Declaration of
Linda Logan, Ph.D.

POLLUTION CONTROL HEARINGS BOARD
FOR THE STATE OF WASHINGTON

AIRPORT COMMUNITIES COALITION, Appellant, v. DEPARTMENT OF ECOLOGY and THE PORT OF SEATTLE, Respondents.	No. PCHB 01-133 DECLARATION OF LINDA R.J. LOGAN, PH. D.

LINDA R.J. LOGAN declares as follows:

1. Identity of Declarant. I am over the age of 18 years, am competent to testify as a witness herein, and have personal knowledge of the facts stated in this declaration.

2. Education and Professional Experience. I have a Ph.D. in Environmental Geochemistry and Health; a Master of Science, Diploma of Imperial College, Environmental Technology; and a Bachelor of Environmental Science, Geological Sciences. I have over 10 years of consulting experience in risk assessment, environmental chemistry, analytical chemistry, stormwater quality and toxicity, and development of site-specific water quality standards. Recent work has included technical support to clients with respect to Clean Water Act 404 permits and 401 certifications, particularly with respect to the quality and toxicity of stormwater and using water effect ratio techniques to develop site-specific standards. I am currently employed as a Division

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ORIGINAL

Manager at Parametrix, Inc. A copy of my professional resume is attached as Exhibit A to this declaration.

3. Familiarity With Master Plan Update Projects at Seattle-Tacoma International Airport. I have worked for over two years on the water quality issues associated with the Master Plan Update projects at the Seattle-Tacoma International Airport ("STIA"). In addition to my familiarity with that proposed project and the current stormwater controls at STIA, I have reviewed the declarations submitted to the Washington Pollution Control Hearings Board by the Airport Communities Coalition ("ACC") with respect to water quality issues; all comment letters and responses regarding water quality issues in the §404 permitting process and §401 certification process for the STIA Master Plan Update projects involved in those processes; the annual stormwater monitoring reports prepared by the Port of Seattle for 1999, 2000 and 2001; the de-icing studies prepared for the Port by Cosmopolitan Engineering Group; the Dissolved Oxygen studies prepared by the Port for 1999-2000; the NPDES permit for STIA; the filter media studies for BMP evaluation done by Parametrix and the Port for potential BMP design at STIA; the whole effluent toxicity testing results performed by Parametrix for the Port at STIA pursuant to the STIA NPDES; the range-finding water effect ratio studies performed at STIA; and a number of other studies, reports and procedural guidance documents that are mentioned in the remainder of this declaration.

4. Purpose of Declaration. The purpose of this declaration is to respond to statements and opinions in the declarations supporting ACC's motion to stay to the Pollution Control Hearings Board. My comments and opinions all deal with water quality issues and are organized in five categories: (1) current compliance with water quality standards at STIA; (2) the whole effluent toxicity (WET) testing program at STIA; (3) the requirement to conduct a water effect ratio or other site-specific study at STIA; (4) tissue screening concentrations for lead and zinc in cutthroat trout, and (5) the impacts from use of glycols for de-icing operations at STIA.

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Current Compliance With Water Quality Standards at STIA

5. As Parametrix and the Port stated in the responses to comments from ACC during the 401 and 404 permitting process, ACC's contention that in-stream water quality standards are being persistently violated is unfounded. ACC's implication that there is no reasonable assurance that the new project will meet water quality standards is also unfounded. ACC's conclusions in this regard seem to be based primarily on a comparison of chemical concentration data from end-of-pipe stormwater samples (or worse, within-pipe stormwater samples) with the generic numerical water quality criteria for receiving streams in WAC 173-201A. It is invalid to conclude that end-of-pipe tests (which are not in waters of the state) show that numerical water quality standards (which apply to in-stream waters of the state) are not being complied with. Even ACC's comparisons to apparent in-stream data (1997) are invalid without information on where, when, or how the samples were taken. The Port owns only a small portion of the relevant watersheds of Miller, Walker and Des Moines creeks, and without further documentation it is impossible to determine compliance, even if numerical water quality standards applied to stormwater at STIA. Furthermore, ACC makes comparisons to chronic (long term) criteria, which are inappropriate for the short duration of stormwater discharges at STIA. As discussed in more detail below, there are several lines of evidence that provide reasonable assurance that the projects at STIA for which the §404 permit is required will meet water quality regulations applicable to stormwater.

6. Washington Department of Ecology regulations for water quality state that "the primary means to be used for requiring compliance with the [water quality] standards shall be through best management practices required in waste discharge permits, rules, orders, and directives issued by the department for activities which generate stormwater pollution." WAC 173-201A-160(3)(d) (emphasis added). Consistent with this regulation, the Port's NPDES permit regulates stormwater discharges from STIA through the use of best management practices ("BMPs). The NPDES permit for STIA requires BMPs and does not contain specific effluent limits for stormwater.

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A copy of the NPDES permit is attached to the accompanying declaration of Paul Fendt. There are no notices of violations of the NPDES permit, and the NPDES permit itself states that "Compliance with this permit is deemed compliance with the Federal Water Pollution Control Act, also known as the Clean Water Act (33 U.S.C. §1251 et seq.) and the Water Pollution Control Act (RCW 90.48)." ACC has presented no documentation showing any present violation of the NPDES permit.

7. In compliance with the NPDES permit, the Port conducts annual monitoring and testing of its stormwater outfalls for many parameters (TPH, TSS, turbidity, fecal coliform, BOD5, ethylene glycol, propylene glycol, copper, lead, and zinc). As described in its annual stormwater reports, the Port conscientiously investigates BMP maintenance, the source of potential contamination, and the feasibility of emerging BMP technologies. Given the state-of-the-science with respect to regulating stormwater, each of these activities contributes to a reasonable assurance that applicable water quality regulations will be met in the future. A copy of the Annual Stormwater Monitoring Report for STIA for the period of July 1, 1999 through June 30, 2000 is attached as Exhibit B to this declaration.

8. In ACC's comments to Ecology, and in the comments of Dr. Strand in his declaration supporting ACC's motion to stay before the Pollution Control Hearings Board, the ACC contends that there are existing, and persistent, in-stream violations of water quality criteria at STIA. ACC has not produced any documentation of such in-stream violations. In my professional opinion, the ACC conclusion is certainly not justified by the existing evidence and studies at STIA.

9. Unlike process water from a steady state industrial processor, stormwater is inherently variable – depending upon the nature of the storm event, the number of dry days prior to the storm event, the nature of the surface over which it drains, and other factors. Samples of end-of-pipe stormwater reflect this variability. For that reason, toxicity testing is a more reliable method to determine whether stormwater from a particular location is having a real adverse effect on water quality. At STIA, in addition to the whole effluent toxicity (WET) testing regime specified in the NPDES permit, toxicity testing of in-stream samples collected from Miller Creek, Walker Creek and

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Des Moines Creek, as well as STIA outfall SDS3, was conducted in 1999 (Parametrix, February 1999). Those tests showed no evidence of in-stream or outfall toxicity. A copy of these testing results is attached as Exhibit C to this declaration. The testing was done during a qualifying storm event in January 1999. (A "qualifying" storm event is defined in the testing protocols pursuant to the STIA NPDES, and requires an event of a certain size, within a certain time period, and after a dry period of a certain time, in order to obtain a representative sample of stormwater quality.) During that event, the Port collected in-stream samples from Miller Creek, Walker Creek, the east and west branches of Des Moines Creek, as well as outfall SDS3. Outfall SDS3 was selected for toxicity testing since it drains a majority of the STIA airfield (runways, taxiways, and infields) and is therefore representative of future stormwater runoff from the new third runway project (which is primarily runways, taxiways and infields). All samples were tested for toxicity using a sensitive freshwater test species, *Ceriodaphnia dubia,* using standard test protocols (U.S.EPA 1993, WDOE 1997) at a Department of Ecology accredited testing laboratory. All samples were tested undiluted and none exhibited toxicity to *C. dubia* (i.e., there was 100 percent survival in 100 percent of the site and outfall water). All control responses and reference toxicant results were within acceptable ranges for all tests. To further test future conditions expected, SDS3 runoff was proportionally mixed with Miller Creek and Walker Creek for toxicity testing. As with the unmixed samples, the resultant "site-water" was also not toxic since *C. dubia* exhibited 100 percent survival in these mixed samples also. Total recoverable and dissolved concentrations of copper, lead and zinc were measured for all these in-stream samples. For most samples, dissolved copper was below detection levels, and the highest total recoverable copper was 3.3 micrograms per liter. For all samples, dissolved lead and total recoverable lead was below detection levels. For all samples dissolved zinc was below detection levels, and the highest total recoverable zinc was 20 micrograms per liter. All of these concentrations are below the hardness-corrected numeric limits in Washington state water

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quality standards. In sum, the results showed no toxicity for the in-stream water in creeks near STIA, and showed concentrations of metals below water quality standards.

10. The following procedural protocol documents were referenced for these test procedures and report at Exhibit C:

- U.S. Environmental Protection Agency 1993. Methods for measuring the acute toxicity of effluents and receiving water freshwater and marine organisms. EPA/600/4-90/027F August 1993. U.S. Environmental Protection Agency, Cincinnati, Ohio; and
- Washington Department of Ecology 1997. Laboratory guidance and whole effluent toxicity test review criteria. Washington State Department of Ecology, Publication No. WQ-R-95-80. Revised March 1997.

The Whole Effluent Toxicity and BMP Testing Program at STIA

11. In compliance with Special Condition S10 of the NPDES permit for STIA, the Port has completed at least two rounds of whole effluent toxicity (WET) testing at four of its stormwater outfalls. The outfalls are two outfalls in the Miller Creek basin and two outfalls in the Des Moines Creek basin: outfalls SDS3, SDE4, SDN4 and SDN1. As mentioned above, the SDS3 outfall is the largest runway and taxiway outfall at STIA, and includes stormwater from runways, taxiways and infields at STIA. This is a good surrogate for the new third runway project at STIA, which will also be comprised of runway, taxiways and infield uses. The results of this testing have been reported in the Port's annual stormwater monitoring report (Exhibit B to this declaration) and in a required summary report delivered to Ecology in May 2000 – the Stormwater Whole Effluent Toxicity (WET) Testing at Seattle-Tacoma International Airport Final Report (May 2000). A copy of this report is attached as Exhibit D to this declaration.

12. Whole effluent toxicity (WET) testing, as its name implies, tests the toxicity of the whole sample, rather than testing for the toxicity due to a single chemical. The tests are conducted according to standard protocols using standard sensitive aquatic species such as the waterflea,

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Ceriodaphnia dubia, or juvenile fathead minnows, *Pimephales promelas*. WET testing is a standard approach in the scientific community for measuring the toxicity of effluents, and the protocols were originally developed and adopted by EPA in the mid-1980s. The state of Washington Department of Ecology has developed its own approved testing criteria based on the EPA protocols (WDOE 1998a).

13. WET testing has several advantages over standard chemical analysis of discharges. First, it relies on biology, not chemistry, as a measure of aquatic life protection. Second, because WET testing tests the "whole effluent," it provides a test of what the affected aquatic organisms actually "see" with regard to the multitude of constituents, known or unknown, in any one sample.

14. Of the four outfalls tested by the Port, three of the outfalls (SDE4, SDS3, and SDN4) met Ecology's performance criteria for organism survival in undiluted, 100 percent stormwater. This includes outfall SDS3, which is representative of the proposed third runway project.

15. Because the WET testing showed that performance criteria were not met for outfall SDN1, the Port conducted further rounds of toxicity testing (i.e., beyond permit requirements) and proactively undertook a source tracing study (POS May 2000; Tobiason and Logan, 2000). The study used concurrent WET testing and chemical-specific analysis to identify what stormwater constituents might be responsible for the observed toxicity and where their source might be. By working back up-the-pipe and using metal chelating techniques (described by Hockett and Mount (1996)), toxicity was attributed to zinc from uncoated galvanized rooftops in the SDN1 subbasin.

16. Based on the above, the Port is currently undertaking further research on the efficacy of different filter media in stormfilter units for metals removal and toxicity reduction of stormwater like that from the SDN1 subbasin. To date, the Port has completed a number of laboratory scale studies using simulated stormwater spiked at three different target zinc concentration. Test media have included both commercially available media as well as newer experimental media. For this particular issue at SDN1, there are BMPs that can be designed to address the issue – either by the use

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of filtering media (to treat the runoff) or by coating or otherwise treating the rooftop (to treat the source). This result presents no problem for the new projects covered by the Ecology §401 Certification, however, because those projects will simply be required to be constructed non-leaching rooftops, which are easily available commercially.

17. In conclusion, the WET testing program at STIA is functioning exactly as designed for existing operations of an already-constructed facility. This approach allows the Port and Ecology to identify any potential problems, trace the potential problem, and design or apply appropriate BMPs to remedy the problem. The knowledge gained from the WET testing also allowed Ecology to be reasonably assured future STIA stormwater will meet applicable water quality regulations. The results from outfall SDS3, which showed no whole effluent toxicity problems, represent the same types of uses that will be discharging from the new third runway and taxiways. There is also reasonable assurance regarding the new rooftop areas on other portions of the new project (e.g., SASA) because they will utilize non-leaching rooftop materials as an effective BMP.

18. In addition to the studies cited above, the following were reviewed in connection with the whole effluent toxicity section of this declaration:

- Ecology (Washington State Department of Ecology). 2000 Stormwater Management Manual for Western Washington. Volume V Runoff Treatment BMPs. August 2000 (Final Draft). Publication No. 99-15;
- Hockett, J.R. and Mount, D.R. 1996. Use of Metal Chelating Agents to Differentiate among Sources of Acute Aquatic Toxicity. Environ. Toxicol. Chem. 15 (10): 1687-1693;
- Tobiason, S., and L.R.J. Logan. 2000. Whole effluent toxicity (WET) testing and source tracing at Seattle-Tacoma International Airport. Presented at WEFTEC 2000, Annual Conference of the Water Environment Federation, Anaheim, CA. October 2000;
- WDOE 1998b. Whole Effluent Toxicity (WET) Evaluation Summary. Publication # 98-03. Washington Department of Ecology. February 1998;

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- WDOE 1998a. Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria. Publication #WQ-R-95-80. Washington Department of Ecology. December 1998.

The Requirement to Conduct a Water Effect Ratio or Other Site-Specific Study

19. In response to past concerns regarding stormwater from STIA, the Port has proactively undertaken several water quality screening studies to evaluate the development of site-specific water quality criteria in accordance with WAC 173-201A-040. WAC 173-201A-040 (3) states "The department may revise [water quality] criteria on a state-wide or waterbody-specific basis as needed to protect aquatic life occurring in waters of the state and to increase the technical accuracy of the criteria being applied." This is more specifically defined in footnotes to the numerical criteria tables (see footnote dd) which states "Metals criteria may be adjusted on a site-specific basis when data are made available to the department clearly demonstrating the effective use of the water effects ratio approach established by USEPA, as generally guided by the procedures in USEPA Water Quality Standards Handbook, December 1983, as supplemented or replaced."

20. The U.S. EPA first published guidelines for developing site-specific water quality criteria in the early 80's (U.S.EPA 1983; U.S. EPA 1984). These were later modified in 1994 (U.S. EPA 1994, see Appendix L). Based on those federal guidelines, the Washington Department of Ecology has incorporated its own guidelines on conducting a water effect ratio (WER) study in Appendix 6 of the DOE permit writer's manual (DOE Jan 2001)

21. The premise behind the WER approach is that the bioavailability (and hence toxicity) of chemicals in receiving streams, creeks, or rivers, is reduced by the presence of natural constituents such as suspended particles or organic matter. This is in contrast to the laboratory water or spring water used in the toxicity tests upon which the generic water quality criteria are based. In a WER study, concurrent toxicity tests are used to calculate the ratio of a chemical's toxicity in site-water to its toxicity in laboratory, or spring, water. The chemical of concern is spiked into the laboratory water and site-water at known concentrations. A median lethal concentration is then determined for

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each water, and the two are compared to generate a WER: This ratio provides an empirical determination of the difference in metal bioavailability –attributed to site-water– and is used to adjust the generic water quality criterion: For example, if the water quality criterion for a chemical is 3 µg/L, and a WER of 3 is derived for a particular site, the resulting site-specific water quality criterion would be 9 µg/L. The resulting standard gives the necessary level of protection intended by the more generic (laboratory water) standard, but with the standard adjusted for the particular characteristics of the water in that particular stream.

22. As the science of metals bioavailability and toxicity has advanced in recent years, particularly in the stormwater arena where site-specific conditions are far removed from laboratory conditions, there is increased recognition of a need to derive site-specific criteria (Carlson et al. 1986; Diamond et al. 1997; Paulson and Amy, 1993; Hall et al 1997; Paquin et al 2000; Allen and Hansen 1996). Indeed, a recent review of proposed federal water quality standards for Indian Country (*Federal Register Proposed Rule January 18, 2001*) shows that all metals criteria are to be explicitly calculated using a WER.

23. To this end the Port conducted a "range-finding" WER study for copper in February 1999 (Parametrix, April 1999). A range-finding WER differs from a comprehensive WER study in that it is based on nominal chemical concentrations and does not examine the effects of seasonal variation. As discussed in Ecology's WER guidance, a preliminary range-finding study is highly recommended since it provides an excellent indication of what the WER might be for a site prior to embarking on a comprehensive study. In layman's terms, the range-finding study is a good predictor of the range within which the WER standard would fall.

24. The February 1999 range-finding study at STIA used three different types of site-water to calculate a WER for copper. Two of the site-waters consisted of SDS3 stormwater mixed with Miller Creek water and Walker Creek water, in ratios anticipated for the new outfalls. That is, it was assumed that the water quality characteristics of current runway and taxiway runoff from

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SDS3, as well as Miller Creek and Walker Creek water quality, are representative of future conditions. The third site-water tested consisted of Des Moines Creek water sampled downstream of SDS3. Concurrent site-water and laboratory-water toxicity tests were conducted using standard protocols (U.S.EPA 1993) with the sensitive freshwater species, *Ceriodaphnia dubia* (waterflea).

25. Based on nominal concentrations for total copper, copper WERs for Miller, Walker and Des Moines Creeks ranged from 7 to 16. That is, copper was shown to be between 7 and 16 times *less* toxic in site-water (i.e., Miller Creek, Walker Creek and Des Moines Creek waters) than in the laboratory water.

26. A second range-finding study for copper was conducted in April 2000 . This time, site-water consisted of receiving stream water collected upstream of the Port's outfalls, and sufficiently downstream to represent a "complete-mix" scenario in accordance with U.S. EPA (1994). Five different types of site-water were tested, two representing upstream conditions and three representing complete-mix conditions. As with the previous range-finding study, these five different site-waters all resulted in nominal copper WERs of around 15 and higher. Again showing that in site-water, copper was 15 or more times *less* toxic than in standard laboratory water.

27. In conclusion, the two range-finding studies show that development of site-specific standards are feasible for STIA. The site-specific standard for copper would be expected to be within the range of standards discussed above – that is, the site-specific standard for copper would be from 6 to 17 times the generic numeric ambient water quality standard. It should be stressed, however, that this is not a decrease in the protectiveness of the standard. The site-specific standard would be just as protective (in site-specific water) as the generic standard (for the laboratory water on which that generic standard was based).

In addition to the materials cited above, the following materials were referenced for this section of my declaration:

AR 012691

- Allen, H.E. and D.J. Hansen 1996. The importance of trace metal speciation to water quality criteria. Water Environment Research. 68(1):42-54;
- Carlson, A.R., H. Nelson, and D. Hammermeister. 1986. Development and validation of site-specific water quality criteria for copper. Environ. Toxicol. Chem. 5:997-1012;
- Diamond, J.M., C. Gerardi, E. Leppo, and T. Miorelli. 1997. Using a water-effect-ratio approach to establish effects of an effluent-influenced stream on copper toxicity to the fathead minnow. Environ. Toxicol. Chem. 7:1480-1487;
- Hall, J.C., W.T. Hall, C.T. Simmons. 1997. Water Quality Criteria for Copper: A need for revisions to the national standard. Water Environment & Technology. June 1997:45-49;
- Paquin, P.R., R.C. Santore, K.B. Wu, C.D. Kavvadas, D.M. Di Toro. 2000. The Biotic Ligand Model: a model of the acute toxicity of metals to aquatic life. Environmental Science & Policy. 3:175-182; Paulson, C.,
- G. Amy. 1993. Regulating Metal Toxicity in Stormwater. Water Environment & Technology. July 1993:44-49;
- U.S. EPA. 1983. Guidelines for deriving site-specific water quality criteria. Chapter 4. *In:* Water Quality Standards Handbook. Office of Water Regulations and Standards, Washington, D.C;
- U.S. EPA. 1984. Guidelines for Deriving Numerical Aquatic Site-Specific Water Quality Criteria by Modifying National Criteria. EPA/600/3/84/099. Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Duluth, MN;
- U.S. EPA. 1993. Methods for measuring the acute toxicity of effluents and receiving waters to freshwater and marine organisms. (4th Edition) EPA-600/4-90/027F;
- U.S. EPA. 1994. Interim guidance on determination and use of water-effect ratios for metals. Appendix L of the Water Quality Standards Handbook: Second Edition. EPA/823/B94/005a. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.;
- WDOE. 1999. Draft Water Effect Ratio Section of the Permit Writer's Manual.

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Tissue Screening Concentrations For Lead And Zinc In Cutthroat Trout

29. In his declaration to the Pollution Control Hearing Board, Dr. Strand states that lead and zinc concentrations in cutthroat trout exceed their respective tissue screening concentrations (TSCs) derived by Shephard (1999). Before commenting on the applicability of these TSCs to cutthroat trout, it is important to emphasize that, as the name suggests, these are just screening concentrations. This is a particularly important consideration for mobile fish species (e.g., trout) that may be exposed to metals that are ubiquitous in urban environments. In these cases, it is not possible to link the measured metal concentration to an individual source.

30. Moreover, the TSCs derived by Shephard are inappropriate to trout and alternative fish-specific TSCs, as described below, are more applicable. However, even at the more appropriate screening criteria, any tissue-based toxicity value for fish should be considered a screening concentration and does not provide conclusive evidence of potential risk or link potential risk to an individual chemical source.

31. The Shephard TSCs reported as the basis for Dr. Strand's contention that lead and zinc are chemicals of concern are 0.32 and 100 mg/kg dry weight (dw) for lead and zinc, respectively. There are three primary reasons why the Shephard TSCs are not applicable to tissue residue data for cutthroat trout. First, the Shephard TSCs are based on a water quality criterion (WQC) which is designed to be protective of 95 percent of the species in an aquatic community. For metals, the WQC is usually driven by sensitive invertebrates, and not specifically applicable to trout. Second, the metal bioconcentration factors (BCF) used by Shephard are highly species-specific because of the wide range of mechanisms aquatic biota have to regulate and/or store metals. Thus, without more information on the basis of the BCF used to derive the TSC, it is uncertain whether the BCF is even relevant to cutthroat trout. The third issue is also related to the BCF and how, for metals, it tends to be highly dependent on the exposure concentration. For most metals and species, the BCF and exposure concentration are inversely related (i.e., the BCF increases as the exposure

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concentration decreases). Therefore, it is always suspect when applying an individual BCF for metals.

32. Based on all three of these issues, Parametrix independently derived what we feel are more appropriate estimates of metal TSCs for cutthroat trout based on (1) chronic toxicity data for trout or salmon species; (2) fish-specific BCFs; and (3) BCFs expressed as a function of the exposure concentration of interest (in this case the chronic toxicity value identified for trout or salmon species). This fish-specific approach for deriving TSCs is more appropriate for interpreting cutthroat trout tissue residue data than those derived by Shephard for the protection of 95% of the aquatic community. The TSCs derived using this method tend to be over an order of magnitude (10 times) greater than those reported by Shephard. This is primarily driven by using direct measures of trout or salmon sensitivity to metals in deriving fish-specific TSCs, rather than use of the WQC which are often driven by more sensitive invertebrates. The concentrations of lead, zinc, and copper cited by Dr. Strand in cutthroat trout do not exceed the fish-specific TSCs derived using the alternate, and more appropriate, approach.

33. The following literature was reviewed and utilized in preparation of this portion of this declaration:

- Brix, K.V. and D.K. DeForest. 2000. Critical review of the use of bioconcentration factors for hazard classification of metals and metal compounds. OECD Aquatic Hazards Extended Workgroup Meeting, Paris, France. May 15, 2000;
- Cairns, M.A., R.R. Garton, and R.A. Tubb. 1982. Use of fish ventilation frequency to estimate chronically safe concentrations. Trans. Amer. Fish. Soc. 111:70-77.;
- Chapman, G.A. 1975. Toxicity of copper, cadmium, and zinc to Pacific northwest salmonids. Interim Report. U.S. EPA, Corvallis, Oregon.;
- Dyer, S.D., C.E. White-Hull, and B.K. Shephard. 2000. Assessments of chemical mixtures via toxicity reference values overpredict hazard to Ohio fish communities. Environ. Sci. Technol. 34:2518-2524.;

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- Farmer, G.J, D. Ashfield, and H.S. Samant. 1979. Effects of zinc on juvenile Atlantic salmon *Salmo salar*: acute toxicity, food intake, growth and bioaccumulation. Environ. Pollut. 19:103-117.;
- Holcombe, G.W., D.A. Benoit, E.N. Leonard, and J.M. McKim. 1976. Long-term effects of lead exposure on three generations of brook trout (*Salvelinus fontinalis*). J. Fish. Res. Board Can. 33:1731-1741.:
- Holcombe, G.W., D.A. Benoit, and E.N. Leonard. 1979. Long-term effects of zinc exposures on brook trout (*Salvelinus fontinalis*). Trans. Am. Fish. Soc. 108:76-87.;
- Lind, D., K. Alto, and S. Chatterton. 1978. Regional copper-nickel study; aquatic toxicology study. 1978. Unpublished report by Minnesota Environmental Quality Board. Minnesota. 53p;
- McKim, J.M., J.G. Eaton, and G.W. Holcombe. 1978. Metal toxicity to embryos and larvae of eight species of freshwater fish. II. Copper. Bull. Environ. Contam. Toxicol. 19:608-616.;
- Phillips, D.J.H. and P.S. Rainbow. 1989. Strategies of trace metal sequestration in aquatic organisms. Mar. Environ. Res. 28:207-210;
- Sauter, S., K.S. Buxton, K.J. Macek, and S.R. Petrocelli. 1976. Effects of exposure to heavy metals on selected freshwater fish. Toxicity of copper, cadmium, chromium and lead to eggs and fry of seven fish species. Office of Research and Development, U.S. Environmental Protection Agency, Duluth, Minnesota. EPA-600/3-76-105;
- Shephard, B.K. 1999. Quantification of ecological risks to aquatic biota from bioaccumulated chemicals. National Sediment Bioaccumulation Conference Proceedings Summary. http://www.epa.gov/OST/cs/confprod.html. Page 2-31 to 2-52;
- Sinley, J.R. and J.P. Goettl, Jr. 1974. The effects of zinc on rainbow trout (*Salmo gairdneri*) in hard and soft water. Bull. Environ. Contam. Toxicol. 12(2):193-201; U.S. EPA. 1985. Ambient aquatic life water quality criteria for copper. Office of Water, Regulations and Standards, Criteria and Standards Division. United States Environmental Protection Agency, Washington, D.C. EPA 440/5-84-031.;

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- U.S. EPA. 1985. Ambient aquatic life water quality criteria for lead. Office of Water, Regulations and Standards, Criteria and Standards Division. United States Environmental Protection Agency, Washington, D.C. EPA 440/5-84-027;
- Davies, P.H., J.P. Goettl, Jr., J.R. Sinley, and N.F. Smith. 1976. Acute and chronic toxicity of lead to rainbow trout Salmo gairdneri, in hard and soft water. Water Res. 10:199-206.

The Impacts From Use Of Glycols For De-Icing Operations At STIA

34. In his declaration, Dr. Strand raises concerns about glycol usage at STIA. Glycols are utilized as a safety feature to de-ice airplanes during certain weather conditions. As an initial matter, it should be noted that glycols are present only infrequently in the STIA stormwater. This is generally because of the relatively mild Seattle-Tacoma climate. Heavy glycol usage is usually limited to the infrequent, one to two day winter weather episodes. The vast majority of the glycols used are routed to the STIA Industrial Wastewater System ("IWS") – and not discharged to stormwater – because all glycol applications must take place in the portion of STIA that drains to the IWS. Any glycol that winds up in stormwater is usually the result of drip or shear off the wings of planes as they take off, or as they wait in line on a runway to take off.

35. When glycols have been detected in stormwater, the Port has implemented appropriate BMPs such as unclogging IWS drain inlets (possible cause of sporadic glycol detection in SDS3) and re-routing additional drainage areas to the IWS (POS September 2000). Monitoring for the year 2000-2001 period indicates that the IWS drain inlet is functioning and shows that glycol concentrations have been substantially reduced in SDS1 discharges.

36. Moreover, Dr. Stand based his comments on possible toxic effects of glycol on a single report (Hartwell 1995) that is contradicted by the great weight of scientific evidence on glycols and which is demonstrably incorrect.

37. In paragraph 20 of his declaration, Dr. Strand correctly identifies that Air Deicers and Anti-icing Fluids (ADAFs) are complex mixtures of known and confidential ingredients (USEPA

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2000). A survey conducted by the Air Transport Association in 1994 of ADAF manufacturers discovered that ADAFs typically consist of mixtures of:

- Ethylene (EG) or propylene glycols (PG),
- Water,
- Surfactants,
- Corrosion inhibitors (including flame retardants),
- pH buffers,
- Dyes,
- 1,4-Dioxane, and
- Complex polymers (thickening agents used in Type II and Type IV ADAFs).

As Dr. Strand noted, the contribution of these additives to ADAF toxicity has been documented, and these additives are suspected to account for much of measured ADAF aquatic toxicity (Cornell et al. 1998; USEPA 2000).

38. However, Dr. Strand fails to mention two additional critical pieces of information required for a complete evaluation of the toxicity of ADAFs to aquatic organisms. First, ADAF manufacturers have been reformulating their ADAF products during the last decade by changing the amounts and types of additives in a particular product, with the specific intent of reducing environmental impacts (USEPA 2000). Secondly, additives vary by the type of ADAF (either I, II, or IV), accounting, in part, for differences noted in toxicity between these types. For example, additives in Types II and IV are more toxic (frequently by an order of magnitude or more) than those in Type I (USEPA 2000). Consequently, any assessment of toxicity must, at a minimum, involve comparisons of toxicity studies of specific ADAF types to those types in particular use at an airport, and acknowledging the changing nature of ADAFs over the last decade.

39. In evaluating ADAF toxicity in Miller and Des Moines creeks, it is important to note that 99% of the ADAFs applied to commercial aircraft at the Seattle Tacoma International Airport

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(STIA) in 1998/1999 were either Type I EG or PG fluids (Table 1). The more toxic Types II and IV comprised only 1% of all ADAFs applied to aircraft at STIA during this time period (Table 1).

Table 1. Relative usage of aircraft de-icing / anti-icing fluids for April 1, 1998 – March 31, 1999 at the Seattle Tacoma International Airport (STIA). (This table is a reprint of Table 7-7, FAA 2000).

	Type I (EG)	Type I (PG)	Type II (PG)	Type IV (PG)
Percent of total ADAFs used	4.1%	94.8%	0.8%	0.2%

EG: ethylene glycol based PG: propylene glycol based

Therefore any evaluation of ADAF toxicity must involve comparing measured concentrations of EG and PG in stormwater discharges or Miller and Des Moines creeks to toxicity values measured for Type I EG or PG ADAFs (as was done in the Biological Assessment [FAA 2000]). Additionally, the older the study, the greater the likelihood that the tested material differs from the ADAF formulations being used today, introducing a greater level of uncertainty that must be taken in consideration in forming any conclusions about toxicity to aquatic resources.

40. In his comments about potential toxicity of glycols at STIA, Dr. Strand based his conclusions solely on a single study reported in Hartwell et al. 1995. The Hartwell study involved the toxicity testing of an unspecified formulation of Type I ethylene glycol (a de-icer) and an unspecified formulation of Type II propylene glycol (an anti-icer) in use at the Baltimore-Washington International Airport (BWI) in 1991, as well as the histological examination of fathead minnows following exposure to both ADAF types. Additionally, Dr. Strand relies significantly on a study cited in Hartwell et al. (1995) that is described in Fisher (1994) and Fisher et al. (1995). Fisher et al.'s study reported the results of the chemical analysis and toxicity tests conducted on stormwater effluent discharged from BWI during two separate deicing operations in 1993.

41. In his comment, Dr. Strand asserts "…that concentrations of total glycols cited in the 1999 and 2000 Annual Stormwater Monitoring Reports, and in the February 2001 stormwater analyses (Port 2001) also exceed the concentrations reported by Hartwell et al. (1995) to be toxic to aquatic life". Dr. Strand infers on the basis of this study that concentrations of total glycols present in Miller and Des Moines will result in (1) acute toxicity to fish exposed to total glycols in these

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creeks and that (2) exposed fish will form gill lesions from which it "…is reasonable to assume that a fish with these symptoms will die if the exposure continued at this same level". We address each assertion individually below in responding to Comment 21.

Dr. Strand's assertion that the total glycol concentrations present in Miller and Des Moines creeks will exceed the concentrations reported by Hartwell et al. (1995) to be toxic to aquatic life is flawed and incorrect on three points:

- The amounts of Type II Propylene glycol ADAF used at BWI in 1993 differed with the amounts of this ADAF type used at STIA in 1998/1999 making this comparison inappropriate;
- The general age of the Hartwell et al. 1995 study (conducted in 1991), resulting in an uncertain comparison of the toxicity of ADAFs in use in 1991 with the toxicity of ADAF formulations in use at STIA in 1999 and 2000;
- An incorrect reporting by Hartwell et al. 1995 of the toxicity data units presented in Fisher et al. 1995, resulting in a incorrect comparison by Dr. Strand between toxicity levels and watershed concentrations.

42. As noted above, determinations of toxicity should be made only between similar types of ADAFs. Patterns of ADAF use at STIA indicate that less than 1% of the ADAFs applied to commercial aircraft are Type II propylene glycol (Table 1 in response to Comment 20). These same data indicate that approximately 95% of propylene glycol based ADAFs applied in 1998/1999 at STIA were Type I. This difference is critical in that Type I propylene glycol anti-deicing fluids range from five to 100 times less toxic to the same test organisms than Type II propylene glycol anti-icing fluids (Table 9-4, page 9-45 in USEPA 2000). In contrast, Type II propylene glycol anti-icing fluids made up $\leq$ 10% of the ADAFs applied at BWI in 1993 (Hartwell et al. 1995).

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43. Dr. Strand's comparison of total glycols measured in Miller and Des Moines creeks to the Type II Propylene Glycol toxicity level reported in Hartwell et al. 1995 is inappropriate[1], in that it presumes 100% of the propylene glycol present is derived from Type II fluids. As Dr. Strand noted himself in Comment No. 20, on which we elaborated in our response to Comment No. 20, it is the type-specific additives that are primarily responsible for ADAF aquatic toxicity not the glycol component itself. Consequently, the ADAF additives contributing to toxicity in the Hartwell et al. (1995) study of Type II Propylene Glycol anti-icing fluids likely differ significantly from the additives present in the Type I Propylene Glycol anti-deicing fluids used at STIA. Therefore, Dr. Strand's observation that Hartwell et al. (1995) reports a toxicity level in the range of glycol concentrations found by the ACC is also inappropriate. Less than 1% of the propylene glycol present in the STIA watershed could be derived from Type II Propylene Glycol anti-icing fluids (based on data reported in Table 1). Therefore this toxicity level is not relevant to the conditions present in the STIA watershed and it is inappropriate to compare measured total glycols to a toxicity study of Type II Propylene Glycol anti-icing fluids.

44. Compounding the inappropriate comparison of ADAF types made by Dr. Strand is the difference in time between Hartwell et al's 1995 study (conducted in 1991) and the time when ACC in-stream measurements of glycols were conducted (presumably 2000 or 2001 as no date is specified in Dr. Strand's declaration). As noted in USEPA (2000), ADAF manufacturers have been reformulating their products to reduce environmental impact over the last decade. Consequently, there is a strong likelihood that that 1991 ADAF preparations analyzed in Hartwell et al. 1995 differed significantly in the types of additives present in each formulation used at STIA today.

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[1] Dr. Strand incorrectly reports that "...Hartwell et al. (1995) determined that the 7-day LC_{50} for commercial anti-icer to fathead minnow ranged between 24.2 and 43.3 mg/L, based on the concentration of total glycols in the test solution". Hartwell et al. (1995) actually reports in their Table 4 (p. 1379) that this data was for their Anti-Icer solution – meaning Type II Propylene Glycol. The use of total glycols in this sentence incorrectly implies that more than one type of glycol was present in the test solution.

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While the specific contributions of these differences are unknown, it does contribute to the level of uncertainty in Dr. Strand's analysis, and further calls into question his conclusions.

45. Lastly, and most importantly, available information indicates that the Hartwell et al. (1995) citation of the Fisher study is in error. Dr. Strand states in his declaration "*It is my opinion that de-icers and their additives can be toxic to aquatic life at relatively low concentrations (1.8-8.7 mg/L), which I base on the work of Hartwell et al. (1995)*". However, close examination of Hartwell et al. 1995 reveals that the values of 1.8 to 8.7 mg/L were not experimentally determined by Hartwell et al., but are actually a citation from work reported in another study (Fisher 1994; Fisher et al. 1995). Fisher et al. (1995) reports the results of acute whole effluent toxicity of storm water generated at BWI during two de-icing events in 1993. This study collected storm water effluent discharged from airport runways, and determined the toxicity of these effluents to standard EPA toxicity test organisms using serial dilutions. Concurrent chemical measurements were made for a number of chemical constituents, including various glycols (Fisher et al. 1995).

The first thing to note about the Fisher et al. 1995 study is that they conducted whole effluent toxicity tests on effluent consisting of a complex mixture of constituents (see their Table 8, p. 1109). These authors make a common assumption of attributing all the toxicity measured in this complex mixture to a single set of constituents – glycols – while discounting the potential contribution of other constituent to measured toxicity. For example, Fisher et al. 1995 reports 1,430 µg/L Zinc at a hardness of ~800 mg/L $CaCO_3$ in the sample collected at Site 1 during Event No. 2, but fail to consider the contribution of this metal to the toxicity observed in this sample.

Even discounting this issue, a careful examination of Fisher et al. 1995 revealed that Hartwell et al. 1995 misidentified the concentrations of acute effluent toxicity to fathead minnows (*Pimephales promelas*) and *Daphnia magna* reported by Fisher et al. 1995 by a factor of 1,000. That is, the actual LC50 values for *Daphnia magna* reported by Fisher et al. 1995 range from 1,998 to 8,666 mg/L

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(Table 2) and not the 1.8-8.7 mg/L as reported in Hartwell et al. 1995 and used by Dr. Strand in formulating his opinion stated in his declaration.

Table 2. Sample concentration data, measured and calculated *Daphnia magna* LC50s using data from Fisher et al. 1995.

Effluent Sample[a]	Concentrations in Effluent Sample (mg/L)				Measured 48-h LC50 as % Effluent Sample[b]	Measured LC50 as Total Glycols (mg/L)[b]	Calculated LC50 as Total Glycols (mg/L)[c]
	Ethylene Glycol	Diethylene Glycol	Propylene Glycol	Total Glycol			
Event 1, Peak	13,000	ND	2,800	15,800	54.8%	8,666	8,658.4
Event 1, Composite	6,600	300	1,700	8,600	69.3%	5,960	5,959.8
Event 2, Peak	98,000	2,900	130,000	230,900	1.7%	3,988	3,925
Event 2, Composite	31,000	1,500	85,000	117,500	1.7%	2,003	1,998

[a]Event 1 samples were collected at Site 1 on 2/12/93 and Event 2 samples were collected at Site 1 on 2/26/93 (Fisher et al. 1995)
[b]As reported in Fisher et al. 1995
[c]Calculated by Parametrix by multiplying the Measured 48h LC50 as % Effluent Sample times the total glycol concentration in each effluent sample

46. If the values reported in Fisher et al. 1995 are correct and the values reported in Hartwell et al. 1995 incorrect, then the "*relatively low concentration*" referred to in Dr. Strand's declaration that "*it is* [his] *opinion that de-icers and their additives can be toxic to aquatic life at relatively low concentrations*" is off by a factor of 1,000, and therefore inappropriate for the basis of this opinion.

47. In an effort to determine which of these reported values is correct, we multiplied the 48-h LC50 as % effluent data reported by Fisher et al. (1995) in their table 4 (p. 1107) by the reported total glycol (in mg/L) reported in their Table 5 (p. 1108). These calculations (reported in the far right column in Table 2) closely confirms the *Daphnia magna* 48-h LC50 as mg/L total glycol data reported in table 6 of Fisher et al. 1995 (p. 1108).

