# Annual Stormwater Monitoring Report

# for

# Seattle-Tacoma International Airport

*for the period July 1, 1995 through June 30, 1996*

*Port of Seattle*

**November 18, 1996**

*prepared by Scott Tobiason*

*Environmental Management Specialist, Port of Seattle*
*Environmental Services*

**AR 027767**

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Acknowledgments

*reviewed by Tom Hubbard, Port of Seattle,*

*and Gary Minton, Resource Planning Associates*

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# Glossary

| Acronym | Definition |
|---|---|
| AMA | Aircraft Movement Area (mainly runways, taxiways) |
| AOA | Airport Operations Area (includes AMA, ramps, etc.) |
| BMP | best management practice |
| $BOD_5$ | 5-day biochemical oxygen demand |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| DMR | discharge monitoring report |
| FOG | fats, oils and grease |
| GSE | ground support equipment |
| IWS | industrial waste system (including the piping) |
| IWTP | industrial waste treatment plant |
| $LC_{50}$ | concentration proving lethal to 50% of test poulation |
| MDL | method detection limit |
| NPDES | National Pollutant Discharge Elimination System |
| NTU | nephelometric turbidity unit |
| ppb | parts per billion, same as µg/l or ppm/1000 |
| ppm | parts per million, same as mg/l |
| SES | Stream Effects Study (Stormwater Receiving Environment Monitoring Plan, Permit condition S8) |
| STIA | Seattle-Tacoma International Airport |
| SWPPP | Stormwater Pollution Prevention Plan |
| TPH | total petroleum hydrocarbons |
| TSS | total suspended solids |
| WAC | Washington Administrative Code |

# Executive Summary

This report is provided to the Department of Ecology as required in Special Condition S9 of the NPDES Permit (WA-002465-1) for the Seattle-Tacoma International Airport (STIA). The report presents and reviews data collected from STIA stormwater outfalls only for the period of July, 1995 through June 1996. This report does not cover the Industrial Waste System (IWS). Permit-required data that describe the storms sampled in the period appear in Appendix A. All analytical data are summarized in figures in the ensuing report and are tabulated in Appendix B.

The Port of Seattle complied with all stormwater monitoring requirements specified in the STIA airport NPDES permit. The Port sampled more storms this year than in the previous year (July 1994 through June 1995) in order to comply with the Stipulated Agreement (Brasher, et. al., 1995).

The results show that stormwater runoff from STIA subbasins that drain the airfield (runways and taxiways) is cleaner than comparable regional areas. There is also a distinct dichotomy between stormwater quality from these four airfield outfalls and the terminal and "landside" outfalls.

Many analytes were consistently not detected, or were found at levels well below receiving water criteria (Washington State Water Quality Standards, WAC 173-201A). The Port recommends changing the oil and grease (FOG) analysis method from 413.1 to 413.2 for results that are more representative, precise, and comparable with total petroleum hydrocarbon (TPH) results.

The Port's Stormwater Pollution Prevention Plan (SWPPP) has achieved measurable results, reducing bacteria and ammonia at SDE4, and reducing petroleum products in the Taxi Yard runoff.

Runway deicing chemical application resulted in stormwater pollutants below any toxic levels, although no standards exist. $BOD_5$ and ammonia were similar to concentrations measured last year. Little of the urea applied to the North and

South Satellite areas during deicing decomposed to ammonia before exiting the STIA outfalls. Concentrations of ammonia were less than 30% of the acute criterion. The majority of urea and potassium acetate chemicals present in STIA stormwater washed off in the first inch of rainfall after deicing. Significantly, less than the 6-month, 24-hour storm (1.3 inches) washed off more than 90% of the total runway pollutant load caused by the deicers.

Aircraft deicing glycols in STIA stormwater appeared well below toxic levels even during the periods of heaviest application where more than 500 aircraft were deiced using over 23,000 gallons of glycol deicer and anti-icer. Glycols were undetected in 75% of all samples (118 total) analyzed over the past two years.

# Introduction

This report is submitted to the Washington Department of Ecology (WDOE) pursuant to Special Condition S.9 of the NPDES permit.

Figure 1 shows the individual stormwater drainage basins and the STIA Stormwater Management Boundary. Note that only colored subbasins drain to the storm system, white or blank areas near the terminals and gates drain to the Industrial Waste System (IWS).. The IWS drains runoff to the Industrial Waste Treatment Plant (IWTP). Monitoring data from the IWTP are not included in this report.

## Sources of Reported Data

Data reported and analyzed in this annual report are limited to discharges from stormwater outfalls only and include:

- Quarterly and annual monitoring required by the NPDES permit;
- Sampling specified by the Stipulated Agreement (Brasher, et. al., 1995);
- Stormwater Receiving Environment Study (Condition S.8 of the STIA NPDES permit), a.k.a. "Stream Effects Study" (SES), and
- The runway deicing washoff study described in last year's annual report.

Note that only data from regular NPDES monitoring, and from the Stipulated Agreement have been submitted to Ecology in the monthly discharge monitoring reports (DMRs), and only for those storms and sampling routines that fully complied with permit requirements. Data from the SES and runway deicing washoff study appear on a formal basis for the first time in this report.

## Requirements for the Annual Report

Special Condition S.9 of the permit states:

"On or before August 1 of each year of this permit cycle, the Permittee shall submit a report to the Department summarizing the stormwater monitoring results obtained 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 required in condition S10."

Further, the permit requires in Special Condition S3C that: "The permittee ... submit the following data for the storm event used: 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". This hydraulic and hydrologic information is provided in Appendix A.

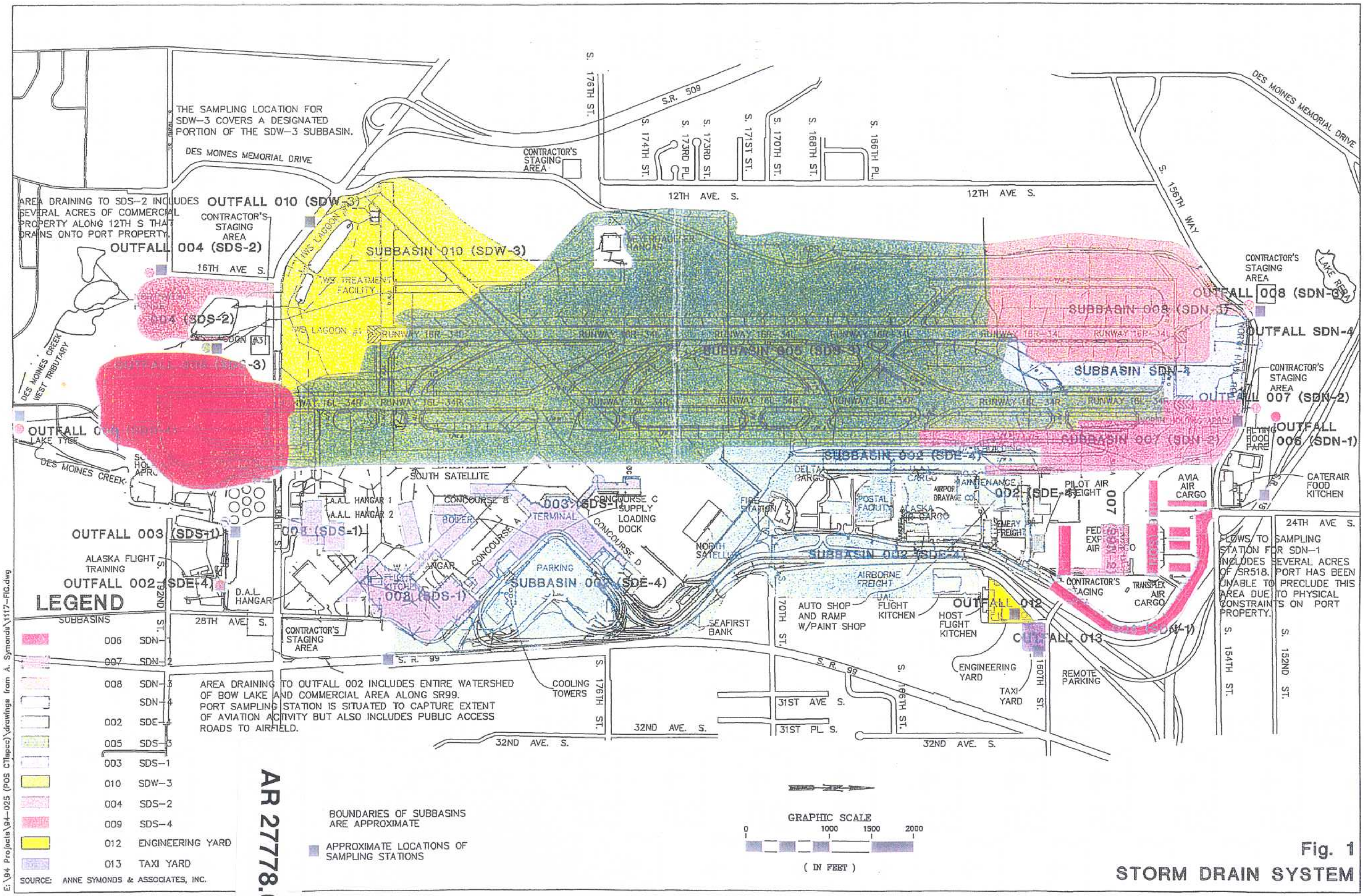


Fig. 1
STORM DRAIN SYSTEM

AR 27778.01

# Background

## Stormwater Monitoring Program

The Port conducts a comprehensive stormwater monitoring program that fulfills a considerable array of significant and unique requirements contained in:

- Quarterly and annual monitoring required by NPDES permit condition S3;
- Stormwater Receiving Environment Monitoring Plan (SES), NPDES permit condition S8;
- The Stipulated Agreement (Brasher et. al., 1995), and
- The runway deicing washoff study described in last year's annual report.

Stormwater discharge monitoring is just one portion of the complete monitoring program required by the NPDES permit. The comprehensive Stream Effects Study (SES) portion evaluates the effects that STIA stormwater discharges have upon the two receiving streams, Miller and Des Moines Creeks. The SES fulfills the permit special condition S8 for the Stormwater Receiving Environment Monitoring Plan, where monitoring is expected to be completed by June 1996.

Keeping these requirements in mind, a particular outfall may require monitoring for more than one objective on any given storm event, and that these objectives rank according to their rigor in what defines a target "storm". That is, NPDES target storms are the most strict in definition, therefore, quarterly outfall storm samples usually take the highest precedent. Figure 2 displays the field log employed to keep track of the multiple objectives and results for a particular monitoring location during a targeted storm event.

Port of Seattle

# Sea-Tac Airport Stormwater Monitoring Log

| Storm Event Data | | | |
|---|---|---|---|
| 48 hr Antecedent Rainfall (in.): | Rain Begin: | Approx Rainfall Depth Sampled: | Rain Gage Data filename: |
| | Rain End: | Total Rainfall Depth: | Hyetograph Filename: |

| Setup Date | Outfall | Objective(s): Qtrly Storm | Qtrly Deice | Runway Deice | Annual Storm | Citizen North | Citizen NPDES | Special | Flowmeter ID# | Sampler ID# | Sample Type | Sampling Begin | Sampling End | Duration Sampled (hrs) | Sample Retrieval Time | Successful? | comments/observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SDE4 (002) | | | ■ | ■ | ■ | | | 4150-14 | 3700-6 | | | | | | | |
| | SDS1 (003) | | | ■ | ■ | ■ | | | 4150-11 | 3700-16 | | | | | | | |
| | SDS3 (005) | | | | ■ | ■ | | | 4230-2 | 3700-1 | | | | | | | |
| | SDS4 (009) | | | ■ | ■ | ■ | | | 4150-15 | 3700-15 | | | | | | | |
| | SDN1 (006) | | | ■ | ■ | | | | 4150-17 | 3700-7 | | | | | | | |
| | SDN2 (007) | | | | ■ | | | | 4150-5 | 3700-14 | | | | | | | |
| | SDN3 (008) | | | ■ | ■ | | | | 4150-1 | 3700-17 | | | | | | | |
| | SDN4 ( ) | | | ■ | ■ | ■ | ■ | | | | | | | | | | |
| | 188B ( ) | | | ■ | ■ | ■ | ■ | | | | | | | | | | |
| | 188D ( ) | | | ■ | ■ | ■ | ■ | | | | | | | | | | |
| | EY (012) | | ■ | ■ | ■ | ■ | | | 3230- | | | | | | | | |
| | TY (013) | | ■ | ■ | ■ | ■ | | | 3230-3 | 3700-11 | | | | | | | |
| | SDW3 (010) | ■ | ■ | | | ■ | | | | | | | | | | | |
| | SDS2 (004) | ■ | ■ | ■ | | ■ | | | | | | | | | | | |
| | L Reba outlet | ■ | ■ | ■ | ■ | | ■ | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

Comments:

Programming Parameters

| Outfall | tubing length (feet) | head (feet) | pipe dia (in.) | Sample Pacing** (gallons) | Current Level (feet) | Enable Level (feet) | Outfall | tubing length (feet) | head (feet) | pipe diameter (inches) | Sample Pacing** (gallons) | Current Level (feet) | EnableLevel (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDE4 (002) | 25 | 20 | 48 | 13,000 | | | SDN4 (new) | | | | | | |
| SDS1 (003) | 10 | 4 | 36 | 1,900 | | 0.10 | 188B (new) | | | | | | |
| SDS3 (005) | 15 | 4 | weir | 33,000 | | | 188D (new) | | | | | | |
| SDS4 (009) | 20 | 8 | 36 | 1,200 | | | EY (012) | | | 8" RCP | | | |
| SDN1 (006) | 17 | 11 | 36 | 2,500 | | 0.08 | TY (013) | | | 12" cmp | 800 | | |
| SDN2 (007) | 12 | 8 | 24 | 750 | | 0.10 | SDW3 (010) | 14 | 7 | ?" RCP | | | |
| SDN3 (008) | 23 | 8 | 48* | 1,500 | | 0.10 | SDS2 (004) | | 5 | 12" cmp | 1500 | | |
| | | | | | | | L Reba outlet | | | | | | |

* Elliptical pipe: major dia = 48", minor = 36"

** to sample all of 0.25" rainfall, using runoff models used in DMRs. See QPACE.xls

AR 027780

*Figure 2 Stormwater Monitoring Field Log*

Scott Tobiason Port of Seattle

printed 11/18/96

This stormwater monitoring program has been in place since 1993, first to develop background, and then under the NPDES permit number WA-002465-1, issued June 30, 1994. The Port conducts the specific monitoring activities as described in the Procedures Manual (Port of Seattle, 1995a). Several consultants carried out monitoring until December, 1995, after which the Port hired a staff member to conduct the monitoring. The Port submitted the first annual report on August 30, 1995 (Port of Seattle, 1995b).

**Sampling locations**

The Port monitors stormwater at 11 locations, one for each subbasin within the boundary of the Stormwater Pollution Prevention Plan (SWPPP, Port of Seattle, 1995c). Subbasin names are coded according to location: EY = engineering yard, TY = taxi yard, SDS1 = storm drain South number 1, SDW3 = storm drain West number 3, etc. Figure 1 shows the location of the outfalls and monitoring locations. Note that the NPDES permit refers to outfalls by number, however, this report refers to subbasins and there outfalls by location. See Table 1.

***Table 1 Outfall Nomenclature Cross Reference***

| *outfall number in permit* | *Port nomenclature* | *Principal Activity* |
|---|---|---|
| 002 | SDE4 | landside |
| 003 | SDS1 | terminal |
| 004 | SDS2 | open space |
| 005 | SDS3 | airfield |
| 006 | SDN1 | landside |
| 007 | SDN2 | airfield |
| 008 | SDN3 | airfield |
| 009 | SDS4 | airfield |
| 010 | SDW3 | airfield |
| 012 | EY | landside |
| 013 | TY | landside |

The subbasins fall into three general categories: "landside", terminal, and airfield. Subbasins SDS3, SDS4, SDW3, SDN2, and SDN3 drain the airfield, officially designated the Aircraft Movement Area (AMA), containing the airport runways and taxiways. The SDS1 subbasin drains certain areas of the aircraft side of the terminal. The remaining subbasins (SDE4, SDN1, EY, and TY) are associated with the landside activities of the airport such as passenger vehicle areas. However, SDS2 drains mainly open space, and is monitored once annually, not falling into any convenient category. Therefore, this report groups subbasins in the airfield, and compares them to the terminal and landside outfalls as a group, a useful distinction indicated by the data.

Note that four monitoring locations (subbasins SDE4, SDN1, EY and TY) are significantly upstream from the point where the discharge actually "daylights" at the final outfall. 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 off-site inputs. Table A2 in Appendix A outlines the characteristics of the 11 subbasins. The Port numbers all manholes and inlets tributary to a particular outfall.

The Port selected sampling locations in a manner that minimizes the sampling of runoff from areas *outside* the Port's SWPPP boundary. The Port achieved this objective for subbasins SDS3, SDN2, SDN3, SDS4, and SDW3. In contrast, non-Port off-site stormwater enters upstream from the sampling points for subbasins SDE4, SDS1, SDS2, and SDN1:

- The total area draining to SDE4 (outfall 002) contains a relatively small area (in proportion to the total SDE4 subbasin area) of commercial property and public roadway along the International Boulevard corridor within the City of SeaTac's jurisdiction and not the Port's.
- In addition to the SDS1 subbasin, the total area draining to the sampling point of outfall 003 contains about two acres of public road (South 188th

Street). This is about 5% of the total drainage area. Roadway runoff could upwardly bias monitoring results for metals and petroleum products.

- In addition to the SDS2 subbasin, the area draining to outfall 004 includes off-site drainage from commercial property along 16th Avenue South as well as 16th Avenue South itself (about 4 acres). This inclusion of off-site parking and roadway stormwater cannot be avoided. The first point of accumulated runoff from the total SDS2 subbasin lies downstream of the off-site stormwater inputs from the gravel parking areas along 16th Avenue South.. Because the majority of SDS2 is vegetated, stormwater from the Port's area drains more slowly than the adjacent roadway's runoff. As a consequence, the offsite runoff may upwardly bias the Port's sample results for total suspended solids (TSS), turbidity, and petroleum products.
- The sampling point for subbasin SDN1 (Outfall 006) is in manhole SDN1-27 on the shoulder of SR518. This pipe carries accumulated airfield, highway and other runoff to the final discharge outfall near Lake Reba. This sampling point receives runoff from about 3.5 acres of the SR518 highway and nearby grassed areas. Total Port property in SDN1 is about 14 acres. Inclusion of the offsite runoff from SR518 elevates certain pollutant concentrations detected at this location. Until recently, excessive depths in upstream manholes precluded the effective sampling of exclusive Port stormwater. .

**Storm Definition**

Special Condition S3C of the permit specifies that: "All samples (stormwater) shall be collected from the discharge resulting from a storm event greater than 0.25 inches and at least 48 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Exceptions to these requirements may be made with approval of the Department for those periods in which no suitable storm event occurs".

## Sampling procedures and constituents

The Procedures Manual (Port of Seattle, 1995a) describes all relevant sampling, programming and handling necessary to comply with requirements of the permit. The reader is referred to this document for details beyond those presented below.

### Sampling frequency and pollutant analytes

The Port samples storms quarterly at seven of nine permitted outfalls. At the remaining two permitted outfalls, one storm is sampled per year. Table 2 lists required pollutant analytes, methods and detection. Other situations may necessitate additional pollutant analyses depending upon the nature of the situation. For example, the Port analyzes total Kjeldahl nitrogen (TKN) and acetate during certain airfield deicing/washoff periods.

## *Table 2 Pollutant Analytes, Methods and Detection Limits*

| Analyte | Method[1] | Detection limit (mg/l) | Subbasins (refer to Table 1_ Airfield outfalls[2] | EY TY | SDS2 SDW3 | Miller Creek Outfalls[3] |
|---|---|---|---|---|---|---|
| pH | 150.1 | 0.10 | X | X | X | |
| FOG (Oil and Grease) | 413.1 | 1.0 | X | X | X | |
| TPH (total petroleum hydrocarbons)[4] | 418.1 mod | 1.0 | X | | X | |
| Fecal coliforms | 9221 E | 2 | X | | X | |
| TSS (total suspended solids) | 160.2 | 0.50 | X | X | X | X |
| Turbidity | 180.1 | 0.10 | X | | X | X |
| $BOD_5$ | 405.1 | 4.0 | X | | X | X |
| Total Ammonia | 350.2S | 0.010 | X | | | X |
| Total Glycols[5] | GC FID | 5 | X | | | X |
| Total Recoverable Priority Pollutant Metals[6] | 200 | varies, see Table 4 | X | | | |
| Surfactants | 425.1 | 0.10 | X | X | | |

1. 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, or as revised.
2. Includes SDE4, SDS1, SDS3, SDS4, SDN1, SDN2, SDN3
3. SDN1, SDN2, SDN3, L. Reba outlet For Stipulated Agreement
4. Washington Department of Ecology method WTPH-418.1 Modified.
5. Analyzed by Gas Chromatograph, Flame Ionization Detector.
6. Metals analyzed by atomic absorption (AA) furnace, unless quantifiable by ICP, Mercury analyzed by Cold Vapor method.

**Sampling procedure and protocols**

The Port uses ISCO automatic samplers paired with ISCO flowmeters for the stormwater monitoring program. Model 4150, 4230, or 3230 flowmeters measure discharge and trigger Model 3700 automatic samplers. Samplers collect a one-gallon first-flush "grab" sample taken immediately when enabled, and then collect a 3-gallon flow-weighted composite sample during the storm discharge hydrograph. Fecal coliforms, pH, FOG, and TPH are analyzed from the grab sample, while remaining pollutants are analyzed from the composite sample.

The Port employs a staff person and an assistant to monitor stormwater. Safety reasons preclude manual grab sampling below grade in the confined spaces of manholes at SDE4, SDN2, SDN1, and the Taxi Yard. The Port utilizes automatic samplers to take all samples. Samplers use Teflon sample tubing and glass containers at all locations to minimize losses of FOG and TPH in the sampling apparatus. The WDOE has reviewed the Port's sampling procedures (Port of Seattle, 1995a).

# Results and Discussion

This section separates the presentation and discussion of results into two parts: stormwater monitoring data and SWPPP activities. The data for the current reporting year, July 1995 through June 1996, are compared to the data for the last two years to July, 1994 because many SWPPP activities and BMPs have been implemented since the last report.

This Report discusses differences in stormwater data for the airfield, "landside", and terminal outfall categories when a distinction is merited:

- the airfield subbasins are: SDS3, SDS4, SDW3, SDN2, and SDN3,
- the landside subbasins are: SDE4, SDN1, EY, and TY, and
- the terminal subbasin is SDS1.

## Stratified Data Set for Stormwater Discharges

Because stormwater discharge data represent different and distinct conditions, a stratified analysis approach is appropriate. These strata are:

1. Discharges from storms meeting the NPDES definition, including:
   a) regular quarterly monitoring,
   b) extra full-suite NPDES samples for the Stipulated Agreement,
   c) Miller Creek outfall samples for the Stipulated Agreement, and
   d) events monitored by the SES
2. Samples analyzed for glycols during aircraft anti-icing and deicing operations
3. Airfield deicing events (runways, taxiways, and ramps)
4. Stipulated agreement sampling at the Miller Creek outfalls

Stratum 1 includes samples taken for at least four different objectives (1a, 1b, 1c, and 1d). Sampling for each of these objectives took place on the same basis: a flow-weighted composite sample. Because these samples share this common basis, they are analyzed together, comprising equally representative samples from NPDES target storms.

Note that samples falling into 1a-1c sub-strata were all taken by the same protocol (automatic sampler), whereas SES samples (1d) were taken automatically but were *manually* flow-weight composited, and usually over a longer duration of the hydrograph. Further note that sub-strata 1a-1c comprise the data set submitted to Ecology in the monthly DMRs. Note also that several samples in Stratum 1 were taken shortly after an airport deicing event sequence. Because metals were analyzed only in samples taken from NPDES storm discharges, they already fall into a distinct stratum under 1a and 1b, above. Thus, metals are discussed only once under Stratum 1.

All results in this Stratum 1 data closely represent "event -mean concentrations" or EMCs, obtained, by definition, from a flow-weighted composite sample taken over the duration of the discharge hydrograph. Because sampling over the *entire* event hydrograph is neither required by the permit, nor practical, the Port's data represent an average over the actual duration sampled. The Port samples a minimum of three hours, or the entire event, whichever is least. These data therefore approximate an average value of a particular pollutant occurring in the runoff from a particular subbasin over the *duration sampled*, or sample mean concentration (SMC). The City of Bellevue also made this distinction in their recent report (Bellevue, 1996).

The main premise, therefore, is that SMCs are comparable storm-to-storm, and site-to-site. In addition, SMCs are more representative than traditional manual grab samples despite the difficulty in sample collection. All data reported in stratum 1 are SMCs, except where all pH, fecal coliform, FOG, and TPH data are from grab samples as required by the permit.

Stratum 2 contains data for a variety of samples where glycols were analyzed to investigate the impact of aircraft deicing operations. These include data in strata

1, 3 and 4 whenever glycol was analyzed. This stratum therefore aggregates all glycol data.

Stratum 3 contains data taken during two runway deicing events, representing pollutants washed-off through the storm drains over the course of up to the first 1.75 inches rainfall after the runway deicing took place. These data are also included in stratum 2 and to a limited degree stratum 4. These airport deicing events require their own special data set because they cause atypical stormwater quality conditions, occurring on the average twice per year at STIA. These events include deicing chemical applications to the runways and taxiways, as well as terminal areas. Note that roadway sanding usually takes place during these freezing conditions. Monitoring takes place over several days on a time-composite basis which is completely different from Stratum 1.

Therefore, airport deicing monitoring results must be considered in their own distinct stratum because they do not represent SMCs, nor typical pollutant loadings experienced throughout the remainder of the year. The deicing chemicals applied to the stormwater subbasins certainly do not result in "typical" runoff quality at STIA. Monitoring done under the runway deicing washoff study provides data for "pollutagraphs" and "loadagraphs" which depict pollutant concentration and load variation over the course of the runoff. These metrics help to identify when the majority of pollutant load washes off as a function of rainfall.

Stratum 4 includes only samples taken for the Stipulated Agreement at the Miller Creek outfalls. These samples were generally flow-weighted composites, yet some were discrete samples, or time-composites depending upon the situation. Several samples share data with the runway washoff data set of Stratum 3. Note that this stratum also contains sub-stratum 1c.

## Stormwater Data Reduction

The following subsections present and discuss data obtained as part of the intensive stormwater monitoring program. Stormwater quality data are compared to one another on a sub-basin basis and are compared to certain reference values for the current year and the past two years. Because objective criteria for stormwater quality do not yet exist, STIA stormwater will be compared to other generally accepted reference comparators . These comparators are:

- Stormwater discharge data from a comprehensive regional study, the City of Bellevue Urban Runoff study (BURP, 1984),
- Stormwater discharge data from the U.S. EPA's National Urban Runoff Program (NURP, 1983),
- Stormwater discharge data from Sturtevant Creek, a commercial/industrial subbasin monitored by the City of Bellevue (Bellevue, 1996), and
- Receiving water quality standards for Washington State class AA waters as specified by the WDOE in WAC 173-201A.

Table 3 shows the comparator values. The "best" comparison was selected as the more conservative of either of the two City of Bellevue studies, because they were comprehensive, local studies.

However, caution must be exercised in comparing stormwater quality data because the WA State water quality standards for pH, temperature, dissolved oxygen, turbidity, ammonia and certain toxic metal parameters apply to the receiving waters. That is, they apply only to the condition of the receiving water itself, not at the end of the pipe. The future comprehensive SES will evaluate receiving water effects.

### *Table 3 Stormwater Quality Comparators*[1]

Note: Best Comparative Values Shaded

| Pollutant | units | Study: NURP, 1983 | Study: BURP, 1984 | Study: Metro, 1982 | Study: Bellevue, 1996[2] | Study: Federal Highway | WDOE Criteria[3] (acute) |
|---|---|---|---|---|---|---|---|
| pH | std units | | 5.2 - 7.4 | | 7.2 - 7.8 | | 6.5 - 8.5 |
| FOG | mg/l | | *2.5* | 7.8 | 3.7 | 30 | *no criteria* |
| TPH | mg/l | | | | 3.7 | | *no criteria* |
| Fecal coliforms | mpn per 100 ml | 1000 to 21000 | *980* | | 201 | | 50 |
| BOD5 | mg/l | 9 | *6.6* | | | | *no criteria* |
| TSS | mg/l | 100 | *50* | | 82.3 | 220 | *no criteria* |
| Turb | mg/l | | 19 | | 29.4 | | based on background |
| NH3[4] | mg/l | | *0.17* | | 0.58 | | 6.8 - 32.6[5] |
| glycols | mg/l | *not analyzed in any of these studies* | | | | | *no criteria* |
| Surf | mg/l | | | | <MDL | | *no criteria* |
| Cd | µg/l | | | 0.7 | 1 | | 1.7 |
| Cr | µg/l | | | 7 | 6.9 | | 311 |
| Cu | µg/l | 34 | | 20 | 10.4 | 43 | 8.9 |
| Pb | µg/l | 144 | 170 | 210 | 26.3 | 550 | 30 |
| Zn | µg/l | 160 | 120 | 110 | 161.4 | 380 | 64 |
| As | µg/l | | | 13 | | | 360 |
| Ni | µg/l | | | 11 | | | 787 |
| statistic reported: | | median | mean[6], *median* | mean | log-normal median | median | metals at hardness = 50 |

1. Blank space means no data available, reported, or applicable
2. Bellevue, 1996 data for "Sturtevant Creek, downstream" site
3. WDOE criteria are for class AA receiving waters, see WAC 173-201A
4. Ammonia values and criteria expressed as total ammonia, not as ammonia-nitrogen
5. Ammonia criteria for pH 6.5 to 8.5 and temperatures 5° to 20°C, salmonids present
6. For Turb, Cr, Cu, Pb, and Zn, BURP 1984 data was mean of grab samples, therefore Bellevue, 1996 data are better comparators because they represent median

**Data Interpretation: censored data**

Many studies encounter what is termed "censored data", or results reported as below or above some value. Most analytical laboratories report these results as "<MDL", indicating that the result is below the detection limit for the analytical method specified. Many resort to a simple assumption to convert these censored data to values suitable for mathematical reduction. Others go on to prove an underlying distribution and actually estimate what the censored values should be based upon probability. This approach is beyond the scope of the Annual Report, where instead, when any pollutants were not detected, one-half the detection limit was assumed to be the concentration present. This approach is a common practice.

Such is the case for the majority of STIA metals data. Subsequent figures list the number of data points and the number below the detection limit that were replaced with a value equal to one-half the MDL. High-censored data, or data reported by the analytical laboratory as "greater than" are replaced with the value given, for example, >92 is replaced with 92. This procedure affects only $BOD_5$ data where several $BOD_5$ results were high-censored due to incomplete incubation. This phenomena happens when a sample receives insufficient dilution to prevent oxygen depletion before the end of the 5-day BOD incubation period. All censored data values are highlighted in the Appendices.

**Data Interpretation: estimators of central tendency**

Stormwater discharge data typically fall into what is known as a "log-normal" distribution. Most data fall in the higher or lower ranges, rather than in "the middle" as in the bell-shaped curve of a "normal" distribution. Median values therefore are a better representation of central tendency, or typical value, than are simple arithmetic means.

The median is that value where half of the data fall on either side. An arithmetic mean, or average value, for log-normally distributed data could over or underestimate typical values considerably, biasing conclusions. Figure 3 illustrates this principal, where both data sets have the same arithmetic mean, but the skewed (log-normal) data set has a median value much less than the mean value.

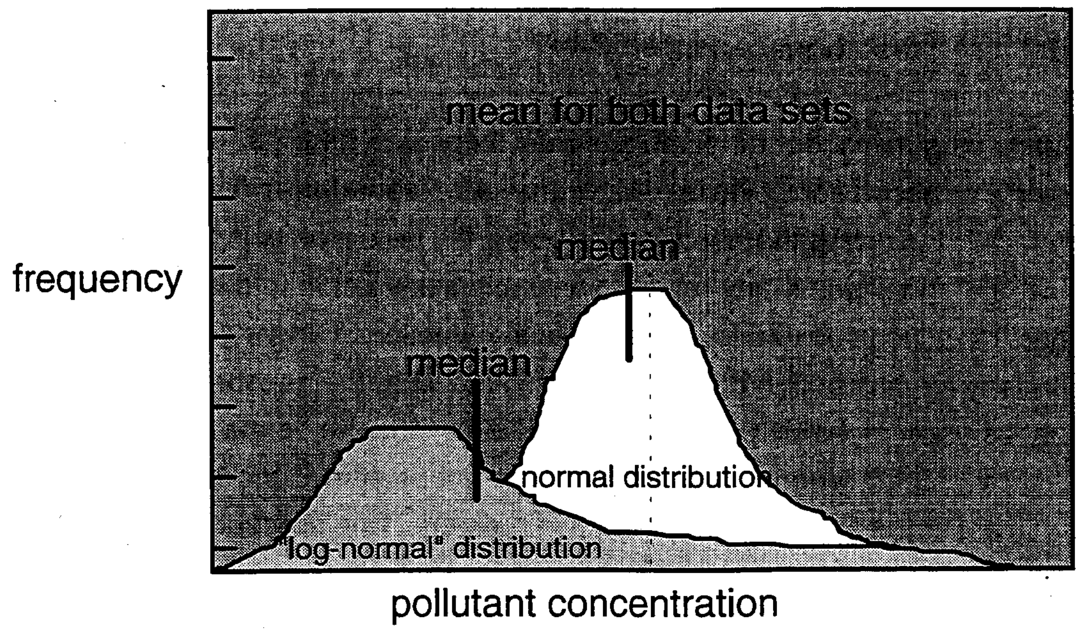


***Figure 3 Comparing Median values for data with same Mean***

Most studies assume log-normal distributions, though few actually go on to confirm this assumption statistically. The City of Bellevue did so in their recent report of several years' worth of stormwater data (Bellevue, 1996). However, this approach is beyond the scope of the STIA Annual Report, where we instead assume the log-normal distribution. Median data for STIA stormwater are compared, where possible, to the median values in the comparative studies.

**"Box" Plots**

Box plots efficiently illustrate the central tendency, spread, and skew that a data set might have. The bold line within a box represents the median value, while the bottom and top of a box show the 25th and 75th percentile, respectively. In other words, half the data fall within the box, or, one could say, 50% of the time the data fall within values highlighted by the box. The smaller the box, the less variable, and hence more predictable, the data. If the median is not in the center of the box, it shows that the data are skewed, further highlighting the log-normal possibility. SPSS software was used to generate the box plots appearing below (SPSS, 1993).

The size of the box shows the variability, and the "whiskers" show the largest values that are not considered outliers. When summarizing data to compare "typical" values, outliers usually represent unusual conditions, atypical of what one could expect on a day-to-day basis.. Thus, the box plots show two separate circumstances and highlight two different management possibilities. SPSS reports two types of outliers: those more than 1.5 box-lengths from the 75th percentile as "o", and those more than 3.0 boxlengths as "*", each captioned with the date of occurrence (SPSS, 1993).

## <u>Stratum 1: all NPDES "Storms"</u>

The following sections and figures present and discuss results within Stratum 1, all NPDES Storms, for each parameter. The tables in Appendix B present the raw data for all Stratum 1 data. Figure 4 through Figure 25 compare results for each subbasin, one to another, using box plots. Comparing outfalls over time and to others using these box plots is expected to show several distinctions: improvement over time and differences between airfield, terminal and "landside" outfalls. Note the reference median parameter concentrations depicted by dashed lines in these figures (BURP, 1984, or Bellevue, 1996). Each figure also shows the method detection limit (MDL), the number "N" of data points for each outfall, and the number of low-censored (<MDL) results replaced with values equal to one-half the particular MDL. All data are from flow-weighted composite samples except FOG, TPH and fecal coliform data are from grab samples as required by the permit.

### FOG and TPH in grab samples

Because FOG and TPH both relate largely to anthropogenic petroleum pollutants, both are discussed concurrently. Note that TPH is a subset of FOG, so that all TPH values should be less than or equal to the FOG results. That is, any petroleum hydrocarbons showing up in the TPH analysis should also show up in the FOG procedure. However, as discussed later, TPH exceeded FOG in seven samples. Minor differences could be attributable to the variation in the analytical procedures. Differences of more than about 1 mg/l suggest that the analytical method is probably at fault and should be changed as recommended subsequently.

Oil and grease (FOG) and total petroleum hydrocarbons (TPH) are a particular interest at airports. The results discussed below demonstrate that the STIA concentrations of both pollutants are consistently less than in stormwater from commercial and residential land uses. The City of Redmond (Redmond, 1990) found FOG in discharges from 120 storms (composite samples) ranging from about 2 to 546 mg/l, with a mean of about 30 mg/l. In contrast, STIA runoff over the past two years ranged from non-detectable to 22 mg/l, with an overall median of 1.9 mg/l, about fifteen times less than in the Redmond study. FOG was detected in less than 73% of all STIA stormwater samples.

FOG tends to be greater than the comparative value of 3.7 mg/l only in discharges from the landside SDE4, SDN1, and TY subbasins where it was consistently detected. Figure 4 shows that these three landside subbasins had median values near or slightly above the most conservative reference value of 3.7 mg/l found in the Bellevue, 1996 study. The box plots show that FOG median values from all other STIA subbasins were well below 3.7 mg/l, and for more than 75% of the data. Therefore, only FOG in STIA runoff from the landside and terminal outfalls is comparable to typical regional values.

This first distinction is clear: petroleum-based pollutants from airfield subbasins (SDS3, SDS4, SDN2 and SDN3) are well below the regional comparators. In contrast, only landside and terminal operations produce petroleum-based pollutants comparable to regional commercial/industrial areas. Figure 6 and Figure 7 show that TPH results for SDE4 and SDS1 also support this distinction. These data establish that the IWS effectively isolates aviation-related fuel spills and drips from the storm drains.

In general, the data show that both TPH and FOG were found in stormwater from terminal and landside subbasins with paved vehicle driving surfaces. Figure 4 and Figure 5 show that the EY had FOG outliers(June 4, 1995, and July 26, 1995) , These higher FOG values could be attributable to an occasional leaky vehicle in the area, because FOG was detected in only 50% of the samples at the EY.

The single TPH value of 6.6 mg/l for SDW3 was from an August 17, 1995 storm. This TPH value was coupled with 2.9 mg/l FOG, illustrating an instance where the

TPH results were greater than the FOG, a result not theoretically possible as discussed subsequently. These results suggest that lighter fuel fractions (e.g. gasoline constituents) boiled-off during FOG analysis. A backwater is typically present at this outfall's sampling point and could have biased results upward if it contained petroleum products in runoff from the adjacent 188th Street. Two other samples taken earlier in 1995 do not show detectable TPH, and, FOG was near or below the 1.0 mg/l MDL. Therefore, future sampling should take place upstream of any backwater present at this outfall.

SDN1 discharges showed higher FOG and TPH than other subbasins. Because about 3.5 acres of the heavily traveled SR518 drain to the SDN1 monitoring location, the Port believes this data is significantly biased by offsite runoff for both FOG and TPH results. In 1994, SR518 had six times the annual average daily traffic (AADT) compared to the portion of Air Cargo Road drained principally by this outfall (compare 56,750 AADT for SR518 to 9,450 AADT for Air Cargo Road). Other data discussed below support this premise.

FOG from the TY has dropped considerably since last year (note the drop in both median value and 75th percentile). This improvement is probably due to using oil-absorbent media in the catch basin insert "socks" (FOSS "Streamguard" units), and increased vigilance by the STITA Taxi Association, which leases this site. Note however that there was an FOG outlier of 19 mg/l on October 16, 1995. This value was probably due to a defective early design of the FOSS "Streamguard" insert that allowed the oil absorbent media to float out of the unit during higher runoff (Minton, personal communication). The Port replaced the older designs with improved units.

