9
MC down	Dec-98	sampling			
Acute*		0.010	0.037	0.070	54.

Shaded results are <MDL, value shown is 1/2 MDL

\*total metals standards calculated (using Ecology's TSDCALC6.xis) at average of hardness values for each



event

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#### 4.7.5 Source Tracing Studies

Because certain sampling results have indicated the possibility of contamination, the Port has conducted source tracing studies aimed at identifying and characterizing potential sources. Through past efforts, the Port has already discovered and eliminated several other sources of stormwater contamination in subbasins SDE4, SDN1, and SDS4 discussed in previous Annual Reports<sup>13</sup>

As discussed in the WET testing section above, during the past year, the Port investigated and found the likely source of toxicity exhibited in SDN1 samples. These results from SDN1 are included in Appendix D, and will be elaborated further in the final WET characterization report expected to be submitted to Ecology this fail. Other source tracing investigations are summarized below.

#### SDE4 Source Tracing

The Port began studying fecal coliforms in SDE4 discharges in 1998 and continues to investigate causes of sporadic elevated results. Approximately 60% of the 31 NPDES grab samples to date were less than 600 per 100 ml, yet 24% were greater than 1600. Though, it is not unusual for stormwater to contain such elevated numbers. The BURP (1984) study found a fecal coliform median of 980 per 100 ml in 326 stormwater samples. Fecal coliforms were often several thousand or more in the 200 stormwater samples taken at instream and outfall locations during the comprehensive Bellevue (1995) study, which concluded that the high concentrations were probably due to animal wastes. Preliminary STIA findings summarized below do not implicate sanitary sewage or other domestic wastewater as a cause.

No obvious inappropriate drainage connections were found after reviewing site plans and inspecting field conditions in August 1998. Sanitary sewer lines run parallel to SDE4 drain lines in several areas, but in most cases are at lower grades. The field review identified a minor source of wash water from the rental car wash attributable to track-out by vehicles. This source was corrected by an asphalt berm added by POS maintenance.

The Port conducted two detailed sampling routines in November 1998, collecting grab samples at up to 11 branches of the SDE4 drainage system upstream from the NPDES monitoring location

<sup>&</sup>lt;sup>13</sup> See POS 1997, 1998. Inappropriate connections to the stormdrains were found and eliminated in subbasins SDE4, SDN1, and SDS4.

(SDE4-47.) These samples indicated elevated fecal coliforms stemming from several locations. Nonetheless, results for other parameters analyzed did not indicate domestic wastewater contamination. The consistency of these findings is limited by the two rainfalt events sampled, the first of which ceased before all samples could be collected.

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Samples were analyzed for fecal coliforms by two methods that yield the number of colonies per 100 milliliters: 1) the routine NPDES testing method or multiple tube fermentation process (9221E) that yields the most probable number or "MPN" metric, and 2) the membrane filter (MF) method (9221D). The latter method was used because it has a higher endpoint without sample dilution. Field QC blanks verified sterile sampling conditions were achieved using the specially developed device used to collect samples remotely in the deep pipes. Sample results are summarized in Appendix F.

According to Lalor, Pitt and Field (1993), surfactants, fluoride, potassium, ammonia and conductivity can be highly effective indicators to determine if and to what degree a variety of domestic wastewaters, including sanitary sewage may contaminate stormwater. When the ratio of ammonia to potassium exceeds 0.9, the presence of sanitary sewage or septage is indicated. In the two November 1998 upstream source tracing sequences, this ratio ranged from 0.01 to 0.46. Ongoing NPDES grab samptes taken from manhole SDE4-47 since these two events show ratios ranging from 0.04 to 0.79. Figure 12 shows that the elevated fecal coliform results are not correlated with these ammonia to potassium ratios. Surfactants<sup>1</sup>, fluoride and ammonia were generally low, near detection limits in nearly all samples. Therefore, these results do not appear to implicate the presence of sanitary sewage. Furthermore, given the sporadic nature of the elevated results and the fact that several baseflow samples showed no contamination, a direct cross connection is unlikely. Nonetheless, the Port is proceeding with other diagnostic tools (similar to Trial, 1993 and King County, 1995) to determine the source of the elevated fecal coliforms.

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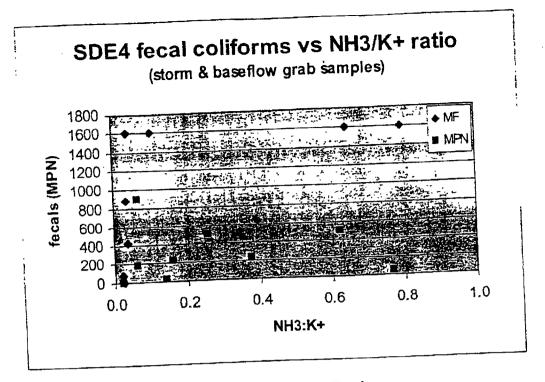


Figure 12 SDE4 Source Tracing

## Observations in SDS1 discharges

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Several SDS1 grab samples and observations in 1999 indicated potential contamination. Foam was observed below the outfall during initial runoff from storms sampled on March 12 and June 20, Surfactants and phosphates were analyzed and may indicate contaminants in these samples, Table 9 below summarizes sampling results. Potential sources and areas to investigate include several small area drain inlets under the South Satellite overhang.

### Table 9 SDS1 Samples (mg/l)

Consile ID	event_	ph	Fecals	TPH-	BOD5	NH3	Surf	total	TDP	SRP	comments
Sample ID	Croin,	<b>-</b>	(MPN)	Dx				glycols	:	-	1.2.4
· · · · · · · · · · · · · · · · · · ·	10 11 00	1	<u> </u>	<u>t:</u>	123	0.012	3.92	48.7			quarterly deice grab
SDS1 031299	12-Mar-99										sample
				1.56			0.470	<4.0	0.145	0.075	Foam observed below
SDS1 062099 #1	20-Jun-99	6.7	/ >1600	1.50							outfall
						·· ·	0.689	<4.0	0.175	0.085	Foam observed below
SDS1 062099 # 2	20-Jun-99	9					0.000				outfall

## Inappropriate connection in SDN1

During the source tracing study conducted relative to the WET testing results, the Port also found an inappropriate connection in the SDN1 subbasin. A slot drain that drains several loading docks in the Avia building number 2 connects to manhole SDN1-19 via a 6" PVC pipe. Instead, this drain should be connected to the nearby IWS drain system. The Port will investigate re-routing this drainage.

#### 4.8 Accomplishments

In the past year, monitoring activities led to several noteworthy accomplishments, some of which have been discussed above. In addition to completing the required routine sampling work, these actions were:

- Identification of a drainage connection from a loading dock drain to the SDN1 storm drainage system.
- Identification of a clogged IWS drain inlet that may overflow to the SDS3 storm drainage system.
- 3. Addition of a berm to prevent the limited water tracked-out of the rental carwash from
  - entering the SDE4 storm drainage system.
- Identification of the likely source of toxicity exhibited in SDN1 WET tests.
- 5. Completion of the WET testing characterization requirements.
- Covering of three SDS3 drain inlets with solid lids, eliminating a limited area of ramp drainage near the C- Concourse.

#### 4.9 Outfall Inspections

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Appendix G summarizes the visual observations made at outfalls during the past year. The number of instances exceeds inspection requirements of the Stormwater Pollution Prevention Plan (SWPPP, POS 1998f.) The annual dry-weather inspection was conducted during August 1998. Visual observations and samples taken did not indicate problems associated with baseflows or other dry-weather flow.

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### 5 CONCLUSIONS



Storm sample results from the past year continue to support the conclusions reached in previous reports that STIA stormwater compares favorably to other comparable regional data, even with instream stormwater data. Constituents and concentrations of concern at STIA have been generally associated with specific activities or locations, and usually not routine runoff. The Port has alleviated many concerns by implementing various BMPs and data generally indicate that these BMPs have been effective. Still, the Port continues to investigate other issues to resolve problems indicated by the data.

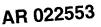
In addition to completing all required routine stormwater sampling, the Port accomplished the following actions in the past year.

- Discovered an inappropriate drainage connection from a loading dock drain to the SDN1 storm drainage system.
- 2. Identified a clogged IWS drain inlet that may overflow to the SDS3 storm drainage system,
- Added a berm to prevent the limited water tracked-out of the rental carwash from entering the SDE4 storm drainage system.
- 4. Identified the likely source of toxicity exhibited in SDN1 WET tests.
- 5. Completed the WET testing characterization requirements.
- Eliminated a limited area of ramp drainage to SDS3 near the C- Concourse by covering three drain inlets with solid lids.

Below are suggestions for further work indicated by the past year's monitoring efforts:

- petition Ecology to eliminate sampling at outfalls SDS1 (003) and SDN2 (007) as allowed for in permit condition S2.B.4. The Port has satisfied the minimum number of sampling events at these two outfalls. The data show that BMPs have been effective,
- 2. continue to investigate possible sources of fecal coliforms in SDE4 discharges,
- investigate the IWS drain inlet drainage backup at structure IWS-563 near C-Concourse gate C8. Overflow from this inlet appears to drain to the next IWS slot drain, but may escape to the nearby and contiguous SDS3 subbasin,
- 4. investigate potential sources of stormwater contamination in subbasin SDS1, and
- investigate alternatives for connection of a loading dock drain that connects to the SDN1 system.