48. The *D. magna* total glycol LC50's reported by Fisher et al. 1995 were further compared to other *D. magna* LC50's summarized in USEPA (2000) (Table 3). Reported *D. magna* LC50 and EC50s for Type1 and Type II Ethylene and Propylene Glycol fluids range from 120 to 26,

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185 mg/L (Table 3). Thus, the LC50's reported by Fisher et al. (1995) for mixtures of ethylene glycol, diethylene glycol, and propylene glycol (1,998 to 8,666 mg/L) fall squarely within the range reported by USEPA (2000) for other studies.

Table 3. Acute Toxicity Data for Type I and II Formulated Fluids (taken from Table 9-4, page 9-45 of USEPA 2000).

Species	Duration and Endpoint	Fluid Type	Life Stage	Temp (°C)	Concentration of Ethylene Glycol Formulated Fluid (mg/L)	Concentration of Propylene Glycol Formulated Fluid (mg/L)	Reference
Water Flea (*Daphnia magna*)	48-hr LC_{50}	I	<24 hr	20	26,185	4,192	Beak Consultants 1995
	48-hr EC_{50}	I	<24 hr	20-21	7,100	6,000	Ward 1994
	48-hr EC_{50}	II	<24 hr	19-20	120	280	Ward 1994

49. The final line of evidence that the range reported by Fisher et al. 1995 is the correct one comes from the experimental data reported by Hartwell et al. 1995 themselves (Table 4a). These authors report LC50s and EC50s for fathead minnow, *D. magna, D. pulex, Ceriodaphnia dubia* in the somewhat unusual volume/volume units of ml/L (Table 4a).

Table 4a. LC50s (EC50s for *C. dubia*) expressed as ml/L from toxicity tests of ethylene glycol de-icer and propylene glycol anti-icer solutions to fish and zooplankton (reproduced from Table 4 of Hartwell et al. 1995).

Species	De-Icer Solution (EG Type I)			Anti-Icer Solution (PG Type II)		
	48-Hr	96-Hr	7-d	48-Hr	96-Hr	7-d
Fathead Minnow	9.82	9.82	9.82	0.07	0.03	0.03
Daphnia magna	13.48	3.83	-	0.24	0.05	-
Daphnia pulex	8.44	4.25	-	0.27	0.06	-
Ceriodaphnia dubia	12.85	8.95	3.02	0.44	0.12	0.07
Reproduction MATC	-	-	0.38	-	-	0.05

50. Using the data provided in Table 2 of Hartwell et al. 1995, we converted this table to mg/L units by developing a regression equation between volume/volume units (ml/L) and weight/volume units (mg/L) (Equation 1).

Equation 1: $y\,(\text{mg/L}) = 1096.4 \times x\,(\text{mL/L}) + 0 \;\; (r^2 = 0.9988)$

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Using this equation, we calculated equivalent mg/L LC50 and EC50's for these test organisms (Table 4b). Thus the experimental data produced by Hartwell et al. directly parallels and confirms the LC50s reported in Table 9-4 of USEPA 2000.

Table 4b. LC50s (EC50s for C. dubia) expressed as mg/L from toxicity tests of ethylene glycol de-icer and propylene glycol anti-icer solutions to fish and zooplankton (reproduced from Table 4 of Hartwell et al. 1995).

Species	De-Icer Solution (EG Type I)			Anti-Icer Solution (PG Type II)		
	48-Hr	96-Hr	7-d	48-Hr	96-Hr	7-d
Fathead Minnow	10,766.5	10,766.5	10,766.5	76.7	32.9	32.9
Daphnia magna	14,779.2	4,199.1	-	263.1	54.8	-
Daphnia pulex	9,253.5	4,659.6	-	296.0	65.8	-
Ceriodaphnia dubia	14,088.5	9,812.6	3,311.1	482.4	131.6	76.7
Reproduction MATC	-	-	416.6	-	-	54.8

51. Based on these multiple lines of evidence, we conclude that the correct LC50 range is that reported in Fisher et al. 1995 (1,998 to 8,666 mg/L), and that the range reported in Hartwell et al. 1995 (1.8-8.7 mg/L) is incorrect. Lastly, this analysis was confirmed in a recent conversation with Dr. D.J. Fisher of the Wye Research and Education Center, Queenstown, Maryland (personal communication with Dr. C.S. Wisdom of Parametrix, Inc., September 26, 2001). Dr. Fisher confirmed in this conversation that the values in his 1993 study were reported in the thousands of milligrams per liter, and the numbers cited in Hartwell et al. (1995) are incorrect.

52. Consequently, we conclude that Dr. Strand's declaration is based on incorrectly reported data, and has no validity in evaluating the toxicity of glycols present in the STIA watershed. Dr. Strand's assertion of direct water column glycol toxicity made in Comment 21 is without merit.

53. Dr. Strand further asserts that the concentrations measured by ACC are at levels that will produce lesions on exposed fish. He again bases this assertion on the data presented in Hartwell et al. 1995. Hartwell et al. (1995) reports that the lowest concentration of Type I ethylene glycol producing mild lesions in 3 or more fish was 275 mg/L, while the lowest concentration of Type II propylene glycol producing mild lesions in 3 or more fish was 17.6 mg/L. Dr. Strand goes on to assert that "*...Hartwell et al. (1995) also observed toxicity and similar gill pathology in fathead*

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minnows exposed to stormwater from a stream receiving winter runoff from a large commercial airport. In these tests, which included detailed chemical monitoring, the LC50 ranged between 1.8 and 5.4 mg/L total glycols".

54. Neither of the lesion thresholds reported by Hartwell et al. 1995 are relevant to the types of ADAFs currently in use at STIA. That is, Hartwell et al. (1995) reports information for Type I Ethylene Glycol anti-deicing fluid, which makes up only 4.1% of the ADAFs applied during 1998/1999 (Table 1) and a lesion threshold for Type II Propylene Glycol anti-icing fluids, which as noted above, make up less than 1% of the ADAFs applied in 1998/1999 at STIA (Table 1). 55.

55. Consequently, Dr. Strand's assertion that the total glycols present in the STIA watershed will cause lesions in exposed fish cannot be verified using the information provided in Hartwell et al. 1995. Additionally, as for the incorrectly cited *D. magna* data discussed above, the italicized statement from Hartwell et al. 1995 in the previous paragraph is based on information incorrectly reported from Fisher et al. 1995 (Table 5). Rather than the 1.8-5.4 mg/L reported in Hartwell et al. 1995, the actual data reported by Fisher et al.1995 is a factor of 1,000 greater – 1,753-5,408 mg/L (Table 5). All the lines of evidence presented above concerning the discrepancy between Hartwell et al. 1995 and Fisher et al. 1995 equally apply here, leading to the same conclusion concerning Dr. Strand's assertions concerning any relationship between lesion formation and acute mortality.

Table 5.Sample concentration data, measured and calculated Fathead Minnow (*Pimephales promelas*) LC50s using data from Fisher et al. 1995.

Effluent Sample[a]	Concentrations in Effluent Sample (mg/L)				Measured 48-h LC50 as % Effluent Sample[b]	Measured LC50 as Total Glycols (mg/L)[b]	Calculated LC50 as Total Glycols (mg/L)[c]
	Ethylene Glycol	Diethylene Glycol	Propylene Glycol	Total Glycol			
Peak	98,000	2,900	130,000	230,900	1.1%	5,408	2,539.9
Composite	31,000	1,500	85,000	117,500	1.5%	1,753	1,762.5

[a]Both samples were collected from Site 1 during Event 1 on 2/26/93 (Fisher et al. 1995)
[b]As reported in Fisher et al. 1995
[c]Calculated by Parametrix by multiplying the Measured 48h LC50 as % Effluent Sample times the total

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56. In light of the discrepancy discovered in the Hartwell et al. 1995 paper, any conclusions they offer concerning a correspondence between lesions and acute toxicity is incorrect (meaning the levels that produce lesions do not produce acute mortality). Actually, close comparison of the data reported in Fisher et al. 1995 and Hartwell et al. 1995 indicates that the LC50 values are 39 times greater than the concentrations producing lesions in fathead minnows for Type I Ethylene Glycol fluids and 1.9 times greater for Type II Propylene Glycol fluids.

57. Overall, it can be concluded that Dr. Strand's declaration of glycol toxicity is based solely on incorrectly reported data and inappropriate comparisons. The opinions expressed regarding glycol toxicity, therefore, have no scientific basis.

58. The following authorities and reports were consulted in preparation of the foregoing section of this declaration regarding glycols:

- ATA (Air Transport Association). 1994. ATA Workshop on Environmental Implications of Aircraft Deicing. February 1994;
- Cornell, J. et al. Chemical Components of Aircraft Deicer Fluid: How they affect propylene glycol degradation rates and deicing waste stream toxicity. 1998;
- FAA (Federal Aviation Administration). 2000. Biological Assessment for the Reinitiation and Initiation of Consultation for Certain Master Plan Update Improvements and Related Actions. Biological Assessment. Master Plan Update Improvements, Seattle-Tacoma International Airport. Prepared by Parametrix, Inc. Kirkland, Washington;
- USEPA (U.S. Environmental Protection Agency). 2000. Preliminary data summary airport de-icing operations. United States Office of Water (4303) EPA 821-R-00-001. U.S. Environmental Protection Agency, Washington, D.C. 20460;
- Beak Consultants. 1995. Chemical Substances Testing Final Study Reports. Prepared for Miller Thomson, Barristers and Solicitors, 1995a-h;

- Fisher, D.J. 1994. Investigation of the impact of whole effluent toxicity of storm water to aquatic life.WREC-94-DI.Final Report. Maryland Department of Environment, Baltimore, MD; Fisher, D.J., M.H. Knott, S.T. Turley, B.S. Turley, L.T. Yonkos, and G.P. Zeigler. 1995. The acute whole effluent toxicity of storm water from an international airport. Environmental Toxicity and Chemistry, 14(8): 1103-1111;
- Hartwell, S.I., D.M. Jordahl, J.E. Evans, and E.B. May. 1993. Toxicity of aircraft de-icer and anti-icer solutions to aquatic organisms. Maryland Department of Natural Resources, Baltimore, Maryland;
- Hartwell, S.I., D.M. Jordahl, J.E. Evans, and E.B. May. 1995. Toxicity of aircraft de-icer and anti-icer solutions to aquatic organisms. Environmental Toxicity and Chemistry, 14(8): 1375-1386;
- USEPA (U.S. Environmental Protection Agency). 2000. Preliminary data summary airport deicing operations. United States Office of Water (4303) EPA 821-R-00-001.U.S. Environmental Protection Agency, Washington, D.C.20460;
- Ward, T. 1994. Comparative acute toxicity to Type I and Type II Deicing and Anti-icing fluids to freshwater and marine fish, invertebrates, and algae. Prepared for ARCO Chemical Company, 1994.

I declare under penalty of perjury under the laws of the state of Washington that the foregoing is true and correct.

Executed at Kirkland, Washington this 28th day of September 2001.

Linda R.J. Logan, Ph. D.

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A

Linda R.J. Logan, Ph.D.

Ph.D., Environmental Geochemistry and Health
Master of Science, Diploma of Imperial College, Environmental Technology
Bachelor of Environmental Science, Geological Sciences

Linda Logan has over 10 years of consulting experience in risk assessment, environmental chemistry, analytical chemistry, stormwater quality and toxicity, and development of site-specific water quality standards. This includes working with technical specialists and local/regional regulators to negotiate the terms and language of consent decrees, agreed orders, and discharge permits. She has managed a number of fate and effects studies such as organometallic aerobic/anaerobic degradation, bioconcentration, bioaccumulation, and toxicity to aquatic life. She has managed a number of risk assessments for both the public and private sector including several sewer overflow projects in Sydney and Hong Kong. These studies have emphasized the need to obtain site-specific data to increase the accuracy of the assessments and meet the needs of local stakeholders. Recent work has included technical support to clients seeking CWA 404 permits and 401certifications, particularly with respect to the quality and toxicity of stormwater and using water effect ratio (WER) techniques to develop more realistic site-specific standards. In her current role as acting Division Manager, she is responsible for managing staff workload, supporting the business development activities of the practice leaders and ensuring the quality of client service.

Selected Project Experience

Surface Water Runoff Evaluation – Anzon Inc., TX
Investigated potential antimony contamination of surface water and sediments downstream of an antimony processing operation in Texas. This included an in-depth examination of analytical data on antimony measurements in water and sediments, evaluation of sediments as a source of antimony to the overlying water column, and the preparation of associated exhibits for use by attorneys and as expert witness material.

Water Quality Criteria Review and Critique – Santa Fe Pacific Gold, Lone Tree Mine, NV
Managed a review and critique of water quality criteria and associated toxicity of arsenic, boron, molybdenum, antimony, zinc, and fluoride for Santa Fe's Lone Tree mine in Nevada. The data and techniques used to derive the Nevada criteria were critiqued in the context of toxicity data found in the scientific literature and the national guidelines for developing water quality criteria. Based on chemical fate and toxicity data found in the literature, revised criteria were proposed. Our findings were summarized in reports as technical challenges to the state agencies.

Tulalip Landfill RI/FS – Rabanco, WA
Managed an in-depth review of analytical data to challenge the NPL ranking of the Tulalip Landfill. The project required familiarity with EPA sampling and analysis techniques, the U.S EPA user's guide to the contract laboratory program (CLP), and the U.S. EPA laboratory data validation functional guidelines for evaluating organics and inorganics. Tasks included liaison with EPA to negotiate FOIA requests, and fast response to attorney requests for information. Detailed reports of key findings were prepared for the court record.

Sea-Tac Airport Master Plan Update On-call Water Quality Services – Port of Seattle, WA
Providing water quality services to support the Port of Seattle in obtaining Section 404 and 401 permits needed to implement the Master Plan Update EIS. The Master Plan Update project includes construction of a new third runway and associated redevelopment projects. Work involves review and analysis of current stormwater outfall and receiving stream water quality data to assess potential impacts of future stormwater quality in the Miller and Des Moines creek basins. In addition to extensive water quality monitoring, this work includes conducting stormwater and receiving stream bioassays, an examination of current and future best management practices (BMPs), and an evaluation of developing site-specific water quality standards for specific constituents, if needed. In addition, toxicity testing and chelation techniques were used in tracing a source of metals from one particular stormwater outfall. As follow-up, the Port is proactively testing a number of experimental BMPs designed specifically for metals removal from stormwater. Throughout, this work has necessitated supporting the Port in meetings with the Department of Ecology, making presentations, and writing technical discussion documents.

Terminal 30 Improvement Project – Port of Seattle, WA
Wrote the scope of work and developed a budget for an ecological risk assessment as an integral part of a Remedial Investigation/Feasibility Study (RI/FS) for the Port of Seattle Terminal 30 Improvement Project. The scope involved identification of contaminants of potential concern (COPC) in soils, groundwater, surface water and sediments at the site and in the immediate vicinity; an ecological exposure assessment to estimate the expected environmental concentrations (EECs) and expected environmental doses (EEDs) of the COPCs in the each of the exposure media; a toxicity assessment to determine the toxicity of the COPCs to the target organisms; and a risk characterization which combines the results of the exposure and toxicity assessments to evaluate the potential risks.

Toxic Sediment Remediation – Municipality of Metropolitan Seattle, WA
Managed a risk-based sediment remediation in Elliott Bay for Seattle Metro. The study used risk-based parameters to identify and rank sites in Elliott Bay for further investigation. A report on using risk assessment for sediment remediation in the Puget Sound area was submitted to a panel consisting of Seattle Metro, the City of Seattle, the National Oceanic and Atmospheric Administration (NOAA), the Muckelshoot Tribe, the Suquamish Tribe and the Washington State Department of Ecology. The report recommended two sites for remediation – Pier 53 and south of Seacrest Marina on the West Seattle side of Elliott Bay.

Natural Resources Damage Assessment-Elliott Bay and the Duwamish Waterway – Municipality of Metropolitan Seattle, WA
Managed an investigation into alleged cause-and-effect relationships between sediments in Elliott Bay and the Duwamish waterway contaminated with polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and metals, and observed aberrations in fish/shellfish populations. This work also included a critical review of the statistical methodologies used to derive Washington State sediment quality criteria using the apparent effects threshold (AET) technique.

Natural Resource Damage Assessment – Heller, Erhman, White and McAuliffe, Commencement Bay, WA
Managed a critique of the Commencement Bay Phase I Natural Resource Damage Assessment Activity 4 Report. This involved an in-depth review of the inferences and suppositions the report made based on limited data. A report was prepared for use by attorneys explaining the flaws and data gaps in the Activity 4 report and putting forth alternative explanations for the phenomena observed in the bay.

Southwest Harbor Sediment Clean up Study Work Plan – Port of Seattle, WA
As part of an overall Work Plan developed by Parametrix on the remediation of contaminated sediments surrounding the Port of Seattle Southwest Harbor, Dr. Logan played an integral part in writing the Work Plan proposed for the ecological risk assessment. This Work Plan involved a proposed ranking of chemicals such as heavy metals and polyaromatic hydrocarbons to determine those chemicals of potential concern (COPCs); an ecological exposure assessment to estimate the expected environmental concentrations of the COPCs in the each of the exposure media; a toxicity assessment to determine the toxicity of the COPCs to target organisms; and a risk characterization which brings together the results of the exposure and toxicity assessments.

Wastewater Reuse Risk Assessment – Municipality of Metropolitan Seattle, WA
Managed a wastewater reuse risk assessment for Seattle Metro. The assessment evaluated human health, aquatic life, and wildlife risks associated with the reuse of secondary treated effluent and three tertiary treated effluents (sand filtered, sand/UV, sand/membrane filtered) from an ongoing pilot study at the Renton Sewage Treatment Plant. The risk assessment examined a number of different reuse options including landscape and recreational park irrigation as well as reuse as an industrial coolant. The ecological risk assessment used a probabilistic approach to assess the relative risks of the different wastewater treatments.

Holliday v. PAMCO and the City of Seattle, WA
Managed study requested by attorneys from the City of Seattle, which involved a review of bacteriological data collected by EPA. The data were from water and sediment samples collected in July 1990 from Union Bay and Cozy Cove on Lake Washington. From the data, it was concluded that it was not possible to determine whether there was any continuing risk (or increased risk) to public health as a result of sewage spills that occurred in 1988.

Site-Specific Water Quality Criteria – ASARCO, MO
Managed a project to develop site-specific water quality criteria (WQC) for two lead mines (West Forks and Sweetwater) and one lead smelter (Glover) in southeast Missouri for ASARCO, Inc. Site-specific WQC were developed for lead and cadmium for the protection of aquatic life, and for thallium for the protection of human health related to the consumption of potentially contaminated fish and/or shellfish. Through the collection of site-specific fish, significant relief was achieved for the thallium WQC. In accordance with the client's NPDES permit, bioassays were conducted as part of a Phase I Toxicity Identification Evaluation (TIE).

Aquatic Ecological Risk Assessment of Produced Waters from Oil and Gas Facilities – Cook Inlet, AK
Played an integral part in conducting the aquatic ecological risk assessment of produced waters in Cook Inlet. This included identifying and interpreting the fate and effects of the constituents in produced water (primarily hydrocarbons), dilution modeling, identification of the species that could potentially be affected, and whether or not the concentrations of the individual constituents or whole effluent would pose an acute or chronic effect within the accepted mixing zones.

State Pollution Control Commission – New South Wales, Australia
Managed peer review of a study conducted off the Sydney coastline concerning contaminant enrichment of the air-sea microlayer as a result of sewage discharge from the Malabar outfall. This involved reviewing a number of analytical reports on the concentrations of heavy metals, polyaromatic hydrocarbons, chlorinated organics and bacteria in and below the microlayer, and a critique of the

summary reports. This review required an understanding of expected contaminant fate processes at the air-sea interface. A report on the findings of the review was submitted to the State Pollution Control Commission.

Ecological Risk Assessment – Fugacity Modeling, Puget Sound, WA
Provided technical support for an ecological risk assessment in Puget Sound. Specifically, this involved the use of the Quantitative Water, Air, Sediment Interaction (QWASI) fugacity model to determine the partitioning and fate of sediment bound polyaromatic hydrocarbons and polychlorinated biphenols. This model uses the concept of fugacity to predict the partitioning of a chemical between the sediment, the water column, suspended particulate matter, the air and the biota of an aquatic system. Predicted water column concentrations were used to assess potential ecological risk to the aquatic biota.

Biological Assessment and Remedial Investigation of Lakes, Tributaries, and Streams – Elf Atochem, TX
Managed a biological assessment and remedial investigation of lakes, tributaries, and streams for Elf Atochem in Texas. As a result of arsenic acid production over the past 40 years, the Texas Natural Resource Conservation Commission (TNRCC) is requiring Atochem to clean up soils, sediment, surface water and groundwater in the drainage basin surrounding the plant. Parametrix has been commissioned to conduct a biological and limnological assessment of the lakes and tributaries in the immediate vicinity of the plant. These assessments involve the collection of water and sediment samples for remedial investigation purposes, and the collection of fish and invertebrates for the evaluation of community structure. In addition, Parametrix is conducting a mass balance of chemicals into and out of the drainage basin via a network of stream gauges and collection of stormwater samples. Monitoring data collected seasonally through 1998 will be used in subsequent human health and ecological risk assessments.

Chemical Manufacturers Association
Provided an intensive review of EPA's March 1991 draft guidance document Assessment and Control of Bioconcentratable Contaminants in Surface Waters. The review focused on the implications of the document to institutions such as the Chemical Manufacturers Association (CMA). The assumptions made in the methodologies (e.g. the relationship between the octanol-water partition coefficient (Kow) and the bioconcentration factor (BCF), the use of high performance liquid chromatography (HPLC) fractionation to evaluate BCFs, and the use of a food chain multiplier (FM), were addressed, as well as those that were not sufficiently emphasized. The review also included a series of strawman decision trees in an effort to narrow the permit requirements and ensure a more objective approach.

Risk Characterization – Rocky Mountain Arsenal, Denver, CO
Principal investigator on a position paper, discussing the inclusion of chemical degradation in a Human Health Risk Characterization being conducted for Rocky Mountain Arsenal. This involved a thorough literature search for degradation data and calculation of chemical half-lives using first order kinetics. Dr. Logan also worked with QA/QC parameter data for biota models at Rocky Mountain Arsenal that are to be used in the Ecological Risk Characterization. This included the QA/QC of a computer-based Importance Analysis on a general predator biota model.

Tributyltin (TBT) Fate and Effects – Consortium of Tributyltin Manufacturers, Various Locations
Overseeing this long-term program to conduct a number of TBT fate and effects studies. These include the sorption/desorption of TBT on soils and sediments, the aerobic and anaerobic metabolism of TBT in soils and sediments, the uptake, bioconcentration and bioaccumulation of TBT through an aquatic food chain and the equivalency of TBTO and TBTM. Dr. Logan's responsibilities include selecting

laboratories to conduct the studies, formatting the study design, reviewing protocols/reports and providing technical support. Dr. Logan was study director for a series of tributyltin sorption (equipment) and storage stability studies conducted by subcontractors-EPL BioAnalytical. As study director, she worked with sub-consultants to design the study, review analytical data, and wrote reports for submission to the U.S. Environmental Protection Agency.

Assessment of Human Exposure to Arsenic (Doctoral Thesis)
The human metabolism and biotransformation of arsenic were studied in a series of laboratory experiments, in the general population and in several groups subject to enhanced environmental or occupational exposure to inorganic arsenic. Metabolism and biotransformation of arsenic was determined via the analytical speciation of arsenic in urine. Using the mineral water Vichy Celestin as a convenient source of inorganic arsenic, the natural detoxification of inorganic arsenic to its methylated metabolites was observed. When compared to the rapid excretion of inert arsenobetaine following the consumption of seafood, the importance of urinary arsenic speciation to distinguish the exposure source is emphasized. Using the above techniques, the increased intake of inorganic arsenic in Cornwall residents (a heavily mineralized area in the south-west of England) was suggested by the more frequent occurrence of inorganic arsenic III and monomethylarsinic acid excreted in urine. The same techniques were applied to workers occupationally exposed to inorganic arsenic. When compared with controls, those engaged in the manufacture of arsenicals exhibited the greatest exposure, followed by those working in the glass manufacturing industry and the timber treatment industry. These findings were discussed in the context of recommended limits and the pathways of exposure to inorganic arsenic.

Natural Enrichment of Arsenic in Loch Lomond Sediments (Doctoral Thesis)
The natural post-depositional remobilization of arsenic in the sediments of Loch Lomond was investigated via the speciation of arsenic in the sediment porewaters. Porewater arsenic III concentrations peaked in the reduction zone at depths of 5-11cm and decreased abruptly at 2-3cm, coinciding with peak arsenic concentrations in the solid phase. This confirmed the reduction and remobilization of arsenic at depth, followed by upward migration and near-surface oxidation with preferential adsorption of arsenic V on precipitated oxides and/or hydroxides of iron.

Chlordane Mobilization and Transport at a Hazardous Waste Site (Post Doctoral Research)
The impact of dissolved organic carbon (DOC) in groundwater on the mobilization and transport of chlordane was assessed through a series of batch solubility and sorption experiments in conjunction with soil column studies. Although batch sorption studies demonstrated the tenacious binding of chlordane to the solid phase, soil columns eluted with solutions of varying DOC showed enhanced chlordane mobilization with increased DOC concentration in the leachate. As a result, retardation factors determined from column studies were greater than those predicted by batch sorption studies.

Aquatic Toxicity Testing of Sparingly Soluble Metals and Metal Compounds – Mining Association of Canada, Ottawa, Ontario
Managed and authored a technical paper on the aquatic toxicity testing of sparingly soluble metals and metal compounds for the Mining Association of Canada. Based on a review of current OECD testing guidelines, the paper discussed the factors affecting the solubility, bioavailability, and toxicity of metals and metal compounds such as water hardness, alkalinity, pH, redox, suspended particulate matter, and susceptibility of the organism. The paper also presented case studies to illustrate some of the difficulties encountered in testing metals and metal compounds of low solubility. The paper initiated an OECD workshop at which leading experts discussed testing procedures, OECD testing protocols, and the expression and reporting of test results for sparingly soluble metals and metal compounds.

Persistence, Bioaccumulation, and Toxicity of Metals and Metal Compounds – International Council on Metals and the Environment, Ottawa, Ontario
Managed and authored a technical paper for ICME on the biodegradation/persistence and bioaccumulation/biomagnification of metals and metal compounds that acted as a springboard for a workshop in Brussels held by the Canada/European Union Metals and Minerals Working Group. The report was initiated because of concerns over impending legislation to classify metals and metal compounds as "dangerous to the environment." The report discussed such topics as differences in the properties and behavior of organic and inorganic (metal) compounds; the variety of environmental conditions (e.g., pH, hardness, alkalinity, presence of methylating agents, Eh, presence of chelators, cation exchange capacity, soil type, dissolved and particulate organic carbon content) that influence the bioavailability and fate of most metals in both aquatic and terrestrial systems; concentrations of an essential metal can be either deficient or toxic, both having adverse effects on the organisms; metal bioconcentration, bioaccumulation, and biomagnification in aquatic and terrestrial organisms; and why biodegradation/persistence and bioaccumulation/biomagnification should not be used alone to determine exposure concentrations and potential effects.

Lead Smelter NPDES Permit Review – Exide Corporation, Reading, PA
Managing a review of a draft NPDES permit for Exide's lead smelter in Reading, Pennsylvania. This involves a review of toxicity testing requirements, modeling conducted to set mixing zones, and advising attorneys with respect to drafting language for the permit.

Brown's Battery Breaking Site – Exide Corporation, Reading, PA
Currently managing the biannual collection of sediment and water for chemical analysis and toxicity testing required under a consent decree between the U.S. and General Battery Corporation. Following negotiation with federal trustees, state and federal agencies, on behalf of Exide, this work also involved drafting consent decree language for attorneys as issues were discussed and resolved. Tasks also include preparation of a work plan, sampling and analysis plan, quality assurance quality control plan, and a health and safety plan. Monitoring of sediment and water will occur one year pre- and 15 years post-site remediation.

Aquatic Evaluation of Mine Tailings in a Marine Environment – Lihir Management Company, Lihir Island, Papau New Guinea
Managed an evaluation of copper released into the marine environment as tailings from an open-cast gold mine on the island of Lihir in Papua, New Guinea. The study involved an assessment of the bioavailability, bioaccumulation, and toxicity of copper to marine life inhabiting and passing through the deep waters off the island. In addition, an evaluation was made of the potential human health risks associated with the consumption of fish caught at depth.

Australian Risk Assessment Guidance Document – Sydney Water, Sydney, Australia
Managed the development of a guidance document on human health and aquatic risk assessment methodologies for Sydney Water in Australia. The document, now accepted by the New South Wales EPA, is the first of its kind in Australia and combines current U.S. risk assessment methodologies with Australian/New Zealand/World Health Organization standards and criteria. The document has since formed the basis for several complex human health and ecological risk assessments of sewer overflow and stormwater discharges in urban watersheds of the Sydney-Illawarra region.

Aquatic Ecological Risk Assessment for A Proposed Offshore Outfall into Haifa Bay – Haifa Chemicals, Israel
Managed an aquatic ecological risk assessment for a proposed offshore outfall for Haifa Chemicals Limited located adjacent to Haifa Bay in Israel. Haifa Chemicals is evaluating the relocation of its effluent discharge from the Kishon River to a submarine outfall two or more kilometers offshore at a water depth of at least 16 meters. The risk assessment evaluated acute and chronic toxicity to fish, invertebrates, and algae arising from exposure to metals and fluoride in the water column and sediments as a result of various proposed discharge and mixing zone scenarios. Because of predicted dilutions at the edge of the mixing zone and the precipitation of metals in the alkaline seawater, no risks were predicted to water column organisms. Similarly, risks to marine life from exposure to metals and fluoride bound to the sediments were also found to be insignificant for two reasons. Firstly, partitioning of these chemicals is unlikely to result in interstitial water concentrations high enough to be acutely or chronically toxic. Second, based on the bay's physicochemical properties beyond two kilometers, long-term accumulation of the chemicals is not expected.

Lavaca Bay Remedial Investigation – Aluminum Company of America, Point Comfort, TX
Was involved in developing an ecological risk-based approach for sediment remediation in Lavaca Bay. This is part of an ongoing multi-million dollar remedial investigation/feasibility study for the bay. The ecological risk-based approach incorporated current state-of-the-art with respect to aquatic and wildlife risk assessment methodologies including those developed by EPA's risk assessment forum and the Great Lakes Institute. A phased risk-based approach was implemented due to the size of the potentially contaminated area (over 60 square miles) and to build upon information gathered during each sampling event.

Hong Kong Strategic Sewage Disposal Scheme Risk Assessment – Montgomery Watson, Hong Kong
Managed an ecological and human health risk assessment for Hong Kong's Environmental Impact Assessment (EIA) of the Strategic Sewage Disposal Scheme (SSDS). The study objective was to assist the Hong Kong Environmental Protection Department (EPD) decide the level of sewage treatment required and the optimum outfall location/configuration for disposal of Hong Kong's municipal and industrial effluent. Potential risks to marine life including the Chinese White Dolphin, and to people who use the waterways and gazetted beaches for recreation and fishing were assessed. Level of treatment was evaluated for effluent discharged from a pilot plant located on Stonecutters Island. Using influent from different municipal and industrial sources (e.g., North West Kowloon, Kwai Chung, and Kwung Tong), the plant tested the effectiveness of different treatment conditions including Magnafloc with ferric chloride, ferric sulphate, and alum, as well as just Zetag 92. Optimal outfall location was assessed using near-field and far-field water quality modeling to predict exposure concentrations following effluent discharge from Stonecutters Island, East and West Lamma Channels, and the Lema Channel. Site-specific information was used where available. For example, survey data were used on the amount and frequency of fish and shellfish consumption by the local population and information on the feeding habits and home range of the Chinese White Dolphin and Finless Porpoise was extracted from the scientific literature and by soliciting input from experts in the ecology of these marine mammals.

Homebush Bay Sediment Investigation and Screening-Level Risk Assessment – Office of Marine Administration, Sydney, Australia
Managed an investigation of sediment contamination in Homebush Bay, which is site of the year 2000 Olympic Games. The study used a risk-based approach as a basis for identifying the area and extent of sediments requiring remediation. Sediments at the site are contaminated with dioxins, organochlorine

pesticides, polyaromatic hydrocarbons, and metals. A screening-level risk assessment evaluated potential risks to human health, aquatic life, and wildlife through direct chemical exposure and possible bioaccumulation through the food chain. Using these results, an evaluation of remedial options was conducted. This resulted in a report on the management of risks in Homebush Bay and the effectiveness of fish advisories.

Sewer Overflow and Stormwater Risk Assessments in Urban Watersheds – Sydney Water Board, Sydney, Australia

Managed two risk assessments that were used by the Sydney Water Board in the strategic management of sewer overflows and sewage treatment plant (STP) discharges in a number of urban watersheds. The assessments focused on wet weather events when STP capacities were exceeded, the sewerage system was overwhelmed, and stormwaters contributed increased loadings to the receiving streams. The assessments considered risks to aquatic life from sporadic exposure to chemical and non-chemical stressors (e.g., low dissolved oxygen, freshwater influx to a saline environment, increased suspended solids), and to people who might swim and recreate in the vicinity of the outfalls shortly after a storm or eat fish caught from the waterways. Chemical concentrations measured in sewer overflow, stormwater, and sediment screened chemicals (e.g., copper, zinc, chlorpyrifos, diazinon, DDT) for detailed analysis in the receiving waters. Receiving water quality under dry and wet weather conditions in the watersheds was modeled using a 2-dimensional hydrodynamic model. Stormwater contributions (urban and rural) were modeled in combination with, and separately from, STP discharges and sewer overflows. To validate the risks predicted to aquatic life, a series of pulsed exposure bioassays for specific chemicals and whole effluent were conducted. These bioassays generated effects data for the short-term

(e.g., 2-8 hr) exposure regimes characteristic of storms. Predicted risks were also validated by bioassessments conducted immediately upstream and downstream of the overflow and discharge points.

Hong Kong On-Call

Determined formation of chlorinated by-product from chlorination/dechlorination of treated wastewater. Selected aquatic and human toxicity information as well as data on bioconcentration and bioaccumulation.

Previous Experience

Memphis State University, Memphis, Tennessee. Department of Biology, Toxicology Laboratory, Post Doctoral Research Associate

Post doctoral research, in collaboration with the U.S. Geological Survey, on potential chlordane mobilization and transport at a hazardous waste site. In addition, Dr. Logan supervised the Toxicology Laboratory for one year, which included ensuring data quality for several post-graduate research projects and conducting a number of acute and chronic (static renewal) daphnia bioassays for several industrial clients.

Springborn Lifesciences, Wareham, MA

Staff specialist, FIFRA residue study for pesticide registration – field manager. Devised standard operating procedures for sampling strategy, sample collection and documentation.

Schering Plough, Memphis, TN

Laboratory Technician, Quality Control Laboratories. Familiarized with GLP and Strict SOP Protocols.

Agricultural Research Council, Wantage, Oxforshire, United Kingdom
Field Studies Department. Collection of agricultural samples, sample processing, sample characterization and documentation.

Professional Affiliations

- American Chemical Society (ACS)
- Society for Environmental Toxicology and Chemistry (SETAC)
- American Society for Testing Materials (ASTM)

Education

Ph.D./1986/Environmental Geochemistry & Health/University of Glasgow, Scotland

M.S.C, D.I.C./1983/Environmental Technology/Imperial College, University of London, England

B.S.C./1982/Geological Sciences/University of East Anglia, England

Publications

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Johnson, L.R. and J.G. Farmer. 1988. Natural Enrichment Profiles and Prewater Arsenic Speciation in Sediments of Loch Lomond. Society of Toxicology and Chemistry, 9th International Annual Meeting, November 13-17, 1988. Arlington, Virginia.

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Farmer, J.G., and L.R. Johnson. 1989. Urinary Arsenic speciation and the Assessment of U.K. Dietary, Environmental and Occupational Exposures to Arsenic. Society of Environmental Geochemistry and Health, 7th European meeting April 11-14, 1989, Royal Holloway and Bedford New College, University of London. The Environmental Geochemical and Health Aspects of Arsenic, Nickel and other elements.

Johnson-Logan, L.R. and S.J. Klaine. 1989. Factors Affecting Mobility of Chlordane in a Hazardous Waste Site. Combined meeting of the Central State Chapter of the Society of Toxicology and Ozark-Prairie Chapter of the Society of Toxicology and Chemistry. April 28-29, 1989. Columbia, Missouri.

Johnson-Logan, L.R., R. Russell and S.J. Klaine. 1989. Physical/Chemical Factors Affecting Chlordane Mobility at a Hazardous Waste Site. 10th International Annual Meeting of Society of Toxicology and Chemistry. October 28 - November 2, 1989. Toronto, Ontario, Canada.

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Pavlou, S.P., S.C. Robinson and L. Logan. 1990. How Clean is Clean: Application of Exposure Pathway Analysis to Ecological Criteria Development. Presented at the International Specialty Conference on How Clean is Clean? Cleanup Criteria for Contaminated Soil and Groundwater. November 6-9, 1990. Boston, Massachusetts.

Novack, S., L.R. Johnson-Logan and S. Pavlou. 1990. The Use of Dependency Trees in Exposure Assessment. 11th International Annual Meeting of Society of Toxicology and Chemistry. November 11-15. Arlington, Virginia.

Hooven-Spence, M.E., L.R. Johnson-Logan and R.D. Cardwell. 1992. Evaluation of AETs in Aquatic Ecological Risk Assessment of Contaminated Urban Bay Sediments. 12th International Annual Meeting of the Society of Environmental Toxicology and Chemistry. November 3-7. Seattle, Washington.

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B

Port of Seattle

Annual Stormwater Monitoring Report

for

Seattle-Tacoma International Airport

for the period July 1, 1999 through June 30, 2000

September 2000

Port of Seattle

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September 28, 2000

Prepared by

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Port of Seattle

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1 EXECUTIVE SUMMARY

This Annual Stormwater Monitoring Report has been prepared pursuant to Special Condition S2.E of the NPDES permit for the Port of Seattle's Seattle-Tacoma International Airport (STIA). The Port took a total of 39 grab and 38 composite stormwater samples in the past year, bringing the 6-year totals to over 350 samples for each type. A total of 20 storms were sampled. The Port complied with all sampling and reporting requirements.

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

Final rounds of source tracing revealed sources of toxicity present in the SDN1 samples, where most whole effluent toxicity (WET) samples tested in 1998-99 did not meet Ecology performance standards. Forensic sampling and analysis techniques, namely metals chelation, indicated that zinc was the most likely toxicant, and was associated with runoff from two cargo buildings with galvanized metal rooftops. The Port is investigating how to remedy this situation, potentially through the use of media filtration treatment. Samples from the three other principal outfalls passed Ecology's performance standards.

The ongoing source tracing in SDE4 has not revealed any significant sources of fecal contamination associated with baseflow, dry-weather discharges or storm runoff. SDE4 discharges have exhibited sporadically elevated fecal coliform levels. In addition to the conventional methods used to date, this year, the source-tracing project also used the microbial source tracing (MST) technique developed at the University of Washington. This MST method isolates *E. coli* bacteria DNA in the samples and compares it to isolates from specific sources already characterized in the regional database. The Port plans to issue a separate report for this study at the conclusion of the project.

The Port eliminated several potential sources of contaminants in SDS1 and SDN1 runoff by re-routing drainage to the IWS. Several samples and observations in the past year showed sporadic, limited contamination associated with aircraft and ground service equipment (GSE) servicing. These BMPs are a direct result of the stormwater monitoring program.

Two short periods of winter weather triggered runway and other ground surface deicing at STIA in the past year. The Port monitored stormwater discharges during these events to characterize the presence, magnitude and duration of ground deicing chemicals in runoff. Key locations in receiving waters were continuously monitored for dissolved oxygen (DO) and other parameters before, during and after these events. The data did not indicate a distinct effect on DO in the receiving waters that could be discerned from the highly variable background conditions established through 3 months of monitoring prior to the events. The Port is preparing a report on this study, the second in two years.

Because of increasing interests in assessing aquatic effects of STIA discharges, the Port plans to study relocating several sampling locations for certain subbasins. Doing so increases the potential for samples to better reflect the influence of all factors prior to discharge to the respective receiving streams. Because most current sampling locations are in-pipe or well above the receiving waters, it may not be appropriate to compare STIA stormwater data to Washington State water quality standards. Nonetheless, toxicity testing in the past 2 years has shown no indications of toxicity present in samples from the three key outfalls that serve 67% of the total STIA storm drainage.

2 INTRODUCTION

The STIA stormwater monitoring program has been in place since 1993 pursuant to the National Pollutant Discharge Elimination System (NPDES) permit. The first permit was renewed and reissued on February 20, 1998, becoming effective March 1, 1998 (permit number WA-002465-1.) In early 1999, a major permit modification issued by Ecology reduced sampling frequency based upon a permit appeal settlement (WDOE 1999.) The Port will begin the next permit renewal process in 2001.