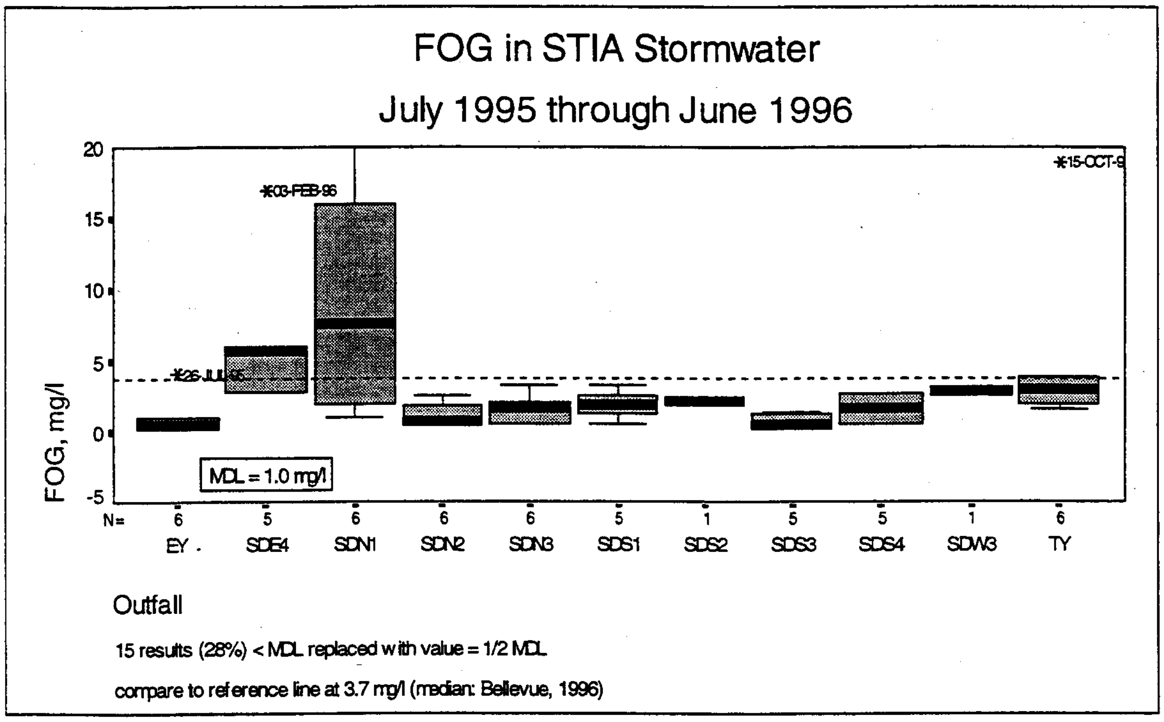


***Figure 4 FOG compared in Box Plot for 1995-1996***

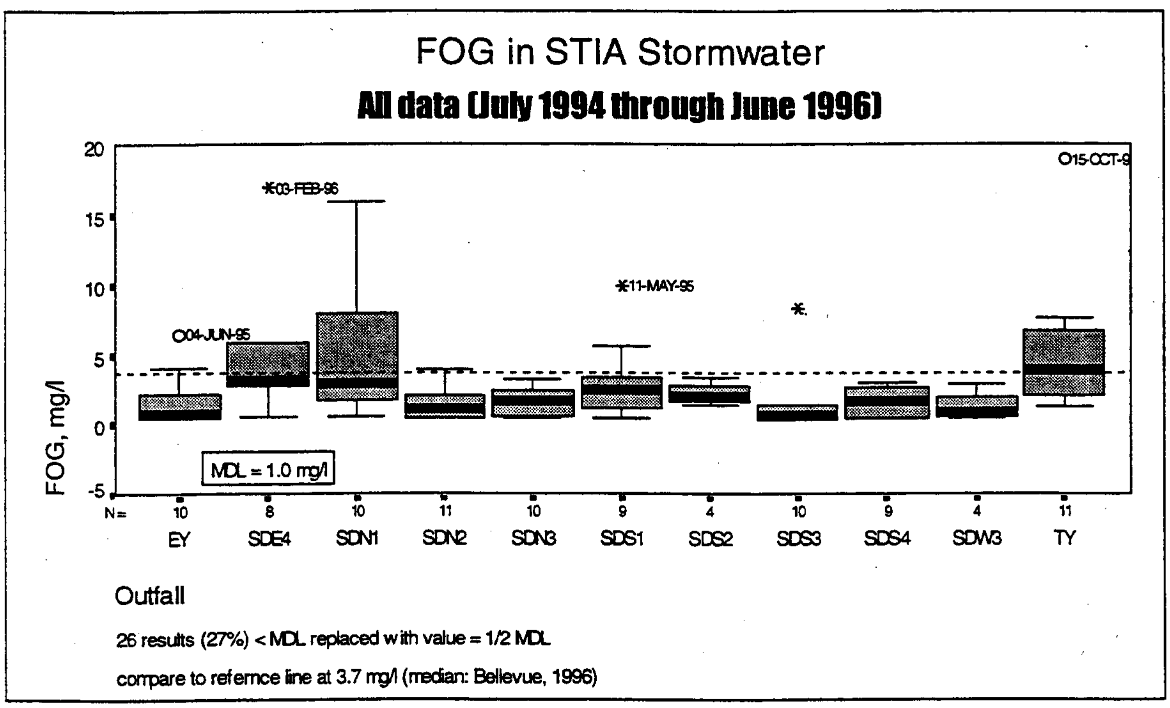


***Figure 5 FOG compared in Box Plot for 1994-1996***

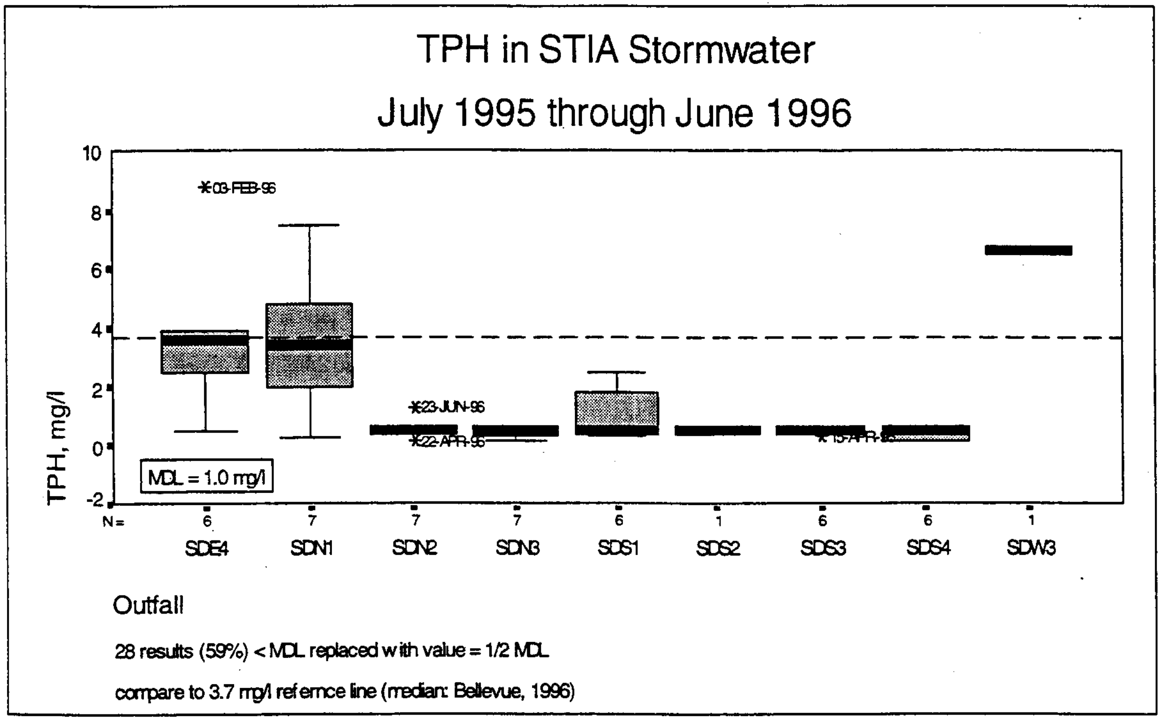


***Figure 6  TPH compared in Box Plot for 1995-1996***

note: TPH of 6.6 mg/l was greater than FOG of 2.9 mg/l in the SDW3 sample (8/17/95).

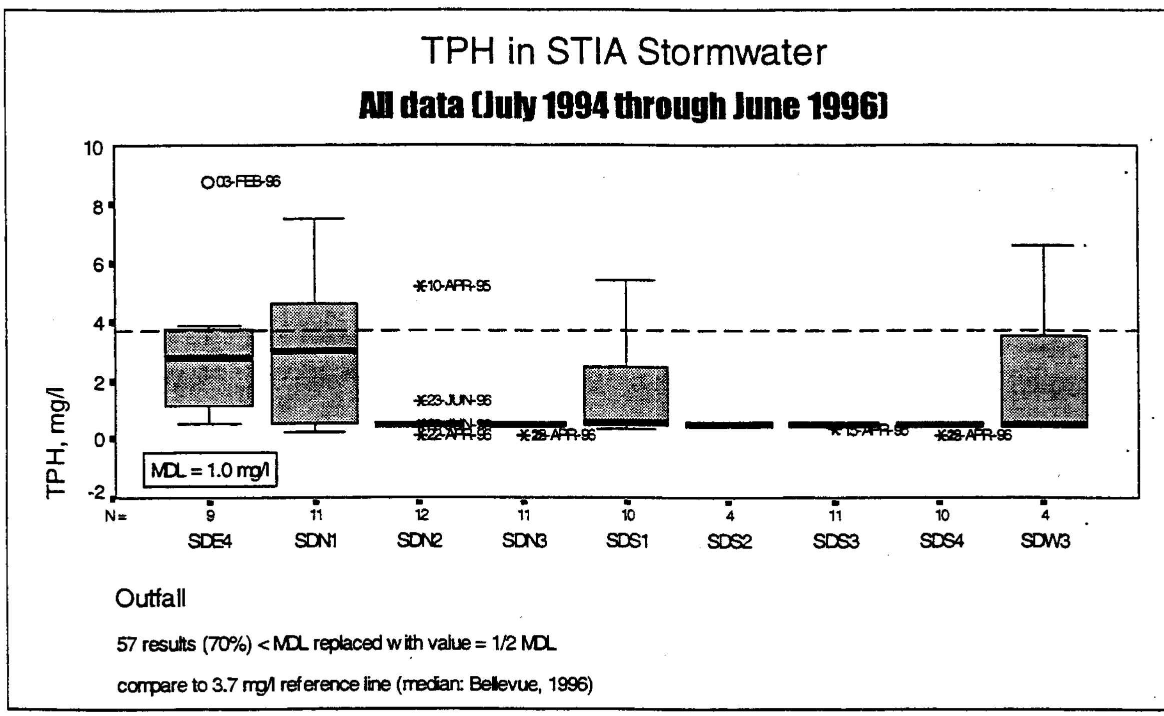


***Figure 7  TPH compared in Box Plot for 1994-1996***

## Suspended Solids and Turbidity

Both total suspended solids (TSS) and turbidity (Turb) are measures of suspended material. In stormwater runoff, TSS and turbidity generally appear proportional to one another. However, high turbidity coupled with low TSS could indicate finer suspended material such as colloidal clays and fine silts from soil erosion, though none of the results in this report indicate this. One could conclude then that the coarser, more settleable fractions probably composed most of the TSS experienced in STIA runoff.

Figure 8 through Figure 11 show that both median TSS and turbidity values for all subbasins were below reference values of 50 mg/l and 29 NTUs, respectively. In fact, the 75th percentile for nearly all subbasins was below these median reference values shown by the dashed lines. Therefore, the data show that suspended material in STIA runoff is much lower than comparable regional urban industrial/commercial sites.

The few aberrations were most likely related to winter weather. Both SDE4 and SDN1 showed higher turbidity values during the February 3, 1996 storm. This storm followed roughly a week of freezing conditions and roadway sanding within the SDE4 and SDN1 subbasins at STIA. See Figure 10

SDW3 was sampled on two back-to back storm events, May 10 and May 11, 1995. The first storm of 0.12" produced TSS and turbidity values much higher (88 mg/l and 310 NTU, respectively) than the 0.20" storm on May 11, 1995 (20 mg/l TSS, and 25 NTU). The higher values, even though not from an NPDES target storm, were reported on the May 1995 DMRs for outfall 010. However, the results from the May 11 storm were more representative because the 0.20" rainfall was closer to the target storm. Nonetheless, the Port believes that the 310 NTU turbidity result was due to construction activity underway at that time.

The Port believes that the gravel shoulder of 16th Ave South contributes sediments to the SDS2 outfall samples. Many vehicles park on this shoulder on a daily basis disturbing the gravel-surfaced shoulder on the east side of this road. Turbid runoff was observed draining in rills and gullies along this shoulder during several recent storm events.

Note that SDN2 showed two outlying values, both on June 23, 1996. Both samples were taken from the same storm, but one for the quarterly requirement, and the other for the SES. Only one of these two should be considered, because they represent duplicate samples. The difference between the two is largely due to the duration of sampling over the event's hydrograph. In any case, both TSS values are less than the most conservative comparator of Table 3.

At the TY, the Port believes that the TSS value of 480 mg/l on October 16, 1995 was caused by a design flaw in the catch basin insert that had been installed. The original design allowed high intensity storms to easily wash-out sediment trapped during earlier, smaller events. The monitoring consultant observed this effect while retrieving samples during the October 16, 1995 storm. Therefore, the TSS value of 480 mg/l is not representative and should be disregarded, especially because seven other samples in the last two years indicate both a mean and median of less than 20 mg/l. Turbidity is not analyzed regularly for the TY subbasin. The Port installed improved inserts in the TY catch basin in early 1996.

In summary, the airfield outfalls SDS3, SDS4, SDN2, and SDN3 produced less than the comparative values for either TSS or turbidity. And overall, STIA runoff had less suspended material and turbidity than comparable regional areas.

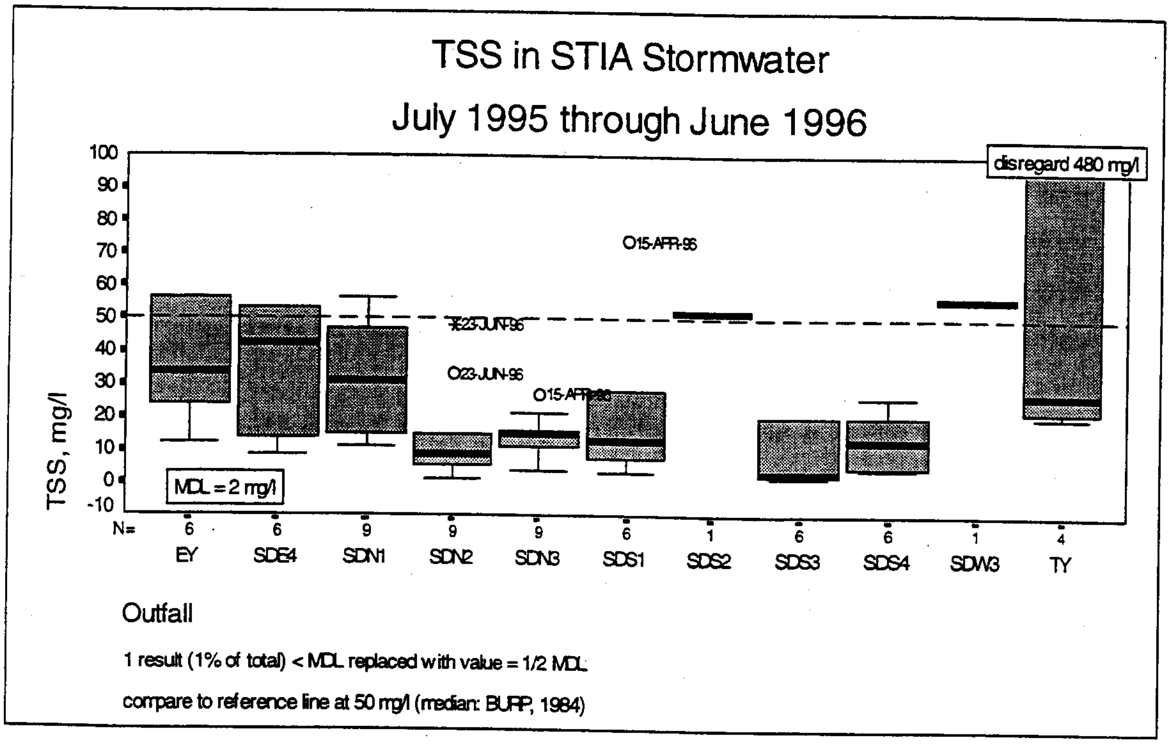


***Figure 8  TSS compared in Box Plot for 1995-1996***

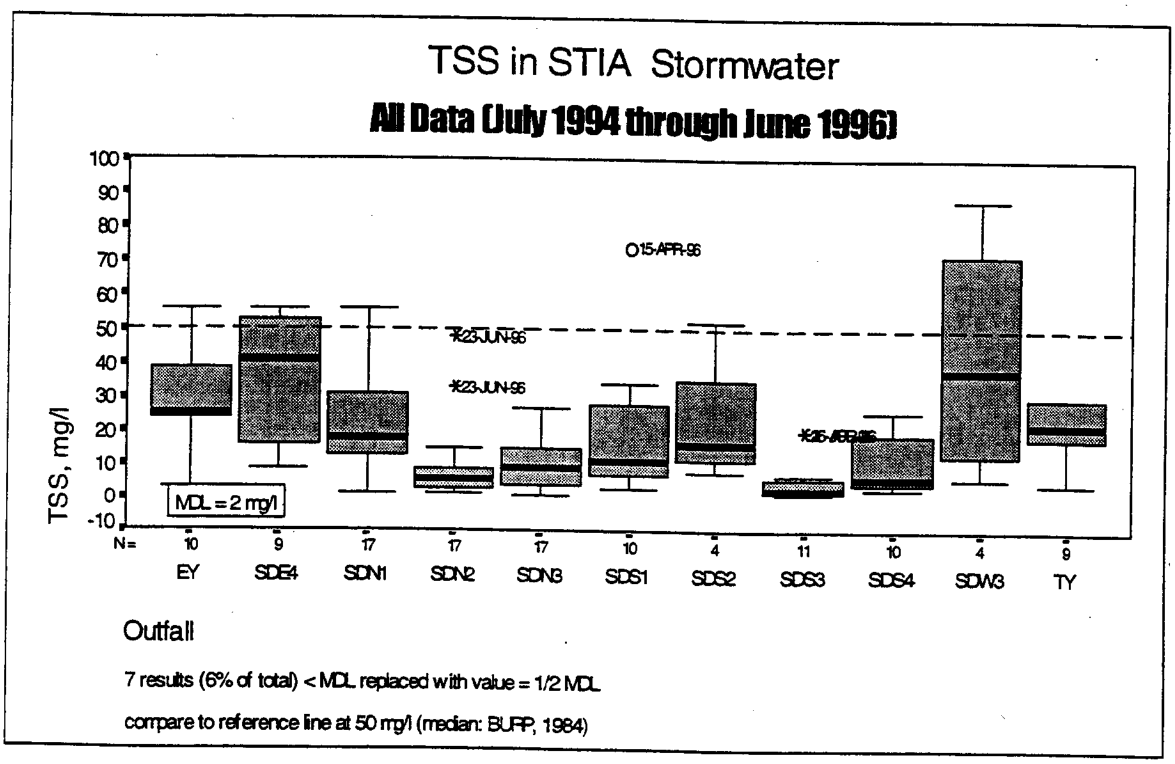


***Figure 9 TSS compared in Box Plot for 1994-1996***

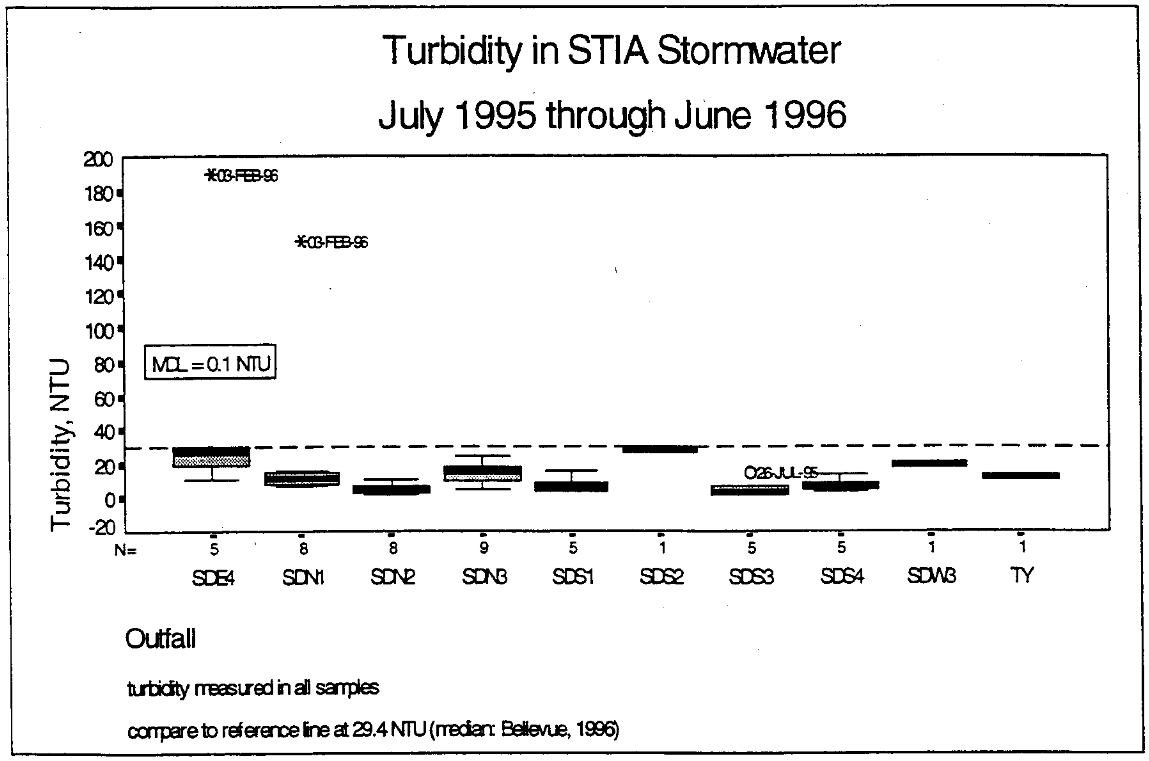


*Figure 10 Turbidity compared in Box Plot for 1995-1996*

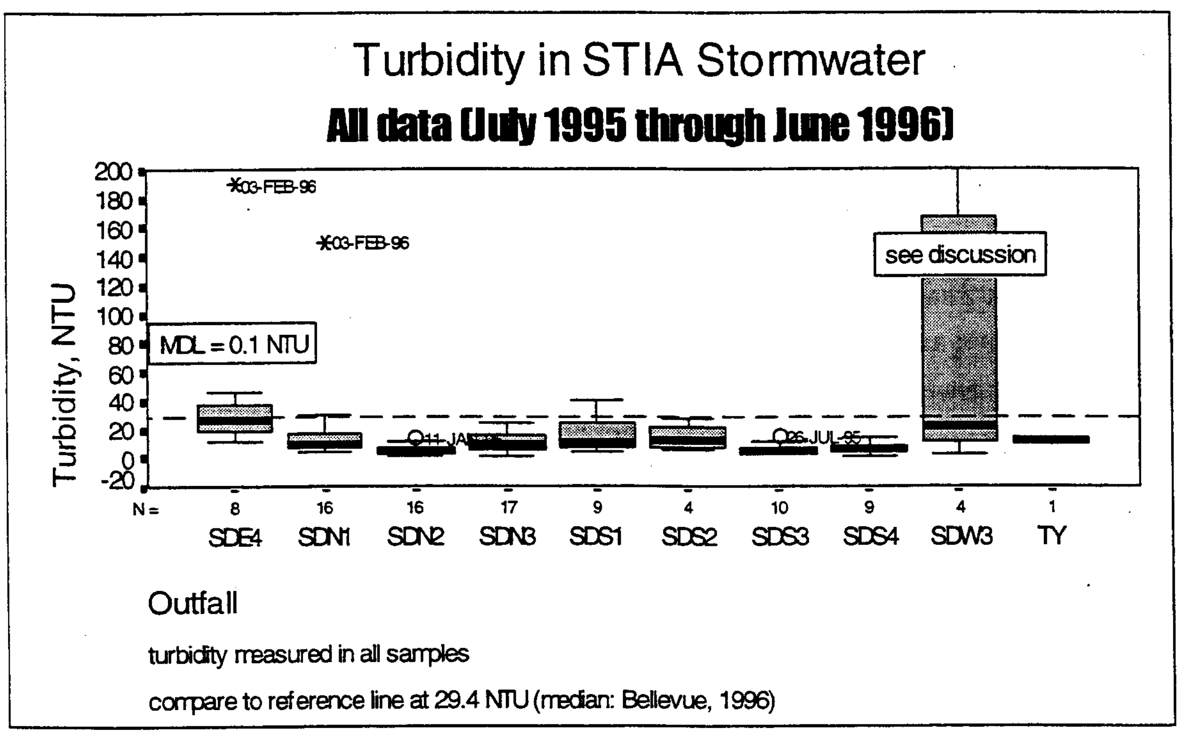


*Figure 11 Turbidity compared in Box Plot for 1994-1996*



AR 027802

## Ammonia

The ammonia reported is expressed as *total ammonia*, the sum of both ionized ($NH_4^+$) and unionized ($NH_3$) forms: not *ammonia-nitrogen.* This section presents and discusses ammonia data from NPDES storms only. Note that the February 3, 1996 results at SDE4 were related to the urea application at the North and South Satellites during a January 29, 1996 airport deicing operation. Urea is no longer used on the airfield.

This report compares STIA *total ammonia* values to *total ammonia* comparative values and the Ecology acute toxicity criteria; see Table 3 . Acute ammonia toxicity ranges from 6.8 to 32.6 mg/l. A range is given because ammonia toxicity depends upon both pH and temperature. Ammonia becomes more toxic as pH and temperature both rise, liberating molecular ammonia. The molecular, unionized $NH_3$ is the toxic fraction. Therefore, the lower ranges represent worst-case possibilities at pH 8 and a temperature of 20°C. STIA stormwater is generally in circumneutral pH ranges, rarely if ever above pH 8. Sample temperatures are not measured during discharge, however ambient air temperatures average about 15°C or less during typical storm events. The Ecology criterion applies to the receiving waters, not to the end-of pipe STIA data..

In the current period, Figure 12 shows one occasion, February 3, 1996, at the SDE4 and SDN1 outfalls, where ammonia exhibited higher concentrations. Both of these were well below the most conservative *acute* criterion of 6.8 mg/l. Because these results appeared in the first runoff following a freezing period; the two values are probably related to the urea deicer applied to the North Satellite terminal area on January 29, 1996. Though the North Satellite is served by the IWS, the urea could have been tracked to the adjacent SDE4 subbasin. Many service vehicles frequently drive through the North Satellite area and into the adjacent SDE4 subbasin. Note that Port Airfield Maintenance no longer use urea on the runways and taxiways. Runoff water quality during airfield deicing events is discussed later.

All ammonia concentrations at all subbasins were well below *acute* toxicity criteria. Other than SDE4 and SDN1, virtually 100% of the ammonia data for STIA subbasins were below the most conservative comparative value of 0.17 mg/l (BURP, 1984). See Figure 12 and Table 3.

Though well below any toxicity concern, SDN1 shows higher ammonia than all other subbasins other than SDE4. An investigation into possible causes is underway.

Comparing Figure 12 to Figure 13 shows that ammonia in runoff from SDE4 decreased markedly from last year to this year's monitoring period. The range dropped and tightened by one-half from about 1.5 to 0.6 mg/l for the 75th percentile. This indicates that the BMPs are effective.

In summary, STIA runoff during typical storms produces ammonia concentrations that are a small fraction of the most conservative acute toxicity standard for receiving waters. Airfield outfalls produce ammonia concentrations less than comparable regional areas during typical storms.

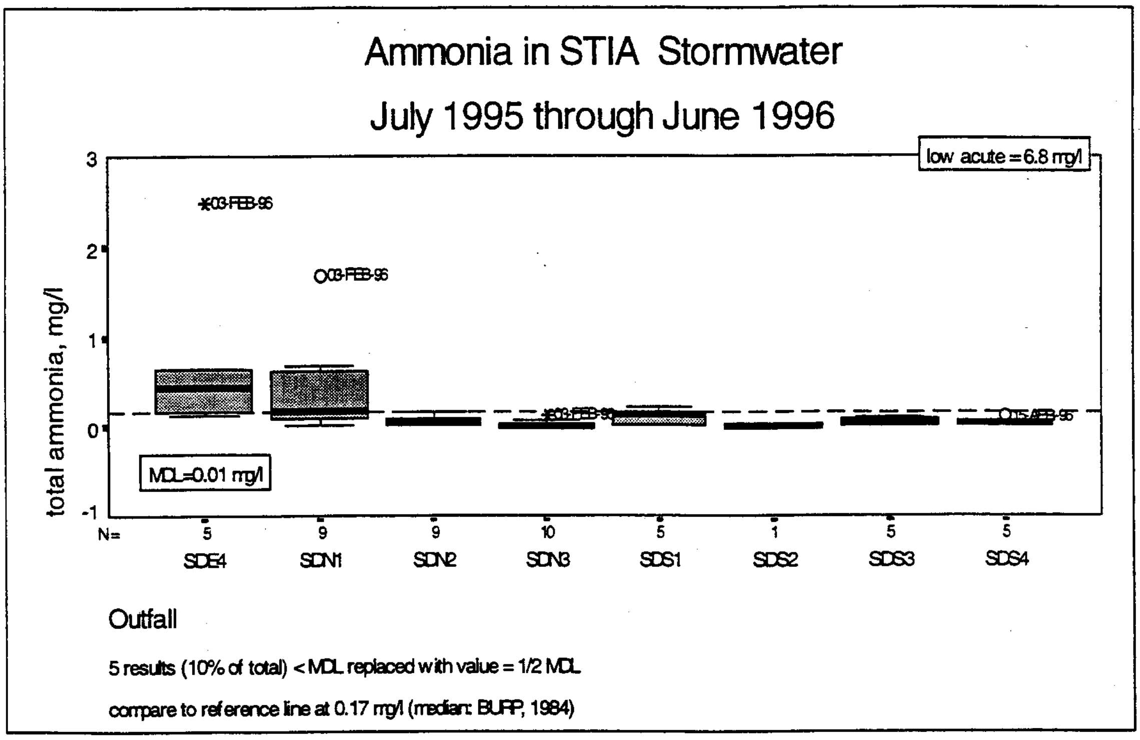


*Figure 12 Ammonia compared in Box Plot for 1995-1996*

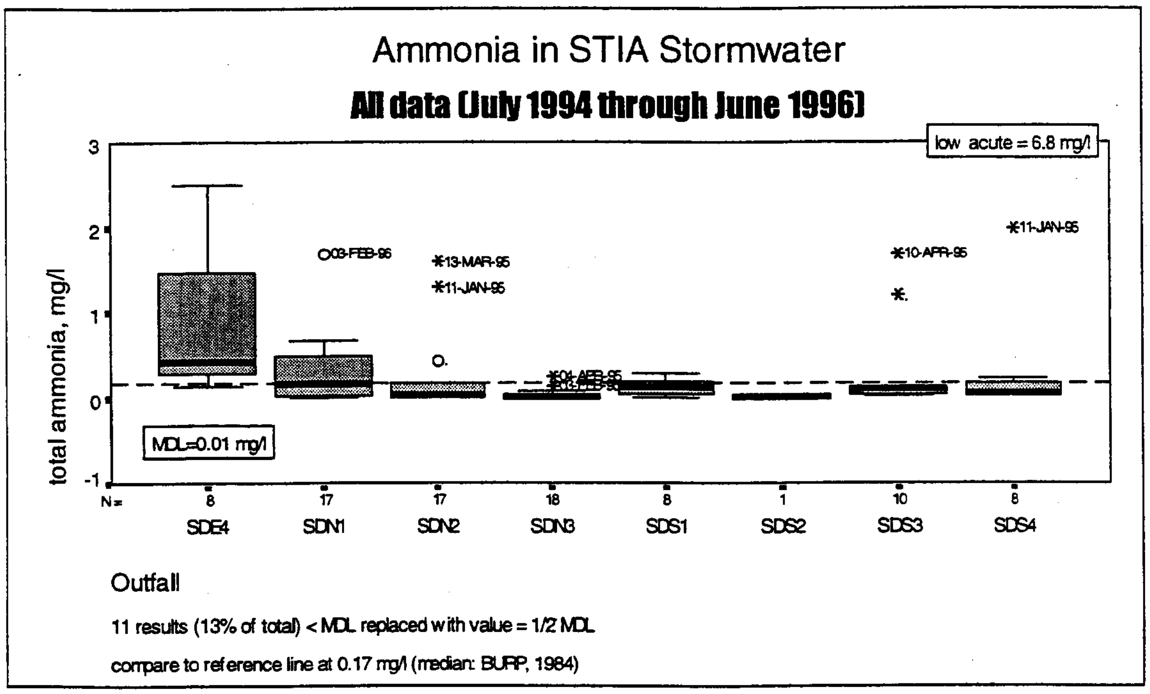


*Figure 13 Ammonia compared in Box Plot for 1994-1996*

**$BOD_5$**

This analyte describes indirectly what mass of oxygen could be depleted in the receiving waters by bacterial action over a period of 5 days. Principal sources of $BOD_5$ at STIA include aircraft deicing glycols, acetate-based runway deicers, and perhaps detergents.

Once again, Figure 12 show that airfield outfalls differ from the terminal (SDS1) and "landside" outfalls SDE4 and SDN1. Overall, the airfield outfalls (SDN2, SDN3, SDS3, SDS4 and SDW3) produced median $BOD_5$ values less than or approximately equal to the comparator value of 6.6 mg/l (BURP, 1984), which in fact is just barely above the MDL of 4 mg/l. In contrast, the terminal (SDS1) and landside SDE4 and SDN1 outfalls had median $BOD_5$ values in the current period about twice or more than those of the airfield.

Several outliers occurred, and are likely related to aircraft deicing events. SDE4 and SDS1 both showed outlying $BOD_5$ values higher than others, and both during periods where considerable aircraft deicing took place (February 15, 1995 and February 3, 1996). See Figure 14 and Figure 15..

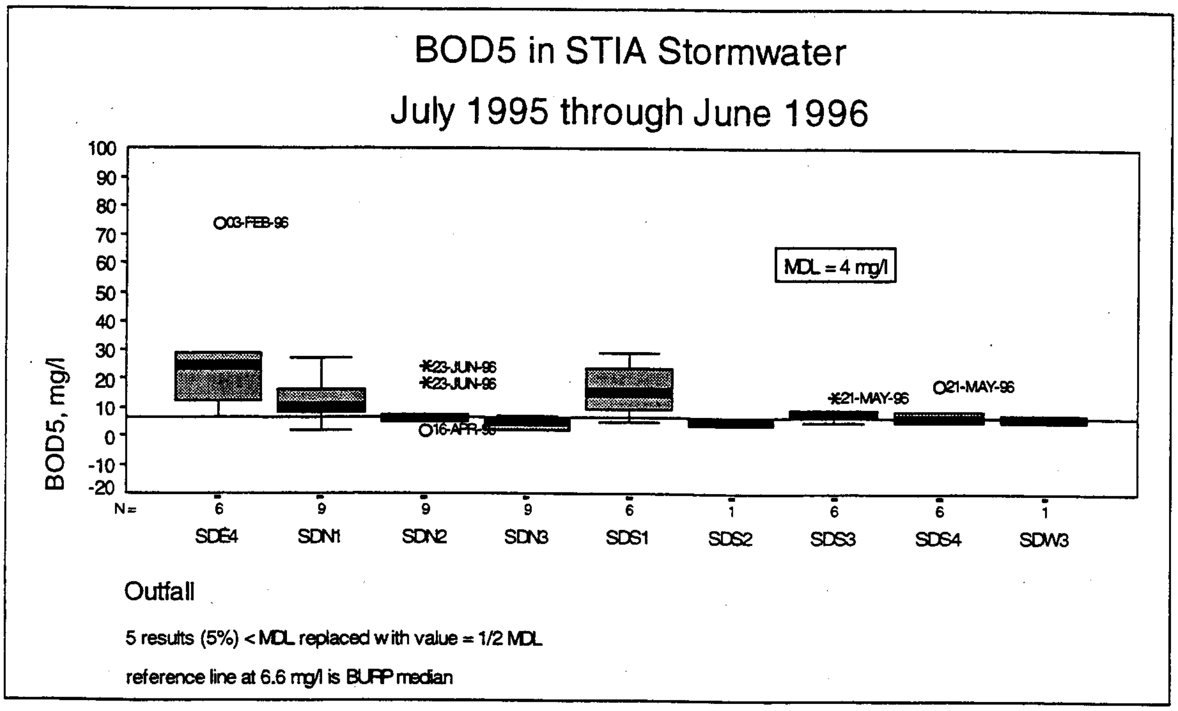


*Figure 14 BOD$_5$ compared in box plot for 1995-1996*

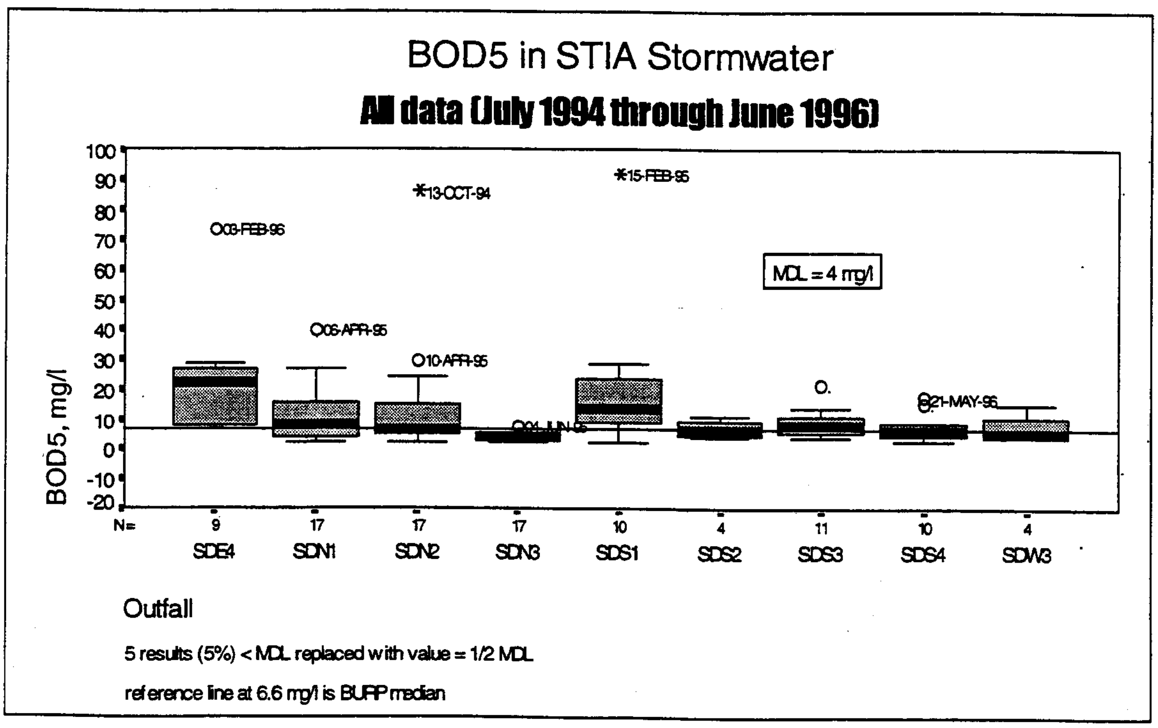


*Figure 15 BOD$_5$ compared in box plot for 1994-1996*

**Fecal coliforms in Grab Samples**

Data for fecal coliforms represent instantaneous values, rather than SMCs, because fecal coliforms are analyzed only in grab samples taken during the first 30 minutes of the discharge (per the NPDES permit). Sample bottles are neither autoclaved nor sealed during automatic sampling as described in the Port's Procedures Manual (Port of Seattle, 1995a). Ecology has reviewed the Port's Procedures Manual. For the current reporting period, seven of the nine subbasins exhibited fecal coliform median values well below the most conservative comparator of 201 per 100 ml (Bellevue, 1996). The SDS4 subbasin had median values of near 400 per 100 ml. A single sample from the SDW3 subbasin showed fecal coliforms at 30,000 per 100 ml, too high to appear even as an outlier value on
Figure 16.

Because there are no sanitary sewer lines, septic tanks, nor aircraft waste transfer activities in either the SDS4 or SDW3 subbasins, the presence of these higher levels of fecal coliforms suggests wild animal sources. In a recent study, 78% of fecal coliforms detected were traced to animals (King County, 1995) as opposed to human sources.

The SDS4 subbasin had three of five samples with fecal coliforms of 350 to >1600 per 100 ml this year. Recently, Port monitoring staff found a pipe just above the water surface of the "duck pond" on the Tyee golf course. This drain pipe connects directly to the SDS4 pipe about 200 yards above the outfall. This pond could easily have overflowed into the pipe, discharging water contaminated with waterfowl excrement during the three "hits" experienced because all three fecal coliform samples were taken during very wet weather. This pipe is now disconnected and terminated. In addition, the duck pond no longer exists as it was filled this summer by the runway 34R Safety Area project.

The Port believes that the SDW3 sample was unrepresentative because it was collected in the backwater and the abundant vegetation (which wild animals could inhabit) at the SDW3 outfall structure. As discussed under the FOG and TPH section, the SDW3 sampling station will be moved upstream to a point above the backwater. Comparing Figure 16 to Figure 17 shows a marked improvement for fecal coliforms at SDE4. Again, as discussed under the ammonia section, the Port believes the improvement is attributed to isolating drainage from the autoclave and two solid waste compactors dumpsters in the service tunnel, the direct result of a SWPPP action. Elevated fecal coliforms were attributed to these sources in the last annual report and SWPPP action recommended (Port of Seattle, 1995b).