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APPENDICES

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# APPENDIX A STORM EVENT HYDROLOGIC AND HYDRAULIC DATA

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In         In<		depth.	dur.	Int.	24hrant.	48hrant.		dryant,	load		
24         0.35         0.03         0.08         10         0.4         3.5         NPDES           38         0.03         0         0         40         2.1         4.1         NPDES           38         0.03         0         0         30         2.1         4.1         NPDES           32         0.05         0         0.09         26         1.1         1.8         NPDES           32         0.06         0         0.09         26         1.1         1.8         NPDES           32         0.07         0         0.06         0.0         0.09         26         1.1         NPDES           33         0.14         0.02         0.34         0.1         3.0         NPDES           34         0.06         0         0.06         0.02         3.0         NPDES           32         0.14         0.02         0.3         1.4         0.0         0.06           33         0.17         0         0.16         0.02         3.0         NPDES           33         0.16         0         0.02         3.1         1.3         NPDES           21         0.05 <td< th=""><th>stormdate</th><th>u u</th><th>Ę</th><th>In/hr</th><th>Ē</th><th>Ē</th><th></th><th>days</th><th>factor</th><th>event type*</th><th>comment</th></td<>	stormdate	u u	Ę	In/hr	Ē	Ē		days	factor	event type*	comment
38         0.03         0         0         48         2.0         14         NPDES           22         0.06         0         0         73         3.3         4.7         NPDES           9         0.07         0         0.05         2.1         4.0         non-storm           19         0.07         0         0.05         0         17         3.2         NPDES           23         0.07         0         0.16         40         1.7         3.2         NPDES           34         0.14         0.02         0.04         9         0.4         1.3         NPDES           33         0.14         0.02         0.04         9         0.4         1.3         NPDES           33         0.1         0         0.61         2.7         1.1         1.9         NPDES           33         0.15         0         0.05         3.3         1.4         1.0         non-storm           33         0.1         0         0.13         0.85         2.5         0.9         NPDES           21         0.05         0         0.13         1.4         1.0         non-storm <t< td=""><td>6/24/99</td><td>1.12</td><td>24</td><td>0.35</td><td>0.03</td><td>0.08</td><td>9</td><td>0.4</td><td>3.5</td><td>NPDES</td><td>grabs only due to more rain than forecast</td></t<>	6/24/99	1.12	24	0.35	0.03	0.08	9	0.4	3.5	NPDES	grabs only due to more rain than forecast
10         0.08         0         0         50         2.1         4.0         non-storm           22         0.06         0         79         3.3         4.7         NPDES           19         0.07         0         0.09         26         1.1         1.8         NPDES           15         0.07         0         0.16         40         1.7         3.0         NPDES           34         0.14         0.02         0.04         9         0.4         1.3         NPDES           32         0.07         0         0.08         1.4         3.0         NPDES           33         0.14         0.02         0.04         9         0.4         1.3         NPDES           33         0.16         0         0.61         2.1         1.1         1.9         NPDES           33         0.16         0         0.65         2.2         0.9         NPDES           222         0.16         0         0.02         3.3         1.4         1.0         NPDES           33         0.16         0         0.05         3.3         1.4         1.0         NPDES           33 <t< td=""><td>6/20/99</td><td>0.21</td><td>38</td><td>0.03</td><td>0</td><td>0</td><td>48</td><td>2.0</td><td>4.4</td><td>NPDES</td><td></td></t<>	6/20/99	0.21	38	0.03	0	0	48	2.0	4.4	NPDES	
22         0.06         0         79         3.3         4.7         NPDES           19         0.07         0         0.15         40         1.1         1.8         NPDES           15         0.07         0         0.15         40         1.7         3.2         NPDES           23         0.07         0         06         26         1.1         1.8         NPDES           34         0.14         0.02         0.04         9         0.4         1.3         NPDES           32         0.06         0         0.61         2.7         1.1         1.9         NPDES           28         0.09         0.01         0.35         22         0.0         1.4         NPDES           33         0.1         0         0.05         23         1.4         NPDES           39         0.16         0         0.05         3.5         1.3         NPDES           39         0.16         0         0.05         3.5         1.4         NPDES           39         0.16         0         0.05         3.5         1.4         NPDES           21         0.05         0         0.55<	5/11/99	0.14	<del>6</del>	0.08	0	0	50	2.1	4.0	non-storm	WET & source trace at SDN1 only
9         0.07         0         0.09         26         1.1         1.8         NPDES           19         0.08         0         0.15         40         1.7         3.2         NPDES           15         0.05         0         0.15         40         1.7         3.2         NPDES           34         0.14         0.02         0.04         9         0.4         1.3         NPDES           32         0.06         0.01         0.35         20         0.8         1.2         NPDES           32         0.07         0         0.61         2.7         1.1         1.9         NPDES           28         0.06         0.01         0.85         2.0         0.8         NPDES           33         0.1         0         0.61         2.7         NPDES           39         0.16         0         0.8         5.4         2.4.5         NPDES           21         0.05         0         0.65         3.1         4.7         NPDES           29         0.18         0         0.25         2.3         1.4         2.4.5         NPDES           21         0.03         0	5/7/99	0.25	22	0.06	0	0	62	3.3	4.7	NPDES	annual samples
19         0.08         0         0.15         40         17         3.2         NPDES           23         0.07         0         0         96         4.0         5.0         NPDES           32         0.06         0.01         0.25         0.04         9         0.4         1.3         NPDES           32         0.06         0.01         0.35         22         0.0         1.1         NPDES           28         0.09         0.01         0.05         23         1.4         3.3         NPDES           33         0.1         0         0.61         27         1.1         1.9         NPDES           22         0.16         0         0.61         27         1.1         1.9         NPDES           21         0.05         0         0.05         33         1.4         3.3         NPDES           22         0.16         0         0         0.55         2.7         NPDES           39         0.16         0         0         0.5         3.1         4.1         NPDES           4         0.03         0         0         0.5         3.5         1.6         NPDES	3/27/99	0.24	ß	0.07	0	0.09	26	1.1	1.8	NPDES	
23         0.07         0         0         71         3.0         5.0         NPDES           34         0.14         0.02         0.04         9         0.4         1.3         NPDES           32         0.06         0.01         0.35         20         0.8         1.2         NPDES           32         0.06         0.01         0.35         20         0.8         1.2         NPDES           33         0.1         0         0.61         2.7         1.1         1.9         NPDES           33         0.1         0         0.61         2.7         1.1         1.9         NPDES           33         0.16         0         0.61         2.7         1.1         1.9         NPDES           21         0.05         0         0.61         2.7         NPDES         1.4         1.0         1.0           39         0.16         0         0         0.54         2.3         1.4         1.0         1.0           4         0.03         0         0.02         0.3         1.4         1.0         1.0         1.4         1.0         1.0           21         0.03         0 <td>3/24/99</td> <td>0.28</td> <td>19</td> <td>0.08</td> <td>0</td> <td>0.15</td> <td>40</td> <td></td> <td>3.2</td> <td>NPDES</td> <td>WET @ SDE4, SDN1 &amp; monthlies</td>	3/24/99	0.28	19	0.08	0	0.15	40		3.2	NPDES	WET @ SDE4, SDN1 & monthlies
15         0.05         0         0         4         0.02         0.04         9         0.4         1.3         NPDES           32         0.06         0.01         0.35         20         0.8         1.2         NPDES           32         0.06         0.01         0.35         20         0.8         1.2         NPDES           32         0.07         0         0.61         27         1.1         1.9         NPDES           33         0.01         0.05         27         1.1         1.9         NPDES           28         0.06         0         0.61         27         1.1         1.9         NPDES           21         0.05         0         0         0.54         2.3         NPDES           39         0.16         0         0         0.54         2.3         1.4         1.0           4         0.03         0         0         0.65         3.1         4.7         NPDES           66         0.18         0         0         0.73         3.1         4.7         NPDES           62         0.15         0         0.06         3.3         1.3         4.7	3/12/99	0.83	23	0.07	۵	0	71		5.0	NPDES	
34         0.14         0.02         0.04         9         0.4         1.3         NPDES           28         0.06         0.01         0.35         20         0.8         1.2         NPDES           28         0.06         0.01         0.35         20         0.8         1.2         NPDES           28         0.07         0         0.61         27         1.1         1.9         NPDES           28         0.07         0         0.61         27         1.4         3.3         NPDES           28         0.05         0         0.65         22         0.9         2.0         NPDES           21         0.05         0         0         0.54         2.4.5         NPDES           21         0.03         0         0         0         2.6         2.7         NPDES           39         0.16         0         0         0         3         2.6         2.7         NPDES           4         0.03         0         0.05         3         1.4         1.0         non-storm           52         0.32         0.33         1.4         1.0         non-storm	3/8/99	0.28	15	0.05	0	¢	96		4.8	NPDES	
32         0.06         0.01         0.35         20         0.8         1.2         NPDES           28         0.06         0         0         59         2.5         4.7         NPDES           28         0.07         0         0.61         27         1.1         1.9         NPDES           28         0.09         0.01         0.05         2         3         1.4         3.3         NPDES           21         0.05         0         0.05         2         3         1.4         3.3         NPDES           21         0.03         0         0         0         54         2.4.5         NPDES           39         0.16         0         0         0         1.4         1.0         non-storm           4         0.03         0         0         0.2         3         1.4         1.0         non-storm           52         0.32         0.03         3         1.4         1.0         non-storm           66         0.18         0         0         0         0         3         1.4         NPDES           62         0.15         0         0.05         3 <t< td=""><td>2/22/99</td><td>0.56</td><td>34</td><td>0.14</td><td>0.02</td><td>0.04</td><td>6</td><td></td><td>1.3</td><td>NPDES</td><td>WET @ SDE4</td></t<>	2/22/99	0.56	34	0.14	0.02	0.04	6		1.3	NPDES	WET @ SDE4
28         0.08         0         0.51         2.5         4.7         NPDES           33         0.1         0         0.61         27         1.1         1.9         NPDES           33         0.1         0         0.01         0.85         23         1.4         3.3         NPDES           22         0.16         0         0.01         0.85         3.5         1.3.6         NPDES           21         0.05         0         0         0.54         2.3         2.7         NPDES           39         0.16         0         0         0         0         54         24.5         NPDES           4         0.03         0         0         0.05         33         1.4         1.0         non-storm           52         0.32         0.28         0.31         8         0.3         2.6         non-storm           52         0.35         0         0         0.3         3         1.3         NPDES           9         0.19         0         0         0         0         3         1.4         1.0           52         0.33         1.4         1.03         2.16	2/18/99	0.6	32	0.06	0.01	0.35	20	0.8	1,2	NPDES	
19 $0.07$ 0 $0.61$ $27$ $1.1$ $1.9$ NPDES         28 $0.09$ $0.01$ $0.95$ $22$ $0.3$ $1.4$ $3.3$ NPDES         22 $0.16$ $0$ $0.02$ $3.3$ $1.4$ $3.3$ NPDES         21 $0.05$ $0$ $0.25$ $2.2$ $0.9$ $2.0$ NPDES         39 $0.16$ $0$ $0.02$ $33$ $1.4$ $3.3$ NPDES         4 $0.03$ $0$ $0.02$ $33$ $1.4$ $1.0$ $non-storm$ 52 $0.32$ $0.26$ $0.31$ $8$ $0.3$ $2.6$ $non-storm$ 66 $0.18$ $0$ $0.0$ $0.3$ $3.1$ $4.7$ NPDES         39 $0.48$ $0.3$ $1.3$ $1.3$ $1.0$ $non-storm$ $4$ $0.03$ $0$ $0.05$ $31$ $1.3$ $1.0$ $1.0$ $52$ $0.19$ $0.73$ $3.1.3$ $1.3$ $1.0$ $1.0$	2/15/99	0.45	28	0.08	0	0	59	2,5	4.7	NPDES	
33       0.1       0       0.02       33       1.4       3.3       NPDES         28       0.09       0.01       0.85       2.5       13.6       NPDES         21       0.05       0       0       54       2.3       NPDES         21       0.05       0       0       54       2.3       NPDES         39       0.16       0       0.02       33       1.4       1.0       non-storm         4       0.03       0       0.02       33       1.4       1.0       non-storm         52       0.32       0.28       0.31       8       0.3       1.4       1.0       non-storm         52       0.32       0       0.02       33       1.4       1.0       non-storm         66       0.15       0       0.05       31       1.3       NPDES         62       0.15       0       0.06       7.3       1.3       NPDES         39       0.48       0       0       0.72       36       1.5       1.4       NPDES         39       0.19       0       0       0       7.3       1.3       NPDES         20	2/3/99	0.28	19	0.07	0	0.61	27	1.1	1.9	NPDES	
28         0.09         0.01         0.85         22         0.9         2.0         NPDES           22         0.16         0         0         54         2.3         5         13.6         NPDES           21         0.05         0         0         54         2.3         5         13.6         NPDES           39         0.16         0         0         0         54         2.4.5         NPDES           4         0.03         0         0.02         33         1.4         1.0         non-storm           52         0.32         0.18         0         0.02         33         1.4         1.0         non-storm           52         0.15         0         0.05         31         1.3         NPDES           66         0.19         0         0         0         3         3         3         4.7         NPDES           39         0.48         0         0         0.07         36         1.5         7.9         NPDES           39         0.48         0         0         0         7.3         7.9         NPDES           20         0.16         0         0 </td <td>1/28/99</td> <td>1.16</td> <td>33</td> <td>0.1</td> <td>0</td> <td>0.02</td> <td>33</td> <td>1.4</td> <td>3.3</td> <td>NPDES</td> <td>SDN2 bypass (maintenance related)</td>	1/28/99	1.16	33	0.1	0	0.02	33	1.4	3.3	NPDES	SDN2 bypass (maintenance related)
22       0.16       0       0       85       3.5       13.6       NPDES         21       0.05       0       0       54       2.3       2.7       NPDES         39       0.16       0       0       54       2.3       2.7       NPDES         4       0.03       0       0.02       33       1.4       1.0 <i>non-storm</i> 4       0.03       0       0.02       33       1.4       1.0 <i>non-storm</i> 66       0.18       0       0       0       73       3       1.3       NPDES         66       0.18       0       0       0.73       3       1.3       NPDES         73       0.15       0       0       0.73       3       1.3       NPDES         9       0.19       0       0       7.3       1.3       NPDES         23       0.26       0       0       0       7.9       NPDES         20       0.16       0       0       7.9       7.9       NPDES         23       0.26       0       0       7.9       7.9       NPDES         10       0.26       1 <td>1/20/99</td> <td>0.42</td> <td>28</td> <td>0.09</td> <td>0.01</td> <td>0.95</td> <td>22</td> <td>0.9</td> <td>2.0</td> <td>NPDES</td> <td>WET @ SDE4</td>	1/20/99	0.42	28	0.09	0.01	0.95	22	0.9	2.0	NPDES	WET @ SDE4
21         0.05         0         0         54         2.3         2.7         NPDES           39         0.16         0         0         153         6.4         2.3         2.7         NPDES           4         0.03         0         0.02         33         1.4         1.0 <i>non-storm</i> 66         0.18         0         0.05         31         1.3         NPDES           66         0.18         0         0.05         31         1.3         4.7         NPDES           66         0.18         0         0.05         31         1.3         4.7         NPDES           39         0.48         0         0.06         7.3         31         1.3         4.7         NPDES           39         0.48         0         0         0.7         36         1.5         7.9         NPDES           20         0.16         0         0         0         7.3         1.4         NPDES           21         0.26         1         1.4         8.2         38.5         NPDES           22         0.16         0         0         7.9         7.9         NPDES     <	1/13/99	1.07	22	0.16	0	0	85	3.5	13.6	NPDES	WET @ SDS3, SDN1, SDN4 + WER (SDS3)
39         0.16         0         0         153         6.4         24.5         NPDES           4         0.03         0         0.02         33         1.4         1.0         non-storm           52         0.32         0         0.02         33         1.4         1.0         non-storm           66         0.18         0         0         0         0         3         1.3         NPDES           62         0.15         0         0.05         31         1.3         4.7         NPDES           39         0.19         0         0.05         31         1.3         4.7         NPDES           39         0.19         0         0.07         35         1.5         7.8         NPDES           3         0.22         0         0.72         3         1.3         1.0         1.0           20         0.16         0         0         0         7.3         1.4         1.1         non-storm           210         0.26         1.4         1.3         4.7         3         2.9         non-storm           220         0.16         0         0         7.3         1.1	1/9/99	0.27	21	0.05	0	•	2	2.3	2.7	NPDES	
4         0.03         0         0.02         33         1.4         1.0         non-storm           52         0.32         0.28         0.31         8         0.3         2.6         non-storm           66         0.18         0.31         8         0.3         2.6         non-storm           66         0.18         0.31         8         0.3         3         1.3         NPDES           62         0.15         0         0.05         31         1.3         4.7         NPDES           39         0.48         0         0.06         35         1.5         16.8         NPDES           39         0.48         0         0.07         36         1.5         7.9         NPDES           3         0.22         0         0.07         36         1.5         7.9         NPDES           20         0.019         0         72         3         1.5         7.9         NPDES           20         0.148         6.2         33         1.5         7.9         NPDES           20         0.16         0         73         6.1         1.1         non-storm           10	12/24/98	1.19	39	0.16	0	0	153	6.4	24.5	NPDES	Snow & runway deicing event
4         0.03         0         0         49         2.0         1.5         non-storm           52         0.32         0.28         0.31         8         0.3         2.6         non-storm           66         0.18         0         0         73         3         1.3         NPDES           62         0.15         0         0.05         31         1.3         4.7         NPDES           39         0.48         0         0.06         35         1.5         16.8         NPDES           39         0.48         0         0.018         35         1.5         1.6         NPDES           3         0.19         0         0         7         3         1.5         7.8         NPDES           3         0.26         0         0.07         36         1.5         7.8         NPDES           20         0.16         0         0         73         10.8         NPDES           20         0.26         0         0         73         10.8         NPDES           21         0.22         0         0         73         10.1         10.1           16	12/17/98	0.11	4	0.03	0	0.02	33	1.4	1.0	mois-non	
52         0.32         0.28         0.31         8         0.3         2.6         non-storm           66         0.18         0         0         73         3         13         NPDES           66         0.15         0         0.05         31         1.3         4.7         NPDES           39         0.48         0         0.05         31         1.3         4.7         NPDES           39         0.48         0         0.06         35         1.5         16.8         NPDES           3         0.19         0         0         73         35         1.5         18         NPDES           3         0.26         0         0.07         36         1.5         7.8         NPDES           20         0.16         0         0         73         6.2         33.5         NPDES           16         0.25         0         0         73         19.8         NPDES           16         0.26         0         0         29         29         29           21         0.1         9.1         1.1         non-storm           22         0.14         0.1 <td< td=""><td>12/10/98</td><td>0.14</td><td>4</td><td>0.03</td><td>0</td><td>٥</td><td>49</td><td>2.0</td><td>1.5</td><td>non-storm</td><td></td></td<>	12/10/98	0.14	4	0.03	0	٥	49	2.0	1.5	non-storm	
66         0.18         0         0         73         3         13         NPDES           39         0.48         0         0.05         31         1.3         4.7         NPDES           39         0.48         0         0.06         35         1.5         16.8         NPDES           39         0.48         0         0.07         35         1.5         16.8         NPDES           3         0.19         0         0         7         35         1.5         18.0         NPDES           3         0.22         0         0.07         36         1.5         7.9         NPDES           23         0.26         0         0.72         36         1.9         NPDES           20         0.16         0         0         73         6.2         33         198         NPDES           16         0.26         0         0         73         10         NPDES         29           29         29         29         29         29         29         29         29           26         0.14         0.01         0.10         9.1         11         100.47	11/25/98	3.45	52	0.32	0.28	0.31	8	0.3	2.6	mole-non	pump station bypass to SDN2
62         0.15         0         0.05         31         1.3         4.7         NPDES           39         0.48         0         0.08         35         1.5         16.8         NPDES           9         0.19         0         0         72         3         1.4         NPDES           3         0.22         0         0.07         36         1.5         7.9         NPDES           23         0.26         0         0.07         36         1.5         7.9         NPDES           20         0.16         0         0         148         6.2         36.5         NPDES           20         0.16         0         0         73         198         NPDES           20         0.16         0         0         73         10         NPDES           20         0.16         0         0         73         73         10         NPDES           20         0.16         0         7         98         NPDES           21         0.26         1         1         1         10         10           22         0.29         29         29         29 <td< td=""><td>11/19/98</td><td>2.34</td><td>99</td><td>0.18</td><td>0</td><td>0</td><td>23</td><td>e</td><td>13</td><td>NPDES</td><td>-</td></td<>	11/19/98	2.34	99	0.18	0	0	23	e	13	NPDES	-
39         0.48         0         0.08         35         1.5         18.8         NPDES           9         0.19         0         0         72         3         1.4         NPDES           3         0.22         0         0.07         36         1.5         7.8         NPDES           23         0.26         0         0.07         36         1.5         7.8         NPDES           20         0.16         0         0         148         6.2         33.5         NPDES           20         0.16         0         0         73         198         NPDES           10         0.25         0         0         73         10         NPDES           21         0.20         0         0         73         non-storm           21         0.04         0         0         29         29         29           22         0.90         0         0         49         29         29         29           22         0.14         0.01         0.10         99         4.1         16.0         7.7           25         0.14         0.01         0.10         99	11/11/98	0.98	62	0.15	0	0.05	31	1.3	4.7	NPDES	WET @ SDS3, SDN1, SDN4
9         0.19         0         0         72         3         14         NPDES           3         0.22         0         0.07         36         1.5         7.9         NPDES           23         0.26         0         0.07         36         1.5         7.9         NPDES           20         0.16         0         0         456         19         73         non-storm           10         0.25         0         0         7456         19         NPDES           16         0.04         0         782         33         198         NPDES           23         29         29         29         29         29         29         29           23         0.14         0.01         0.10         0         49         2.0         4.7           25         0.14         0.01         0.10         99         4.1         16.0           nbours         re Manual for Stormwater Monitoring (POS 1999a)         nours         16.0         16.0         16.0	11/3/98	1.62	39	0.48	0	0.08	35	1.5	16.8	NPDES	very intense storm. 0.48 & 0 49 In/hr consec.
3         0.22         0         0.07         36         1.5         7.9         NPDES           23         0.26         0         0         148         6.2         38.5         NPDES           20         0.16         0         0         456         19         73         non-storm           10         0.255         0         0         782         33         198         NPDES           16         0.04         0         0         264         11         11         non-storm           29         20         20         20         20	10/27/98	0.64	0	0.19	0	0	72	e	14	NPDES	
23         0.26         0         0         148         6.2         36.5         NPDES           20         0.16         0         0         456         19         73         non-storm           10         0.25         0         0         782         33         198         NPDES           10         0.25         0         0         782         33         198         NPDES           29         29         29         29         29         29         29         29           22         0.09         0         0         49         2.0         4.1         16.0           25         0.14         0.01         0.10         99         4.1         16.0           re Manual for Stormwater Monitoring (POS 1999a)         nours         in hours         in hours         in hours	10/3/98	0.4	ი	0.22	0	0.07	36	1.5	7.9	NPDES	short, intense storm
20         0.16         0         0         456         19         73         non-storm           10         0.25         0         0         792         33         196         NPDES           16         0.04         0         0         264         11         11         non-storm           29         29         29         29         29         29         29           22         0.09         0         0         48         2.0         4.7           25         0.14         0.01         0.10         99         4.1         16.0           re Manual lor Stormwater Monitoring (POS 1999a)         in hours         in hours         in hours         10.10         20.14         20.0	9/24/98	0.47	23	0.26	0	0	148	6.2	38.5	NPDES	
10         0.25         0         0         792         33         198         NPDES           16         0.04         0         0         26.4         11         11         non-storm           29         29         29         29         29         29         29         29           22         0.09         0         0         49         2.0         4.7         25           25         0.14         0.01         0.10         99         4.1         16.0         16.0           rb danual lor Stormwater Monitoring (POS 1999a)         in hours         in hours         10.01 to 10.0         10.0 <td>9/18/98</td> <td>0.19</td> <td>20</td> <td>0.16</td> <td>0</td> <td>۵</td> <td>456</td> <td>5</td> <td>73</td> <td>non-storm</td> <td>thunderstorm</td>	9/18/98	0.19	20	0.16	0	۵	456	5	73	non-storm	thunderstorm
16         0.04         0         0         264         11         11         11           29         20         4.7         7         25         0.14         0.01         0.10         99         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         16.0         36         4.1         36         36         <	8/16/98	0.31	10	0.25	0	0	792	33	198	NPDES	thunderstorm
ound         29         29         29         29         29         29         29         29         29         29         29         29         29         29         29         29         29         20         47         7         7         70         71         71         70         47         7         70         47         70         47         70         47         70         47         70         70         47         70         47         70         70         47         71         16.0         70         70         47         71         16.0         70 <th< td=""><td>7/14/98</td><td>0.13</td><td>16</td><td>0.04</td><td>0</td><td>0</td><td>264</td><td>Ξ</td><td>Ξ</td><td>non-storm</td><td></td></th<>	7/14/98	0.13	16	0.04	0	0	264	Ξ	Ξ	non-storm	
nedian     0.42     22     0.09     0     49     2.0     4.7       verage     0.59     25     0.14     0.01     0.10     99     4.1     16.0       nad factor = maxint (in/hr)*dryant (hrs)     36     10.10     99     4.1     16.0       see criteria in Procedure Manual for Stormwater Monitoring (POS 1999a)     4.1     16.0       2.1" is rainfall duration in hours     2.0     4.1     16.0	ount	29	29	29	29	29	29	29	29		
<pre>verage 0.69 25 0.14 0.01 0.10 99 4.1 16.0 ad factor = maxint (in/hr)*dryant (hrs) see criteria in Procedure Manual for Stormwater Monitoring (POS 1999a) dur" is rainitall duration in hours dur" is rainitall duration in hours</pre>	nedian	0.42	22	0.09	0	٥	49	2.0	4.7		
3ad factor = maxint {ir/hr}*dryent {hrs} see criteria in Procedure Manual for Stormwater Monitoring {POS 1999a} dur* is rainfall duration in hours 24nrent* and *8hrant* is the lotal rainfall in the 24 and 48 hours preceding the event respectively	verage	0.69	25	0.14	0.01	0.10	66	4.1	16.0		
see criteria in Procedure Manuel for Stormwater Monitoring (POS 1999a) dur" is raintait duration in hours 24hrant" and "48hrant" is the total rainfall in the 24 and 48 hours preceding the event respectively	aad factor = r	naxint (in	hr)'dŋ	/ant (hrs	÷.						
dut" is raintail duration in hours 24hrant" and "48hrant" is the fold rainfall in the 24 and 48 hours preceding the event respectively 	See Criteria I	Procedu	Jre Ma	nual ror	Stormwate	ar monitoring		(BARA			
zahranti andi "annanti isi na lokari raintali ni na za ano as nours presentang una event respectively 	dur" is rainfai	duration	In hou	IS Vitility							
	Z4nrant and	4 contant	IS UNB	total rat	ontali un une oct des cor	24 8110 40 1	nours pre	ceuirig are	r everit res 121 colorali	респувку	
dryant' is the ouration of the antecedent ory period to the last measurable (0.011) reinital	dryant" is me	duration	of the	anteceu	ent ary per		ast measu	ITADIO (U.U	1) rainiai		