The Port conducts the required monitoring activities according to the specific guidelines and criteria of the Ecology-approved Procedure Manual for Stormwater Monitoring (POS, 1999a). This report summarizes and discusses results from the sixth year of sampling conducted in the 12-month period July 1999 through June 2000, the conclusions, and potential new initiatives to be undertaken. Results summarized in this report include data already submitted to Ecology in Discharge Monitoring Reports (DMRs) plus additional results from other samples unrelated to DMR reporting. The Port has previously submitted five Annual Reports (1995, 1996, 1997a, 1998a, 1999b)

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

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

3 BACKGROUND

3.1 Sea-Tac International Airport

Seattle-Tacoma International Airport (STIA) lies about mid-way between the cities of Seattle and Tacoma, Washington. The airport was built in the 1940s and has expanded throughout the years to become the 18^{th} busiest airport in the U.S. The highly urbanized cities of SeaTac, Des Moines, and Burien surround the airport.

STIA storm drainage discharges through 14 individual outfalls, four that drain to Miller Creek, eight that drain to Des Moines Creek, and two that drain to a City of SeaTac system. These outfalls drain a total of 963 acres which contain about 44% impervious surfaces. Only 17% of this total area (165 acres) drains to Miller Creek, while the remaining 798 acres drains to Des Moines Creek. Another 370 acres, mostly the impervious surfaces of terminal gate and ramp areas, drain to the Industrial Waste System (IWS) and the Industrial Waste Treatment Plant (IWTP.) Three large lagoons detain and equalize runoff flowing to the IWTP which removes suspended solids and petroleum products using the dissolved air flotation unit process. The IWTP discharges directly to Puget Sound via a separate outfall that combines with the Midway sewage treatment plant. IWTP sampling results are not included in nor required to be addressed in this report.

The Port is examining future stormwater management needs in the Preliminary Comprehensive Stormwater Management plan (CSMP) which is part of the Master Plan Update. Issues addressed in this plan include the potential retrofit of existing development to meet state and local guidelines for stormwater quantity and quality BMPs (POS, 2000).

3.2 STIA Storm Drainage Subbasins

The NPDES permit refers to outfalls by number; however, this report refers to subbasins and their outfalls by location names (see Table 1). The Port codes STIA storm drainage subbasin names according to location, for example, "SDS1" means "storm drain south number 1". In addition, the Port identifies all manholes according to an alphanumeric scheme, some of which are referred to in this report. For convenience and consistency, many of these locations were renamed and renumbered in 1999, though physical monitoring locations have not been moved. Drainage area estimates are included in Appendix A. Figure 1 shows the individual stormwater drainage subbasins and the STIA stormwater management boundaries.

STIA stormwater subbasins fall into the general categories listed in Table 1. These categories group subbasins together that have similar land use and other characteristics. These categories include "landside," "airfield," and other non-specific, low-activity areas. Previous reports showed that concentrations of TPH, TSS and other constituents were different for the landside and airfield categories (POS, 1996, 1997a.)

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

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

Table 1 Outfall Nomenclature

Outfall #	Port Name	Category	Creek	Proximity to receiving water
002	SDE4	landside	Des Moines	Combines w/Bow Lake & City flows before daylighting in East Branch
003	SDS1	none	Des Moines	Direct outfall to East Branch
004	SDS2	none	Des Moines	Flows through swale, NW Ponds then into W. Branch
005	SDS3	airfield	Des Moines	Flows through swale, NW Ponds then into W. Branch
006	SDN1	landside	Miller	Flows through 1000'+ natural channel and Lake Reba detention Pond
007	SDN2	Drains to IWS[1]	Miller	Same as SDN1
008	SDN3	airfield	Miller	Same as SDN1
009	SDS4	airfield	Des Moines	Direct outfall near confluence of East and West Branches
010	SDS7[2]	none	Des Moines	Combines w/City streets commercial area, via swale & NW Ponds
011	SDN4	airfield	Miller	Same as SDN1
012	EY	landside	Gilliam	Via City drains to stream
013	TY	landside	Gilliam	Via City drains to stream
014	SDS6[2]	none	Des Moines	Same as SDS7
015	SDS5[2]	none	Des Moines	Same as SDS7

Table notes:

1. Two pump stations divert all runoff from the former SDN2 subbasin to the IWS. Discharges to SDN2 only occur when rainfall intensity exceeds the 0.20 inches per hour design for these pump stations. These two pump stations were constructed in 1997 as SWPPP BMPs.
2. Outfalls 010, 014 and 015 were previously named "SDW3", "B" and "D", respectively

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

3.3 Sampling locations

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

Four monitoring locations (subbasins SDE4, SDN1, EY, and TY) are upstream from the final discharge point where the outfall actually "daylights". Runoff contributions from other, non-STIA sources that are outside the Port's jurisdiction enter these storm drains and therefore necessitate monitoring at the first location, often a manhole, upstream of the majority of offsite inputs. Table 2 lists these offsite influences. However, offsite runoff is inextricable for sampling stations for SDE4, SDS1, SDS2, and SDS3. Considering that the offsite area for outfalls SDS1 and SDS2 is primarily roadways, the contribution from non-Port entities is substantial.

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

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

location at "SDN1up" for the ensuing period. See the discussion for Figure 11 and Figure 12 in Section 4.5.3.

It is important to note that because of their distance from receiving waters, certain current sampling locations do not integrate all possible factors that could influence water quality prior to discharging to the streams. Only two of STIA's current outfalls (SDS1 and SDS4) discharge directly to the receiving waters. These two outfalls are sampled at these "daylight", or end-of-pipe locations.

In contrast, because of factors in addition to those mentioned above, all other outfalls are sampled at points well-removed from the biotic community. See Table 1. As a result, the sampling results do not reflect the complex, interactions with chemical, physical, and biological elements that can enhance water quality prior to where STIA stormwater actually enters receiving waters.

For example, drainage from all four Miller Creek outfalls (SDN1, SDN2, SDN3, and SDN4) passes through additional piping and more than 1000 linear feet of open, natural channels, and the Lake Reba detention pond prior to entering Miller Creek. The potential influences of these factors, especially considering that the detention pond is a constructed BMP, are not accounted for in the current sampling scheme required by the permit. These issues should be addressed in the NPDES permit renewal.

3.4 Storm sampling procedures and analytes

The Port's Procedure Manual for Stormwater Monitoring (POS 1999a) describes the criteria for sampling storm events, and describes all relevant sampling, programming, and handling necessary to comply with requirements of the permit. Table 4 lists required sampling frequencies, constituent analytes, methods, and detection limits. The Port reports data on DMRs only where results from storms and samples meet representativeness criteria of the manual. In addition to data provided in the DMRs, results from samples not meeting these criteria or those taken for other purposes are also included in this report. Using automatic samplers, the Port generally takes a grab sample then a flow-weighted composite sample during rainstorms of 0.20 inches or greater that are preceded by less than 0.1inch of rainfall in the previous 24 hours.

Table 2 Offsite Influences Affecting STIA Monitoring Locations[1]

Outfall (manhole)[2]	Total Area (ac)	Offsite Area (ac)	Percent Offsite	Comment
SDE4 (SDE4-65)	149	0.6	<1%	Offsite area of SR99, may be greater than 0.6 acre
SDS1 (outfall)	10.7	5.1	47%	Offsite area of S. 188th St. includes area added by City in Fall 1998
SDS2 (outfall)	13.2	2.9+	>21%	Offsite 16th Ave S., S. 188th St, and possible non-Port commercial area.
SDS3 (outfall)	462	3	< 1%	Approximate offsite area of S. 188th St.
SDN1 (manhole SDN1-56)	24+	9.9+	>40%	Former SDN1 location includes public road runoff. Runoff from additional 49 acres of non-POS area enters below this point prior to entering Lake Reba
SDN1up (SDN1-41)	13.8	0	0%	Air Cargo Road is about 50% of SDN1.

Table notes

1. All area estimates are as of 27 October 1998 and subject to change.
2. Though manhole number designations were changed in 1999, sampling locations remained the same as in previous years.

Table 3 Analytes, Methods and Detection Limits

			Applicable Subbasins			
Analyte	Method[a]	Detection limit (MDL) mg/l	SDE4, SDS3, SDN1, SDN4	EY TY, SDN2	SDS1, SDN2	SDS1, SDS2, SDN3, SDS4, SDS5, SDS6, SDS7
pH[e]	150.1	0.1	X	X	X	X
FOG (Oil and Grease)	413.1	1.0	(f)	(f)	(f)	(f)
TPH (IR)	418.1 mod[b]	1.0	(f)	(f)	(f)	(f)
TPH (GC)	NWTPH-Dx	0.15	X	X	X	X
Fecal coliforms (MPN)	9221 E	2	X	n/a	n/a	X
TSS (total suspended solids)	160.2	0.5	X	X	X	X
Turbidity	180.1	0.1	X	n/a	X	X
BOD_5	405.1	4	X	n/a	X	n/a
Total Glycols[c]	GC FID	4	X	n/a	X	X
Total Recoverable copper, lead, zinc[d]	200	Cu: 2 µg/l Pb: 2 µg/l Zn: 5 µg/l	X	n/a	n/a	n/a

(a) Method refers to EPA-600/4-79-020, March 1979. Fecal coliform method refers to 18th edition of Standard Methods for the Examination of Water and Wastewater (APHA, 1995), or as revised.
(b) Washington State Department of Ecology method WTPH-418.1 Modified.
(c) Analyzed by Gas Chromatograph, Flame Ionization Detector
(d) Lead and copper by atomic absorption (AA) furnace, zinc by ICP.
(e) pH is not required by permit, but is used as a reference parameter
(f) FOG and TPH (IR) methods replaced by NWTPH-Dx March 1, 1998.

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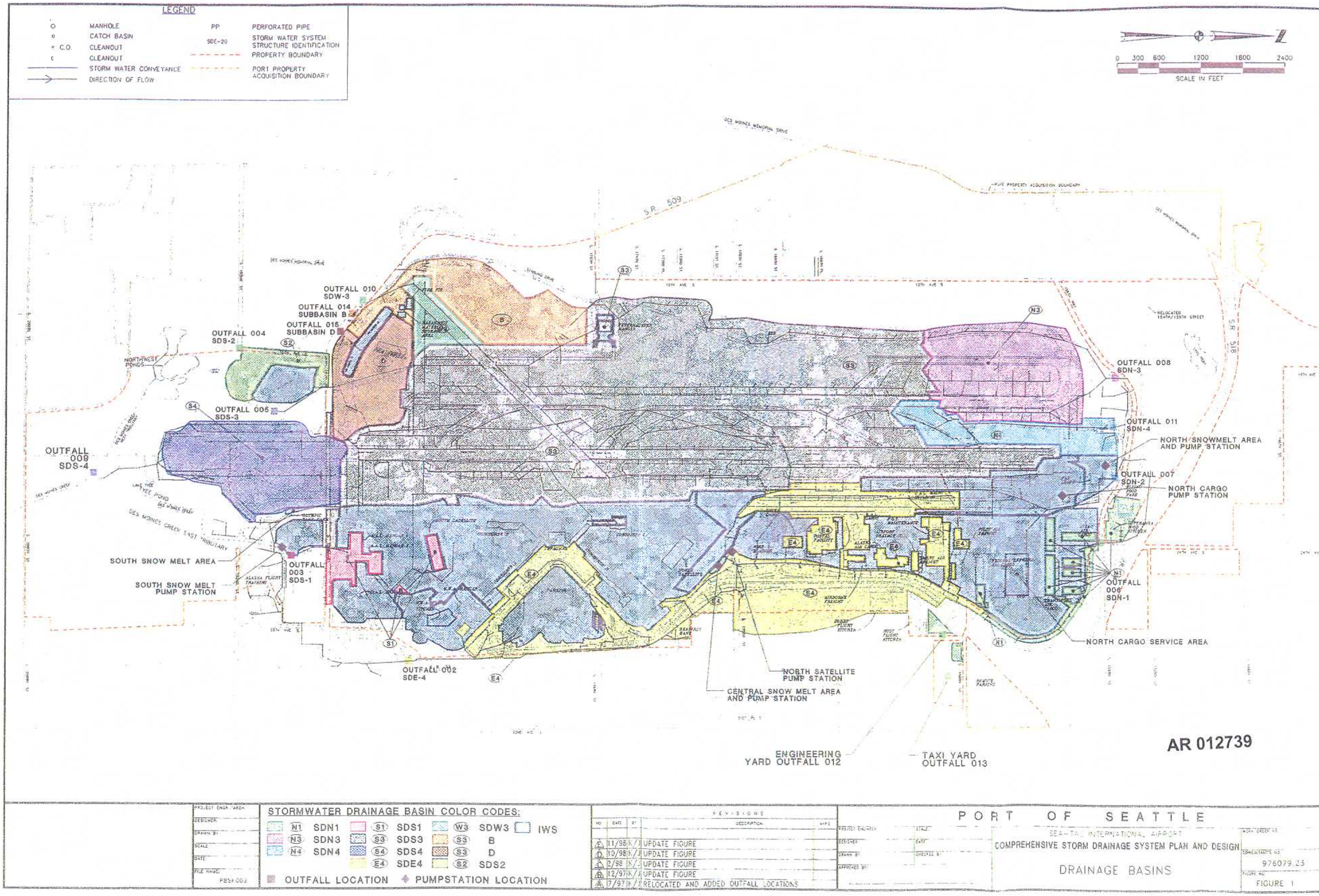
LEGEND
MANHOLE
CATCH BASIN
C.O. CLEANOUT
CLEANOUT
STORM WATER CONVEYANCE
DIRECTION OF FLOW
PP PERFORATED PIPE
SDE-20 STORM WATER SYSTEM STRUCTURE IDENTIFICATION
PROPERTY BOUNDARY
PORT PROPERTY ACQUISITION BOUNDARY
0 300 600 1200 1800 2400
SCALE IN FEET
S.R. 509
S.R. 518
OUTFALL 010 SDW-3
OUTFALL 014 SUBBASIN B
OUTFALL 015 SUBBASIN D
OUTFALL 004 SDS-2
OUTFALL 005 SDS-3
OUTFALL 009 SDS-4
OUTFALL 008 SDN-3
OUTFALL 011 SDN-4
NORTH SNOWMELT AREA AND PUMP STATION
OUTFALL 007 SDN-2
NORTH CARGO PUMP STATION
OUTFALL 006 SDN-1
NORTH CARGO SERVICE AREA
SOUTH SNOW MELT AREA
SOUTH SNOW MELT PUMP STATION
OUTFALL 003 SDS-1
OUTFALL 002 SDE-4
NORTH SATELLITE PUMP STATION
CENTRAL SNOW MELT AREA AND PUMP STATION
ENGINEERING YARD OUTFALL 012
TAXI YARD OUTFALL 013
AR 012739
STORMWATER DRAINAGE BASIN COLOR CODES:
N1 SDN1
N3 SDN3
N4 SDN4
S1 SDS1
S3 SDS3
S4 SDS4
E4 SDE4
W3 SDW3
S3 B
S3 D
S2 SDS2
IWS
OUTFALL LOCATION
PUMPSTATION LOCATION
REVISIONS
E 11/98 UPDATE FIGURE
D 10/98 UPDATE FIGURE
C 2/98 UPDATE FIGURE
B 12/97 UPDATE FIGURE
A 7/97 RELOCATED AND ADDED OUTFALL LOCATIONS
PBSF002
PORT OF SEATTLE
SEA-TAC INTERNATIONAL AIRPORT
COMPREHENSIVE STORM DRAINAGE SYSTEM PLAN AND DESIGN
DRAINAGE BASINS
976079.23
FIGURE 1

4 SAMPLING RESULTS

4.1 General

This chapter presents and discusses data separately for results from grab samples, composite samples, and deicing event (glycol) samples. These types of samples employ different protocols that represent different temporal periods of the particular stormwater discharge event (i.e., grab samples versus composite samples) and should be addressed separately.

The required hydraulic and hydrologic data are included in Appendix A. Samples were validated according to the representativeness criteria described in the Port's Procedure Manual for Stormwater Monitoring (Port 1999a). Appendix B tabulates and summarizes analytical results for each outfall. Data previously submitted to Ecology in the monthly DMRs represent samples collected strictly from those storms and sampling routines that fully met the criteria of the Procedure Manual. In addition to this DMR data, this report summarizes all other data collected at the storm drain outfalls covered under the NPDES permit (Table 1).

4.2 Data Presentation Methods

This report compares the Port's stormwater data to others' stormwater data listed as reference comparators in Table 4. Most reference comparators discussed in this report were the lowest results from two City of Bellevue studies. These comprehensive, local studies had similar sampling protocols to the Port's. However, the samples in the 1995 Bellevue study were taken at instream stations and therefore reflect receiving water conditions during stormflows, as opposed to just outfall discharges. Nonetheless, contrasting STIA *outfall* discharges to this *instream* comparator results in more conservative conclusions. This report uses the Portland NPDES data for copper because it better represents commercial and industrial outfall discharges *before* mixing with receiving waters. Again, the reader should consider the nature of the STIA sampling locations discussed in Section 3.3.

Comparator data and outfall sampling results appear on box plots that illustrate the central tendency, spread, and skew of the Port's data (Figures 2 through 9). The bold line within a box represents the median value, while the bottom and top of a box show the 25th and 75th percentiles, respectively. In other words, the interquartile range (central 50 percent) of the data fall within values highlighted by the box. SPSS software was used to generate the box plots (SPSS 1999).

When summarizing data to compare typical values, outliers usually represent unusual conditions, atypical of what could be expected under usual circumstances. In a box plot, the "whiskers" show the largest values that are not considered outliers. SPSS box plots show two types of outliers: those more than 1.5 box-lengths from the 75th percentile plotted with the symbol "o", and those more than 3.0 boxlengths with a star symbol ("*"). In most cases, the boxplots show the outliers, but in some cases the scales selected prevent plotting all outliers. All data are tabulated in Appendix B.

4.3 Storm events sampled

The 1999-2000 sampling season began on July 1, 1999 and ended June 30, 2000. During this 12 month period, 36.8 inches of rain fell at STIA, which is 4% below the 60+ year average. The 9.6 inches of rainfall in November 1999 was about 50% more than the average of 6 inches. Unlike the 1998-99 period, influenced by the very wet La Nina weather pattern, rainfall in the past year was much more typical and no new records were set. See Figure 2.

In the 12 months ending June 2000, the Port sampled 19 rainfall events. Rainfall during these events ranged from 0.1 to 1.76 inches. These events were preceded by less than a day to up to 2 weeks of dry weather. There were no qualifying sample events in the month of September 1999. Appendix A summarizes daily rainfall and storms sampled.

Table 4 Stormwater Quality Comparators[a]

		Study						
Constituent	**Units**	**NURP, 1983**	**BURP, 1984**	**Metro, 1982**	**Bellevue, 1995[b]**	**Highway Runoff[c] 1981**	**Portland NPDES[d] 1993**	**WA State Standard[e]**
pH	std units		**5.2 - 7.4**		7.2 - 7.8			6.5 - 8.5
TPH	mg/l				**3.7**		6.5	*no standard*
Fecal coliforms	mpn per 100 ml	1000 to 21000	*980*		**201**			50
BOD_5	mg/l	9	**6.6**				20	*no standard*
TSS	mg/l	100	**50**		82.3	106	119	*no standard*
Turb	mg/l		19		**29.4**			based on background
glycols	mg/l	*not analyzed in any of these studies*						*no standard*
Cu (TR)[f]	µg/l	34		20	10.4	43	**40**	10.3[f]
Pb (TR)[f]	µg/l	144	170	210	**26.3**	466[c]	25	39[f]
Zn (TR)[f]	µg/l	160	120	110	**161.4**	638	376	72[f]
statistic reported:		median	mean[g], *median*	mean	log-normal median	mean	median	metals standards[f] at hardness =56 mg/l

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

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

(c) Highway runoff from an I5 location in Seattle with 57,000 ADT, 43 to 54 storm samples in 1980-81 (Chui, Mar, and Horner, 1982). Because this study was conducted prior to the phase-out of leaded gasoline, lead results were higher than other later studies.

(d) City of Portland 1993 NPDES Part 2 Municipal Application. Median of 10 samples from I2 "industrial" outfall.

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

(f) Total recoverable metals. WA State acute standards expressed as total recoverable, calculated at 56 mg/l hardness using Ecology's "TSDCALC8.XLW" spreadsheet. This hardness value is the median of seven instream samples collected in Miller and Des Moines Creeks in 1999.

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

Unlike the 1998-99 season, in the past year there was only a single summer storm event associated with higher than typical constituent concentrations. In previous years, thunderstorms producing intense rainfall after protracted dry periods of a month or more caused elevated levels of certain constituents. These meteorological factors resulted in the unusual combination of a lengthy accumulation period and a high scour from the intense rainfall. Several fall 1998 storms followed this pattern. These factors are important to take into account when considering how representative a particular sample result is given the naturally occurring, and perhaps infrequent seasonal influences.

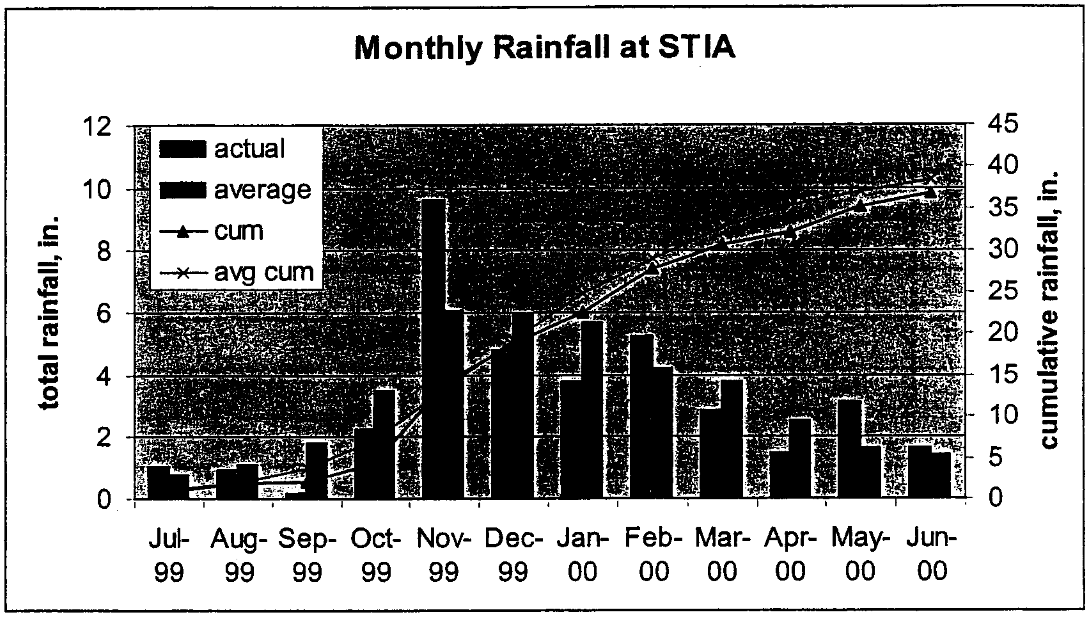

Figure 2 Rainfall Summary

4.4 Grab Sample Results

The following discussion includes results from 39 grab samples collected in the past year, bringing the 6-year total to 399 total grab samples.

4.4.1 Total Petroleum Hydrocarbons (TPH)

The results from the current year presented in Figure 2 continue to demonstrate that concentrations of petroleum-type constituents in STIA stormwater are consistently less than in stormwater from other urban areas.

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

- STIA stormwater overall continues to have less petroleum-type constituents than typical urban runoff. During the past 3 years, more than 95 percent of the 161 STIA results were less than the Bellevue, 1995 median (instream samples) of 3.7 milligrams per liter (mg/l). All 39 samples in the past year were below the Bellevue median. The overall STIA TPH median dropped from 0.4 to 0.3 mg/l because of low results in the past year. On the whole, TPH was not detected in 58 (36%) of a total of 161 samples taken since March 1998.

- Airfield stormwater (SDS3, SDS4, SDN3, and SDN4) continues to contain far less TPH than runoff from the landside subbasins (SDE4, SDN1, and TY.) To date, median airfield TPH is 0.08 mg/l compared to the 1.0 to 2.5 mg/l median levels for the four landside outfalls. TPH was not detected in 43 (67 percent) of the 64 airfield outfall samples analyzed by the new method in the past three years. The maximum TPH value of these 64 airfield outfall samples was 0.5 mg/l, which is one half the detection limit of the previous TPH (IR) method of 1.0 mg/l. Current results are similar, with no new maxima. See Figure 3.

- Because most of the TPH detected in landside runoff is motor oil, it is likely attributable to cars and trucks. Figure 2 and the tabular data in Appendix B show that motor oil represents the majority of the TPH at these outfalls (SDE4, SDN1, and TY.)

- The IWS effectively isolates aviation-related fuel spills and drips from the storm drains. For all outfalls, measurements of diesel fractions, which would represent certain constituents of aviation fuel (JP4, JP5, etc.) are typically below detection limits (90% of the 161 samples), with a historical maximum of 0.8 mg/l. Considering that subbasins SDE4 and SDS3 are contiguous with aircraft service (IWS) areas where fueling takes place, sample results for these two outfalls show low incidence of TPH. Up to 90% of the 30 samples from SDE4 had TPH less than the 3.7 mg/l comparative value for urban areas. More than 60% of the total of 30 SDS3 samples had non-detectable TPH.

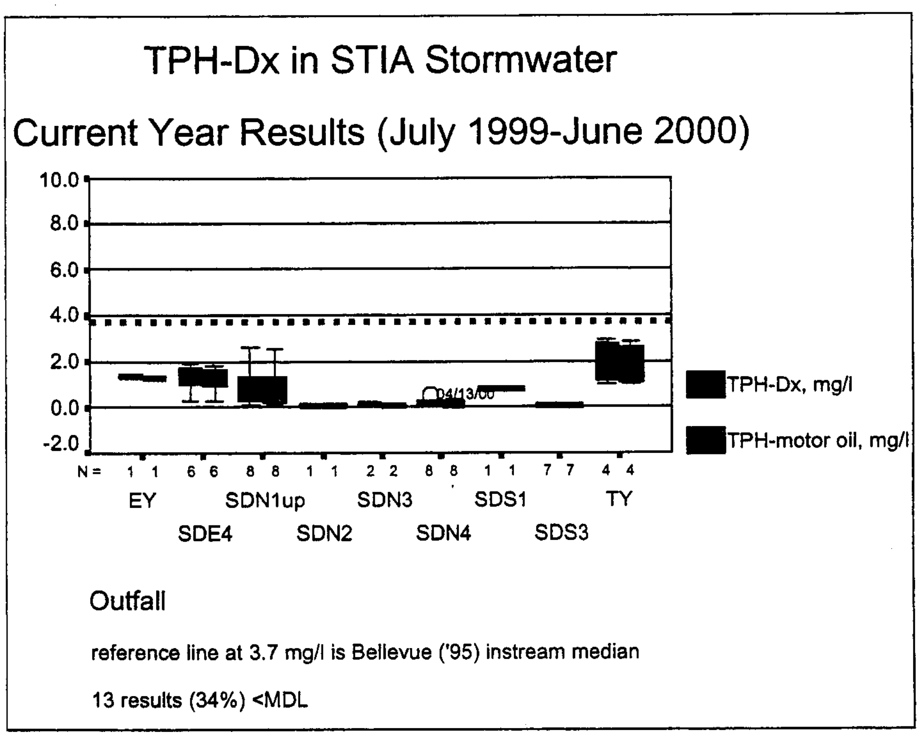

Figure 3 TPH for current year

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4.4.2 Fecal Coliforms

Overall, the median value for fecal coliforms in 302 samples to date is 42 per 100 ml, with more than two thirds of the results less than 200 per 100 ml. Relative to the comparative values (Table 4), these overall results indicate that STIA stormwater contains fewer fecal coliforms than typical urban stormwater. More than 81 percent of the 126 airfield subbasin samples taken to date showed fecal coliforms less than the Bellevue (1995) comparative value of 201 per 100 ml (see Figure 4). Current year results from a total of 32 samples from six outfalls continue this pattern, where 81 percent were less than the comparative value.

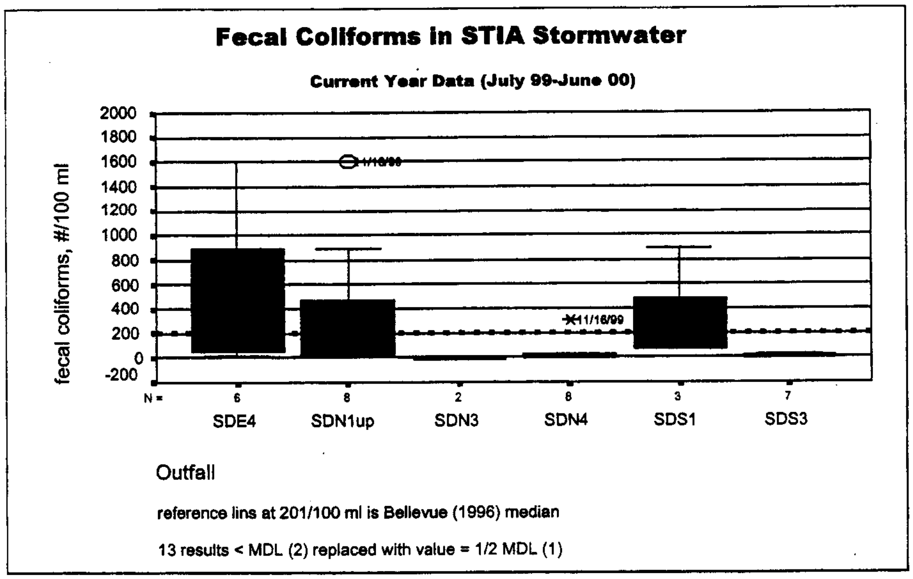

Figure 4 Fecal Coliforms for Current year

There are numerous sources of fecal coliforms including fecal waste products of birds and all mammals. Urban stormwater often contains fecal coliforms at sporadically elevated levels. Human sources, such as septage or sanitary sewage are not always implicated as contaminants. Importantly, all fecal coliform test methods often overestimate true fecal numbers, plus they are susceptible to interference from non-pathogenic coliform bacteria including Klebsiella species (U.S. EPA, 1986). Fecal coliforms are a presumptive indicator, meaning that if present, pathogens are presumed present as well, which may not always be the case.

To remove these sources of uncertainty and to better serve public health, the U.S. EPA stated in 1986 that *E. coli* and enterococcus-based methods and standards should be used by the states (U.S. EPA, 1986) as a means of measuring the presence of pathogens. Ecology is considering these changes in the triennial review of water quality standards process (WDOE, 1998, 2000b).

A method called the Microbial Source Tracing (MST) technique matches "fingerprints" isolated from *E. Coli* bacteria DNA with those previously characterized from known human and animal sources. The University of Washington's School of Environmental Health developed this technique which has been used in several surface water studies in the region. Using the MST technique, the limited sampling for the Des Moines Creek Basin Plan showed that some of the fecal contamination in the lower watershed was attributable to human septage and that animal sources exist as well (KCDNR, 1997). Human sources were less prevalent upstream nearer the airport, where dog and avian sources together comprised up to 34% of the results. This study had limited statistical power due to limited number of samples, plus a number of the isolates were unmatched with known sources. The Port is using the MST technique to identify potential sources in airport runoff. See Section 4.7.3.

In past reports, the Port showed that sporadically elevated numbers of fecal coliforms were found principally in the landside subbasin SDE4. Of the six current year results for SDE4, only two samples showed elevated results, while the remaining four were less than 200 per 100 ml, well within the typical range for STIA and other regional stormwater (see Table 4). Nonetheless, the Port is continuing the source tracing study intended to identify potential sources of contamination. Preliminary results, included in Section 4.7.3, do not indicate sanitary sewage as a source in storm or baseflows. Uncontaminated baseflow samples indicate that there is no continuous source of fecal coliform bacteria, whether arising from human, animal or other sources. Investigations are targeted for completion by the end of the year.

4.5 Composite Sample Results

In the past year, the Port took a total of 38 flow-weighted composite samples, bringing the six-year total to 354 for all outfalls. The discussion of these composite sample results are segregated from grab samples because grab samples represent only instantaneous values. Composite sample results, especially those from samples that comprise the entire hydrograph, represent an average value or event-mean concentration (EMC) existing over a longer time period. There were no non-representative composite sample results for the past year. All composite samples analyzed met representativeness criteria of the Procedure Manual.

4.5.1 Suspended Solids and Turbidity

STIA outfalls continue to discharge typically less total suspended solids (TSS) and turbidity than urban areas. In the six-year sampling history at STIA, more than 80 percent of the 327 TSS samples and 281 turbidity samples were below the comparative values of 50 mg/l, and 29 NTUs, respectively. As shown in Figure 5 and Figure 6, the majority of results for the past year continue to be consistently low.

The four airfield outfalls (SDS3, SDS4, SDN3, and SDN4) continue to produce less TSS and turbidity than the two principal landside subbasins (SDE4 and SDN1). In the past six years, 86 percent of the 121 TSS results from the airfield outfalls were less than one-half the regional comparative median value. Because these airfield outfalls represent about 61 percent of the total SDS area, the data show that the majority of STIA runoff is much lower in suspended material than runoff from comparable regional urban areas.

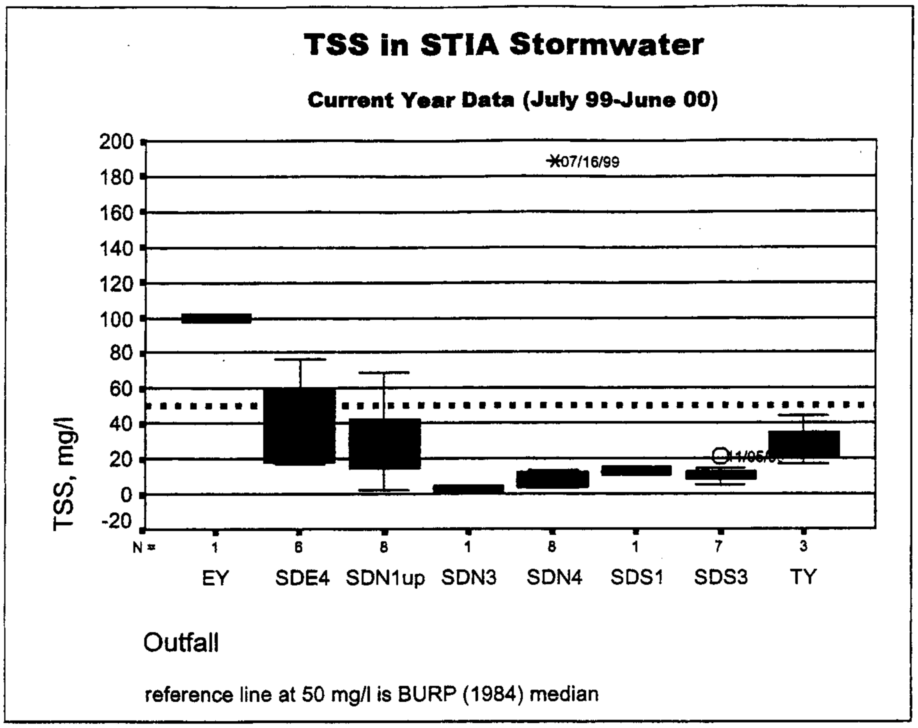

Figure 5 TSS for Current Year

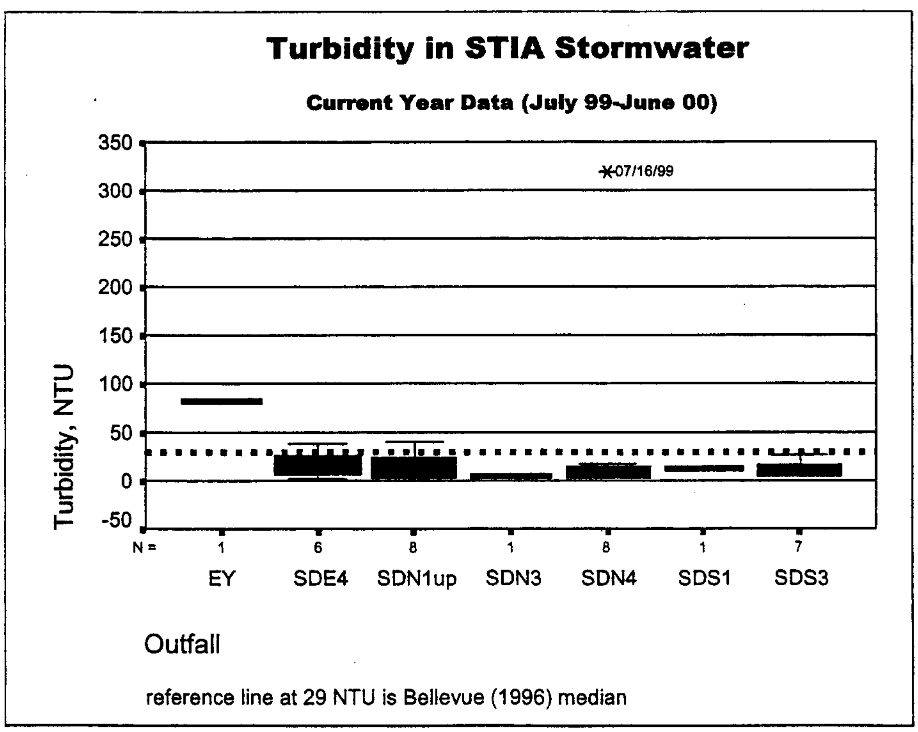

Figure 6 Turbidity for Current Year

Unlike the previous reporting period, in the past year, there was only one storm event associated with higher than typical TSS and turbidity, which occurred at SDN4 on July 17, 1999. This one-time occurrence was due to vehicle activity disturbing a small area of soils on a nearby Port construction project. The erosion control BMPs already in place were adjusted to better prevent recurrence. The next storm sample at SDN4 did not exhibit unusual TSS or turbidity.

The Port's construction erosion and sediment control program provides effective erosion and sediment controls. The stormwater batch treatment system used over the past two seasons for the third runway embankment project was highly effective. Discharges from this system always met water quality standards for turbidity in Miller Creek, and in fact, were typically much cleaner than background conditions in the creek upstream from the project (Tobiason et al., 2000).

4.5.2 Biochemical Oxygen Demand (BOD_5)

Results for the past year continue to indicate overall low levels of BOD_5 in STIA stormwater. In 32 samples analyzed in the past year, the median BOD_5 was 5.6 mg/l, and 57 percent of all samples were below the 6.6 mg/l regional urban comparator (BURP, 1984, see Table 4). The 95^{th} percentile of the samples associated with routine, non-ground deicing operations was 22 mg/l. See Figure 7.

Principal sources of elevated BOD_5 concentrations in the past were associated primarily with infrequent and short-lived winter weather episodes and ground surface deicing. During these events, acetate-based ground surface deicing chemicals are the primary sources of BOD_5. The Port discontinued the use of urea and glycol-based ground surface deicers in 1996. There have been only a few isolated indications of limited BOD_5 contributions to stormwater from aircraft deicing glycols. The Port has rerouted drainage from a limited area near the South Satellite that can receive infrequent aircraft deicing/anti-icing fluids

(ADAFs) when and if applied to aircraft at gates S3 and S4. See Section 4.7.3. All other known direct sources of glycols have been eliminated from the storm drains through numerous BMPs (POS, 1998c).

In the past year, two limited periods of winter weather occurred: January 11-12, 2000 and January 18-19, 2000. Section 4.6 discusses these in more detail. The minor snowfall from the first event did not require plowing or storage of snow in the snowmelt BMP areas. There was no snowfall associated with the second event. During both of these events, there were no discharges from outfall SDN2, which could drain the north snowmelt BMP area in the event of an IWS pump station bypass[2]. Compared to past years, snowfall and chemical usage, including aircraft glycols, was far less (POS 1998b, POS 1997b.) One sample taken during the first event had an elevated BOD_5 concentration of 646 mg/l. Both events were monitored at key receiving stream stations as part of the second-year Dissolved Oxygen Study (in press).

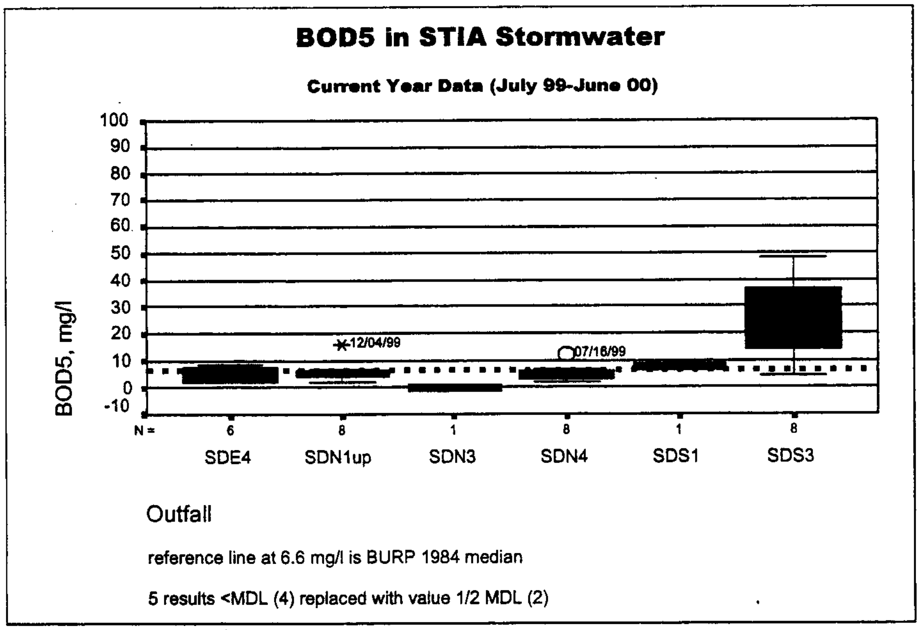

Figure 7 BOD_5 for Current Year

[2] The entire drainage area of outfall SDN2 was re-routed to the IWS in 1997 as a result of two BMPs.