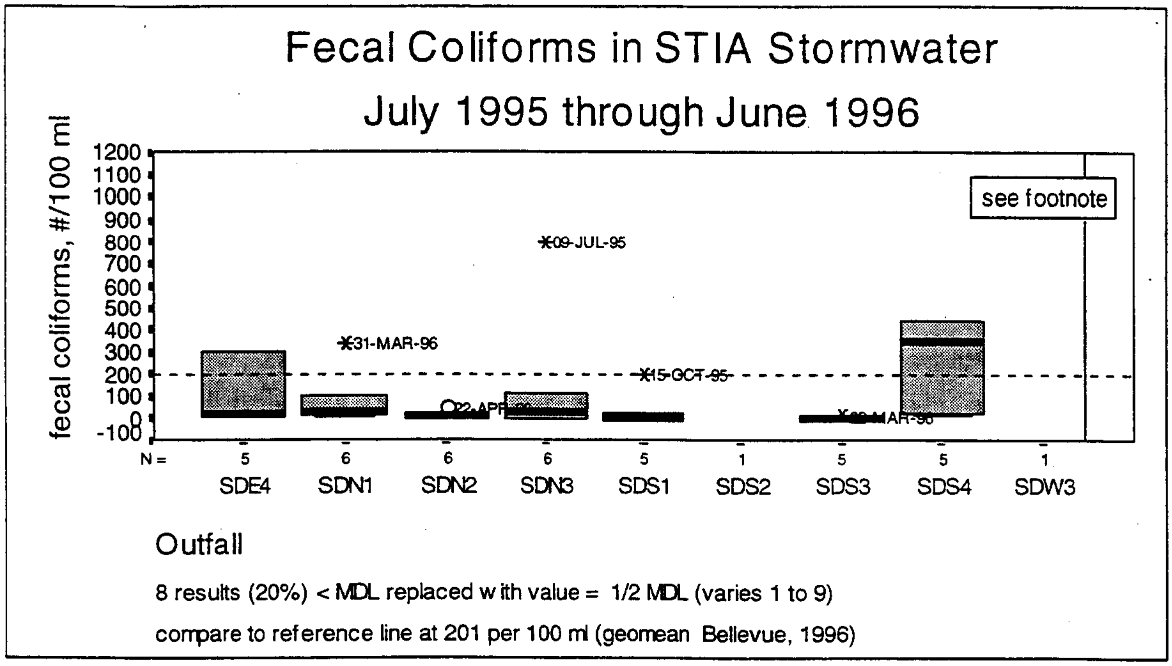


***Figure 16 Fecal coliforms compared in Box Plot for 1995-1996***

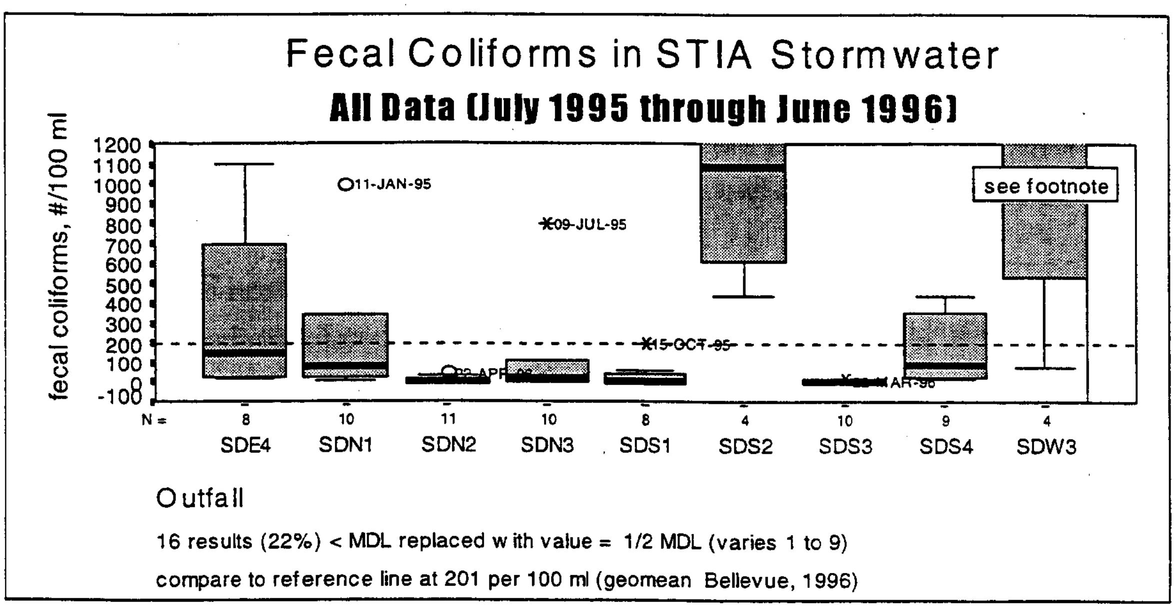


***Figure 17 Fecal coliforms compared in Box Plot for 1994-1996***

1

[1] SDW3 sample of 30,000 per 100 ml is not representative as it was collected in the backwater and abundant vegetation at the outfall structure. Sample bottles are neither autoclaved nor sealed during automatic sampling.

**Surfactants**

Surfactants tend to indicate the presence of detergents. There are no suitable surfactant comparator values readily available in the literature. Values above approximately 5 times the detection limit, or about 0.5 mg/l would tend to indicate a positive presence of surfactants. Using this criterion, the STIA outfall data show that surfactants appeared infrequently at only 4 of the 9 outfalls tested. Five outfalls never had surfactants appear above even 0.25 mg/l. Once again, the airfield outfalls represent four of these five subbasins showing the absence of surfactants.

Figure 18 shows that median values for surfactants at all outfalls did not appear much above the detection limit. In fact, 35% of all samples were below the detection limits. The 75th percentile for all subbasins was well below 0.5 mg/l and only 7 of a total of 85 values in the last two years appeared significantly above the detection limits at values that would tend to positively indicate the presence of surfactants.

In the current period, surfactants were less than 0.5 ppm at 5 of the 9 outfalls tested (SDN2, SDN3, SDS3, SDS4, and TY). Comparing Figure 18 to Figure 19 shows improvements at the TY and SDS1 subbasins. Other subbasins showed no differences over the two years.

In summary, surfactants were only present at the terminal and landside outfalls, and very rarely so. Little evidence exists, if at all, to indicate the positive presence of surfactants in runoff from the five airfield subbasins.

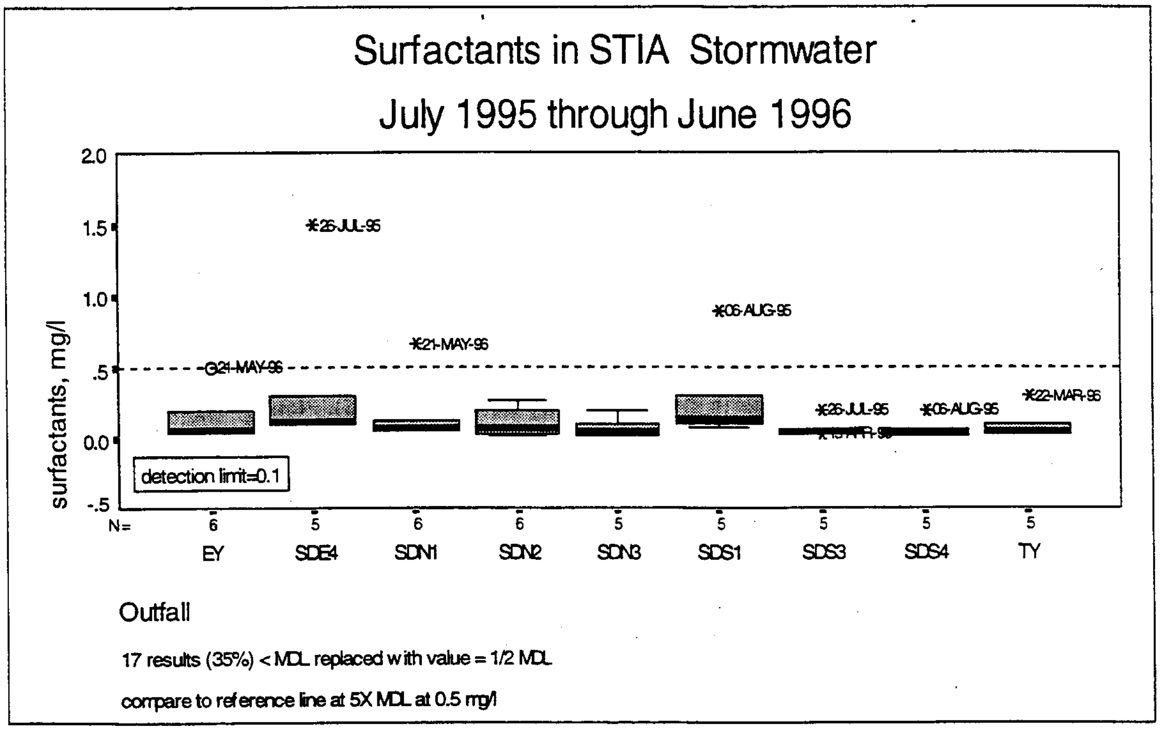


***Figure 18 Surfactants compared in Box Plot for 1995-1996***

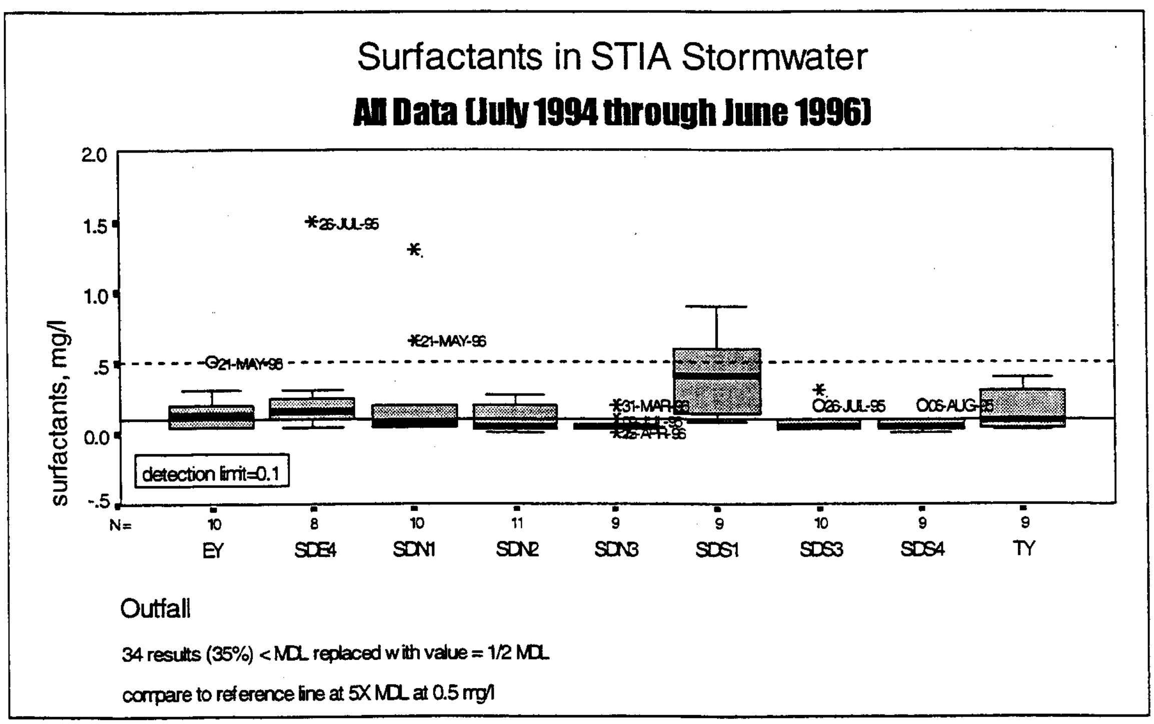


***Figure 19 Surfactants compared in Box Plot for 1994-1996***

## Metals

As mentioned above, there is no need to break the metals data set into different strata: metals were analyzed only in samples from NPDES storms. The consistency of the composite sampling method permits this analysis, because sample results should be equally representative of average concentrations in each storm event sampled. All metals data are for total recoverable metals. Ecology criteria for acute toxicity apply only to dissolved metals, except for total recoverable arsenic, chromium, mercury, and selenium. Ecology criteria apply to only the receiving waters, not stormwater runoff at the outfall. The Port monitors total recoverable priority pollutant metals as required by the NPDES permit. The permit does not require dissolved metals analysis, though the Port has conducted limited analyses for dissolved copper, lead, and zinc (Port of Seattle, 1995b).

Table 4 shows that of the 13 priority pollutant metals analyzed in 70 samples since July 1995, only four were detected regularly: arsenic, copper, lead, and zinc. The remaining 9 metals were absent or below detection limits in 67% or more of the samples. Beryllium (Be), cadmium (Cd), mercury (Hg), and silver (Ag) went undetected in 90% or more of the samples. Similarly, antimony (Sb), chromium (Cr), nickel (Ni), selenium (Se), and thallium (Tl), were undetected in at least two thirds of the samples, and when detected were less than 10% of the acute criteria.

Arsenic data showed a maximum value of 5 ppb, and a median of the detected values of 2 ppb, both just above the MDL of 1 ppb. The acute toxicity criterion for total recoverable arsenic is 360 ppb (at 50 mg/l hardness), nearly 2 orders of magnitude greater than the maximum arsenic value detected. Accordingly, box-plot evaluations are limited to three metals, copper, lead, and zinc presented in Figure 20 through Figure 25.

*Table 4 Metals in STIA Stormwater*

**results for total recoverable metals, values in mg/l**

| | *Sb* | *As* | *Be* | *Cd* | *Cr* | *Cu* | *Pb* | *Hg* | *Ni* | *Se* | *Ag* | *Tl* | *Zn* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| detection limit | 0.001 | 0.001 | 0.001 | 0.002 | 0.005 | 0.002 | 0.001 | 0.0001 | 0.005 | 0.001 | 0.003 | 0.001 | 0.004 |
| number analyzed | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| non detects | 47 | 20 | 69 | 63 | 52 | 0 | 3 | 68 | 56 | 54 | 69 | 58 | 0 |
| % nondetect | 67% | 29% | 99% | 90% | 74% | 0% | 4% | 97% | 80% | 77% | 99% | 83% | 0% |
| Median | 0.001 | 0.002 | 0.001 | 0.001 | 0.003 | 0.028 | 0.005 | 0.000 | 0.005 | 0.001 | 0.002 | 0.001 | 0.078 |
| Mean of detected | 0.002 | 0.002 | | 0.004 | 0.009 | 0.037 | 0.011 | 0.0012 | 0.010 | 0.001 | | 0.001 | 0.163 |
| Maximum | 0.011 | 0.005 | 0.002 | 0.013 | 0.030 | 0.121 | 0.104 | 0.0021 | 0.02 | 0.005 | 0.024 | 0.002 | 1.03 |
| acute criteria[1] | 9.0 | 0.360[2] | 0.130 | 0.002 | 0.311[2] | 0.009 | 0.030 | 0.002[2] | 0.787 | 0.020[2] | 0.001 | 1.400 | 0.064 |

1. Acute criteria listed are at 50 mg/l total hardness. All criteria are for **dissolved** metals except total recoverable arsenic, chromium, mercury, and selenium
2. total recoverable

Figure 20 through Figure 25 show box plots of total recoverable copper, lead, and zinc in discharges from each outfall.

**Copper: Figure 20 and Figure 21**

Little relative change between the two periods is evident upon comparing the two figures. The highest median copper came from the terminal (SDS1) and largest landside outfall (SDE4) with overall median values of 0.062 and 0.042 mg/l, respectively. Comparing box widths, both figures show that SDS1 exhibited much more variability than SDE4. The SDN1 subbasin also had higher copper values, probably the result of the SR 518 freeway drainage.

Note that copper concentrations from the four airfield (AMA) subbasins were typically lower than the terminal and landside data. The SDS3 outfall however produced the third highest median copper value, just above that from SDN1. Nearly all copper results were above the comparative median value of 0.010 mg/l (Bellevue, 1996).

**Lead: Figure 22 and Figure 23**

Figure 22 and Figure 23 show that lead values were typically less than the regional comparator median of 0.026 mg/l (Bellevue, 1996). The two exceptions are the lead concentrations from the major landside subbasin SDE4, and SDS1 terminal subbasin. The only outfall with median lead above the comparator, SDE4 exhibited median SMCs of about 0.025 mg/l for the current and overall periods. The SDS1 outfall produced an outlying value of 0.09 mg/l on April 15$^{th}$ this year. Other than SDE4 and a single value at SDS1, *38 of 42 (90%)* lead SMCs from all outfalls were below the regional comparator, which also puts them below the acute criterion of 0.030 mg/l for *dissolved lead*. Typically, the SES has found dissolved lead to be about 25% of total recoverable lead (Minton, personal communication). Again, a clear distinction is apparent: airfield subbasins produce less lead than a comparable commercial/industrial area in the Puget Sound region.

Because SDE4 contains heavily used vehicle parking surfaces and roadways, leaded gasoline could be a source of the higher lead found in that outfall. Even though most vehicles burn unleaded gasoline today, there may be enough still contributing to lead output in exhaust. The City of Bellevue found that although lead levels in urban stormwater dropped dramatically from 0.17 to 0.01 mg/l from 1984 to 1996 in relation to the ban on leaded fuels, lead did not disappear in entirety (BURP, 1984, Bellevue, 1996).

### Zinc: Figure 24 and Figure 25

Figure 24 and Figure 25 show total zinc for the current and past reporting periods, respectively. Note that zinc was consistently detected in all samples. Three of the seven subbasins showed median zinc values above the comparative value of 0.161 mg/l. These three subbasins, the terminal (SDS1) and landside subbasins, SDE4, SDN1 experience considerable vehicle traffic where tire wear can be a significant source of zinc (EPA, 1993). Therefore, the terminal and landside outfalls generate more zinc than the airfield outfalls.

SDN1 discharges showed the highest zinc, which is probably the result of offsite roadway runoff from SR518, where vehicle traffic is 9 times greater than on the portion of Air Cargo Road within the SDN1 subbasin.. Notice that the narrow box widths in both figures show the consistency in zinc SMCs from SDN1. SDN1 also had an outlying zinc SMC of 1.03 mg/l during one of the first storms of the wet season on September 14, 1994.

In summary, airfield outfalls produce less zinc than a comparative commercial/industrial subbasin. The Port believes that vehicle traffic (tire wear) accounts for higher zinc SMCs in the terminal and landside outfalls, especially at SDN1 which receives considerable offsite roadway runoff from SR 518.

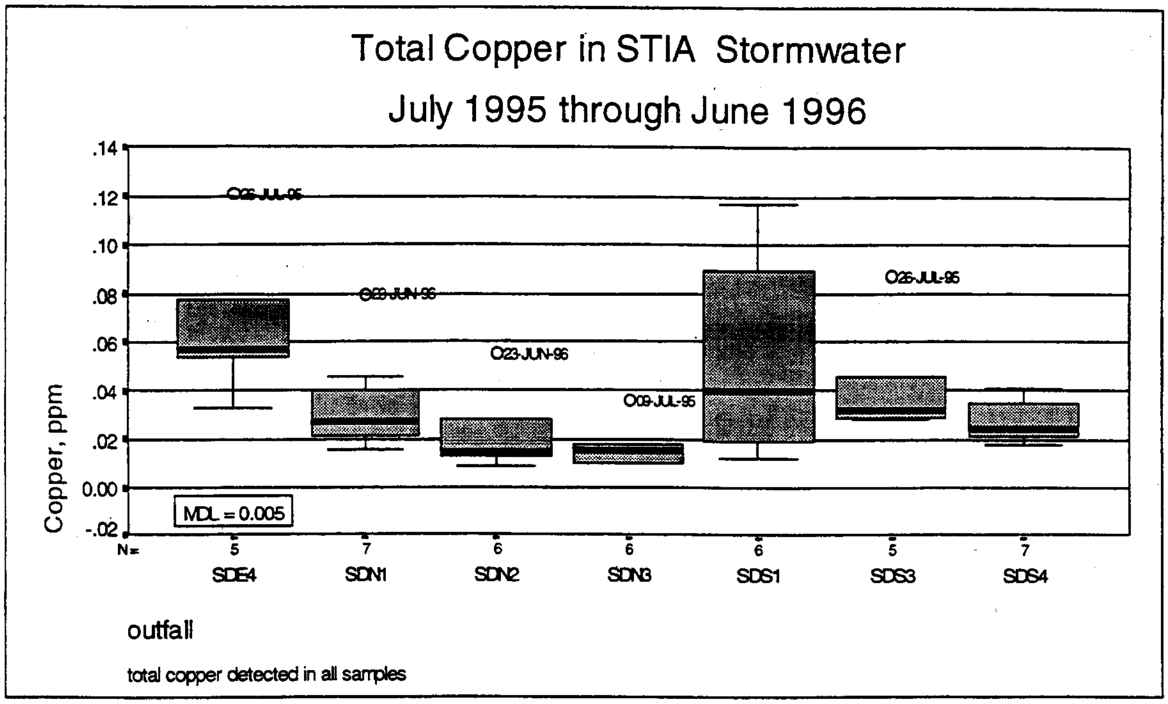


*Figure 20 Copper compared in Box Plot for 1995-1996*

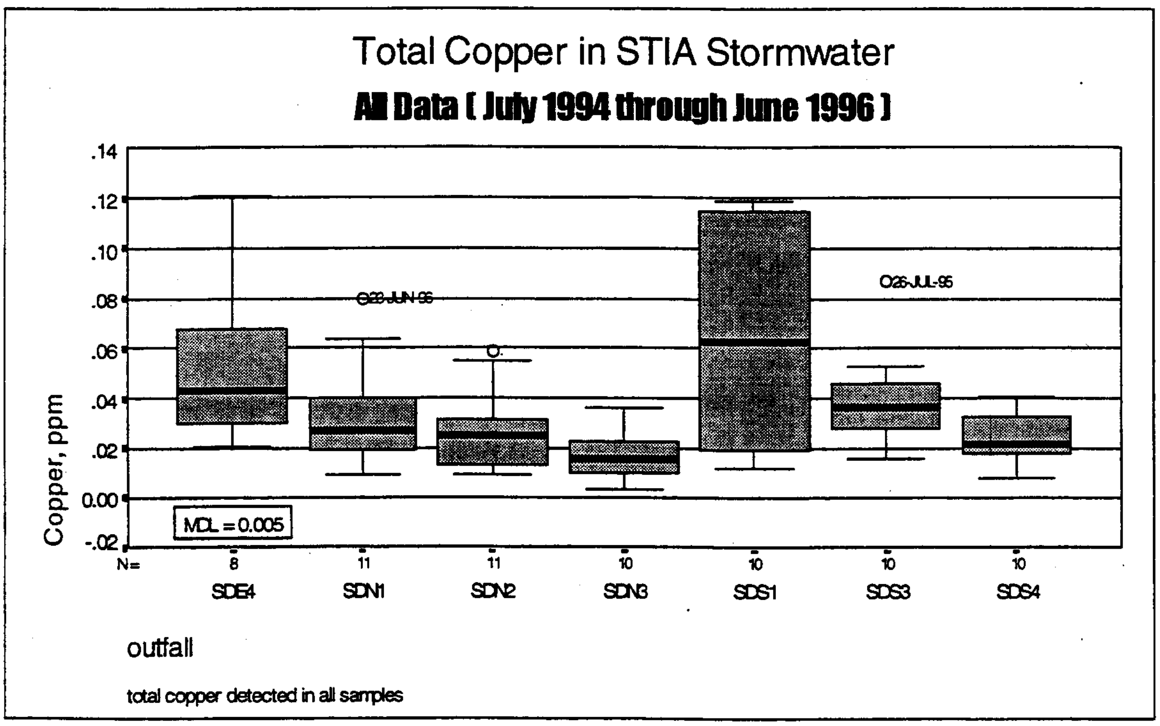


*Figure 21 Copper compared in Box Plot for 1994-1996*

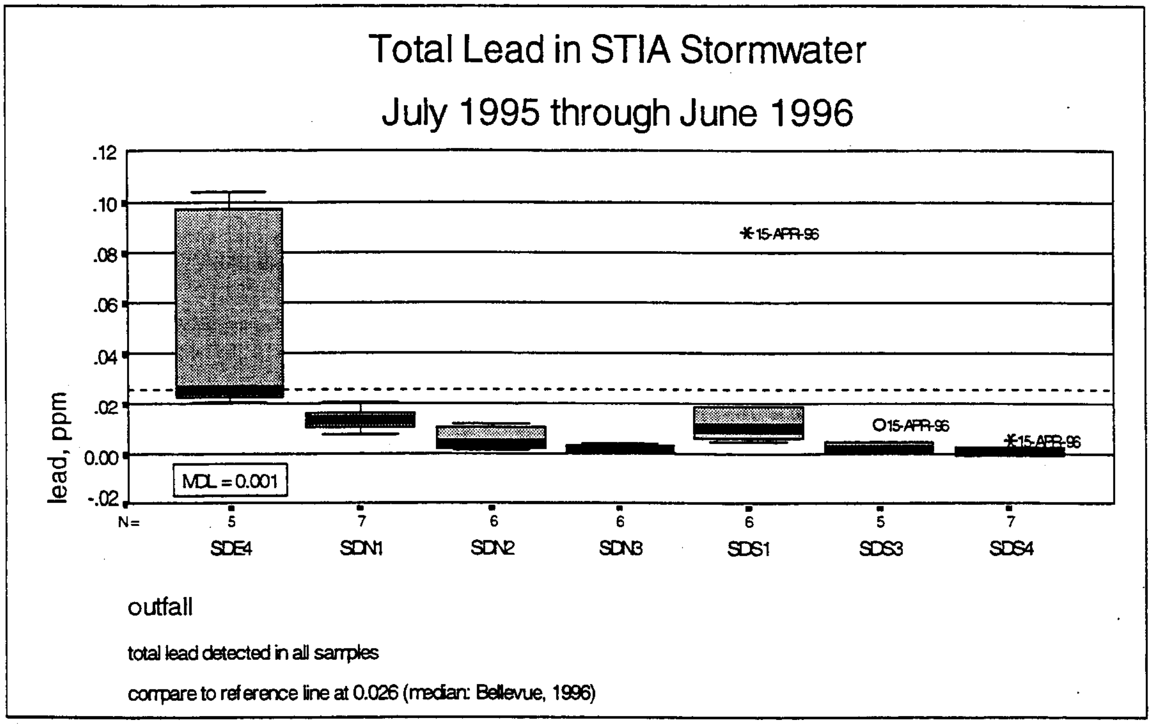


*Figure 22 Lead compared in Box Plot for 1995-1996*

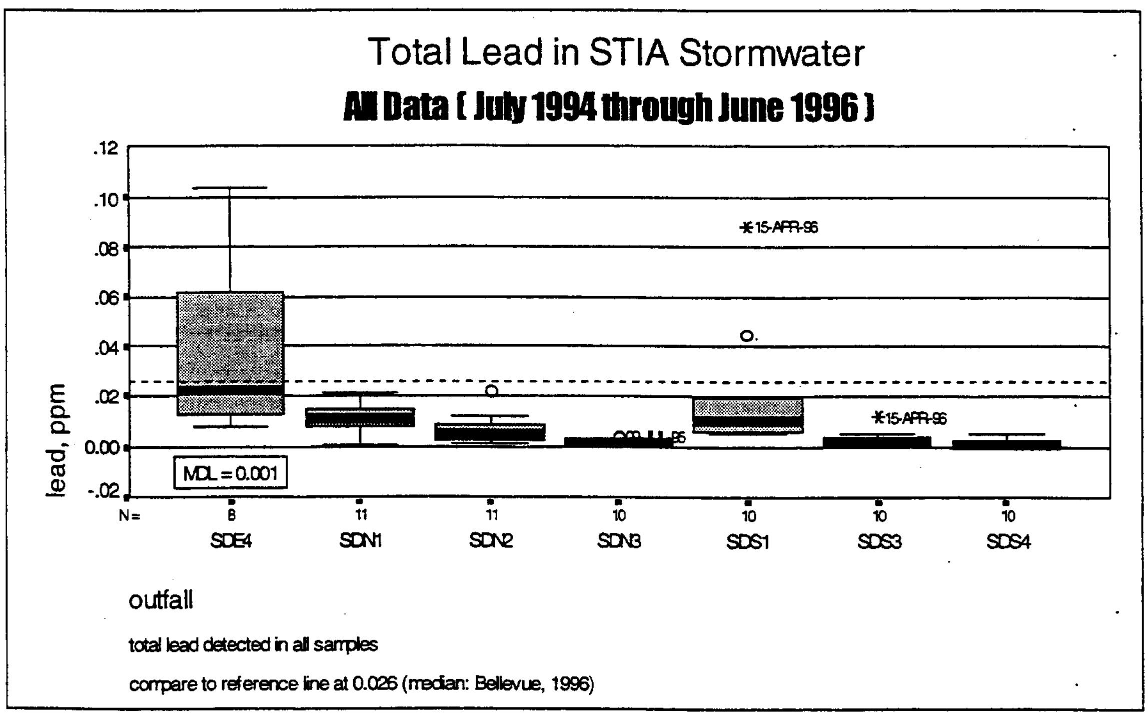


*Figure 23 Lead compared in Box Plot for 1994-1996*

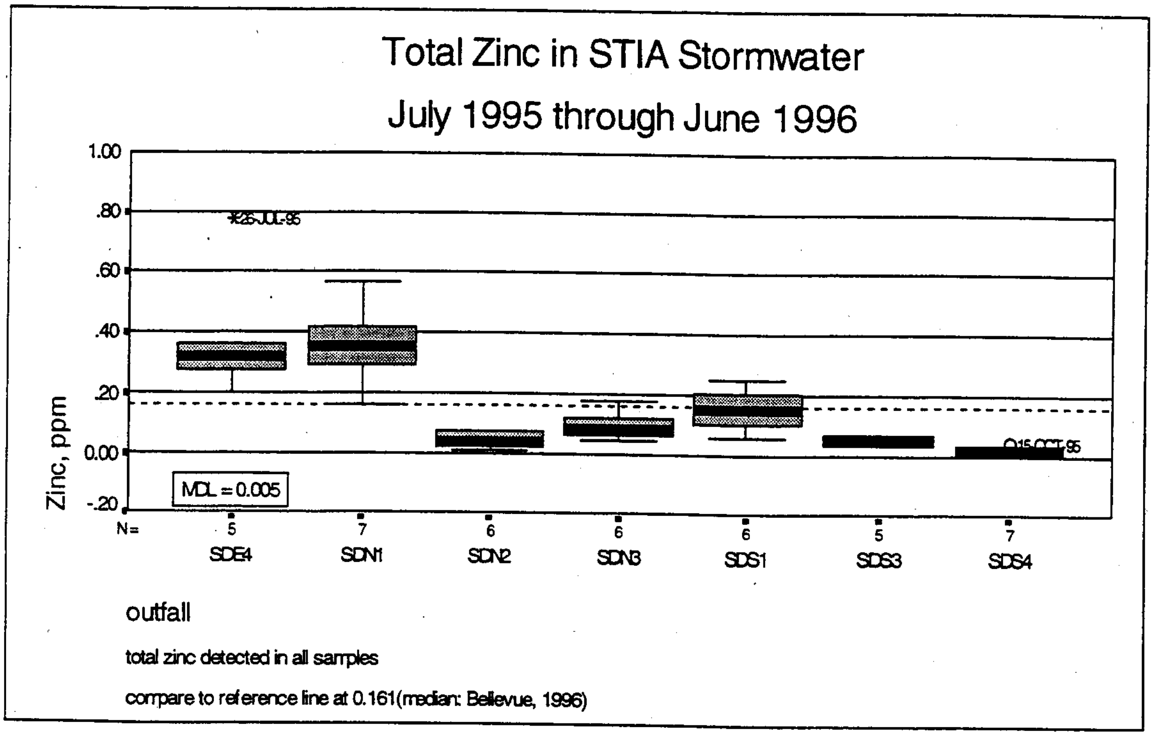


*Figure 24 Zinc compared in Box Plot for 1995-1996*

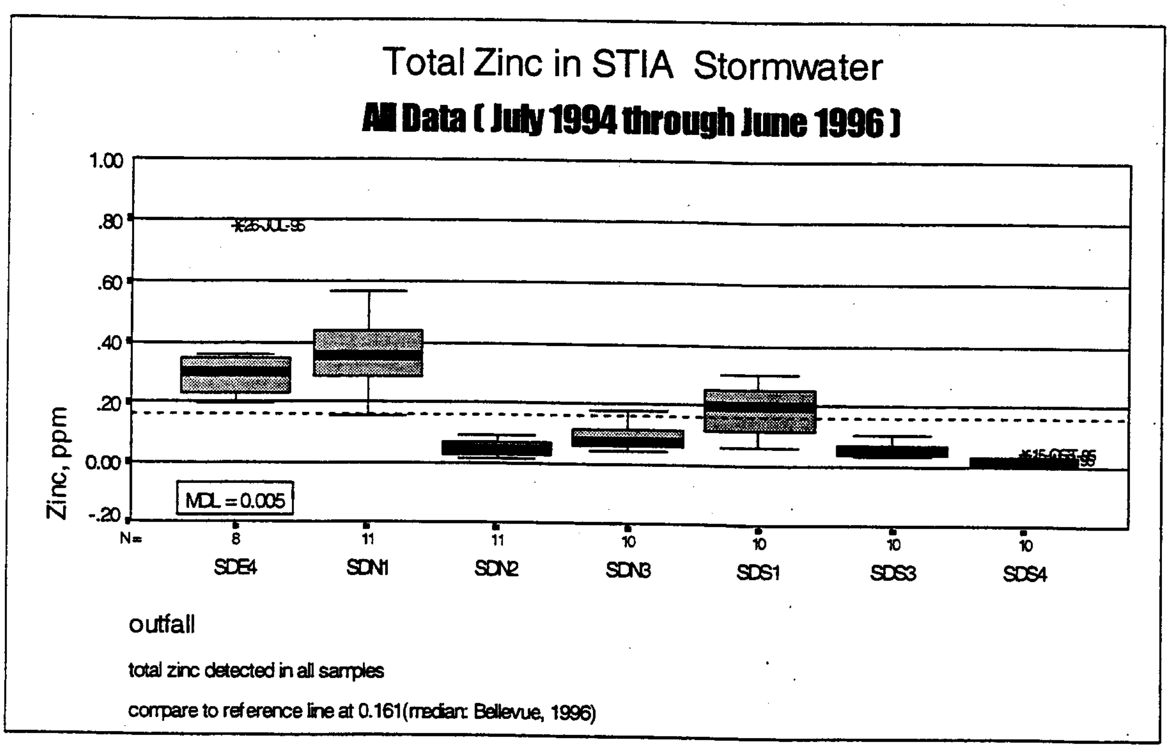


*Figure 25 Zinc compared in Box Plot for 1994-1996*

**Stratum 2: Aircraft Deicing**

The Annual Glycol Report (Port of Seattle, 1996a) details the history of glycol application airport-wide. The Report identifies both ethylene and propylene glycol volumes applied and number of aircraft treated each day and for each airline. Only Alaska and Horizon airlines applied ethylene glycol-based anti-icers. All other airlines applied only propylene-glycol based treatments. The Port analyzes both types of glycol and sums the two results as "total glycols" which are also referred to as "glycols". The MDL is 5 mg/l for each glycol type, and therefore 10 mg/l for total glycols.

The glycol data discussed below encompass mostly composite samples taken during periods of aircraft deicing, representing average values during a storm event discharge, or in baseflow. The data set also includes storm and baseflow samples from the multi-day aircraft deicing sequences during the period January 18 through February 4, 1996. These data appear summarized in Table 5 and in Figures 26 and 27 as well as in Appendix B.

During the past year, the Port detected glycols in only 21% of the samples. Glycols were either below the detection limit or at relatively low values at most outfalls. In general, these concentrations were so low as to suggest that there is no impact on either Miller or Des Moines Creeks. However, definitive conclusions must await the completion of the SES which monitors outfalls and the streams concurrently. The SES will determine the levels of glycols in the streams. The Port is therefore waiting for the completion of the SES before drawing conclusions about whether modifications to the SWPPP are required.

An exception to the above statement is that somewhat higher concentrations (above 50 to 100 mg/l) were observed infrequently at outfalls SDN2, SDS3, and SDS1. The Port believes that these rare occurrences are associated with cold weather periods and the attendant extensive aircraft deicing. Results for SDN2 and SDS3 show only limited periods where glycols exceeded the 50 to 100 mg/l concentration, but only during these cold weather periods. The Port is currently evaluating its operations to determine the sources of these limited aberrations, although the SES may determine that such concentrations have no adverse impact on either Miller or Des Moines Creeks.

At SDS1, a glycol concentration of 6,200 mg/l was observed on the day of heaviest aircraft deicing, January 28, 1996. While this result was much higher than other values, it was from a baseflow grab sample rather than a stormwater composite sample. Regardless, the Port SWPPP has already identified the glycol source area within the SDS1 subbasin responsible for this high value. As stated in the SWPPP, the Port will be connecting this area to the IWS. This work will be completed by June 30, 1997 as required by the SWPPP

***Table 5 Glycol Data Summary***

| outfall [illegible] | total number of samples[1] | number detected | mean glycol[2] (mg/l) | maximum glycol (mg/l) |
|---|---|---|---|---|
| SDW3 | 1 | 1 | 11.7 | 11.7 |
| SDE4 | 12 | 5 | 11 | 30 |
| SDS1 | 16 | 8 | 458 | 6220[3] |
| SDS3 | 17 | 5 | 20 | 115 |
| SDS4 | 10 | 2 | 10 | 30.8 |
| SDN1 | 20 | 1 | 5 | 6.1 |
| SDN2 | 20 | 5 | 13 | 55 |
| SDN3 | 22 | 0 | 5 | 5 |

1. Includes SMCs, grab samples and average of time-composite samples from July 1994 to June 1996.
2. Includes results where one-half the MDL was substituted when results reported as less than the MDL.
3. This result was from a baseflow grab sample, not a composite. See discussion.