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99AppendixA storms

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#### 1998-99 Daily Rainfall

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day			Aug-98	the second division of	Oct-98	Nov-98	Dec-98	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99
	1	0	0	. 0	0.08	0.08	0.69	0	0.41	0.32	0	0.05	0
	_ 2	0.02	ō	0	0.01	0.05	0.2	0	0.27	0.15	0.14	0.2	Ċ
	3	0.09	0	0	0.35	0.16	00	0	0.27	0.2	0.12	0.18	0
	4	0.06	0	0	0	1.5	0.01	0	0.04	0.09	0.05	0	0.06
	5_	0	0	0	0	0.08	0,1	0	0.12	0	0.01	Ď	0.00
	6	0	0	0	0	0	0	0.12	0.48	0	ō	0.1	0
	7	٥	0	0	0	0	0.34	0.01	0.52	·	0.1	0.19	0.08
	8	0	0	0	0.54	0.02	0.02 <sup>`</sup>	0	0.26	 0.27	0.04	0	0.01
	9	0	0	0	0.1	0.06	0	D.14	0.01	0		0.09	4.03
	10	0.02	ຼີ້ດໍ	່ວ່	0.09	0.03	0.16	0.16	0.01	- o	0.08	0.00	0
	11	0.04	Ö	Ő	0	0.22	0.91		0	o-		0.19	ő
	12	ס ד	0_	0	0.7	0.68	0.96	0.01	0	0,67	0.02	0.2	0
	13	0	ົ້ວ	Ö	0.28	0.31	1.02	0.26	0.26	0.56	0	0.04	0
	14	0.05	0	0	0.41	0.45	0	0.92	0	0.21		······································	. 0
	15	0.11	0.14	0	0	0.22	0.02	0.25	0.03	0.06	0		. o
	16	0	0.20	0	0	0.08	0	0,16	0.3	0	0	0.06	~ •
	17	0	0	0.02	0.14	0	0.11	0.81	0.07	0.02		0.65	· 0
	18	0	01	0.14	0	0	0	0.65	0.54	0.02	<del>0</del>	0.04	Ö.02
	19	0	0	0	0	0.5	0	0.45	0.09	0	0.21	0	- 0.02
	20	0	0	O	0	1.3	0	0.18	0.02	0	0.16	0	0.19
	21	0	0	0	0	0.78	0	0.19	0.03	0.1	0	0	0.08
	22	0	0	0	0	0.15	0	0.44	0.44	0.15	0	0	0.05
	23	0	0.01	0	0	0.22	0	0.18	0.61	~ 0	0	0	1.27
_	24	C	0	0.10	0.03	0.49	0.43	0	0.74	0.27	0	0.11	0.02
	25	0	0	0.46	0.01	2.96	1.06	0	0.01	0.08	0.18	0	0.01
	26	0	0	0	Ö	0.58	0.07	0.02	m	0.02	0.01	<u> </u>	0
	27	0	0	0	0.55	0.04	1.53	0.38	0.85	0.04	0.27		ŭ
	28	0	0	0	0	0.05	0.11	0.78	0.47	0.26	0	0	0.04
	29	0	0	0	0	0.35	0.97	0.16		0.17	0	<u>-</u>	0.02
	30	0.01	0	0	0	0.25	0	0.2	<u> </u>	0	0.09	0	0.01
	31	0	0		0.19		0.18	0.37		0			
daily ma	XE XE	0.11	0.2	0.46	0.7	2.96	1,53	0.92	0.85	0.67	0.27	0.65	1.27
otal		0.4	0.35	0.72	3.48	11.61	8.89	6.84	6.85	3.66	1.48	2.10	1.85
the second s	avg*	27%	46%	63%	185%	359%	152%	115%	127%	92%	42%	90%	109%
ytd		0.4	0.75	1.47	4.95	16.56	25.45	32.29	39.14	42.8	44.28	46.38	48.23
	6avg*	27%	33%	43%	94%	195%	177%	159%	152%	144%	133%	130%	129%
avg*		1.5	0.76	1.14	1.88	3.23	5.83	5.97	5.38	3,99	3.54	2.33	1.7
avg cun		1.5	2,26	. 3.4	5.28	8.51	14.34	20.31	25.69	29.68	33.22	35.55	37.25
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# samp		0	1	1	2	3	1	4	4	4	ō	1	1
month n		3.82	2.39	4.59	5.95	8.95	10.71	11.85	12.92	9,11	8.4	6.53	4.76
month n	nin*	0.13	T	0.01	Т	0.31	0.74	1.37	0.58	0.35	0.57	0.33	0.12

\*Source: National Weather Service (http://161.55.224.1/smith/climate/search.html)

32 possible "storm" events

22 Sampled events in bold in table. Totals are for 24-hr period and not necessarily an entire "event"

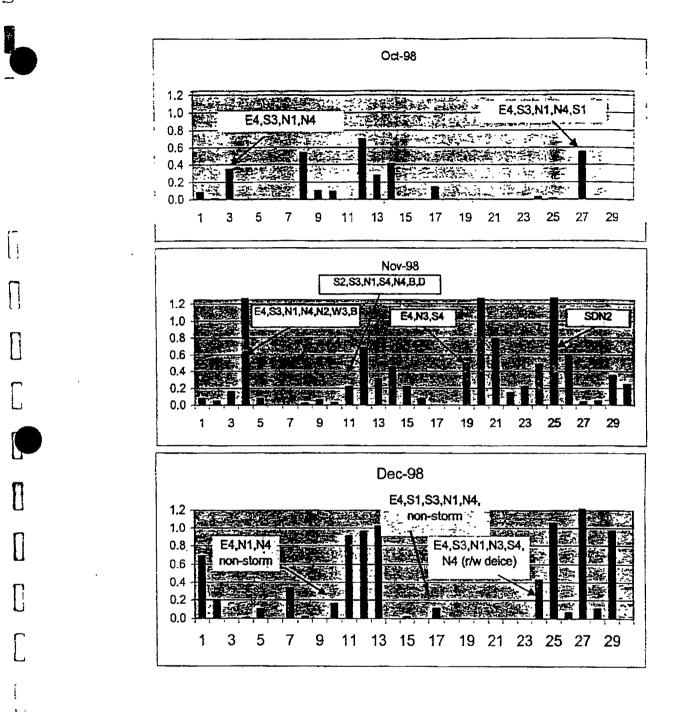
6 non-"storms" sampled (grabs only)

Nov 98 total is new monthly max record (previous 10.71)

99AppendixA rainfall

1998-99 Rainfall at Sea-Tac Airport

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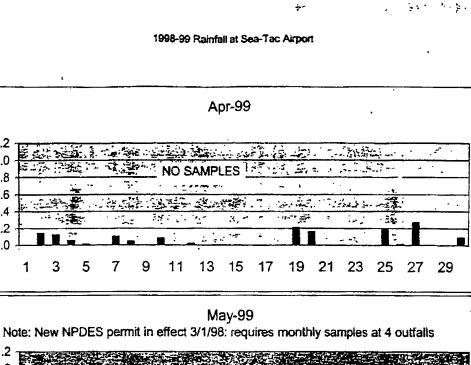
99AppendixA rainfall

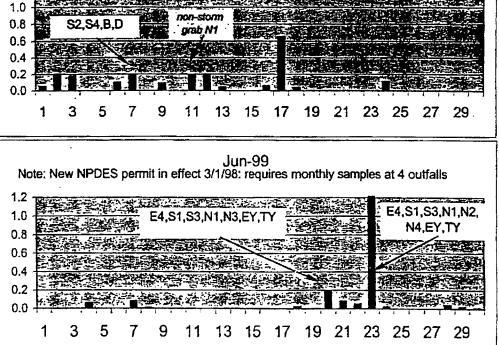
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99AppendixA rainfall

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Estimated Runoff Volumes for Storm Eve Monocod Partitie VII 1987 (1983) 2000 Event P. D. Raimall, 1980 002 (2000) 2003 2010 Determine Raimall, 1980 002 (2000) 2000 6024090 1.12 3.121,000 198,000	6/20/89 5/11/99 5/7/99 3/21/99 3/12/99	2/2/99 2/2/96 2/15/99 2/15/99 1/20/99 1/12/9/98 1/12/9/98 1/12/17/98	11/125/98 11/19/98 11/19/98 11/3/98 10/27/98 10/3/98	9/18/98 8/16/98 7/14/98	Reinfall det from Netlonel Weether Servic Reinfall det from Netlonel Weether Servic SUN2 volumes Dased upon basin-specific SDN2 volumes gaged by flowmeter during Note-sorreitons bruit into embedded functiv	Nue, evenue, evenue, evenue, max runoff, gal/in Ar', impervious srea, so "Ap", pervious srea, so Cr ( =0, 30(A)) + 0.25(Ap)	