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4.5.3 Metals

All data reported below are for total recoverable metals. It is important to note that Washington State Water Quality Standards (WAC 173-201A) apply to the receiving waters, not to the discharges from a particular outfall. See the discussion in Section 3.3 concerning the STIA monitoring locations relative to the receiving streams.

The Washington State water quality standards for copper, lead, and zinc are based on the dissolved fraction of the metal. Because of complex water chemistry, only a portion of the dissolved fraction is actually bioavailable (Hall et al., 1997). Thus, direct comparisons of dissolved metals with standards may result in "false positives" where a sample is not actually toxic. Limited results for dissolved metals analyzed in source tracing studies appear in Appendix F. The comparisons offered below are based on the total recoverable metal using the non-specific partitioning coefficients provided in the water quality standards and Ecology's TSDCALC8 workbook. The application of site-specific coefficients for these calculations would be more appropriate.

4.5.3.1 Copper

Overall, in 257 samples in the past six years, the median copper value for all outfalls is 0.025 mg/l. Airfield and landside outfall data in this case are similar, with medians ranging from 0.014 to 0.031 mg/l. See Figure 8. Generally, STIA data are less than the 0.040 mg/l median for copper from the City of Portland's sampling results (City of Portland, 1993.) This comparison is more representative of outfall discharges than the Bellevue, 1995 median of 0.01 mg/l which was for *instream* stormwater samples. However, note that the comparators listed in Table 4 show that urban runoff typically exceeds standards for copper.

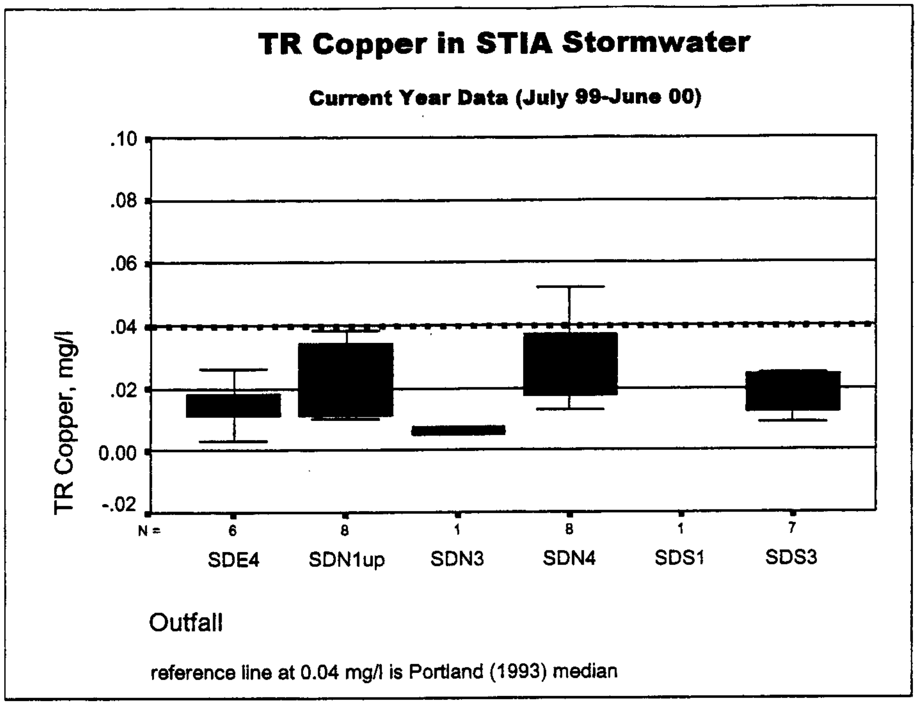

Figure 8 Total Recoverable Copper for Current Year

4.5.3.2 Lead and zinc

Samples from airfield outfalls continue to contain less lead and zinc concentrations than typical urban sources. In the six-year permit sampling history, over 75 percent of the 257 results for copper, lead and zinc in all STIA outfalls were below the median for comparable regional data for commercial areas. For the four airfield outfalls, which comprise more than 65% of the total SDS, nearly all (more than 97%) of the 120 sample results to date for lead and zinc were less than the comparators.

These comparisons have added significance given that the commercial/industrial comparators cited (see Table 4) are the most conservative data available. Plus, the lead and zinc comparators reflect *instream* sample concentrations after outfall discharges were mixed with receiving waters. Thus, metals in the vast majority of STIA stormwater, especially airfield runoff, are far lower than those measured in other local and regional studies. Current results continue these patterns, See Figure 9 and Figure 10.

Much of the airfield outfall lead and zinc data are below water quality standards. All but one of 120 lead results in the past six years are below the standard of 0.039 mg/l calculated at a hardness of 56 mg/l (Table 4.) In fact, lead was not detected in 49% of these 120 total samples. Airfield zinc was similar in that more than 85% of the 120 results are less than the standard of 0.072 mg/l at 56 mg/l hardness[3]. See Figure 9 and Figure 10.

It should also be noted that lead and zinc concentrations measured in airfield outfall samples were far lower than those in the landside outfall samples were. The overall median lead and zinc values for principal airfield outfalls SDS3 and SDN4 were nearly 5 times less than for the landside outfalls SDE4 and SDN1. See Figure 9 and Figure 10. This difference is likely due to the amount of passenger and service vehicle usage in the landside areas.

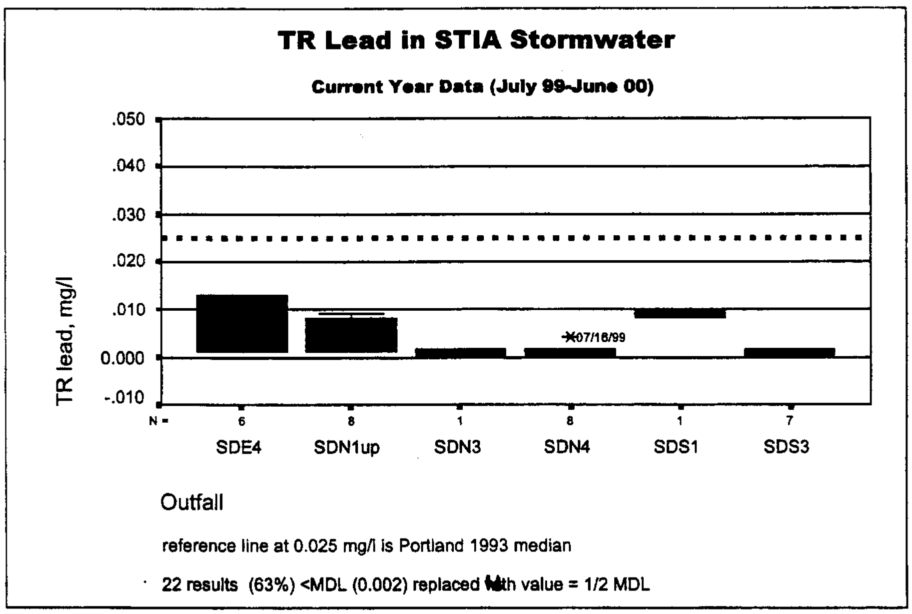

Figure 9 Total Recoverable Lead for Current Year

[3] In two storms in 1999, hardness values in seven Miller and Des Moines Creek instream composite samples ranged from 41 to 74 mg/l with a median of 56 mg/l.

The landside subbasins experience considerable vehicle traffic where tire wear is a likely source of zinc (EPA 1993). Roads and parking areas constitute more than 50 percent of the impervious surfaces draining to SDE4 and SDN1. The lower results for the airfield outfall samples are most likely attributable to the fact that airfield runoff flows through grass areas prior to draining to the piping system. Certain portions of landside subbasins SDE4 and SDN1 will be assessed for appropriate BMP retrofits, such as biofiltration, according to the recent CSMP (POS, 2000).

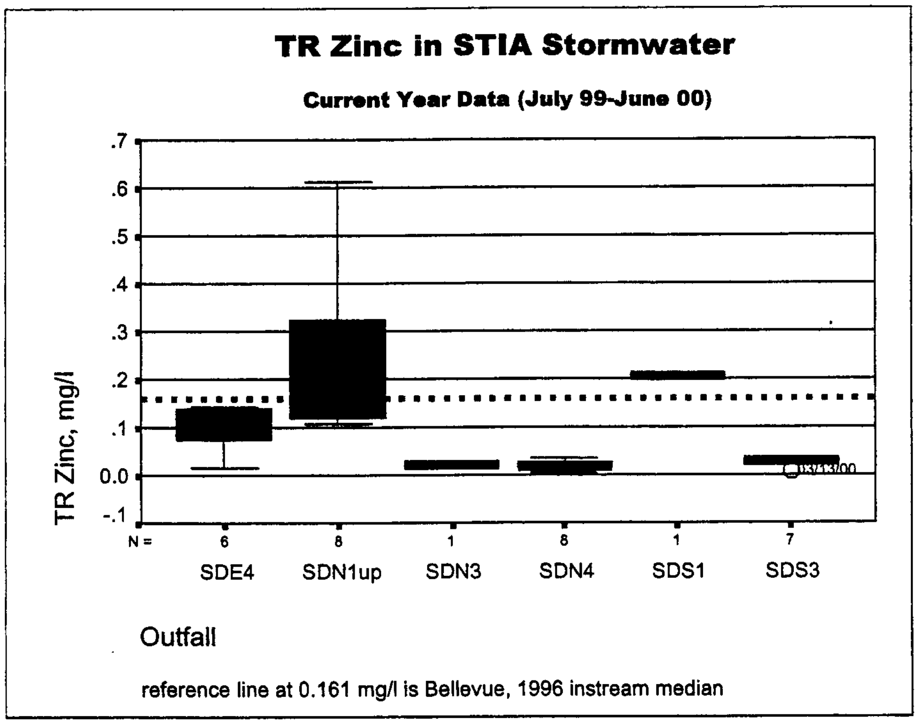

Figure 10 Total Recoverable Zinc for Current Year

4.5.3.3 outliers

There were no copper, lead or zinc outliers that were associated with elevated TSS and/or turbidity as was discussed in last year's Annual Report. However, there was a new maximum copper value from the SDS1 sample of July 2, 1999, which is above the scale in the figure below. This copper result is believed

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attributable to an inappropriate connection near the South Satellite that drains to SDS1. The Port implemented a BMP for this situation in September 2000, rerouting the drainage to the IWS. See Section 4.7.3.

4.5.3.4 Comparison of SDN1 sampling Stations

Copper and zinc in SDN1 samples from the current station continue to show lower median values than samples from the previous station sampled until the end of 1996. This difference is attributable to removing the bias imparted by SR 518 runoff that was inextricably combined in samples from the previous location[4]. See Figure 11 and Figure 12. Therefore, the current station, "SDN1up" continues to provide results that are more representative of STIA runoff. Characterization of SDN1 runoff should therefore be limited to the data beginning in 1997 that excludes the high bias imparted by runoff from non-Port entities. Data for the two stations have been segregated and discussed separately in this report and the past three Annual Reports (POS 1999b, 1998a, 1997a.).

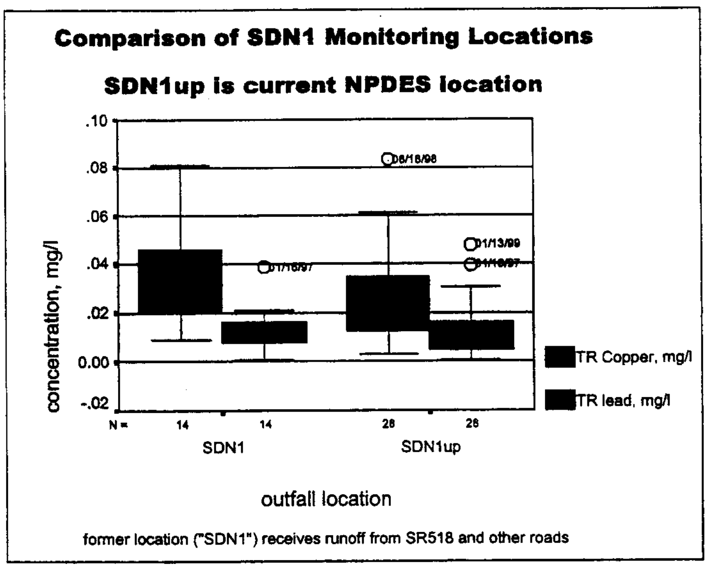

Figure 11

[4] In October 1996, the Port changed the sampling location for SDN1 from manhole SDN1-27 (now SDN1-56) to manhole SDN1-22 (now SDN1-41), upgradient from 10.5 acres of public road runoff. Ecology approved this action. Past annual reports compare data from both locations.

Note that despite removing the bias from non-POS road runoff, SDN1 exhibits higher zinc concentrations than other outfalls. The Port has traced the source of this zinc to galvanized metal rooftops and is investigating several BMPs. See Section 4.7.3.

It is important to note that the SDN1 dataset for either location represents in-pipe water quality and not in a receiving environment with a biotic community. The sampling location, for reasons mentioned in Section 3.4, is several thousand linear feet above the final discharge to Miller Creek. Considerable chemical, physical and biological factors exist between the sampling points and this final discharge point. These include open, natural channels and the Lake Reba detention pond system common to the other three north-end outfalls (SDN2, SDN3, and SDN4) See the discussion of outfall monitoring locations in Section 3.3

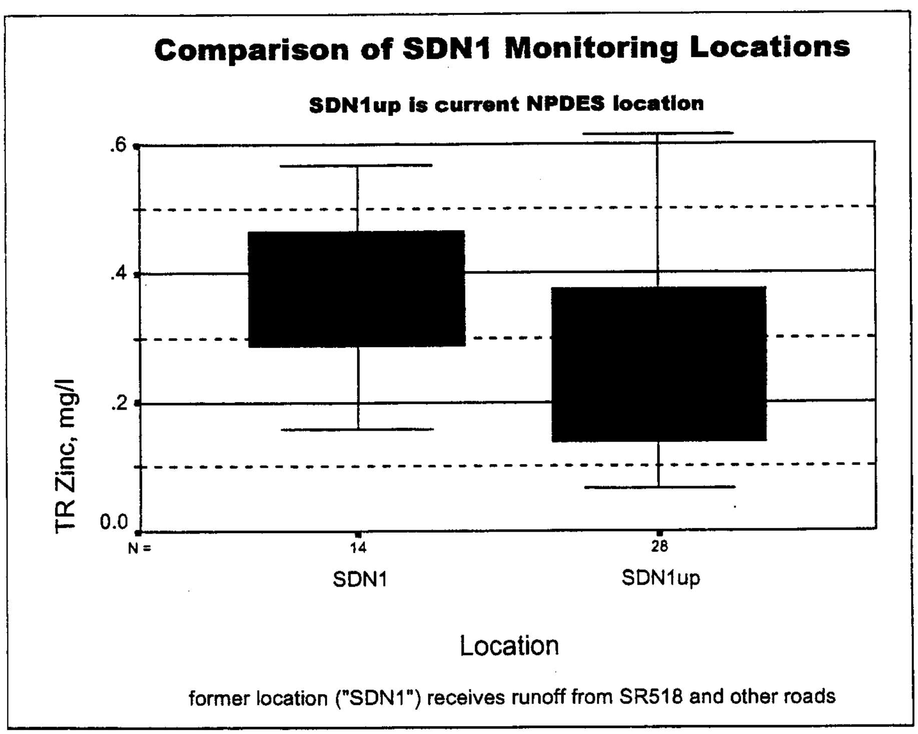

Figure 12

4.6 Deicing Event Samples

The permit requires sampling and analysis for glycols during "deicing events". The Port conducts this sampling according to the Ecology-approved Procedure Manual (POS, 1999a.) The glycol data discussed below encompass mostly composite samples collected during periods of aircraft deicing, representing average values during a storm event discharge. Some of the data are from grab samples as required for outfalls SDS1 and SDN2.

<u>4.6.1 Background.</u>

In 1995-1997, as recommended by the SWPPP, the Port implemented seven BMPs that rerouted drainage to the IWS from certain areas in four SDS subbasins: SDE4, SDS1, SDS3, and SDN2 (POS 1998c). Several limited areas within these subbasins were subject to aircraft servicing, including periodic ADAF (glycol) application. Two of these BMPs use multiple pump stations that have performed as intended over the past three years.

Two of these pump stations divert runoff from the entire SDN2 subbasin to the IWS. In the past year, there were only two storms (December 15, 1999 and May 10, 2000) that resulted in bypasses from these pump stations to the SDN2 outfall. Both bypasses were of very short duration compared to the length of the rainfall event. As intended in the station design, these bypasses to SDN2 represented only a fraction of the peak flows of the hydrograph.

The Port's Annual Glycol Reports (POS 2000a) detail ADAF (glycol) application at STIA. These reports summarize data reported by the airlines for the volumes of both ethylene and propylene glycol applied and number of aircraft treated each day. The Federal Aviation Administration (FAA) authorizes only ethylene and propylene glycols for aircraft deicing and anti-icing. Port tenants perform all glycol application at STIA (applied by airlines or their ground service providers).

Importantly, to ensure public safety, aircraft pilots make the ultimate decision on whether to apply glycols or not.

4.6.2 Results

Glycols have been present infrequently, usually limited to the rare, one to two day winter weather episodes, amounting to just a few days annually. In the past year, glycols were analyzed in a total of 33 samples from six outfalls. The majority of samples were collected at the regular sampling locations (SDE4, SDS3, and SDN4.) Total glycol concentrations ranged from non-detectable to a maximum of 801 mg/l in an SDS1 grab sample. Twenty four of these 33 results (73 percent) were below the detection limit of 2 mg/l. The total number of aircraft deiced in the dry period before sampling events ranged from 3 to 261, with a median of 31. Data appear in Figure 13 and are summarized in tabular form in Appendix C. These results continue to indicate that glycols are typically absent in STIA stormwater discharges.

In the past year, two limited periods of winter weather occurred: January 11-12, 2000 and January 18-19, 2000. During the first event, the minor snowfall of 2 to 3 inches did not require plowing because it melted rapidly with the ensuing rainfall. The second event had no snow but was associated with heavy frost formation on ground surfaces during clear night skies. In both events, deicing/anti-icing chemicals were applied to ground surfaces during brief periods of 24 hours or less.

These were the only periods in the winter of 1999-2000 when the Port applied chemicals to ground surfaces (primarily runways and taxiways.) Storms following both events were sampled at various outfalls. In addition to this NPDES sampling, both of these events were also monitored for the Dissolved Oxygen

Study (POS, in press.) There were no discharges from outfall SDN2 during either of these events[5].

Snowfall and chemical usage in the past year, including aircraft glycols, was less than in previous years. During the January 11-12 event, glycol results were 12 mg/l, 801 mg/l and 364 mg/l at outfalls SDE4, SDS1, and SDS3, respectively. The SDS1 result was from a grab sample while the others were flow-weighted composite samples.

Last year's annual report identified a clogged IWS drain inlet that may overflow to SDS3. Because of the proximity to certain gates of the C-Concourse, these overflows could be a potential source of glycols found sporadically in SDS3 samples. The Port corrected this problem this year and the IWS drain inlet now functions properly.

An elevated glycol result of 801 mg/l in the SDS1 sample of January 12, 2000 was associated with substantial aircraft deicing that took place nearby. Several small area drains near gates S3 and S4 at the South Satellite receive limited runoff from a small area between the nearby IWS flush gutters and the building. Only the forward sections of larger aircraft may overhang this area, resulting in the potential for ADAFs to enter the drains and SDS1 system. See Section 4.7.3. Though it is not certain that ADAFs were applied specifically to aircraft at the S3 and S4 gates, it is likely that the glycol result of 801 mg/l was attributable to at least one of the 15 aircraft deiced at the South Satellite on January 11-12, 2000. The Port has implemented an appropriate BMP by rerouting this drainage to the IWS (September 2000).

[5] The entire drainage area of outfall SDN2 was re-routed to the IWS in 1997 as a result of two BMPs.

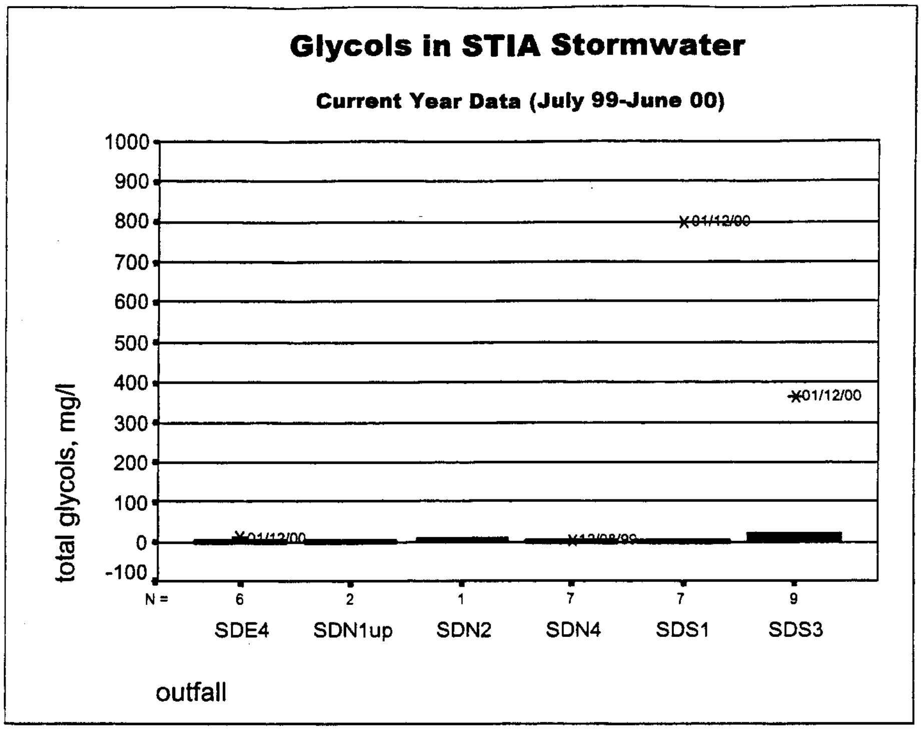

Figure 13 Glycol results for Current Year

The Port has completed all sampling requirements of Special Condition S2B4 for deicing events at outfalls SDS1 (003) and SDN2 (007). This permit condition was added when the current permit became effective on March 1, 1998. Previous annual reports have discussed how the data signify that the BMPs have been effective and the intent of this monitoring requirement is satisfied. As allowed for in Special Condition S2B4, the Port has requested Ecology's approval to cease this monitoring (POS, 1999e, POS, 2000b).

4.7 Other Results

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

4.7.1 Field Quality Control Samples

The Port routinely collects duplicate and equipment blank samples during NPDES sampling events according to the Procedure Manual. Appendix E summarizes these results. The field equipment blanks taken in the past year indicate that sampling techniques and equipment do not contribute a high bias to sample results reported, notably for metals. These results support the efficacy of the Port's "clean" sampling methods that were developed for stormwater monitoring, in particular for the WET testing source tracing (POS, 1999d).

4.7.2 WET samples

As required by permit condition S10, The Port completed two rounds of whole effluent toxicity (WET) testing at the four principal outfalls (SDE4, SDS3, SDN1 and SDN4) in the previous year (1998-99). The final report summarizing these WET testing results was submitted to Ecology in May 2000 (POS, 2000c).

WET testing bioassays used the two required aquatic test species: *Daphnia pulex* (a daphnid or waterflea), and *Pimephales promelas* (fathead minnow.) Results did not indicate toxic conditions in the stormwater discharges sampled at outfalls SDE4, SDS3, and SDN4. Furthermore these results met the performance standards for WET according to Ecology guidelines[6]. In contrast, results from outfall SDN1 exhibited toxicity, where most samples did not meet the performance standards. Final testing of SDN1 runoff in late 1999 showed that the toxicity was attributable to metals, most likely zinc, leaching from galvanized metal rooftops. The final WET testing report discusses the source tracing data that lead to this conclusion. Appendix D contains the source tracing data for SDN1 samples collected in later 1999. The Port is currently investigating how to remedy this source of zinc.

[6] Performance standards for acute WET tests: the average survival in 100% effluent must be at least 80%, and no single sample must have less than 65% survival (WAC 173-205)

4.7.3 Source Tracing Studies

Because certain sampling results have indicated the possibility of contamination, the Port has conducted source tracing studies aimed at identifying and characterizing potential contaminant sources. Through past efforts, the Port has already discovered and eliminated several other sources of stormwater contamination in subbasins SDE4, SDN1, and SDS4 that are discussed in previous Annual Reports[7].

As discussed in the WET testing section above, during the past year, the Port investigated and found the likely source of toxicity exhibited in SDN1 samples. These results from SDN1 are included in Appendix D, and were elaborated further in the final WET characterization report submitted to Ecology in May 2000. Other source tracing investigations are summarized below.

4.7.3.1 SDE4 Source Tracing

The Port began studying fecal coliforms in SDE4 discharges in 1998 and continues to investigate causes of sporadic elevated results using several forensic techniques. The discussions below focus on results from storm samples, baseflow samples, microbial source tracing, measures of contamination, and potential source characterization. Sample results from the past year are summarized in Appendix F

4.7.3.1.1 Stormflow samples

To date, the median of the 46 NPDES storm event grab samples from SDE4 is 280 per 100 ml, which is similar to median values at other STIA outfalls. See Appendix B. Consistent with past annual reports, source-tracing findings summarized below do not implicate sanitary sewage or other domestic

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[7] See POS 1997, 1998. Inappropriate connections to the stormdrains were found and eliminated in subbasins SDE4, SDN1, and SDS4.

wastewater as a cause of sporadic elevated numbers of fecal coliforms. Many other studies have shown that fecal coliforms in stormwater can be highly variable with frequent highly elevated numbers. The BURP (1984) study found a fecal coliform median of 980 per 100 ml in 326 *instream* stormwater samples. Fecal coliforms were often several thousand or more in the 200 stormwater samples taken at instream and outfall locations during the comprehensive Bellevue (1995) study, which concluded that the high concentrations were probably due to animal wastes. Again, the fecal coliform test is subject to interference from non-pathogenic bacteria. See the discussion below.

In the routine NPDES stormwater grab samples taken at SDE4 the Port has also analyzed certain chemical indicators of potential contamination. See Appendix E. Fecal coliforms were low (<50/100 ml) in two samples where fluoride concentrations suggested the presence of domestic water. Concentrations of ammonia and surfactants were also low in these samples. In addition, the ammonia to potassium ratios were also well below the 0.9 value generally indicative of wastewater[8]. These particular indicators have shown that the only sporadically high fecal coliforms found in these samples were not associated with the presence of wastewater. Consistent with conclusions in last year's annual report, these findings point toward the absence of sanitary sewage draining into the SDE4 system.

4.7.3.1.2 Baseflow samples

Two rounds of baseflow sampling showed very low counts in SDE4 samples, indicating the general absence of baseflow contamination. Importantly, these findings demonstrate, as did last year's baseflow results, that there were no continuous discharges of contamination. Thus, these results eliminate the possibility of direct cross connections with the sanitary sewer. This conclusion is

[8] See Lalor, Pitt, and Field, (1993)

further supported by the sporadic nature of the elevated results in storm samples which also indicate a direct cross connection with sanitary is unlikely.

No obvious inappropriate drainage connections were found after reviewing site plans and inspecting field conditions for a number of SDE4 manholes in August 1998. Sanitary sewer lines run parallel to SDE4 drain lines in several areas, but in most cases the sewer lines are below the storm drain lines. Thus, the potential for sanitary sewer leakage into SDE4 is limited. The field review identified a minor source of wash water from the rental car wash attributable to track-out by vehicles. This source was corrected by an asphalt berm added by POS maintenance as a BMP in early 1999, diverting the runoff to the IWS. Another inappropriate connection with rental car wash effluent was found and corrected in 1997. It is unlikely that these sources were associated with the elevated fecal coliform numbers.

4.7.3.1.3 Microbial source tracing (MST)

The Port conducted seven rounds of microbial source tracing (MST) routines in the first 6 months of 2000 and plans to complete the remaining half of the MST study by the end of the year. This MST technique uses a special method of RNA fingerprinting developed by Professor Mansour Samadpour of the University of Washington's School of Environmental Health. Several other local and regional studies used this technique and attributed some of the fecal contamination in surface waters to multiple sources, including domestic animals and septage (Trial et al., 1993, King County 1995, Herrera, 1999). Ecology recognizes the MST method as "...an excellent method for determining some of the sources of fecal contamination in a watershed" (Sargeant, 1999.)

Using the MST technique, King County (1997) attributed up to 64% of the results in the lower Des Moines Creek basin to human septage. In upstream samples taken nearer the airport, human septage sources comprised 10% or less of the results, while avian and dog sources together represented up to 34%. However, the two rounds of MST analysis in this King County study provide limited statistical power and resulted in 36% to 59% unmatched results, which may also be due to the limited number of "fingerprints" available in the database at that time. Nonetheless, the study indicated that human sources were prevalent in lower basin areas suggesting that aging septic systems should be addressed.

Sampling and MST work at STIA also aims to characterize potential sources present in SDS3 runoff and in Des Moines Creek near South 200th Street. This instream location was also sampled during the limited MST work done for the Des Moines Creek Basin Plan (King County 1997). The Port's results to date show very low counts in SDS3 runoff, which are consistent with the 6-years' sampling summarized in Section 4.4.2. Four baseflow samples at SDS3 showed non-detectable fecal coliforms. Instream results have varied more, with less than 100 per 100 ml in four baseflow samples, but up to 2000 or more in two of six storm samples. The MST technique will characterize potential sources indicated for samples from these stations. The Port plans to issue a separate report at the conclusion of this study.

4.7.3.1.4 Measures of contamination

Another part of this study examines the potential relationships among several indicators of bacterial contamination. Most fecal coliform bacteria are not pathogenic, but are used to indicate contamination from mammalian, avian, and human fecal waste products. Washington state water quality standards (WAC 173-201A) are based on fecal coliforms. Importantly, this metric does not distinguish actual sources, whether human, animal, or interference (false positives) from other non-pathogenic coliform bacteria such as Klebsiella sepcies. For example, recent studies in Colorado showed that Klebsiella significantly interfered with fecal coliform results, causing the potential for false exceedances of permit criteria for a WWTP and implying higher than necessary disinfectant usage (Elmund et al., 1999).

For many years, various proponents, including EPA, have suggested that other metrics which correlate better with actual measures of disease are more appropriate (U.S. EPA, 1986). In 1986, the U.S. EPA stated that *E. coli* and enterococci-based standards would serve public health better than fecal coliforms and that states should change standards, effluent limits and test methods accordingly (U.S. EPA, 1986). The U.S. EPA issued an implementation guidance document this year (U.S. EPA, 2000). Ecology's triennial review of water quality standards, currently in progress, generally concurs with EPA, and as of May 2000 Ecology is considering *E. coli* and Enterococcus as alternative standards (WDOE, 1998, 2000).

The Port's study has not yet examined *E. coli* numbers, but has analyzed enterococcus in one round of sampling done in May, 2000, the results of which appear in Figure 14. Some of these samples correlated well, but notably, the samples from the routine SDE4 monitoring location had much lower enterococcus numbers than fecal coliforms.

4.7.3.1.5 Local source characterization

Another aspect of the Port's MST study examines and characterizes specific potential sources of fecal contamination that could contribute to SDE4. The regional *E. coli* database already contains thousands of genetic "fingerprints" that are unique for humans and various species of mammals and birds. The Port's study has already collected 16 local fecal material samples (mostly from birds) that have been genetically typed and used to build the database with local populations of *E. coli* to increase the chance for matching with *E. coli* from STIA stormwater.

During source sampling, a large colony of pigeons was discovered roosting on the rooftops of the A-concourse. The guano deposits here indicate that this colony has inhabited the area for a considerable time. Because this colony is near aircraft gates, these birds are being trapped and removed to eliminate the safety hazard posed for aircraft operations. The guano deposits will be removed when the entire A-concourse is demolished and removed this fall in preparation for new concourse construction.

This study also collected samples of local municipal wastewater (MWW) generated by STIA and aircraft wastewater (AWW), known as "biffy" waste. *E. coli* from these samples have been genetically typed to build the database with local human sources. Samples of MWW and AWW taken to date have shown very high fecal coliform counts ranging from 39,000 to 48,000,000 per 100 ml (membrane filter method; APHA, 1995). Importantly, the presence of high counts in the AWW samples indicates that the toilet chemical added by the airlines has limited sanitizing effects. This aspect should be considered in spill response.

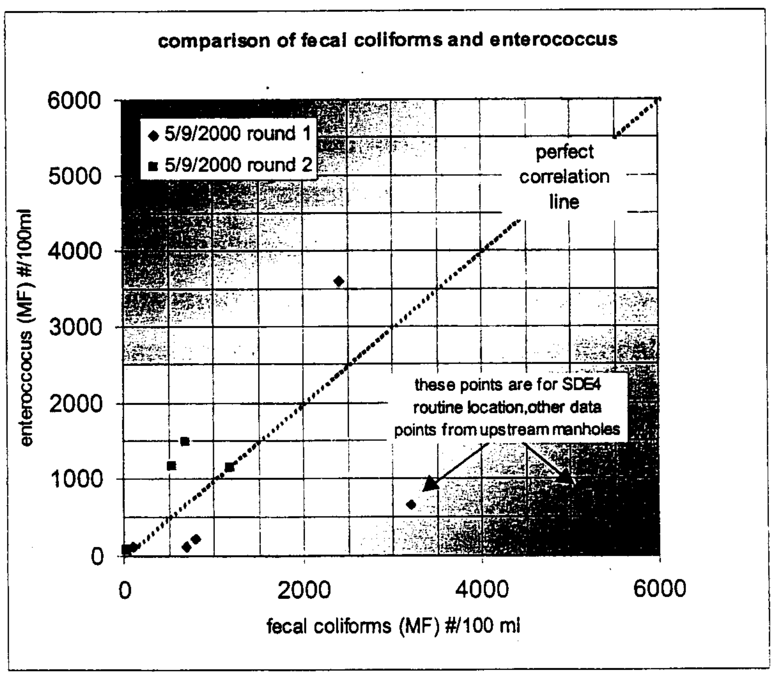

Figure 14 indicator correlation

4.7.3.2 Observations for SDS1 discharges

Several SDS1 stormwater samples and observations in 1999 indicated limited, but not severe contamination from unusual sources. In addition to the two events mentioned in the last annual report, foam was again observed below the outfall during initial runoff from storms sampled on July 2 and September 23, 1999. Inconsistent analytical results and generally low levels of certain indicators signify sporadic, low-level contamination, most likely from washwater. Table 5 below summarizes stormwater sampling results from last year and the current year. Baseflow was generally low or absent and did not exhibit foam. Dry-weather discharges were not observed.

Fluoride concentrations near 0.1 mg/l indicated that the stormwater runoff contained less than about 10% domestic water[9] (potentially wash water). In addition, the ammonia to potassium ratios were also well below the 0.9 value generally indicative of wastewater[10]. But, the surfactants and phosphate results indicated detergents/soaps to a limited degree.

Neither the July or September event samples showed significant surfactants, though the July samples showed a higher percentage of polyphosphates that could be attributable to soaps and/or detergents[11]. The sporadic indications in these analytical results may be because the slug of contaminants had passed before the samples were collected, while the foam persisted. Foam was not observed during visits to the SDS1 outfall on 19 other occasions in the past year, including storms and dry weather (see Appendix G).

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[9]Local domestic water is treated with fluoride to a nominal target of 1 mg/l concentration (SPU, 1999)

[10] See Lalor, Pitt, and Field, 1993

[11] The difference between total dissolved phosphorus (TDP) and soluble reactive phosphorus (SRP) can be attributable to the presence of polyphosphates, a common and significant component of synthetic detergents (Sawyer and McCarty, 1978).

Nonetheless, certain visual observations and the analytical results, especially the March 12, 1999 sample, indicate the presence of detergents and/or soaps. The July 2 composite sample also showed the highest historical value for copper at SDS1 and the zinc concentration was near the 75th percentile. These results denote that the contaminants were only discharged sporadically in limited quantities during stormflows and were not due to dry-weather discharges of process water.

Dye and flow tracing performed on October 13, 1999 confirmed that a number of small area drains under the overhang of the South Satellite connect to the SDS1 system. Most of these inlets are sheltered from runoff or blow in. However, several inlets near gates S3 and S4 receive runoff from a limited ramp area that is between the nearby IWS flush gutter and these small area drains. Aircraft and/or GSE servicing near these gates is believed responsible for the 1999 foam observations and the elevated glycols found in the January 12, 2000 sample at SDS1 (801 mg/l, see Section 4.6.2). It is highly unlikely that runoff from South 188th Street was associated with these observations because no vehicle washing or other commercial operations exist in this additional drainage area of SDS1 downstream of Port property. The Port recently eliminated these sources of potential stormwater contamination in SDS1 by rerouting the drainage from the South Satellite area drains to the IWS.

4.7.3.3 Observations in SDS3 discharge on November 6, 1999

The runoff at outfall SDS3 from the November 6, 1999 storm event produced considerable greenish foam below the outfall. Field investigations that day revealed that this anomaly was attributable to the hydromulch that had been applied the previous day to an area of about 20 acres of the recently completed taxiway construction project in the SDS3 subbasin. Because this hydromulch had not fully cured, the rainfall washed some of the conventional green dye and tackfier used in the mix into the SDS3 system. The results from this sample did not indicate unusual levels of BOD_5, TSS or other constituents measured (see

Appendix B). Normally, the Port applies hydromulch as an erosion control BMP so that it has sufficient time to cure, achieving full effectiveness prior to forecasted rainfall. The Port has discontinued the use of the particular hydromulch product and now uses a faster curing mix.

4.7.3.4 Inappropriate connection in SDN1

During the source tracing study conducted relative to the WET testing results, the Port also found an inappropriate connection to the stormdrain in the SDN1 subbasin. A slot drain serving several loading docks E9-E13 along the east side of the number 2 AFCO (previously "Avia") building connects to manhole SDN1-19 via a 6" PVC pipe. This drain was temporarily plugged immediately after finding it. A permanent plug was installed recently. Drainage from the surrounding area now flows to the adjacent slot drain, which was verified as already connected to the IWS.

4.8 Outfall Inspections

Appendix G summarizes the visual observations made at outfalls during the past year. The number of instances exceeds the minimum of 3 wet season inspections required by the permit and reflected in the SWPPP (POS 1998c.) Most outfalls were visited more than 20 times in the past year during routine monitoring equipment deployment and maintenance. Indications of potential problems were limited to 3 occasions at outfalls SDS1 and SDS3 as discussed earlier in this report. The annual dry-weather inspection was conducted during September 1999. Visual observations recorded during these inspections did not indicate problems associated with baseflows or other dry-weather flow.

Table 5 SDS1 Source Tracing Sample Results (mg/l)

Storm event	type	ph	Fecals (MPN)	TPH-Dx	Turb (NTU)	BOD_5	NH_3	Surf	glycols	TDP	SRP	F^-	K^+	NH3/ K+	Cond (µmhos)	hard	SRP/ TDP	note
12-Mar-99	grab					123	0.012	3.92	48.7									1, 2
20-Jun-99	Grab 1	6.7	>1600	1.56				0.470	<4.0	0.145	0.075						52%	2,3
20-Jun-99	Grab 2							0.689	<4.0	0.175	0.085						58%	2,3
7/2/99	Comp	7.3	900	0.8	13	7.7	0.35	0.12	<4	1.1	0.06	0.07	1.54	0.23	48	25	5%	2,4
7/2/99	grab 1	6.8				13.4	0.19	0.18	<4	1.3	0.062	0.09	1.57	0.12	68	30.1	5%	2,3
7/2/99	grab 2	6.9				9.7	0.26	0.10	<4	0.77	0.055	0.06	1.77	0.15	40	19.7	7%	2,3
9/23/99	grab 1		82		21	58.8	3.33	0.84		0.183	0.101	0.16	9.17	0.36	260		55%	2,3
9/23/99	grab 2		78		8.3	76.5	0.005	0.72		0.314	0.091	0.15	3.88	0.001	213		29%	2,3

Yellow shaded results indicate atypical stormwater constituents.

Notes for table:

1. quarterly deice grab sample
2. Foam observed below outfall
3. Source tracing sample
4. Routine annual NPDES flow-weighted composite sample

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5 CONCLUSIONS

Storm sample results from the past year continue to support the conclusions reached in previous annual reports that STIA stormwater compares favorably to other comparable regional data, even with instream stormwater data. Constituents and concentrations of concern at STIA have been generally associated with specific activities or locations, and usually not routine runoff.