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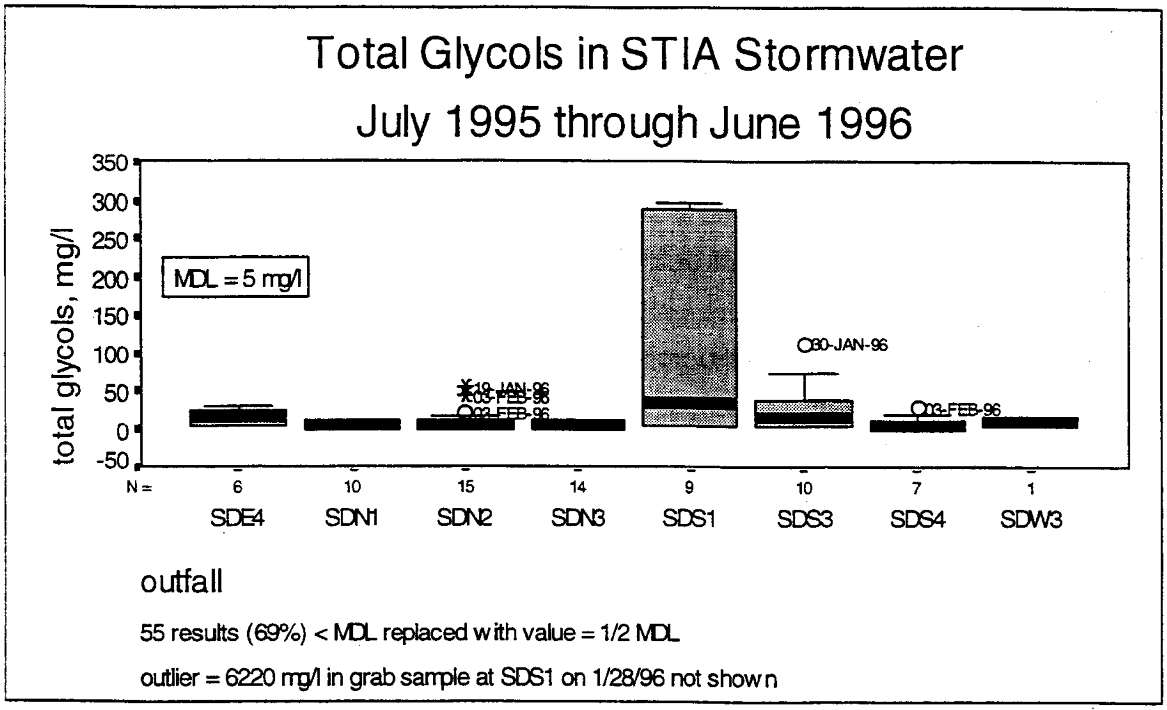


*Figure 26 Total Glycol Box Plot for 1995-96*

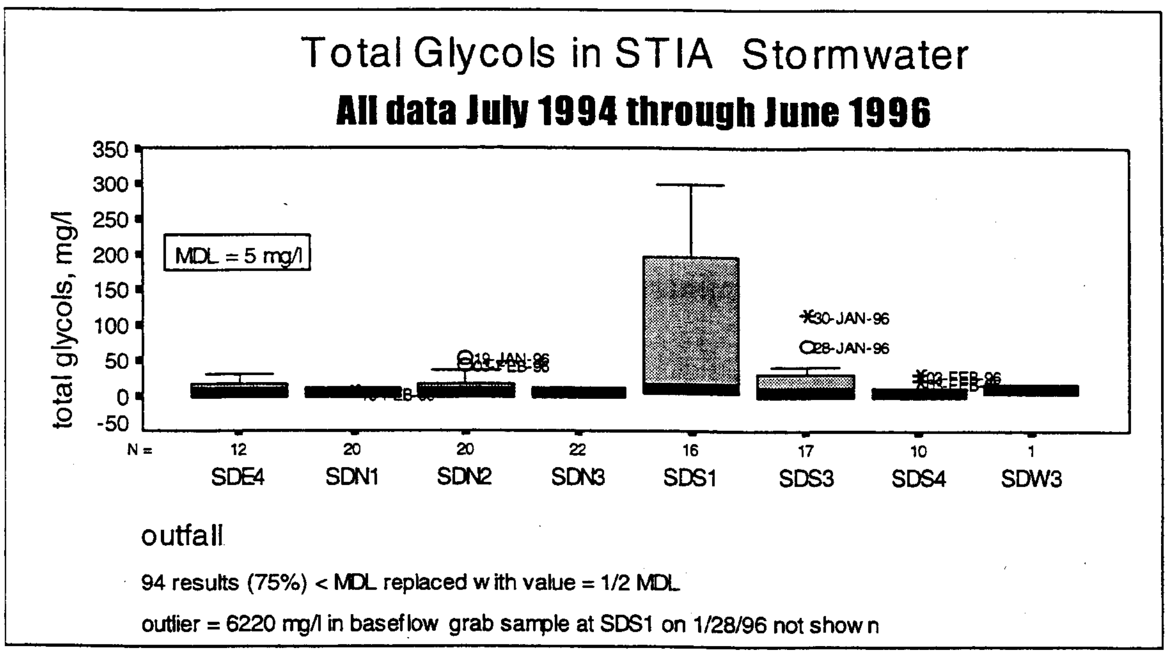


*Figure 27 Total Glycol Box Plot for All Data*

note: Glycols never detected in 24 samples from SDN3, and in only 1 of 22 samples at SDN1. Per the SWPPP, SDS1 glycol source area will be diverted to the IWS by June 1997.

## Stratum 3: Airfield Deicing Operations

### Background

Because a variety of airport deicing activity takes place when freezing conditions exist, monitoring results are combined into one category here, stratum 3, for discussion. These include deicing and anti-icing the runways and taxiways, ramps (aircraft terminal gate areas), airport vehicle drivelanes, and passenger vehicle roadways near the terminal. Generally in 1996, potassium acetate (PA) compound was applied only to the runways and taxiways, while urea was applied to the ramp and terminal areas drained by the IWS. Sand may be applied to passenger vehicle routes including the access roads and terminal drive. Glycols are not applied to any traveled surfaces. Glycols measured and reported under this section of the report are strictly from aircraft deicing that took place at the gates.

In terms of stormwater quality, these activities manifest themselves in pollutants such as $BOD_5$ (from PA and aircraft glycols), total Kjeldahl nitrogen (TKN) and ammonia (from urea), and TSS and turbidity (from sand). TKN is the sum of organic nitrogen (such as urea), and the ammonia form of nitrogen. Ammonia results when the organic nitrogen in urea decomposes.

### 1996 Airfield Deicing Summary

During the current reporting period, the STIA runways and taxiways and other surfaces were deiced on two occasions. The first period of chemical application covered a period of two days on January 18 and 19, 1996, and the second continued for four days from January 27 through January 30, 1996. The Airfield crew applied both PA and urea compounds during both periods (Port of Seattle, 1996). Table 6 summarizes application dates and chemical quantities. Note that roughly twice the volume of deicing compounds was applied in the second event. Sand was also applied to the "landside" roadways including the terminal access and Air Cargo roads during the second event.

*Table 6 Runway Deicing Events and Chemicals Applied*

| Date | Urea Applied | Potassium Acetate applied (gal) | Runways Applied | Taxiways Applied | Other Applied |
|---|---|---|---|---|---|
| Jan 18, 1996 | 1250 gal | 1250 | both | N | |
| Jan 19, 1996 | | 4150 | both | M, N, P | |
| *event 1 total* | ***1250 gal*** | ***5400 gal*** | ***2 days*** | ***2 days*** | |
| Jan 27, 1996 | | 3650 | both | | drivelanes |
| Jan 28, 1996 | | 7500 | both | A, B, N, M | |
| Jan 29, 1996 | 1550 gal | | | | N. Satellite |
| Jan 29, 1996 | | 2300 | 16L | B | |
| Jan 29, 1996 | 7500 lb solid | | | | N & S Satellites |
| Jan 30, 1996 | | 2750 | both | A, B | |
| *event 2 total* | ***1550 gal 7500 lb solid*** | ***13,450 gal*** | ***4 days*** | ***3 days*** | ***3 days*** |

During the period monitored for both events, aircraft deicing was the heaviest of any other periods during the past year. Table 7 summarizes data from the Annual Glycol Report (Port of Seattle, 1996) for aircraft deicing and glycol application, and monitoring during these two events. Glycols are discussed in a prior section of this report.

*Table 7 Sampling and Aircraft Deicing during Runway Deicing periods*

| | | | Aircraft Deicing | | Monitoring History | | |
|---|---|---|---|---|---|---|---|
| Data | snowfall (in) | rainfall (in.) | number aircraft | glycol (gal) | SDN2 | SDS3 | other |
| 17-Jan | | 0.06 | 110 | 4,671 | | | |
| 18-Jan | 2 | 0.07 | 75 | 2,653 | | | |
| 19-Jan | T | T | 184 | 11,401 | 7 samples: began 00:45 | 5 samples began 12:00 | SDN3, SDE4, SDS4, SDS1 |
| 20-Jan | | 0.78 | 71 | 2,376 | 4 samples | 2 samples began 14:00 | SDN3, SDE4, SDS4, SDS1 |
| 21-Jan | T | 0.62 | 138 | 6,213 | 2 samples | 3 samples | |
| 22-Jan | | 0.12 | 76 | 3,062 | 3 samples | 3 samples | |
| 23-Jan | | 0.10 | 72 | 2,463 | | | |
| 24-Jan | | 0.14 | 73 | 2,393 | | | |
| 25-Jan | | 0.06 | 173 | 7,977 | | | |
| 26-Jan | | 0.03 | 141 | 6,068 | | | |
| 27-Jan | | 0.04 | 165 | 6,697 | | | |
| 28-Jan | | 0.34 | 254 | 12,810 | | grab | SDS1 grab |
| 29-Jan | 2 | 0.04 | 129 | 6,364 | | | |
| 30-Jan | 1 | 0 | 27 | 843 | | grab | |
| 31-Jan | 1 | 0 | 1 | 27 | | | |
| 1-Feb | | 0 | 5 | 222 | | grab | SDS4 grab |
| 2-Feb | | 0 | 7 | 242 | | | |
| 3-Feb | | 0.25 | 18 | 657 | grab | began 17:14 | SDE4, SDS4 |
| 4-Feb | | 0.31 | 31 | 1368 | 2 samples | 3 samples | SDN3, SDE4, SDS4, SDS1, SDW3 |
| 5-Feb | | 0.93 | 9 | 328 | 3 samples | 3 samples | SDS4 |
| 6-Feb | | 0.29 | 19 | 610 | 3 samples | 2 samples | |

## Monitoring Results

Stormwater discharges were monitored at the SDN2 and SDS3 outfalls over a period of the first 1.75" total rainfall immediately following each of the two runway deicing events. Other outfalls were also monitored, but on a different basis, including SDW3, SDE4, SDS4, SDS1, and SDN3. The SES also intensively monitored instream sites on both creeks during both events. The Port sampled baseflow before any runoff, then took 3 to 6 time-composite samples each day over the course of runoff monitoring, including snowmelt and rainfall. Sample aliquots were taken every 15 to 20 minutes and composited over a four to eight hour period.

The following analyses and discussion are limited to SDS3 as the discharge record is more complete for this outfall. SDS3 also drains the vast majority of runway surfaces treated by deicing chemicals. In the first event, 3 baseflow samples were taken in the five days before first runoff, followed by 8 time-composite samples during the rainfall period. The second event had a distinct snowmelt period where 5 time composites were taken, followed by 11 time composites over the rainfall period.

Pollutant concentrations varied widely over the course of discharges from the SDS3 outfalls. Figure 28 through Figure 31 show peak concentrations appeared during the first portion of runoff, generally in the first one half inch. These early peaks followed by much lower concentrations, especially during continued heavy rainfall/runoff illustrate the first-flush effect. Furthermore, pollutant load calculations show a highly correlated relationship between pollutant washoff and total rainfall accumulated. Appendix B contains the raw and reduced data for both washoff events at the SDS3 outfall. The following discussion summarizes this data for SDS3.

### Urea and nitrogen in runway washoff

Figure 28 and Figure 29 show that the urea applied washed off mainly in the organic form. Only a fraction of the urea decomposed into ammonia. Ammonia concentrations were well below the acute toxicity criterion. Because the main water quality consequence of urea is the toxicity of its decomposition product, ammonia, the data suggest that toxic effects in the receiving waters should be non-existent.

It should be noted that urea is usually only applied to areas draining to the IWS. An exception in event 1 took place where a mixed truckload of urea and PA were applied to the runways and taxiways. Hence, Figure 28 for event 1 shows higher TKN and ammonia concentrations in SDS3 runoff. Note that in either case, the maximum ammonia concentration did not exceed 1.5 mg/l in any of the 11 to 16 time-composite samples taken over the duration of either event's washoff period at the SDS3 outfall. These maximum ammonia values were less than one fifth of what occurred during the December 5-9, 1995 runway deicing event where ammonia was present at 7 to 8 mg/l for up to two days in SDS3 runoff (Port of Seattle, 1995b). These data show an improvement over the past year attributed to reduced and/or discontinued urea application on the runways and taxiways.

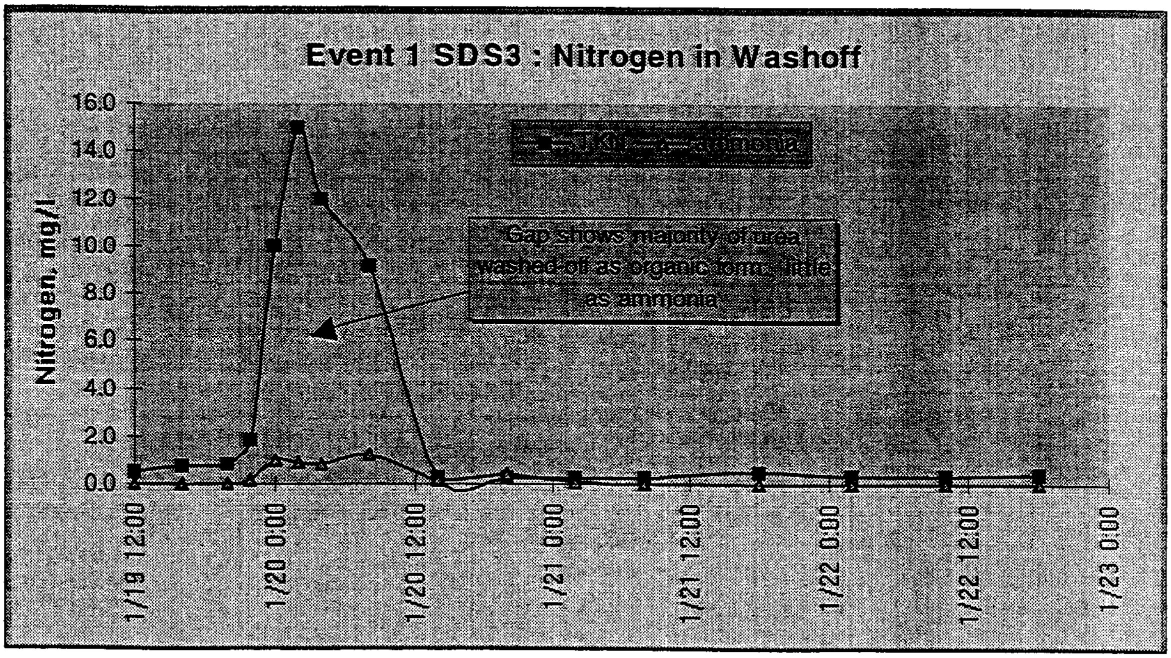


*Figure 28 Nitrogen Forms in Event 1 Runway Washoff*

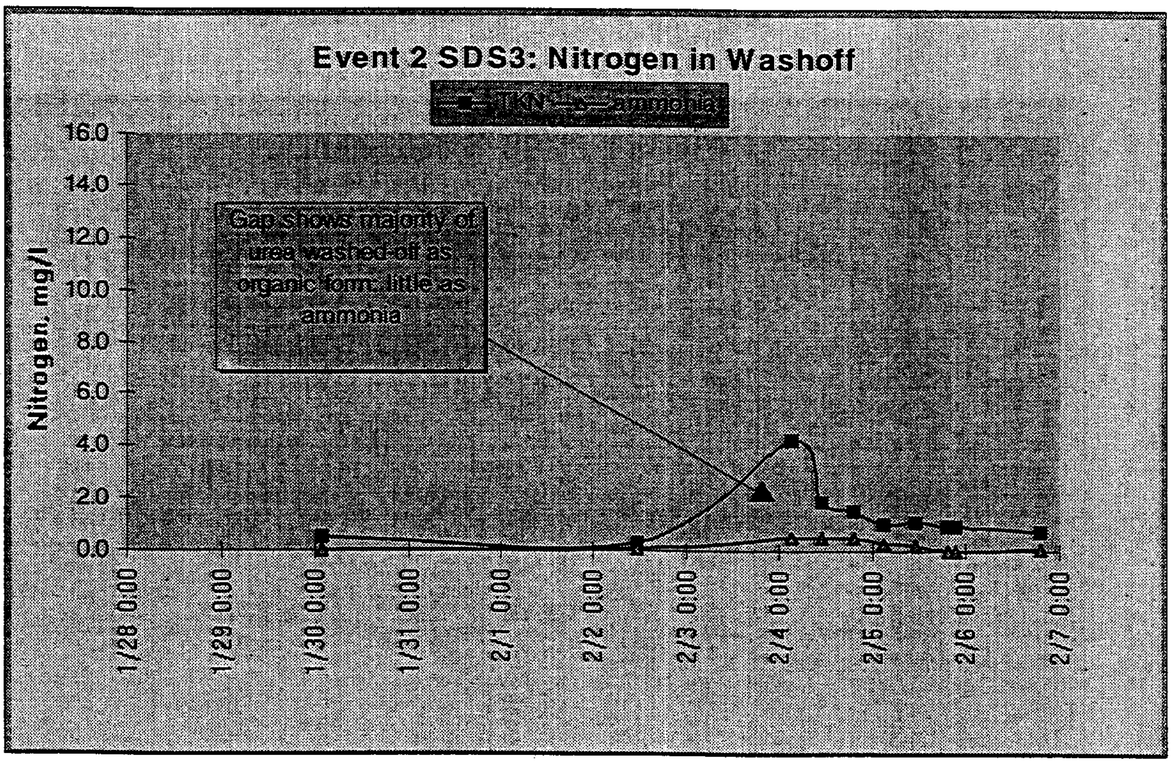


*Figure 29 Nitrogen forms in Event 2 Runway Washoff*

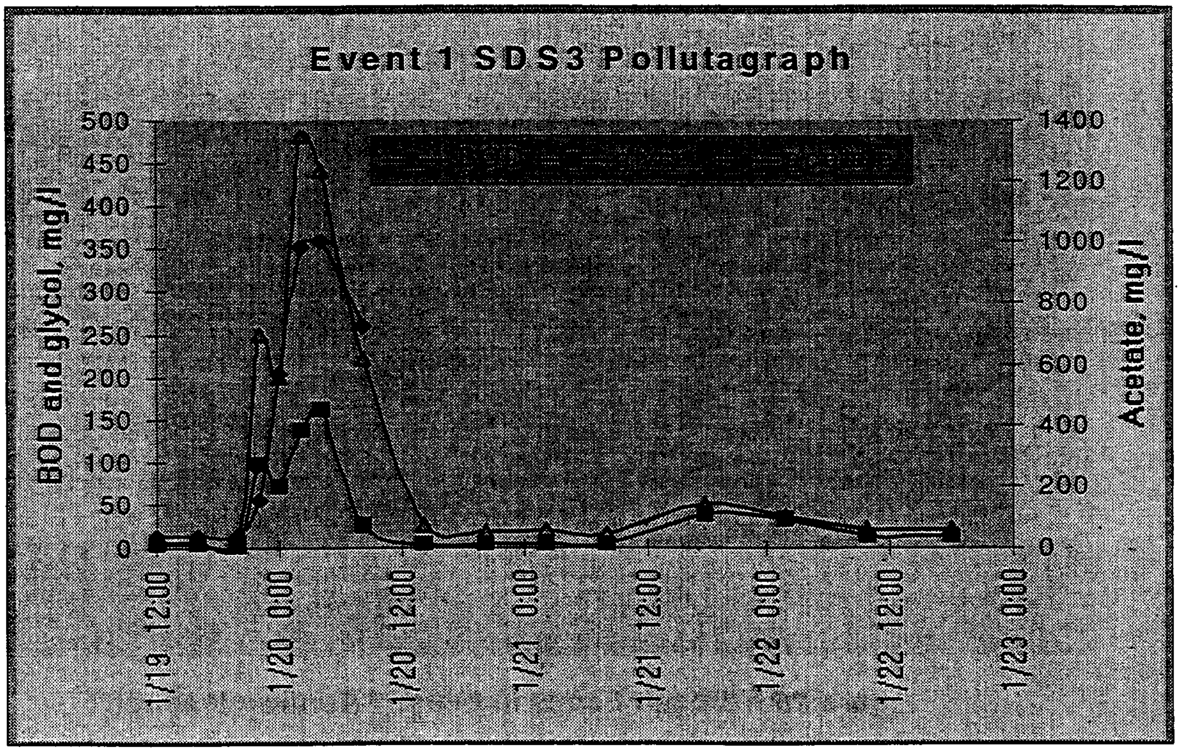


*Figure 30 Event 1 SDS3 Pollutagraph*

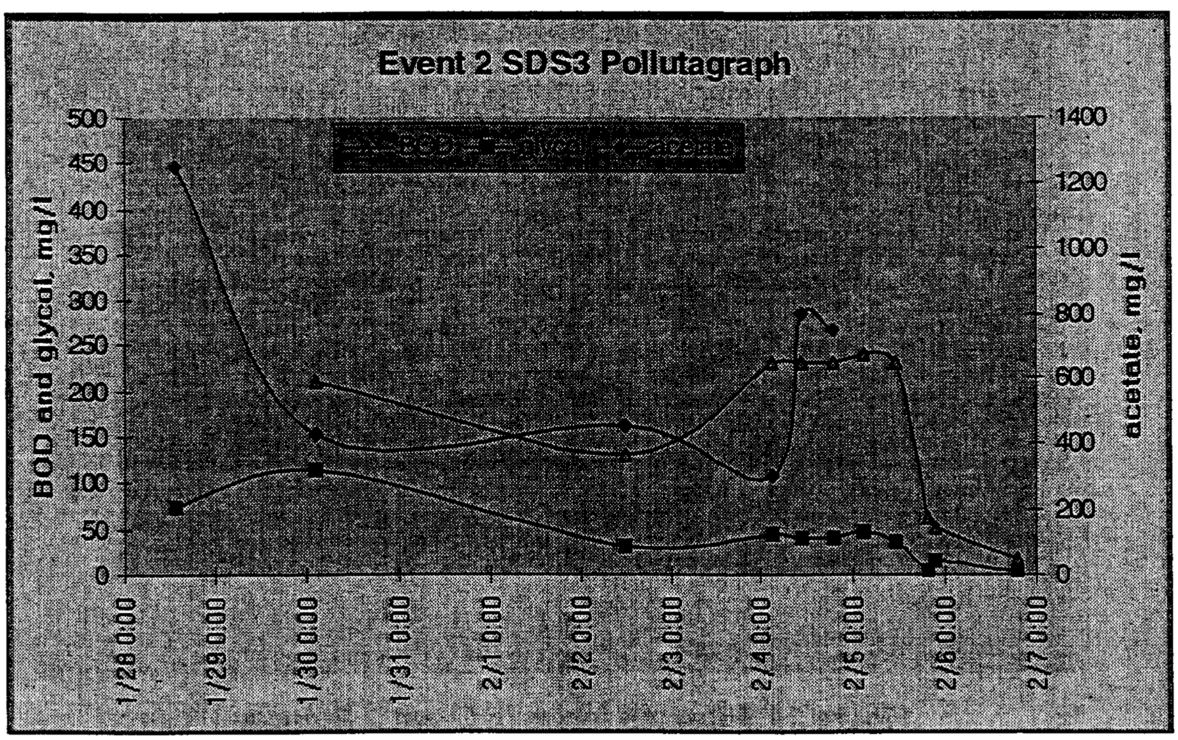


*Figure 31 Event 2 SDS3 Pollutagraph*



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### $BOD_5$ in runway washoff

$BOD_5$ in runway deicing washoff aggregates the oxygen-demanding effects of both aircraft deicing glycols and PA. Oxygen demand due to the aircraft glycols should be a small fraction of the total $BOD_5$ because the PA is applied to the runways/taxiways on a much higher mass-loading basis than would be attributable to glycol dripping/shearing off aircraft.. Glycols, PA, and mixtures of both have about the same ultimate $BOD_5$ of about 1 gram $BOD_5$/gram. Subsequent loading analysis for event 1 showed about 2,200 pounds of glycol washed off compared to an acetate load in excess of 17,360 pounds. See Table 8 Runway Deicing Pollutant Washoff Summary.

Though the data do not extend through the end of the monitoring period, they do exist for the peak concentration. The mirrored peaks in $BOD_5$ support this idea. Acetate concentrations were below the 1000 to 10,000 mg/l range of toxic levels found in comparable calcium magnesium acetate roadway deicer.

$BOD_5$ ranged from about 20 to 480 mg/l in samples where glycol and acetate were both detected. In event 2, $BOD_5$ results for five samples were incomplete due to oxygen depletion before the end of the analysis period, with the consequence that $BOD_5$ could only be reported as in excess of a certain amount. Because glycol and acetate concentrations were similar between the two events, the incomplete $BOD_5$ values in event 2 should be similar to those of event 1. To simplify data reduction, the true value was assumed to be the value reported as greater than, i.e. >230 mg/l was assumed to be 230 mg/l. Next season's washoff monitoring should aim to ensure all $BOD_5$ analysis goes to completion by doing multiple dilutions in the laboratory.

$BOD_5$ also followed a first flush effect, and mirrored acetate and glycol concentration closely. See Figure 30. This relationship was not quite as clear during event 2 (Figure 31), yet generally still held true.

### Washoff functions

Analyzing pollutant load over the course of the discharge hydrograph leads to a strong correlation between percent washed-off and total rainfall accumulation.

These results apply directly only to the SDS3 subbasin at this time because the SDN2 subbasin had faulty hydraulic data. It can be inferred however that SDN2 behaved similarly. These results begin to identify the management opportunities for capturing and treating the pollutant loads.

Figure 32 and Figure 33 show that about 80 to 90 percent of the total pollutant load was washed-off by less than one inch of accumulated precipitation. Note that these relationships between washoff and rainfall were best described by second or third order polynomials regressed with correlation coefficients ($R^2$) of 0.93 to 0.96. A correlation coefficient of 1.0 means that the regression equation is a perfect fit of the data.

These figures show that rainfall less than the 6-month, 24-hour storm (1.3" total rainfall) washed-off the bulk of chemicals applied during the deicing/anti-icing periods. In fact, the 1-month, 24-hour storm (0.65") washed-off 80% of the $BOD_5$ in both events and from 60 to 90% of the TKN. These curves also strongly illustrate the "first flush" principal where the majority of the pollutant load is washed off in a fraction of the total precipitation. Therefore, the first 0.6 to 1.0 inch precipitation after a major runway deicing event washes off the vast majority of deicing chemicals applied. The corollary is also the Pareto effect, where ever diminishing pollutant loads were washed off by increasing rainfall.

Pollutant loads were estimated as the product of pollutant concentration and discharge volume between samples. Total runoff volumes gaged at the SDS3 weir were 77 and 84 percent respectively of the total rainfall depth for event 1 and 2 over the 430 acres of SDS3. These ratios are in fact the measured runoff coefficients, $C_r$, 0.77 and 0.84. The difference between the two probably was due to the variable source area phenomenon because roughly half the SDS3 subbasin is covered by grass that can produce more runoff as it becomes saturated. In addition, these runoff coefficients show a high degree of accuracy in the SDS3 discharge gaging.

Table 8 summarizes the two events in terms of chemicals applied, pollutant load washed-off, etc. Note the disproportionality between chemicals applied and pollutant loads for event 1 and event 2. Event 1 experienced one eighth the urea application as event 2, yet event 1 saw twice the TKN load washed off. This is probably due to the fact that a mixed load of both urea and PA were applied to the runways and taxiways during event 1. In contrast, the urea applied during event 2 was applied as a solid only around the North and South Satellites, drained by the IWS. The washoff function curves for TKN in the second event reflect a slower (less steeply sloped) washoff than event 1, probably due to this fact that the urea was applied in solid form in event 2.

$BOD_5$ loads appear at first to be about the same for both events. Note however that 5 samples during event 2 had $BOD_5$ analyzed as ">230 mg/l", which significantly impacts the event 2 load estimate. Due to the uncertainty in estimating an anticipated $BOD_5$ value, insufficient sample dilutions were used in the analytical laboratory, resulting in these values reported as "greater than". This uncertainty does not sway the hypothesis of a first flush, however, nor does it negatively change the washoff function curve. Instead, substituting higher estimates of the true values for the ">230 mg/l" results only strengthens the argument, and causes the washoff function to become more conservative.

Because event 2 experienced 3 times the PA application as event 1, it is likely that the event 2 $BOD_5$ load is higher than estimated. Since aircraft deicing was similar between the two events, SDS3 probably experienced a higher $BOD_5$ load due to the higher PA application in the second event than in the first.

Unfortunately this direct comparison is not yet possible between TKN and urea the chemical stoichiometry is unknown at this time. Similarly, $BOD_5$ relates to both the PA and glycol, so it is difficult at best to discern any relationships here also.

**Summary**

In summary, $BOD_5$ and TKN washed off the STIA runways and taxiways in a predictable manner, accompanying a first-flush effect demonstrated at the SDS3 outfall. Aircraft deicing glycols also washed off in a first flush manner, though their continuing application on aircraft over the period complicates realization of any washoff function. Little of the urea applied decomposed to ammonia by the time it discharged from STIA outfalls. The ammonia present was far below the acute toxicity criterion.

The first half-inch of runoff (about 0.6" rainfall) washed off about 70% of the total $BOD_5$ and 60% of the total TKN mass. The next half inch washed off another 10 to 20% of the total monitored. This means that it took far less than the 6-month, 24-hour storm to wash off the vast majority of deicing chemicals manifested as pollutants. Overall, it appears that the 1-month, 24-hr storm (0.65" rainfall) washes off 70% to 80% of the total..

***Table 8 Runway Deicing Pollutant Washoff Summary***

| event # | 1 | 2 |
|---|---|---|
| dates | Jan 18-23 | Jan 27- Feb 6 |
| duration monitored, days | 4 | 10 |
| total rainfall, in | 1.67 | 1.76 |
| duration of rainfall, days | 2.75 | 3.25 |
| total runoff, gal | 13,089,657 | [illegible] |
| [illegible] runoff, in | 1.46 | 1.41 |
| iterated runoff coefficient, C | 0.77 | 0.84 |
| duration of runoff, days | 3.2 | 9.2 |
| urea applied, lb | 1250 | 9050 |
| TKN load washed-off, lb | 249 | 126 |
| acetate applied, gal | 5400 | 16200 |
| acetate load washed-off[2], lb | 17,368 | 9,757 |
| BOD load[3], lb | 8,126 | 8,698 |

[2] Acetate load estimate is incomplete for both events, and is at least mass shown. Acetate was analyzed only during the first 0.43" rainfall in event 1, and first 0.25" rainfall in event 2.

[3] The BOD load estimated for event 2 is not comparable to event 1. Oxygen in five samples depleted before the end of the BOD test, so five resutls were reported as ">230 mg/l", complicating loading estimates.

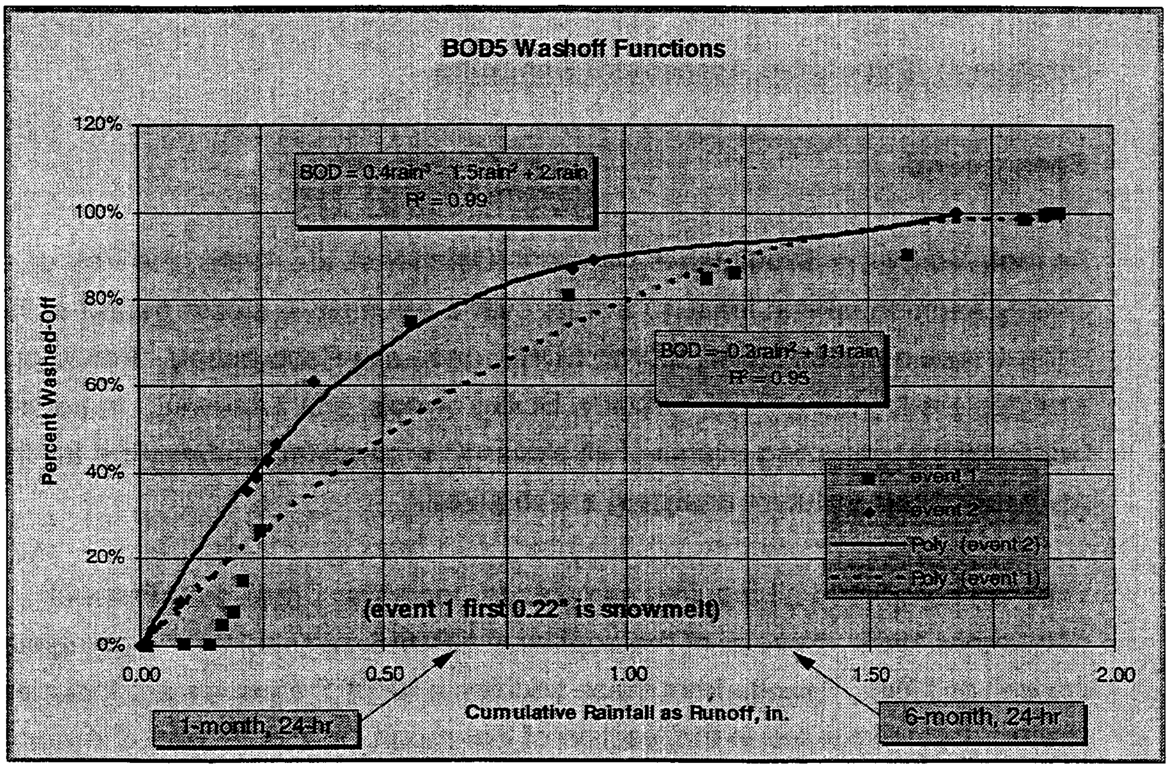


*Figure 32 $BOD_5$ washoff functions*

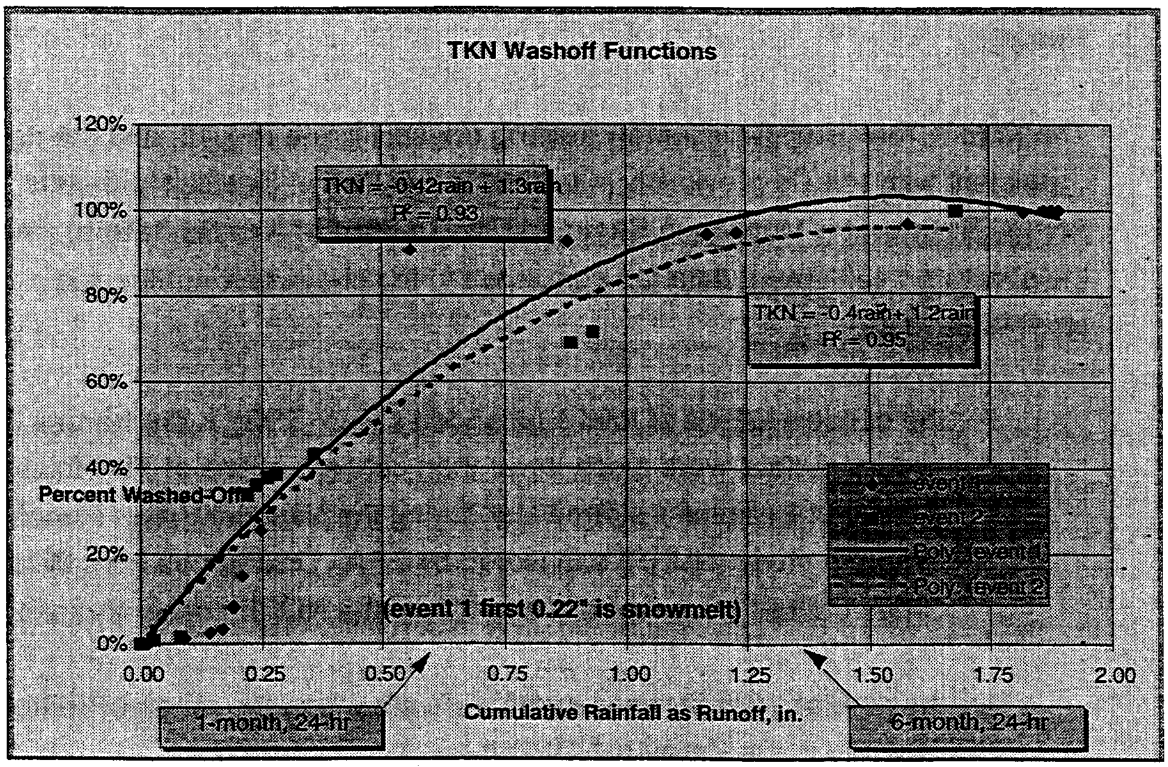


*Figure 33 TKN washoff functions*

## Stratum 4: Stipulated Agreement Sampling

### Background

As required by the Stipulated Agreement (Brasher et. al., 1995), the Port of Seattle must sample at least 16 events over a minimum 4 month period at the Miller Creek outfalls (SDN1, SDN2, SDN3, and Lake Reba outlet). Pollutant analytes are limited to TSS, turbidity, $BOD_5$, glycols, and ammonia. In addition, two additional sampling events of all eleven (11) permitted outfalls (the full list of permit-required pollutant analytes) are required.

The Port completed all required samples for the Miller Creek outfalls as of September 1996. Several of the additional NPDES samples will be completed by the end of 1996. Results from these additional NPDES samples are included in stratum 1 as discussed in that section of this report. In this section, the report presents and discusses only the Miller Creek outfall sample results. Raw data and summary statistics appear in Appendix B.

### Results

The Miller Creek outfall data show nothing unusual in the results, and the data are consistent with results previously published in the Port of Seattle's previous Annual Stormwater Monitoring Summary Report (Port of Seattle, 1995b). When the stipulated settlement data are compared to regional water quality and stormwater data:

- the concentrations of total suspended solids (TSS) in discharges from all four outfalls were much lower than concentrations of TSS found in the city of Bellevue's stormwater during the National Urban Runoff Program study (NURP) sponsored by EPA. Discharges from Miller Creek outfalls were typically one-fifth of the NURP concentrations.

- the median turbidity concentrations were within the range of values reported in the Bellevue NURP data.

- the median of $BOD_5$ concentrations from all four outfalls were equal to the median of $BOD_5$ concentrations found in the NURP study.

- ammonia was not detected in 16% of all samples. When ammonia was detected, the concentrations were well-below the acute criteria for receiving waters. The median concentrations were 3 percent or less than the most conservative acute criteria.

- total glycols were undetected in more than 80% of the samples. Glycols were never detected in discharges from SDN1 and SDN3. Glycols were only detected from SDN2 and Lake Reba. Only half of the SDN2 samples had any detectable glycol and one-quarter of the Lake Reba samples had detectable glycol. The concentrations of glycol in the Lake Reba samples were always lower than those from SDN2.

- when glycols were detected at these outfalls, the concentrations were far less than the rainbow trout 96 hour $LC_{50}$ (concentrations of glycol that prove lethal to 50% of test organisms during a continuous 4 day exposure). The highest concentration of total glycols (ethylene and propylene) found in all of the first half of the samples was 99 mg/l. The rainbow trout 96 hour $LC_{50}$ is greater than 18,500 mg/l for ethylene glycol and 42,476 mg/l for propylene glycol. Therefore the concentrations of ethylene glycol were 0.2% of $LC_{50}$, and the concentrations of propylene glycol were 0.1% of $LC_{50}$. There are no water quality standards for glycols.

- there may have been a sampling error with the baseflow sample of SDN1 on April 5, 1996, where the ammonia concentration is higher than that of all other samples. Because the flow in the pipe was very small, the sampler may have collected decaying organic material in the bottom of the pipe and therefore not be representative of typical stormwater discharged from this outfall. In the second half of the samples, there will be other baseflow samples from this outfall for comparison.

- although glycols were relatively low in the discharge from SDN2 on February 4,1996, we believe the elevated concentration of $BOD_5$ was the result of runway de-icing materials applied in the preceding period as explained in the annual stormwater monitoring report.

## Analytes for Petroleum Products in Stormwater Discharges

Results for TPH and FOG indicate at least 7 occasions where TPH was analyzed as greater than FOG. Generally, FOG is typically a higher value than TPH because various organic lipids and other organic compounds are included as well as the petroleum hydrocarbons in the FOG analysis: FOG is a method-defined analyte (APHA, 1989). In contrast, the TPH analysis includes only the <u>petroleum</u> hydrocarbons, excluding lipids, vegetable matter, etc. Therefore, because TPH is a subset of FOG, values of TPH greater than FOG by about 1 mg/l are suspect. TPH exceeded FOG by more than 1 mg/l in 5 of these 7 samples, ranging from 1.2 to 3.7 mg/l. See Table 9.

***Table 9 TPH greater than FOG results***[1]

| *Sample ID* | *FOG, mg/l* | *TPH, mg/l* | *difference, mg/l* |
|---|---|---|---|
| SDE4 032296 | 2.8 | 3.9 | **1.1** |
| SDE4 041696 | 2.8 | 3.35 | 0.55 |
| SDN1 011295 | 2.6 | 5.1 | **2.5** |
| SDN1 020496 | 7.3 | 7.5 | 0.2 |
| SDN2 041295 | 4 | 5.2 | **1.2** |
| SDS1 021695 | 3.4 | 5.3 | **1.9** |
| SDW3 081795 | 2.9 | 6.6 | **3.7** |

1. differences greater than 1 mg/l suggest using an IR analytical method for FOG

The cause is most likely due to the analytical method required by the permit. Analyzed by gravimetric means (EPA 413.1), the lighter, more volatile fuels of the FOG extracted by the Freon-113 solvent are easily lost during Freon boil-off (APHA, 1989). In contrast, little if any of the light fuels are lost by the TPH (method WTPH 418.1) because it employs an infrared (IR) measurement, rather than a gravimetric method. These findings suggest that both FOG and TPH should be analyzed from the same sample extract, and both by the IR method.



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- Gasoline, diesel, and jet fuel are target constituents at STIA, and many of the shorter hydrocarbon chain compounds contained in these complex fuel mixtures, specifically those that volatilize below 70° C, can be lost in the gravimetric FOG analysis.
- Furthermore, the IR method for FOG has an order of magnitude better detection limit. Analyzing the same sample extract for both FOG and TPH by IR saves $30 per sample for about $1000 annually.
- EPA supports a change from a Freon-113 to a n-hexane solvent used in the FOG and TPH analysis (EPA, 1996).

## Complications caused by sampling locations

As discussed under Background, several sampling locations include runoff from non-STIA sources. Data suggest that the offsite runoff biases results, causing higher concentrations of several pollutants than is representative of STIA runoff. The Port plans to adjust sampling locations where possible.

### Subbasin SDN1, outfall 006

As discussed earlier, the sampling point for subbasin SDN1 (manhole SDN1-27, outfall 006) receives non-STIA runoff from about 3.5 acres of SR518 and nearby grassed areas. Total Port property within SDN1 is about 14 acres, or 82% of the area now draining to the monitoring location. Zinc, TPH and FOG are significantly greater in samples here than in other STIA subbasins. As a result, the Port believes that zinc, TPH, and FOG from this site are considerably high-biased by roadway runoff from SR518.