88AppendixA runoff volumes

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3/24/99	0.08	3630	310	140	9400	360	1270	1060	290	450	42	25	480	380
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2/18/99	0.06	2720	230	110	71001	270	950	800	220	340	31	19	360	290
2/15/99	0.08	3630.	310	140	9400	360,	1270	1060	290	450,	42	25	480	380
2/3/99	0.07	3180	270	130	0300	320	1110	930	250	400	36	22	420	330
1/28/99	0.10	4540	390	180	11800	450	1590	1330	360	570	62	32	600	480
1/20/99	0.09	4080	350	160	10600	410	1430	1200	330	510	47	29	540	430
1/13/99	0.16,	7260	630	290	18900	720	2540	2130	580	800	83	51	990	760
1/8/99	0.05	2270	200	06	5900	230	790	660	180	2,80	26	16	300	240
12/24/98	0.10	7260	630	290	18900	720	2640	2130	580	800	83	51	960	780
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11/3/98	0.48	21780	1880	860	58700	2170	7810	6380	1760	2710	250	152	2870	2290
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9/18/98	0.16,		630	290	18900	720	2640	2130	580	008	8	51	960	9
8/16/98	0.251	11340	980	450	29500	1130	3960	3320	910	1410.	130	61	1500	1190
7/14/98	0.04	1820	160	20	4700	180	630	530	150	230	21	<b>₽</b>	240	190
Reinfall data from Port of	hor Port	of Seatt	e and/o	r Nation	Seattle and/or National Weath		Service rain	1e egeo	Sea-l'ac	Alrport				
Peak runoff rates based upon "rational method": Q=CIA	rates based	uodn į	rational	method					,, ·					
-A", Basin Areas, ac	8, ac	149	F	13	462	Į₹	20	63	14	30	1.5	0.8	22	34
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"Al", impervious area, ac	US BFOB, BC	67	9.2		224	10.2	27	20.8	~	Ð	1,2	0 B	-	32
"Ap", pervious area, ac	8r88.8c	52	1.5		238	3.3	43	42.6	7	23	0		48	30,7
Cr ( =0.90(Al) + 0.25(Ap)	+ 0.25(Ap))	0.0	19.0	<u>195-0</u>	10.0	6.0	0.0	0.40	199.0	0.4	0.78	0.20	17.0	50

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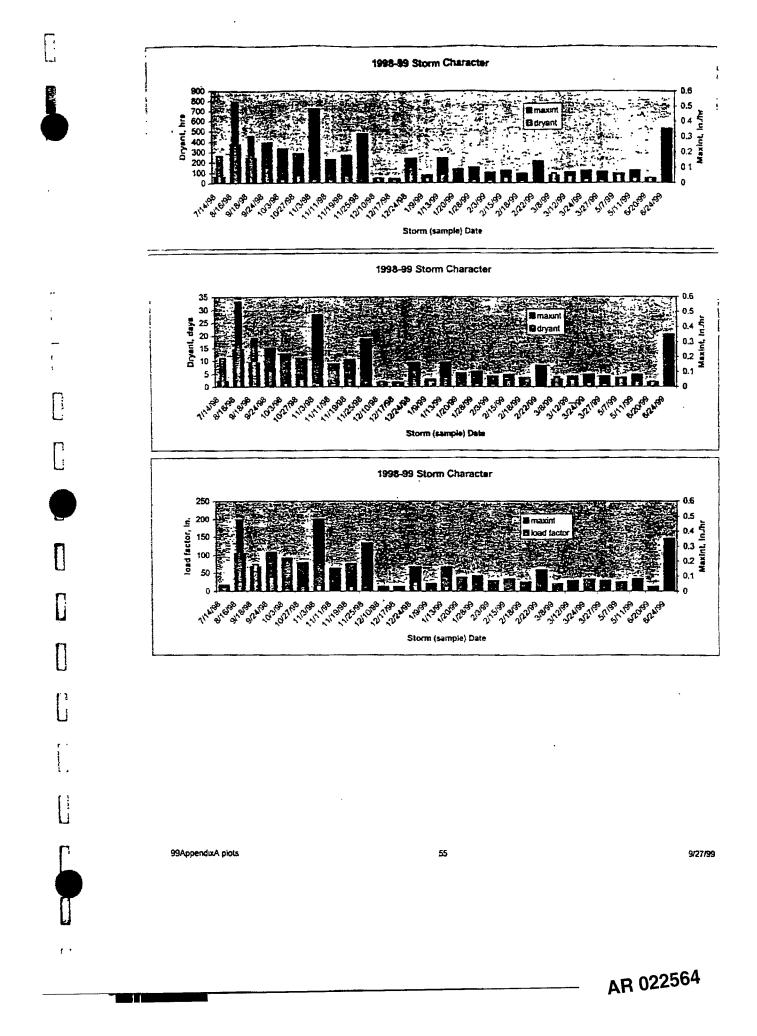
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# APPENDIX B TABULAR NPDES SAMPLE DATA SUMMARIES

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### APPENDIX C TABULAR DEICING EVENT SAMPLE DATA SUMMARIES



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Speck (1) (17)         Speck (11)         Speck (1) (17)         Speck (11)         Speck (11) <th< td=""><td>SDE4 010797 AVG SDE4 010797 AVG SDE4 0112797 SDE4 003037 SDE4 003037 SDE4 003037 SDE4 003037</td><td></td><td>97 97 storm 97 storm</td><td></td><td></td><td>4 1 0</td><td></td><td>_</td><td>_</td><td>-</td><td>•</td><td>-</td><td>ol and BOD<mdl< td=""></mdl<></td></th<>	SDE4 010797 AVG SDE4 010797 AVG SDE4 0112797 SDE4 003037 SDE4 003037 SDE4 003037 SDE4 003037		97 97 storm 97 storm			4 1 0		_	_	-	•	-	ol and BOD <mdl< td=""></mdl<>
SDE4 010797 MCG         12/2016         191         SEE         aeriae arg         yes         256         13         8         15         23           SDE4 010797 MCG         12/2017         1997 storm         12.1         118         13         3	SDE4 010797 AVG SDE4 011697 SDE4 012997 SDE4 050397 SDE4 050397 SDE4 050397 SDE4 050397 SDE4 050397		97 97 storm 97 storm	,21 1 1 2 1				-		•		6-da	ave of 15 lime-composite samples
SDE4 01/07 Avol         12/209         1997         36/07         12/1997         1393         36/07         12/1997         1393         36/07         12/1997         1307         36/07         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307         1307 <td>SDE4 010/9/ AVG SDE4 011697 SDE4 011697 SDE4 012797 SDE4 050397 SDE4 050397 SDE4 050397</td> <td></td> <td>97 97 storm 97 storm</td> <td>_</td> <td></td> <td></td> <td></td> <td>256</td> <td></td> <td>6</td> <td>15</td> <td>23 23</td> <td>1 15 BOD SMOL 11 N15 NVCO SMOL</td>	SDE4 010/9/ AVG SDE4 011697 SDE4 011697 SDE4 012797 SDE4 050397 SDE4 050397 SDE4 050397		97 97 storm 97 storm	_				256		6	15	23 23	1 15 BOD SMOL 11 N15 NVCO SMOL
SDE4 011697         1/1697         1997         100m         1221         105 MDEE         Now we comp ino         136         13         3 <th< td=""><td>SDE4 01 1697 SDE4 012797 SDE4 012797 SDE4 050397 SDE4 050397 SDE4 050397</td><td></td><td>97 storm 97 storm 97 storm</td><td>1.01</td><td></td><td>}</td><td></td><td></td><td></td><td>- ,</td><td>4</td><td></td><td></td></th<>	SDE4 01 1697 SDE4 012797 SDE4 012797 SDE4 050397 SDE4 050397 SDE4 050397		97 storm 97 storm 97 storm	1.01		}				- ,	4		
SDE4 017797         112797         1997 storm         0.41         100< Study         100         145         2         3         4         4         2           SDE4 013697         6.3797         1997 storm         0.33         75, HDEES         flow-wit comp         00         2         1         2         3         <	SDE4 012797 SDE4 012797 SDE4 00397 SDE4 00397 SDE4 102897		97 storm		• -		comp comp			•	<b>n</b> !	n :	
SDE4 000607         3557         937         939         401         0.29         47, NPDES         Dew wit comp         00         21         4         3 <td>SDE4 010697 SDE4 010697 SDE4 060397 SDE4 102897</td> <td></td> <td>97 storm</td> <td>0.41</td> <td></td> <td>109 SlipAg</td> <td></td> <td>145</td> <td></td> <td>•</td> <td>40</td> <td>49</td> <td></td>	SDE4 010697 SDE4 010697 SDE4 060397 SDE4 102897		97 storm	0.41		109 SlipAg		145		•	40	49	
SDE4 000307         6/397         197         50mm         0.73         76         76         76         77         72 <td>SDE4 040897 SDE4 060397 SDE4 102897</td> <td></td> <td></td> <td>0.00</td> <td></td> <td>42 NPDES</td> <td></td> <td>15</td> <td></td> <td>e</td> <td>e</td> <td>2</td> <td></td>	SDE4 040897 SDE4 060397 SDE4 102897			0.00		42 NPDES		15		e	e	2	
SDE4 000367         10/28/97         1996 (somm         1         26 (NPDES         Row with comp         no         9         4         1         2           SDE4 101136         21/397         1998 (somm         1         2         2         1         2         2         1         2	SDE4 050397 SDE4 102897			120	-	76 NPDES		~		-	-	2	
SDE4         102897         102893         102894         10289         102894         10289         10289         10289         10289         10289         1028 <td>SDE4 102897</td> <td>-</td> <td></td> <td></td> <td></td> <td>26 NPDES</td> <td></td> <td>G</td> <td></td> <td>-</td> <td>-</td> <td>2</td> <td></td>	SDE4 102897	-				26 NPDES		G		-	-	2	
SDE4 121697         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/2/397         1/3/37         1/2/397         1/3/37 </td <td></td> <td></td> <td></td> <td>5</td> <td>-</td> <td>D INDUES</td> <td></td> <td>90</td> <td></td> <td></td> <td>-</td> <td></td> <td></td>				5	-	D INDUES		90			-		
SDE4 011398         7/7484         1998         1007         013         101         013         101         013	SUCA 12169/ 1	_	10015106	_		121 NDDES			_	9	ŝ		NOUR TIME COMPOSITE
SDE4 030196         37/39         1996         30mm         0.13           SDE4 030196         37/39         1996         30mm         0.42         132/NPDES         10www.comp         10         13           SDE4 051496         31679         1998         30mm         0.46         131/NPDES         10www.comp         10         15         11         1         2           SDE4 051496         51/1895         1998 30mm         0.19         0.16         356 NPDES         10www.comp         10         15         11         1         2           SDE4 010398         110/398         1999 30mm         0.16         356 NPDES         10www.comp         10         25         14         1         2           SDE4 100398         11/1398         1999 30mm         0.16         132 NPDES         10www.comp         10         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2	SDE4 011398	_		- c		8 NDUES				-			
SDE4 030908         36/38         1996         storm         0.86         132,NPDES         flow-wit comp         100         154         1         2           SDE4 030908         5/14908         1996         storm         0.46         254,NPDES         flow-wit comp         100         51         1         2           SDE4 0613908         9/18/969         1999         storm         0.46         256,NPDES         flow-wit comp         100         51         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         1         2         2         1         2         2         1         2         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2	_	_			-					•			an for averall deicing only. GRAB FAILE
SDE4         012396         173         1936         100         113         11			islorm	0.86		132-NPDES	~ ~ `	154		-	-		Liquid Detected)
SDE4         042396         4/2396         1996         storm         0.46         264         NPDES         Inow wit comp         Ino         55         11         22           SDE4         063988         9/1496         1999         storm         0.46         73         NPDES         Inow wit comp         100         55         14         12           SDE4         092598         9/1496         1999         storm         0.41         0.26         148         NPDES         Inow wit comp         100         55         14         12         14         12         14         12         10         12         10         16         15         10         10         3         2         14         2         2         14         12         14         12         10         10         10         12         10         10         12         10         10         12         10         10         12         14         12         14         12         14         12         14         12         14         12         14         12         10         10         12         10         10         12         10         10         12         10	_		196	-						-	-		
SDE4 051406         \$11496         1998 storm         0.21         1251NDES         10ee we comp ino         15         11         22         5         12         22         22         23         23         23         23         23         23         23         23         23         23         23         23         23         23         23         24         23         23         24         23         23         24         23         23         24         23         23         24         23         23         24         24         25         14         24         25         14         25         24         25         14         25         24         25         24         25         24         25         26         26 <th26< th=""> <th26<< td=""><td>SDF4 042398</td><td></td><td>98 storm</td><td>0 46</td><td></td><td>264 NPDES</td><td>_</td><td>-</td><td></td><td></td><td></td><td>• •</td><td></td></th26<<></th26<>	SDF4 042398		98 storm	0 46		264 NPDES	_	-				• •	
SDE4 091398         9/18/96         1999         100m         150mm         140mm         170mm	SDF4 D51498	-	19B storm	0.21		125 NPDES	~~	-			_ ,		
SDE4 002588         972498         1999         Storm         0.47         0.26         143         NPDES         Now-wit comp         100         3         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         2         1         2 <th1< td=""><td>ELCA DO 1808</td><td></td><td>199 nonston</td><td></td><td>0.16</td><td>456 NPDES</td><td></td><td>2</td><td></td><td>-</td><td>-</td><td></td><td></td></th1<>	ELCA DO 1808		199 nonston		0.16	456 NPDES		2		-	-		
SDE4 100398         10/398         1999 storm         0.4         0.22         36 NPDES         10w-wt comp         100         22         5         1         2         5         1         2         5         1         2         5         1         2         5         1         2         2         5         1         2         5         1         2         5         1         2         5         1         2         2         1         2         3         3         NPDES         10w-wt comp         100         12         5         1         2         3         3         NPDES         10w-wt comp         100         12         3         11         3         NPDES         10w-wt comp         100         12         3         10         3         NPDES         10w-wt comp         100         12         1 <td></td> <td></td> <td>ag slorm</td> <td></td> <td>0.26</td> <td>148,NPDES</td> <td></td> <td><del>ຕ</del>ີ</td> <td></td> <td>-</td> <td>-</td> <td>2</td> <td></td>			ag slorm		0.26	148,NPDES		<del>ຕ</del> ີ		-	-	2	
SDE4         10239         1033         72         NPDES         Ilow wt comp         10         12         5         1         2           SDE4         102793         1033         35         NPDES         Ilow wt comp         10         12         5         1         2           SDE4         11938         111938         111934         1399 storm         1.62         0.48         35         NPDES         Iow wt comp         10         4         7         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2 <td< td=""><td></td><td></td><td>00 alorm</td><td>04</td><td>0.22</td><td>36 NPDES</td><td></td><td>2</td><td></td><td>-</td><td>-</td><td>2</td><td></td></td<>			00 alorm	04	0.22	36 NPDES		2		-	-	2	
SDE4         102/96         11/3360         1999         storm         0.48         35 NPDES         Inni-rep comp         100         8         2         1         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         1         2         1         2         1         2         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         2         1         2<				UBAI	010	72 NPDES		12		-	-		
SDE4         11/336         1999         1000         162         0.48         35         NPDES         non-rep comp         100         8         2         1         1         2         1         2         1         1         2         1         2         1         1         1         2         1         1         1         1         1	SUE4 102/30											δ	representative, incomplete sample. flow
SDE4 110408         11/3040         19995/storm         2.34         0.18         73         NPDES         flow-wf comp         100         244         7         1         2           SDE4 1119308         11/19908         12/11908         11/19908         133         131         135         13         144         7         1         2           SDE4 7119308         12/17908         12/17908         10.03         33         NPDES         flow-wf comp         100         20         1         2         2         1         2         2         1         2         3         4         2         1         2         3         4         2         1         2         3         1         3         1         2         2         3         1         3         1         2         2         3         1         3         3         4         3         1         3         3         1         1         2         2         3         1         3         1         2         2         3         1         3         3         4         3         1         2         1         2         1         2         1         2         1				4 4 2				80		÷	-		the error
SDE4 111998         1111998         1111994         1111994         1111994         1111994         1111994         1111994         1111994         1111994         1111994         1111994         1111994         11119         11111         1111         11111         11111         1111         1111         1111         1111         1111         11111         11111         11111         11111         111111         11111         11111	SDE4 110498							44	_	-	-	-	current WET sample
SDE4 121788         121/1783         1989, funning         0.10         5.3         NDES         ND	SDE4 11 1998									-	•		-storm, suitbale for givcols only
SDE4 122408         122409         1929 storm         0.1 <th0.1< th="">         0.1         0.1</th0.1<>	SDE4 121798		199 nonsion		0.0					5			
SDE4 011099         1/9/199         1/9/399         1/9/399         1/0/10         2/1         0.0.5         5/4 NPDES         Non-tep comp         2/2	SDE4 122498		199 slorm	1.19	9.0	Saurues	_	_		2•	; r		teorosentative. Jaken Inn Jale
SDE4 012293         1/20/39         1999 storm         0.42         0.09         22,NPDES         flow-vic comp         100         14         1         2           SDE4 012399         1/20/39         1999 storm         0.6         0.06         20,NPDES         flow-vic comp         100         15         2         1         2           SDE4 022399         2/21999         1999 storm         0.56         0.015         96,NPDES         flow-vic comp         100         15         2         1         2           SDE4 021399         3939 storm         0.28         0.07         71 [NPDES         flow-vic comp         10         16         2         1         2         5         6           SDE4 031399         3/12/99         1999 storm         0.28         0.07         71 [NPDES         flow-vic comp         10         16         2         1         2         5         6         5         <		-	male 661	0.27	0.05	54 NPDES		<b>Q</b> :			• •		
SDE4         021899         1999         storm         0.6         0.06         22/NPDES         Now wt comp         10         15         2         1         2           SDE4         021899         1999         100m         0.56         0.14         9         NPDES         Now wt comp         10         15         2         1         1         2           SDE4         021899         1999         100m         0.26         0.14         9         NPDES         Now wt comp         10         14         1         1         2         1         1         2         1         2         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         2         2         1         1         2         1         2         2         1         2         2         1         2         2         1         2         2         2         2         2         2         2         2	SDE4 012299		199 storm	0.42	0.09	22 NPDES		4				_	
SDE4         022339         1999         storm         0.56         0.14         B         NPDES         flow-wt camp, no         15         2         1         2           SDE4         023399         1999         storm         0.26         0.05         96         NPDES         flow-wt camp, no         15         2         1         1         5         6           SDE4         031399         31/2999         1999         storm         0.05         96         NPDES         flow-wt camp, no         13         6         1         1         5         6           SDE4         031399         31/2999         1999         storm         0.03         41         NPDES         flow-wt camp, no         53         5         1         1         2         2         2         2         2         2         2         2         5         6         6         7         10         10         5         6         1         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         2 <td>SUFA 021899</td> <td></td> <td>199 storm</td> <td>0.6</td> <td>0 06</td> <td>20'NPDES</td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td>	SUFA 021899		199 storm	0.6	0 06	20'NPDES				-			
SDE4 030899         3/8/91         1999         10.28         D.05         56         NPDES         Itow wt camp         10         1         5           SDE4 030899         3/8/91         1999         1001         011         11         105         5         1         10         1         5         1         5         1         5         1         5         1         5         1         5         1         5         1         5         5         1         1         5         5         1         1         1         <	EDE1 022300		199 <sup>1</sup> slorm	_,	0.14	9 NPDES		15		-	-		TORREN WELS SAMPLE
SDE4         0.0099         31/209         0.99         5/am         0.83         0.07         71 NPDES         Ilow/wt comp         50         5         1           SDE4         0.31999         301399         301399         301399         301399         1999 (starm         0.28         0.08         40, NPDES         Ilow/wt comp         10         11         6         1           SDE4         0.32499         327/199         1999 (starm         0.24         0.07         28 NPDES         Ilow/wt comp         11         6         1         1           SDE4         0.32499         327/199         1999 (starm         0.24         0.07         28 NPDES         Ilow/wt comp         1         1         2         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         1         1         5         5			190 slorm		D.05,	96 NPDES		147			ŝ	9	
SDE4         0.01339         1.302         1.303         1.1         6           SDE4         0.024         0.08         0.08         0.08         10.1         6           SDE4         0.02499         1.324/199         1999         1500         100         7         2           SDE4         0.02899         1.377/199         1999         1500         0.07         26         NPDES         Now witcomp. 100         7         2           SDE4         0.02899         1.377/199         1999         1500         0.24         0.07         26         NPDES         No. witcomp. 100         7         2		_	199 storm		0.07	71 INPOES		53		-	-	2	
SDE4 032439 1 327799 1999 storm 0.24 0.01 26 NPDES htew-wt comp. no 7 2 SDE4 032899 327799 1999 storm 0.24 0.01 26 NPDES htew-wt comp. no 54			100 storm	-	0.08	40 NPDES		=	÷	-	-	2	
SUC4 VICTOR CONTRACTOR FOR Deservice 0. 1 NPDES 1 10 54			100 storm	_	0.07	26 NPDES		-	7	f	1	2	
	SUC4 032033		Vec Pasellor	I.	-	NPIPES			3	R	P	32	