The Port has implemented various BMPs to address specific findings of the stormwater monitoring program. The data generally indicate that these BMPs have been effective. Still, the Port continues to investigate other issues to resolve problems indicated by the data.

Sampling locations for certain outfalls are in-pipe or are well above the final discharge point to receiving waters. Because these locations do not account for the influence of other factors prior to discharge, namely detention, it is not appropriate to compare the STIA data to water quality standards. Addressing the suggestions below may lead to more appropriate locations for assessing the relevance of STIA discharges with respect to water quality standards.

In addition to completing all required routine stormwater sampling, the Port accomplished the following pro-active measures in the past year.

1. Corrected an inappropriate drainage connection from a loading dock drain to the SDN1 storm drainage system.
2. Corrected a clogged IWS drain inlet that may overflow to the SDS3 storm drainage system.
3. Confirmed the likely source of toxicity exhibited in SDN1 WET tests.
4. Discovered the source of infrequent contamination in SDS1 samples. This drainage from several area drains under the South Satellite overhangs near gates S3 and S4 was re-routed to the IWS in September 2000.

5. Completed the first half of the SDE4 MST fecal coliform source tracing project.
6. Completed a second year of receiving water and outfall monitoring to assess dissolved oxygen during runway deicing events

The past year's monitoring efforts lead to these suggestions:

1. Complete the investigation of possible sources of fecal coliforms in SDE4 discharges,
2. Study how the Port could consolidate sampling locations. Instead of four locations for outfalls SDN1-SDN4, sample at a single point at the Lake Reba detention facility outlet that integrates discharges from all four outfalls. This location would be more representative of discharges where they enter the receiving waters. This location also accounts for the stormwater's contact with natural channels and detention prior to ultimate discharge to Miller Creek. These factors are not represented in the current sampling locations. Examine the benefits provided and risks engendered by sampling at this new location. Consider a similar approach for several Des Moines Creek outfalls (SDS5-SDS7).
3. Test several stormwater treatment technologies, including media filtration, to determine if they are a technically and cost effective BMP to consider for alleviating roof runoff water quality problems.

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APPENDICES

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APPENDIX A STORM EVENT HYDROLOGIC AND HYDRAULIC DATA

Table 1

Monthly Summary of Daily Rainfall at STIA
source: NWS rain gage (POS rain gage for July 99

day	Jul-	Aug-	Sep-	Oct-	Nov-	Dec-	Jan-	Feb-	Mar-	Apr-	May-00	Jun-
1	0	0	0	0	0	0.23	0.27	1.34	0	0	0.16	0
2	0.3	0	0	0	0	0.34	0	0	0.37	0	0.02	0
3	0.02	0.21	0	0	0.06	0	0.27	0	0.34	0	0.24	0
4	0	0.06	0	0	0	0.19	0.31	0	0.39	0	0.14	0
5	0	0.07	0.02	0	0.29	0.15	0	0.06	0	0.02	0.05	0.01
6	0	0.25	0	0.01	0.38	0.39	0.03	0	0	0.12	0	0.1
7	0	0.07	0	0.21	0	0	0.21	0.34	0	0	0	0.05
8	0	0.01	0	0.65	0.26	0.3	0.31	0.74	0.04	0	0.12	0.15
9	0	0	0	0.01	0.84	0.15	0.2	0.01	0.05	0	0.74	0.1
10	0	0	0	0	0.54	0.01	0.19	0	0.1	0	0.61	0.06
11	0	0	0	0.09	1.06	0.04	0.05	0	0.03	0	0	0.55
12	0	0	0	0.01	1.51	0.86	0.22	0	0	0	0	0.56
13	0	0.02	0	0.02	0.3	0.12	0.1	0.01	0.46	0.35	0	0
14	0	0	0	0	0.01	0.14	0.29	0.5	0.03	0.14	0	0
15	0	0.17	0	0	0.08	1.4	0	0.01	0.04	0.13	0	0
16	0.51	0	0	0	0.47	0.09	0.28	0	0.22	0	0	0
17	0.19	0	0	0	0.14	0.33	0.01	0	0.05	0	0	0
18	0	0	0.01	0	0	0	0	0	0.18	0	0.4	0.01
19	0	0	0	0	0.28	0.08	0.08	0	0	0	0	0
20	0	0	0	0	0.8	0	0.15	0	0	0	0	0
21	0	0	0	0	0.09	0	0.19	0.19	0	0.1	0.09	0
22	0	0	0	0	0.17	0	0.02	0.61	0.44	0.01	0	0
23	0	0	0.07	0.03	0.02	0	0	0	0	0.1	0	0
24	0	0	0.08	0	0.32	0	0	0	0	0	0	0.01
25	0	0	0	0.14	1.03	0	0.1	0.27	0	0.34	0	0
26	0	0	0	0	0.13	0	0	0.25	0	0	0.18	0
27	0	0	0	0.3	0.3	0	0	0.17	0.06	0.07	0.17	0
28	0	0	0	0.25	0	0	0	0.1	0.01	0.1	0.07	0
29	0	0.06	0	0.06	0.2	0	0	0.65	0.01	0	0.08	0
30	0	0	0	0.38	0.31	0	0.03	0	0	0	0.02	0.01
31	0	0	0	0.1	0	0	0.46	0	0	0	0.04	0
total	1.02	0.92	0.18	2.26	9.59	4.82	3.77	5.25	2.82	1.48	3.13	1.61
NWS avg	0.79	1.1	1.79	3.48	6.05	5.92	5.7	4.21	3.75	2.51	1.66	1.44
actual	1.02	1.94	2.12	4.38	13.97	18.79	22.56	27.81	30.63	32.11	35.24	36.85
avg cum	0.79	1.89	3.68	7.16	13.21	19.13	24.83	29.04	32.79	35.3	36.96	38.4

12-month	36.85
12-month NWS avg	38.4
Departure from avg	-4%

Drainage Basin	Current (1998) Perv. (acres)	Imperv. (acres)	Total (acres)	total percent of *each Creek* perv	imperv	total	total percent of *SDS* perv	imperv	total	total percent of *Airfield* perv	imperv	total
Miller Creek SDS												
SDN-1 (above monitoring point)	3.3	10.2	13.5	3%	16%	8%	0.6%	2.4%	1.4%			
SDN-1 (POS below mon. pt.)	0.42	5.0	5.4	0.4%	8%	3%	0.1%	1.2%	0.6%			
SDN-1 (offsite below mon. pt.)	34	12	46	33%	19%	28%	6.3%	2.8%	4.8%			
SDN-2	0.0	0.0	0.0	0%	0%	0%	0.0%	0.0%	0.0%	0%	0%	0%
SDN-3	43	27	70	42%	44%	42%	8.0%	6.3%	7.3%	12%	9%	10.9%
SDN-4	23	7.7	30	22%	12%	18%	4.2%	1.8%	3.1%	7%	3%	4.7%
Des Moines Creek SDS												
SDE-4	52	97	149	12%	27%	19%	9.7%	22.7%	15.5%	na	6.1%	2.6%
SDS-1	1.5	9.2	10.7	0.3%	2.5%	1%	0.3%	2.2%	1.1%			
SDS-2	12.2	1.0	13.2	3%	0.3%	2%	2.3%	0.2%	1.4%			
SDS-3	238	224	462	55%	62%	58%	44.5%	52.4%	48.0%	69%	76%	72%
SDS-4	43	21	63	10%	6%	8%	8.0%	4.9%	6.6%	12%	7%	9.9%
W-3	7.0	7.0	14.0	2%	1.9%	2%	1.3%	1.6%	1.5%			
B	48.2	1.4	49.6	11%	0.4%	6%	9.0%	0.3%	5.1%			
D	30.7	3.2	33.9	7%	0.9%	4%	5.7%	0.7%	3.5%			
Other SDS												
Taxi Yard	0.00	0.78	0.78									
Engineering Yard	0.28	1.20	1.48									
IWS												
Primary drainage	6.3	286	292									
'97 North Snowmelt pump stn	6.4	0.24	6.6									
'97 Central Snowmelt pump stn	0.05	0.70	0.75									
'97 South Snowmelt pump stn	0.0	0.34	0.34									
'97 North Cargo pump stn	6.5	33.3	39.8									
'96 North Satellite pump stn	0.31	13.4	13.8									
'97 IWS-510 Diversion from SDS1	0.42	16.1	16.5									

Note: "airfield" category includes 17 acres of taxiway in SDE4 subbasin drainage

TOTALS		Perv. (acres)	Imperv. (acres)	Total (acres)
Miller Creek SDS		103	62	165
	% of SDS	19%	14%	17%
	% of total	19%	8%	12%
Des Moines Creek SDS		432	364	796
	% of SDS	81%	85%	83%
	% of total	78%	47%	60%
Other SDS (EY, TY)		0.3	2.0	2.3
	% of SDS	0.1%	0.5%	0.2%
	% of total	0.1%	0.3%	0.2%
total airfield (S3, S4, N3, N4, +17ac E4)		346	297	643
	% of SDS	65%	69%	67%
	% of total	62%	38%	48%
total SDS		535	428	963
	% of total	96%	55%	72%
IWS		20	350	370
	% of total	4%	45%	28%
Total drainage		555	778	1333

Summary of Storms Sampled 7/1/99 - 6/30/00

Storm Date	Depth, in.	Dur, hr	Max Int, in/hr	24hrant, in	48hrant, in	Dryant, hr	Dryant, Days	Load Factor	Event Type	Comment
4/21/00	0.1	7	0.04						Other Storm	
4/13/00	0.34	12	0.08	0	0	74	3.1	5.9	NPDES Storm	
3/22/00	0.43	8	0.14	0	0	86	3.6	12.0	NPDES Storm	
3/13/00	0.47	9	0.13	0	0	49	2.0	6.4	NPDES Storm	
2/25/00	0.28	6	0.09	0	0	70	2.9	6.3	NPDES Storm	
2/21/00	0.28	36	0.06	0	0	72	3.0	4.3	NPDES Storm	
2/7/00	1.18	25	0.12	0	0.05	31	1.3	3.7	NPDES Storm	
1/31/00	1.76	29	0.15	0.07	0.07	9	0.4	1.3	NPDES Storm	
1/12/00	0.37	48	0.04	0.07	0.31	10	0.4	0.4	NPDES Storm	runway deice event, concurrent DO Study/instream
1/7/00	0.38	12	0.12	0.01	0.05	23	1.0	2.8	NPDES Storm	
12/17/99	0.34	11	0.08	0	1.15	26	1.1	2.1	NPDES Storm	
12/15/99	1.26	13	0.32	0.15	0.32	8	0.3	2.6	Other Storm	
12/8/99	0.49	27	0.09	0	0.36	40	1.7	3.6	NPDES Storm	
12/4/99	0.24	10	0.1	0	0	60	2.5	6.0	NPDES Storm	
11/27/99	0.32	16	0.07	0.02	0.62	22	0.9	1.5	NPDES Storm	
11/24/99	0.33	16	0.05	0	0.15	26	1.1	1.3	NPDES Storm	
11/16/99	0.6	15	0.07	0.01	0.08	23	1.0	1.6	NPDES Storm	
11/5/99	0.68	12	0.11	0	0.05	44	1.8	4.8	NPDES Storm	WET & source trace at SDN1
9/23/99	0.07	2	0.05	0	0	124	5.2	6.2	Other Storm	
7/16/99	0.7	34	0.11	0	0	300	12.5	33.0	NPDES Storm	
7/2/99	0.3	6	0.11	0	0	103	4.3	11.3	NPDES Storm	
Count	21	21	21	21	21	21	21	21		
Median	0.37000	12	0.09	0	0.0500000	40	1.7	3.7		
Average	0.52	17	0.10	0.02	0.15	57	2.4	5.6		

AR 012784

load factor = maxint (in/hr)*dryant(hrs)
Event Type defined in Procedure Manual for Stormwater Monitoring
"dur" = rainfuall duration in hours
"24hrant" and "48hrant" is the total rainfall in the 24 and 48 hours preceding the event respectively
"dryant" is the duration of the antecedent dry period to the last measurable (0.01 in.) rainfall

POS EMIS

Estimated Peak Runoff Rates (gpm) for Storm Events Monitored 7/1/99 - 6/30/00

Storm Date	Peak RI, in./hr	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 SDS-7	011 SDN-4	012 EY	013 TY	014 SDS-6	015 SDS-5
4/21/00	0.04	1,810	160	71	4,700	180		630	530	150	230	21	13	239	190
4/13/00	0.08	3,630	310	140	9,400	360		1,270	1,060	290	450	42	25	478	380
3/22/00	0.14	6,350	550	250	16,500	630		2,220	1,860	510	790	73	44	837	670
3/13/00	0.13	5,900	510	230	15,400	590		2,060	1,730	470	730	68	41	777	620
2/25/00	0.09	4,080	350	160	10,600	410		1,430	1,200	330	510	47	29	538	430
2/21/00	0.06	2,720	230	110	7,100	270		950	800	220	340	31	19	359	290
2/7/00	0.12	5,440	470	210	14,200	540		1,900	1,590	440	680	63	38	718	570
1/31/00	0.15	6,810	590	270	17,700	680		2,380	1,990	550	850	78	48	897	720
1/12/00	0.04	1,810	160	71	4,700	180		630	530	150	230	21	13	239	190
1/7/00	0.12	5,440	470	210	14,200	540		1,900	1,590	440	680	63	38	718	570
12/17/99	0.08	3,630	310	140	9,400	360		1,270	1,060	290	450	42	25	478	380
12/15/99	0.32	14,520	1,250	570	37,800	1,450		5,070	4,250	1,160	1,810	167	102	1,914	1,530
12/8/99	0.09	4,080	350	160	10,600	410		1,430	1,200	330	510	47	29	538	430
12/4/99	0.1	4,540	390	180	11,800	450		1,590	1,330	360	560	52	32	598	480
11/27/99	0.07	3,180	270	120	8,300	320		1,110	930	250	400	37	22	419	330
11/24/99	0.05	2,270	200	89	5,900	230		790	660	180	280	26	16	299	240
11/16/99	0.07	3,180	270	120	8,300	320		1,110	930	250	400	37	22	419	330
11/5/99	0.11	4,990	430	200	13,000	500		1,740	1,460	400	620	57	35	658	520
9/23/99	0.05	2,270	200	89	5,900	230		790	660	180	280	26	16	299	240
7/16/99	0.11	4,990	430	200	13,000	500		1,740	1,460	400	620	57	35	658	520
7/2/99	0.11	4,990	430	200	13,000	500		1,740	1,460	400	620	57	35	658	520
A = total Basin Area, ac		149.0	10.7	13.2	462.0	13.5		70.0	63.4	14.0	30.2	1.5	0.8	49.6	33.9
Ai = impervious area, ac		97.0	9.2	1.0	224.0	10.2		27.0	20.8	7.0	7.6	1.2	0.8	1.3	3.2
Ap = pervious area, ac		52.0	1.5	12.2	238.0	3.3		43.0	42.6	7.0	22.6	0.3	0.0	48.2	30.7
Cr = (0.90(Ai)+0.25(Ap))/A		0.67	0.81	0.30	0.57	0.74		0.50	0.46	0.58	0.41	0.77	0.90	0.27	0.31

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.

Estimated Runoff Volumes (gal) for Storm Events Monitored 7/1/99 - 6/30/00

Storm Date	Depth, in.	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 SDS-7	011 SDN-4	012 EY	013 TY	014 SDS-6	015 SDS-5
4/21/00	0.1	0	0	11,000	0	0		0	0	22,000	34,000	4,000	2,000	36,000	29,000
4/13/00	0.34	496,000	15,000	37,000	1,075,000	60,000		94,000	112,000	75,000	116,000	11,000	7,000	123,000	98,000
3/22/00	0.43	862,000	26,000	47,000	1,870,000	105,000		162,000	196,000	94,000	146,000	14,000	9,000	155,000	124,000
3/13/00	0.47	1,056,000	32,000	51,000	2,291,000	128,000		199,000	241,000	103,000	160,000	15,000	9,000	169,000	135,000
2/25/00	0.28	306,000	10,000	31,000	664,000	37,000		58,000	68,000	62,000	95,000	9,000	6,000	101,000	81,000
2/21/00	0.28	306,000	10,000	31,000	664,000	37,000		58,000	68,000	62,000	95,000	9,000	6,000	101,000	81,000
2/7/00	1.18	3,316,000	104,000	127,000	7,391,000	399,000		815,000	950,000	258,000	401,000	38,000	23,000	424,000	339,000
1/31/00	1.76	5,346,000	176,000	189,000	12,753,000	640,000		1,681,000	1,733,000	385,000	597,000	56,000	34,000	632,000	505,000
1/12/00	0.37	607,000	19,000	40,000	1,316,000	74,000		114,000	138,000	81,000	126,000	12,000	8,000	133,000	107,000
1/7/00	0.38	646,000	20,000	41,000	1,402,000	79,000		122,000	147,000	84,000	129,000	12,000	8,000	137,000	109,000
12/17/99	0.34	496,000	15,000	37,000	1,075,000	60,000		94,000	112,000	75,000	116,000	11,000	7,000	123,000	98,000
12/15/99	1.26	3,580,000	113,000	136,000	8,063,000	431,000		916,000	1,046,000	276,000	428,000	40,000	25,000	453,000	362,000
12/8/99	0.49	1,160,000	35,000	53,000	2,518,000	141,000		218,000	266,000	108,000	167,000	16,000	10,000	176,000	141,000
12/4/99	0.24	204,000	7,000	26,000	443,000	25,000		39,000	45,000	53,000	82,000	8,000	5,000	87,000	69,000
11/27/99	0.32	428,000	13,000	35,000	928,000	52,000		81,000	96,000	70,000	109,000	11,000	7,000	115,000	92,000
11/24/99	0.33	461,000	14,000	36,000	1,000,000	56,000		87,000	104,000	73,000	112,000	11,000	7,000	119,000	95,000
11/16/99	0.6	1,550,000	46,000	65,000	3,169,000	188,000		256,000	375,000	132,000	204,000	19,000	12,000	216,000	172,000
11/5/99	0.68	1,778,000	53,000	73,000	3,684,000	215,000		315,000	442,000	149,000	231,000	22,000	13,000	245,000	195,000
9/23/99	0.07	0	0	0	0	0		0	0	0	0	0	0	0	0
7/16/99	0.7	1,835,000	55,000	76,000	3,816,000	222,000		330,000	460,000	154,000	238,000	22,000	14,000	252,000	201,000
7/2/99	0.3	365,000	11,000	33,000	791,000	44,000		69,000	82,000	66,000	102,000	10,000	6,000	108,000	86,000
A = total Basin Area, ac		149.0	10.7	13.2	462.0	13.5		70.0	63.4	14.0	30.2	1.5	0.8	49.6	33.9
Ai = impervious area, ac		97.0	9.2	1.0	224.0	10.2		27.0	20.8	7.0	7.6	1.2	0.8	1.3	3.2
Ap = pervious area, ac		52.0	1.5	12.2	238.0	3.3		43.0	42.6	7.0	22.6	0.3	0.0	48.2	30.7
Cr = (0.90(Ai)+0.25(Ap))/A		0.67	0.81	0.30	0.57	0.74		0.50	0.46	0.58	0.41	0.77	0.90	0.27	0.31
Max runoff, gal/in		4,045,708	290,531	358,412	12,544,409	366,557		1,900,668	1,721,462	380,134	820,002	40,729	21,179	1,346,759	920,466
Cr Est runoff, gal/in		2,723,386	235,004	107,252	7,089,492	271,660		951,692	797,466	218,577	339,133	31,361	19,061	358,955	286,594

Only certain outfalls sampled during a particular event

Rainfall data from National Weather Service and/or Port of Seattle rain gage at Sea-Tac Airport.

Runoff volumes based upon basin-specific estimation models.

SDN2 volumes gaged by flowmeter during pump station bypass sampling events.

Note: equations built into embedded functions above apply for rainfall from 0.1" to 2.0".

APPENDIX B TABULAR NPDES SAMPLE DATA SUMMARIES

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
SDE4	SDE4 111394	1995	11/11/94	1	0.28	14				46	NPDES	No		2.8	1.1				1100	
SDE4	SDE4 111994	1995	11/19/94	1	0.42	24			0.05	52	NPDES	No								
SDE4	SDE4 010795	1995	1/7/95	1	0.21	62			0	252	NPDES	No	7	3.6	2.8				45	
SDE4	SDE4 041095	1995	4/10/95	1	0.29	18			0	56	NPDES	No	6.6	0.55	1.1				260	
SDE4	SDE4 050295	1995	5/2/95	2	0.42	20				36	NPDES	No								
SDE4	SDE4 072695	1996	7/26/95	1	0.41	36			0		NPDES	No	6.9	5.7	3.8				4000	
SDE4	SDE4 081795	1996	8/16/95	1	1.34	12			0.01		NPDES	No								
SDE4	SDE4 102695	1996	10/25/95	1	0.28	8			0.01		NPDES	No	7.1	5.9	0.5				300	
SDE4	SDE4 020496 GRAB	1996	2/3/96	1	1.6	8					NPDES	Yes	7.9	17	8.8				22	
SDE4	SDE4 032296 GRAB	1996	3/22/96	1	0.21				0		StipAg	No	7.1	2.8	3.9				20	
SDE4	SDE4 041696 GRAB	1996	4/15/96	1	0.49	16			0.09		NPDES	No	6.39	2.8	3.35				17	
SDE4	SDE4 071796 GRAB	1997	7/17/96	1	0.27	31			0		NPDES	No							220	
SDE4	SDE4 090396 GRAB	1997	9/3/96	1	0.29	1.2			0	76	NPDES	No	7.31	3.1	2.64	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			1600	
SDE4	SDE4 121596 GRAB	1997	12/15/96	2	0.11	4			0	72	NPDES	No	6.61	2.9	1.8				50	backup data in case short on data for 96 Q4
SDE4	SDE4 121996 GRAB	1997	12/19/96	1	0.36	37			0	103	NPDES	No	6.45	3.3	1.97				220	
SDE4	SDE4 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	7.06	9	10				1600	
SDE4	SDE4 012797 GRAB	1997	1/27/97	1	0.41	26			0	109	StipAg	No	6.17	0.5	5				50	
SDE4	SDE4 030597 GRAB	1997	3/5/97	1	0.39	20			0.24	42	NPDES	No	6.33	~~493~~	3.06				1600	FOG result not representative, laboratory error, see letter of May 15, 1997
SDE4	SDE4 053097	1997	5/30/97	1	1.64	36			0.04	14	NPDES	No		1.1	1.2					backup FOG/TPH for March 1997 Lab errors (SDE4 030597 grab)
SDE4	SDE4 061697 GRAB	1997	6/16/97	1	0.36	28			0	135	NPDES	No	8	1.6	1.48				188	
SDE4	SDE4 102897 GRAB	1998	10/28/97	1	0.47	10.8			0.08	26	NPDES	No	6.5	0.5	2.09				1600	
SDE4	SDE4 121597 GRAB	1998	12/15/97	1	1	33			0	87	NPDES	No	6.59	1.8	2.3				80	
SDE4	SDE4 030198 GRAB	1998	3/1/98	1	0.98	86			0.07	6	NPDES	No	7.15		1.5	1.58	0.045	1.54	~~500~~	fecal coliform result not representative: exceeded holding time by 9+ hours
SDE4	SDE4 040798 GRAB	1998	4/7/98	2	0.03	0.5			0.04	87	NPDES	No	7.03		2.4	3.4	0.025	3.4	110	NON-"STORM"
SDE4	SDE4 041098 GRAB	1998	4/9/98	2	0.09	17			0	62	NPDES	No	6.86		2.27	3.1	0.05	3.05	900	NON-"STORM"
SDE4	SDE4 042398 GRAB	1998	4/23/98	1	0.46	20			0	264	NPDES	No	6		3.5	2.5	0.025	2.48	500	
SDE4	SDE4 050998 GRAB	1998	5/9/98	2	0.12	8			0	360	NPDES	No	7.03		1.8	2.53	0.09	2.44	1600	NON-"STORM"
SDE4	SDE4 051498 GRAB	1998	5/14/98	1	0.21	8			0.01	125	NPDES	No	6.93		2.6	3.04	0.1	2.94	80	
SDE4	SDE4 062498 GRAB	1998	6/24/98	1	0.43	4			0	288	NPDES	No	6.94		1.9	2.77	0.84	1.93	300	
SDE4	SDE4 071498 GRAB	1999	7/14/98	2	0.13	16	0.04	0	0	264	NPDES	No	6.72		2.9	5.56	0.025	5.54	1600	nonstorm
SDE4	SDE4 081698 GRAB	1999	8/16/98	1	0.31	10	0.25	0	0	792	NPDES	No	6.62		0.125	0.21	0.04	0.17	500	thunderstorm, 0.25 in/hr
SDE4	SDE4 091898 GRAB	1999	9/18/98	2	0.19	20	0.16	0	0	456	NPDES	No	7.42			2.11	0.025	2.09	500	nonstorm
SDE4	SDE4 092498 GRAB	1999	9/24/98	1	0.47	23	0.26	0	0	148	NPDES	No	6.79			1.19	0.025	1.17	1600	
SDE4	SDE4 100398 GRAB	1999	10/3/98	1	0.4	3	0.22	0	0.07	36	NPDES	No	6.67		2.2	4.94	0.025	4.92	1600	
SDE4	SDE4 110398 GRAB	1999	11/3/98	1	1.62	39	0.48	0	0.08	35	NPDES	No	6.58			2.85	0.025	2.83	1600	
SDE4	SDE4 111998 GRAB	1999	11/19/98	1	2.34	66	0.18	0	0	73	NPDES	No	9			1.46	0.025	1.44	240	
SDE4	SDE4 121098 GRAB	1999	12/10/98	2	0.14	4	0.03	0	0	49	NPDES	No	6.62			0.88	0.025	0.86	220	nonstorm
SDE4	SDE4 121798 GRAB	1999	12/17/98	2	0.11	4	0.03	0	0.02	33	NPDES	No	6.47			3.57	0.025	3.55	900	nonstorm
SDE4	SDE4 122498 GRAB	1999	12/24/98	1	1.19	39	0.16	0	0	153	NPDES	Yes	7.76			8.66	0.025	8.64		fecals not analyzed due to holiday lab closure
SDE4	SDE4 012099 GRAB	1999	1/20/99	1	0.42	28	0.09	0.01	0.95	22	NPDES	No	6.98			3.03	0.03	3	170	CONCURRENT WET TEST
SDE4	SDE4 021899 GRAB	1999	2/18/99	1	0.6	32	0.06	0.01	0.35	20	NPDES	No	10.7			0.27	0.025	0.25	1	
SDE4	SDE4 030699 GRAB	1999	3/6/99	1	0.28	15	0.05	0	0	96	NPDES	No	6.5	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998		3.66	0.025	3.64	30	
SDE4	SDE4 031299 GRAB	1999	3/12/99	1	0.83	23	0.07	0	0	71	NPDES	No	6.94			1.99	0.025	1.97	500	
SDE4	SDE4 032499 GRAB	1999	3/24/99	1	0.28	19	0.08	0	0.15	40	NPDES	No	6.32			3.17	0.06	3.11	500	CONCURRENT WET TEST
SDE4	SDE4 032799 GRAB	1999	3/27/99	1	0.24	9	0.07	0	0.09	28	NPDES	No	6.45			2.63	0.05	2.58	50	
SDE 4	SDE4 070299 grab	2000	7/2/99	1	0.3	6	0.11	0	0	103	NPDES	No	6.58			1.47	0.025	1.47	900	
SDE 4	SDE4 111699 GRAB	2000	11/16/99	1	0.6	15	0.07	0.01	0.08	23	NPDES	No	6.25			0.99	0.025	0.97	1600	
SDE 4	SDE4 112499 GRAB	2000	11/24/99	1	0.33	16	0.05	0	0.15	28	NPDES	No	6.85			1.73	0.05	1.68	21	
SDE 4	SDE4 120499 grab	2000	12/4/99	1	0.24	10	0.1	0	0	60	NPDES	No	6.77			0.97	0.04	0.93	50	
SDE 4	SDE4 031300 grab	2000	3/13/00	1	0.47	9	0.13	0	0	49	NPDES	No	6.67			1.86	0.025	1.84	170	
SDE 4	SDE4 041300 GRAB	2000	4/13/00	1	0.34	12	0.08	0	0	74	NPDES	No	6.69			0.31	0.025	0.29	130	
SDE4	SDE4 062099 GRAB	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No	6.65			2.64	0.025	2.62	1600	
SDS1	SDS1 101994	1995	10/19/94	1	0.2	32				120	NPDES	No	5.76	1.1	0.5				10	
SDS1	SDS1 111994	1995	11/19/94	1	0.42	24			0.05	52	NPDES	No								
SDS1	SDS1 021695	1995	2/15/95	1	1.1	56			0	86	NPDES	Yes	6.6	3.4	5.3				4.5	
SDS1	SDS1 050295	1995	5/2/95	2	0.42	20				36	NPDES	No								
SDS1	SDS1 051195	1995	5/11/95	1	0.2	8			0.12		NPDES	No	7.4	10	0.5					
SDS1	SDS1 060495	1995	6/4/95	1	0.7	28			0	384	NPDES	No	6.4	5.6	5.4				60	
SDS1	SDS1 080795	1996	8/6/95	1	0.4	8			0		NPDES	No	7.2	3.3	0.5				4	

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
SDS1	SDS1 101695	1996	10/15/95	1	0.35	12			0		NPDES	No	7.1	1.2	0.5	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			200	
SDS1	SDS1 011396 GRAB	1996	1/13/96	1	0.37	20			0		NPDES	No	7.1	0.5	1.8				0.5	
SDS1	SDS1 041696 GRAB	1996	4/15/96	1	0.49	16			0.09		NPDES	No	6.65	2.5	0.32				4	
SDS1	SDS1 042296 GRAB	1996	4/22/96	1	2.83	8			0		StipAg	No	7.54	1.9	0.58				23	
SDS1	SDS1 070396 GRAB	1997	7/3/96	1	0.23	12			0		NPDES	No	5.88	0.5	0.35				2a	Fecals exceeded 30 hour holding time, results not representative
SDS1	SDS1 071796 GRAB	1997	7/17/96	1	0.27	31			0		NPDES	No							1600	fecals make up for 7/3/96
SDS1	SDS1 080296 GRAB	1997	8/2/96	1	1.01	27			0	325	StipAg	No	5.36	0.5	0.42				130	
SDS1	SDS1 120496 GRAB	1997	12/4/96	1	0.82	7.5			0.16	44	NPDES	No	6.81	2.4	0.35				1600	
SDS1	SDS1 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	6.62	0.5	2.9				350	
SDS1	SDS1 041397 GRAB	1997	4/13/97	1	0.31	12			0.04		NPDES	No	7.13	0.5	2.6				23	
SDS1	SDS1 061797 GRAB	1997	6/16/97	1	0.36	28			0	135	NPDES	No	7	0.5	0.95				1600	
SDS1	SDS1 102897 GRAB	1998	10/28/97	1	0.47	10.8			0.08	26	NPDES	No	5.86	0.5	0.84				80	
SDS1	SDS1 111997 GRAB	1998	11/19/97	1	0.65	39			0.12	24	NPDES	No			0.83				1600	
SDS1	SDS1 121597 GRAB	1998	12/15/97	1	1	33			0	87	NPDES	No	6.09	0.5	1.3				23	
SDS1	SDS1 030898 GRAB	1998	3/8/98	1	0.86	27			0	132	NPDES	No	6.22		0.95	0.72	0.16	0.56	1	FULLFILS QUARTERLY DEICING SAMPLE RQMT PLUS ANNUAL SAMPLE RQMT
SDS1	SDS1 121798	1999	12/17/98	2	0.11	4	0.03	0	0.02	33	NPDES	No		TPH-Dx replaced FOG and TPH (IR) on March 1, 1998						nonstorm
SDS1	SDS1 031299 GRAB	1999	3/12/99	1	0.83	23	0.07	0	0	71	NPDES	No								quarterly deice grab sample in first 60 minutes
SDS1	SDS1 062099 GRAB 1	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No	6.68			1.56	0.025	1.54	1600	foam observed below outfall
SDS1	SDS1 070299 GRAB 1	2000	7/2/99	1	0.3	6	0.11	0	0	103	NPDES	No	6.82			0.78	0.025	0.76	900	foam observed below outfall
SDS1	SDS1 070299 GRAB 2	2000	7/2/99	1	0.3	6	0.11	0	0	103	Source Trac	No	6.95							foam observed below outfall
SDS1	SDS1 092399 grab 1	2000		2								No							82	foam observed below outfall
SDS1	SDS1 092399 grab 2	2000		2								No							78	foam observed below outfall
SDS1	SDS1 062099 GRAB 2	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No								FOAM OBSERVED BELOW OUTFALL
SDS2	SDS2 051095	1995	5/9/95	1	0.12	7.5			0	102	NPDES	No	7.2	3.4	0.5	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			440	
SDS2	SDS2 051195	1995	5/11/95	1	0.2	8			0.12		NPDES	No	7.4	1.4	0.5				780	
SDS2	SDS2 061095	1995	6/10/95	1	0.3	10			0	96	NPDES	No	7.1	1.8	0.5				1400	
SDS2	SDS2 090595	1996	9/5/95	1							NPDES	No	6.7	2.2	0.5				2600	
SDS2	SDS2 112396 GRAB	1997	11/23/96	1	0.63	34.1			0	72	NPDES	Yes	6.71	0.5	0.125				23	
SDS2	SDS2 120496 GRAB	1997	12/4/96	1	0.82	7.5			0.16	44	NPDES	No	6.68	0.5	0.125				8	
SDS2	SDS2 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	StipAg	No	6.77	0.5	0.125				220	
SDS2	SDS2 021197 GRAB	1997	2/11/97	1	0.48	18			0	205	StipAg	No	6.76	4	0.125				11	LAST FOR STIP AG
SDS2	SDS2 111198 GRAB	1999	11/11/98	1	0.98	62	0.15	0	0.05	31	NPDES	No				0.08	0.025	0.055	110	
SDS2	SDS2 050799 GRAB	1999	5/6/99	1	0.25	22	0.06	0	0	79	NPDES	No	7.45			0.31	0.025	0.29	900	ANNUAL SAMPLE
SDS3	SDS3 090894	1995	9/8/94	1	0.69	22				93	NPDES	No								
SDS3	SDS3 091494	1995	9/13/94	1	0.15	9				118	NPDES	No	7.14	8.3	0.5	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			20	
SDS3	SDS3 101394	1995	10/13/94	1	0.32	14			0	480	NPDES	No		1.4	0.5				1	
SDS3	SDS3 111994 grab	1995	11/19/94	1	0.42	24			0.05	52	NPDES	No		0.5	0.5				2	
SDS3	SDS3 010795	1995	1/7/95	1	0.21	62			0	252	NPDES	No	7.2	0.65	0.5				1	
SDS3	SDS3 041295	1995	4/10/95	1	0.29	18			0	56	NPDES	No	7.3	0.55	0.5				1	
SDS3	SDS3 050295	1995	5/2/95	2	0.42	20				36	NPDES	No								
SDS3	SDS3 072695	1996	7/26/95	1	0.41	36			0		NPDES	No	7.7	0.65	0.5				1.5	
SDS3	SDS3 101695	1996	10/15/95	1	0.35	12			0		NPDES	No	7.4	1.4	0.5				1	
SDS3	SDS3 011396 GRAB	1996	1/13/96	1	0.37	20			0		NPDES	No	7.4	0.5	0.5				0.5	
SDS3	SDS3 032296 grab	1996	3/22/96	1	0.21				0		StipAg	No	7.5	0.5	0.5				13	
SDS3	SDS3 041696 GRAB	1996	4/15/96	1	0.49	16			0.09		NPDES	No	7.38	1.2	0.31				1	
SDS3	SDS3 071796 GRAB	1997	7/17/96	1	0.27	31			0		NPDES	No							1	fecals make up for 7/3/96 > hold time
SDS3	SDS3 080296 GRAB	1997	8/2/96	1	1.01	27			0	325	NPDES	No	7.35	0.5	0.3				8	
SDS3	SDS3 090396 GRAB	1997	9/3/96	1	0.29	1.2			0	76	NPDES	No	6.96	0.5	0.125				1600	
SDS3	SDS3 102196 GRAB	1997	10/21/96	1	0.68	4.1			0	64	NPDES	No	6.97	0.5	0.125				130	
SDS3	SDS3 112396 GRAB	1997	11/23/96	1	0.63	34.1			0	72	StipAg	Yes	7.29	0.5	0.125				1	
SDS3	SDS3 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	6.87	3	0.54				30	
SDS3	SDS3 030597 GRAB	1997	3/5/97	1	0.39	20			0.24	42	NPDES	No	7.22	0.5	0.125				1	
SDS3	SDS3 060397 GRAB	1997	6/3/97	1	0.26	18			0	76	NPDES	No	7.49	0.5	3.7				130	
SDS3	SDS3 102897 GRAB	1998	10/28/97	1	0.47	10.8			0.08	26	NPDES	No	7.13	0.5	0.125				13	
SDS3	SDS3 012998 GRAB	1998	1/29/98	1	0.2	14			0	107	NPDES	No	7.26	1.1	0.125				1	
SDS3	SDS3 030198 GRAB	1998	3/1/98	1	0.98	86			0.07	6	NPDES	No	7.69		0.125	0.19	0.08	0.11	1	
SDS3	SDS3 030998 GRAB	1998	3/8/98	1	0.86	27			0	132	NPDES	No			0.125	0.075	0.025	0.05	1	backup monthly sample in case 3/1/98 sample didn't qualify under new permit
SDS3	SDS3 042398 GRAB	1998	4/23/98	1	0.46	20			0	264	NPDES	No	7.39		0.125	0.075	0.025	0.05	1	