The Port drainage area of SDN1 includes roof tops, the northern half of Air Cargo Road, and a small portion of an air cargo freight yard (less than 1% of the total drainage area). There is no runoff from pavement where aviation industrial activity occurs in this subbasin. Drainage from rooftops is generally less contaminated than street runoff, and certainly much less likely to contribute the higher zinc, TPH, and FOG experienced.

The Port recently located the 18 foot deep SDN1-22 manhole, previously buried, near the South 154th St and 24th Avenue South intersection. This manhole is immediately at the final confluence of STIA subbasin SDN1 stormwater and is suitable for monitoring. The Port plans to relocate the SDN1 subbasin sampling location (outfall 006) to this new manhole in the near future. By taking dual upstream and downstream samples for a limited period at the new and old manholes, the Port hopes to show the magnitude that the SR518 runoff biases the zinc, TPH, and FOG results.

**Subbasin SDS2, outfall 004**

Because the majority of SDS2 is vegetated, stormwater from this subbasin probably reaches the sampling point well after the additional drainage from the offsite areas within and along 16th Avenue South. As a consequence, it is likely that the Port samples off-site runoff at this location. The off-site runoff reaches the sampler first, enabling the sampler which then begins it routine filling sample bottles before the Port subbasin's water arrives. More information should be gathered to assess any bias this factor has on the dilution or addition of pollutants in SDS2 samples.

**Stormwater Discharge Hydraulic and Hydrologic Data**

Appendix A presents hydraulic and hydrologic data items required by the permit.

**Storm Targeting and General Monitoring Success**

STIA stormwater monitoring was much more intense this year compared to last. Two additional samples beyond the permit obligation were required by the Stipulated Agreement (Brasher et. al., 1995) at each permitted outfall, most have been completed. In addition, a total of 64 extra samples were also required at the three Miller Creek Outfalls (SDN1, SDN2, SDN3), plus Lake Reba.

A total of 15 storms were targeted for monitoring from January 1, 1996 through June 30, 1996. Typically, sampling equipment was deployed, programmed and setup at three to eight outfalls per storm targeted, for a total of 54 site-setup occasions over the first half of 1996. Five of 15 storms targeted did not meet the NPDES criteria, so a total of 8 samples (one sample each at sites targeted) were discarded. Therefore, the methods used to target potential storms that would ultimately meet NPDES criteria were reasonably successful.

## Stormwater Pollution Prevention Plan (SWPPP) Actions

Table 10 presents a summary of best management practice (BMP) activities described in the Stormwater Pollution prevention Plan (SWPPP). The Port conducted a wet weather outfall survey, required by permit condition S10, section C on April 26, 1996. See Appendix C for wet-weather inspection report results.

## *Table 10 SWPPP BMP SUMMARY*

**(SWPPP dated NOVEMBER 27, 1995)**

| ACTIVITY | BMP | TYPE | STATUS | LEAD DIVISION |
|---|---|---|---|---|
| Universal BMP's | SWPPP Implementation monitor | Operational | Implemented 10/95 | HSEM |
| | Inspections | Operational | Implemented 10/95 | HSEM |
| | Pollution Prevention Team | Operational | In effect | PMG (SWIM comm.) |
| | SDS outfall monitoring | Operational | In effect | HSEM |
| | Signing catch basins (dump no waste) | Operational | In effect | Maintenance |
| Aircraft Servicing | Restricted to IWS areas | Operational | In effect | Airfield LOB |
| | Tenant education on Port policy | Operational | In effect | Airfield LOB |
| | Store glycol in IWS areas | Operational | In effect | Maintenance |
| | Connect problem SDS areas to IWS | Capital | by 6/30/97 | PMG |
| | Monitor SDS during deicing | Operational | In effect | HSEM |
| Airfield anti-icing | Termination of glycol use | Source control | In effect | Airfield LOB |
| | Surface sensor system | Operational | In effect | Airfield LOB |
| | Sweep storage areas | Source control | In effect | Maintenance |
| | Stream monitoring study | Operational | On going | HSEM |
| | Evaluate alternative chemicals | Capital* | See Footnote ** | Maintenance |
| | Diversion of runway runoff to IWS | Capital | See Footnote ** | PMG |
| Snow storage | Connect storage areas to IWS | Capital | by 6/30/97 | PMG |



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| | | | | |
|---|---|---|---|---|
| Roadway de-icing | Stream monitoring study | Operational | On going | HSEM |
| | Evaluate alternative chemicals | Capital* | See Footnote ** | Maintenance |
| Spill Control | Implement Spill Plan | Operational | In effect | PMG |
| | Tenant spill control plans | Operational | In effect | PMG |
| Construction sites | Erosion control BMP's | Source control | In effect | HSEM |
| | Restrictions on equipment servicing | Source control | In effect | HSEM |
| | Secondary containment | Source Control | In effect | HSEM |
| Bare ground surfaces in non-construction areas | Erosion control BMP's of contractor staging areas | Source control | In effect | HSEM |
| | Clarification of responsibility for BMP's in contractor staging area | Operational | In effect | PMG |
| | BMP's for clear zone roads | Source control | In effect | Maintenance |
| Vehicle Washing & maintenance | Terminate activity in SDS areas | Source control | In effect | PMG |
| | Place signs in key locations | Operational | In effect | Maintenance |
| | Inspections | Operational | In effect | PMG/Maintenance |
| | Annually clean sumps in Taxi yard | Source control | In effect | Maintenance |
| Landscape management | Use environmentally benign chemicals | Operational | In effect | Maintenance |
| | Restrict use near waterways | Operational | In effect | Maintenance |
| | Proper cleaning/disposal | Operational | In effect | Maintenance |
| | Apply during dry periods | Operational | In effect | Maintenance |
| | Incorporate BMP's into specifications | Operational | In effect | Maintenance |
| Port Maintenance Shop yard | Secondary containment | Source control | In effect | Maintenance |
| | Used fluid under cover | Source control | In effect | Maintenance |
| | Connect shop yard to IWS | Capital | By 6/30/97 | PMG |

| | | | | |
|---|---|---|---|---|
| Airfield Maintenance | Sweep pavement | Source control | In effect | Maintenance |
| | Clean catch basins regularly | Source control | In effect | Maintenance |
| Inappropriate connections and discharges | Monitor base flows | Operational | In effect | HSEM |
| | Semi-annual inspection | Operational | On going | PMG |
| | SWPPP monitor | Operational | In effect | HSEM |
| | Packing material source control | Operational | On going | PMG |
| Temporary hazardous waste storage | Enclosed storage structures | Capital | In effect | Maintenance |
| | Move storage sheds to IWS areas | Capital | In effect | Maintenance |

* - It is anticipated that using an alternative chemical would require capital investment.

** - Whether an alternative chemical should be used or whether runoff from the runways following a de-icing event should be diverted to the IWS depends upon whether the Stream Effects Study finds that runoff causes adverse effects on either Miller or Des Moines Creeks.

# Conclusions and Recommendations

## Stormwater Quality

Overall, STIA stormwater quality is cleaner than regionally comparable data. The dichotomy between airfield outfalls when compared to the terminal and landside outfall data indicate a distinct difference in stormwater runoff quality. Stormwater quality at the airfield outfalls under typical conditions is cleaner than regional commercial and industrial areas.

Furthermore, the data show improvements in water quality as a result of the Port's SWPPP actions at the Taxi Yard and SDE4 subbasins. Monitoring in the upcoming year should demonstrate the success that several storm drain re-routes have upon reducing glycols in the SDS1 subbasin stormwater.

## Aircraft Deicing

Aircraft deicing glycols in STIA stormwater appeared similar to last year's data, and were well below toxic levels even during the periods of heaviest glycol application. Glycols were undetected in 75% of all samples analyzed over the past two years. Glycols have never been detected in 24 samples at the SDN3 outfall, and only in one of 22 samples (6.1 mg/l) at SDN1.

## Runway Deicing Pollutant Washoff

Airport runway deicing chemicals manifest themselves in STIA runoff as $BOD_5$. The vast majority of any urea applied washes off in the organic nitrogen form, little breaks down into ammonia. All data for ammonia indicate conditions far from acute toxicity in the stormwater itself, even though this criterion applies to the receiving waters. Potassium acetate used for the majority of runway deicing shows up at concentrations below those suggesting any acute toxicity.

$BOD_5$ and TKN wash off the STIA runways and taxiways in a predictable manner, accompanying the first-flush effect demonstrated at the SDS3 outfall.



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The one-month, 24-hour storm (0.65") washes off from 70% to 80% of the of deicing chemicals manifested as pollutants applied to the runways and taxiways during deicing. Less than the 6-month, 24-hour storm (1.3") washes off the vast majority. Monitoring should continue in 1996-97 to further verify these conclusions and recommend a specific design storm for a water quality management target.

## Recommendations

### Move Sampling Locations

Move the SDN1 subbasin sampling location from manhole SDN1-27 to SDN1-22. Study magnitude of bias that the SR518 runoff has on zinc, TPH, and FOG.

Move the SDW3 (outfall 010) sampling location to the first manhole upstream, preventing sampling in backwater at outfall.

### Change FOG analysis method

Change FOG analysis method from 413.1 to 413.2

- As discussed above, the 7 occasions where TPH exceeded FOG values show that FOG should be determined by the IR method (EPA 413.2), rather than the current gravimetric method (EPA 413.1). Doing so ensures more representative results, preventing loss of the lighter fuel fractions lost during the gravimetric FOG analysis.

# References

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3. EPA, 1993. Stormwater discharges potentially addressed by Phase II of the NPDES program. Draft report to Congress. October, 1993.

4. EPA, 1996. Letter describing changes in solvent used for FOG and TPH analysis: "Direct Replacement of Currently Approved Methods with Method 1664 for Determination of the Conventional Pollutant "Oil and Grease", dated July 9, 1996. US EPA, WA, DC

5. King County, 1995. Little Soos Creek Microbial Source Tracking: A Survey. Prepared by Dr. Mansour Samadpour and Naomi Checkowitz of the University of Washington for King County Department of Public Works, Surface Water Management Division. August, 1995

6. Minton, G. R., Resource Planning Associates, Seattle, WA, personal communication.

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11. Redmond, 1990. Redmond Way Oil/Water Separator Engineering Report. City of Redmond, 1990

12. SPSS, 1993. SPSS for Windows, Base System User's Guide. Release 6.0 SPSS Inc., Chicago IL, © 1993

13. WDOE, 1996. Letter from Lisa Zinner of WA department of Ecology to Michael Feldman, Port of Seattle, authorizing silver to be dropped from Stormwater Receiving Environment Study, dated August 14, 1996.

14. WDOE 1994 National Pollutant Discharge Elimination System permit No. WA-002465-1, issued June 30, 1994 by Washington Department of Ecology, Olympia, WA

# Appendices

# Appendix A

## Hydraulic and Hydrologic Estimations

This appendix presents hydraulic information required by the STIA NPDES permit. Paragraph 2 of section C of NPDES permit special condition S3 states "The Permittee shall submit the following data for the storm event used: date, duration, the number of dry hours preceding the storm event, total rainfall during the storm event (inches), maximum flow rate (gallons per minute), and the total flow from the rain event (gallons)." This appendix contains these required data items. Daily maximum runoff volumes are reported monthly on DMRs.

Table 11 outlines the storms monitored, the outfalls sampled, and the storm date, total rainfall, duration, and 48-hour antecedent precipitation.

### Runoff Volumes

In 1995, the Port developed a WATERWORKS software-based model for hydraulic evaluation of the stormwater subbasins at STIA. Port Engineering, amongst others, uses the model to evaluate the stormwater piping for various design storms. Runoff volumes generated by this model were used to develop linear equations for estimating runoff volumes for each subbasin. These equations are nested in the spreadsheet that estimates the maximum daily discharge values submitted in the monthly DMRs. The Port has used this procedure since the fourth quarter of 1995. Table 12 presents total runoff volumes estimated for each storm event monitored.

The reader is referred to the Procedures Manual (Port of Seattle, 1995b) and last year's annual report (Port of Seattle, 1995c) for a discussion of the method used to estimate runoff volumes. Table 14 shows the areas estimated for each subbasin. The areas of some subbasins will change as portions of SDS areas are connected to the IWS as specified in the SWPPP.

### Peak Discharges

Peak discharges presented in Table 13 are estimated by the "rational method" for each storm event sampled in the preceding year. The peak rate of each storm depends upon the time-of-concentration, or $T_c$ , for the particular subbasin and the rainfall distribution of the particular storm. The WATERWORKS model developed the $T_c$ values presented in Table 14. The peak discharge, $Q_p$, is then estimated by the rational method using the following equation.

$$Q_p \text{ (gpm)} = \frac{C \times I \times A \times 43560 \text{ ft}^3/\text{ac} \times 7.48 \text{ gal/ft}^3}{12 \text{ in/ft} \times 60 \text{ min/hr}}$$

where:

C = runoff coefficient = $(0.90(A_i) + 0.25(A_p))/A$

where :

$A_i$ = the impervious area in acres, and

$A_p$ = the pervious area in acres

I = peak intensity in inches/hour

A = subbasin area in acres

The Port's ISCO rain gage records rainfall at 5-minute intervals, thus resolving rainfall rates, or "intensities" for periods as short as 5-minutes. The rainfall record for the storm of interest is examined to determine the peak intensity for the time span that matches the time-of-concentration. The ISCO rain gage allows the user to aggregate rainfall for multiples of the 5-minute recording interval that best approaches the times of concentration desired. This basin-specific intensity is then translated to an hourly peak intensity using the following equation:

$$I = i \times 60/T_c$$

where:

i = maximum rainfall depth (inches) of a time equal to the time of concentration

$T_c$ = the time of concentration, displayed in Table A3.

For example, the $T_c$ for SDE-4 is 21 minutes; therefore, the rainfall record for the storm of interest is examined to find the one period of 20 minutes that has the greatest rainfall depth

*Table 11  Monitored Storm Event Data*

**Storm Event Sampling History for July, 1995 through June, 1996**

| | | | Rainfall | | | Outfalls Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Storm quarter | Type | Dur (hr) | Depth (in.) | 48-hr Ant (in) | 002 SDE4 | 003 SDS1 | 004 SDS2 | 005 SDS3 | 006 SDN1 | 007 SDN2 | 008 SDN3 | 009 SDS4 | 010 SDW3 | 012 EY | 013 TY | MC3 |
| 6/23/96 | 96 Q2 | NPDES | 13 | 0.46 | 0.00 | | | | | 1 | 1 | | | | 1 | failed | |
| 5/21/96 | 96 Q2 | NPDES | 36 | 0.31 | 0.02 | | | | | 1 | 1 | stip | | | 1 | | |
| 4/22/96 | 96 Q2 | NPDES | 58 | 2.83 | 0.00 | | 1 | | | 1 | 1 | 1 | 1 | | 1 | 1 | 1 |
| 4/15/96 | 96 Q2 | NPDES | 12 | 0.49 | 0.09 | 1 | 1 | | 1 | stip | stip | stip | 1 | | | 1 | 1 |
| 3/31/96 | 96 Q1 | NPDES | 24 | 0.64 | 0.01 | | | | | grab | grab | 1 | | | | failed | |
| 3/22/96 | 96 Q1 | NPDES | 16 | 0.21[1] | 0.00 | 1 | | | 1 | | | | failed | | | grab | |
| 2/17/96 | 96 Q1 | NPDES | 60 | 1.29 | 0.00 | | | | | | 1 | | | | 1 | failed | |
| 2/3/96 | 96 Q1 | NPDES | 31 | 1.60 | 0.00 | 1 | | | wo | 1 | wo | stip | | wo | | | 1 |
| 1/19/96 | 96 Q1 | R/W deice | 48+ | 1.80 | 0.00 | | | | wo | | wo | wo | | | | | |
| 1/13/96 | 96 Q1 | NPDES | 20 | 0.37 | 0.00 | failed | 1 | | 1 | failed | failed | 1 | 1 | | | | |
| 11/6/95 | 95 Q4 | NPDES | 42 | 3.89 | 0.09 | | | | | 1 | | 1 | | | | | |
| 10/25/95 | 95 Q4 | NPDES | 8 | 0.28 | 0.01 | 1 | | | | | | | | | | | |
| 10/16/95 | 95 Q4 | NPDES | 12 | 0.35 | 0.00 | | 1 | | 1 | | 1 | | 1 | | 1 | 1 | |
| 9/29/95 | 95 Q3 | DB | | 0.00 | 0.18 | | 1 | | 1 | | | | | | | | |
| 9/5/95 | 95 Q3 | NPDES | ND | ND | ND | | | 1 | | | | | | | | 1 | |
| 8/17/95 | 95 Q3 | DS | 16 | 1.34 | 0.01 | 1 | | | | | | | | 1 | | 1 | |
| 8/7/95 | 95 Q3 | NPDES | 8 | 0.40 | ND | | 1 | | | 1 | 1 | | 1 | | | | |
| 7/26/95 | 95 Q3 | NPDES | ND | 0.41 | ND | 1 | | | 1 | | | | | | 1 | | |
| 7/9/95 | 95 Q3 | NPDES | 10 | 0.81 | 0.00 | | | | | | | 1 | | | | | |

1. WDOE granted OK to use since <0.25"
"1" means NPDES grab and composite sample obtained
ND means No Data available; rain gage failed to record data, or gap exists in rainfall data records.
"wo" means a runway deicing washoff sample obtained
"grab" means only a grab sample taken
"DB" means aircraft deicing event, baseflow sample, "DS" means aircraft deicing event, storm sample
"stip" means only sampled for parameters of the Stipulated Agreement for Miller Creek outfalls.

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### *Table 12 Estimated Runoff Volumes for Storm Events Monitored July, 1995 through June, 1996*

| Monitored Event Date | Rainfall (in.) | Runoff Volumes for Sea-Tac Airport Sub-Basins, gallons 002 SDE-4 | 003 SDS-1 | 004 SDS-2 | 005 SDS-3 | 006 SDN-1 | 007 SDN-2 | 008 SDN-3 | 009 SDS-4 | 010 SDW-3 |
|---|---|---|---|---|---|---|---|---|---|---|
| 6/23/96 | 0.46 | 810,000 | 113,000 | 27,000 | 2,031,000 | 126,000 | 230,000 | 160,000 | 160,000 | 87,000 |
| 5/21/96 | 0.31 | 319,000 | 45,000 | 11,000 | 799,000 | 50,000 | 91,000 | 63,000 | 62,000 | 34,000 |
| 4/22/96 | 2.83 | 7,880,000 | 1,286,000 | 607,000 | 23,858,000 | 1,205,000 | 2,383,000 | 3,442,000 | 2,585,000 | 1,410,000 |
| 4/15/96 | 0.49 | 934,000 | 130,000 | 31,000 | 2,343,000 | 146,000 | 265,000 | 184,000 | 184,000 | 101,000 |
| 3/31/96 | 0.64 | 1,339,000 | 185,000 | 43,000 | 3,187,000 | 209,000 | 365,000 | 240,000 | 284,000 | 155,000 |
| 3/22/96 | 0.21 | 113,000 | 16,000 | 4,000 | 284,000 | 18,000 | 32,000 | 23,000 | 21,000 | 12,000 |
| 2/17/96 | 1.29 | 2,964,000 | 435,000 | 142,000 | 7,744,000 | 459,000 | 839,000 | 806,000 | 751,000 | 410,000 |
| 2/3/96 | 1.60 | 3,833,000 | 577,000 | 210,000 | 10,387,000 | 592,000 | 1,102,000 | 1,190,000 | 1,038,000 | 567,000 |
| 1/19/96 | 1.80 | 4,426,000 | 677,000 | 261,000 | 12,253,000 | 682,000 | 1,285,000 | 1,477,000 | 1,246,000 | 680,000 |
| 1/13/96 | 0.37 | 489,000 | 68,000 | 16,000 | 1,225,000 | 76,000 | 139,000 | 97,000 | 96,000 | 52,000 |
| 11/6/95 | 3.89 | 12,134,000 | 2,080,000 | 1,114,000 | 39,294,000 | 1,844,000 | 3,790,000 | 6,317,000 | 4,440,000 | 2,422,000 |
| 10/25/95 | 0.28 | 247,000 | 35,000 | 9,000 | 618,000 | 39,000 | 70,000 | 49,000 | 48,000 | 26,000 |
| 10/16/95 | 0.35 | 428,000 | 60,000 | 14,000 | 1,073,000 | 67,000 | 122,000 | 85,000 | 84,000 | 46,000 |
| 9/29/95 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9/5/95 | ND | | | | | | | | | |
| 8/17/95 | 1.34 | 3,100,000 | 457,000 | 152,000 | 8,150,000 | 480,000 | 880,000 | 863,000 | 795,000 | 434,000 |
| 8/7/95 | 0.40 | 587,000 | 82,000 | 20,000 | 1,472,000 | 92,000 | 167,000 | 116,000 | 115,000 | 63,000 |
| 7/26/95 | 0.41 | 622,000 | 87,000 | 21,000 | 1,559,000 | 97,000 | 177,000 | 123,000 | 122,000 | 67,000 |
| 7/9/95 | 0.81 | 1,739,000 | 244,000 | 63,000 | 4,250,000 | 271,000 | 479,000 | 357,000 | 388,000 | 212,000 |

Rainfall data from Port of Seattle and/or National Weather Service rain gage at Sea-Tac Airport
Runoff volumes based upon basin-specific engineering models
ND means No Data available; rain gage failed to record data, or gap exists in rainfall data records.

## *Table 13 Estimated Peak Runoff Rates for Storm Events Monitored July, 1995 through June, 1996*

| Monitored Event Date | Peak Rainfall Intensity (in/hr) during times of concentration (min) of: | | | | | | | | Peak Runoff Rates for Sea-Tac Airport Sub-Basins, gpm | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 10 | 20 | 40 | 50 | 55 | 60 | 80 | 002 SDE4 | 003 SDS-1 | 004 SDS-2 | 005 SDS-3 | 006 SDN-1 | 007 SDN-2 | 008 SDN-3 | 009 SDS-4 | 010 SDW-3 | 012 EY | 013 TY |
| 6/23/96 | 0.02 | 0.03 | 0.14 | 0.14 | 0.16 | 0.16 | 0.19 | 0.14 | | | | | 1,026 | 2,263 | | | | 147 | *failed* |
| 5/21/96 | 0.01 | 0.02 | | | 0.06 | 0.06 | | | | | | | 684 | 849 | 745 | | | 73 | |
| 4/22/96 | 0.03 | 0.04 | | 0.17 | 0.16 | 0.19 | | | | 4,153 | | | 1,368 | 2,263 | 2,358 | 1,972 | | 220 | 293 |
| 4/15/96 | 0.03 | 0.04 | 0.08 | 0.12 | 0.14 | 0.14 | | 0.16 | 9,750 | 2,932 | | 13,211 | 1,368 | 1,980 | 1,738 | 1,725 | | | 293 |
| 3/31/96 | | 0.05 | | | 0.10 | 0.12 | | | | | | | 1,710 | 1,414 | 1,489 | | | | *failed* |
| 3/22/96 | 0.01 | | 0.02 | | | | | 0.05 | 2,438 | | | 4,128 | | | | *failed* | | | 98 |
| 2/17/96 | 0.01 | | | | 0.08 | | | | | | | | | 1,131 | | | | 73 | *failed* |
| 2/3/96 | | 0.02 | 0.03 | 0.05 | 0.07 | 0.07 | | 0.09 | 3,656 | | | 7,431 | 684 | 990 | 869 | | 424 | | |
| 1/19/96 | | | | | 0.12 | 0.12 | | 0.17 | | | | 14,037 | | 1,697 | 1,489 | | | | |
| 1/13/96 | | | | 0.11 | 0.13 | 0.15 | | 0.19 | *failed* | 2,687 | | 15,688 | *failed* | *failed* | 1,862 | 1,602 | | | |
| 11/6/95 | | 0.07 | | | | 0.23 | | | | | | | 2,394 | | 2,855 | | | | |
| 10/25/95 | | | 0.03 | | | | | | 3,656 | | | | | | | | | | |
| 10/16/95 | 0.02 | | | 0.08 | 0.10 | | | 0.07 | | 1,954 | | 5,780 | | 1,414 | | 1,232 | | 147 | 195 |
| 9/29/95 | | | | 0.00 | | | | 0.00 | | | | | | | | | | | |
| 9/5/95 | ND | | | | | | ND | | | | ND | | | | | | | ND | ND |
| 8/17/95 | 0.03 | | 0.10 | 0.16 | | | | | 12,188 | | | | | | | | 1,357 | | 293 |
| 8/7/95 | | ND | | ND | ND | | | | | ND | | | ND | ND | | ND | ND | | |
| 7/26/95 | ND | | ND | | | | | ND | ND | | | ND | | | | | | ND | ND |
| 7/9/95 | | | | | | 0.18 | | | | | | | | | 2,234 | | | | |

Absent values indicate location not sampled for that storm
Rainfall data from Port of Seattle and/or National Weather Service rain gage at Sea-Tac Airport
Peak runoff rates based upon "rational method": Q=CIA.
ND means No Data available; rain gage failed to record data, or gap exists in rainfall data records.

*Table 14 Summary of Subbasin Hydrologic Characteristics*

| Subbasin | Outfall Number | $A_p$ (acres) | $A_i$ (acres) | Total Area (ac) | C | $T_C$ (min) |
|---|---|---|---|---|---|---|
| SDE-4 | 002 | 28 | 92 | 120 | .75 | 21 |
| SDS-1 | 003 | 0 | 40 | 40 | .90 | 40 |
| SDS-2 | 004 | 13 | 0 | 13 | .25 | 60 |
| SDS-3 | 005 | 221 | 209 | 430 | .57 | 78 |
| SDN-1 | 006 | 0 | 14 | 14 | .90 | 10 |
| SDN-2 | 007 | 7 | 27 | 34 | .77 | 50 |
| SDN-3 | 008 | 43 | 16 | 59 | .43 | 55 |
| SDS-4 | 009 | 26 | 18 | 44 | .52 | 50 |
| SDW-3 | 010 | 14 | 10 | 24 | .52 | 38 |
| Eng Yard | 012 | 0 | 1.5 | 1.5 | .90 | 5 |
| Taxi Yard | 013 | 0 | 2 | 2 | .90 | 5 |

# Appendix B

## Summarized Analytical Data for all Storm Events Monitored

1995 Report data this section

| stormdate | POS ID | location | annual reported | event | purpose | type | pH | FOG | TPH | TSS | Turb | Fecals | BOD5 | NH3 | total glycols | Surf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08-Mar-95 | EY 030995 | EY | 1995 | 1 | 1 | | 6.6 | 0.5 | | 3.2 | | | | | | 0.05 |
| 04-Jun-95 | EY 060495 | EY | 1995 | 1 | 1 | | 5.5 | 6.5 | | 25 | | | | | | 0.2 |
| | EY 091494 | EY | 1995 | 1 | 1 | | 6.9 | 2.2 | | 24.9 | | | | | | 0.3 |
| | EY 101394 | EY | 1995 | 1 | 1 | | 7.0 | 2.1 | | 25 | | | | | | 0.2 |
| 07-Jan-95 | SDE4 010795 | SDE4 | 1995 | 1 | 1 | | 7.0 | 3.6 | 2.8 | 16 | 27 | 45 | 26 | 2.3 | | 0.05 |
| 10-Apr-95 | SDE4 041095 | SDE4 | 1995 | 1 | 1 | | 6.6 | 0.55 | 1.1 | 16 | 19 | 260 | 8 | 0.42 | 5 | 0.2 |
| | SDE4 111394 | SDE4 | 1995 | 1 | 1 | | | 2.8 | 1.1 | 56 | 46 | 1,100 | 7 | 0.39 | 5 | 0.2 |
| 11-Jan-95 | SDN1 011295 | SDN1 | 1995 | 1 | 1 | | 7.4 | 2.6 | 5.1 | 22 | 30 | 1,000 | 4 | 0.37 | | 0.05 |
| 04-Mar-95 | SDN1 030595 | SDN1 | 1995 | 1 | 2 | | | | | 1 | 3.5 | | 4 | 0.005 | 5 | |
| 08-Mar-95 | SDN1 030995 | SDN1 | 1995 | 1 | 2 | | | | | 14 | 17 | | 6 | 0.35 | 5 | |
| 13-Mar-95 | SDN1 031595 | SDN1 | 1995 | 1 | 2 | | | | | 9.6 | 17 | | 4 | 0.05 | 5 | |
| 04-Apr-95 | SDN1 040595 | SDN1 | 1995 | 1 | 2 | | | | | 6 | 7.6 | | 5 | 0.078 | 5 | |
| 06-Apr-95 | SDN1 040795 | SDN1 | 1995 | 1 | 1 | | 7.6 | 0.6 | 0.5 | 18 | 6.2 | 58 | 40 | 0.005 | 5 | 0.05 |
| | SDN1 091494 | SDN1 | 1995 | 1 | 1 | | 6.6 | 3.3 | 0.5 | 21.5 | 6.4 | 4,000 | 194 | 0.025 | | 1.3 |
| | SDN1 101994 | SDN1 | 1995 | 1 | 1 | | 6.8 | 1.8 | 0.5 | 13 | 10 | 180 | 8 | 0.5 | | 0.2 |
| 11-Jan-95 | SDN2 011295 | SDN2 | 1995 | 1 | 1 | | 8.0 | 2.3 | 0.5 | 7.5 | 14 | 4 | 4 | 1.3 | | 0.05 |
| 04-Mar-95 | SDN2 030595 | SDN2 | 1995 | 1 | 2 | | | | | 2.4 | 2.1 | | 12 | 0.021 | 36 | |
| 13-Mar-95 | SDN2 031595 | SDN2 | 1995 | 1 | 2 | | | | | 1 | 2.2 | | 5 | 1.6 | 5 | |
| 06-Apr-95 | SDN2 040795 | SDN2 | 1995 | 1 | 2 | | | | | 7.2 | 4.8 | | 15 | 0.005 | 5 | |
| 10-Apr-95 | SDN2 041295 | SDN2 | 1995 | 1 | 1 | | 7.6 | 4 | 5.2 | 5.6 | 4.9 | 1 | 30 | 5 | 19 | 0.05 |
| | SDN2 090894 | SDN2 | 1995 | 1 | 1 | | 6.8 | 1.8 | 0.5 | 3.2 | 4.1 | 3 | 11 | 0.005 | | 0.2 |
| | SDN2 101394 | SDN2 | 1995 | 1 | 1 | | | 1.1 | 0.5 | 6.5 | 8.1 | 2 | 86 | 0.44 | | 0.2 |
| | SDN2 111394 | SDN2 | 1995 | 1 | 1 | | | 0.5 | 0.5 | 2 | 5.4 | 30 | 7 | 0.041 | | 0.05 |
| 07-Jan-95 | SDN3 010795 | SDN3 | 1995 | 1 | 1 | | 7.8 | 0.55 | 0.5 | 0.62 | 1.6 | 1 | 2 | 0.011 | | 0.05 |
| 04-Mar-95 | SDN3 030595 | SDN3 | 1995 | 1 | 2 | | | | | 1 | 2.3 | | 3 | 0.005 | 5 | |
| 08-Mar-95 | SDN3 030995 | SDN3 | 1995 | 1 | 2 | | | | | 5 | 12 | | 3 | 0.016 | 5 | |
| 13-Mar-95 | SDN3 031595 | SDN3 | 1995 | 1 | 2 | | | | | 4 | 5.9 | | 5 | 0.018 | 5 | |
| 04-Apr-95 | SDN3 040595 | SDN3 | 1995 | 1 | 2 | | | | | 1 | 1.8 | | 3 | 0.25 | 5 | |
| 04-Jun-95 | SDN3 060495 | SDN3 | 1995 | 1 | 1 | | 7.0 | 2.5 | 0.5 | 15 | 25 | 40 | 8 | 0.005 | | 0.05 |
| | SDN3 090894 | SDN3 | 1995 | 1 | 1 | | 6.4 | 1.1 | 0.5 | 2.1 | 5.1 | 2,200 | 5 | 0.061 | | 0.05 |
| | SDN3 102594 | SDN3 | 1995 | 1 | 1 | | | 2.9 | 0.5 | 9.2 | 8 | 2 | 4 | 0.038 | | 0.05 |
| 15-Feb-95 | SDS1 021695 | SDS1 | 1995 | 1 | 1 | | 6.6 | 3.4 | 5.3 | 6.7 | 40 | 5 | 92 | 0.06 | 275 | 0.4 |
| 11-May-95 | SDS1 051195 | SDS1 | 1995 | 1 | 1 | | 7.4 | 10 | 0.5 | 34 | 25 | | 2 | | | 0.6 |
| 04-Jun-95 | SDS1 060495 | SDS1 | 1995 | 1 | 1 | | 6.4 | 5.6 | 5.4 | 14 | 36 | 60 | 15 | 0.29 | | 0.8 |
| | SDS1 101994 | SDS1 | 1995 | 1 | 1 | | 5.8 | 1.1 | 0.5 | 2.5 | 11 | 10 | 12 | 0.13 | | 0.5 |
| 09-May-95 | SDS2 051095 | SDS2 | 1995 | 1 | 1 | | 7.2 | 3.4 | 0.5 | 15 | 15 | 440 | 11 | | | |
| 11-May-95 | SDS2 051195 | SDS2 | 1995 | 1 | 1 | | 7.4 | 1.4 | 0.5 | 7.8 | 6.1 | 780 | 4 | | | |
| | SDS2 061095 | SDS2 | 1995 | 1 | 1 | | 7.1 | 1.8 | 0.5 | 18 | 8.2 | 1,400 | 8 | | | |
| 07-Jan-95 | SDS3 010795 | SDS3 | 1995 | 1 | 1 | | 7.2 | 0.65 | 0.5 | 2 | 3.7 | 1 | 5 | 0.14 | | 0.05 |
| 10-Apr-95 | SDS3 041295 | SDS3 | 1995 | 1 | 1 | | 7.3 | 0.55 | 0.5 | 1 | 1.9 | 1 | 4 | 1.7 | 5 | 0.05 |
| | SDS3 091494 | SDS3 | 1995 | 1 | 1 | | 7.1 | 8.3 | 0.5 | 4.5 | 5.8 | 20 | 8 | 0.061 | | 0.3 |
| | SDS3 101394 | SDS3 | 1995 | 1 | 1 | | | 1.4 | 0.5 | 6.7 | 12 | 1 | 22 | 1.2 | | 0.1 |
| | SDS3 112194 | SDS3 | 1995 | 1 | 1 | | | 0.5 | 0.5 | 2.3 | 4.9 | 2 | 22 | 0.12 | 5 | 0.05 |
| 11-Jan-95 | SDS4 011295 | SDS4 | 1995 | 1 | 1 | | 7.8 | 0.5 | 0.5 | 3.5 | 8.4 | 92 | 3 | 2 | | 0.05 |
| 11-May-95 | SDS4 051295 | SDS4 | 1995 | 1 | 1 | | 7.5 | 1.8 | 0.5 | 7.7 | 5.3 | 16 | 4 | | | 0.05 |
| | SDS4 091494 | SDS4 | 1995 | 1 | 1 | | 7.1 | 3 | 0.5 | 2.8 | 1.3 | 132 | 8 | 0.233 | | 0.2 |
| | SDS4 101394 | SDS4 | 1995 | 1 | 1 | | 7.0 | 1.2 | 0.5 | 5.7 | 5.6 | 70 | 16 | 0.029 | | 0.1 |
| 09-May-95 | SDW3 051095 | SDW3 | 1995 | 1 | 1 | | 7.3 | 0.5 | 0.5 | 88 | 310 | 1,700 | 15 | | | |
| 11-May-95 | SDW3 051195 | SDW3 | 1995 | 1 | 1 | | 7.4 | 1.1 | 0.5 | 20 | 25 | 73 | 4 | | | |
| | SDW3 061095 | SDW3 | 1995 | 1 | 1 | | 7.0 | 0.6 | 0.5 | 5.7 | 2.3 | 1,000 | 5 | | | |
| 04-Mar-95 | TY 030495 | TY | 1995 | 1 | 1 | | 6.9 | 5.7 | | 18 | | | | | 5 | 0.05 |
| 04-Jun-95 | TY 060495 | TY | 1995 | 1 | 1 | | 5.5 | 7.6 | | 22 | | | | | | 0.4 |
| | TY 090894 | TY | 1995 | 1 | 1 | | 7.9 | 3.9 | | 4 | | | | | | 0.3 |
| | TY 101994 | TY | 1995 | 1 | 1 | | 6.5 | 1.3 | | 10 | | | | | | 0.4 |

1996 Report data this section

| stormdate | POS ID | location | annual reported | event | purpose | type | pH | FOG | TPH | TSS | Turb | Fecals | BOD5 | NH3 | total glycols | Surf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Feb-96 | EY 021796 COMP | EY | 1996 | 1 | 1 | 2 | | | | 24 | | | | | | 0.05 |
| 17-Feb-96 | EY 021796 GRAB | EY | 1996 | 1 | 1 | 1 | 7.7 | 0.5 | | | | | | | | |
| 22-Apr-96 | EY 042296 COMP | EY | 1996 | 1 | 1 | 2 | | | | 39 | | | | | | 0.054 |
| 22-Apr-96 | EY 042296 GRAB | EY | 1996 | 1 | 1 | 1 | 7.2 | 0.5 | | | | | | | | |
| 21-May-96 | EY 052296 COMP | EY | 1996 | 1 | 1 | 2 | | | | 28 | | | | | | 0.511 |
| 21-May-96 | EY 052296 GRAB | EY | 1996 | 1 | 1 | 1 | 6.1 | 1 | | | | | | | | |
| 23-Jun-96 | EY 062396 COMP | EY | 1996 | 1 | 1 | 2 | | | | 262 | | | | | | 0.058 |
| 23-Jun-96 | EY 062396 GRAB | EY | 1996 | 1 | 1 | 1 | 6.2 | 0.5 | | | | | | | | |
| 26-Jul-95 | EY 072695 | EY | 1996 | 1 | 1 | | 5.8 | 4.1 | | 56 | | | | | | 0.2 |
| 15-Oct-95 | EY 101695 | EY | 1996 | 1 | 1 | | 6.5 | 0.55 | | 12 | | | | | | 0.05 |
| 03-Feb-96 | SDE4 020496 COMP | SDE4 | 1996 | 1 | 1 | 2 | 7.6 | | | 210 | 190 | | 74 | 2.5 | 26 | 0.1 |
| 03-Feb-96 | SDE4 020496 GRAB | SDE4 | 1996 | 1 | 1 | 1 | 7.9 | 17 | 8.8 | | | 22 | | | | |
| 22-Mar-96 | SDE4 032296 COMP | SDE4 | 1996 | 1 | 1 | 2 | | | | 44 | 19 | | 12 | 0.64 | 5 | 0.3 |
| 22-Mar-96 | SDE4 032296 GRAB | SDE4 | 1996 | 1 | 1 | 1 | 7.1 | 2.8 | 3.9 | | | 20 | | | | |
| 15-Apr-96 | SDE4 041696 COMP | SDE4 | 1996 | 1 | 1 | 2 | | | | 53 | 11 | | 6.54 | 0.128 | 5 | 0.123 |
| 15-Apr-96 | SDE4 041696 GRAB | SDE4 | 1996 | 1 | 1 | 1 | 6.4 | 2.8 | 3.35 | | | 17 | | | | |
| 21-May-96 | SDE4 052296 | SDE4 | 1996 | 1 | 4 | 2 | 7.3 | | 2.5 | 8.8 | | | 22 | | | |