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	comments							and be average samples 5 TKN <mol< th=""><th>14 hr avg of 6 discrete samples 1 glycol</th><th>-JUNA&gt;</th><th></th><th></th><th>taken hor aircraft deicing only</th><th></th><th>nut representative (&lt;2 mg) recorded to how with the second state of the second state o</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>5 glycols and BOD on labloh "J 014"</th><th></th><th></th><th>о чо</th><th></th><th></th><th></th><th>40 Samples 7 glycol, 4 TKN 2 NH3 -MDL</th><th>2-ttay avg of 8 time-comp samples</th><th>29 5B(D) viesuli, 2 giycol, 1 1413 - 200</th><th>2</th><th>5</th><th>But and the second seco</th><th>boxcere</th><th></th><th></th><th></th><th></th></mol<>	14 hr avg of 6 discrete samples 1 glycol	-JUNA>			taken hor aircraft deicing only		nut representative (<2 mg) recorded to how with the second state of the second state o															5 glycols and BOD on labloh "J 014"			о чо				40 Samples 7 glycol, 4 TKN 2 NH3 -MDL	2-ttay avg of 8 time-comp samples	29 5B(D) viesuli, 2 giycol, 1 1413 - 200	2	5	But and the second seco	boxcere				
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SDS1 (01239)         BT/R493 storm         0.21         0.013         40         NPDES         preb         TO           SDS3 (00139)         911 669         mortal         0.21         0.013         40         NPDES         preb         TO         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1         2         1         1		•••				preb	g	23	123	n ·			FOM DECEMENTED ON OUTFALL
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SDS3 081998         91896         01805         018         01         01         04         04         04         04         04         04         04         04         04         03         04         04         03         04         03         04         04         03         04         03         04         04         03         04         04         03         04         04         04         04         04 <th04< th="">         04</th04<>		-			Я.			,  -	-	-	-		noi representative, extended into post-stumi
DDS 103799         F72409 isom         0.47         0.28         146         NPDES         Row we comp         00         2         4         5         4         5         4         5         4         5         4         5         4         5         5         4         5         5         4         5         5         4         5         5         4         5         5         4         5         7         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5 <td>ľ</td> <td>-</td> <td></td> <td></td> <td>_</td> <td>non-rep comp</td> <td>5</td> <td>'n</td> <td>2</td> <td>5</td> <td>-</td> <td>-</td> <td>baseltow period</td>	ľ	-			_	non-rep comp	5	'n	2	5	-	-	baseltow period
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SDS3 111398       [2117199] Interval       011       013       NPDES       Inow M comp       20       450       32       80         SDS3 121938       [2172496] storm       119       016       133       NPDES       Inow M comp       20       373       450       32       81       10       11         SDS3 011099       1172496       101       016       53       NPDES       Inow M comp       20       373       450       32       23       81       10       11       22       87       113       23       81       22       11       22       11       22       11       22       11       22       11       22       11       22       11       22       11       22       11       22       11       22       11       22       12       23       11       22       12       12       23       11       22       13       12       23       13       12       24       12       24       12       24       12       24       12       24       12       24       12       24       12       24       12       24       12       24       12       24       12       24	-				_	( flow-wt comp	2	16	18.	Ξ,			concentrate VAC 1 Sources
SDS3 12798         1272498 storm         119         016         153         NPDES         Iowwi comp         703         227         22         22         22         22         22         22         22         22         22         22         23         13         23         23         13         23         23         13         23         23         13         23         23         13         23         23         13         23         23         13         23         23         23         23         23         23         23         23         23         23         23         23         23         23         23         33			_			llow-w comp	01	20		- 1			
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SDS 01399       317299 storm       0 83       0 07       71       NPDES       flow-wt comp       00       31       2       1       2		3/8/99 slorm						4	22				
SDS3 02593       324/99 slorm       0.28       0.06       40       NPDES       flow witcomp       no       1       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       1       2       2       2       1       2       2       1       2       2       1       2	-	3/12/99 slorm						3:	- 0 c			• •	
SDN1 122596         9/16/96         monstor         0.16         456         NPDES         flow wf comp         mo         33         116         14         12         26           SDN1 122596         12/24/95         inom         1.19         0.16         153         NPDES         flow wf comp         mo         33         116         14         12         26           SDN2 112596         11/125/95         nonator         1.19         0.16         153         NPDES         grab         no         15         2         1         2<		3/24/99.slorm			1	4			•	. .	-		nonslotith
SDN1 122590         12224/98 itom         1.19:         0.16         153         NPDES         liowwiccomp         73         23         NPDES         grab         70         82         1         2         1	MIN SONI 001898	1 9/16/98 nonstor	0 19					с <u>г</u>	116.	14	12		
SDN2 116496 GRAB         1172496         Increation         1.62         0.48         35         NPDES         grab         no         15         2         1         2           SDN2 112599 GRAB         11/12296         monstori         1.16         0.1         33         NPDES         grab         no         15         2         1         2           SDN2 112599 GRAB         17/12496         monstori         1.16         0.1         33         NPDES         grab         no         15         2         1         2           SDN2 012899 GRAB         1/122496         10/12         0.35         NPDES         grab         no         15         2         1         2         1         2         1         2         1         2         1         2         1         2         2         1         2         2         1         2         2         1         2         2         1         2         1         2         1         2         1         2         1         2         1         2         2         1         2         2         1         2         1         2         1         2         1         2         1	N110 SDN1 122598	12/24/98-storm			_	4		,	ŕ		-	Ī	N CARGO PUMP STATION BYPASS
SDN2 112598 GRAB         11/25/96         menalor(         3.45         0.33         NPDES         grab         no         1           SDN2 012899 GRAB         1/26/99         fromator         1.6         0.1         33         NPDES         grab         no         1         2           SDN2 012899 GRAB         1/26/99         fromator         1.6         0.1         33         NPDES         grab         no         1         2           SDN2 012899 GRAB         1/22/498         storm         1.12         0.35         10         NPDES         grab         no         1         2         2         1         15         2         1         15         2         1         15         2         1         1         2         2         1         1         2         2         1         15         2         1         2         2         1         1         2         2         1         2         2         1         1         2         2         1         2         2         1         2         2         1         2         2         1         2         2         3         3         3         3         3         3		t-	1.62				2		40		• •		from North Cergo Purnp Stelrun bypess
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SDN4 09559         9/24/38 storm         0.47         0.261         148         NFUES         Nturne         2         1         1         2           SDN4 100398         1/0/3498         0.27         36         NFDES         100www.dcomp         02         2         1         1		11/19/98 storm	1	ľ					-	-	2		GLYCOLS MAY BE HIGH BIASED, DUPE WAS (MOL
SDN4 100398 10/2/398 40/00 024 022 00 NDDES 10/00/40 00/10 12 5 1 1 2		9/24/98 slorm		-			_		~~~		•	2	
	• •	10/3/98 storm			_				2		-	~	not representative, insulficient duration {-1hr}
	•	10/27/98 storm							2		-	3	

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# 99AppendixC 99 deicing

BOD5 E-glycol glycol glycols	2	1681 7 2/ 34 2 1 1 2 concurrent WET sample	2			46, 54; 54	450, 32, 151	222 12	12			51 24	233% 185% 28	16 45 40	837 1 7.0	16 16 16	335 13 31			20 1.0, 10	20 10 10 10	x 314% 175% 230%	- Cu		51 51 5	123		65. 1	35		1 128% 106% 200%	0	0% 80% 81% 417%	
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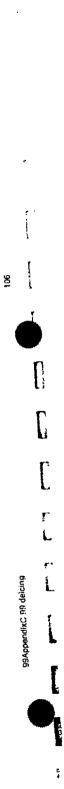
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# ggAppendixC 99 delcing

p. total diycol giycols comments		1 1 1 1 1		92% 10 11%
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E-glycol	NNNN	2	2007 + 20 2007 + 20 2007	52 70% 7 70% 91%
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1998-99 Delcing Event Sample Data		••• ~	·	
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## APPENDIX D WHOLE EFFLUENT TOXICITY SAMPLE DATA SUMMARIES