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
SDS3	SDS3 050998 GRAB	1998	5/9/98	2	0.12	8			0	360	NPDES	No	7.07		0.34	0.33	0.025	0.31	17	NON-"STORM"
SDS3	SDS3 051498 GRAB	1998	5/14/98	1	0.21	8			0.01	125	NPDES	No	7.23		0.26	0.18	0.05	0.13	70	CONSIDERABLE POLLEN IN SAMPLE
SDS3	SDS3 061098 GRAB	1998	6/10/98	1	0.28	10			0	288	NPDES	No	7.51		0.125	0.075	0.025	0.05	4	
SDS3	SDS3 071598 GRAB	1999	7/14/98	2	0.13	16	0.04	0	0	264	NPDES	No	7.32		0.38	0.2	0.025	0.18	30	nonstorm
SDS3	SDS3 081698 GRAB	1999	8/16/98	1	0.31	10	0.25	0	0	792	NPDES	No	7.75		0.125	0.19	0.025	0.17	500	thunderstorm, 0.25 in/hr
SDS3	SDS3 091898 GRAB	1999	9/18/98	2	0.19	20	0.16	0	0	456	NPDES	No	7.71			0.15	0.025	0.13	300	nonstorm
SDS3	SDS3 092498 GRAB	1999	9/24/98	1	0.47	23	0.26	0	0	148	NPDES	No	7.14			0.21	0.025	0.19	900	
SDS3	SDS3 100398 GRAB	1999	10/3/98	1	0.4	3	0.22	0	0.07	36	NPDES	No	6.99		0.56	0.53	0.025	0.51	50	
SDS3	SDS3 102798 GRAB	1999	10/27/98	1	0.84	9	0.19	0	0	72	NPDES	No	7.34			0.07	0.025	0.045	13	
SDS3	SDS3 111198 GRAB	1999	11/11/98	1	0.98	62	0.15	0	0.05	31	NPDES	No	7.1			0.35	0.025	0.33	30	
SDS3	SDS3 121098 GRAB	1999	12/10/98	2	0.14	4	0.03	0	0	49	NPDES	No	7.27			0.085	0.03	0.055	16	nonstorm
SDS3	SDS3 121798 GRAB	1999	12/17/98	2	0.11	4	0.03	0	0.02	33	NPDES	No	7.09			0.075	0.025	0.05	24	nonstorm
SDS3	SDS3 122498 GRAB	1999	12/24/98	1	1.19	39	0.16	0	0	153	NPDES	Yes	7.62			0.47	0.025	0.45		fecals not analyzed due to holiday lab closure
SDS3	SDS3 010999 GRAB	1999	1/9/99	1	0.27	21	0.05	0	0	54	NPDES	No	7.65			0.085	0.03	0.055	1	
SDS3	SDS3 011399 grab	1999	1/13/99	1	1.07	22	0.16	0	0	85	NPDES	No	7.5			0.26	0.025	0.24	23	
SDS3	SDS3 020399 GRAB	1999	2/3/99	1	0.28	19	0.07	0	0.61	27	NPDES	No	7.44			0.08	0.025	0.055	2	
SDS3	SDS3 030699 GRAB	1999	3/6/99	1	0.28	15	0.05	0	0	96	NPDES	No	7.01	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998		0.075	0.025	0.05	1	
SDS3	SDS3 031299 GRAB	1999	3/12/99	1	0.83	23	0.07	0	0	71	NPDES	No	7.23			0.35	0.025	0.33	1600	
SDS3	SDS3 032499 GRAB	1999	3/24/99	1	0.28	19	0.08	0	0.15	40	NPDES	No	7.26			0.075	0.025	0.05	8	
SDS 3	SDS3 070299 GRAB	2000	7/2/99	1	0.3	6	0.11	0	0	103	NPDES	No	7.16			0.075	0.025	0.05	23	
SDS 3	SDS3 110599 GRAB	2000	11/5/99	1	0.68	12	0.11	0	0.05	44	NPDES	No	7.53			0.075	0.025	0.05	16	
SDS 3	SDS3 111699 GRAB	2000	11/16/99	1	0.6	15	0.07	0.01	0.08	23	NPDES	No	7.59			0.075	0.025	0.05	13	
SDS 3	sds3 120499 GRAB	2000	12/4/99	1	0.24	10	0.1	0	0	60	NPDES	No	7.17			0.075	0.025	0.05	1	
SDS 3	SDS3 120899 GRAB	2000	12/8/99	1	0.49	27	0.09	0	0.36	40	NPDES	No	7.38			0.075	0.025	0.05	1	
SDS 3	SDS3 031300 grab	2000	3/13/00	1	0.47	9	0.13	0	0	49	NPDES	No	7.35			0.075	0.025	0.05	4	
SDS 3	SDS3 041300 GRAB	2000	4/13/00	1	0.34	12	0.08	0	0	74	NPDES	No	7.69			0.075	0.025	0.05	8	
SDS3	SDS3 062099 GRAB	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No	7.38			0.08	0.025	0.055	220	
SDS4	SDS4 091494	1995	9/13/94	1	0.15	9				118	NPDES	No	7.14	3	0.5				132	
SDS4	SDS4 101394	1995	10/13/94	1	0.32	14			0	480	NPDES	No	7.02	1.2	0.5				70	
SDS4	SDS4 111994	1995	11/19/94	1	0.42	24			0.05	52	NPDES	No								
SDS4	SDS4 011295	1995	1/11/95	1	0.3	60			0.04	24	NPDES	No	7.8	0.5	0.5				92	
SDS4	SDS4 021695	1995	2/15/95	1	1.1	56			0	86	NPDES	Yes								
SDS4	SDS4 051295	1995	5/11/95	1	0.2	8			0.12		NPDES	No	7.5	1.8	0.5				16	
SDS4	SDS4 080795	1996	8/6/95	1	0.4	8			0		NPDES	No	7.6	2.7	0.5				16	
SDS4	SDS4 101695	1996	10/15/95	1	0.35	12			0		NPDES	No	7.7	1.7	0.5				27.5	
SDS4	SDS4 011496 GRAB	1996	1/13/96	1	0.37	20			0		NPDES	No	7.4	0.5	0.5				440	
SDS4	SDS4 020596	1996	2/3/96	2	1.6	8					SES	Yes								
SDS4	SDS4 041696 GRAB	1996	4/15/96	1	0.49	16			0.09		NPDES	No	7.63	2.7	0.125				350	
SDS4	SDS4 042296 GRAB	1996	4/22/96	1	2.83	8			0		StipAg	No	7.15	0.5	0.125	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			1600	
SDS4	SDS4 070396 GRAB	1997	7/3/96	1	0.23	12			0		NPDES	No	6.67	0.5	0.76				300*	Fecals exceeded 30 hour holding time, results not representative
SDS4	SDS4 071796 GRAB	1997	7/17/96	1	0.27	31			0		NPDES	No							500	fecals make up for 7/4/96 grab that exceeded holding time
SDS4	SDS4 100396 GRAB	1997	10/4/96	1	0.59	8.1			0.08	18	NPDES	No	6.74	0.5	0.125				500	
SDS4	SDS4 120496 GRAB	1997	12/4/96	1	0.82	7.5			0.16	44	NPDES	No	6.78	0.5	0.125				80	
SDS4	SDS4 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	7.38	4	0.26				1600	
SDS4	SDS4 012797 GRAB	1997	1/27/97	1	0.41	26			0	109	StipAg	No	7.45	3	0.125				30	
SDS4	SDS4 041997 GRAB	1997	4/19/97	1	1.16	26			0	64	NPDES	No	7.4	0.5	0.5				50	
SDS4	SDS4 082497 GRAB	1998	8/25/97	1	0.2	10.5			0.07	96	NPDES	No	7.77	0.5	0.125				70	
SDS4	SDS4 111797 GRAB	1998	11/16/97	1	0.47	12.6			0	222	NPDES	No	7.46	0.5	0.125				29	
SDS4	SDS4 012998 GRAB	1998	1/29/98	1	0.2	14			0	107	NPDES	No	7.21	0.5	0.125				4	MATCHING COMPOSITE NOT REPRESENTATIVE, NOT REPORTED
SDS4	SDS4 030998 GRAB	1998	3/8/98	1	0.86	27			0	132	NPDES	No	7.5	0.5	0.125				1	EXTRA GRAB (HAS MAKEUP COMP FOR 98QW)
SDS4	SDS4 111998 GRAB	1999	11/19/98	1	2.34	66	0.18	0	0	73	NPDES	No	7.09			0.075	0.025	0.05	300	-79% RPD in lab dupe
SDS4	SDS4 050799 GRAB	1999	5/6/99	1	0.25	22	0.06	0	0	79	NPDES	No	7.46			0.11	0.06	0.05	900	ANNUAL SAMPLE
SDS7	SDW3 051095	1995	5/9/95	1	0.12	7.5			0	102	NPDES	No	7.3	0.5	0.5				1700	
SDS7	SDW3 051195	1995	5/11/95	1	0.2	8			0.12		NPDES	No	7.4	1.1	0.5				73	
SDS7	SDW3 061095	1995	6/10/95	1	0.3	10			0	96	NPDES	No	7	0.6	0.5				1000	
SDS7	SDW3 081795	1996	8/16/95	1	1.34	12			0.01		NPDES	No	7.2	2.9	6.6	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			30000	
SDS7	SDW3 112396 GRAB	1997	11/23/96	1	0.63	34.1			0	72	NPDES	Yes	7.41	0.5	0.26				50	composite failed
SDS7	SDW3 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	StipAg	No	6.7	0.5					148	
SDS7	SDW3 021197 GRAB	1997	2/11/97	1	0.48	18			0	205	StipAg	No	6.75	0.5	0.125				17	grab makes up for 12/4/96 missed grab
SDS7	SDW3 022697 GRAB	1997	2/26/97	1	0.24	25			0	167	StipAg	No	6.13	9.7	0.125				1	grab makes up for 1/27/97 missed grab
SDS7	SDW3 110498 GRAB	1999	11/3/98	1	1.62	39	0.48	0	0.08	35	NPDES	No				3.79	0.025	3.77	500	

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
SDS7	SDW3 021699 GRAB	1999	2/15/99	1	0.45	28	0.08	0	0	59	NPDES	No				0.14	0.025	0.12	80	1998 annual sample
SDS7	SDW3 021899 GRAB	1999	2/18/99	1	0.6	32	0.06	0.01	0.35	20	NPDES	No				0.13	0.025	0.11	1	1998 annual sample
SDS7	SDW3 031299 GRAB	1999	3/12/99	1	0.83	23	0.07	0	0	71	NPDES	No				0.14	0.03	0.11	2	1999 annual sample-no comp
SDS7	SDW3 032499 GRAB	1999	3/24/99	1	0.28	19	0.08	0	0.15	40	NPDES	No	7.65			0.075	0.025	0.05	1	1999 annual sample
SDS6	B 120496 GRAB	1997	12/4/96	1	0.82	7.5			0.16	44	NPDES	No	6.51	0.5	0.125				2	
SDS6	B 012797 GRAB	1997	1/27/97	1	0.41	26			0	109	NPDES	No	7.11	0.5	0.125				4	
SDS6	B 041997 GRAB	1997	4/19/97	1	1.16	26			0	64	NPDES	No	6.85	0.5	0.5				30	pairs with 3/6/97 composite for 97 spring qtr
SDS6	B 110498 GRAB	1999	11/3/98	1	1.62	39	0.48	0	0.08	35	NPDES	No	7.18			0.15	0.025	0.13	1600	
SDS6	B 111298 GRAB	1999	11/11/98	1	0.98	62	0.15	0	0.05	31	NPDES	No	7.42			0.075	0.025	0.05	220	
SDS6	B 050799 GRAB	1999	5/6/99	1	0.25	22	0.06	0	0	79	NPDES	No	6.57			0.19	0.025	0.17	1600	ANNUAL SAMPLE
SDS5	D 120496 GRAB	1997	12/4/96	1	0.82	7.5			0.16	44	NPDES	No	6.78	1.2	0.125				70	composite for this storm not representative, equipment malfunction
SDS5	D 011797 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	6.95	3.9	0.47	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			350	no composite sample for this event, equipment malfunction
SDS5	D 012797 GRAB	1997	1/27/97	1	0.41	26			0	109	NPDES	No	7.11	13	0.125				170	makeup for 96Q4 (3 unsuccessful attempts)
SDS5	D 021197 GRAB	1997	2/11/97	1	0.48	18			0	205	NPDES	No	6.54	7.1	0.25				38	
SDS5	D 030597 GRAB	1997	3/5/97	1	0.39	20			0.24	42	NPDES	No	7.03	0.5	0.125				2	
SDS5	D 061797 GRAB	1997	6/16/97	1	0.36	28			0	135	NPDES	No	6.87	0.5	0.125				1600	
SDS5	D 011399 GRAB	1999	1/13/99	1	1.07	22	0.16	0	0	85	NPDES	No				0.08	0.025	0.055	1600	
SDS5	D 050699 GRAB	1999	5/6/99	1	0.25	22	0.06	0	0	79	NPDES	No	7.01			0.075	0.025	0.05	500	ANNUAL SAMPLE
SDN1	SDN1 091494	1995	9/13/94	1	0.15	9				118	NPDES	No	6.56	3.3	0.5				4000	
SDN1	SDN1 101994	1995	10/19/94	1	0.2	32				120	NPDES	No	6.83	1.8	0.5				180	
SDN1	SDN1 111994	1995	11/19/94	1	0.42	24			0.05	52	NPDES	No								
SDN1	SDN1 011295	1995	1/11/95	1	0.3	60			0.04	24	NPDES	No	7.4	2.6	5.1				1000	
SDN1	SDN1 021695	1995	2/15/95	1	1.1	56			0	86	NPDES	Yes								
SDN1	SDN1 030595	1995	3/4/95	1	0.18	24			0	158	SlipAg	No								
SDN1	SDN1 030995	1995	3/8/95	1	2.16	114			0	88	SlipAg	No								
SDN1	SDN1 040595	1995	4/4/95	1	0.17	4			0	270	SlipAg	No								
SDN1	SDN1 040795	1995	4/6/95	1	0.61	28			0.04	60	NPDES	No	7.6	0.6	0.5				58	
SDN1	SDN1 080795	1996	8/6/95	1	0.4	8			0		NPDES	No	7.8	21	5.6				42	
SDN1	SDN1 110795	1996	11/6/95	1	3.89	48			0.09		NPDES	No	6.7	16	3.4	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			25	
SDN1	SDN1 020496 GRAB	1996	2/3/96	1	1.6	8					NPDES	Yes	7.4	7.3	7.5				100	
SDN1	SDN1 033196 GRAB	1996	3/31/96	1	0.64	0			0.01		SlipAg	No	6.9	8	4.1				340	xtra NPDES/Slip Ag
SDN1	SDN1 042296 GRAB	1996	4/22/96	1	2.83	8			0		NPDES	No	7.26	1	0.25				6	
SDN1	SDN1 062396 GRAB	1996	6/23/96	1	0.46	10			0		SlipAg	No	5.52	2	0.92				23	xtra NPDES/Slip Ag
SDN1	SDN1 070396 GRAB	1997	7/3/96	1	0.23	12			0		NPDES	No	6.17	2.8	1.8				999‡	Fecals exceeded 30 hour holding time, results not representative
SDN1	SDN1 071796 grab	1997	7/17/96	1	0.27	31			0		NPDES	No							500	fecals make up for 7/4/96 grab that exceeded holding time
SDN1	SDN1 110496 GRAB	1997	11/3/96	2	0.14	2			0	120	source trace	Yes	5.99	2.5	1.3				240	paired up/down sample
SDN1	SDN1 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	5.16		3.6				161	paired up/down sample
SDN1up	SDN1up 100496 GRAB	1997	10/4/96	1	0.59	8.1			0.06	18	NPDES	No	7.23	0.5	0.5				500	paired up/down sample
SDN1up	SDN1up 110496 GRAB	1997	11/3/96	2	0.14	2			0	120	source trace	Yes	4.59	0.5	0.39				23	paired up/down sample
SDN1up	SDN1up 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	4.37	0.5	2.1	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			23	paired up/down sample
SDN1up	SDN1 041397 grab	1997	4/13/97	1	0.31	12			0.04		NPDES	No	4.57	0.5	1.08				33	
SDN1up	SDN1 060397 GRAB	1997	6/3/97	1	0.26	16			0	76	NPDES	No	3.49	0.5	4.3				17	
SDN1up	SDN1 102897 grab	1998	10/28/97	1	0.47	10.8			0.08	26	NPDES	No	6.54	0.5	0.125				50	
SDN1up	SDN1 121597 GRAB	1998	12/15/97	1	1	33			0	87	NPDES	No	7.34	0.5	1.5				11	
SDN1up	SDN1 030198 GRAB	1998	3/1/98	1	0.98	86			0.07	6	NPDES	No	6.33		0.48	0.68	0.03	0.65	2	
SDN1up	SDN1 030998 GRAB	1998	3/8/98	1	0.86	27			0	132	NPDES	No	6.68		0.47	0.78	0.06	0.72	1	backup monthly sample in case 3/1/98 sample didn't qualify under new permit
SDN1up	SDN1 040798 GRAB	1998	4/7/98	2	0.03	0.5			0.04	87	NPDES	No	5.56		0.34	0.89	0.05	0.84	1	NON-"STORM"
SDN1up	SDN1 041098 GRAB	1998	4/9/98	2	0.09	17			0	62	NPDES	No	6.26		1.16	1.4	0.79	0.61	2	NON-"STORM"
SDN1up	SDN1 042398 GRAB	1998	4/23/98	1	0.46	20			0	264	NPDES	No	5.35		1.2	0.97	0.025	0.95	170	
SDN1up	SDN1 050998 GRAB	1998	5/9/98	2	0.12	8			0	360	NPDES	No	4.94		0.6	0.55	0.06	0.49	80	NON-"STORM"
SDN1up	SDN1 051498 GRAB	1998	5/14/98	1	0.21	8			0.01	125	NPDES	No	6.21		0.56	0.41	0.025	0.39	50	CONSIDERABLE POLLEN IN SAMPLE
SDN1up	SDN1 061098 GRAB	1998	6/10/98	1	0.28	10			0	288	NPDES	No	6.45		0.76	1.03	0.025	1.01	240	
SDN1up	SDN1 071498 GRAB	1999	7/14/98	2	0.13	16	0.04	0	0	264	NPDES	No	5.46		1.9	2.55	0.46	2.09	240	nonstorm
SDN1up	SDN1 081698 GRAB	1999	8/16/98	1	0.31	10	0.25	0	0	792	NPDES	No	6.36		0.125	0.64	0.03	0.61	900	thunderstorm, 0.25 in/hr
SDN1up	SDN1 091898 GRAB	1999	9/18/98	2	0.19	20	0.16	0	0	456	NPDES	No	6.95			2.46	0.025	2.45	1600	nonstorm
SDN1up	SDN1 092498 GRAB	1999	9/24/98	1	0.47	23	0.26	0	0	148	NPDES	No	6.73			1.82	0.025	1.8	80	
SDN1up	SDN1 100398 GRAB	1999	10/3/98	1	0.4	3	0.22	0	0.07	36	NPDES	No	6.08		2.1	1.95	0.03	1.92	170	
SDN1up	SDN1 102798 GRAB	1999	10/27/98	1	0.64	9	0.19	0	0	72	NPDES	No	8.08			2.01	0.025	1.99	130	

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
SDN1up	SDN1 110498 GRAB	1999	11/3/98	1	1.62	39	0.48	0	0.08	35	NPDES	No	5.97			0.37	0.025	0.35	500	
SDN1up	SDN1 111198 GRAB	1999	11/11/98	1	0.96	62	0.15	0	0.05	31	NPDES	No	7.08			0.96	0.025	0.94	80	
SDN1up	SDN1 121098 GRAB	1999	12/10/98	2	0.14	4	0.03	0	0	49	NPDES	No	7.4			0.91	0.025	0.89	1600	nonstorm
SDN1up	SDN1 121798 GRAB	1999	12/17/98	2	0.11	4	0.03	0	0.02	33	NPDES	No	7.23			3.16	0.025	3.14	500	nonstorm
SDN1up	SDN1 122498 GRAB	1999	12/24/98	1	1.19	39	0.16	0	0	153	NPDES	Yes	7.86			4.95	0.025	4.93		fecals not analyzed due to holiday lab closure
SDN1up	SDN1 010999 GRAB	1999	1/9/99	1	0.27	21	0.05	0	0	54	NPDES	No	6.87			3.51	0.03	3.48	23	
SDN1up	SDN1 011399 GRAB	1999	1/13/99	1	1.07	22	0.16	0	0	85	NPDES	No	7.27			2.81	0.03	2.78	1600	
SDN1up	SDN1 020399 GRAB	1999	2/3/99	1	0.28	19	0.07	0	0.61	27	NPDES	No	7.32			1.4	0.025	1.38	30	
SDN1up	SDN1 030899 GRAB	1999	3/8/99	1	0.28	15	0.05	0	0	96	NPDES	No	6.58			1.04	0.025	1.02	7	
SDN1up	SDN1 031299 GRAB	1999	3/12/99	1	0.83	23	0.07	0	0	71	NPDES	No	6.71	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998		0.99	0.025	0.97	1	
SDN1up	SDN1 032499 GRAB	1999	3/24/99	1	0.28	19	0.08	0	0.15	40	NPDES	No	6.92			1.69	0.025	1.67	8	
SDN1up	SDN1 032799 GRAB	1999'	3/27/99	1	0.24	9	0.07	0	0.09	26	NPDES	No	6.36			0.86	0.025	0.84	2	
SDN1up	SDN1 070299 GRAB	2000	7/2/99	1	0.3	6	0.11	0	0	103	NPDES	No	7.33			0.6	0.025	0.58	50	
SDN1up	SDN1 110599 GRAB	2000	11/5/99	1	0.68	12	0.11	0	0.05	44	NPDES	No	6.61			1.17	0.025	1.15	42	
SDN1up	SDN1 111699 GRAB	2000	11/16/99	1	0.6	15	0.07	0.01	0.08	23	NPDES	No	7.62			2.59	0.025	2.57	1600	
SDN1up	SDN1 120499 grab	2000	12/4/99	1	0.24	10	0.1	0	0	60	NPDES	No	6.21			1.53	0.045	1.49	4	
SDN1up	SDN1 121799 grab	2000	12/17/99	1	0.34	11	0.08	0	1.15	26	NPDES	No	7.54			0.87	0.025	0.85	900	
SDN1up	SDN1 031300 grab	2000	3/13/00	1	0.47	9	0.13	0	0	49	NPDES	No	6.2			0.12	0.025	0.1	1	
SDN1up	SDN1 032200 grab	2000	3/22/00	1	0.43	8	0.14	0	0	86	NPDES	No	5.06			0.31	0.025	0.29	1	
SDN1up	SDN1 041300 GRAB	2000	4/13/00	1	0.34	12	0.08	0	0	74	NPDES	No	5.94			0.23	0.1	0.13	1	
SDN1UP	SDN1 062099 GRAB	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No	5.85			4.97	0.025	4.95	1600	
SDN2	SDN2 090894	1995	9/8/94	1	0.69	22				93	NPDES	No	6.82	1.8	0.5				3	
SDN2	SDN2 101394	1995	10/13/94	1	0.32	14			0	480	NPDES	No		1.1	0.5				2	
SDN2	SDN2 111394	1995	11/11/94	1	0.28	14				46	NPDES	No		0.5	0.5				30	
SDN2	SDN2 111994	1995	11/19/94	1	0.42	24			0.05	52	NPDES	No								
SDN2	SDN2 011295	1995	1/11/95	1	0.3	60			0.04	24	NPDES	No	8	2.3	0.5				4	
SDN2	SDN2 030595	1995	3/4/95	1	0.18	24			0	158	StipAg	No								
SDN2	SDN2 040795	1995	4/6/95	1	0.61	28			0.04	60	StipAg	No								
SDN2	SDN2 041295	1995	4/10/95	1	0.29	18			0	56	NPDES	No	7.6	4	5.2				1	
SDN2	SDN2 080795	1996	8/6/95	1	0.4	8			0		NPDES	No	7	2.6	0.5				15	
SDN2	SDN2 101695	1996	10/15/95	1	0.35	12			0		NPDES	No	7.3	1.9	0.5				1	
SDN2	SDN2 021796 GRAB	1996	2/17/96	1	1.29	12			0		NPDES	No	7.6	0.5	0.5	TPH-Dx replaced FOG and TPH (IR) on March 1, 1998			10	
SDN2	SDN2 032996 GRAB	1996	3/29/96	2	0.13	8			0.01	120	StipAg	No								nonstorm
SDN2	SDN2 033196 GRAB	1996	3/31/96	1	0.64	0			0.01		StipAg	No	6.7	0.5	0.5				16	xtra NPDES/Stip Ag
SDN2	SDN2 041996	1996	4/19/96	2	0.09	28			0.56	16	StipAg	No								nonstorm (0.02" storm)
SDN2	SDN2 042296 GRAB	1996	4/22/96	1	2.83	8			0		NPDES	No	7.17	0.5	0.125				50	
SDN2	SDN2 062396 GRAB	1996	6/23/96	1	0.46	10			0		StipAg	No	6.83	1	0.46				2	xtra NPDES/Stip Ag
SDN2	SDN2 071796 grab	1997	7/17/96	1	0.27	31			0		NPDES	No							4	xtra fecals analyzed
SDN2	SDN2 090396 GRAB	1997	9/3/96	1	0.29	1.2			0	76	NPDES	No	7.24	1.6	0.29				900	some composite aliquots in grab
SDN2	SDN2 102196 GRAB	1997	10/21/96	1	0.68	4.1			0	64	NPDES	No	6.45	0.5	0.32				2	
SDN2	SDN2 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	7.45	4.3	0.39				11	
SDN2	SDN2 041997 GRAB	1997	4/19/97	1	1.16	26			0	64	NPDES	No	6.91	0.5	0.87				4	
SDN2	SDN2 082497 GRAB	1998	8/25/97	1	0.2	10.5			0.07	96	NPDES	No	7.08	1.2	0.43				500	no composite, equipment malfunction
SDN2	SDN2 110498 GRAB	1999	11/3/98	1	1.62	39	0.48	0	0.08	35	NPDES	No				1.09	0.035	1.07		North Cargo Pump Station bypass
SDN2	SDN2 112598 GRAB	1999	11/25/98	2	3.45	52	0.32	0.28	0.31	8	NPDES	No				0.13	0.025	0.11		North Cargo Pump Station bypass
SDN2	SDN2 012899 GRAB	1999	1/28/99	2	1.16	33	0.1	0	0.02	33	NPDES	No		TPH-Dx replaced FOG and TPH (IR) on March 1, 1998		0.17	0.025	0.15		pump station bypass, STORM<<DESIGN. MAINT NOTIFIED (O&M IN PROGRESS)
SDN 2	SDN2 121599 grab	2000	12/15/99	2	1.26	13	0.32	0.15	0.32	8	NPDES	No				0.075	0.025	0.05		North Cargo Pump Station bypass
SDN2	SDN2 062499 GRAB	1999	6/24/99	1	1.12	24	0.35	0.03	0.08	10	NPDES	No				0.26	0.025	0.24		30 min. North Cargo Pump Station bypass
SDN3	SDN3 090894	1995	9/8/94	1	0.69	22				93	NPDES	No	6.4	1.1	0.5				2200	
SDN3	SDN3 102694	1995	10/25/94	1	1.96	44				114	NPDES	No		2.9	0.5				2	
SDN3	SDN3 111994	1995	11/19/94	1	0.42	24			0.05	52	NPDES	No								
SDN3	SDN3 010795	1995	1/7/95	1	0.21	62			0	252	NPDES	No	7.8	0.55	0.5				1	
SDN3	SDN3 021695	1995	2/15/95	1	1.1	56			0	86	NPDES	Yes								
SDN3	SDN3 030595	1995	3/4/95	1	0.18	24			0	158	StipAg	No								
SDN3	SDN3 030995	1995	3/8/95	1	2.16	114			0	88	StipAg	No								
SDN3	SDN3 040595	1995	4/4/95	1	0.17	4			0	270	StipAg	No								
SDN3	SDN3 060495	1995	6/4/95	1	0.7	28			0	384	NPDES	No	7	2.5	0.5				40	
SDN3	SDN3 071095	1996	7/9/95	1	0.81	13			0		NPDES	No	7	3.3	0.5				800	
SDN3	SDN3 110795	1996	11/6/95	1	3.89	48			0.09		NPDES	No	7.2	2.1	0.5				4	
SDN3	SDN3 011496 GRAB	1996	1/13/96	1	0.37	20			0		NPDES	No	7.2	0.5	0.6				1	
SDN3	SDN3 033096 GRAB	1996	3/29/96	2	0.13	8			0.01	120	StipAg	No								nonstorm, insuff flow to enable sampler
SDN3	SDN3 033196 GRAB	1996	3/31/96	1	0.64	0			0.01		StipAg	No	6.8	1.4	0.5				1	xtra NPDES/Stip Ag

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
SDN3	SDN3 041296 GRAB	1996	4/11/96	2	0.21	40			0	110	StipAg	No								nonstorm
SDN3	SDN3 041696 GRAB	1996	4/15/96	1	0.49	16			0.09		NPDES	No	7.61	2	0.125				50	
SDN3	SDN3 041996	1996	4/19/96	2	0.09	28			0.56	16	StipAg	No								nonstorm
SDN3	SDN3 042296 GRAB	1996	4/22/96	1	2.83	8			0		StipAg	No	7.12	0.5	0.125				110	xtra NPDES/Stip Ag
SDN3	SDN3 080396 GRAB	1997	8/2/96	1	1.01	27			0	325	NPDES	No	7.41	0.5	0.3				900	delayed hydrograph, very dry antecedent
SDN3	SDN3 112396 GRAB	1997	11/23/96	1	0.63	34.1			0	72	NPDES	Yes	7.32	0.5	0.125				14	insufficient sample for composite
SDN3	SDN3 120496 GRAB	1997	12/4/96	1	0.82	7.5			0.16	44	NPDES	No	6.46	0.5	0.125				14	
SDN3	SDN3 122096 GRAB	1997	12/19/96	1	0.36	37			0	103	NPDES	No	6.32	0.5	0.125				7	
SDN3	SDN3 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	6.68	1.4	0.125				4	
SDN3	SDN3 030597 GRAB	1997	3/5/97	1	0.39	20			0.24	42	NPDES	No	7.18	36*	0.125				1	FOG result not representative, laboratory error, see letter of May 15, 1997
SDN3	SDN3 053097	1997	5/30/97	1	1.84	36			0.04	14	NPDES	No		0.5	0.125					BACKUP fog/tph for March lab errors on SDN3 030597 grab
SDN3	SDN3 062197 GRAB	1997	6/21/97	1	0.27	11.8		0.01	0.02	24	NPDES	No	7.51	0.5	0.125				80	
SDN3	SDN3 102897 GRAB	1998	10/28/97	1	0.47	10.8			0.06	26	NPDES	No	6.72	0.5	0.125				1600	
SDN3	SDN3 121597 GRAB	1998	12/15/97	1	1	33			0	87	NPDES	No	7.28	1.5	0.125				50	HAD QC DUPLICATE ALSO: GOOD DUPLICATION
SDN3	SDN3 111998 GRAB	1999	11/19/98	1	2.34	66	0.18	0	0	73	NPDES	No	6.52			0.075	0.025	0.05	240	
SDN3	SDN3 012099 GRAB	1999	1/20/99	1	0.42	28	0.09	0.01	0.95	22	NPDES	No				0.08	0.025	0.055	1	
SDN 3	SDN3 071699 grab	2000	7/16/99	1	0.7	34	0.11	0	0	300	NPDES	No	7.07			0.2	0.07	0.13	2	
SDN 3	SDN3 120899 GRAB	2000	12/8/99	1	0.49	27	0.09	0	0.36	40	NPDES	No	7.67			0.075	0.025	0.05	1	
SDN3	SDN3 062299 GRAB	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No	7.5			0.13	0.025	0.11	240	
SDN4	SDN4 090396 GRAB	1997	9/3/96	1	0.29	1.2			0	76	NPDES	No	6.63	1.2	0.125				280	taken in 2 BOTTLES: FOG/TPH, and fecals
SDN4	SDN4 120496 GRAB	1997	12/4/96	1	0.82	7.5			0.16	44	NPDES	No	6.57	0.5	0.125				1	
SDN4	SDN4 011697 GRAB	1997	1/16/97	1	1.21	23			0	154	NPDES	No	7.34	1.6	0.125				4	
SDN4	SDN4 030597 GRAB	1997	3/5/97	1	0.39	20			0.24	42	NPDES	No	8.08	0.5	0.125				1	
SDN4	SDN4 060397 GRAB	1997	6/3/97	1	0.26	16			0	76	NPDES	No	9.07	0.5	0.125				13	
SDN4	SDN4 102897 GRAB	1998	10/28/97	1	0.47	10.8			0.08	26	NPDES	No	8.44	0.5	0.125				7	
SDN4	SDN4 121597 GRAB	1998	12/15/97	1	1	33			0	87	NPDES	No	7.81	0.5	0.125				8	
SDN4	SDN4 030198 GRAB	1998	3/1/98	1	0.98	86			0.07	6	NPDES	No	7.88		0.125	0.08	0.025	0.055	1	
SDN4	SDN4 030998 GRAB	1998	3/8/98	1	0.86	27			0	132	NPDES	No	7.62		0.125	0.075	0.025	0.05	1	backup monthly sample in case 3/1/98 sample didn't qualify under new permit
SDN4	SDN4 042398 GRAB	1998	4/23/98	1	0.46	20			0	264	NPDES	No	7.86		0.125	0.075	0.025	0.05	1	
SDN4	SDN4 052598 GRAB	1998	5/24/98	1	0.58	11			0	87	NPDES	No	6.94		0.125	0.13	0.08	0.05	9	
SDN4	SDN4 062498 GRAB	1998	6/24/98	1	0.43	4			0	288	NPDES	No	8.26		0.125	0.075	0.025	0.05	130	
SDN4	SDN4 081698 GRAB	1999	8/16/98	1	0.31	10	0.25	0	0	792	NPDES	No	7.68		0.125	0.135	0.055	0.06	170	thunderstorm, 0.25 in/hr
SDN4	SDN4 092498 GRAB	1999	9/24/98	1	0.47	23	0.26	0	0	148	NPDES	No	7.13			0.075	0.025	0.05	22*	FECALS EXCEED HOLDING TIME
SDN4	SDN4 100398 GRAB	1999	10/3/98	1	0.4	3	0.22	0	0.07	38	NPDES	No	7.04		0.28	0.075	0.025	0.05	30	
SDN4	SDN4 102798 GRAB	1999	10/27/98	1	0.64	9	0.19	0	0	72	NPDES	No	7.9			0.075	0.025	0.05	2	
SDN4	SDN4 110498 GRAB	1999	11/3/98	1	1.62	39	0.48	0	0.08	35	NPDES	No	9.26			0.075	0.025	0.05	17	
SDN4	SDN4 111398 GRAB	1999	11/11/98	1	0.98	62	0.15	0	0.05	31	NPDES	No	8.91			0.075	0.025	0.05	17	
SDN4	SDN4 121098 GRAB	1999	12/10/98	2	0.14	4	0.03	0	0	49	NPDES	No	7.15			0.08	0.025	0.055	1600	nonstorm
SDN4	SDN4 121798 GRAB	1999	12/17/98	2	0.11	4	0.03	0	0.02	33	NPDES	No	7.3			0.08	0.025	0.055	8	nonstorm
SDN4	SDN4 122498 GRAB	1999	12/24/98	1	1.19	39	0.16	0	0	153	NPDES	Yes	7.59			0.075	0.025	0.05		fecals not analyzed due to holiday lab closure
SDN4	SDN4 011099 GRAB	1999	1/9/99	1	0.27	21	0.05	0	0	54	NPDES	No	7.13			0.08	0.025	0.055	23	
SDN4	SDN4 011399 GRAB	1999	1/13/99	1	1.07	22	0.16	0	0	85	NPDES	No	7.09			0.085	0.03	0.055	1600	
SDN4	SDN4 020399 GRAB	1999	2/3/99	1	0.28	19	0.07	0	0.61	27	NPDES	No	7.18			0.08	0.025	0.055	1	
SDN4	SDN4 031299 GRAB	1999	3/12/99	1	0.83	23	0.07	0	0	71	NPDES	No	7.28			0.075	0.025	0.05	1	
SDN 4	SDN4 071699 grab	2000	7/16/99	1	0.7	34	0.11	0	0	300	NPDES	No	6.98			0.29	0.025	0.27	8	
SDN 4	SDN4 110599 GRAB	2000	11/5/99	1	0.68	12	0.11	0	0.05	44	NPDES	No	7.73			0.18	0.025	0.16	30	
SDN 4	SDN4 111699 GRAB	2000	11/16/99	1	0.6	15	0.07	0.01	0.08	23	NPDES	No	7.63			0.08	0.025	0.055	300	
SDN 4	SDN4 120899 GRAB	2000	12/8/99	1	0.49	27	0.09	0	0.36	40	NPDES	No	7.45			0.075	0.025	0.05	1	
SDN 4	SDN4 121799 grab	2000	12/17/99	1	0.34	11	0.06	0	1.15	26	NPDES	No	7.67			0.075	0.025	0.05	1	
SDN 4	SDN4 013100 grab	2000	1/31/00	1	1.76	29	0.15	0.07	0.07	9	NPDES	No	6.67			0.075	0.025	0.05	4	
SDN 4	SDN4 031300 grab	2000	3/13/00	1	0.47	9	0.13	0	0	49	NPDES	No	7.48			0.21	0.025	0.19	4	
SDN 4	SDN4 041300 GRAB	2000	4/13/00	1	0.34	12	0.08	0	0	74	NPDES	No	7.39			0.52	0.17	0.35	33	
SDN4	SDN4 032799 GRAB	1999	3/27/99	1	0.24	9	0.07	0	0.09	26	NPDES	No	7.02			0.075	0.025	0.05	1	
EY	EY 091494	1995	9/13/94	1	0.15	9				118	NPDES	No	6.93	2.2						
EY	EY 101394	1995	10/13/94	1	0.32	14			0	480	NPDES	No	6.98	2.1						
EY	EY 030995	1995	3/8/95	1	2.16	114			0	88	NPDES	No	6.6	0.5						
EY	EY 060495	1995	6/4/95	1	0.7	28			0	384	NPDES	No	5.5	6.5						
EY	EY 072695	1996	7/26/95	1	0.41	36			0		NPDES	No	5.8	4.1						
EY	EY 101695	1996	10/15/95	1	0.35	12			0		NPDES	No	6.5	0.55						

TPH-Dx replaced FOG and TPH (IR) on March 1, 1998

TPH-Dx replaced FOG and TPH (IR) on March 1, 1998

TPH-Dx replaced FOG and TPH (IR) on March 1, 1998

AR 012794

All Grab Sample Data					storm caharcteristics								concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
EY	EY 021796 GRAB	1996	2/17/96	1	1.29	12			0		NPDES	No	7.7	0.5						
EY	EY 042296 GRAB	1996	4/22/96	1	2.83	8			0		NPDES	No	7.19	0.5						
EY	EY 052296 GRAB	1996	5/21/96	1	0.31	30			0.02		StipAg	No	6.06	1		TPH-Dx replaced FOG and TPH (IR) on March 1, 1998				
EY	EY 062396 GRAB	1996	6/23/96	1	0.46	10			0		StipAg	No	8.15	0.5						
EY	EY 070396 GRAB	1997	7/3/96	1	0.23	12			0		NPDES	No	6.26	0.5						
EY	EY 102196 GRAB	1997	10/21/96	1	0.68	4.1			0	64	NPDES	No	5.8	0.5						
EY	EY 021197 GRAB	1997	2/11/97	1	0.48	18			0	205	NPDES	No	5.63	1.9						
EY	EY 030597 GRAB	1997	3/5/97	1	0.39	20			0.24	42	NPDES	No	5.11	0.5						
EY	EY 060397 GRAB	1997	6/3/97	1	0.26	16			0	76	NPDES	No	5.54	0.5						
EY	EY 110697 GRAB	1998	11/6/97	1	0.16	4.4			0.01	72	NPDES	No	6.28	0.5						
EY	EY 012998 GRAB	1998	1/29/98	1	0.2	14			0	107	NPDES	No	6.19	0.5						
EY	EY 052598 GRAB	1998	5/24/98	1	0.58	11			0	87	NPDES	No				0.2	0.025	0.18		
EY	EY 011399 GRAB	1999	1/13/99	1	1.07	22	0.16	0	0	85	NPDES	No				1.79	0.03	1.76		
Eng.Yard	EY 013100 grab	2000	1/31/00	1	1.76	29	0.15	0.07	0.07	9	NPDES	No				1.34	0.025	1.32		
EY	EY 062099 GRAB	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No				0.78	0.025	0.76		
TY	TY 090894	1995	9/8/94	1	0.69	22				93	NPDES	No	7.91	3.9						
TY	TY 101994	1995	10/19/94	1	0.2	32				120	NPDES	No	6.52	1.3						
TY	TY 030495	1995	3/4/95	1	0.18	24			0	158	NPDES	No	6.9	5.7						
TY	TY 060495	1995	6/4/95	1	0.7	28			0	384	NPDES	No	5.5	7.8						
TY	TY 081795	1996	8/16/95	1	1.34	12			0.01		NPDES	No	6.8	2.3						
TY	TY 090595	1996	9/5/95	1							NPDES	No		1.6						
TY	TY 101695-1	1996	10/15/95	1	0.35	12			0		NPDES	No	6.7	19						
TY	TY 032296 GRAB	1996	3/22/96	1	0.21				0		StipAg	No	6.9	3.9						
TY	TY 041696 GRAB	1996	4/15/96	1	0.49	16			0.09		NPDES	No	6.06	3.7						
TY	TY 042296 GRAB	1996	4/22/96	1	2.83	8			0		NPDES	No	7.31	2						
TY	TY 070396 GRAB	1997	7/3/96	1	0.23	12			0		NPDES	No	6.15	1.4		TPH-Dx replaced FOG and TPH (IR) on March 1, 1998				
TY	TY 071796 grab	1997	7/17/96	1	0.27	31			0		StipAg	No	5.91	1.9						
TY	TY 080296 GRAB	1997	8/2/96	1	1.01	27			0	325	StipAg	No	6.43	1.6						
TY	TY 100496 GRAB	1997	10/4/96	1	0.59	8.1			0.08	18	NPDES	No	7.19	1.4	1.34					
TY	TY 021197 GRAB	1997	2/11/97	1	0.48	18			0	205	NPDES	No	5.72	5.1						
TY	TY 030597 GRAB	1997	3/5/97	1	0.39	20			0.24	42	NPDES	No	5.98	~~48~~						FOG result not representative, laboratory error, see letter of May 15, 1997
TY	TY 060397 GRAB	1997	6/3/97	1	0.26	16			0	76	NPDES	No	6.07	1.4						
TY	TY 111697 GRAB	1998	11/16/97	1	0.47	12.6			0	222	NPDES	No	6.67	0.5						
TY	TY 012998 GRAB	1998	1/29/98	1	0.2	14			0	107	NPDES	No	6.31	1						MATCHING COMPOSITE NOT REPRESENTATIVE, NOT REPORTED
TY	TY 030998 GRAB	1998	3/8/98	1	0.86	27			0	132	NPDES	No	6.83	0.5	1.2	1.41	0.09	1.32		EXTRA GRAB (HAS MAKEUP COMP FOR 98QW)
TY	TY 061098 GRAB	1998	6/10/98	1	0.28	10			0	288	NPDES	No			1.2	1.05	0.025	1.03		
TY	TY 020399 GRAB	1999	2/3/99	1	0.28	19	0.07	0	0.61	27	NPDES	No				4.34	0.025	4.32		
TaxiYard	TY 070299 GRAB	2000	7/2/99	1	0.3	6	0.11	0	0	103	NPDES	No				1.25	0.025	1.23		
TaxiYard	TY 022100 grab	2000	2/21/00	1	0.28	36	0.06	0	0	72	NPDES	No				1.03	0.025	1.01		
TaxiYard	TY 022500 grab	2000	2/25/00	1	0.28	6	0.09	0	0	70	NPDES	No				2.92	0.025	2.9		
TaxiYard	TY 031300 grab	2000	3/13/00	1	0.47	9	0.13	0	0	49	NPDES	No				2.6	0.025	2.4		
TY	TY 062099 GRAB	1999	6/20/99	1	0.21	38	0.03	0	0	48	NPDES	No				5.77	0.025	5.75		
			total from "storm"	360																
			total "nonstorm"	39																
<MDL, value shown is 1/2 MDL											All outfalls	count	326	194	202	161	161	161	302	
> value shown												max	10.7	21	10	8.7	0.8	8.6	30000	
lined-out values are outliers or non-representative data trimmed from data analysis												95th	7.8	8	4	3.7	0.1	3.6	1600	
												75th	7.4	3	1.1	1.5	0.03	1.5	330	
												median	7.0	1	0.5	0.3	0.03	0.3	42	
												25th	6.6	0.5	0.1	0.1	0.03	0.1	4	
												min	3.5	0.5	0.1	0.1	0.03	0.0	0.5	
												sd	0.7	3	2	1.4	0.1	1.4	1815.0	
												CV, %	11%	143%	149%	134%	214%	138%	412%	
												# non-detected		90	110	58	145	52	49	
												% non-detected		46%	54%	36%	90%	32%	16%	
																			68%	