**AR 027856**

| stormdate | #OSID | location | annual reported | event | purpose | type | pH | TOC | TPH | TSS | Turb | Fecals | BOD5 | NH3 | total glycols | Surf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26-Jul-95 | SDE4 072695 | SDE4 | 1996 | 1 | 1 | | 6.9 | 5.7 | 3.8 | 41 | 30 | 4,000 | 29 | 0.44 | | 1.5 |
| 25-Oct-95 | SDE4 102695 | SDE4 | 1996 | 1 | 1 | | 7.1 | 5.9 | 0.5 | 14 | 27 | 300 | 27 | 0.18 | | 0.1 |
| 03-Feb-96 | SDN1 020496 COMP | SDN1 | 1996 | 1 | 1 | 2 | 7.5 | | | 130 | 150 | | 15 | 1.7 | 5 | 0.1 |
| 03-Feb-96 | SDN1 020496 GRAB | SDN1 | 1996 | 1 | 1 | 1 | 7.4 | 7.3 | 7.5 | | | 100 | | | | |
| 31-Mar-96 | SDN1 033196 GRAB | SDN1 | 1996 | 1 | 1 | 1 | 6.9 | 8 | 4.1 | | | 340 | | | | |
| 15-Apr-96 | SDN1 041696 COMP | SDN1 | 1996 | 1 | 2 | 2 | | | | 47 | 7.1 | | 2 | 0.103 | 5 | |
| 22-Apr-96 | SDN1 042296 COMP | SDN1 | 1996 | 1 | 1 | 2 | | | | 31 | 9.5 | | 8.8 | 0.184 | 5 | 0.048 |
| 22-Apr-96 | SDN1 042296 GRAB | SDN1 | 1996 | 1 | 1 | 1 | 7.3 | 1 | 0.25 | | | 6 | | | | |
| 13-May-96 | SDN1 051396 | SDN1 | 1996 | 1 | 2 | 2 | | | | 14 | 15 | | 4.22 | 0.027 | 5 | |
| 21-May-96 | SDN1 052296 | SDN1 | 1996 | 1 | 1 | 2 | | | | 11 | 7.3 | | 10.2 | 0.164 | 5 | 0.657 |
| 23-Jun-96 | SDN1 062396 A | SDN1 | 1996 | 1 | 4 | 2 | 6.3 | | 3 | 22 | | | 16 | 0.63 | | |
| 23-Jun-96 | SDN1 062396 COMP | SDN1 | 1996 | 1 | 1 | 2 | | | | 36 | 8.3 | | 20 | 0.684 | 5 | 0.124 |
| 23-Jun-96 | SDN1 062396 GRAB | SDN1 | 1996 | 1 | 1 | 1 | 5.5 | 2 | 0.92 | | | 23 | | | | |
| 06-Aug-95 | SDN1 080795 | SDN1 | 1996 | 1 | 1 | | 7.8 | 21 | 5.6 | 56 | 16 | 42 | 27 | 0.011 | | 0.05 |
| 06-Nov-95 | SDN1 110795 | SDN1 | 1996 | 1 | 1 | | 6.7 | 16 | 3.4 | 15 | 14 | 25 | 8 | 0.52 | | 0.05 |
| 17-Feb-96 | SDN2 021796 COMP | SDN2 | 1996 | 1 | 1 | 2 | | | | 1 | 2 | | 6 | 0.005 | 17.3 | 0.05 |
| 17-Feb-96 | SDN2 021796 GRAB | SDN2 | 1996 | 1 | 1 | 1 | 7.6 | 0.5 | 0.5 | | | 10 | | | | |
| 31-Mar-96 | SDN2 033196 GRAB | SDN2 | 1996 | 1 | 1 | 1 | 6.7 | 0.5 | 0.5 | | | 16 | | | | |
| 16-Apr-96 | SDN2 041696 COMP | SDN2 | 1996 | 1 | 2 | 2 | | | | 15 | 11 | | 2 | 0.044 | 5 | |
| 22-Apr-96 | SDN2 042296 COMP | SDN2 | 1996 | 1 | 1 | 2 | | | | 5.3 | 2.5 | | 6.64 | 0.005 | 5 | 0.0125 |
| 22-Apr-96 | SDN2 042296 GRAB | SDN2 | 1996 | 1 | 1 | 1 | 7.2 | 0.5 | 0.125 | | | 50 | | | | |
| 13-May-96 | SDN2 051396 | SDN2 | 1996 | 1 | 2 | 2 | | | | 5.6 | 5.3 | | 4.86 | 0.045 | 5 | |
| 21-May-96 | SDN2 052296 | SDN2 | 1996 | 1 | 1 | 2 | | | | 10 | 2 | | 5.08 | 0.043 | 5 | 0.266 |
| 23-Jun-96 | SDN2 062396 A | SDN2 | 1996 | 1 | 4 | 2 | 6.8 | | 1.3 | 48 | | | 24 | 0.12 | | |
| 23-Jun-96 | SDN2 062396 COMP | SDN2 | 1996 | 1 | 1 | 2 | | | | 33 | 7.5 | | 18.3 | 0.166 | 5 | 0.026 |
| 23-Jun-96 | SDN2 062396 GRAB | SDN2 | 1996 | 1 | 1 | 1 | 6.8 | 1 | 0.46 | | | 2 | | | | |
| 06-Aug-95 | SDN2 080795 | SDN2 | 1996 | 1 | 1 | | 7.0 | 2.6 | 0.5 | 8.9 | 5.1 | 15 | 6 | 0.091 | | 0.2 |
| 15-Oct-95 | SDN2 101695 | SDN2 | 1996 | 1 | 1 | | 7.3 | 1.9 | 0.5 | 1.25 | 1.8 | 1 | 5 | 0.021 | | 0.1 |
| 13-Jan-96 | SDN3 011496 COMP | SDN3 | 1996 | 1 | 1 | 2 | | | | 3.8 | 4.7 | | 5 | 0.011 | 5 | 0.05 |
| 13-Jan-96 | SDN3 011496 GRAB | SDN3 | 1996 | 1 | 1 | 1 | 7.2 | 0.5 | 0.5 | | | 1 | | | | |
| 03-Feb-96 | SDN3 020496 | SDN3 | 1996 | 1 | 2 | 2 | | | | | 9.7 | | | 0.14 | 5 | |
| 31-Mar-96 | SDN3 033196 GRAB | SDN3 | 1996 | 1 | 1 | 1 | 6.8 | 1.4 | 0.5 | | | 1 | | | | |
| 31-Mar-96 | SDN3 040196 COMP | SDN3 | 1996 | 1 | 1 | 2 | | | | 11 | 16 | | 5 | 0.013 | 5 | 0.2 |
| 15-Apr-96 | SDN3 041696 COMP | SDN3 | 1996 | 1 | 1 | 2 | | | | 27 | 22 | | 2 | 0.04 | 5 | 0.0125 |
| 15-Apr-96 | SDN3 041696 GRAB | SDN3 | 1996 | 1 | 1 | 1 | 7.6 | 2 | 0.125 | | | 50 | | | | |
| 22-Apr-96 | SDN3 042296 COMP | SDN3 | 1996 | 1 | 1 | 2 | | | | 15 | 9.5 | | 6.56 | 0.034 | 5 | 0.0125 |
| 22-Apr-96 | SDN3 042296 GRAB | SDN3 | 1996 | 1 | 1 | 1 | 7.1 | 0.5 | 0.125 | | | 110 | | | | |
| 13-May-96 | SDN3 051396 | SDN3 | 1996 | 1 | 2 | 2 | | | | 16 | 18 | | 2 | 0.075 | 5 | |
| 22-May-96 | SDN3 052296 | SDN3 | 1996 | 1 | 2 | 2 | | | | 16 | 5.2 | | 2 | 0.005 | 5 | |
| 23-Jun-96 | SDN3 062396 A | SDN3 | 1996 | 1 | 4 | 2 | 7.3 | | 0.5 | 7.3 | | | 5 | 0.014 | | |
| 09-Jul-95 | SDN3 071095 | SDN3 | 1996 | 1 | 1 | | 7.0 | 3.3 | 0.5 | 21 | 24 | 800 | 7 | 0.005 | | 0.1 |
| 06-Nov-95 | SDN3 110795 | SDN3 | 1996 | 1 | 1 | | 7.2 | 2.1 | 0.5 | 15 | 16 | 4 | 3 | 0.005 | | |
| 13-Jan-96 | SDS1 011396 GRAB | SDS1 | 1996 | 1 | 1 | 1 | 7.1 | 0.5 | 1.8 | | | 1 | | | | |
| 13-Jan-96 | SDS1 011496 COMP | SDS1 | 1996 | 1 | 1 | 2 | | | | 3.2 | 4 | | 18 | 0.012 | 5 | 0.3 |
| 15-Apr-96 | SDS1 041696 COMP | SDS1 | 1996 | 1 | 1 | 2 | | | | 74 | 16 | | 23.9 | 0.219 | 5 | 0.081 |
| 15-Apr-96 | SDS1 041696 GRAB | SDS1 | 1996 | 1 | 1 | 1 | 6.7 | 2.5 | 0.32 | | | 4 | | | | |
| 22-Apr-96 | SDS1 042296 COMP | SDS1 | 1996 | 1 | 1 | 2 | | | | 17 | 6.3 | | 9.28 | 0.023 | 5 | 0.134 |
| 22-Apr-96 | SDS1 042296 GRAB | SDS1 | 1996 | 1 | 1 | 1 | 7.5 | 1.9 | 0.58 | | | 23 | | | | |
| 21-May-96 | SDS1 052296 | SDS1 | 1996 | 1 | 4 | 2 | 7.3 | | 2.5 | 7.8 | | | 29 | | | |
| 06-Aug-95 | SDS1 080795 | SDS1 | 1996 | 1 | 1 | | 7.2 | 3.3 | 0.5 | 28 | 8.9 | 4 | 13 | 0.14 | | 0.9 |
| 15-Oct-95 | SDS1 101695 | SDS1 | 1996 | 1 | 1 | | 7.1 | 1.2 | 0.5 | 8.6 | 3.6 | 200 | 5 | 0.17 | | 0.1 |
| 05-Sep-95 | SDS2 090595 | SDS2 | 1996 | 1 | 1 | | 6.7 | 2.2 | 0.5 | 52 | 28 | 2,600 | 5 | 0.012 | | |
| 13-Jan-96 | SDS3 011396 GRAB | SDS3 | 1996 | 1 | 1 | 1 | 7.4 | 0.5 | 0.5 | | | 1 | | | | |
| 13-Jan-96 | SDS3 011496 COMP | SDS3 | 1996 | 1 | 1 | 2 | | | | 1.6 | 2.1 | | 8 | 0.025 | 5 | 0.05 |
| 22-Mar-96 | SDS3 032296 COMP | SDS3 | 1996 | 1 | 1 | 2 | | | | 4.1 | 2.9 | | 8 | 0.021 | 5 | 0.05 |
| 22-Mar-96 | SDS3 032296 grab | SDS3 | 1996 | 1 | 1 | 1 | 7.5 | 0.5 | 0.5 | | | 13 | | | | |
| 15-Apr-96 | SDS3 041696 COMP | SDS3 | 1996 | 1 | 1 | 2 | | | | 20 | 6.6 | | 6.36 | 0.036 | 5 | 0.033 |
| 15-Apr-96 | SDS3 041696 GRAB | SDS3 | 1996 | 1 | 1 | 1 | 7.4 | 1.2 | 0.31 | | | 1 | | | | |
| 21-May-96 | SDS3 052296 | SDS3 | 1996 | 1 | 4 | 2 | 8.9 | | 0.5 | 2.6 | | | 14 | | | |
| 26-Jul-95 | SDS3 072695 | SDS3 | 1996 | 1 | 1 | | 7.7 | 0.5 | 0.5 | 20 | 15 | 2 | 8 | 0.085 | | 0.2 |
| 15-Oct-95 | SDS3 101695 | SDS3 | 1996 | 1 | 1 | | 7.4 | 1.4 | 0.5 | 2.2 | 3 | 1 | 5 | 0.12 | | 0.05 |
| 13-Jan-96 | SDS4 011496 COMP | SDS4 | 1996 | 1 | 1 | 2 | | | | 20 | 6 | | 6 | 0.02 | 5 | 0.05 |
| 13-Jan-96 | SDS4 011496 GRAB | SDS4 | 1996 | 1 | 1 | 1 | 7.4 | 0.5 | 0.5 | | | 440 | | | | |
| 15-Apr-96 | SDS4 041696 COMP | SDS4 | 1996 | 1 | 1 | 2 | | | | 26 | 14 | | 4.64 | 0.128 | 5 | 0.0125 |
| 15-Apr-96 | SDS4 041696 GRAB | SDS4 | 1996 | 1 | 1 | 1 | 7.6 | 2.7 | 0.125 | | | 350 | | | | |
| 22-Apr-96 | SDS4 042296 COMP | SDS4 | 1996 | 1 | 1 | 2 | | | | 19 | 8.9 | | 6.44 | 0.047 | 5 | 0.0125 |
| 22-Apr-96 | SDS4 042296 GRAB | SDS4 | 1996 | 1 | 1 | 1 | 7.2 | 0.5 | 0.125 | | | 1,600 | | | | |
| 21-May-96 | SDS4 052296 | SDS4 | 1996 | 1 | 4 | 2 | 7.9 | | 0.5 | 4.8 | | | 18 | | | |
| 06-Aug-95 | SDS4 080795 | SDS4 | 1996 | 1 | 1 | | 7.6 | 2.7 | 0.5 | 4.2 | 3.7 | 16 | 9 | 0.018 | | 0.2 |
| 15-Oct-95 | SDS4 101695 | SDS4 | 1996 | 1 | 1 | | 7.7 | 1.7 | 0.5 | 6.6 | 4.2 | 27 | 5 | 0.049 | | 0.05 |
| 16-Aug-95 | SDW3 081795 | SDW3 | 1996 | 1 | 1 | | 7.2 | 2.9 | 6.6 | 56 | 20 | 30,000 | 6 | | | |

**AR 027857**

| stormdate | POS ID | location | annual reported | event | purpose | type | pH | FOG | TPH | TSS | Turb | Fecals | BOD5 | NH3 | total glycols | Surf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22-Mar-96 | TY 032296 COMP | TY | 1996 | 1 | 1 | 2 | | | | | 12 | | | | | 0.3 |
| 22-Mar-96 | TY 032296 GRAB | TY | 1996 | 1 | 1 | 1 | 6.9 | 3.9 | | | | | | | | |
| 15-Apr-96 | TY 041696 COMP | TY | 1996 | 1 | 1 | 2 | | | | 30 | | | | | | 0.032 |
| 15-Apr-96 | TY 041696 GRAB | TY | 1996 | 1 | 1 | 1 | 6.1 | 3.7 | | | | | | | | |
| 22-Apr-96 | TY 042296 COMP | TY | 1996 | 1 | 1 | 2 | | | | 23 | | | | | | 0.041 |
| 22-Apr-96 | TY 042296 GRAB | TY | 1996 | 1 | 1 | 1 | 7.3 | 2 | | | | | | | | |
| 16-Aug-95 | TY 081795 | TY | 1996 | 1 | 1 | | 6.8 | 2.3 | | 20 | | | | | | 0.1 |
| 05-Sep-95 | TY 090595 | TY | 1996 | 1 | 1 | | | 1.6 | | | | | | | | |
| 15-Oct-95 | TY 101695-1 | TY | 1996 | 1 | 1 | | 6.7 | 19 | | 480 | | | | | | 0.05 |
| ~~15-Oct-95~~ | ~~TY 101695-2~~ | ~~TY~~ | ~~1996~~ | ~~1~~ | ~~1~~ | | | ~~22~~ | | ~~730~~ | **do not include, since is duplicate** | | | | | |
| | | | | | | | | | | | | | | | | |
| results < MDL replaced with value = 1/2 MDL | | | | All Data | count | | 97 | 96 | 82 | 118 | 94 | 74 | 99 | 87 | 50 | 85 |
| results > value indicated | | | | | mean | | 7.1 | 3.2 | 1.4 | 31.5 | 17.6 | 756 | 13.9 | 0.3 | 12.0 | 0.2 |
| | | | | | median | | 7.1 | 1.9 | 0.5 | 14.0 | 8.2 | 24.0 | 7.0 | 0.1 | 5.0 | 0.1 |
| | | | | | geomean | | 7.05 | | | | | 32 | | | | |
| **key:** | | | | | | max | 8.9 | 22 | 9 | 730 | 310 | 30000 | 194 | 5 | 275 | 1.5 |
| event = | storm type | | | | | min | 5.5 | | | | | | | | | |
| 1 | NPDES storm | | | | detected | | 97 | 70 | 25 | 111 | 94 | 58 | 94 | 76 | 5 | 51 |
| purpose = | monitoring objective | | | | non-detected | | 0 | 26 | 57 | 7 | 0 | 16 | 5 | 11 | 45 | 34 |
| 1 | NPDES monitoring | | | | % non detected | | | 27% | 70% | 6% | 0% | 22% | 5% | 13% | 90% | 40% |
| 2 | Stipulated Agreement | | | | | | | | | | | | | | | |
| 3 | Runway Washoff monitoring | | | 1996 report | count | | 60 | 53 | 47 | 64 | 48 | 40 | 53 | 49 | 31 | 48 |
| 4 | SES monitoring | | | | detected | | | 38 | 19 | 63 | 48 | 32 | 48 | 44 | 2 | 31 |
| type = | sample type | | | | nondetected | | | 15 | 28 | 1 | 0 | 8 | 5 | 5 | 29 | 17 |
| 1 | first flush grab sample | | | | % non detected | | | 28% | 60% | 2% | 0% | 20% | 9% | 10% | 94% | 35% |
| 2 | flow-weighted composite | | | | | | | | | | | | | | | |

**AR 027858**

| POS ID | reported | stormdate | location | ph | Sb | As | Be | Cd | Cr | Cu | Pb | Hg | Ni | Se | Ag | Tl | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDE4 010795 | 1995 | | SDE4 | 7.0 | 0.001 | 0.003 | 0.0005 | 0.001 | 0.005 | 0.031 | 0.014 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.337 |
| SDE4 041095 | 1995 | | SDE4 | 6.6 | 0.001 | 0.001 | 0.0005 | 0.002 | 0.0025 | 0.029 | 0.011 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.263 |
| SDE4 111394 | 1995 | | SDE4 | | 0.001 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.021 | 0.008 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.195 |
| SDN1 011295 | 1995 | | SDN1 | 7.4 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.006 | 0.020 | 0.016 | 0.00005 | 0.005 | 0.005 | 0.0015 | 0.001 | 0.285 |
| SDN1 040795 | 1995 | | SDN1 | 7.6 | 0.0005 | 0.0005 | 0.0005 | 0.001 | 0.0025 | 0.009 | 0.001 | 0.00005 | 0.005 | 0.001 | 0.0015 | 0.0005 | 0.286 |
| SDN1 091494 | 1995 | | SDN1 | 6.6 | 0.002 | 0.001 | 0.0005 | 0.001 | 0.008 | 0.064 | 0.008 | 0.00005 | 0.01 | 0.001 | 0.0015 | 0.0005 | 1.030 |
| SDN1 101994 | 1995 | | SDN1 | 6.8 | 0.001 | 0.0005 | 0.0005 | 0.001 | 0.0025 | 0.034 | 0.008 | 0.00005 | 0.005 | 0.002 | 0.0015 | 0.0005 | 0.416 |
| SDN2 011295 | 1995 | | SDN2 | 8.0 | 0.0005 | 0.003 | 0.0005 | 0.001 | 0.007 | 0.035 | 0.022 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.076 |
| SDN2 041295 | 1995 | | SDN2 | 7.6 | 0.002 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.025 | 0.003 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.098 |
| SDN2 090894 | 1995 | | SDN2 | 6.8 | 0.0005 | 0.003 | 0.0005 | 0.001 | 0.0025 | 0.028 | 0.007 | 0.00005 | 0.005 | 0.001 | 0.0015 | 0.0005 | 0.022 |
| SDN2 101394 | 1995 | | SDN2 | | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.059 | 0.005 | 0.00005 | 0.005 | 0.002 | 0.0015 | 0.0005 | 0.067 |
| SDN2 111394 | 1995 | | SDN2 | | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.013 | 0.004 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.030 |
| SDN3 010795 | 1995 | | SDN3 | 7.8 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.005 | 0.003 | 0.001 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.052 |
| SDN3 060495 | 1995 | | SDN3 | 7.0 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.011 | 0.001 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.126 |
| SDN3 090894 | 1995 | | SDN3 | 6.4 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.032 | 0.002 | 0.00005 | 0.005 | 0.002 | 0.0015 | 0.0005 | 0.063 |
| SDN3 102594 | 1995 | | SDN3 | | 0.001 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.023 | 0.001 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.080 |
| SDS1 021695 | 1995 | | SDS1 | 6.6 | 0.0005 | 0.0005 | 0.0005 | 0.001 | 0.0025 | 0.016 | 0.006 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.125 |
| SDS1 051195 | 1995 | | SDS1 | 7.4 | 0.002 | 0.004 | 0.0005 | 0.013 | 0.017 | 0.119 | 0.045 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.304 |
| SDS1 060495 | 1995 | | SDS1 | 6.4 | 0.002 | 0.002 | 0.002 | 0.011 | 0.014 | 0.115 | 0.017 | 0.00005 | 0.010 | 0.0005 | 0.024 | 0.0005 | 0.290 |
| SDS1 101994 | 1995 | | SDS1 | 5.8 | 0.003 | 0.001 | 0.0005 | 0.001 | 0.007 | 0.084 | 0.006 | 0.00005 | 0.005 | 0.002 | 0.0015 | 0.0005 | 0.234 |
| SDS3 010795 | 1995 | | SDS3 | 7.2 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.005 | 0.016 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.058 |
| SDS3 041295 | 1995 | | SDS3 | 7.3 | 0.001 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.041 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.044 |
| SDS3 091494 | 1995 | | SDS3 | 7.1 | 0.002 | 0.004 | 0.0005 | 0.001 | 0.0025 | 0.041 | 0.004 | 0.00005 | 0.005 | 0.002 | 0.0015 | 0.0005 | 0.031 |
| SDS3 101394 | 1995 | | SDS3 | | 0.0005 | 0.003 | 0.0005 | 0.001 | 0.006 | 0.053 | 0.003 | 0.00005 | 0.005 | 0.001 | 0.0015 | 0.0005 | 0.076 |
| SDS3 112194 | 1995 | | SDS3 | | 0.0005 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.027 | 0.004 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.002 | 0.108 |
| SDS4 011295 | 1995 | | SDS4 | 7.8 | 0.0005 | 0.003 | 0.0005 | 0.001 | 0.0025 | 0.017 | 0.003 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.001 | 0.019 |
| SDS4 051295 | 1995 | | SDS4 | 7.5 | 0.0005 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.008 | 0.0005 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.010 |
| SDS4 091494 | 1995 | | SDS4 | 7.1 | 0.002 | 0.002 | 0.0005 | 0.001 | 0.005 | 0.020 | 0.004 | 0.00005 | 0.005 | 0.002 | 0.0015 | 0.0005 | 0.009 |
| SDE4 020496 COMP | 1996 | 03-Feb-96 | SDE4 | 7.6 | 0.001 | 0.003 | 0.0005 | 0.001 | 0.030 | 0.054 | 0.104 | 0.00005 | 0.020 | 0.0005 | 0.0015 | 0.0005 | 0.279 |
| SDE4 032296 COMP | 1996 | 22-Mar-96 | SDE4 | | 0.002 | 0.003 | 0.0005 | 0.001 | 0.007 | 0.057 | 0.026 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.361 |
| SDE4 041696 COMP | 1996 | 15-Apr-96 | SDE4 | | 0.0015 | 0.0015 | 0.001 | 0.002 | 0.015 | 0.078 | 0.0977 | 0.00005 | 0.014 | 0.0015 | 0.005 | 0.0005 | 0.320 |
| SDE4 072695 | 1996 | 26-Jul-95 | SDE4 | 6.9 | 0.008 | 0.004 | 0.0005 | 0.001 | 0.006 | 0.121 | 0.023 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.779 |
| SDE4 102695 | 1996 | 25-Oct-95 | SDE4 | 7.1 | 0.001 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.033 | 0.021 | 0.00005 | 0.005 | 0.001 | 0.0015 | 0.001 | 0.204 |
| SDN1 020496 COMP | 1996 | 03-Feb-96 | SDN1 | 7.5 | 0.0005 | 0.001 | 0.0005 | 0.001 | 0.005 | 0.019 | 0.021 | 0.00005 | 0.005 | 0.001 | 0.0015 | 0.0005 | 0.288 |
| SDN1 042296 COMP | 1996 | 22-Apr-96 | SDN1 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.016 | 0.0111 | 0.00005 | 0.006 | 0.0015 | 0.005 | 0.0011 | 0.160 |
| SDN1 052296 COMPOSITE | 1996 | 21-May-96 | SDN1 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.027 | 0.0074 | 0.00005 | 0.0025 | 0.0015 | 0.005 | 0.0005 | 0.299 |
| SDN1 062396 COMP | 1996 | 23-Jun-96 | SDN1 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.080 | 0.013 | 0.00005 | 0.0025 | 0.0015 | 0.005 | 0.0005 | 0.569 |
| SDN1 070496 | 1996 | 03-Jul-96 | SDN1 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.046 | 0.0193 | 0.00005 | 0.009 | 0.0015 | 0.005 | 0.0005 | 0.355 |
| SDN1 080795 | 1996 | 07-Aug-95 | SDN1 | 7.8 | 0.002 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.035 | 0.009 | 0.0002 | 0.005 | 0.001 | 0.0015 | 0.0005 | 0.464 |
| SDN1 110795 | 1996 | 06-Nov-95 | SDN1 | 6.7 | 0.0005 | 0.0005 | 0.0005 | 0.0007 | 0.0025 | 0.023 | 0.013 | 0.00005 | 0.005 | 0.0005 | 0.0001 | 0.0005 | 0.375 |
| SDN2 021796 COMP | 1996 | 17-Feb-96 | SDN2 | | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.009 | 0.005 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.027 |
| SDN2 042296 COMP | 1996 | 22-Apr-96 | SDN2 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.013 | 0.0028 | 0.00005 | 0.0025 | 0.0015 | 0.005 | 0.0005 | 0.017 |
| SDN2 052296 COMPOSITE | 1996 | 21-May-96 | SDN2 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.014 | 0.0016 | 0.00005 | 0.0025 | 0.0015 | 0.005 | 0.0005 | 0.076 |
| SDN2 062396 COMP | 1996 | 23-Jun-96 | SDN2 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.055 | 0.0117 | 0.00005 | 0.0025 | 0.0015 | 0.005 | 0.0005 | 0.076 |
| SDN2 080795 | 1996 | 07-Aug-95 | SDN2 | 7.0 | 0.001 | 0.004 | 0.0005 | 0.001 | 0.0025 | 0.028 | 0.01 | 0.0021 | 0.005 | 0.001 | 0.0015 | 0.0005 | 0.049 |
| SDN2 101695 | 1996 | 15-Oct-95 | SDN2 | 7.3 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.016 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.024 |
| SDN3 011496 COMP | 1996 | 13-Jan-96 | SDN3 | | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.010 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.002 | 0.047 |

| POS ID | reported | stormdate | location | ph | Sb | As | Be | Cd | Cr | Cu | Pb | Hg | Ni | Se | Ag | Tl | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDN3 040196 COMP | 1996 | 31-Mar-96 | SDN3 | | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.015 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.101 |
| SDN3 041696 COMP | 1996 | 15-Apr-96 | SDN3 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.018 | 0.0034 | 0.00005 | 0.006 | 0.0015 | 0.005 | 0.0005 | 0.121 |
| SDN3 042296 COMP | 1996 | 22-Apr-96 | SDN3 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.016 | 0.0013 | 0.00005 | 0.006 | 0.0015 | 0.005 | 0.0012 | 0.063 |
| SDN3 071095 | 1996 | 09-Jul-95 | SDN3 | 7.0 | 0.0005 | 0.005 | 0.0005 | 0.001 | 0.0025 | 0.036 | 0.004 | 0.00005 | 0.010 | 0.0005 | 0.0015 | 0.0005 | 0.180 |
| SDN3 110795 | 1996 | 06-Nov-95 | SDN3 | 7.2 | 0.0005 | 0.002 | 0.0005 | 0.0001 | 0.0025 | 0.010 | 0.001 | 0.00005 | 0.005 | 0.0005 | 0.0001 | 0.0005 | 0.068 |
| SDS1 011496 COMP | 1996 | 13-Jan-96 | SDS1 | | 0.0005 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.019 | 0.006 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.104 |
| SDS1 041696 COMP | 1996 | 15-Apr-96 | SDS1 | | 0.0015 | 0.0015 | 0.001 | 0.004 | 0.016 | 0.117 | 0.0883 | 0.00005 | 0.014 | 0.0015 | 0.005 | 0.0005 | 0.255 |
| SDS1 042296 COMP | 1996 | 22-Apr-96 | SDS1 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.012 | 0.0077 | 0.00005 | 0.0025 | 0.0015 | 0.005 | 0.0005 | 0.062 |
| SDS1 070496 | 1996 | 03-Jul-96 | SDS1 | | 0.0015 | 0.0048 | 0.001 | 0.001 | 0.005 | 0.038 | 0.0127 | 0.00005 | 0.0025 | 0.0015 | 0.005 | 0.0005 | 0.188 |
| SDS1 080795 | 1996 | 07-Aug-95 | SDS1 | 7.2 | 0.002 | 0.003 | 0.0005 | 0.0002 | 0.007 | 0.089 | 0.019 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.211 |
| SDS1 101695 | 1996 | 15-Oct-95 | SDS1 | 7.1 | 0.001 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.042 | 0.005 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.116 |
| SDS3 011496 COMP | 1996 | 13-Jan-96 | SDS3 | | 0.0005 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.029 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.001 | 0.054 |
| SDS3 032296 COMP | 1996 | 22-Mar-96 | SDS3 | | 0.001 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.028 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.054 |
| SDS3 041696 COMP | 1996 | 15-Apr-96 | SDS3 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.046 | 0.0116 | 0.00005 | 0.014 | 0.0015 | 0.005 | 0.0005 | 0.074 |
| SDS3 072695 | 1996 | 26-Jul-95 | SDS3 | 7.7 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.087 | 0.005 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.001 | 0.069 |
| SDS3 101695 | 1996 | 15-Oct-95 | SDS3 | 7.4 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.032 | 0.002 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.037 |
| SDS4 011496 COMP | 1996 | 13-Jan-96 | SDS4 | | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.018 | 0.0005 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.001 | 0.019 |
| SDS4 041696 COMP | 1996 | 15-Apr-96 | SDS4 | | 0.0111 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.041 | 0.0054 | 0.00005 | 0.009 | 0.0015 | 0.005 | 0.0005 | 0.031 |
| SDS4 042296 COMP | 1996 | 22-Apr-96 | SDS4 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.033 | 0.0005 | 0.00005 | 0.005 | 0.0015 | 0.005 | 0.0013 | 0.017 |
| SDS4 070496 | 1996 | 03-Jul-96 | SDS4 | | 0.0015 | 0.0015 | 0.001 | 0.001 | 0.005 | 0.024 | 0.001 | 0.00005 | 0.009 | 0.0015 | 0.005 | 0.0005 | 0.020 |
| SDS4 080795 | 1996 | 07-Aug-95 | SDS4 | 7.6 | 0.001 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.020 | 0.002 | 0.00005 | 0.005 | 0.001 | 0.0015 | 0.0005 | 0.016 |
| SDS4 101394 | 1996 | 15-Oct-95 | SDS4 | 7.0 | 0.0005 | 0.002 | 0.0005 | 0.001 | 0.0025 | 0.036 | 0.001 | 0.00005 | 0.005 | 0.002 | 0.0015 | 0.0005 | 0.047 |
| SDS4 101695 | 1996 | 15-Oct-95 | SDS4 | 7.7 | 0.0005 | 0.001 | 0.0005 | 0.001 | 0.0025 | 0.023 | 0.001 | 0.00005 | 0.005 | 0.0005 | 0.0015 | 0.0005 | 0.022 |

| statistic | Sb | AS | Be | Cd | Cr | Cu | Pb | Hg | Ni | Se | Ag | Tl | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Count | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| Mean | 0.001 | 0.002 | 0.001 | 0.001 | 0.005 | 0.037 | 0.011 | 0.0001 | 0.006 | 0.001 | 0.003 | 0.001 | 0.163 |
| Median | 0.001 | 0.002 | 0.001 | 0.001 | 0.003 | 0.028 | 0.005 | 0.000 | 0.005 | 0.001 | 0.002 | 0.001 | 0.078 |
| Mean detected | 0.002 | 0.002 | | 0.004 | 0.009 | | | 0.0012 | 0.010 | 0.001 | | 0.001 | |
| Max | 0.011 | 0.005 | 0.002 | 0.013 | 0.030 | 0.121 | 0.104 | 0.0021 | 0.02 | 0.005 | 0.024 | 0.002 | 1.03 |
| non detects | 47 | 20 | 69 | 63 | 52 | 0 | 3 | 68 | 56 | 54 | 69 | 58 | 0 |
| detected | 23 | 50 | 1 | 7 | 18 | 70 | 67 | 2 | 14 | 16 | 1 | 12 | 70 |
| % nondetect | 67% | 29% | 99% | 90% | 74% | 0% | 4% | 97% | 80% | 77% | 99% | 83% | 0% |
| acute | 9.0 | 0.360 | 0.130 | 0.002 | 0.311 | 0.009 | 0.030 | 0.002 | 0.787 | 0.020 | 0.001 | 1.400 | 0.064 |
| Mean detected % acute | 0.02% | 0.60% | 0.00% | 250% | 2.9% | 316% | 17% | 64.8% | 1.3% | 7.2% | 229% | 0.1% | 123% |
| max% acute | 0.1% | 1% | 2% | 745% | 10% | 1366% | 345% | 100% | 3% | 25% | 3668% | 0.1% | 1619% |

Note: all results less than the detection limit replaced with a value equal to 1/2 the detection limit reported for that sample.
acute toxicity criteria at 50mg/l hardness
All criteria are for dissolved metals, except for total recoverable Arsenic, Chromium (trivalent), Mercury, and Selenium
Criteria from WDOE-supplied spreadsheet "tsdcalc5.xlw" dated 10/95, include WAC and Gold Book references

criteria are for the total recoverable metal, not dissolved

AR 027860

| POS ID | Outfall | Report Year | storm date | volume glycol, gal | number aircraft deiced | sampler | start time | end time | total glycols | E-glycol | P-glycol | BOD5 | acetate | TKN | NH3 | NO3+ NO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDN1 010595 | SDN1 | 1995 | 05-Jan-95 | | | | | | 5 | 2.5 | 2.5 | 11 | | | | |
| SDN1 020895 | SDN1 | 1995 | 08-Feb-95 | | | | | | 5 | 2.5 | 2.5 | | | | | |
| SDN3 020895 | SDN3 | 1995 | 08-Feb-95 | | | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS1 020895 | SDS1 | 1995 | 08-Feb-95 | | | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS3 020895 | SDS3 | 1995 | 08-Feb-95 | | | | | | 5 | 2.5 | 2.5 | | | | | |
| SDN1 021395 | SDN1 | 1995 | 13-Feb-95 | | | | | | 5 | 2.5 | 2.5 | 5 | | | 0.095 | |
| SDN3 021395 | SDN3 | 1995 | 13-Feb-95 | | | | | | 5 | 2.5 | 2.5 | 3 | | | 0.005 | |
| SDS1 021395 | SDS1 | 1995 | 13-Feb-95 | | | | | | 5 | 2.5 | 2.5 | 5 | | | 0.25 | |
| SDS4 021395 | SDS4 | 1995 | 13-Feb-95 | | | | | | 5 | 2.5 | 2.5 | 5 | | | 0.07 | |
| SDN1 021695 | SDN1 | 1995 | 15-Feb-95 | | | | | | 6.1 | 6.1 | 2.5 | 31 | | | 0.54 | |
| SDN3 021695 | SDN3 | 1995 | 15-Feb-95 | | | | | | 5 | 2.5 | 2.5 | 60 | | | 1.2 | |
| SDS1 021695 | SDS1 | 1995 | 15-Feb-95 | | | | | | 275 | 260 | 15 | 92 | | | 0.06 | |
| SDN1 030595 | SDN1 | 1995 | 04-Mar-95 | | | | | | 5 | 2.5 | 2.5 | 4 | | | 0.005 | |
| SDN2 030595 | SDN2 | 1995 | 04-Mar-95 | | | | | | 36 | 36 | 2.5 | 12 | | | 0.021 | |
| SDN3 030595 | SDN3 | 1995 | 04-Mar-95 | | | | | | 5 | 2.5 | 2.5 | 3 | | | 0.005 | |
| SDN1 030995 | SDN1 | 1995 | 08-Mar-95 | | | | | | 5 | 2.5 | 2.5 | 6 | | | 0.35 | |
| SDN3 030995 | SDN3 | 1995 | 08-Mar-95 | | | | | | 5 | 2.5 | 2.5 | 3 | | | 0.016 | |
| SDN1 031595 | SDN1 | 1995 | 13-Mar-95 | | | | | | 5 | 2.5 | 2.5 | 4 | | | 0.05 | |
| SDN2 031595 | SDN2 | 1995 | 13-Mar-95 | | | | | | 5 | 2.5 | 2.5 | 5 | | | 1.6 | |
| SDN3 031595 | SDN3 | 1995 | 13-Mar-95 | | | | | | 5 | 2.5 | 2.5 | 5 | | | 0.018 | |
| SDN1 040595 | SDN1 | 1995 | 04-Apr-95 | 189 | 7 | | | | 5 | 2.5 | 2.5 | 5 | | | 0.078 | |
| SDN3 040595 | SDN3 | 1995 | 04-Apr-95 | 189 | 7 | | | | 5 | 2.5 | 2.5 | 3 | | | 0.25 | |
| SDN1 040795 | SDN1 | 1995 | 06-Apr-95 | 116 | 5 | | | | 5 | 2.5 | 2.5 | 40 | | | 0.005 | |
| SDN2 040795 | SDN2 | 1995 | 06-Apr-95 | 116 | 5 | | | | 5 | 2.5 | 2.5 | 15 | | | 0.005 | |
| SDE4 041095 | SDE4 | 1995 | 10-Apr-95 | 189 | 7 | | | | 5 | 2.5 | 2.5 | 8 | | | 0.42 | |
| SDN2 041295 | SDN2 | 1995 | 10-Apr-95 | 189 | 7 | | | | 19 | 2.5 | 19 | 30 | | | 5 | |
| SDS3 041295 | SDS3 | 1995 | 10-Apr-95 | 189 | 7 | willey | | | 5 | 2.5 | 2.5 | 4 | | | 1.7 | |
| SDE4 042895 | SDE4 | 1995 | 28-Apr-95 | 54 | 2 | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS1 042895 | SDS1 | 1995 | 28-Apr-95 | 54 | 2 | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS3 042895 | SDS3 | 1995 | 28-Apr-95 | 54 | 2 | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS1 050295 | SDS1 | 1995 | 02-May-95 | 126 | 5 | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS3 050295 | SDS3 | 1995 | 02-May-95 | 126 | 5 | | | | 5 | 2.5 | 2.5 | | | | | |
| SDN1 111994 | SDN1 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 6 | | | | |
| SDN2 111994 | SDN2 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 10 | | | | |
| SDN3 111994 | SDN3 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 4 | | | | |
| SDS1 111994 | SDS1 | 1995 | | | | | | | 14 | 14 | 2.5 | 46 | | | | |
| SDS1 111894 | SDS1 | 1995 | | | | | | | 32 | 32 | 2.5 | 54 | | | | |
| SDS3 112194 | SDS3 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 22 | | 0.3 | 0.12 | |
| SDS3 090894 | SDS3 | 1995 | | | | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS3 111994 | SDS3 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 2 | | | | |
| SDS4 021695 | SDS4 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 98 | | | 2.5 | |
| SDS4 111994 | SDS4 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 5 | | | | |
| SDE4 111394 | SDE4 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 7 | | 1.3 | 0.39 | |
| SDE4 111894 | SDE4 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 26 | | | | |
| SDE4 111994 | SDE4 | 1995 | | | | | | | 5 | 2.5 | 2.5 | 8 | | | | |
| SDE4 050295 | SDE4 | 1995 | | | | | | | 9.6 | 9.6 | 2.5 | | | | | |
| SDE4 081795 | SDE4 | 1996 | 16-Aug-95 | 108 | 4 | | | | 7.9 | 2.5 | 7.9 | | | | | |
| SDS1 092995 | SDS1 | 1996 | 29-Sep-95 | 104 | 4 | | | | 5 | 2.5 | 2.5 | | | | | |
| SDS3 093095 | SDS3 | 1996 | 29-Sep-95 | 104 | 4 | WILLEY | | | 5 | 2.5 | 2.5 | | | | | |
| SDS3 093095 | SDS3 | 1996 | 29-Sep-95 | 104 | 4 | WILLEY | | | 5 | 2.5 | 2.5 | | | | | |
| SDN2 121095 | SDN2 | 1996 | 09-Dec-95 | 3767 | 97 | MINTON | | | 5 | 2.5 | 2.5 | | | | | |
| SDN3 011496 | SDN3 | 1996 | 13-Jan-96 | 909 | 31 | Tobiason | | | 5 | 2.5 | 2.5 | 5 | | | 0.011 | |
| SDS1 011496 | SDS1 | 1996 | 13-Jan-96 | 909 | 31 | Tobiason | | | 5 | 2.5 | 2.5 | 18 | | | 0.012 | |
| SDS3 011496 | SDS3 | 1996 | 13-Jan-96 | 909 | 31 | Tobiason | | | 5 | 2.5 | 2.5 | 8 | | | 0.025 | |
| SDS4 011496 | SDS4 | 1996 | 13-Jan-96 | 909 | 31 | Tobiason | | | 5 | 2.5 | 2.5 | 6 | | | 0.02 | |
| SDE4 012096 AVG | SDE4 | 1996 | 19-Jan-96 | 11401 | 184 | MINTON | 1/19/96 12:00 | 1/20/96 8:00 | 24 | 13 | 11 | 72 | | 6 | 0.79 | 0.31 |
| SDN2 012296 | SDN2 | 1996 | 19-Jan-96 | 23052 | 469 | TOBIASON | 1/19/96 15:17 | 1/22/96 18:58 | 55 | 27 | 30 | 21 | | 1.4 | 0.17 | |
| SDS1 012096 AVG | SDS1 | 1996 | 19-Jan-96 | 11401 | 184 | MINTON | 1/19/96 12:00 | 1/20/96 8:00 | 298 | 105 | 193 | 130 | | 0.71 | 0.04 | 0.11 |
| SDS3 012296 AVG | SDS3 | 1996 | 19-Jan-96 | 23052 | 469 | Tobiason/mi | 1/19/96 12:00 | 1/22/96 17:56 | 40 | 25 | 14 | 118 | 369 | 3.3 | 0.29 | 0.49 |
| SDS4 012096 AVG | SDS4 | 1996 | 19-Jan-96 | 11401 | 184 | MINTON | 1/19/96 12:00 | 1/20/96 8:00 | 5.6 | 2.5 | 3.9 | 138 | 550 | 4.5 | 0.93 | 0.22 |
| SDS1 012896 | SDS1 | 1996 | 28-Jan-96 | 12810 | 254 | MINTON | | | 6220 | 320 | 5900 | | | | | |
| SDS3 012896 | SDS3 | 1996 | 28-Jan-96 | 12810 | 254 | MINTON | | | 73 | 28 | 45 | | | | | |
| SDS1 013096 | SDS1 | 1996 | 30-Jan-96 | 843 | 27 | MINTON | | | 291 | 71 | 220 | 690 | | 3.2 | 0.40 | |
| SDS3 013096 | SDS3 | 1996 | 30-Jan-96 | 843 | 27 | MINTON | | | 115 | 96 | 19 | 210 | | 0.5 | 0.03 | |
| SDS1 020196 | SDS1 | 1996 | 01-Feb-96 | 222 | 5 | MINTON | | | 36 | 13 | 23 | 170 | | 0.9 | 0.61 | |
| SDS3 020196 | SDS3 | 1996 | 01-Feb-96 | 222 | 5 | MINTON | | | 31 | 18 | 13 | 130 | | 0.3 | 0.06 | |
| SDS4 020196 | SDS4 | 1996 | 01-Feb-96 | 222 | 5 | MINTON | | | 5 | 2.5 | 2.5 | 4 | | 0.3 | 0.12 | |
| SDE4 020496 | SDE4 | 1996 | 03-Feb-96 | 1368 | 31 | Tobiason | | | 26 | 14 | 12 | 74 | | | 2.5 | |
| SDE4 020496 AVG | SDE4 | 1996 | 03-Feb-96 | 1368 | 31 | MINTON | 2/3/96 19:30 | 2/4/96 5:30 | 30 | 18 | 12 | 95 | | 21 | 2.7 | 0.73 |
| SDN1 020496 | SDN1 | 1996 | 03-Feb-96 | 1368 | 31 | Tobiason | | | 5 | 2.5 | 2.5 | 15 | | | 1.7 | |
| SDN2 020696 | SDN2 | 1996 | 03-Feb-96 | 2306 | 59 | TOBIASON | 2/4/96 8:42 | 2/6/96 19:45 | 23 | 9 | 14 | 108 | 800 | 0.54 | 0.05 | |
| SDN2 020496 | SDN2 | 1996 | 03-Feb-96 | 1368 | 31 | Tobiason | 2/3/96 22:40 | 2/3/96 22:40 | 44 | 18 | 26 | 180 | 5 | 2 | 0.30 | |
| SDN3 020496 | SDN3 | 1996 | 03-Feb-96 | 1368 | 31 | Tobiason | | 2/4/96 15:00 | 5 | 2.5 | 2.5 | | 120 | 0.6 | 0.14 | |
| SDS1 020496 AVG | SDS1 | 1996 | 03-Feb-96 | 1368 | 31 | MINTON | 2/3/96 20:00 | 2/4/96 10:00 | 118 | 23 | 49 | 131 | | 6.5 | 0.68 | 0.33 |
| SDS3 020696 AVG | SDS3 | 1996 | 03-Feb-96 | 2306 | 59 | Tobiason | 2/3/96 17:14 | 2/6/96 19:00 | 29.3 | 16 | 13 | 162 | 617 | 1.5 | 0.25 | |
| SDS4 020596 | SDS4 | 1996 | 03-Feb-96 | 328 | 9 | MINTON | | | 21.2 | 14 | 7.2 | 13 | | 0.9 | 0.03 | |
| SDS4 020496 AVG | SDS4 | 1996 | 03-Feb-96 | 1368 | 31 | MINTON | 2/3/96 20:45 | 2/4/96 8:45 | 30.8 | 13 | 17.8 | 242 | | 3.18 | 0.53 | 0.48 |
| SDW3 020496 AVG | SDW3 | 1996 | 3-Feb-96 | 1368 | 31 | TOBIASON | 2/3/96 19:20 | 2/4/96 19:20 | 11.7 | 6 | 5.7 | 76 | 122 | 4.5 | 0.3 | |
| SDN2 021796 | SDN2 | 1996 | 17-Feb-96 | 73 | 3 | Tobiason | | | 17.3 | 6.3 | 11 | 6 | | | 0.005 | |
| SDE4 032296 | SDE4 | 1996 | 22-Mar-96 | 92 | 4 | Tobiason | | 3/22/96 6:24 | 5 | 2.5 | 2.5 | 12 | | | 0.64 | |
| SDS3 032296 | SDS3 | 1996 | 22-Mar-96 | 92 | 4 | Tobiason | | 3/22/96 9:07 | 5 | 2.5 | 2.5 | 8 | | | 0.021 | |
| SDN2 032996 | SDN2 | 1996 | 29-Mar-96 | 156 | 2 | Willey | | 3/29/96 15:30 | 5 | 2.5 | 2.5 | 10 | | | 0.32 | |
| SDN3 033096 | SDN3 | 1996 | 29-Mar-96 | 156 | 2 | Willey | | 3/30/96 13:00 | 5 | 2.5 | 2.5 | 5 | | | 0.043 | |