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	Сотив	Comment 2. 3
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WET. % survival daphrid alther 95 E 100 7 100 7 100 7 100 7	WET.X. survival daphalid fathes 80 8 80 8 65 9	4aphnld 80 90 10 10 10 10 10
rank d 71% 58% 58% 50% 50%	29% 79% 58%	avg rank 87% 61% 56% 60%
Cond         avg           5         34           10         36           10         36           11         10           13         16	cond 52 61 2 61	Hard Cond 16 24 16 27 16 27 14 2 10 21
n Hard 0012 14 002 14 002 14 002	DZn Hard 0038 2 0128 2 010 2 010 2 010 2 0 10 2 0 10 2 1 2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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concentra           2         6032         0           2         6032         0           2         0022         0           35%         2         0         0           2         0         0         0         0           10         0         0         0         0         0           2         0	Concenti           115         023           11         023           11         023           11         023           11         023           11         023           11         023           11         023           11         023           12         32           25         31           25         0132           32         0004           5         0132	CDITCentration           Surf Ujycols TRCu TRPb           Ma         0.024         0.025         0.025           Ma         n/a         0.024         0.025         0.025           Ma         n/a         0.025         0.025         0.025         0.025           Ma         n/a         0.035         0.02         0.025         0.02         0.02         0.02         0.02         0.025         0.025         0.02         0
NH3         Surf glycole         TRCu TRPb           0.5         Nia         2         0.032         0.031           0.5         Nia         2         0.032         0.031           0.10         0.06         2         0.022         0.031           0.5         n/a         2         0.022         0.031           0.5         0.28         0.015         0.02         0.015           0.5         0.28         2         0.02         0.015           0.5         0.28         2         0.02         0.015           0.5         0.28         2         0.02         0.01           0.5         0.2         2         0.023         0.01           0.5         0.2         2         0.023         0.03           0.5         0.2         2         0.023         0.03           0.5         0.2         2         0.023         0.03           2.0         0.020         0.0         0.020         0.0	Surf gly N/a n/a	NH3 Surf U 05 Ma 05 Ma 1 N/8 03 N/8 03 N/8
2000 325% 325% 325% 325% 325% 325% 325% 325%	36 13 13 13 13 13 13 13 13 13 13 13 13 13	BOD         BOD         BOD           0         0         2         0         2           0         0         0%         2         3         3           0         0         0%         5         3%         3         3           0         1         1         1         1         3
Turb         Turb           10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10           11         10         10         10	19 19 19 19 19 19 19 19 19 19 19 19 19 1	SS         Turk           53         Turk           53         Turk           53         100           6378         50           78         10           615         5:           65         5:           17%         7           17%         7           17%         7           17%         1           17%         1           17%         1
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1998-99 WET Testing Sample Data           1998-99 WET Testing Sample Data           SDE4         tsample famous           SDE4         type         depth rep rain         dur           SDE4         trank         0.35         0.42         28           M rank         0.35         0.55         34         06           M rank         0.35         0.56         34         36           M rank         0.7299         EMC         0.25         0.56         34           M rank         out         0.27         0.30         6         77299         50         40           M rank         out         0.27         0.30         6         77299         50         6         76         19           M rank         averago         0.27         0.27         0.30         6         77299         50         6         76         19           M rank         averago         0.27         0.28         0.34         50         6	depth rep 7 0 52 0 85	depth rep 0.85 0.13 0.13 0.30
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WET. % aurvival

# via Data .

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VET. % survival concentration, mg/l concentration, mg/l comment recur TRPb TRZn Dcu DPb DZn Hard cond avg rank daphuld fathead comment recur TR2 TRZn Dcu DPb DZn Hard cond avg rank daphuld fathead recur TR2 TRZn Dcu DPb DZn Hard cond avg rank daphuld fathead recur TR2 TR2 TR2 TR2 DCU DPB DZn Hard cond avg rank daphuld fathead recur TR2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 001 0 038 26 86			
concentration, mg/l giycola TRCu TRPb TRZn Dcu	23% 81% 100% 08378 23% 81% 100% 08378	9% 27% 77% 0.000 2 0.023 0.001 0.081 0.018	16 22 23 23 20 0000 0 127	2 0015 0001 0014 2 0035 0001 0025	
135 Turb BOD NH3 Surf	5 22 15 2 1 1/8 94% 89% 0% 75 43	58 2 84 2 44 44 44 44 44 44 44 44 44 44 44 44	unt 20 20 22	57	
spie Data storm characteriatics		<u>0 85 1 07 22 0 16 0 85 0</u>	average /	SDN4 Historical data (7/94-6/99)	110000
1998-89 WET Testing Sample Data	8DN4 1ype depthrep cain duc maxim annum	% (ank 1/13/99 EMC 0 85 1 0 % (ank	average	S	

SDE4 Jan 20, 1999 sample lab erfor un tathead test was 48-m mistead of 96-hr
 SDE4 Jan 20, 1999 samples convolitated at 72 5% survux-al (univnon is >90%)
 July 2, 1999 samples convolitated at 72 5% survux (univnon is >90%)
 July 2, 1999 SDN1 sample insuficient # ui organisms to start deplund test
 July 2, 1999 SDN1 sample laken for source traunit (was a non storm) only, not to explicitly satisfy permit conduton S10
 May 11, 1999 SDN1 sample laken for source traunit (was a non storm) only. not to explicitly satisfy permit conduton S10

ARDL, value shown is 1/2 MDL exceeds single value and/or average criterion for survival

P.H. anmona hardness and curductivity ineasured at Parametic textcology lab
 Dissolved meals not rownoly analyzet thrunkisu or summary statistics povided
 Summary statistics for each ordination of relative tummed data set July 1004 flooruph June 30, 1999
 Summary statistics for each ordination tocated in manifold SON1-22
 A did data for SON1 are from "up" statistic. Research unless shown as shaded in lable
 Animonia values of analyzed at Aquatic. Research unless shown as shaded in lable

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B9AppendixD WET data

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### APPENDIX E OTHER SAMPLE DATA

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1998-99	1998-99 Field Duplicates	- topic	трн-Ок	Fecals (MI TSS	•	concentration, mg/l Turb BOD5 glycc	, mg/l) glycols	ū	Рр	u Z	comments
type	date sample IU	NPDES		50	-						
grab	12/15/97 SON3 121597 GRAB	-		130							
grab	12/15/9/ SUNS 12 139/ GIVE DOI -	-1		-160%				0 0122	0.000510.042	0.042	
0000	1 1/16/97 SDN3 011697 DUPE	NPDES		12	+	12 5.38		0.0119	0.0005 0 043	0 043	
comp	1/16/97 SDN3 011797	NPDES			8.4	-8% 9%		11%	1 1	-2%	
		NPDES		2.2	-	1.9					
comp	2/11/9/ SUW3 02119/	NPDES		2.4	H	1.5					
comp					8%			20000	1 0 000510 017	10 017	
uttro	1 3/5/97 B 030697	NPDES		13		23	24	0.0087	0.0005 0 019	0 019	field duplicale
duio:	3/5/97 B 030697 DUPE	NPDES			7.0	Ŏ		-32%	70	-12%	
		1.0000			5	17.0	    -	0.0415	0 0128	0.433	
comp	4/13/97 SDN1 041397	NPUES		26	-	18 16.2		0.0436	0.0169	0.4	field duplicate
comp	4/13/97 SDN1 041397 dupe	INFUES			24%	5% 5%		-5%	-32%		
						4.0		0.0189	0 0 1 6 8	0.222	
comp	10/28/97 SDN1 102897	NPUES			19	27 4.74		0.0136	0 0 1 3	0.255	field duplicate
сотр	10/28/97 SDN1 102897 DUPE	NPUE3			%0	4% -19%		28%	237	-15%	
		INDRES		111	1		2	2 0.011			
comp	12/15/97 SDN3 12169/	NPDES			13	26	2	2 0.0098	0.0	0	field duplicate
comp	12/15/97 SUN3 12169/ DUFE				-18%	<u>0 %0</u>		0% 11%	. 1	10%	
		NDDES		1	9	12 12.8		0.0616	-	0 401	•
сотр	4/23/98 SDN1 042398	NDDFS			25	12 11 7		0.0258		0	field duplicate
comp	4/23/98/SDN1 042398 00FC				4%	%6 %0	4	58%			
		<b>NDDES</b>			•	71 9.84		0.0557	_	0 360	
comp	6/10/98 SDN1 061098	NDOES			33	66 9 10		0.0832	희		field uuplicate
comp	6/10/98/SDN1 061098 00FE				37	7% 8%	%	497		81%	
	210,001 EDE2 030300	NPDES			92	11 6.06	3.06	0.0164	4	0 001 0 027	Stanitar Little
comp	2/3/99/5/US3 04039	NPDES			4	4.6		0	_	5	lieid dupiicere
comp	2/3/99/SUS3 020399 0015				9%	9% 23%		35% 13%		- 1	
		INPDES			131	54 4.26		2 0.0029	4		Contraction of the second of t
comp	2/18/99/SUE4 UZ 1033	NPDES			126	54 4 58		5	õ	_	0.0025 Held auplicate
comp	2/18/99/SUE4 02 1033 0015				4%	0% -8%		0% 21%	. <b>-</b> F	- f	
	1 00000 0001 00000	INPDES			49	31 9.72	5.76	0.0159	-	0.18	tiald during
comp	3/8/39/30/64 4 03/0939	NPDES			69	8.7	5.60	o	2	믹	lieid uupireate
comp	3/8/39/5/064 030039 001 5				-41%	-3% 10%		3% -13%		12%	
	1 541100 EDNIA 031300	INPLIES			2.9	7	2	2 0.0185	-+	CZU U 100 0	field durleale
comp		NPDES			38			000	4	3	lifeio onbiicare
comp					-31%	0%	0%	0% 3	3% 0%	V9L V	
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					concentration, mg/l)	(I)gm			
188-8861	1998-99 FIGIO DIBUKS		Tou DV	Facals (MLTSS	Turb BOD5	8	Cu Pb	υz	CONTINUE
type	date sample ID	111979				<10.0			field UC blank
rand orab	12/26/96/SDS3 FIELD BLANK 123096	6			0.12 20.0	0.011			field QC blank
rand orah	1/16/97 SDS2 011797 BLANK	NPDES		2 <0.5	0.13 <4.0	10.01			field OC blank
dere bree	2/5/07/EV 030697 BI ANK1	NPDES		<0.5			N 006 20 001	╀	0.016 field QC blank
tally year		NPDFS		13 < 0.5	0.21 <4.0	<4.0		+	0.043 Feld OC blank
rand grap				< 13	3 0.46 <4	<4 0	0 0048 <0.001	2000	
rand grab	12/15/97 SDN3 12169/ BLANK	NFUES	1. 0	- U/ C	+	<4.0	0.0047 < 0.001	1 <0.005	<0.005 [leig UC Ularia
rand orab	4/23/98 SDN1 042398 BLANK	NPDES	CI:0>		1		<0.002 <0.002		0.013 field QC blank
rand orab	11/12/98 SDE2-46 111298 BLANK	nonstorm					0 006 <0 002		0.038 field OC blank
rand orab	11/12/98 SDE4-42 111298	nonstarm					0.0045<0.002	1	0.036 field QC blank
rand orah	11/12/98 SDE4-42 111298 DUPE	nonstorm					<0.002 <0.002	⊢	0.019 field OC blank
depo boes	11/12/98 STF4-47 111298 BLANK	nonstorm		-				12 1<0.005	A ANY A ANY A AN AND Field OC blank
			<0.15	<2<05	0 25 <4.0			0000	n nn6 fiald OC blank
rang grau			<0.15	5 <2 <0 5	0.27 <4 0	<4 0	<0.002 <0.002		Fold OC hlank
rand grab			2015	6	1.5 0 75 <4.0	<4.0	<0.002 <0.0	7]	<0.002 [<0.002 ]<0.002 [<0.002 ]
rand orab	1/15/99 SDS3 011599 BLANK				1	4.38	4.38 0.0082 <0 002		0.000 field UC plate
rand grab	3/8/99 SDS3 030999 BLANK	INPDES		2.02					
							1 50 0 000 0 000 0 038	0.038	
		Max	<0 15	13	1.5 0.75 (	50.4 1	n.000	8	
		count >MDL	<u> </u>	4	3 n/a		? <del>;</del>	, tt	
		total # blanks	· • .	1 +	9 9				-

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Max	<0.15	2	0.1.0	2			c	
	2	Y	3 n/a	0		0	2	
COUNT > MULL	>	<b>r</b> 1			æ	11	11	
total # blanks	4	~	y y	ת				