AR 012795

All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
											SDE4	count	46	17	28	30	30	30	46	
											(002)	max	10.7	17	10	9	0.8	9	4000	
												95th	8.0	11	7.5	5.3	0.10	5	1600	
												75th	7.0	4	3.1	3.1	0.04	3.0	1475	
												median	6.7	3	2.3	2.5	0.03	2.3	280	
												25th	6.6	1.6	1.7	1.5	0.03	1.4	80	
												min	6.0	0.5	0.1	0.2	0.03	0.2	1	
												sd	0.8	4	2	1.7	0.1	1.7	800	
												CV, %	11%	106%	77%	69%	238%	71%	119%	
												# non-detected		3	2	0	26	0	1	
												% non-detected		18%	7%	0%	87%	0%	2%	
																0.9				
											SDS1	count	21	17	19	3	3	3	22	
											(003)	max	7.5	10	5.4	1.6	0.2	1.5	1600	
												95th	7.4	6.5	5.3	1.5	0.1	1.5	1600	
												75th	7.1	2.5	1.6	1.2	0.1	1.2	763	
												median	6.7	1.1	0.8	0.8	0.0	0.8	79	
												25th	6.2	0.5	0.5	0.8	0.0	0.7	13	
												min	5.4	0.5	0.3	0.7	0.0	0.6	1	
												sd	0.6	3	1.6	0.5	0.1	0.5	665	
												CV, %	9%	120%	111%	46%	111%	54%	147%	
												# non-detected		8	4	0	2	0	2	
												% non-detected		47%	21%	0%	67%	0%	9%	
											SDS2	count	9	8	8	2	2	2	10	
											(004)	max	7.5	4	0.5	0.3	0.03	0.3	2600	
												95th	7.4	3.8	0.5	0.3	0.03	0.3	2060	
												75th	7.2	2.5	0.5	0.3	0.03	0.2	870	
												median	6.8	1.6	0.3	0.2	0.03	0.2	330	
												25th	6.7	0.5	0.1	0.1	0.03	0.1	45	
												min	6.7	0.5	0.1	0.1	0.03	0.1	8	
												sd	0.3	1	0.2	0.2	0.00	0.2	829	
												CV, %	5%	76%	64%	83%	0%	96%	128%	
												# non-detected		3	8	1	2	1	0	
												% non-detected		38%	100%	50%	100%	50%	0%	
											SDS3	count	46	19	28	30	30	30	49	
											(005)	max	7.8	8	3.7	0.53	0.08	0.5	1600	
												95th	7.7	3.5	0.55	0.42	0.04	0.4	740	
												75th	7.5	1.2	0.50	0.20	0.03	0.2	30	
												median	7.3	0.5	0.33	0.08	0.03	0.1	8	
												25th	7.2	0.5	0.13	0.08	0.03	0.1	1	
												min	6.9	0.5	0.13	0.07	0.03	0.0	1	
												sd	0.2	2	0.66	0.13	0.01	0.1	344	
												CV, %	3%	149%	151%	80%	39%	98%	289%	
												# non-detected		13	20	18	29	18	18	
												% non-detected		68%	71%	60%	97%	60%	37%	
											SDS4	count	21	19	19	2	2	2	21	
											(009)	max	7.8	4	0.76	0.11	0.06	0.1	1600	
												95th	7.8	3.1	0.53	0.11	0.06	0.1	1600	
												75th	7.5	2.3	0.50	0.10	0.05	0.1	440	
												median	7.4	0.5	0.26	0.09	0.04	0.1	80	
												25th	7.1	0.5	0.13	0.08	0.03	0.1	29	
												min	6.7	0.5	0.13	0.08	0.03	0.1	1	
												sd	0.3	1	0.2	0.0	0.02	0.0	484	
												CV, %	4%	86%	65%	27%	58%	0%	149%	
												# non-detected		11	17	1	1	2	1	
												% non-detected		58%	89%	50%	50%	100%	5%	

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
											SDS7	count	9	8	7	5	5	5	13	
											(010)	max	7.7	10	6.6	3.8	0.03	3.8	30000	
												95th	7.6	7.3	4.8	3.1	0.03	3.0	13020	
												75th	7.4	1.6	0.5	0.1	0.03	0.1	500	
												median	7.2	0.6	0.5	0.1	0.03	0.1	73	
												25th	6.8	0.5	0.2	0.1	0.03	0.1	2	
												min	6.1	0.5	0.1	0.1	0.03	0.1	1	
												sd	0.5	3	2.4	1.6	0.00	1.6	8254	
												CV, %	7%	157%	193%	192%	9%	197%	320%	
												# non-detected		5	5	1	5	1	3	
												% non-detected		63%	71%	20%	100%	20%	23%	
											SDS6	count	6	3	3	3	3	3	6	
											(014)	max	7.4	1	0.5	0.2	0.03	0.2	1600	
												95th	7.4	0.5	0.5	0.2	0.03	0.2	1600	
												75th	7.2	0.5	0.3	0.2	0.03	0.2	1255	
												median	7.0	0.5	0.1	0.2	0.03	0.1	125	
												25th	6.6	0.5	0.1	0.1	0.03	0.1	11	
												min	6.5	0.5	0.1	0.1	0.03	0.1	2	
												sd	0.4	0	0.2	0.1	0.00	0.1	797	
												CV, %	5%	0%	87%	42%	0%	52%	138%	
												# non-detected		3	3	1	3	1	0	
												% non-detected		100%	100%	33%	100%	33%	0%	
											SDS5	count	7	6	6	2	2	2	8	
											(015)	max	7.1	13	0.5	0.1	0.03	0.1	1600	
												95th	7.1	11.5	0.4	0.1	0.03	0.1	1600	
												75th	7.0	6.3	0.2	0.1	0.03	0.1	775	
												median	7.0	2.6	0.1	0.1	0.03	0.1	260	
												25th	6.8	0.7	0.1	0.1	0.03	0.1	62	
												min	6.5	0.5	0.1	0.1	0.03	0.1	2	
												sd	0.2	5	0.1	0.0	0.00	0.0	674	
												CV, %	3%	113%	69%	5%	0%	7%	125%	
												# non-detected		2	4	2	2	2	0	
												% non-detected		33%	67%	100%	100%	100%	0%	
											SDN1	count	13	12	13	0	0	0	13	
											(006)	max	7.8	21	7.5				4000	
							(former location downstream at SDN1-27, ends 1996)					95th	7.7	18.3	6.4				2200	
												75th	7.4	7.5	4.1				340	
												median	6.8	2.7	1.8				161	
												25th	6.2	2.0	0.5				42	
												min	5.2	0.6	0.3				6	
												sd	0.8	6	2.4				1083	
												CV, %	12%	113%	88%				211%	
												# non-detected		1	3				0	
												% non-detected		8%	23%				0%	
											SDN1up	count	55	19	31	35	35	35	54	
											(006)	max	8.1	21	7.5	5.0	0.79	5.0	4000	
							(upstream location at SDN1-22, begins 1997)					95th	7.7	16.5	5.4	3.9	0.21	3.9	1600	
												75th	7.2	3.1	2.1	2.0	0.03	2.0	315	
												median	6.6	1.8	1.1	1.0	0.03	1.0	54	
												25th	6.0	0.5	0.5	0.7	0.03	0.6	13	
												min	3.5	0.5	0.1	0.1	0.03	0.1	1	
												sd	1.0	6	1.9	1.2	0.15	1.2	698	
												CV, %	15%	149%	105%	80%	223%	84%	193%	
												# non-detected		8	6	0	30	0	6	
												% non-detected		42%	19%	0%	86%	0%	11%	

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All Grab Sample Data

outfall	POS ID	reported	stormdate	event	storm caharcteristics: depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	concentration, mg/l: ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
											SDN2	count	14	16	16	5	5	5	17	
											(007)	max	8.0	4	5.2	1.1	0.04	1.1	900	
									(pumped to IWS as of late 1997)			95th	7.7	4.1	2.0	0.9	0.03	0.9	580	
												75th	7.4	2.0	0.5	0.3	0.03	0.2	16	
												median	7.1	1.2	0.5	0.2	0.03	0.2	4	
												25th	6.9	0.5	0.4	0.1	0.03	0.1	2	
												min	6.5	0.5	0.1	0.1	0.03	0.1	1	
												sd	0.4	1	1.2	0.4	0.00	0.4	240	
												CV, %	6%	79%	158%	122%	17%	130%	262%	
												# non-detected		6	9	1	5	1	2	
												% non-detected		38%	56%	20%	100%	20%	12%	
											SDN3	count	22	19	20	5	5	5	24	
											(008)	max	7.8	3	0.50	0.20	0.07	0.1	2200	
												95th	7.7	2.9	0.50	0.19	0.06	0.1	1495	
												75th	7.4	1.8	0.50	0.13	0.03	0.1	143	
												median	7.2	0.6	0.13	0.08	0.03	0.1	14	
												25th	6.7	0.5	0.13	0.08	0.03	0.1	2	
												min	6.3	0.5	0.13	0.08	0.03	0.1	1	
												sd	0.4	1	0.19	0.05	0.02	0.0	564	
												CV, %	6%	76%	85%	49%	59%	48%	213%	
												# non-detected		10	19	3	4	3	6	
												% non-detected		53%	95%	60%	80%	60%	25%	
											SDN4	count	34	7	14	27	27	27	32	
											(011)	max	9.3	2	0.28	0.52	0.17	0.4	1600	
												95th	9.0	1.5	0.18	0.27	0.07	0.2	885	
												75th	7.8	0.9	0.13	0.08	0.03	0.1	30	
												median	7.5	0.5	0.13	0.08	0.03	0.1	8	
												25th	7.1	0.5	0.13	0.08	0.03	0.1	1	
												min	6.6	0.5	0.13	0.08	0.03	0.1	1	
												sd	0.7	0	0.0	0.1	0.03	0.1	392	
												CV, %	9%	60%	30%	84%	88%	92%	291%	
												# non-detected		5	13	21	25	23	10	
												% non-detected		71%	93%	78%	93%	85%	31%	
											EY	count	17	17	0	4	4	4	0	
											(012)	max	7.7	7		1.8	0.03	1.8		
												95th	7.3	4.6		1.7	0.03	1.7		
												75th	6.6	1.9		1.5	0.03	1.4		
												median	6.2	0.5		1.1	0.03	1.0		
												25th	5.8	0.5		0.6	0.03	0.6		
												min	5.1	0.5		0.2	0.03	0.2		
												sd	0.7	2		0.7	0.00	0.7		
												CV, %	11%	120%		67%	10%	68%		
												# non-detected		11		0	4	0		
												% non-detected		65%		0%	100%	0%		
											TY	count	19	19	3	8	8	8	0	
											(013)	max	7.9	19	1.3	5.8	0.09	5.8		
												95th	7.4	8.7	1.3	5.3	0.07	5.2		
												75th	6.9	3.9	1.3	3.3	0.03	3.3		
												median	6.5	1.9	1.2	2.0	0.03	1.9		
												25th	6.1	1.4	1.2	1.2	0.03	1.2		
												min	5.5	0.5	1.2	1.0	0.03	1.0		
												sd	0.6	4	0.1	1.7	0.02	1.7		
												CV, %	9%	122%	6%	68%	69%	70%		
												# non-detected		2	0	0	7	0		
												% non-detected		11%	0%	0%	88%	0%		

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All Grab Sample Data			storm caharcteristics										concentration, mg/l							
outfall	POS ID	reported	stormdate	event	depth, in.	dur, hr	maxint, in/hr	24hrant, in.	48hrant, in.	dryant, hr	Obj	ground deice?	ph	FOG	TPH (IR)	TPH-Dx	TPH-D	TPH-MO	Fecals (MPN)	comments
											Airfield	count	123	64	81	64	64	64	126	
											SDS3, SDS4, SDN3, SDN4	max	9.3	8.3	3.7	0.5	0.17	0.5	2200	
												95th	7.9	3.0	0.5	0.4	0.1	0.3	1600	
												75th	7.6	1.4	0.5	0.2	0.0	0.1	80	
												median	7.3	0.5	0.13	0.08	0.03	0.05	14	
												25th	7.1	0.5	0.13	0.08	0.03	0.05	1	
												min	6.3	0.5	0.13	0.07	0.03	0.05	0.5	
												sd	0.5	1.3	0.42	0.11	0.02	0.10	431	
												CV, %	6%	105%	131%	82%	69%	100%	233%	
												# non-detected		63	13	43	43	43	10	
												% non-detected		98%	16%	67%	67%	67%	8%	
																			0.81	

All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
SDE4	SDE4 111394	1995	11/11/94	0.28	14				46	NPDES		no	56	46	7	2.5	2.5	5	0.021	0.008	0.195	
SDE4	SDE4 111994	1995	11/19/94	0.42	24			0.05	52	NPDES		no			8	2.5	2.5	5				
SDE4	SDE4 010795	1995	1/7/95	0.21	62			0	252	NPDES		no	16	27	26				0.031	0.014	0.337	
SDE4	SDE4 030995	1995	3/8/95	2.16	114			0	88	other		no							0.013	0.004	0.132	
SDE4	SDE4 041095	1995	4/10/95	0.29	18			0	56	NPDES		no	16	19	8	2.5	2.5	5	0.029	0.011	0.263	
SDE4	SDE4 072695	1996	7/26/95	0.41	36			0		NPDES		no	41	30	29				0.121	0.023	0.779	Zn is outlier
SDE4	SDE4 081795	1996	8/16/95	1.34	12			0.01		NPDES		no				2.5	7.9	7.9				
SDE4	SDE4 102695	1996	10/25/95	0.28	8			0.01		NPDES		no	14	27	27				0.033	0.021	0.204	
SDE4	SDE4 020396	1996	2/3/96	1.6	8					NPDES		yes	210	190	74	14	12	26	0.054	0.104	0.279	
SDE4	SDE4 032296	1996	3/22/96	0.21				0		StipAg		no	44	19	12	2.5	2.5	5	0.057	0.026	0.361	
SDE4	SDE4 041696	1996	4/15/96	0.49	16			0.09		NPDES		no	53	11	6.54	2.5	2.5	5	0.078	0.098	0.320	
SDE4	SDE4 051796	1996	5/17/96	0.24	15			0		SES		no							0.027	0.011	0.110	has metals results only
SDE4	SDE4 052296	1996	5/21/96	0.31	30			0.02		SES		no	8.8		22				0.045	0.018	0.243	
SDE4	SDE4 090396	1997	9/3/96	0.29	1.2			0	76	NPDES		no	40	15	7.08	2.5	2.5	5	0.053	0.025	0.138	
SDE4	SDE4 122196	1997	12/19/96	0.36	37			0	103	NPDES		no	42	24	11.7	2.5	2.5	5	0.030	0.029	0.171	
SDE4	SDE4 011697	1997	1/16/97	1.21	23			0	154	NPDES		no	140	1.5	12.8	2.6	2.5	5	0.042	0.076	0.190	
SDE4	SDE4 012797	1997	1/27/97	0.41	26			0	109	StipAg		no	49	20	2	2.5	49.4	49.4	0.031	0.049	0.148	
SDE4	SDE4 030697	1997	3/5/97	0.39	20			0.24	42	NPDES		no	30	14	4.36	2.5	2.5	5	0.023	0.023	0.098	
SDE4	SDE4 060397	1997	6/3/97	0.26	16			0	76	NPDES	EMC	no	79	19	6.24	1	1	2	0.035	0.033	0.122	
SDE4	SDE4 102897	1998	10/28/97	0.47	10.6			0.08	26	NPDES	EMC	no	34	41	4.02	1	1	2	0.208	0.016	0.106	
SDE4	SDE4 121697	1998	12/15/97	1	33			0	87	NPDES	SMC	no	66	30	2	1	1	2	0.024	0.031	0.162	
SDE4	SDE4 030198	1998	3/1/98	0.98	86			0.07	6	NPDES	SMC	no	253	75	5.4	1	1	2	0.003	0.005	0.196	
SDE4	SDE4 030998	1998	3/8/98	0.86	27			0	132	NPDES	SMC	no				1	1	2				taken for aircraft deicing only, GRAB FAILED (No Liquid Detected)
SDE4	SDE4 042398	1998	4/23/98	0.46	20			0	264	NPDES	SMC	no	64	27	20.8	1	1	2	0.075	0.042	0.312	
SDE4	SDE4 051498	1998	5/14/98	0.21	8			0.01	125	NPDES	EMC	no	60	21	11.1	1	1	2	0.062	0.038	0.299	
SDE4	SDE4 062498	1998	6/24/98	0.43	4			0	288	NPDES	EMC	no	33	25	4.96				0.024	0.013	0.095	
SDE4	SDE4 092598	1999	9/24/98	0.47	23	0.26	0	0	148	NPDES	EMC	no	54	79	2	1	1	2	0.037	0.029	0.094	
SDE4	SDE4 100398	1999	10/3/98	0.4	3	0.22	0	0.07	36	NPDES	EMC	no	67	20	5.46	1	1	2	0.048	0.039	0.276	
SDE4	SDE4 102798	1999	10/27/98	0.64	9	0.19	0	0	72	NPDES	SMC	no	45	26	4.76	1	1	2	0.006	0.001	0.041	
SDE4	SDE4 111998	1999	11/19/98	2.34	66	0.18	0	0	73	NPDES	SMC	no	66	52	6.8	1	1	2	0.032	0.031	0.163	concurrent WET sample
SDE4	SDE4 122498	1999	12/24/98	1.19	39	0.16	0	0	153	NPDES	SMC	yes	250	145	335	13.4	30.9	44.3	0.005	0.006	0.151	
SDE4	SDE4 012299	1999	1/20/99	0.42	28	0.09	0.01	0.95	22	NPDES	EMC	no	92	52	5.82	1	1	2	0.022	0.013	0.168	concurrent WET sample
SDE4	SDE4 021899	1999	2/18/99	0.6	32	0.06	0.01	0.35	20	NPDES	SMC	no	131	54	4.26	1	1	2	0.003	0.001	0.003	
SDE4	SDE4 022399	1999	2/22/99	0.56	34	0.14	0.02	0.04	9	NPDES	EMC	no	53	44	2	1	1	2	0.015	0.022	0.108	concurrent WET sample
SDE4	SDE4 030699	1999	3/8/99	0.28	15	0.05	0	0	96	NPDES	EMC	no	49	31	9.72	1	4.76	5.76	0.016	0.018	0.118	
SDE4	SDE4 031399	1999	3/12/99	0.83	23	0.07	0	0	71	NPDES	EMC	no	52	57	5.16	1	1	2	0.018	0.023	0.113	
SDE4	SDE4 032499	1999	3/24/99	0.28	19	0.06	0	0.15	40	NPDES	EMC	no	41	32	5.88	1	1	2	0.020	0.017	0.134	concurrent WET sample
SDE4	SDE4 032899	1999	3/27/99	0.24	9	0.07	0	0.09	26	NPDES	EMC	no	9.5	7.9	2	1	1	2	0.012	0.001	0.106	
SDE 4	SDE4 070299	2000	7/2/99	0.3	6	0.11	0	0	103	NPDES	EMC	no	45	39	6.84				0.026	0.013	0.141	
SDE 4	SDE4 110699	2000	11/5/99	0.68	12	0.11	0	0.05	44	NPDES	SMC	no	22	16	2	1	1	2	0.013	0.008	0.082	
SDE 4	SDE4 111799	2000	11/16/99	0.6	15	0.07	0.01	0.08	23	NPDES	EMC	no	17	25	2	1	1	2	0.011	0.005	0.077	
SDE 4	SDE4 120599	2000	12/4/99	0.24	10	0.1	0	0	60	NPDES	EMC	no	18	9.4	7.54	1	1	2	0.014	0.013	0.084	
SDE 4	SDE4 011300	2000	1/12/99	0.37	48	0.04	0.07	0.31	10	NPDES	SMC	yes				4.5	7.47	12				runway deice
SDE 4	SDE4 031300	2000	3/13/00	0.47	9	0.13	0	0	49	NPDES	SMC	no	76	14	5.62	1	1	2	0.003	0.001	0.015	
SDE 4	SDE4 041300	2000	4/13/00	0.34	12	0.08	0	0	74	NPDES	SMC	no	59	2.2	8.88	1	1	2	0.018	0.001	0.139	
SDS1	SDS1 101994	1995	10/19/94	0.2	32				120	NPDES		no	2.5	11	12				0.084	0.006	0.234	
SDS1	SDS1 111994	1995	11/19/94	0.42	24			0.05	52	NPDES		no			46	14	2.5	14				
SDS1	SDS1 021695	1995	2/15/95	1.1	56			0	86	NPDES		yes	6.7	40	92	260	15	275	0.016	0.006	0.125	
SDS1	SDS1 051195	1995	5/11/95	0.2	8			0.12		NPDES		no	34	25	2				0.119	0.045	0.304	
SDS1	SDS1 060495	1995	6/4/95	0.7	28			0	384	NPDES		no	14	38	15				0.115	0.017	0.290	
SDS1	SDS1 080795	1996	8/6/95	0.4	8			0		NPDES		no	28	8.9	13				0.089	0.019	0.211	
SDS1	SDS1 101695	1996	10/15/95	0.35	12			0		NPDES		no	8.6	3.6	5				0.042	0.005	0.116	
SDS1	SDS1 011496	1996	1/13/96	0.37	20			0		NPDES		no	3.2	4	18	2.5	2.5	5	0.019	0.006	0.104	
SDS1	SDS1 041696	1996	4/15/96	0.49	16			0.09		NPDES		no	74	16	23.9	2.5	2.5	5	0.117	0.088	0.255	
SDS1	SDS1 042296	1996	4/22/96	2.83	8			0		StipAg		no	17	6.3	9.28	2.5	2.5	5	0.012	0.008	0.062	
SDS1	SDS1 052296	1996	5/21/96	0.31	30			0.02		SES		no	7.8		29				0.035	0.010	0.106	
SDS1	SDS1 070496	1997	7/3/96	0.23	12			0		NPDES		no	17	6	11.2	2.5	2.5	5	0.038	0.013	0.188	
SDS1	SDS1 080296	1997	8/2/96	1.01	27			0	325	StipAg		no	15	7.2	12.5				0.102	0.015	0.209	
SDS1	SDS1 120496	1997	12/4/96	0.82	7.5			0.16	44	NPDES		no	22	21	40.5	2.5	24	29	0.028	0.001	0.096	

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All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
SDS1	SDS1 011697	1997	1/16/97	1.21	23			0	154	NPDES		no	37	17	79	2.5	33.4	33.4	0.041	0.027	0.112	
SDS1	SDS1 041397	1997	4/13/97	0.31	12			0.04		NPDES		no	49	27	21.2	2.5	2.5	5	0.071	0.041	0.253	
SDS1	SDS1 061797	1997	6/16/97	0.36	28			0	135	NPDES	EMC	no	25	15	4.5	1	1	2	0.038	0.027	0.119	
SDS1	SDS1 102897	1998	10/28/97	0.47	10.8			0.08	26	NPDES	EMC	no	12	46	7.18	1	1	2	0.030	0.011	0.152	
SDS1	SDS1 112097	1998	11/19/97	0.65	39			0.12	24	NPDES	EMC	no			2	1	1	2	0.013	0.004	0.082	
SDS1	SDS1 121697	1998	12/15/97	1	33			0	87	NPDES	EMC	no	1.8	6.2	6.44	1	1	2	0.013	0.003	0.080	
SDS1	SDS1 030998	1998	3/8/98	0.86	27			0	132	NPDES	SMC	no	6	12		1	6.1	7.1	0.022	0.005	0.075	FULFILLS ANNUAL SAMPLE RQMT
SDS1	SDS1 102798	1999	10/27/98	0.64	9	0.19	0	0	72	NPDES	SMC	no	11	13	6.3	1	1	2	0.028	0.001	0.118	
SDS 1	SDS1 070299	2000	7/2/99	0.3	6	0.11	0	0	103	NPDES	EMC	no	13	13	7.68	1	1	2	0.366	0.009	0.206	
SDS2	SDS2 051095	1995	5/9/95	0.12	7.5			0	102	NPDES		no	15	15	11							
SDS2	SDS2 051195	1995	5/11/95	0.2	8			0.12		NPDES		no	7.8	6.1	4							
SDS2	SDS2 061095	1995	6/10/95	0.3	10			0	96	NPDES		no	18	8.2	8							
SDS2	SDS2 090595	1996	9/5/95							NPDES		no	52	28	5							
SDS2	SDS2 120496	1997	12/4/96	0.82	7.5			0.16	44	NPDES		no	37	29	2							
SDS2	SDS2 011797	1997	1/16/97	1.21	23			0	154	StipAg		no	16	19	2							
SDS2	SDS2 021197	1997	2/11/97	0.48	18			0	205	StipAg		no	32	39	3							LAST FOR STIP AG
SDS2	SDS2 111398	1999	11/11/98	0.86	62	0.15	0	0.05	31	NPDES	SMC	no	20	31	2				0.009	0.006	0.213	
SDS2	SDS2 050799	1999	5/6/99	0.25	22	0.06	0	0	79	NPDES	EMC	no	65	20					0.007	0.001	0.084	ANNUAL SAMPLE
SDS3	SDS3 090894	1995	9/8/94	0.69	22				93	NPDES		no				2.5	2.5	5				
SDS3	SDS3 091494	1995	9/13/94	0.15	9				118	NPDES		no	4.5	5.8	8				0.041	0.004	0.031	
SDS3	SDS3 101394	1995	10/13/94	0.32	14			0	480	NPDES		no	6.7	12	22				0.053	0.003	0.076	
SDS3	SDS3 111994	1995	11/19/94	0.42	24			0.05	52	NPDES		no	2.3	4.9	18	2.5	2.5	5	0.027	0.004	0.108	
SDS3	SDS3 010795	1995	1/7/95	0.21	62			0	252	NPDES		no	2	3.7	5				0.016	0.002	0.058	
SDS3	SDS3 030895	1995	3/8/95	2.18	114			0	88	other		no							0.005	0.001	0.029	
SDS3	SDS3 041295	1995	4/10/95	0.29	18			0	58	NPDES		no	1	1.9	4	2.5	2.5	5	0.041	0.002	0.044	
SDS3	SDS3 072695	1996	7/26/95	0.41	36			0		NPDES		no	20	15	8				0.067	0.005	0.069	
SDS3	SDS3 101695	1996	10/15/95	0.35	12			0		NPDES		no	2.2	3	5				0.032	0.002	0.037	
SDS3	SDS3 011496	1996	1/13/96	0.37	20			0		NPDES		no	1.6	2.1	8	2.5	2.5	5	0.029	0.002	0.054	
SDS3	SDS3 032296	1996	3/22/96	0.21				0		StipAg		no	4.1	2.9	8	2.5	2.5	5	0.028	0.002	0.054	
SDS3	SDS3 041696	1996	4/15/96	0.49	16			0.09		NPDES		no	20	6.6	6.36	2.5	2.5	5	0.046	0.012	0.074	
SDS3	SDS3 052296	1996	5/21/96	0.31	30			0.02		SES		no	2.6		14				0.035	0.001	0.036	
SDS3	SDS3 060296	1997	6/2/96	1.01	27			0	325	NPDES		no	19	13	9.8				0.115	0.009	0.097	
SDS3	SDS3 090396	1997	9/3/96	0.29	1.2			0	76	NPDES		no	33	16	11.4				0.060	0.016	0.062	
SDS3	SDS3 102196	1997	10/21/96	0.68	4.1			0	64	NPDES		no	4.8	4.2	2	2.5	2.5	5	0.025	0.003	0.022	
SDS3	SDS3 112396	1997	11/23/96	0.63	34.1			0	72	StipAg		yes	16	9.2	34.2	18	10	28	0.039	0.014	0.061	Cu data entry error corrected
SDS3	SDS3 011697	1997	1/16/97	1.21	23			0	154	NPDES		no	5.6	0.7	9.78	2.5	2.5	5	0.029	0.002	0.042	
SDS3	SDS3 030597	1997	3/5/97	0.39	20			0.24	42	NPDES		no	3.4	2.5	2	2.5	2.5	5	0.018	0.002	0.037	
SDS3	SDS3 060397	1997	6/3/97	0.26	16			0	76	NPDES	EMC	no	10	6	2.5				0.054	0.004	0.039	
SDS3	SDS3 102897	1998	10/28/97	0.47	10.8			0.08	26	NPDES	EMC	no	3.6	5.3	15.9				0.028	0.003	0.037	
SDS3	SDS3 013098	1998	1/29/98	0.2	14			0	107	NPDES	EMC	no	3.6	5.4	13.5	5.4	4.2	9.6	0.028	0.002	0.055	
SDS3	SDS3 030198	1998	3/1/98	0.96	86			0.07	6	NPDES	SMC	no	21	13	6.2	1	1	2	0.034	0.007	0.045	
SDS3	SDS3 030998	1998	3/8/98	0.86	27			0	132	NPDES	SMC	no	3.2	5.2	38.3	23	8.7	31.7	0.037	0.002	0.034	backup monhtly sample in case 3/1/98 sample didn't qualify under new permit
SDS3	SDS3 042398	1998	4/23/98	0.46	20			0	264	NPDES	SMC	no	7.3	4	9.4	1	1	2	0.081	0.001	0.064	
SDS3	SDS3 051498	1998	5/14/98	0.21	8			0.01	125	NPDES	EMC	no	14	9.5	6.32	1	1	2	0.076	0.003	0.116	
SDS3	SDS3 061098	1998	6/10/98	0.28	10			0	288	NPDES	EMC	no	6	42	8.3				0.068	0.002	0.060	
SDS3	SDS3 081798	1999	8/16/98	0.31	10	0.25	0	0	792	NPDES	EMC	no	51	19	10.4				0.136	0.006	0.056	thunderstorm, 0.25 in/hr
SDS3	SDS3 092598	1999	9/24/98	0.47	23	0.26	0	0	148	NPDES	EMC	no	224	166	5.14	1	2.2	3.2	0.069	0.012	0.043	GLYCOLS MAY BE HIGH BIASED, DUPE WAS <MDL
SDS3	SDS3 100398	1999	10/3/98	0.4	3	0.22	0	0.07	36	NPDES	EMC	no	43	23	4.2	1	1	2	0.055	0.008	0.194	
SDS3	SDS3 102798	1999	10/27/98	0.64	9	0.19	0	0	72	NPDES	SMC	no	95	64	4.74	1	4.2	5.2	0.004	0.001	0.003	
SDS3	SDS3 110498	1999	11/3/98	1.62	39	0.48	0	0.08	35	NPDES	SMC	no	310	85	6.76	4.7	1	5.7	0.083	0.043	0.149	
SDS3	SDS3 111398	1999	11/11/98	0.98	62	0.15	0	0.05	31	NPDES	SMC	no	24	29	17.6	10.5	1	11.5	0.022	0.004	0.189	concurrent WET sample
SDS3	SDS3 122598	1999	12/24/98	1.19	39	0.16	0	0	153	NPDES	SMC	yes	18	15	450	31.5	81.6	113	0.047	0.002	0.134	
SDS3	SDS3 011099	1999	1/9/99	0.27	21	0.05	0	0	54	NPDES	EMC	no	3.7	6.2	21.9	8.4	14	22.4	0.019	0.001	0.030	
SDS3	SDS3 011499	1999	1/13/99	1.07	22	0.16	0	0	85	NPDES	EMC	no	22	16	7.84	1	10	11	0.023	0.004	0.030	concurrent WET and WER
SDS3	SDS3 020399	1999	2/3/99	0.28	19	0.07	0	0.61	27	NPDES	SMC	no	9.2	11	6.06	1	2.06	3.06	0.016	0.001	0.027	
SDS3	SDS3 021499	1999	2/13/99	0.28	5	0.04	0	0	102	other	EMC	yes			80				0.049	0.001	0.074	for DO study
SDS3	SDS3 030999	1999	3/8/99	0.28	15	0.05	0	0	98	NPDES	EMC	no	9.2	14	220	6.52	151	157.5	0.024	0.002	0.053	

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All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
SDS3	SDS3 031399	1999	3/12/99	0.83	23	0.07	0	0	71	NPDES	SMC	no	7.6	15	15	1	6.21	7.21	0.022	0.001	0.036	
SDS3	SDS3 032599	1999	3/24/99	0.28	19	0.06	0	0.15	40	NPDES	EMC	no	8.7	3.5	2	1	1	2	0.019	0.001	0.027	
SDS 3	SDS3 070299	2000	7/2/99	0.3	6	0.11	0	0	103	NPDES	EMC	no	11	14	4.7				0.025	0.001	0.028	
SDS 3	SDS3 110699	2000	11/5/99	0.68	12	0.11	0	0.05	44	NPDES	SMC	no	21	26	15.2	1	1	2	0.025	0.001	0.031	
SDS 3	SDS3 111699	2000	11/16/99	0.6	15	0.07	0.01	0.08	23	NPDES	SMC	no	10	15	12.3	1	6.09	7.1	0.023	0.001	0.023	
SDS 3	SDS3 120599	2000	12/4/99	0.24	10	0.1	0	0	60	NPDES	EMC	no	6.4	6.3	48.4	3	18	21	0.013	0.001	0.031	
SDS 3	SDS3 120999	2000	12/8/99	0.49	27	0.09	0	0.36	40	NPDES	EMC	no	5	9	25.8	1	22.8	23.8	0.012	0.001	0.023	
SDS 3	SDS3 011300	2000	1/12/00	0.37	48	0.04	0.07	0.31	10	NPDES	SMC	yes			646	9.47	355	364				runway deice
SDS 3	SDS3 031300	2000	3/13/00	0.47	9	0.13	0	0	49	NPDES	SMC	no	11	5.5	15.5	1	9.05	10.05	0.009	0.001	0.006	
SDS 3	SDS3 041400	2000	4/13/00	0.34	12	0.06	0	0	74	NPDES	SMC	no	15	7.2	18.1	1	1	2	0.024	0.001	0.029	
SDS4	SDS4 091494	1995	9/13/94	0.15	9				118	NPDES		no	2.8	1.3	8				0.020	0.004	0.009	
SDS4	SDS4 101394	1995	10/13/94	0.32	14			0	480	NPDES		no	5.7	5.6	16				0.036	0.001	0.047	
SDS4	SDS4 111994	1995	11/19/94	0.42	24			0.05	52	NPDES		no			5	2.5	2.5	5				
SDS4	SDS4 011295	1995	1/11/95	0.3	60			0.04	24	NPDES		no	3.5	6.4	3				0.017	0.003	0.019	
SDS4	SDS4 021695	1995	2/15/95	1.1	56			0	86	NPDES		yes			96	2.5	2.5	5				
SDS4	SDS4 051295	1995	5/11/95	0.2	8			0.12		NPDES		no	7.7	5.3	4				0.006	0.001	0.010	
SDS4	SDS4 080795	1996	8/6/95	0.4	8			0		NPDES		no	4.2	3.7	9				0.020	0.002	0.016	
SDS4	SDS4 101695	1996	10/15/95	0.35	12			0		NPDES		no	6.6	4.2	5				0.023	0.001	0.022	
SDS4	SDS4 011496	1996	1/13/96	0.37	20			0		NPDES		no	20	6	6	2.5	2.5	5	0.018	0.001	0.019	
SDS4	SDS4 041696	1996	4/15/96	0.49	16			0.09		NPDES		no	26	14	4.64	2.5	2.5	5	0.041	0.005	0.031	
SDS4	SDS4 042296	1996	4/22/96	2.83	8			0		StipAg		no	19	8.9	6.44	2.5	2.5	5	0.033	0.001	0.017	
SDS4	SDS4 052296	1996	5/21/96	0.31	30			0.02		SES		no	4.8		18				0.036	0.001	0.018	
SDS4	SDS4 070496	1997	7/3/96	0.23	12			0		NPDES		no	20	11	6	2.5	2.5	5	0.024	0.001	0.020	
SDS4	SDS4 100496	1997	10/4/96	0.59	8.1			0.06	18	NPDES		no	4340[a]	2650[a]	6.04				~~0.18[a]~~	~~0.0460[a]~~	~~0.220[a]~~	results not typical due to POS construction (34R safety fill), BMP implemented.
SDS4	SDS4 120496	1997	12/4/96	0.82	7.5			0.16	44	NPDES		no	11	6.5	2	2.5	2.5	5	0.023	0.002	0.032	
SDS4	SDS4 011797	1997	1/16/97	1.21	23			0	154	NPDES		no	17	2.2	3.92				0.031	0.002	0.024	
SDS4	SDS4 012797	1997	1/27/97	0.41	26			0	109	StipAg		no	12	9.1	4.3				0.017	0.001	0.020	
SDS4	SDS4 041997	1997	4/19/97	1.16	26			0	64	NPDES		no	42	12	4.44	2.5	2.5	5	0.039	0.003	0.038	
SDS4	SDS4 082497	1998	8/25/97	0.2	10.5			0.07	96	NPDES	EMC	no	104	95	5.38				0.032	0.004	0.044	
SDS4	SDS4 111797	1998	11/16/97	0.47	12.6			0	222	NPDES	SMC	no	31	34	4.54				0.019	0.002	0.039	
SDS4	SDS4 030998	1998	3/8/98	0.86	27			0	132	NPDES	SMC	no	3.8	5.7	2	1	1	2	0.016	0.001	0.012	makeup comp for 96Qw non-rep comp, has extra grab
SDS4	SDS4 111998	1999	11/19/98	2.34	66	0.18	0	0	73	NPDES	SMC	no	2.1	2.9	2	1	1	2	0.029	0.001	0.015	
SDS4	SDS4 021399	1999	2/13/99	0.26	5	0.04	0	0	102	other	EMC	yes			10.5				0.006	0.001	0.036	for DO study
SDS4	SDS4 050799	1999	5/6/99	0.25	22	0.06	0	0	79	NPDES	EMC	no	36	12					0.023	0.001	0.008	ANNUAL SAMPLE
SDS7	SDW3 051095	1995	5/9/95	0.12	7.5			0	102	NPDES		no	88	310	15							
SDS7	SDW3 051195	1995	5/11/95	0.2	8			0.12		NPDES		no	20	25	4							
SDS7	SDW3 061095	1995	6/10/95	0.3	10			0	96	NPDES		no	6.7	2.3	5							
SDS7	SDW3 081795	1996	8/16/95	1.34	12			0.01		NPDES		no	56	20	6							
SDS7	SDW3 120496	1997	12/4/96	0.82	7.5			0.16	44	NPDES		no	7.2	2.6	2							grab missed
SDS7	SDW3 011697	1997	1/16/97	1.21	23			0	154	StipAg		no	7.1	1	4.18							
SDS7	SDW3 012797	1997	1/27/97	0.41	26			0	109	StipAg		no	3.2	3.2	6.7							no grab sample taken
SDS7	SDW3 021197	1997	2/11/97	0.48	18			0	205	StipAg		no	2.2	1.9	2							
SDS7	SDW3 021999	1999	2/18/99	0.6	32	0.06	0.01	0.35	20	NPDES	EMC	no	8.6	13					0.001	0.001	0.003	1998 annual sample
SDS7	SDW3 032599	1999	3/24/99	0.28	19	0.06	0	0.15	40	NPDES	EMC	no	12	7.3					0.006	0.001	0.010	1999 annual sample
SDS 6	B 120496	1997	12/4/96	0.82	7.5			0.16	44	NPDES		no	91	110	2				0.028	0.006	0.041	
SDS6	B 011797	1997	1/16/97	1.21	23			0	154	NPDES		no	37	40	5.66				0.018	0.002	0.034	no grab sample for this event, equipment malfunction
SDS6	B 012897	1997	1/27/97	0.41	26			0	109	NPDES		no	23	35	3.28				0.015	0.002	0.028	
SDS6	B 030697	1997	3/5/97	0.39	20			0.24	42	NPDES		no	13	23	2				0.007	0.001	0.017	had QC dups. no grab sample (no liquid detected). pairs with 4/19/97 grab
SDS6	B 111398	1999	11/11/98	0.98	62	0.15	0	0.05	31	NPDES	EMC	no	29	126	2				0.013	0.007	0.124	
SDS6	B 050799	1999	5/6/99	0.25	22	0.06	0	0	79	NPDES	EMC	no	8.8	14					0.006	0.001	0.006	ANNUAL SAMPLE
SDS5	D 012897	1997	1/27/97	0.41	26			0	109	NPDES		no	38	35	11.3				0.016	0.004	0.023	makeup for 95Q4 (3 unsuccessful attempts)
SDS5	D 021297	1997	2/11/97	0.48	18			0	205	NPDES		no	38	49	3				0.008	0.001	0.003	
SDS5	D 030597	1997	3/5/97	0.39	20			0.24	42	NPDES		no	34	25	2				0.021	0.006	0.022	
SDS5	D 011499	1999	1/13/99	1.07	22	0.16	0	0	85	NPDES	SMC	no	51	40	2				0.014	0.003	0.129	
SDS5	D 050799	1999	5/6/99	0.25	22	0.06	0	0	79	NPDES	EMC	no	58	14					0.005	0.001	0.008	ANNUAL SAMPLE