| POS ID | Outfall | Report Year | storm date | volume glycol, gal | number aircraft deiced | sampler | start time | end time | total glycols | E-glycol | P-glycol | BOD5 | acetate | TKN | NH3 | NO3+ NO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDN3 040196 | SDN3 | 1996 | 31-Mar-96 | 327 | 12 | WILLEY | 4/1/96 9:00 | 4/1/96 11:20 | 5 | 2.5 | 2.5 | 5 | | | 0.013 | |
| SDN1 040596 | SDN1 | 1996 | 05-Apr-96 | | 12 | WILLEY | | 4/5/96 16:15 | 5 | 2.5 | 2.5 | 44 | | | 0.88 | |
| SDN2 040596 | SDN2 | 1996 | 05-Apr-96 | | 12 | WILLEY | | 4/5/96 15:35 | 5 | 2.5 | 2.5 | 0.5 | | | 0.15 | |
| SDN3 040596 | SDN3 | 1996 | 05-Apr-96 | | 12 | Willey | | 4/5/96 15:20 | 5 | 2.5 | 2.5 | 5 | | | 0.01 | |
| SDN1 041296 | SDN1 | 1996 | 11-Apr-96 | | 8 | WILLEY | | 4/12/96 10:00 | 5 | 2.5 | 2.5 | 15 | | | 0.23 | |
| SDN3 041296 | SDN3 | 1996 | 11-Apr-96 | | 8 | WILLEY | | 4/12/96 9:20 | 5 | 2.5 | 2.5 | 4 | | | 0.005 | |
| SDE4 041696 | SDE4 | 1996 | 15-Apr-96 | | 2 | TOBIASON | 4/15/96 22:34 | 4/16/96 14:00 | 5 | 2.5 | 2.5 | 6.54 | | | 0.128 | |
| SDN1 041696 | SDN1 | 1996 | 15-Apr-96 | | 2 | WILLEY | 4/15/96 23:00 | 4/16/96 0:07 | 5 | 2.5 | 2.5 | 2 | | | 0.103 | |
| SDN3 041696 | SDN3 | 1996 | 15-Apr-96 | | 2 | TOBIASON | 4/16/96 2:18 | 4/16/96 14:00 | 5 | 2.5 | 2.5 | 2 | | | 0.04 | |
| SDS1 041696 | SDS1 | 1996 | 15-Apr-96 | | 2 | TOBIASON | 4/15/96 22:56 | 4/16/96 14:00 | 5 | 2.5 | 2.5 | 23.9 | | | 0.219 | |
| SDS3 041696 | SDS3 | 1996 | 15-Apr-96 | | 2 | TOBIASON | 4/15/96 23:17 | 4/16/96 14:00 | 5 | 2.5 | 2.5 | 6.36 | | | 0.036 | |
| SDS4 041696 | SDS4 | 1996 | 15-Apr-96 | | 2 | TOBIASON | 4/16/96 0:11 | 4/16/96 14:00 | 5 | 2.5 | 2.5 | 4.64 | | | 0.128 | |
| SDN2 041696 | SDN2 | 1996 | 16-Apr-96 | | 1 | WILLEY | 4/15/96 23:22 | 4/16/96 8:15 | 5 | 2.5 | 2.5 | 2 | | | 0.044 | |
| SDN2 041996 | SDN2 | 1996 | 19-Apr-96 | | 5 | WILLEY | | 4/19/96 15:30 | 5 | 2.5 | 2.5 | 2 | | | 0.056 | |
| SDN3 041996 | SDN3 | 1996 | 19-Apr-96 | | 5 | WILLEY | | 4/19/96 15:00 | 5 | 2.5 | 2.5 | 2 | | | 0.018 | |
| SDN1 042296 | SDN1 | 1996 | 22-Apr-96 | | 2 | TOBIASON | 4/22/96 16:30 | 4/23/96 14:00 | 5 | 2.5 | 2.5 | 8.8 | | | 0.184 | |
| SDN2 042296 | SDN2 | 1996 | 22-Apr-96 | | 2 | TOBIASON | 4/22/96 16:35 | 4/23/96 14:00 | 5 | 2.5 | 2.5 | 6.64 | | | 0.005 | |
| SDN3 042296 | SDN3 | 1996 | 22-Apr-96 | | 2 | TOBIASON | 4/22/96 18:17 | 4/23/96 14:00 | 5 | 2.5 | 2.5 | 6.56 | | | 0.034 | |
| SDS1 042296 | SDS1 | 1996 | 22-Apr-96 | | 2 | TOBIASON | 4/22/96 15:39 | 4/23/96 14:00 | 5 | 2.5 | 2.5 | 9.28 | | | 0.023 | |
| SDS4 042296 | SDS4 | 1996 | 22-Apr-96 | | 2 | TOBIASON | 4/22/96 15:39 | 4/23/96 14:00 | 5 | 2.5 | 2.5 | 6.44 | | | 0.047 | |
| SDN1 042596 | SDN1 | 1996 | 25-Apr-96 | | 5 | WILLEY | | 4/25/96 20:00 | 5 | 2.5 | 2.5 | 2.4 | - | | 0.071 | |
| SDN2 042596 | SDN2 | 1996 | 25-Apr-96 | | 5 | WILLEY | | 4/25/96 17:00 | 5 | 2.5 | 2.5 | 2.14 | | | 0.005 | |
| SDN3 042596 | SDN3 | 1996 | 25-Apr-96 | | 5 | WILLEY | | 4/25/96 16:00 | 5 | 2.5 | 2.5 | 1 | | | 0.005 | |
| SDN3 050796 | SDN3 | 1996 | 07-May-96 | | 1 | WILLEY | | 5/7/96 16:00 | 5 | 2.5 | 2.5 | 2 | | | 0.005 | |
| SDN3 051096 | SDN3 | 1996 | 10-May-96 | | 2 | WILLEY | | 5/10/96 13:00 | 5 | 2.5 | 2.5 | 2 | | | 0.071 | |
| SDN1 051396 | SDN1 | 1996 | 13-May-96 | | 5 | WILLEY | | 5/13/96 17:00 | 5 | 2.5 | 2.5 | 4.22 | | | 0.0267 | |
| SDN2 051396 | SDN2 | 1996 | 13-May-96 | | 5 | WILLEY | | 5/13/96 16:45 | 5 | 2.5 | 2.5 | 4.86 | | | 0.045 | |
| SDN3 051396 | SDN3 | 1996 | 13-May-96 | | 5 | WILLEY | | 5/13/96 16:30 | 5 | 2.5 | 2.5 | 2 | | | 0.075 | |
| SDN1 052296 | SDN1 | 1996 | 21-May-96 | | 6 | WILLEY | | 5/22/96 14:00 | 5 | 2.5 | 2.5 | 10.2 | | | 0.164 | |
| SDN2 052296 | SDN2 | 1996 | 21-May-96 | | 6 | WILLEY | | 5/22/96 6:00 | 5 | 2.5 | 2.5 | 5.08 | | | 0.043 | |
| SDN1 052296 | SDN1 | 1996 | 22-May-96 | | 3 | WILLEY | | 5/21/96 14:00 | 5 | 2.5 | 2.5 | 12.4 | | | 0.52 | |
| SDN2 052296 | SDN2 | 1996 | 22-May-96 | | 3 | WILLEY | | 5/22/96 1:44 | 5 | 2.5 | 2.5 | 5.7 | | | 0.005 | |
| SDN3 052296 | SDN3 | 1996 | 22-May-96 | | 3 | WILLEY | | 5/22/96 8:00 | 5 | 2.5 | 2.5 | 2 | | | 0.005 | |
| SDN1 062396 | SDN1 | 1996 | 23-Jun-96 | | 1 | WILLEY | | 6/23/96 16:00 | 5 | 2.5 | 2.5 | 20 | | | 0.684 | |
| SDN2 062396 | SDN2 | 1996 | 23-Jun-96 | | 1 | WILLEY | | 6/23/96 16:00 | 5 | 2.5 | 2.5 | 18.3 | | | 0.166 | |

All data extracted by "qryall_glycol" in ACCESS relational database

**shading codes:**

Results <MDL replaced with value = 1/2 MDL

BOD5 Results > value indicated due to premature oxygen depletion during analysis

Values in table are average of time composites taken over duration of runway washoff event

| | | total glycols | E-glycol | P-glycol | BOD5 | acetate | TKN | NH3 | NO3+ NO2 |
|---|---|---|---|---|---|---|---|---|---|
| All Data | count | 118 | 118 | 118 | 99 | 7 | 21 | 90 | 7 |
| | mean | 71 | 12 | 59 | 38 | 369 | 3.0 | 0.36 | 0.38 |
| | **median** | **5.0** | **2.5** | **2.5** | **7.0** | **369** | **1.4** | **0.07** | **0.33** |
| | geomean | 8.3 | 4.1 | 3.9 | 11.4 | 185 | 1.5 | 0.08 | 0.33 |
| | max | 6220 | 320 | 5900 | 690 | 800 | 21.0 | 5.0 | 0.73 |
| | min | 5.0 | 2.5 | 2.5 | 0.5 | 5.0 | 0.3 | 0.01 | 0.11 |
| | detected | 29 | 28 | 24 | 88 | 7 | 21 | 77 | 7 |
| | non-detected | 89 | 90 | 94 | 11 | 0 | 0 | 13 | 0 |
| | % non detecte | 75% | 76% | 80% | 11% | 0% | 0% | 14% | 0% |
| 1996 report | count | 72 | 72 | 72 | 64 | 7 | 19 | 65 | 7 |
| | mean | 108 | 14 | 94 | 49 | 369 | 3 | 0.28 | 0.38 |
| | **median** | **5** | **2.5** | **2.5** | **8** | **369** | **1.5** | **0.07** | **0.33** |
| | geomean | 9.9 | 4.6 | 5.0 | 12.5 | 185 | 1.7 | 0.08 | 0.33 |
| | max | 6220 | 320 | 5900 | 690 | 800 | 21 | 2.7 | 0.73 |
| | min | 5 | 2.5 | 2.5 | 0.5 | 5 | 0.3 | 0.01 | 0.11 |
| | detected | 22 | 20 | 22 | 53 | 7 | 19 | 57 | 7 |
| | nondetected | 50 | 52 | 50 | 11 | 0 | 0 | 8 | 0 |
| | % non detecte | 69% | 72% | 69% | 17% | 0% | 0% | 12% | 0% |
| 1996 samples with glycol detected | count | 22 | 20 | 22 | 53 | 7 | 19 | 57 | 7 |
| | mean | 343 | 39 | 302 | 146 | 410 | 3.6 | 1 | 0.4 |
| | **median** | **31** | **17** | **14** | **130** | **460** | **2.0** | **0.30** | **0.33** |

AR 027862

| | POS Sample ID | sampling end time | TSS, mg/l | Turb, NTU | BOD5, mg/l | NH3, mg/l | Ethylene glycol, mg/l | Propylene glycol, mg/l | total glycols, mg/l | comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MC3 030595 | | 65 | 52 | 10 | 0.21 | 2.5 | 2.5 | 5 | |
| 2 | MC3 030995 | | 38 | 28 | 5.0 | 0.26 | 2.5 | 2.5 | 5 | |
| 3 | MC3 031595 | | 6.0 | 6.2 | 3.0 | 0.06 | 2.5 | 2.5 | 5 | |
| 4 | MC3 040595 | | 6.0 | 3.2 | 3.0 | 0.005 | 2.5 | 2.5 | 5 | |
| 5 | MC3 040795 | | 10 | 6.0 | 7.0 | 0.005 | 2.5 | 2.5 | 5 | |
| 6 | MC3 012096 | 1/20/96 8:00 | | | 45 | 0.20 | 12 | 8 | 20 | S. McEvoy requested. First storm after runway deice. Avg of six time composites over 24 hours |
| 7 | MC3 020496 | 2/4/96 10:10 | 10 | 8.5 | 27 | 0.39 | 5.7 | 4.7 | 10 | First storm after runway deice. Average of seven time composites over 18 hours |
| 8 | MC3 032996 | 3/29/96 17:45 | 7.5 | 5.4 | 7.0 | 0.11 | 2.5 | 2.5 | 5 | 0.13" storm |
| | | # non-detected | 0 | 0 | 0 | 2 | 6 | 6 | 6 | Note: Due to human error, TSS and Turbidity were not requested for laboratory analysis on the January 20th sample at Lake Reba outlet |
| | | % non-detected | 0% | 0% | 0% | 25% | 75% | 75% | 75% | |
| | **L. Reba Outlet** | median | 10 | 6 | 7 | 0.16 | 2.5 | 2.5 | 5 | |
| | | NURP median* | 50 | 4 - 150 | 6.6 | 0.01 - 7.2 | *ND* | *ND* | *ND* | |
| | | 1995 median** | *ND* | *ND* | *ND* | *ND* | *ND* | *ND* | *ND* | |
| 1 | SDN1 030595 | | 1 | 3.5 | 4.0 | 0.005 | 2.5 | 2.5 | 5 | |
| 2 | SDN1 030995 | | 14 | 17 | 6.0 | 0.35 | 2.5 | 2.5 | 5 | |
| 3 | SDN1 031595 | | 9.6 | 17 | 4.0 | 0.05 | 2.5 | 2.5 | 5 | |
| 4 | SDN1 040595 | | 6.0 | 7.6 | 5.0 | 0.08 | 2.5 | 2.5 | 5 | |
| 5 | SDN1 040596 | 4/5/96 16:15 | 48 | 9.3 | 44 | 0.88 | 2.5 | 2.5 | 5 | Baseflow grab sample using auto sampler pump, no storm. possible sampling error |
| 6 | SDN1 041296 | 4/12/96 10:00 | 5.0 | 16 | 15 | 0.23 | 2.5 | 2.5 | 5 | 0.20" storm over 24 hours |
| 7 | SDN1 041696 | 4/16/96 0:07 | 47 | 7.1 | 2.0 | 0.10 | 2.5 | 2.5 | 5 | 0.49" NPDES storm |
| 8 | SDN1 042596 | 4/25/96 20:00 | 12 | 12 | 2.4 | 0.07 | 2.5 | 2.5 | 5 | 0.31" storm |
| | | # non-detected | 1 | 0 | 1 | 1 | 8 | 8 | 8 | |
| | | % non-detected | 13% | 0% | 13% | 13% | 100% | 100% | 100% | |
| | **SDN1 Outfall** | median | 11 | 11 | 5 | 0.09 | 2.5 | 2.5 | 5 | |
| | | NURP median* | 50 | 4 - 150 | 6.6 | 0.01 - 7.2 | *ND* | *ND* | *ND* | |
| | | 1995 median** | 20 | 12 | 18 | 0.23 | 2.5 | 2.5 | 5 | |

**notes:**

* Median values from medium-high density residential, and mixed residential/commercial areas from "Bellevue Urban Runoff Program", 1984

** Median values for 1994-95 stormwater runoff from runway outfalls. Does not include runway deice events. See Sea-Tac "Annual Stormwater Monitoring Report", 8/30/95.

values shaded were below detection limits: true value assumed = 1/2 detection limit

ND = no data available

AR 027863

| | POS Sample ID | sampling end time | TSS, mg/l | Turb, NTU | BOD5, mg/l | NH3, mg/l | Ethylene glycol, mg/l | Propylene glycol, mg/l | total glycols, mg/l | comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SDN2 030595 | | 2.4 | 2.1 | 12 | 0.02 | 36 | 2.5 | 36 | BOD>12 due to insufficient dilution of sample in laboratory |
| 2 | SDN2 031595 | | 1 | 2.2 | 5.0 | 1.6 | 2.5 | 2.5 | 5 | Elevated ammonia, suspect contamination. No urea used since Feb 17, 1995 |
| 3 | SDN2 040795 | | 7.2 | 4.8 | 15 | 0.005 | 2.5 | 2.5 | 5 | |
| 4 | SDN2 011996 | 1/19/96 21:17 | 18 | 32 | 26 | 0.74 | 48 | 51 | 99 | S. McEvoy requested. Runway deice: avg of six time composites of snowmelt runoff over 18 hours |
| 5 | SDN2 012096 | 1/20/96 9:42 | 3.1 | 4.3 | 19 | 0.21 | 11 | 12 | 23 | S. McEvoy requested. First storm after runway deice. Avg of two time composites over 12 hours |
| 6 | SDN2 020496 | 2/4/96 16:42 | 15 | 13 | 203 | 0.23 | 16 | 23 | 39 | First storm after runway deice. Average of grab plus two time composites over 18 hours |
| 7 | SDN2 032996 | 3/29/96 15:30 | 34 | 3.3 | 10 | 0.32 | 2.5 | 2.5 | 5 | 0.13" storm |
| 8 | SDN2 040596 | 4/5/96 15:35 | 0.6 | 0.5 | 0.50 | 0.15 | 2.5 | 2.5 | 5 | Baseflow sample, no stormflow |

| SDN2 Outfall | | TSS, mg/l | Turb, NTU | BOD5, mg/l | NH3, mg/l | Ethylene glycol, mg/l | Propylene glycol, mg/l | total glycols, mg/l |
|---|---|---|---|---|---|---|---|---|
| | # non-detected | 2 | 0 | 1 | 1 | 4 | 5 | 4 |
| | % non-detected | 25% | 0% | 13% | 13% | 50% | 63% | 50% |
| | median | 5 | 4 | 14 | 0.22 | 6.6 | 2.5 | 14 |
| | NURP median* | 50 | 4 - 150 | 6.6 | 0.01 - 7.2 | *ND* | *ND* | *ND* |
| | 1995 median** | 6 | 5 | 9 | 0.09 | 2.5 | 11 | 13 |

| | POS Sample ID | sampling end time | TSS, mg/l | Turb, NTU | BOD5, mg/l | NH3, mg/l | Ethylene glycol, mg/l | Propylene glycol, mg/l | total glycols, mg/l | comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SDN3 030595 | | 1 | 2.3 | 3.0 | 0.005 | 2.5 | 2.5 | 5 | |
| 2 | SDN3 030995 | | 5 | 12 | 3.0 | 0.02 | 2.5 | 2.5 | 5 | |
| 3 | SDN3 031595 | | 4.0 | 5.9 | 5.0 | 0.02 | 2.5 | 2.5 | 5 | |
| 4 | SDN3 040595 | | 1 | 1.8 | 3.0 | 0.25 | 2.5 | 2.5 | 5 | |
| 5 | SDN3 011996 | 1/19/96 21:42 | 4.8 | 4.2 | 42 | 0.18 | 2.5 | 2.5 | 5 | S. McEvoy requested. Runway deice: sample of snowmelt runoff |
| 6 | SDN3 012096 | 1/20/96 9:01 | 5.5 | 9.7 | 18 | 0.08 | 2.5 | 2.5 | 5 | S. McEvoy requested. First storm after runway deice. |
| 7 | SDN3 020496 | 2/4/96 15:00 | | 9.7 | | 0.14 | 2.5 | 2.5 | 5 | First storm after runway deice, insuff stormflow for full sample, S. McEvoy requested it anyway. |
| 8 | SDN3 033196 | 3/31/96 13:00 | 26 | 2.8 | 5.0 | 0.04 | 2.5 | 2.5 | 5 | 0.13" storm, but no stormflow to enable sampler at this site, S. McEvoy requested it anyway. |

| SDN3 Outfall | | TSS, mg/l | Turb, NTU | BOD5, mg/l | NH3, mg/l | Ethylene glycol, mg/l | Propylene glycol, mg/l | total glycols, mg/l |
|---|---|---|---|---|---|---|---|---|
| | # non-detected | 3 | 0 | 1 | 1 | 8 | 8 | 8 |
| | % non-detected | 43% | 0% | 14% | 13% | 100% | 100% | 100% |
| | median | 5 | 5 | 5 | 0.06 | 2.5 | 2.5 | 5 |
| | NURP median* | 50 | 4 - 150 | 6.6 | 0.01 - 7.2 | *ND* | *ND* | *ND* |
| | 1995 median** | 12 | 12 | 4.0 | 0.01 | 2.5 | 2.5 | 5 |

| POS Sample ID | sampling end time | TSS, mg/l | Turb, NTU | BOD5, mg/l | NH3, mg/l | Ethylene glycol, mg/l | Propylene glycol, mg/l | total glycols, mg/l | comments |
|---|---|---|---|---|---|---|---|---|---|
| ***All Miler Creek Outfalls*** | # non-detected | 6 | 0 | 3 | 5 | 26 | 27 | 26 | |
| | % non-detected | 20% | 0% | 10% | 16% | 81% | 84% | 81% | |
| | median | 7 | 6 | 6 | 0.13 | 2.5 | 2.5 | 5 | |
| | NURP median* | 50 | 4 - 150 | 6.6 | 0.01 - 7.2 | *ND* | *ND* | *ND* | |
| | 1995 median** | 9 | 8 | 7 | 0.04 | 2.5 | 2.5 | 5 | |

AR 027865

**Outfall: SDS3**

# 1/19/96-1/22/96 Runway/Aircraft Anti-ice Pollutant Washoff Analysis for 3-4" Snowmelt followed by 1.75" rainfall

| Sample data | | Pollutant Concentrations | | | | | |
|---|---|---|---|---|---|---|---|
| Bottle | Ending Time | BOD mg/l | glycol mg/L | acetate mg/L | TKN mg/L | NH3 mg/L | comments |
| A | 1/19/96 12:00 | 4 | 5.0 | 40 | 0.50 | 0.01 | SE study |
| B | 1/19/96 16:00 | 6 | 5.0 | 40 | 0.70 | 0.01 | SE study |
| C | 1/19/96 20:00 | 3 | 5.0 | 40 | 0.80 | 0.03 | SE study |
| CD | 1/19/96 22:00 | 250 | 97 | 150 | 1.80 | 0.14 | SE study |
| D | 1/20/96 0:00 | 200 | 72 | 570 | 10.00 | 0.93 | SE study |
| DE | 1/20/96 2:00 | 480 | 138 | 983 | 15.00 | 0.88 | SE study |
| E | 1/20/96 4:00 | 440 | 162 | 1000 | 12.00 | 0.79 | SE study |
| F | 1/20/96 8:00 | 220 | 27 | 720 | 9.10 | 1.2 | SE study |
| 1--6 | 1/20/96 14:00 | 27 | 5.0 | | 0.26 | 0.15 | POS |
| 7--12 | 1/20/96 20:00 | 20 | 5.0 | | 0.26 | 0.39 | POS |
| 13-18 | 1/21/96 2:00 | 22 | 5.0 | | 0.26 | 0.04 | POS |
| 19-24 | 1/21/96 8:00 | 17 | 5.0 | | 0.26 | 0.04 | POS |
| A1 | 1/21/96 17:56 | 50 | 39.0 | | 0.50 | 0.01 | POS |
| A2 | 1/22/96 1:56 | 36 | 32.0 | | 0.30 | 0.01 | POS |
| A3 | 1/22/96 9:56 | 22 | 15.0 | | 0.30 | 0.01 | POS |
| A4 | 1/22/96 17:56 | 22 | 15.0 | | 0.40 | 0.01 | POS |

greater than value indicated due to insufficient dilution

[illegible] low detection limit; use 1/2 detection limit for loading analysis

## Computed Pollutant Loadings

| Bottle | cum vol, gal | RUNOFF cum % of total | delta Vol, gal | BOD load, lb | cum BOD load, lb | BOD cum% of total |
|---|---|---|---|---|---|---|
| A | 815,995 | 1% | 96,122 | 3 | 3 | 0.04% |
| B | 1,339,609 | 5% | 523,615 | 26 | 29 | 0.4% |
| C | 1,719,429 | 8% | 379,819 | 9 | 39 | 0.5% |
| CD | 1,898,029 | 9% | 178,600 | 371 | 409 | 5% |
| D | 2,044,248 | 10% | 146,219 | 243 | 652 | 8% |
| DE | 2,177,945 | 11% | 133,698 | 533 | 1185 | 15% |
| E | 2,441,301 | 13% | 263,356 | 962 | 2146 | 26% |
| F | 4,590,762 | 30% | 2,149,460 | 3925 | 6071 | 75% |
| 1--6 | 6,830,969 | 47% | 2,240,208 | 502 | 6573 | 81% |
| 7--12 | 8,815,697 | 62% | 1,984,728 | 329 | 6903 | 85% |
| 13-18 | 9,240,083 | 65% | 424,385 | 77 | 6980 | 86% |
| 19-24 | 11,684,270 | 84% | 2,444,187 | 345 | 7325 | 90% |
| A1 | 13,316,039 | 96% | 1,631,769 | 677 | 8002 | 98% |
| A2 | 13,604,102 | 98% | 288,062 | 86 | 8089 | 100% |
| A3 | 13,709,303 | 99% | 105,201 | 19 | 8108 | 100% |
| A4 | 13,809,530 | 100% | 100,227 | 18 | 8126 | 100% |

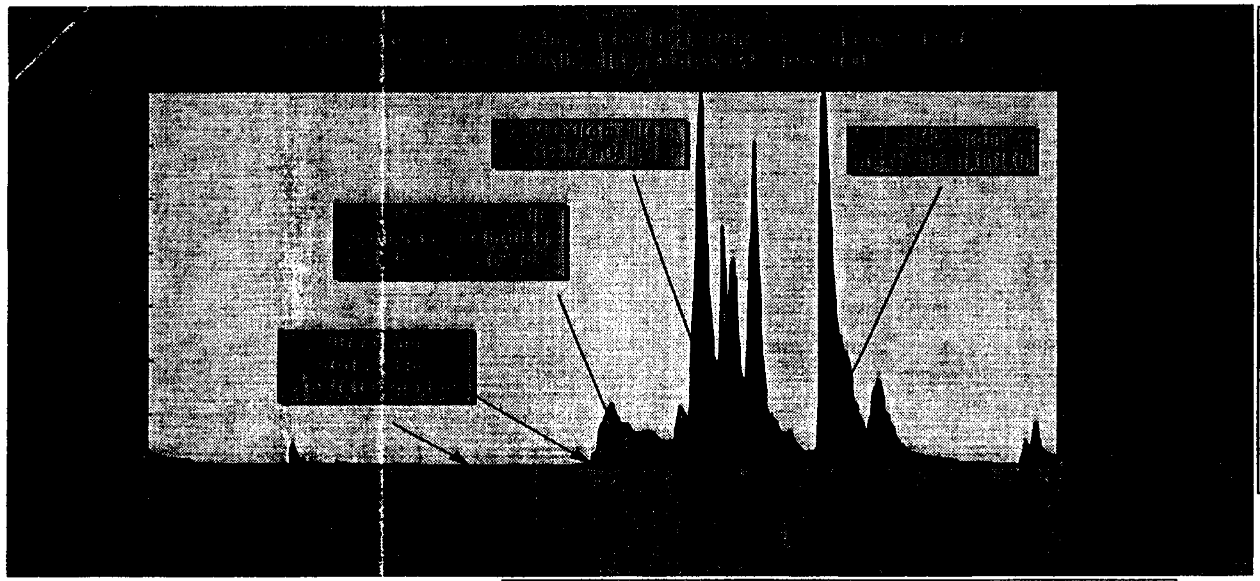
| Bottle | Glycol load, lb | cum Glycol load, lb | Glycol cum% of total | Acetate load, lb | cum Acetate load, lb | Acetate cum% of total | TKN load, lb | cum TKN load, lb | TKN cum% of total |
|---|---|---|---|---|---|---|---|---|---|
| A | 4 | 4 | 0.18% | 32 | 32 | 0.18% | 0.40 | 0 | 0.16% |
| B | 22 | 26 | 1.2% | 174 | 206 | 1.2% | 3.04 | 3 | 1.4% |
| C | 16 | 41 | 1.9% | 126 | 332 | 1.9% | 2.52 | 6 | 2.4% |
| CD | 144 | 185 | 8% | 222 | 554 | 3.2% | 2.67 | 9 | 3.5% |
| D | 87 | 273 | 12% | 692 | 1246 | 7.2% | 12.14 | 21 | 8% |
| DE | 153 | 426 | 19% | 1091 | 2337 | 13.5% | 16.65 | 37 | 15% |
| E | 354 | 780 | 36% | 2186 | 4523 | 26% | 26.23 | 64 | 26% |
| F | 482 | 1262 | 58% | 12845 | 17368 | 100% | 162.35 | 226 | 91% |
| 1--6 | 93 | 1355 | 62% | | | | 4.83 | 231 | 93% |
| 7--12 | 82 | 1437 | 66% | | | | 4.28 | 235 | 94% |
| 13-18 | 18 | 1455 | 67% | | | | 0.92 | 236 | 95% |
| 19-24 | 101 | 1556 | 71% | | | | 5.27 | 241 | 97% |
| A1 | 528 | 2084 | 95% | | | | 6.77 | 248 | 99% |
| A2 | 77 | 2161 | 99% | | | | 0.72 | 249 | 100% |
| A3 | 13 | 2174 | 99% | | | | 0.26 | 249 | 100% |
| A4 | 12 | 2186 | 100% | | | | 0.33 | 249 | 100% |

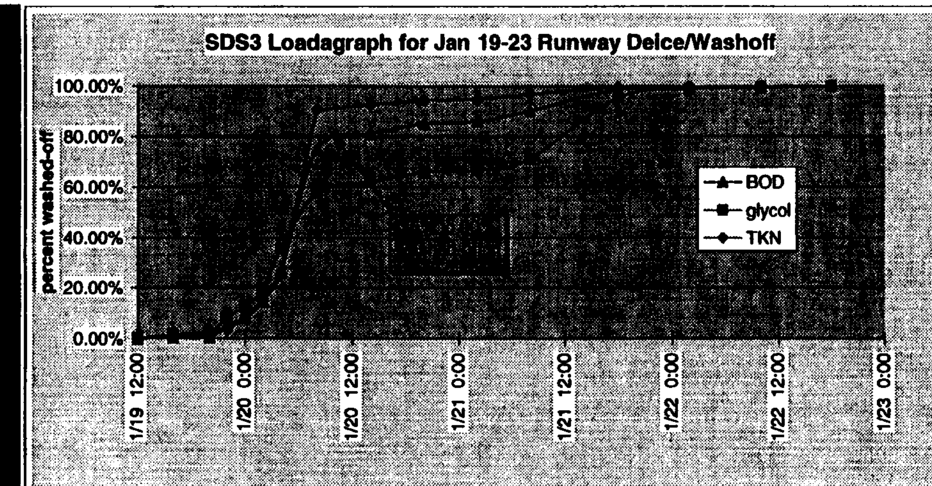
conclusion: 0.5" rain washed-off 75% to 90% of BOD and TKN pollutant loads

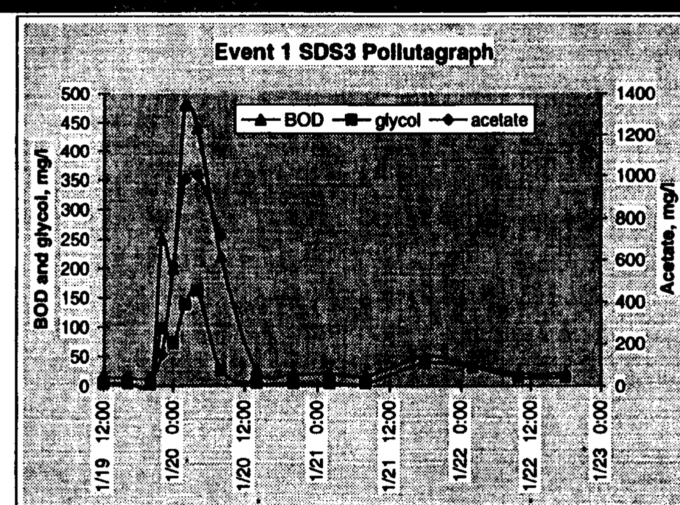
acetate data incomplete, but drop in BOD indicates majority washed-off in first 0.5" rainfall

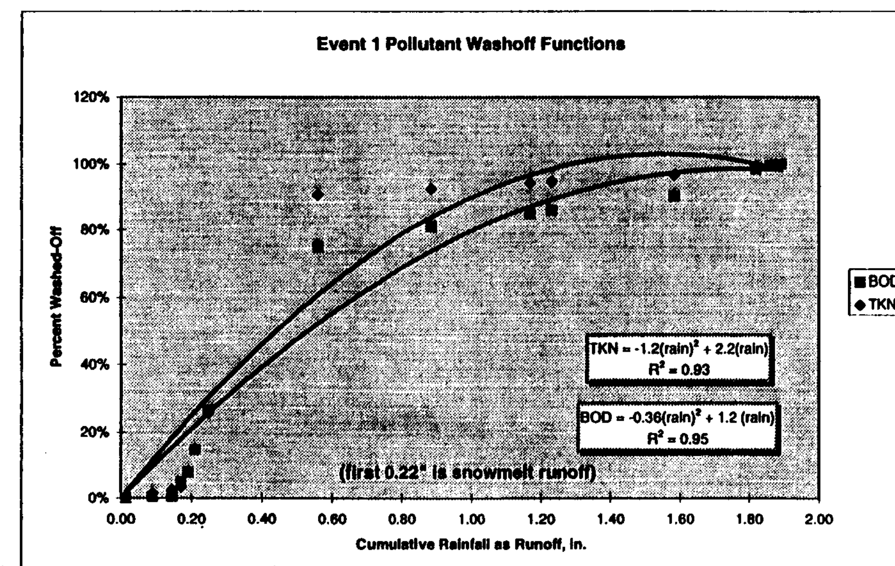
| | |
|---|---|
| TOTAL RUNOFF, gal | 13,089,657 |
| duration = | 3.2 |
| TOTAL BOD, lb | 8,126 |
| TOTAL glycol, lb | 2,186 |
| TOTAL glycol, gal | 273 |
| TOTAL acetate, lb | 17,368 |
| TOTAL TKN, lb | 249 |

AR 027866




SDS3 Loadagraph for Jan 19-23 Runway Deice/Washoff
percent washed-off
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
BOD
glycol
TKN
1/19 12:00
1/20 0:00
1/20 12:00
1/21 0:00
1/21 12:00
1/22 0:00
1/22 12:00
1/23 0:00


Event 1 SDS3 Pollutagraph
BOD and glycol, mg/l
Acetate, mg/l
BOD
glycol
acetate
500
450
400
350
300
250
200
150
100
50
0
1400
1200
1000
800
600
400
200
0
1/19 12:00
1/20 0:00
1/20 12:00
1/21 0:00
1/21 12:00
1/22 0:00
1/22 12:00
1/23 0:00


Event 1 Pollutant Washoff Functions
Percent Washed-Off
120%
100%
80%
60%
40%
20%
0%
TKN = -1.2(rain)$^2$ + 2.2(rain)
$R^2$ = 0.93
BOD = -0.36(rain)$^2$ + 1.2 (rain)
$R^2$ = 0.95
(first 0.22" is snowmelt runoff)
BOD
TKN
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
Cumulative Rainfall as Runoff, In.