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99AppendixE non-rep comps

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#### APPENDIX F SOURCE TRACING SAMPLE DATA SUMMARIES

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	Ansile         Truncial         Description         Descriprescription         Description		1	
	wear         image         wear         image         wear         image         wear         image         wear         image         wear	•		source fracing
	Items         Items <th< td=""><td></td><td></td><td>source leacing</td></th<>			source leacing
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	11/12/2008         200         000         018         01         01           11/102/06         500         500         000         018         01         01           11/102/06         500         500         500         000         01         01         01           11/102/06         500         500         500         500         01         01         01           11/102         500         500         500         500         500         01         01         01           11/102         500         500         500         500         500         500         01         01           11/102         500		0 27 0	54 moi representative taken 100 tale
	11/1149         MPDES NO         5051         1100         0.39         10,10           11/1149         MPDES NO         5051         10,296         10,10         10,10           11/1149         MPDES NO         5051         10,296         10,00         10,10           11/1149         MPDES NO         5051         10,000         20,2         10,00           11/1149         MPDES NO         5051         10,000         20,1         10,10           11/1149         MPDES NO         5051         10,000         20,1         10,00           11/1149         MPDES NO         5051         10,000         10,00         10,00           11/1149         MPDES NO         5051         10,000         10,00         10,00           11/1149         MPDES NO         5051         10,000         10,00         10,00           11/1149         MPDES NO         5051         10,00	28 11		9.e
	11/1193         11/11193         11/1111111111111111111111111111111111	7 36 25		
	1/1055         MURSE MURES         SDE 40/055         MURSE MURES         MURSE MURSE MURSE         MURSE	6 11 0 40 1		ጽ
	7720065         5075         000         014           7720065         5075         0164         018         014           7720065         5075         0164         018         014           7720065         5075         5075         0164         018         014           7720065         5075         5075         0164         018         014           7720065         5075         5075         0164         018         014           772006         5075         5075         0164         014         014           772006         5075         5075         0164         014         014           77205         5075         5075         10001         1010         117         110         117         117         117         117         117         117         117         117         117         117         117         117         117	67 3		
Witches         Special (1000000000000000000000000000000000000	7/17706         STE1         1/02665         300         018           7/17706         STE1         1/02665         300         018           7/17706         STE1         1/02665         300         018           7/17706         STE1         STE1         1/0265         300         018           7/17706         STE1         1/0265         STE1         1/0265         300         018           7/17706         STE1         STE1         1/0265         STE1         1/026         300           7/17706         STE1         STE1         1/026         STE1         1/026         300           7/17706	5 8 JIL 0.	5	
Type         Type <th< td=""><td>072956         NUTZ266         RTAB         22           072956         NUTZ266         STEL UT756         STEL UT756         STEL UT756           072056         NUTZ266         STEL UT756         STEL UT756         STEL UT756           072056         NUTZ261         STEL UT756         STEL UT756         STEL UT756           072056         STEL UT756         STEL UT756         STEL UT756         STEL UT756           072156         STEL UT756         STEL UT756         STEL UT756         STEL UT756           0717776         STEL UT756         STEL U10167         STEL 17395         STEL 17395           0711777         NPDES NO         STEL 17395         STAL         ND           0711777         NPDES NO         STEL 17395         STAL         ND           0711777         NPDES NO         STEL 12159         STAL         ND           071176         NPDES NO         STEL 12159         STAL         ND           07116</td><td>8 2</td><td></td><td></td></th<>	072956         NUTZ266         RTAB         22           072956         NUTZ266         STEL UT756         STEL UT756         STEL UT756           072056         NUTZ266         STEL UT756         STEL UT756         STEL UT756           072056         NUTZ261         STEL UT756         STEL UT756         STEL UT756           072056         STEL UT756         STEL UT756         STEL UT756         STEL UT756           072156         STEL UT756         STEL UT756         STEL UT756         STEL UT756           0717776         STEL UT756         STEL U10167         STEL 17395         STEL 17395           0711777         NPDES NO         STEL 17395         STAL         ND           0711777         NPDES NO         STEL 17395         STAL         ND           0711777         NPDES NO         STEL 12159         STAL         ND           071176         NPDES NO         STEL 12159         STAL         ND           07116	8 2		
TXTMM         TXTMM <th< td=""><td>7/17/169       FUEL 011996 GRAB       20         7/17/169       FUEL 011996 GRAB       20         7/17/169       FUEL 011297 GRAB       20         7/17/169       FUEL 010397 GRAB       20         7/17/169       FUEL 010397 GRAB       100         7/1196       FUEL 010797 GRAB       100     &lt;</td><td>1 28 3</td><td></td><td></td></th<>	7/17/169       FUEL 011996 GRAB       20         7/17/169       FUEL 011996 GRAB       20         7/17/169       FUEL 011297 GRAB       20         7/17/169       FUEL 010397 GRAB       20         7/17/169       FUEL 010397 GRAB       100         7/1196       FUEL 010797 GRAB       100     <	1 28 3		
Nitras legis         State of the state         V         0.1           Nitras legis         State of the state         20         10.1         21	1/1706         SDE 4 071796 GAAB         220           7/1706         NPDES too         SDE 4 071796 GAAB         200           7/1707         NPDES too         SDE 4 071797 GAAB         1001           7/1087         NPDES too         SDE 4 071876 GAAB         1001           7/1087         NPDES too         SDE 4 071807 GAAB         1001           7/1087         NPDES too         SDE 4 071807 GAAB         1001           7/1081         NPDES too         SDE 4 071807 GAAB         1001           7/11481         NPDES too         SDE 4 071807 GAAB         1001           7/11481         NPDES too         SDE 4 07180 GAAB         1001           7/11481         NPDES too         SDE 4 07180 GAAB         1001           7/11481         NPDES too         SDE 4 07180 GAAB         1001           7/11481 <td< td=""><td>26,3</td><td></td><td>inam scendownstream in DM Creek - CC</td></td<>	26,3		inam scendownstream in DM Creek - CC
1/1768         VOL         1/17         VOL         1/17         VOL         1/17         VOL         1/17         VOL         1/17         VOL         VOL <td< td=""><td>17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       16/15&lt;</td><td></td><td></td><td>lated</td></td<>	17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       17/1768       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       12/1568       16/15<			lated
Milling Holls         Split Unitide (Shid)         220           Trans Holls         Split United (Shid)         200           Trans Holls         Split United (Shid)         201           Tr	7/17/168         VPDES NO         SDE 4 071968         GAAB         200           9/2368         NPDES NO         SDE 4 071958         GAAB         200           9/2368         NPDES NO         SDE 4 017958         GAAB         200           17/1786         NPDES NO         SDE 4 017095         GAAB         200           17/1786         NPDES NO         SDE 4 017095         GAAB         200           17/13707         NPDES NO         SDE 4 017097         GAAB         1001           17/1031         NPDES NO         SDE 4 017095         GAAB         1001           17/1031			76
911       9	93346       kPDES to:       SDE4 101906 GAAB       500         1211996       FYES       SDE4 101907 GAAB       220         111007       FYES       SDE4 101907 GAAB       200         1211996       FYES       SDE4 101907 GAAB       200         1211996       FYES       SDE4 101907 GAAB       200         1211996       FYES       SDE4 101907 GAAB       500         1211997       KPDES to:       SDE4 101907 GAAB       500         1211991       KPDES to:       SDE4 101907 GAAB       500         1211991       KPDES to:       SDE4 101907 GAAB       500         121192       KPDES to:       SDE4 1019016       FAAB       500         1211994       KPDES to:       SDE4 1019016       FAAB       500         1211994       KPDES to:       SDE4 1019016       FAAB       500         1211949       KPDES to:       SDE4 019018       FAAB       500         121149       KPDES to:       S	- -		72 backup tiala in case short on dala for 96
1718/661 (10)       5024 (17196 (100)       100       121	172/15/80       SDE4 171596 GANB       20         172/15/80       SDE4 171596 GANB       20         172/15/81       SDE4 010687 GANB       20         172/15/81       SDE4 010687 GANB       1001         172/15/81       SDE4 010687 GANB       1001         172/15/81       SDE4 010687 GANB       1001         171/16/81       SDE4 1010667 GANB       1001         171/15/91       SDE4 1010567 GANB       1001         171/15/91       SDE4 1010567 GANB       1001         171/15/91       SDE4 1010167 GANB       1001         171/16/91       SDE4 1010167 GANB       1001         171/15/91       GANB       1001         171/15/91       SDE4 1010967 GANB       1001         171			
Triand         Triand<	17/1996         17/1996         17/1996         17/1996         17/1996         17/1996         17/19         1000         100			diy wealther discharge
10000       100000       10000 <t< td=""><td>1/1697         5 YES         SDE4 010087 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010087 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010367 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010367 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010367 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010307 GAAB         50           1/1707         37706         SDE4 010306 GAAB         50           1/1707         37706         SDE4 010306 GAAB         50           1/1707         37706         SDE4 010306 GAAB         50           37706         SDE4 010306 GAAB         50         110           1/1708         100         SDE4 010306 GAAB         50           37706         SDE4 010306 GAAB         50         110           1/1708         100         SDE4 010306 GAAB         100           1/1708         100         SDE4 010306 GAAB         100           1/1708         100         110         110           1/1408         100         110         110           1/1408         100         110         100</td><td></td><td>21</td><td>154</td></t<>	1/1697         5 YES         SDE4 010087 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010087 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010367 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010367 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010367 GAAB         50           1/1707         37707 (140 CES no)         SDE4 010307 GAAB         50           1/1707         37706         SDE4 010306 GAAB         50           1/1707         37706         SDE4 010306 GAAB         50           1/1707         37706         SDE4 010306 GAAB         50           37706         SDE4 010306 GAAB         50         110           1/1708         100         SDE4 010306 GAAB         50           37706         SDE4 010306 GAAB         50         110           1/1708         100         SDE4 010306 GAAB         100           1/1708         100         SDE4 010306 GAAB         100           1/1708         100         110         110           1/1408         100         110         110           1/1408         100         110         100		21	154
11/1007 NJOES to 954 NJOST (5005 to	11/16/07       NPOES NO       S0E4 01087 GAAB       100         11/16/07       NPOES NO       S0E4 01087 GAAB       100         11/16/07       NPOES NO       S0E4 10287 GAAB       100         10/26/07       NPOES NO       S0E4 10289 GAAB       100         10/26/07       NPOES NO       S0E4 10288 GAAB       100         11/19/07       NPOES NO       S0E4 04078 GAAB       100         11/19/07       NPOES NO       S0E4 04098 GAAB       100         11/19/07       NPOES NO       S0E4 04098 GAAB       100         11/19/07       NPOES NO       S0E4 04098 GAAB       100         11/19/07       NP			100 · · · · · · · · · · · · · · · · · ·
1:27:107/1401       0:21 </td <td>117709*       VFDEE no       SDE4 0013057       GRAB       1601         117709*       VFDEE no       SDE4 001305       GRAB       1601         117109*       VFDEE no       SDE4 001305       GRAB       1601         117109*       VFDEE no       SDE4 010130       GRAB       1601         117109*       VFDEE no       SDE4 010130       GRAB       1601         117109*       VFDEE no       SDE4 010130       GRAB       1001         117109*       VFDEE no       SDE4 010130       GRAB       100         117109*       VFDEE no       SDE4 010130       GRAB       100         117109*       VFDEE no       SDE4 010130       GRAB       100         117109*       VFDEE no       SDE4 01130       GRAB       100         11819*       VFDE no       SDE4 01130       GRAB       100         11819*       VFDE       SDE4 01140       GRAB       100       110         11819*       VFDE       SDE4 01140       GRAB       100       110       110       111         11819*       VFDE       SDE4 01140       GRAB       100       110       111       111       111       111       111       111</td> <td></td> <td></td> <td>T(N) testil toli ngka56nidiye laton di</td>	117709*       VFDEE no       SDE4 0013057       GRAB       1601         117709*       VFDEE no       SDE4 001305       GRAB       1601         117109*       VFDEE no       SDE4 001305       GRAB       1601         117109*       VFDEE no       SDE4 010130       GRAB       1601         117109*       VFDEE no       SDE4 010130       GRAB       1601         117109*       VFDEE no       SDE4 010130       GRAB       1001         117109*       VFDEE no       SDE4 010130       GRAB       100         117109*       VFDEE no       SDE4 010130       GRAB       100         117109*       VFDEE no       SDE4 010130       GRAB       100         117109*       VFDEE no       SDE4 01130       GRAB       100         11819*       VFDE no       SDE4 01130       GRAB       100         11819*       VFDE       SDE4 01140       GRAB       100       110         11819*       VFDE       SDE4 01140       GRAB       100       110       110       111         11819*       VFDE       SDE4 01140       GRAB       100       110       111       111       111       111       111       111			T(N) testil toli ngka56nidiye laton di
3-551 NPDES No         SDE4 103697 (5AAB 1000         1601         175         161         175         161         175         161         175         161         175         161         175         161         175         161         175         <	35567       NPDES NO       SDE4 000507       GRAB       100         371567       NPDES NO       SDE4 000507       GRAB       100         1701667       SDE4 00055       SDE4 00050       GRAB       100         1701667       SDE4 00055       SDE4 000180       GRAB       100         170167       SDE4 000180       GRAB       110       100         170167       SDE4 010780       GRAB       100       100         171087       SDE4 010780       GRAB       100       100         171087       SDE4 01180       GRAB       100       110         171087       SDE4 01180       GRAB       100       120         1711988       SDE4 01180       GRAB       100       122         1711988       SDE4 01180       GRAB       100       122         1711988       SDE4 01180       GRAB       100       122         1711988       SDE4 01180       GRAB       100       011	-	U 80	42 see letter til May 14 1991
3591 NFDES to 1072197 (FMA 12010)       3554 00009 (FMA 100)       100       100       100       100         2014 10155 to 2014 1015 to 20	35,61       NPDES to SDE4 000507 GFAB       100         1/215,67       SDE4 000507 GFAB       100         1/215,67       SDE4 00055 To SDE4 00016 GFAB       100         1/215,67       SDE4 00055 To SDE4 00016 GFAB       100         21/106       NPDES to SDE4 00016 GFAB       500         21/106       SDE4 00016 GFAB       100         21/106       SDE4 00016 GFAB       500         21/106       NPDES to SDE4 000186 GFAB       500         21/106       NPDES to SDE4 00186 GFAB       500         21/108       NPDES to SDE4 01296 GFAB       500         21/108       NP		36	511
Unitary infolision         Spiration form         Spi	U10647         NPDES NO         SDE4 020180         GRAB         100           12/1587         NPDES NO         SDE4 020180         GRAB         500           12/1587         NPDES NO         SDE4 121597         GRAB         500           12/1587         NPDES NO         SDE4 121597         GRAB         500           12/1587         NPDES NO         SDE4 121597         GRAB         500           12/1587         NPDES NO         SDE4 020180         GRAB         500           12/1587         NPDES NO         SDE4 021480         GRAB         500           12/1587         NPDES NO         SDE4 021480         GRAB         800           12/1587         NPDES NO         SDE4 021480         GRAB         800           12/1587         SDE4 021480         GRAB         800         1000           12/1587         SDE4 021480         GRAB         800         1000           12/1597         NPDES NO         SDE4 021480         100         100           12/1598         NPDES NO         SDE4 021480         100         100         100           11/17/158         NPDES NO         SDE4 01480         100         100         11         11         11 </td <td></td> <td>17</td> <td>26</td>		17	26
1715       711       713	10/20091         NPDES NO         SDE4 102897         GRAB         110           17/1547         NPDES NO         SDE4 12159         GRAB         110           17/1547         NPDES NO         SDE4 12159         GRAB         110           17/164         NPDES NO         SDE4 12159         GRAB         110           17/164         NPDES NO         SDE4 020106         GRAB         110           17/164         NPDES NO         SDE4 020106         GRAB         100           17/164         NPDES NO         SDE4 020106         GRAB         100           5976         SDE4 020106         GRAB         100         110           5976         SDE4 020106         GRAB         100         1720           5974         SDE4 02148         GRAB         100         1720           5974         SDE4 02148         GRAB         100         1720           5974         SDE4 02016         GRAB         100         1720           5974         SDE4 02036         GRAB         500         1020         111           910968         SDE4 02198         GRAB         500         1220         111           9111199         SDE4 02198 <td< td=""><td>•</td><td>0 -</td><td></td></td<>	•	0 -	
17/15/16/16       505/17/16/16       17/15       15/15/16       000       000         17/15/16       505/17/16       17/15       17/15       17/15       17/15       15/15/16       000         17/16       505/17/16       17/16       17/15	Tyrister         SDE1 (2150) (6 CAAB         500           31/168 NPDES to         SDE4 000106 GRAB         100           442309         NPDES to         SDE4 000106 GRAB         100           5014 00109         SDE4 001096 GRAB         000         000           442309         NPDES to         SDE4 001496 GRAB         000           5014 001496 GRAB         000         000         000         011         011         013           8/1438         NPDES to         SDE4 001996 GRAB         500         10200         000         011         011         013         014         111         314           8/1438         NPDES to         SDE4 01996 GRAB         500         10200         003         011			lecal collorm result not representative
JIIIBN NFDES ID         SDE4 010186 GAAB         500           JIIIBN NFDES ID         SDE4 010186 GAAB         500           JATMAR 1am         TO         SDE4 010186 GAAB         500           JATMAR 1am         SDE4 010186 GAAB         500           JATMAR 1am         SDE4 010186 GAAB         500           JATMAR 1am         SDE4 010186 GAAB         500           STRE 1041686 GAAB         500           SDE4 041086 GAAB         500           STRE 1042386 GAAB         500           SDE4 041086 GAAB         500	31/108         NPDES to 270:00         SDE4 020186 GRAB (STE 04/108) GRAB         500 bits           477/041         SDE4 02/0186 GRAB (STE 04/108) GRAB         500 bits         1000 bits         1000 bits<	- -	99	6 exceeded holding time by 9+ hours
J/108         NPDES         SDE4 00008         GRM         100         277         00         277         00         277         00         277         00         100	2/108 NPDES to         SDE4 030106 GFAB         000           4/2081 ran         00         SDE4 040196 GFAB         000           4/2081 ran         00         SDE4 040196 GFAB         000           4/2081 ran         00         SDE4 040196 GFAB         000           4/2081 ran         00         SDE4 042196 GFAB         000           4/2081 ran         00         SDE4 042196 GFAB         000           5014 042196 GFAB         000         1720         01401           61/4691 PDE5 to         SDE4 041480 GFAB         000         000           80/4146 GFAB         000         000         000         000           80/4146 GFAB         000         000         000         000         000           80/4146 GFAB         000         000         000         000         011         011         011           81/461 PDE5 to         SDE4 101096 GFAB         000         000         000         011 <td></td> <td>50</td> <td>NON-STURM</td>		50	NON-STURM
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	(urb comment	I ransplax roomops	Transiplex rooltops	Transpiex rooltops	[ransiplex rooftous	Iransiplex rooltops	Inading diach diam (Avia #2, 00015 13-14)	loading dock drain (Avia #2 gours 52 513)	loading dock digin (Avia #2, uxura to 1-1)			Avia blog #1 rovitop	Avia Bidg #2 rootion	Avia Bidg #2 roution	Avia Bldg #2 roollop	Air Cargo Rd+Transiplex+new Feder	Au Carget Rei+ I can while x + new t edit x	Au t mithe [14] thundan anon [ 60]	ין און אינויאטאאוואנוין ואון אווין אינויין אין אינויין אינויין אינויין אינויין אינויין אינויין אינויין אינויין	a 100 4 way, and supply the tider of the	Air (argo Rd+ (ramaplex+new fedex	An Curryo Refe Learnsquest now 1 605 x	Air Cariju Rd+ Lansiplex+ new redex	Air Cargo Rd+ Iransiplex + new reus	Iolal Avra ronlinps	Intal Avea roothins	scholand and the	PUPI AVIE FOOLOOP	39 Intal Avia roofinps	2 JULI AVIA FOOTUIS	Intal Avia rootings	Injai Avia roollops	IQIAI AVIA EDOTIONS	citrinoo) BiAV (8)0)
1/61	Hard suct NH3 0		8	0 4 29		8 653	1 392	0 56	1		~	6 28	0 131	11 392	9 41	1 634		12 8.19		27, 20 hALU 621 U				16	53	53 653		55 317	32	700 5200×584 690	0.86			391
	DiseTR ratios Zn Cu Pb Zn	0.021 0.68 0.44	0 69	0.44	0.046 0.68 0.96	0.81	0134 0 75 0 66 0 71	0 92 0 94	0 91 0 78	0 7.B	Q 42 Q 29	0217 063 066	0 033 0 65 0 40		0 62 0 38	1017	0.41 0.06		0.64 0.06	0134 055 042	01010101000				0 227 0 26 0 53	0.052 0.54 0.53	0.128 0.74	0 207	0210 070	0 168 0 61	0.368 0.62			
	Zn Cu Pb	100 0 00 0 00 0 001					0.011 0.001 0.019 0.014 0.008 0.134		0072 0014 0389 0066 0011 0263	0 POS D 001 0 108 0 007 0 001 0 034	0 000 0 003 0 133 0 013 0 001 0 122	0 012 0 001 0 330 0 020 0 001 0 217	0.001 0.001 0.001 0.001 0.033				1011 1021 0 100 0 000 0 001 0 078			0.007 0.011 0.345 0.023 0.001					0 033 0 003 0 202 0 051 0 038 0 013 0 001 0 227						0.062 0.001 0.449 0.051 0.001		001 0 422	0 001 0 254
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				N	•	1'plex 3/24 1 GF		•			-		AVIAR 1 J/24	•	~ .	Avia#2 3/24 2 G	-	3/24	3/24 2 0		đ			112 2	< comp	5111	BAC .	3/24	3/24 2.0	11/0				렬
3	sing in Multiple	station	16	16	16 1	32 16 <u>1</u>	16	19 dock		19 dock	194		19A	20A		20A	4 8 22-18 Ro	32 22-18 Ro				144 22-18 Ro	22-18	22-18	22-18 Ho	22-21	8 22-21				22-21 Avi	22.21	22.21	113 22 21 Avia
:	999 SDN1 Source Tracing in Multiple Uper	rain maxiedryar LF	107 016 85	1 07 0 16 65	0 26 0 05 96	0.26.0.08 40	0 26 0 08 40	0 28 0 05 96	028 008 40	0.28 0.08 40	0 26 0 05 96	028 008 40	0 28 0 08 40	0 28 0 05 96	028 008 40	0.28 0.08 40	0 28 0 05 96	0 28 0 08 40	0.28	10	9 0 14 0 08 50	021003 48	03 011 103	03 011 103	03 011 103	107 016 85	w 028,005 96	1, 0.26 0.06 40	ar 0.268 0.08 40	014 008	0 14 0 08 50	02100348	03 011 103	501 110 E0
	1999 SC	event	13-Jan 98	13-Jan-99	8 Mac	24-Mar	24-Mar	8-Mar	24-Mar	24-Mar	8-Mar	24-Mar	24-Mar	B-Mar	24-Mar	24-Mar	B-Mar	24-Mar	24-Mac	11-May 98	11 May-09	20-Jun-99	2-Jul	1 1 2-Jul	101-2	13-Jan-99	B-Mar	24 N' I	24-Mar	11-May-99	11-May-99	20-Jun-95	101-2	2.00

99AppendikF SDN1

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APPENDIX G OUTFALL INSPECTION SUMMARY

					'Visual Õbasmations"'	
1998 Dry Weather Inspection for Permitted Outfalls Conducted on <u>011488</u> by Scott Toblated, Stateh Oleen	Dry Wea or Permi Conducta	1998 Dry Weather Inspection for Permitted Outfalls conducted on <u>0/1488</u> isot Jebsren. Olan Seales, Sarah Ol	pection fails é		india i india i india i i i i i i i i i i i i i i i i i i	
				ן		ł
Distail Nama	Outfall	boint [1]	date (2)	depth of Row	Piert & a	THE ALL AND A DEPENDENCE REMAINING A
SDE4	200	manhole SINE 47	14.Aug	.1-		took grab sample of basedow, sightly histord Analyzed at laboratory see tham not activity
SUSI	. 68	uulia#	14-Aug	Suidoup	0 0 0 0 0 0	took sample 6/10/98, took 10 menuas to fill 1 gallon (flow « 0 1 gam)
sos7	100	autfall	14 Aug	na flow	nu disetisarge	pupe and duch were dry
50S1	ŝ	llejmo	14.Aug	1* (0 (19° en wen)	0 1 0 0 0 0	nsignificent discheige floo hille la semple), no problems spijalent
2DNI	8	dram inket	14 Aug	no Aow	na discharge	
SDNJ	111)	manhale	11-449	no flow	no distherge	lettus woled E stock of the second
ENDS	800	Reila	14 Aug	-9 5.	0 0 0 0 0 0	unegndicant discharge (too latte to sample), ho problems apparent
\$051	8	outlatt	11.Aug	no Row	na discherge	
LUW3	011)	(Infal)	14 Aug	ve flow	no descharge	
SDN	110	autist	14.Aug	no flaw	ne discherge	
Eng Yard	012	draw mlet	14 Aug	no flow	no discharge	
Tari Yard	610	drain indel	11-Aug	no fo*	no discharge	
Subbasin R	110	l liethuu l	14.440	4 <b>05'</b>		insignaticant discharge (hoo Mile to sample). No problems apparent
Subbasin D	01 <b>5</b>	ouffall	DUA 11	no flaw	na discharge	
nales: 1 Irispected visu 2 Monthly samp 3 Depths of flow	ially from sur ling sues visi v are approxi	face through i ded on humer mate, unless	inlets, or by rous ather d registered b	pumped samp aid guing the yr lacat manda	Jest:	roles: not set are set of the set of the set of the set of angelide 0 = absent 5 = present or conservation were I inspected assumptions and affect hough inters, of by pumped sample for outlaits with monetoing points requiring contineed space entry [SDE4, SDM1, SDM2, EY 1Y] A monthy sampling sues variated on humacous divertations developed in remarks 3. Depths of flow are appointmate, unless registered by forcat monduring equipment
Other observations at non permit locations:	lans at non	peinit locat	lons:			
S 20th St outfall	ĘZ	Heliuo				optional location not inspected
DM Creek above SDS1	e/u	creek	14-Aug	17		
DM Creek Wen	e Al	creek				optional location not inspected
UM Creek at SDSJ	2	track	14.Aug	4 -	0 0 0 0 0 0	
		nullet	14-Aun	1 35' on staff	0 0 0 0 0 0	
L KEDS OUND						

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- regueron ! \* 10000 100 1000 1000 10000 10000 ŝ ... p = bypass accurred, no sample due to low water level (deN)= info from detering notes p = bypass accurred, no sample due to low water level (deN)= info from chain of custody(N)= Information from log book . 8561 61 -9910910AV Ś Z 9861 81 100 180 1 . . ٠ N Ś ŝ S Ē BEEL <2 - SQUERON Σ (N) 9851 57 -03710940W z M+-M = visited for set up or for maintenance PE61 12 - 29109491 ۰ . . S ŝ S Ś  $10^{12}$  evolutions  $1 = 10.27200 \text{ SECO} + \text{suspended (while (3) and hubbidity (3), sample results TSS = 95. Turbidity = 64$  $<math>2 = 1104.904 = 80.903 + \text{suspended (while (5) and hubbidity (5) anyrab sample (1))$ \*• ٠ • . . . . BOSI S JOGURANN S ŝ S S, S 5 S ٠ Post A Jog Nover ŝ 5 **≯**+. NA. ٠ ٠ \* ~ ٠ ARSI OF BOLD . 5 Ś ŝ co, s ŝ E 1 October 1 300 Ħ  $\mathbf{W} + \mathbf{z}$  sample plus WET II = hlank taken \* ٠ \* , . ر<sub>داری</sub>ور روزی S s 5 ŝ ŝ 1 . ! ł E L : ردیاملایے کر<sub>چو</sub> Z N.A = sampled but not analyzed ł \* ٠ . . 1 S S ŝ S I 18 2 Ę 2 3 1 Ξ 22 -وب 8 22 g 9 2NU3 FY TY S= Sample N.Cargo d NS08 SDE4 SDS2 SDS3 SDS3 ENDS outfall

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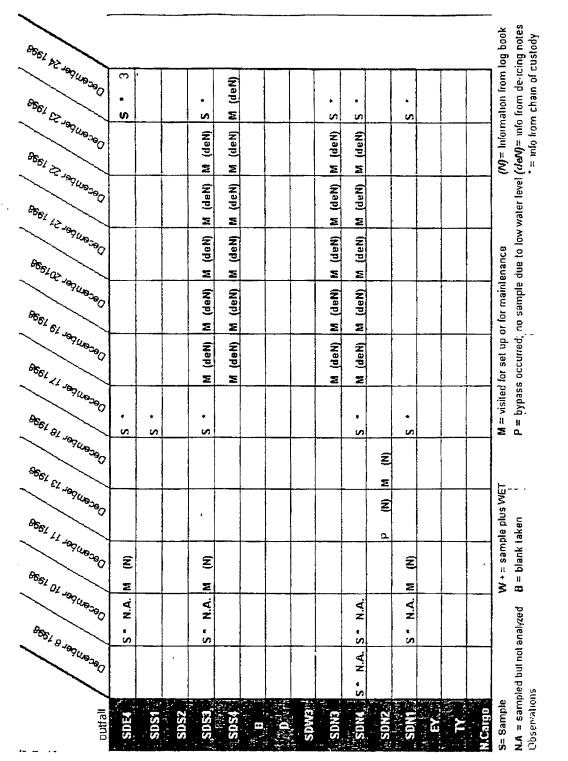
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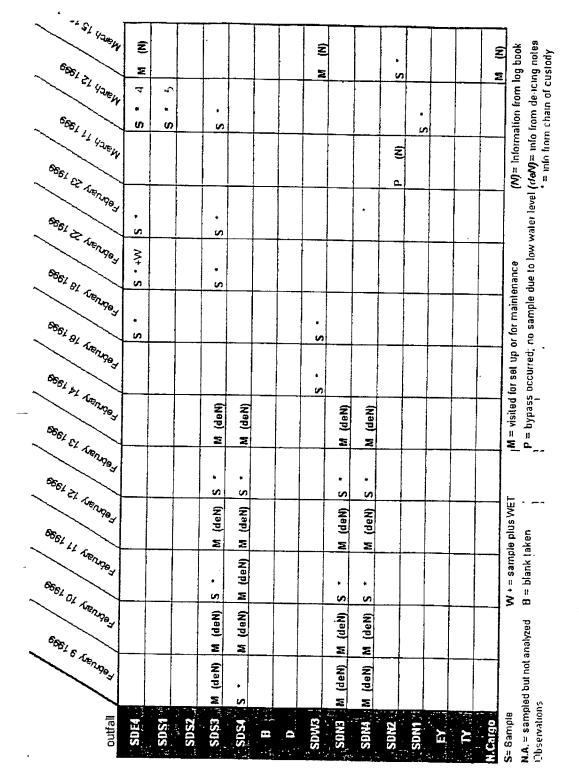


Tenges M = visited for set up or for maintenance (vy - muximum for set up or for maintenance P = bypass occurred, no sample due to low water level (deV) = info from chain of custodyM (deN) (deN) M (deN) M (deN) 6051 8 Jog 9 Ξ (daN) (deN) (deN) M (deN) 2001 5 Jacob Σ Σ Σ . ŧ . . 861 82 Januer S S S Ś F. Carlos 2 BELLE CONCER Ś **№**‡\* BEL OF CONTROL S ٠ SEL SI CRIMIC - Aller Ś Periner, 14 1800 . ٠ \* ] ф 8 B M+ **∗** ¥ . . . DEL OF TRANSP \* S S S S S ŝ .∔ ۸ŧ. æ 6661 6 CENTER 1 S S s W + ≈ sample plus WET -----ا ک<sup>ورو</sup>س نوبر ع<sub>ک</sub> 7<sub>95</sub>م B = blank taken ۲ ۰. 1 5 ŝ د Ē ( کەرط<sup>ی ئے ر</sup>کام آج<sub>اری</sub> Σ N.A = sampled bul not analyzed Dibiservations Z ا کهرهم که <sup>زی</sup>رج ٩ . M (deN) M (deN) (Neb) M (deN) X 1 SDN3 SDN4 SDN2 FV SDN2 FV TV TV S= Sample oulfall η

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-BI Stery P = bypass occurred, no sample due to low water level (deM)= mfo from de-icing notes ; ;\*= info from chain of custody (N)= Information from log book Ξ SSI S TOW 2 \* . \* . SSI Sterry S S 5 S Î E 282 22/40 J Σ Σ E E Ξ E 6951 82 100 L Ξ Ξ Z Σ Ē E M = visited for set up or for maintenance 605 61 100 J Ξ Σ ŝ Ξ E ŝ E ଅ E SSL 9 INOL Z 2 Σ Z Σ S Σ (N) Ê E Î (N) (N) (N April 2 Tage Σ Σ X Σ Σ X Σ Ē SSI I ILAN Σ E £ Ξ E est is they Σ Z Ξ Z W + = sample plus WET ----. B = blank taken \$ 551 ÷ 124 ÷ . \* . . See - See W S 2 ŝ S N.A = sampled but not analyzed . ٠ . S S s . . . . . S Ś ŝ าประกันในกร EV TY N.Cargo B D SDW3 SDN26 120S S= Sample outfall **F**SQ2 ENUS SDEA NOS INGS

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