AR 027867

## Differing Precipitation Data: Taking into account Snowmelt recorded in rain gage

(2.08" ppt gaged, ~0.3" was snowmelt)

| | Precipitation tagged to sample time (POS +KCSWM data) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | unadjusted | | adjusted* | | adj no snow | | cum | |
| hour end | ppt, in. | total | ppt, in. | total | ppt, in. | total | % of total | |
| 1/19/96 12:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0% | snowmelt |
| 1/19/96 16:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0% | snowmelt |
| 1/19/96 20:00 | 0.08 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 4% | snowmelt |
| 1/19/96 22:00 | 0.12 | 0.20 | 0.05 | 0.05 | 0.00 | 0.00 | 10% | snowmelt |
| 1/20/96 0:00 | 0.10 | 0.30 | 0.15 | 0.20 | 0.00 | 0.00 | 16% | rain |
| 1/20/96 2:00 | 0.15 | 0.45 | 0.14 | 0.34 | 0.06 | 0.06 | 23% | rain |
| 1/20/96 4:00 | 0.08 | 0.53 | 0.14 | 0.48 | 0.14 | 0.20 | 27% | rain |
| 1/20/96 8:00 | 0.27 | 0.80 | 0.24 | 0.72 | 0.30 | 0.50 | 41% | POS |
| 1/20/96 14:00 | 0.21 | 1.01 | 0.30 | 1.02 | 0.30 | 0.80 | 52% | POS |
| 1/20/96 20:00 | 0.17 | 1.18 | 0.22 | 1.24 | 0.22 | 1.02 | 61% | POS |
| 1/21/96 2:00 | 0.04 | 1.22 | 0.04 | 1.28 | 0.04 | 1.06 | 63% | POS |
| 1/21/96 8:00 | 0.33 | 1.55 | 0.29 | 1.57 | 0.29 | 1.35 | 80% | POS |
| 1/21/96 17:56 | 0.33 | 1.88 | 0.15 | 1.72 | 0.15 | 1.50 | 97% | KCSWM |
| 1/22/96 1:56 | 0.01 | 1.89 | 0.00 | 1.72 | 0.13 | 1.63 | 98% | KCSWM |
| 1/22/96 9:56 | 0.00 | 1.89 | 0.01 | 1.73 | 0.02 | 1.65 | 98% | KCSWM |
| 1/22/96 17:56 | 0.04 | 1.93 | 0.03 | 1.76 | 0.00 | 1.65 | 100% | KCSWM |
| | includes snowmelt | | | | | | | |
| TOTAL ppt | w/snow | 1.93 | adjusted | 1.76 | adjusted w/out snow | 1.65 | | |

*rainfall at 1.5 hours prior to sample to allow runoff at outfall
tc = 78 minutes

used for washoff curve: rainfall adjusted 1.5 hrs to allow runoff, and 0.22" as snow removed

| | 6 hour Precipitation (POS +KCSWM data) | | cum | 6 hour Precipitation without snowmelt | | |
|---|---|---|---|---|---|---|
| hour end | ppt, in. | total | % of total | ppt, in. | total | % of total |
| 1/19/96 12:00 | 0 | 0.00 | 0% | 0 | 0.00 | 0% |
| 1/19/96 18:00 | 0.02 | 0.02 | 1% | 0 | 0.00 | 0% |
| 1/20/96 0:00 | 0.42 | 0.44 | 21% | [redacted] | 0.00 | 0% |
| 1/20/96 6:00 | 0.43 | 0.87 | 42% | | 0.50 | 29% |
| 1/20/96 12:00 | 0.19 | 1.06 | 51% | | 0.75 | 43% |
| 1/20/96 18:00 | 0.19 | 1.25 | 61% | 0.19 | 0.94 | 54% |
| 1/21/96 0:00 | 0.02 | 1.27 | 62% | 0.02 | 0.96 | 55% |
| 1/21/96 6:00 | 0.32 | 1.59 | 77% | 0.32 | 1.28 | 73% |
| 1/21/96 12:00 | 0.2 | 1.79 | 87% | 0.2 | 1.48 | 85% |
| 1/21/96 18:00 | 0.13 | 1.92 | 93% | 0.13 | 1.61 | 92% |
| 1/22/96 0:00 | 0.02 | 1.94 | 94% | 0.02 | 1.63 | 93% |
| 1/22/96 6:00 | 0 | 1.94 | 94% | 0 | 1.63 | 93% |
| 1/22/96 12:00 | 0 | 1.94 | 94% | 0 | 1.63 | 93% |
| 1/22/96 18:00 | 0.04 | 1.98 | 96% | 0.04 | 1.67 | 95% |
| 1/23/96 0:00 | 0.08 | 2.06 | 100% | 0.08 | 1.75 | 100% |
| 1/23/96 6:00 | 0 | 2.06 | 100% | 0 | 1.75 | 100% |
| | TOTAL ppt | | 2.06 | TOTAL ppt | 1.75 | |

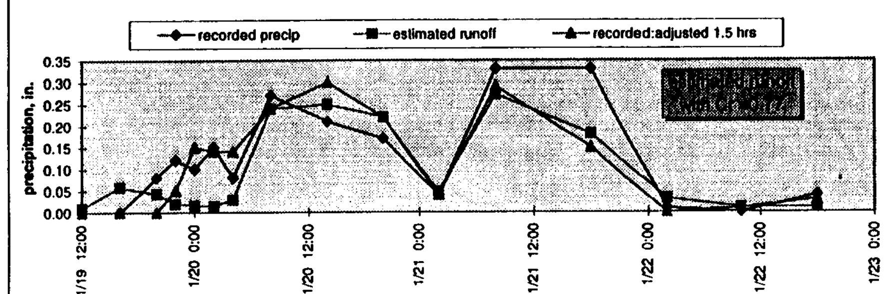
[redacted]

duration = 2.75 days

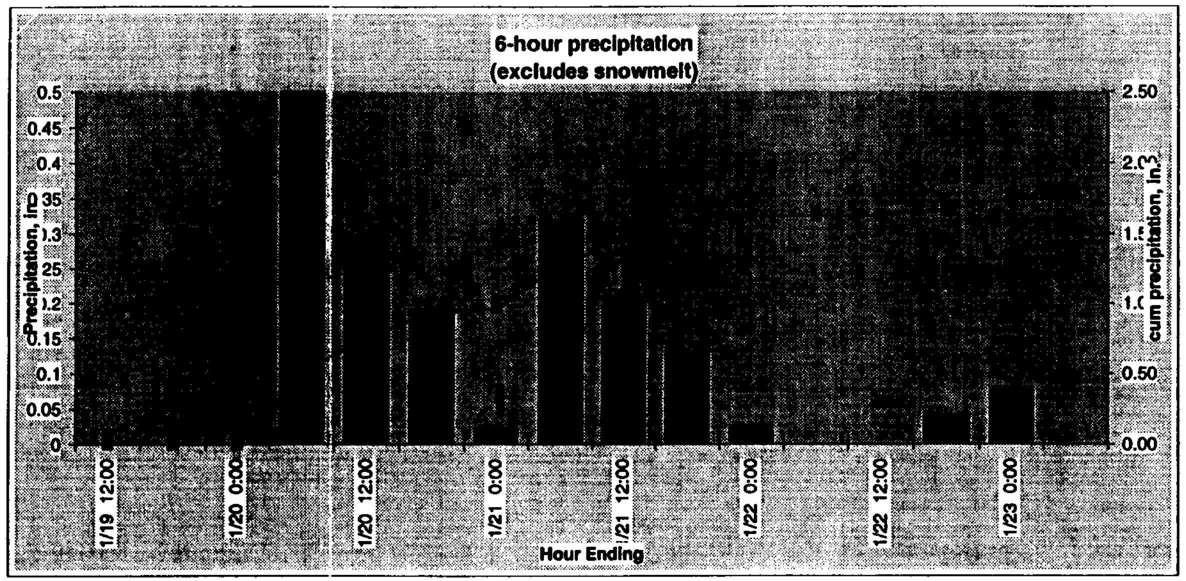
| | runoff equivalent, in. including snowmelt | | |
|---|---|---|---|
| sample time | filtered ... computed | cum | equivalent incident ppt |
| 1/19/96 12:00 | 0.01 | 0.01 | 0.01 |
| 1/19/96 16:00 | 0.06 | 0.07 | 0.09 |
| 1/19/96 20:00 | 0.04 | 0.11 | 0.14 |
| 1/19/96 22:00 | 0.02 | 0.13 | 0.17 |
| 1/20/96 0:00 | 0.02 | 0.15 | 0.19 |
| 1/20/96 2:00 | 0.01 | 0.16 | 0.21 |
| 1/20/96 4:00 | 0.03 | 0.19 | 0.25 |
| 1/20/96 8:00 | 0.24 | 0.43 | 0.56 |
| 1/20/96 14:00 | 0.25 | 0.68 | 0.88 |
| 1/20/96 20:00 | 0.22 | 0.90 | 1.17 |
| 1/21/96 2:00 | 0.05 | 0.95 | 1.23 |
| 1/21/96 8:00 | 0.27 | 1.22 | 1.58 |
| 1/21/96 17:56 | 0.18 | 1.40 | 1.82 |
| 1/22/96 1:56 | 0.03 | 1.43 | 1.86 |
| 1/22/96 9:56 | 0.01 | 1.44 | 1.88 |
| 1/22/96 17:56 | 0.01 | 1.46 | 1.89 |

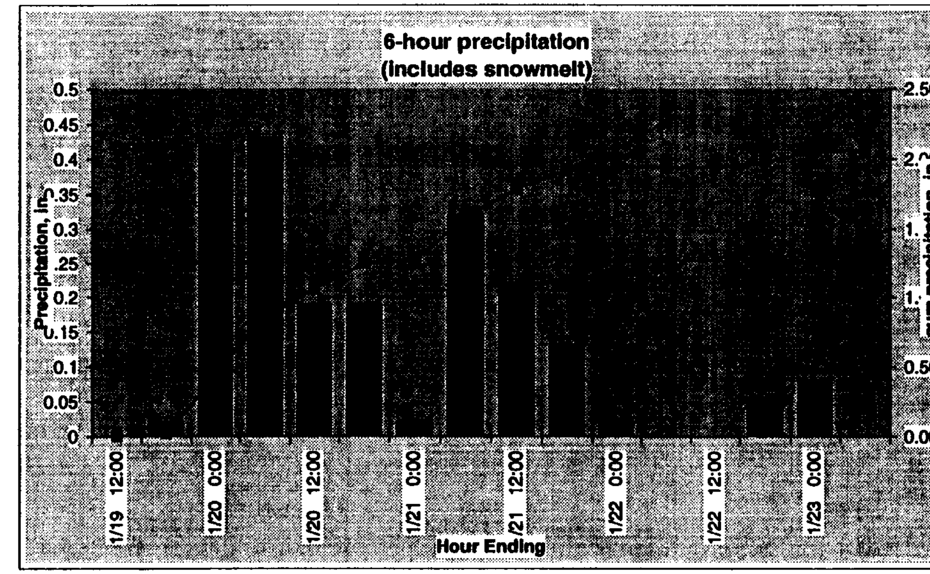
[redacted]

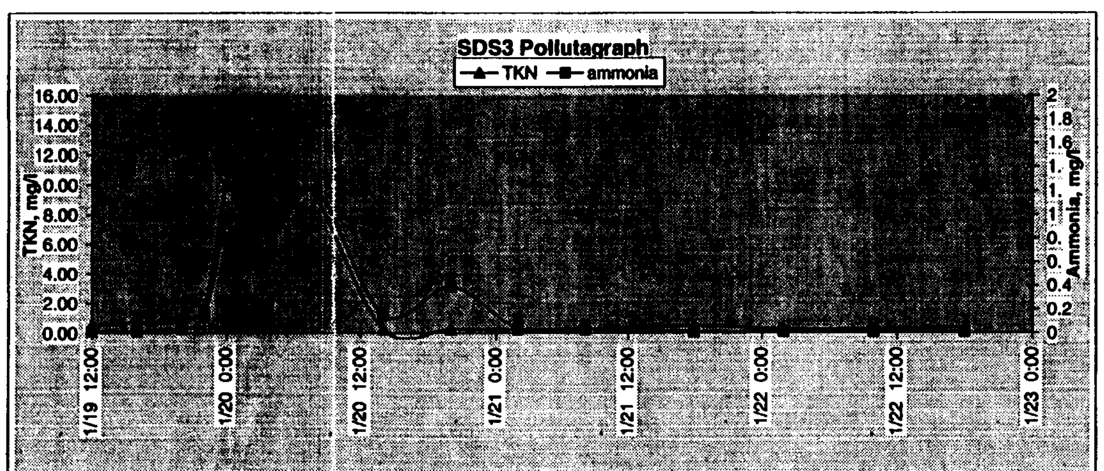
Compare recorded precip to estimated runoff equivalent

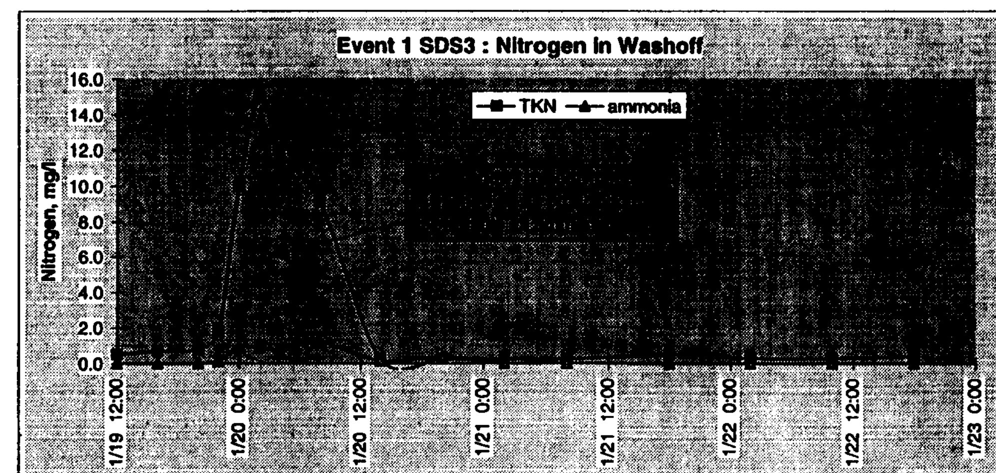



AR 027868


6-hour precipitation
(excludes snowmelt)
Precipitation, in.
cum precipitation, in.
Hour Ending


6-hour precipitation
(includes snowmelt)
Precipitation, in.
cum precipitation, in.
Hour Ending


SDS3 Pollutagraph
TKN
ammonia
TKN, mg/l
Ammonia, mg/l


Event 1 SDS3 : Nitrogen in Washoff
TKN
ammonia
Nitrogen, mg/l

AR 027869

# Outfall: SDS3 — January 27-February 6, 1996 Runway/Aircraft Anti-ice Pollutant Washoff Analysis for ~3" Snowmelt followed by _1.72" rainfall over 3 days

## Computed Pollutant Loadings

| Sample data | | | Pollutant Concentrations | | | | | | computed* | RUNOFF | | BOD | | | Glycol | | | Acetate | | | TKN | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bottle | Ending Time | sample duration hrs | BOD mg/l | glycol mg/L | acetate mg/L | TKN mg/L | NH3 mg/L | comments | cum runoff vol, gal | cum % of total | delta Vol, gal | load, lb | cum load, lb | cum% of total | load, lb | cum load, lb | cum% of total | load, lb | cum load, lb | cum% of total | TKN* load, lb | cum TKN load, lb | cum% of total |
| SE1 | 1/28/96 13:30 | 0 | | 73 | 1250 | | | SE study | 213,472 | 2% | 213,472 | 0 | 0 | 0.00% | 130 | 130 | 7% | 2233 | 2233 | 23% | 0.00 | 0 | 0.00% |
| SE2 | 1/30/96 2:00 | 0 | 210 | 115 | 424 | 0.50 | 0.034 | SE study | 419,875 | 3% | 206,403 | 363 | 363 | 4% | 199 | 329 | 19% | 732 | 2966 | 30% | 0.86 | 1 | 0.7% |
| SE3 | 2/2/96 11:45 | 0.0 | 130 | 31 | 453 | 0.30 | 0.061 | SE study | 882,161 | 6% | 462,286 | 503 | 866 | 10% | 120 | 449 | 26% | 1753 | 4719 | 48% | 1.16 | 2 | 2% |
| A1 | 2/4/96 3:14 | 8.0 | [redacted] | 45.0 | 300 | 4.20 | 0.50 | POS | 2,046,057 | 15% | 1,163,895 | 2241 | 3106 | 36% | 438 | 887 | 51% | 2923 | 7641 | 78% | 40.92 | 43 | 34% |
| A2 | 2/4/96 11:14 | 8.0 | [redacted] | 40.0 | 800 | 1.90 | 0.47 | POS | 2,202,980 | 16% | 156,923 | 302 | 3409 | 39% | 53 | 940 | 54% | 1051 | 8692 | 89% | 2.50 | 45 | 36% |
| A3 | 2/4/96 19:14 | 8.0 | [redacted] | 41.0 | 750 | 1.50 | 0.48 | POS | 2,372,626 | 17% | 169,646 | 327 | 3735 | 43% | 58 | 998 | 57% | 1065 | 9757 | 100% | 2.13 | 48 | 38% |
| B1 | 2/5/96 3:14 | 8.0 | [redacted] | 47.0 | | 1.00 | 0.29 | POS | 2,536,887 | 18% | 164,261 | 330 | 4065 | 47% | 65 | 1063 | 61% | 0 | 9757 | 100% | 1.37 | 49 | 39% |
| B2 | 2/5/96 11:14 | 8.0 | [redacted] | 36.0 | | 1.10 | 0.22 | POS | 3,173,801 | 23% | 636,915 | 1226 | 5291 | 61% | 192 | 1255 | 72% | 0 | 9757 | 100% | 5.86 | 55 | 43% |
| C1 | 2/5/96 19:28 | 8.0 | 62 | [redacted] | | 0.90 | 0.01 | POS | 7,544,014 | 54% | 4,370,212 | 2268 | 7559 | 87% | 183 | 1438 | 83% | 0 | 9757 | 100% | 32.92 | 88 | 69% |
| C2 | 2/5/96 21:28 | 2.0 | 52 | 15.0 | | 0.90 | 0.01 | mpler proble | 7,920,467 | 56% | 376,453 | 164 | 7723 | 89% | 47 | 1485 | 85% | 0 | 9757 | 100% | 2.84 | 91 | 72% |
| C3 | 2/6/96 19:00 | 22 | 19 | [redacted] | | 0.70 | 0.05 | mpler proble | 14,049,482 | 100% | 6,129,015 | 975 | 8698 | 100% | 256 | 1741 | 100% | 0 | 9757 | 100% | 35.91 | 126 | 100% |

[redacted]

[redacted]

[redacted]

conclusion: 0.25" rainfall washed off only 30 to 50% of pollutant load, and it took about an inch or more to wash off near 90% of the load

[redacted]

[redacted]

[redacted]

[redacted]

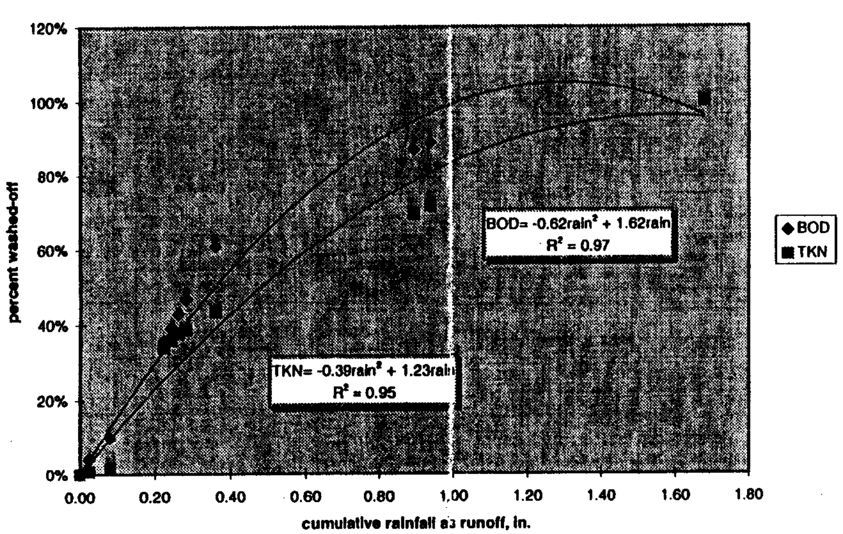
| | | |
|---|---|---|
| duration = | 9.23 | days |
| TOTAL RUNOFF, gal | | 14,049,482 |
| TOTAL BOD, lb | | 8,698 |
| TOTAL glycol, lb | | 1,741 |
| TOTAL glycol,gal | | 218 |
| TOTAL acetate, lb | | 9,757 |
| TOTAL TKN, lb | | 126 |

[redacted]

| | |
|---|---|
| 1,020,491 | gallons runoff gaged from 0.25" event (excludes nominal 0.5 cfs baseflow) |
| 1,064,531 | gallons baseflow discharge in 6 days before first rainfall (0.25") |

conclusion: baseflow was source of 10-28% of total load of BOD, acetate, and Glycol, but not significant source of TKN (nor ammonia) loads

Event 2 Pollutant Washoff Functions



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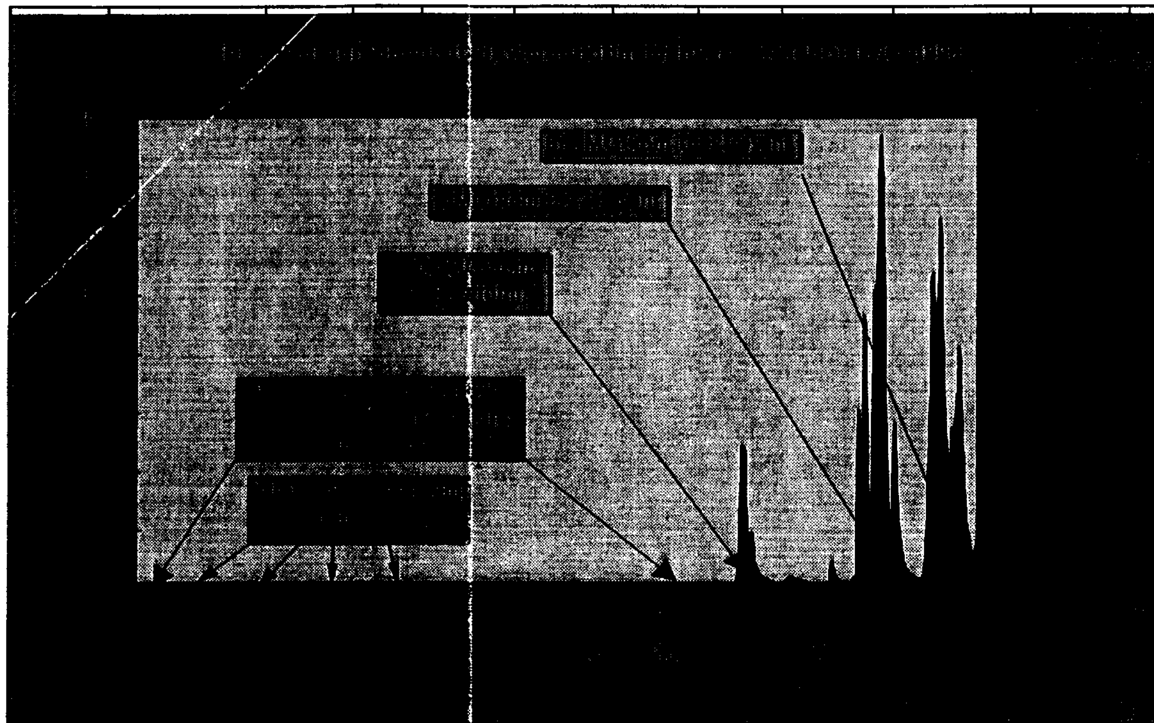
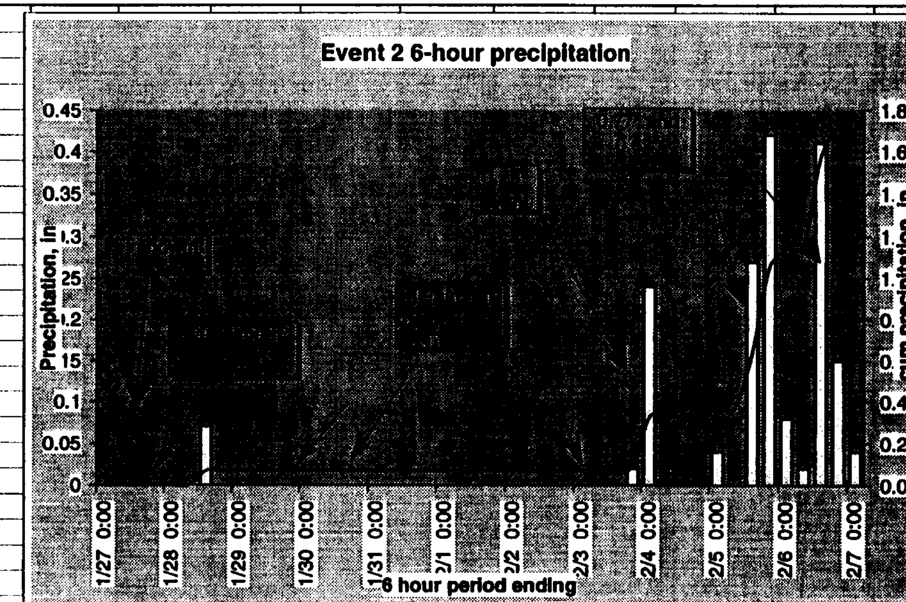
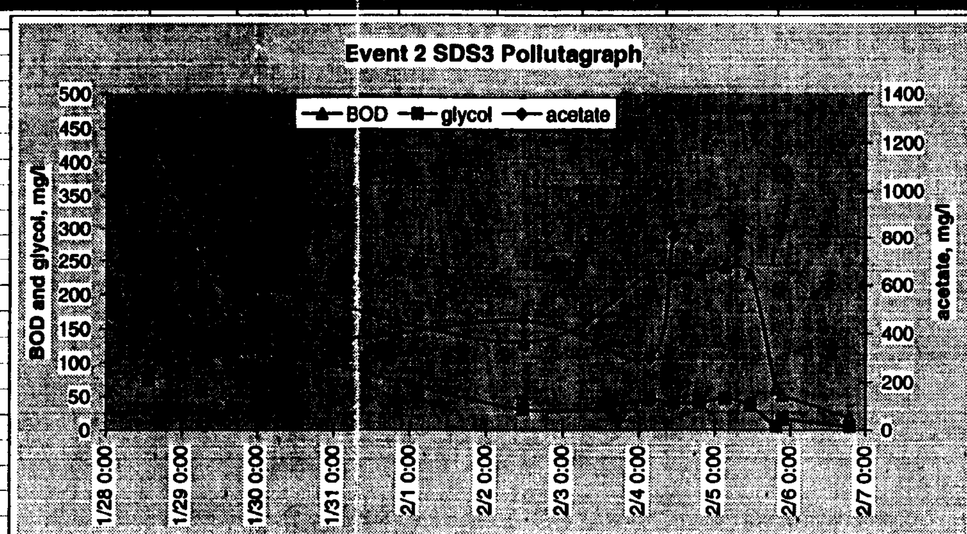
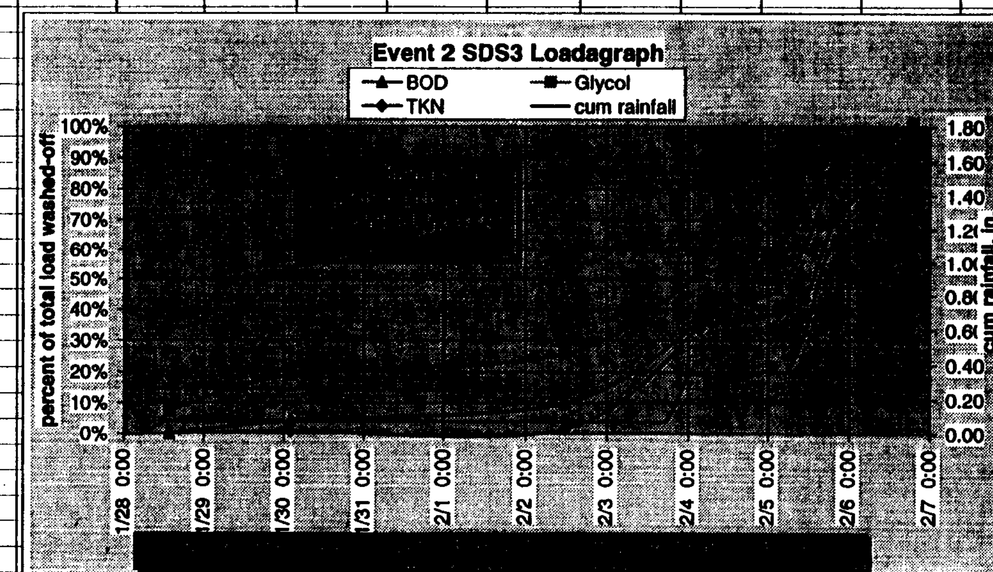



Event 2 6-hour precipitation
Precipitation, in
0.45
0.4
0.35
0.05
0
cum precipitation, in.
1.8
1.6
0.4
0.2
0.0
1/27 0:00
1/28 0:00
1/29 0:00
1/30 0:00
1/31 0:00
2/1 0:00
2/2 0:00
2/3 0:00
2/4 0:00
2/5 0:00
2/6 0:00
2/7 0:00
6 hour period ending


Event 2 SDS3 Pollutagraph
BOD
glycol
acetate
BOD and glycol, mg/l
500
450
400
350
300
250
200
150
100
50
0
acetate, mg/l
1400
1200
1000
800
600
400
200
0
1/28 0:00
1/29 0:00
1/30 0:00
1/31 0:00
2/1 0:00
2/2 0:00
2/3 0:00
2/4 0:00
2/5 0:00
2/6 0:00
2/7 0:00


Event 2 SDS3 Loadagraph
BOD
Glycol
TKN
cum rainfall
percent of total load washed-off
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
cum rainfall, in.
1.80
1.60
1.40
0.40
0.20
0.00
1/28 0:00
1/29 0:00
1/30 0:00
1/31 0:00
2/1 0:00
2/2 0:00
2/3 0:00
2/4 0:00
2/5 0:00
2/6 0:00
2/7 0:00

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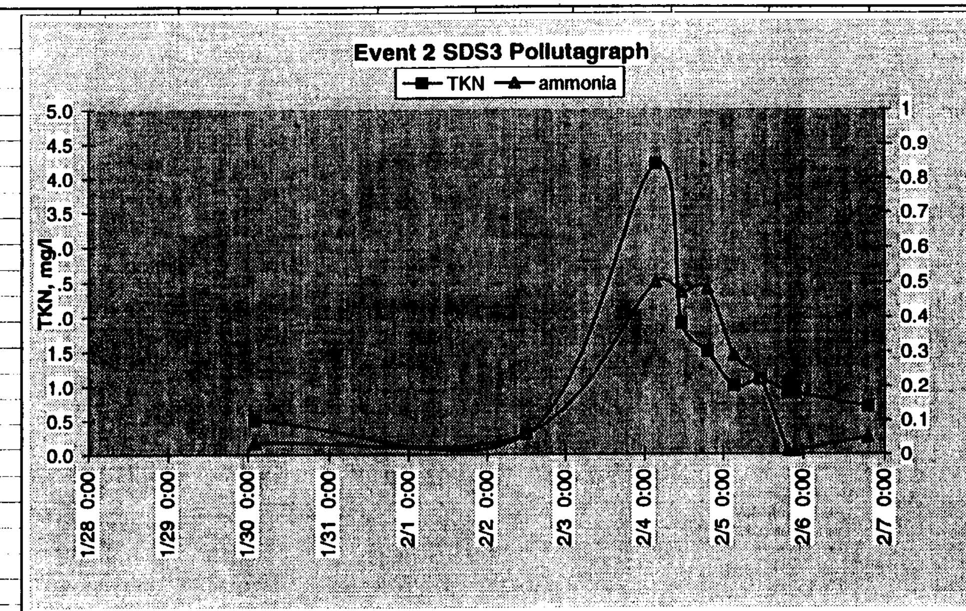
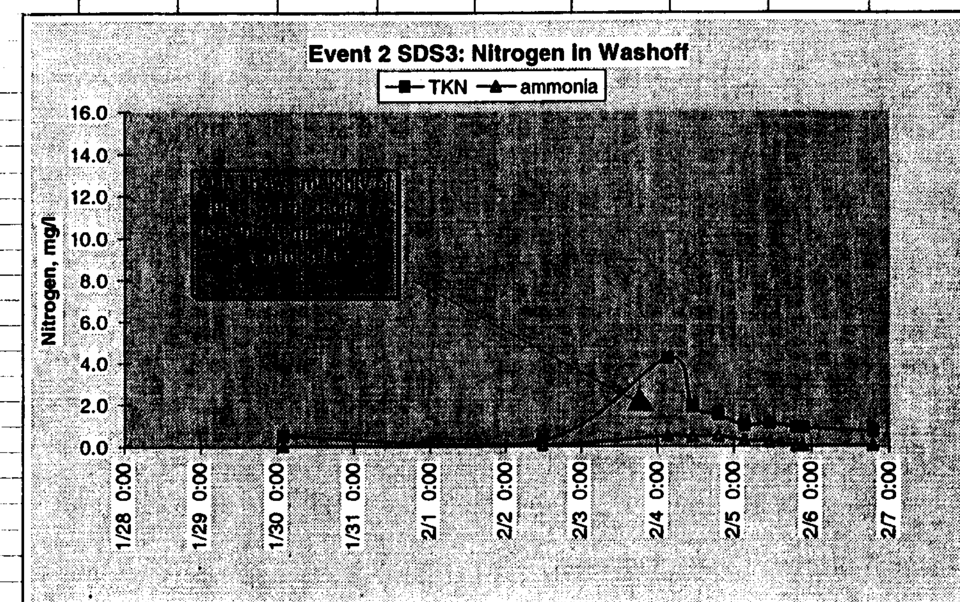
## 6-hr Precipitation Data

| | (POS + KCSWM data) | | | cum |
|---|---|---|---|---|
| | hour end | ppt, in. | total | % of total |
| 3650 gallons PMA | 1/27/96 0:00 | 0 | 0.00 | 0% |
| 16 L/R+drive lanes | 1/27/96 6:00 | 0 | 0.00 | 0% |
| | 1/27/96 12:00 | 0 | 0.00 | 0% |
| | 1/27/96 18:00 | 0 | 0.00 | 0% |
| 7500 gallons PMA | 1/28/96 0:00 | 0 | 0.00 | 0% |
| 16 L/R+A,B,N,M | 1/28/96 6:00 | 0 | 0.00 | 0% |
| | 1/28/96 12:00 | 0.07 | 0.07 | 4% |
| | 1/28/96 18:00 | 0 | 0.07 | 4% |
| 1550 gal urea N Sat | 1/29/96 0:00 | 0 | 0.07 | 4% |
| 2300 gal PMA 16L, B | 1/29/96 6:00 | 0 | 0.07 | 4% |
| | 1/29/96 12:00 | 0 | 0.07 | 4% |
| | 1/29/96 18:00 | 0 | 0.07 | 4% |
| 2750 gal PMA | 1/30/96 0:00 | 0 | 0.07 | 4% |
| 16 L/R+A,B | 1/30/96 6:00 | 0 | 0.07 | 4% |
| | 1/30/96 12:00 | 0 | 0.07 | 4% |
| | 1/30/96 18:00 | 0 | 0.07 | 4% |
| | 1/31/96 0:00 | 0 | 0.07 | 4% |
| | 1/31/96 6:00 | 0 | 0.07 | 4% |
| | 1/31/96 12:00 | 0 | 0.07 | 4% |
| | 1/31/96 18:00 | 0 | 0.07 | 4% |
| | 2/1/96 0:00 | 0 | 0.07 | 4% |
| | 2/1/96 6:00 | 0 | 0.07 | 4% |
| | 2/1/96 12:00 | 0 | 0.07 | 4% |
| | 2/1/96 18:00 | 0 | 0.07 | 4% |
| | 2/2/96 0:00 | 0 | 0.07 | 4% |
| | 2/2/96 6:00 | 0 | 0.07 | 4% |
| | 2/2/96 12:00 | 0 | 0.07 | 4% |
| | 2/2/96 18:00 | 0 | 0.07 | 4% |
| | 2/3/96 0:00 | 0 | 0.07 | 4% |
| | 2/3/96 6:00 | 0 | 0.07 | 4% |
| | 2/3/96 12:00 | 0 | 0.07 | 4% |
| | 2/3/96 18:00 | 0.02 | 0.09 | 5% |
| | 2/4/96 0:00 | 0.24 | 0.33 | 19% |
| | 2/4/96 6:00 | 0 | 0.33 | 19% |
| | 2/4/96 12:00 | 0 | 0.33 | 19% |
| | 2/4/96 18:00 | 0 | 0.33 | 19% |
| | 2/5/96 0:00 | 0.04 | 0.37 | 21% |
| | 2/5/96 6:00 | 0 | 0.37 | 21% |
| | 2/5/96 12:00 | 0.27 | 0.64 | 36% |
| | 2/5/96 18:00 | 0.42 | 1.06 | 60% |
| | 2/6/96 0:00 | 0.08 | 1.14 | 65% |
| | 2/6/96 6:00 | 0.02 | 1.16 | 66% |
| | 2/6/96 12:00 | 0.41 | 1.57 | 89% |
| | 2/6/96 18:00 | 0.15 | 1.72 | 98% |
| | 2/7/96 0:00 | 0.04 | 1.76 | 100% |

| | runoff equivalent, in. including snowmelt | | |
|---|---|---|---|
| sample | [redacted] | | equivalent |
| time | computed | cum | incident ppt |
| 1/28/96 13:30 | 0.022 | 0.000 | 0.00 |
| 1/30/96 2:00 | 0.021 | 0.021 | 0.03 |
| 2/2/96 11:45 | 0.047 | 0.068 | 0.08 |
| 2/4/96 3:14 | 0.119 | 0.187 | 0.22 |
| 2/4/96 11:14 | 0.016 | 0.203 | 0.24 |
| 2/4/96 19:14 | 0.017 | 0.220 | 0.26 |
| 2/5/96 3:14 | 0.017 | 0.237 | 0.28 |
| 2/5/96 11:14 | 0.065 | 0.302 | 0.36 |
| 2/5/96 19:28 | 0.446 | 0.747 | 0.89 |
| 2/5/96 21:28 | 0.038 | 0.786 | 0.94 |
| 2/6/96 19:00 | 0.625 | 1.411 | [redacted] |

[redacted]

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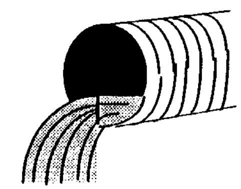
# Appendix C

## Wet Weather Inspection Results

**Port of Seattle** Sea-Tac Airport Stormwater Program

# Wet Weather Inspection for Permitted Outfalls
## Conducted April 26, 1996
**by Scott Tobiason, Peter Ressler**




| Outfall Name | Outfall # | Inspection point (1) | date (2) | depth of flow (3), in. | Indicate "Y" if present: floatables | suspended solids | oil sheen | discolorations | turbidity | odor | other | Remarks (4) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDE4 | 002 | 28th Ave S | 26-Apr | 5 | n | n | n | n | n | n | | inspected at 28th Ave S outfall, combined with others' runoff |
| SDS1 | 003 | outfall | 26-Apr | 1 | n | n | n | n* | n | n* | | *baseflow has iron bacteria, slight septic odor on 4/15/96 |
| SDS2 | 004 | outfall | 26-Apr | 1 | n | n | n | n | n | n | | |
| SDS3 | 005 | outfall | 26-Apr | 0.37 | n* | n | n | n | n | n | | * ~1 gallon styrofoam packing on 4/8/96 |
| SDN1 | 006 | drain inlet | 26-Apr | 0.2 | n | n | n | n | n | n | | |
| SDN2 | 007 | manhole | 26-Apr | 3.5 | n | n | n | n | n | n | | |
| SDN3 | 008 | outfall | 26-Apr | 0.75 | y | n | n | n | n | n | | occasional small patchy surface foam, looks typical. Surfactant history: 0.1 ppm max, 5 non-detects |
| SDS4 | 009 | outfall | 26-Apr | 4 | y | n | n | n | n | n | | occasional small patchy surface foam, looks typical. Surfactant history: 0.2 ppm max, 4 of 7 non-detected |
| SDW3 | 010 | outfall | 26-Apr | 2 | n | n | n | n | n | n | | |
| Eng Yard | 012 | drain inlet | 26-Apr | trickle | n | n | n | n | n | n | | |
| Taxi Yard | 013 | drain inlet | 26-Apr | trickle | n | n | n* | n | n | n | | *free product found in catch basin filter on 4/11/96 |

**notes:**

1. Inspection points at first visible point downstream from outfalls with monitoring points below the surface (SDE4, SDN1, SDN2, EY, TY)
2. Quarterly sampling sites visited on numerous other dates during this wet season, findings indicated with " * " above
3. Depths of flow are approximate, unless registered by local monitoring equipment.
4. Other observations included to account for numerous other site visits during this wet season.

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