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All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
SDN1	SDN1 091494	1995	9/13/94	0.15	9				118	NPDES		no	21.5	6.4	194				0.064	0.006	1.030	
SDN1	SDN1 101994	1995	10/19/94	0.2	32				120	NPDES		no	13	10	8				0.034	0.006	0.416	
SDN1	SDN1 111994	1995	11/19/94	0.42	24			0.05	52	NPDES		no			6	2.5	2.5	5				
SDN1	SDN1 011295	1995	1/11/95	0.3	60			0.04	24	NPDES		no	22	30	4				0.020	0.016	0.285	
SDN1	SDN1 021695	1995	2/15/95	1.1	56			0	86	NPDES		yes			31	6.1	2.5	6.1				
SDN1	SDN1 030595	1995	3/4/95	0.18	24			0	158	StlpAg		no	1	3.5	4	2.5	2.5	5				
SDN1	SDN1 030995	1995	3/8/95	2.16	114			0	88	StlpAg		no	14	17	6	2.5	2.5	5				
SDN1	SDN1 040595	1995	4/4/95	0.17	4			0	270	StlpAg		no	6	7.6	5	2.5	2.5	5				
SDN1	SDN1 040795	1995	4/6/95	0.61	28			0.04	60	NPDES		no	18	6.2	40	2.5	2.5	5	0.009	0.001	0.286	
SDN1	SDN1 080795	1996	8/6/95	0.4	8			0		NPDES		no	56	16	27				0.035	0.009	0.464	
SDN1	SDN1 110795	1996	11/6/95	3.89	48			0.09		NPDES		no	15	14	8				0.023	0.013	0.375	
SDN1	SDN1 020496	1996	2/3/96	1.6	8					NPDES		yes	130	150	15	2.5	2.5	5	0.019	0.021	0.288	
SDN1	SDN1 041696	1996	4/15/96	0.49	16			0.09		StlpAg		no	47	7.1	2	2.5	2.5	5				
SDN1	SDN1 042296	1996	4/22/96	2.83	8			0		NPDES		no	31	9.5	8.8	2.5	2.5	5	0.016	0.011	0.160	
SDN1	SDN1 051396	1996	5/13/96	0.99	20			0.07	12	StlpAg		no	14	15	4.22	2.5	2.5	5				
SDN1	SDN1 052296	1996	5/21/96	0.31	30			0.02		StlpAg		no	11	7.3	10.2	2.5	2.5	5	0.027	0.007	0.299	xtra NPDES/Stlp Ag
SDN1	SDN1 062396	1996	6/23/96	0.46	10			0		StlpAg		no	36	8.3	20	2.5	2.5	5	0.080	0.013	0.589	xtra NPDES/Stlp Ag
SDN1	SDN1 062396 A	1996	6/23/96	0.46	10			0		SES		no	22		16				0.081	0.010	0.506	
SDN1	SDN1 070496	1997	7/3/96	0.23	12			0		NPDES		no	51	18	10.7	2.5	2.5	5	0.046	0.019	0.355	
SDN1	SDN1 071796	1997	7/17/96	0.27	31			0		StlpAg		no	19	2.1	25.1	2.5	2.5	5				
SDN1	SDN1 080296	1997	8/2/96	1.01	27			0	325	StlpAg		no	35	20	14.2	2.5	2.5	5				
SDN1	SDN1 090396	1997	9/3/96	0.29	1.2			0	78	StlpAg		no	49.3	15	9.88	2.5	2.5	5				
SDN1	SDN1 091496	1997	9/13/96	0.72	48			0	144	StlpAg		no	50	22	10.3	2.5	2.5	5				
SDN1	SDN1 091996	1997	9/18/96	0.36	20			0.02	28	StlpAg		no	3.6	7	2	2.5	2.5	5				
SDN1	SDN1 011697	1997	1/16/97	1.21	23			0	154	NPDES		no	66	30	23.6				0.039	0.039	0.343	paired up/down sample
SDN1	SDN1 041397	1997	4/13/97	0.31	12			0.04		NPDES		no	34	19	17				0.042	0.013	0.433	downstream location at SDN1-27
SDN1up	SDN1up 100496	1997	10/4/96	0.59	8.1			0.08	18	NPDES		no	21	6.7	2				0.025	0.016	0.219	paired up/down sample
SDN1up	SDN1up 011697	1997	1/16/97	1.21	23			0	154	NPDES		no	62	29	9.94				0.030	0.040	0.391	paired up/down sample
SDN1up	SDN1 060397	1997	6/3/97	0.26	16			0	76	NPDES	EMC	no	77	30	17.9				0.038	0.027	0.211	
SDN1up	SDN1 102897	1998	10/28/97	0.47	10.8			0.08	26	NPDES	EMC	no	19	28	4				0.019	0.017	0.222	
SDN1up	SDN1 121597	1998	12/15/97	1	33			0	87	NPDES	SMC	no	22	21	4.68	1	1	2	0.017	0.013	0.191	
SDN1up	SDN1 030198	1998	3/1/98	0.98	86			0.07	6	NPDES	SMC	no	104	39	4.82				0.010	0.007	0.084	
SDN1up	SDN1 042398	1998	4/23/98	0.46	20			0	264	NPDES	SMC	no	26	12	12.8				0.062	0.005	0.401	
SDN1up	SDN1 051498	1998	5/14/98	0.21	8			0.01	125	NPDES	EMC	no	43	21	8.8				0.053	0.010	0.540	
SDN1up	SDN1 061098	1998	6/10/98	0.28	10			0	288	NPDES	EMC	no	34	71	9.84				0.056	0.009	0.360	
SDN1up	SDN1 081698	1999	8/16/98	0.31	10	0.25	0	0	792	NPDES	EMC	no	192	63	28.9				0.083	0.030	0.589	thunderstorm, 0.25 in/hr
SDN1up	SDN1 100398	1999	10/3/98	0.4	3	0.22	0	0.07	36	NPDES	EMC	no	67	21	4.22				0.018	0.017	0.247	
SDN1up	SDN1 102798	1999	10/27/98	0.64	9	0.19	0	0	72	NPDES	SMC	no	85	44	6.82				0.006	0.001	0.066	
SDN1up	SDN1 110498	1999	11/3/98	1.62	39	0.48	0	0.08	35	NPDES	SMC	no	32	17	2				0.014	0.011	0.127	
SDN1up	SDN1 111398	1999	11/11/98	0.98	62	0.15	0	0.05	31	NPDES	EMC	no	53	46	2				0.024	0.025	0.487	concurrent WET sample
SDN1up	SDN1 122598	1999	12/24/98	1.19	39	0.16	0	0	153	NPDES	SMC	yes	156	95	116	13.8	12.3	26.1	0.003	0.004	0.122	
SDN1up	SDN1 011499	1999	1/13/99	1.07	22	0.16	0	0	85	NPDES	EMC	no	78	31	2				0.024	0.048	0.182	concurrent WET sample
SDN1up	SDN1 020499	1999	2/3/99	0.28	19	0.07	0	0.61	27	NPDES	EMC	no	45	22	5.84				0.020	0.006	0.233	
SDN1up	SDN1 030899	1999	3/8/99	0.28	15	0.05	0	0	98	NPDES	EMC	no	40	24					0.015	0.009	0.170	
SDN1up	SDN1 032499	1999	3/24/99	0.28	19	0.08	0	0.15	40	NPDES	EMC	no	61	40	4.86				0.015	0.010	0.175	concurrent WET sample
SDN1up	SDN1 032899	1999	3/27/99	0.24	9	0.07	0	0.09	26	NPDES	EMC	no	9.7	6.4	2				0.012	0.001	0.218	
SDN1up	SDN1 070299	2000	7/2/99	0.3	6	0.11	0	0	103	NPDES	EMC	no	69	25	4.28				0.038	0.009	0.238	
SDN1up	SDN1 110699	2000	11/5/99	0.68	12	0.11	0	0.05	44	NPDES	SMC	no	26	20	4.14				0.011	0.009	0.12	
SDN1up	SDN1 111699	2000	11/16/99	0.6	15	0.07	0.01	0.08	23	NPDES	SMC	no	39	41	4.98	1	1	2	0.011	0.007	0.108	
SDN1up	SDN1 120599	2000	12/4/99	0.24	10	0.1	0	0	60	NPDES	EMC	no	16	8.4	16				0.01	0.005	0.151	
SDN1up	SDN1 121799	2000	12/17/99	0.34	11	0.08	0	1.15	26	NPDES	EMC	no	25	16	5.54				0.013	0.005	0.122	
SDN1up	SDN1 031300	2000	3/13/00	0.47	9	0.13	0	0	49	NPDES	SMC	no	13	3.1	5.66				0.034	0.001	0.613	
SDN1up	SDN1 032200	2000	3/22/00	0.43	8	0.14	0	0	86	NPDES	SMC	no	1.9	0.63	2				0.028	0.001	0.203	
SDN1up	SDN1 041300	2000	4/13/00	0.34	12	0.08	0	0	74	NPDES	EMC	no	46	15	6.54	1	1	2	0.035	0.001	0.41	
SDN2	SDN2 090894	1995	9/8/94	0.69	22				93	NPDES		no	3.2	4.1	11				0.028	0.007	0.022	
SDN2	SDN2 101394	1995	10/13/94	0.32	14			0	480	NPDES		no	6.5	8.1	86				0.059	0.005	0.067	
SDN2	SDN2 111394	1995	11/11/94	0.28	14				46	NPDES		no	2	5.4	7				0.013	0.004	0.030	
SDN2	SDN2 111994	1995	11/19/94	0.42	24			0.05	52	NPDES		no			10	2.5	2.5	5				
SDN2	SDN2 011295	1995	1/11/95	0.3	60			0.04	24	NPDES		no	7.5	14	4				0.035	0.022	0.076	
SDN2	SDN2 030595	1995	3/4/95	0.18	24			0	158	StlpAg		no	2.4	2.1	12	36	2.5	36				

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All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	Int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
SDN2	SDN2 030895	1995	3/8/95	2.16	114			0	88	other		no							0.012	0.003	0.026	
SDN2	SDN2 040795	1995	4/6/95	0.61	28			0.04	60	SlipAg		no	7.2	4.8	15	2.5	2.5	5				
SDN2	SDN2 041295	1995	4/10/95	0.29	18			0	56	NPDES		no	5.6	4.9	30	2.5	19	19	0.025	0.003	0.098	
SDN2	SDN2 080795	1996	8/6/95	0.4	8			0		NPDES		no	8.9	5.1	6				0.028	0.010	0.049	
SDN2	SDN2 101695	1996	10/15/95	0.35	12			0		NPDES		no	1.25	1.8	5				0.016	0.002	0.024	
SDN2	SDN2 021796	1996	2/17/96	1.29	12			0		NPDES		no	1	2	6	6.3	11	17.3	0.009	0.005	0.027	
SDN2	SDN2 041696	1996	4/15/96	0.49	16			0.09		SlipAg		no	15	11	2	2.5	2.5	5				
SDN2	SDN2 042296	1996	4/22/96	2.83	8			0		NPDES		no	5.3	2.5	6.64	2.5	2.5	5	0.013	0.003	0.017	
SDN2	SDN2 051396	1996	5/13/96	0.99	20			0.07	12	SlipAg		no	5.6	5.3	4.86	2.5	2.5	5				
SDN2	SDN2 052296	1996	5/21/96	0.31	30			0.02		SlipAg		no	10	2	5.08	2.5	2.5	5	0.014	0.002	0.076	xtra NPDES/Slip Ag
SDN2	SDN2 062396 A	1996	6/23/96	0.46	10			0		SES		no	48		24				0.076	0.022	0.138	
SDN2	SDN2 062396	1996	6/23/96	0.46	10			0		SlipAg		no	33	7.5	18.3	2.5	2.5	5	0.055	0.012	0.076	xtra NPDES/Slip Ag
SDN2	SDN2 090396	1997	9/3/96	0.29	1.2			0	76	NPDES		no	10	10	12.3				0.033	0.008	0.042	
SDN2	SDN2 102196	1997	10/21/96	0.68	4.1			0	64	NPDES		no	4.2	2.9	4.5	2.5	2.5	5	0.010	0.002	0.020	
SDN2	SDN2 011697	1997	1/16/97	1.21	23			0	154	NPDES		no	8.8	1.5	120	2.5	50.9	50.9	0.018	0.011	0.048	
SDN2	SDN2 041997	1997	4/19/97	1.16	26			0	64	NPDES		no	17	8.5	2	2.5	2.5	5	0.042	0.019	0.083	
SDN2	SDN2 062499	1999	6/24/99	1.12	24	0.35	0.03	0.06	10	NPDES	EMC	no	18									30 MIN PUMP STATION BYPASS
SDN3	SDN3 090894	1995	9/8/94	0.69	22				93	NPDES		no	2.1	5.1	5				0.032	0.002	0.063	
SDN3	SDN3 102694	1995	10/25/94	1.96	44				114	NPDES		no	9.2	8	4							
SDN3	SDN3 111994	1995	11/19/94	0.42	24			0.05	52	NPDES		no			4	2.5	2.5	5				
SDN3	SDN3 010795	1995	1/7/95	0.21	62			0	252	NPDES		no	0.62	1.6	2				0.003	0.001	0.052	
SDN3	SDN3 021695	1995	2/15/95	1.1	56			0	86	NPDES		yes			90	2.5	2.5	5				
SDN3	SDN3 030595	1995	3/4/95	0.18	24			0	158	SlipAg		no	1	2.3	3	2.5	2.5	5				
SDN3	SDN3 030995	1995	3/8/95	2.16	114			0	88	SlipAg		no	5	12	3	2.5	2.5	5				
SDN3	SDN3 040595	1995	4/4/95	0.17	4			0	270	SlipAg		no	1	1.8	3	2.5	2.5	5				
SDN3	SDN3 060495	1995	6/4/95	0.7	28			0	384	NPDES		no	15	25	8				0.011	0.001	0.126	
SDN3	SDN3 071095	1996	7/9/95	0.81	13			0		NPDES		no	21	24	7				0.036	0.004	0.180	
SDN3	SDN3 110795	1996	11/6/95	3.89	48			0.09		NPDES		no	15	16	3				0.010	0.001	0.068	
SDN3	SDN3 011496	1996	1/13/96	0.37	20			0		NPDES		no	3.8	4.7	5	2.5	2.5	5	0.010	0.002	0.047	
SDN3	SDN3 020496	1996	2/3/96	1.6	8					SlipAg		yes		9.7		2.5	2.5	5				storm after runway deice
SDN3	SDN3 040196	1996	3/31/96	0.64	0			0.01		SlipAg		no	11	18	5	2.5	2.5	5	0.015	0.002	0.101	xtra NPDES/Slip Ag
SDN3	SDN3 041696	1996	4/15/96	0.49	16			0.09		NPDES		no	27	22	2	2.5	2.5	5	0.018	0.003	0.121	
SDN3	SDN3 042296	1996	4/22/96	2.83	8			0		SlipAg		no	15	9.5	6.56	2.5	2.5	5	0.016	0.001	0.063	xtra NPDES/Slip Ag
SDN3	SDN3 051396	1996	5/13/96	0.99	20			0.07	12	SlipAg		no	16	18	2	2.5	2.5	5				
SDN3	SDN3 052296	1996	5/21/96	0.31	30			0.02		SlipAg		no	16	5.2	2	2.5	2.5	5				
SDN3	SDN3 062396 A	1996	6/23/96	0.46	10			0		SES		no	7.3		5				0.004	0.000	0.051	
SDN3	SDN3 080396	1997	8/2/96	1.01	27			0	325	NPDES		no	26	26	2				0.037	0.004	0.156	delayed hydrograph, very dry antecedent
SDN3	SDN3 120496	1997	12/4/96	0.82	7.5			0.16	44	NPDES		no	16	14	2	2.5	2.5	5	0.018	0.002	0.033	
SDN3	SDN3 122196	1997	12/19/96	0.36	37			0	103	NPDES		no	2.6	4.5	4	2.5	2.5	5	0.011	0.001	0.045	
SDN3	SDN3 011797	1997	1/16/97	1.21	23			0	154	NPDES		no	13	13	4.92				0.012	0.001	0.043	
SDN3	SDN3 030597	1997	3/5/97	0.39	20			0.24	42	NPDES		no	10	10	2	6.2	2.5	6.2	0.011	0.001	0.032	
SDN3	SDN3 062197	1997	6/21/97	0.27	11.8		0.01	0.02	24	NPDES	EMC	no	2.2	10	2				0.014	0.001	0.048	
SDN3	SDN3 111797	1998	11/16/97	0.47	12.6			0	222	NPDES	EMC	no	12	42	2				0.018	0.002	0.049	
SDN3	SDN3 121697	1998	12/15/97	1	33			0	87	NPDES	SMC	no	11	26	2	1	1	2	0.011	0.002	0.040	HAD QC DUPLICATE: GOOD DUPLICATION
SDN3	SDN3 122498	1999	12/24/98	1.19	39	0.16	0	0	153	NPDES	SMC	yes	12	9	222	1	14.2	15.2	0.017	0.001	0.069	
SDN3	SDN3 021399	1999	2/13/99	0.26	5	0.04	0	0	102	other	EMC	yes			17.6				0.020	0.010	0.060	for DO study
SDN3	SDN3 120999	2000	12/9/99	0.49	27	0.09	0	0.36	40	NPDES	EMC	no	2.8	4.9	0.006				0.006	0.001	0.02	
SDN4	SDN4 090396	1997	9/3/96	0.29	1.2			0	76	NPDES		no	8	3	14.1				0.139	0.001	0.047	
SDN4	SDN4 120496	1997	12/4/96	0.82	7.5			0.16	44	NPDES		no	7	4.5	8.46	2.5	2.5	5	0.034	0.002	0.023	
SDN4	SDN4 011697	1997	1/16/97	1.21	23			0	154	NPDES		no	11	1.7	12.1				0.036	0.001	0.025	
SDN4	SDN4 030597	1997	3/5/97	0.39	20			0.24	42	NPDES		no	3.8	2.5	2	2.5	2.5	5	0.031	0.001	0.019	
SDN4	SDN4 060397	1997	6/3/97	0.26	16			0	76	NPDES	EMC	no	2.2	2.6	3.12				0.052	0.001	0.020	
SDN4	SDN4 102897	1998	10/28/97	0.47	10.8			0.06	26	NPDES	EMC	no	2.8	6	7.38	1	1	2	0.039	0.002	0.024	
SDN4	SDN4 121697	1998	12/15/97	1	33			0	87	NPDES	SMC	no	2.6	3.9	4.68	1	1	2	0.026	0.001	0.022	
SDN4	SDN4 030198	1998	3/1/98	0.98	86			0.07	6	NPDES	SMC	no	17	18	2	1	1	2	0.031	0.001	0.029	
SDN4	SDN4 030998	1998	3/8/98	0.86	27			0	132	NPDES	SMC	no	3.2	6.1	4.06	1	1	2	0.049	0.001	0.018	backup monthly sample in case 3/1/98 sample didn't qualify under new permit
SDN4	SDN4 042498	1998	4/23/98	0.46	20			0	264	NPDES	EMC	no	2	3.5	5.44				0.091	0.001	0.029	
SDN4	SDN4 052598	1998	5/24/98	0.58	11			0	87	NPDES	EMC	no	3.7	5.5	5.2	1	1	2	0.030	0.001	0.027	
SDN4	SDN4 062498	1998	6/24/98	0.43	4			0	288	NPDES	EMC	no	4	4	4.54				0.047	0.001	0.018	

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All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
SDN4	SDN4 081698	1999	8/16/98	0.31	10	0.25	0	0	792	NPDES	EMC	no	94	98	8				0.067	0.003	0.022	thunderstorm, 0.25 in/hr
SDN4	SDN4 092598	1999	9/29/98	0.47	23	0.26	0	0	148	NPDES	EMC	no	76	43	6.74	1	2.2	3.2	0.043	0.001	0.016	GLYCOLS MAY BE HIGH BIASED, DUPE WAS <MDL
SDN4	SDN4 100398	1999	10/3/98	0.4	3	0.22	0	0.07	36	NPDES	EMC	no	27	23	2	1	1	2	0.061	0.001	0.045	
SDN4	SDN4 110498	1999	11/3/98	1.62	39	0.48	0	0.08	35	NPDES	SMC	no	18	5.6	2	1	1	2	0.047	0.001	0.070	
SDN4	SDN4 111398	1999	11/11/98	0.98	62	0.15	0	0.05	31	NPDES	EMC	no	22	15	2	1	1	2	0.025	0.001	0.127	concurrent WET sample
SDN4	SDN4 122598	1999	12/24/98	1.19	39	0.16	0	0	153	NPDES	SMC	yes	12	12	168	7	27.3	34.3	0.023	0.001	0.075	
SDN4	SDN4 011499	1999	1/13/99	1.07	22	0.16	0	0	86	NPDES	EMC	no	7	9.2	2	1	1	2	0.020	0.001	0.034	concurrent WET sample
SDN4	SDN4 020499	1999	2/3/99	0.28	19	0.07	0	0.61	27	NPDES	EMC	no	3.8	4.8	2	1	1	2	0.015	0.001	0.024	
SDN4	SDN4 021399	1999	2/13/99	0.26	5	0.04	0	0	102	other	EMC	yes			36				0.036	0.001	0.026	for DO study
SDN4	SDN4 031399	1999	3/12/99	0.83	23	0.07	0	0	71	NPDES	EMC	no	2.9	7	2	1	1	2	0.019	0.001	0.025	
SDN4	SDN4 032899	1999	3/27/99	0.24	9	0.07	0	0.09	26	NPDES	EMC	no	4.3	3.6	2	1	1	2	0.022	0.001	0.014	
SDN4	SDN4 071799	2000	7/16/99	0.7	34	0.11	0	0	300	NPDES	EMC	no	188	320	12.5				0.052	0.004	0.017	
SDN4	SDN4 110699	2000	11/5/99	0.68	12	0.11	0	0.05	44	NPDES	SMC	no	12	17	6.94	1	1	2	0.017	0.001	0.023	
SDN4	SDN4 111699	2000	11/16/99	0.6	15	0.07	0.01	0.08	23	NPDES	SMC	no	5.3	7.2	4.06	1	1	2	0.029	0.001	0.033	
SDN4	SDN4 120999	2000	12/8/99	0.49	27	0.09	0	0.36	40	NPDES	SMC	no	2.8	6.2	5.4	1	2.1	3.1	0.016	0.001	0.031	
SDN4	SDN4 121799	2000	12/17/99	0.34	11	0.08	0	1.15	26	NPDES	EMC	no	4.2	6.1	2	1	1	2	0.02	0.001	0.015	
SDN4	SDN4 013100	2000	1/31/00	1.76	29	0.15	0.07	0.07	9	NPDES	SMC	no	6.2	5.1	2	1	1	2	0.013	0.001	0.017	
SDN4	SDN4 031400	2000	3/13/00	0.47	9	0.13	0	0	49	NPDES	EMC	no	14	6	4.04	1	1	2	0.03	0.001	0.0025	
SDN4	SDN4 041300	2000	4/13/00	0.34	12	0.08	0	0	74	NPDES	SMC	no	4.7	4.5	5.82	1	1	2	0.044	0.001	0.016	
EY	EY 091494	1995	9/13/94	0.15	9				118	NPDES		no	24.9									
EY	EY 101394	1995	10/13/94	0.32	14			0	480	NPDES		no	25									
EY	EY 030995	1995	3/8/95	2.16	114			0	88	NPDES		no	3.2									
EY	EY 060495	1995	6/4/95	0.7	28			0	384	NPDES		no	25									
EY	EY 072695	1996	7/26/95	0.41	36			0		NPDES		no	56									
EY	EY 101695	1996	10/15/95	0.35	12			0		NPDES		no	12									
EY	EY 021796	1996	2/17/96	1.29	12			0		NPDES		no	24									
EY	EY 042296	1996	4/22/96	2.83	8			0		NPDES		no	39									
EY	EY 052296	1996	5/21/96	0.31	30			0.02		StipAg		no	28									
EY	EY 062396	1996	6/23/96	0.46	10			0		StipAg		no	262									
EY	EY 070496	1997	7/3/96	0.23	12			0		NPDES		no	16									
EY	EY 102196	1997	10/21/96	0.68	4.1			0	64	NPDES		no	12	4.3								
EY	EY 021297	1997	2/11/97	0.48	18			0	205	NPDES		no	6.6									
EY	EY 030597	1997	3/5/97	0.39	20			0.24	42	NPDES		no	17									
EY	EY 061797	1997	6/16/97	0.36	28			0	135	NPDES	EMC	no	72									
EY	EY 110697	1998	11/6/97	0.16	4.4			0.01	72	NPDES	EMC	no	10									
EY	EY 013098	1998	1/29/98	0.2	14			0	107	NPDES	EMC	no	12									
EY	EY 052598	1998	5/24/98	0.58	11			0	87	NPDES	EMC	no	26									
EY	EY 011499	1999	1/13/99	1.07	22	0.16	0	0	85	NPDES	EMC	no	76									
EY	EY 062499	1999	6/24/99	1.12	24	0.35	0.03	0.08	10	NPDES	SMC	no	128						0.0195	0.0263	0.179	metals data optional
EY	EY 013100	2000	1/31/00	1.76	29	0.15	0.07	0.07	9	NPDES	SMC	no	96	71								
TY	TY 090894	1995	9/8/94	0.69	22				93	NPDES		no	4									
TY	TY 101994	1995	10/19/94	0.2	32				120	NPDES		no	10									
TY	TY 030495	1995	3/4/95	0.18	24			0	158	NPDES		no	18			2.5	2.5	5				
TY	TY 060495	1995	6/4/95	0.7	28			0	384	NPDES		no	22									
TY	TY 081795	1996	8/16/95	1.34	12			0.01		NPDES		no	20									
TY	TY 090595	1996	9/5/95							NPDES		no										
TY	TY 101695-1	1996	10/15/95	0.35	12			0		NPDES		no	480									
TY	TY 032296	1996	3/22/96	0.21				0		NPDES		no		12								
TY	TY 041696	1996	4/15/96	0.49	16			0.09		NPDES		no	30									
TY	TY 042296	1996	4/22/96	2.83	8			0		NPDES		no	23									
TY	TY 070496	1997	7/3/96	0.23	12			0		NPDES		no	28									
TY	TY 071896	1997	7/17/96	0.27	31			0		StipAg		no	13									
TY	TY 080296	1997	8/2/96	1.01	27			0	325	StipAg		no	33									
TY	TY 100496	1997	10/4/96	0.59	8.1			0.06	18	NPDES		no	17	4								
TY	TY 021297	1997	2/11/97	0.48	18			0	205	NPDES		no	29									
TY	TY 030697	1997	3/5/97	0.39	20			0.24	42	NPDES		no	188									possible insert (RMF) failure indicated by elevated FOG and TSS
TY	TY 060397	1997	6/3/97	0.26	16			0	76	NPDES	SMC	no	73									
TY	TY 111797	1998	11/16/97	0.47	12.6			0	222	NPDES	SMC	no	26									

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All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
TY	TY 030998	1998	3/8/98	0.86	27			0	132	NPDES	SMC	no	15									MAKEUP COMPOSITE FOR 98QW, HAS EXTRA GRAB
TY	TY 061098	1998	6/10/98	0.28	10			0	288	NPDES	EMC	no	20									
TY	TY 020399	1999	2/3/99	0.28	19	0.07	0	0.61	27	NPDES	SMC	no	28									
TY	TY 07029	2000	7/2/99	0.3	6	0.11	0	0	103	NPDES	EMC	no	24									
TY	TY 020800	2000	2/7/00	1.18	25	0.12			31	NPDES	EMC	no	17									
TY	TY 031300	2000	3/13/00	0.47	9	0.13	0	0	49	NPDES	SMC	no	45									

not detected: value is 1/2 MDL
EG is ethylene glycol, PG is propylene glycol
> value indicated
lined-out values arenon-representative data trimmed from data analysis

purpose	type	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn
All outfalls	count	327	281	291	173	173	173	257	257	257
	max	480	320	646	260	355	364	0.366	0.104	1.030
	95th	102	71	77	12	23	34	0.085	0.038	0.393
	75th	39	25	12	2.5	2.5	5.0	0.039	0.011	0.160
	median	17	13	6.0	2.5	2.5	5.0	0.025	0.004	0.069
	25th	7.4	5.6	4.0	1.0	1.0	2.0	0.016	0.001	0.029
	min	0.6	0.6	0.0	1.0	1.0	2.0	0.001	0.000	0.003
	sd	50	36	56.1	20.1	30.3	37.5	0.034	0.015	0.139
	CV, %	151%	161%	300%	448%	406%	317%	101%	159%	116%
	# non-detected	5	0	56	152	139	133	1	78	5
	% non-detected	2%	0%	19%	88%	80%	77%	0.4%	30%	1.9%
		0.82	0.80					0.755	0.957	0.751
SDE4	count	39	38	40	37	37	37	41	41	41
(002)	max	253	190	335	14	49	49	0.208	0.104	0.779
	95th	214	89	31	8	16	30	0.078	0.076	0.337
	75th	68	43	11	2.5	2.5	5.0	0.042	0.029	0.204
	median	49	27	6.7	1.0	1.0	2.0	0.026	0.018	0.141
	25th	33.5	19.0	4.7	1.0	1.0	2.0	0.015	0.008	0.106
	min	8.8	1.5	2.0	1.0	1.0	2.0	0.003	0.001	0.003
	sd	58	36	52.8	2.9	9.3	10.7	0.036	0.023	0.130
	CV, %	91%	100%	288%	130%	219%	169%	104%	100%	73%
	# non-detected	0	0	7	34	31	31	0	5	0
	% non-detected	0%	0%	18%	92%	84%	84%	0%	12%	0%
SDS1	count	21	20	22	16	16	16	22	22	22
(003)	max	74	46	92	260	33	275	0.366	0.088	0.304
	95th	49	40	77	76	26	94	0.119	0.045	0.288
	75th	25	22	23	2.5	3.4	8.8	0.068	0.019	0.211
	median	14	13	12.3	2.5	2.5	5.0	0.038	0.010	0.122
	25th	7.8	7.0	6.6	1.0	1.0	2.0	0.023	0.005	0.105
	min	1.8	3.6	2.0	1.0	1.0	2.0	0.012	0.001	0.062
	sd	18	12	23.9	64.4	9.6	67.4	0.077	0.020	0.075
	CV, %	91%	74%	114%	345%	154%	273%	117%	120%	47%
	# non-detected	0	0	2	14	12	11	0	1	0
	% non-detected	0%	0%	9%	88%	75%	69%	0%	5%	0%
SDS2	count	9	9	8	0	0	0	2	2	2
(004)	max	65	39	11				0.009	0.006	0.213
	95th	60	36	10				0.009	0.005	0.206
	75th	37	29	6				0.008	0.005	0.176
	median	20	20	3.5				0.008	0.003	0.139
	25th	16.0	15.0	2.0				0.007	0.002	0.101
	min	7.8	6.1	2.0				0.007	0.001	0.064
	sd	19	11	3.3				0.001	0.003	0.105
	CV, %	65%	50%	71%				17%	99%	76%
	# non-detected	0	0	3				0	1	0
	% non-detected	0%	0%	38%				0%	50%	0%

AR 012806

All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
										SDS3	count		45	44	47	34	34	34	47	47	47	
										(005)	max		310	166	646	32	355	364	0.136	0.043	0.194	
											95th		86	61	178	20	106	129	0.086	0.014	0.145	
											75th		20	15	18	4.3	9.0	11.4	0.051	0.004	0.063	
											median		9	9	9.8	2.5	2.5	5.0	0.029	0.002	0.043	
											25th		4.1	5.1	6.2	1.0	1.3	3.7	0.023	0.001	0.031	
											min		1.0	0.7	2.0	1.0	1.0	2.0	0.004	0.001	0.003	
											sd		56	28	114.9	6.9	65.4	67.6	0.028	0.007	0.042	
											CV, %		224%	165%	282%	148%	302%	257%	71%	158%	74%	
											# non-detected		1	0	3	24	18	16	0	14	0	
											% non-detected		2%	0%	6%	71%	53%	47%	0%	30%	0%	
										SDS4	count		20	19	23	10	10	10	21	21	21	
										(009)	max		104	95	96	3	3	5	0.041	0.005	0.047	
											95th		45	40	18	3	3	5	0.039	0.004	0.044	
											75th		22	12	7	2.5	2.5	5.0	0.032	0.002	0.032	
											median		12	7	5.0	2.5	2.5	5.0	0.023	0.001	0.020	
											25th		4.7	4.8	4.2	2.5	2.5	5.0	0.018	0.001	0.016	
											min		2.1	1.3	2.0	1.0	1.0	2.0	0.006	0.001	0.008	
											sd		23	21	19.2	0.6	0.6	1.3	0.010	0.001	0.012	
											CV, %		123%	162%	190%	29%	29%	29%	39%	77%	50%	
											# non-detected		0	0	3	10	10	10	0	6	0	
											% non-detected		0%	0%	13%	100%	100%	100%	0%	29%	0%	
										SDS7	count		10	10	8	0	0	0	2	2	2	
										(010)	max		88	310	15				0.006	0.001	0.010	
											95th		74	182	12				0.005	0.001	0.010	
											75th		18	18	6				0.004	0.001	0.008	
											median		8	5	4.6				0.003	0.001	0.006	
											25th		6.1	2.4	3.5				0.002	0.001	0.004	
											min		2.2	1.0	2.0				0.001	0.001	0.003	
											sd		28	96	4.2				0.003	0.000	0.005	
											CV, %		135%	248%	74%				96%	0%	85%	
											# non-detected		0	0	2				1	2	0	
											% non-detected		0%	0%	25%				50%	100%	0%	
										SDS6	count		6	6	5	0	0	0	6	6	6	
										(014)	max		91	126	6				0.028	0.007	0.124	
											95th		78	122	5				0.025	0.006	0.103	
											75th		35	93	3				0.017	0.005	0.039	
											median		26	38	2.0				0.014	0.002	0.031	
											25th		15.5	26.0	2.0				0.008	0.001	0.020	
											min		8.8	14.0	2.0				0.006	0.001	0.006	
											sd		30	48	1.6				0.008	0.003	0.042	
											CV, %		89%	82%	53%				57%	92%	101%	
											# non-detected		0	0	3				0	1	0	
											% non-detected		0%	0%	60%				0%	17%	0%	
										SDS5	count		5	5	4	0	0	0	5	5	5	
										(015)	max		58	49	11				0.021	0.006	0.129	
											95th		57	47	10				0.020	0.006	0.108	
											75th		51	40	5				0.016	0.004	0.023	
											median		36	35	2.5				0.014	0.003	0.022	
											25th		38.0	25.0	2.0				0.008	0.001	0.008	
											min		34.0	14.0	2.0				0.005	0.001	0.003	
											sd		10	14	4.5				0.006	0.002	0.052	
											CV, %		23%	42%	99%				48%	81%	147%	
											# non-detected		0	0	2				0	1	0	
											% non-detected		0%	0%	50%				0%	20%	0%	

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All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
										SDN1	count		24	23	26	18	18	18	14	14	14	
										(006)	max		130	150	194	6	3	6	0.081	0.039	1.030	
										(former location downstream at SDN1-27, ends 1996)	95th		65	30	38	3	3	5	0.060	0.027	0.730	
											75th		48	19	19	2.5	2.5	5.0	0.045	0.015	0.456	
											median		22	14	10.3	2.5	2.5	5.0	0.035	0.012	0.365	
											25th		14.0	7.2	6.0	2.5	2.5	5.0	0.021	0.008	0.291	
											min		1.0	2.1	2.0	2.5	2.5	5.0	0.009	0.001	0.160	
											sd		28	30	36.8	0.8	0.0	0.3	0.023	0.009	0.206	
											CV, %		86%	154%	183%	31%	0%	5%	60%	66%	50%	
											# non-detected		1	0	2	17	18	17	0	1	0	
											% non-detected		4%	0%	8%	94%	100%	94%	0%	7%	0%	
										SDN1up	count		28	28	27	4	4	4	28	28	28	
										(006)	max		192	95	116	14	12	26	0.083	0.048	0.613	
										(upstream location at SDN1-22, begins 1997)	95th		138	68	26	12	11	22	0.060	0.036	0.572	
											75th		68	39	9	4.2	3.8	8.0	0.034	0.016	0.368	
											median		42	23	5.0	1.0	1.0	2.0	0.019	0.009	0.215	
											25th		24.3	15.8	4.1	1.0	1.0	2.0	0.013	0.005	0.145	
											min		1.9	0.6	2.0	1.0	1.0	2.0	0.003	0.001	0.066	
											sd		43	21	21.8	6.4	5.7	12.1	0.019	0.012	0.155	
											CV, %		82%	75%	197%	152%	148%	150%	72%	98%	60%	
											# non-detected		0	0	6	3	3	3	0	5	0	
											% non-detected		0%	0%	22%	75%	75%	75%	0%	18%	0%	
										SDN2	count		21	19	21	13	13	13	17	17	17	
										(007)	max		48	14	120	36	51	51	0.076	0.022	0.138	
										(pumped to IWS as of late 1997)	95th		33	11	86	18	32	42	0.062	0.022	0.106	
											75th		10	8	15	2.5	2.5	17.3	0.035	0.011	0.078	
											median		7	5	7.0	2.5	2.5	5.0	0.025	0.005	0.048	
											25th		4.2	2.3	5.0	2.5	2.5	5.0	0.013	0.003	0.026	
											min		1.0	1.5	2.0	2.5	2.5	5.0	0.009	0.002	0.017	
											sd		11	4	29.4	9.3	13.8	14.7	0.019	0.007	0.034	
											CV, %		108%	65%	158%	173%	169%	114%	68%	85%	62%	
											# non-detected		1	0	2	11	10	9	0	0	0	
											% non-detected		5%	0%	10%	85%	77%	69%	0%	0%	0%	
										SDN3	count		26	26	29	17	17	17	21	21	21	
										(008)	max		27	42	222	6	14	15	0.037	0.010	0.180	
											95th		25	26	61	3	5	8	0.036	0.004	0.156	
											75th		15	18	5	2.5	2.5	5.0	0.018	0.002	0.089	
											median		11	10	3.0	2.5	2.5	5.0	0.014	0.001	0.052	
											25th		3.1	5.1	2.0	2.5	2.5	5.0	0.011	0.001	0.045	
											min		0.6	1.6	0.0	1.0	1.0	2.0	0.003	0.000	0.020	
											sd		8	10	43.1	1.1	2.9	2.6	0.009	0.002	0.043	
											CV, %		71%	74%	298%	42%	93%	48%	59%	108%	60%	
											# non-detected		2	0	10	16	16	15	0	5	0	
											% non-detected		8%	0%	34%	94%	94%	88%	0%	24%	0%	
										SDN4	count		30	30	31	23	23	23	31	31	31	
										(011)	max		188	320	168	7	27	34	0.139	0.004	0.127	
											95th		86	73	25	3	3	5	0.079	0.003	0.073	
											75th		14	11	7	1.0	1.0	2.0	0.047	0.001	0.030	
											median		6	8	4.5	1.0	1.0	2.0	0.031	0.001	0.024	
											25th		3.7	4.1	2.0	1.0	1.0	2.0	0.022	0.001	0.018	
											min		2.0	1.7	2.0	1.0	1.0	2.0	0.013	0.001	0.003	
											sd		38	59	29.8	1.3	5.5	6.7	0.025	0.001	0.023	
											CV, %		200%	271%	265%	93%	230%	178%	65%	64%	78%	
											# non-detected		0	0	11	22	20	20	0	18	0	
											% non-detected		0%	0%	35%	96%	87%	87%	0%	58%	0%	

All Composite Sample Data			Storm Characteristics										concentration, mg/l									
outfall	POS ID	reported	date	depth, in.	dur, hr	int, in/hr	24hrant, in.	48hrant, in.	dryant, hr	purpose	type	ground deice?	TSS	Turb, NTU	BOD5	EG	PG	total glycols	Cu	Pb	Zn	comments
										EY	count		21	2	0	0	0	0	0	0	0	
										(012)	max		262	71.0								
											95th		128									
											75th		56									
											median		25									
											25th		12.0									
											min		3.2	4.3								
											sd		59									
											CV, %		128%									
											# non-detected		0	0								
											% non-detected		0%	0%								
										TY	count		43	4	0	1	1	1	0	0	0	
										(013)	max		480	12.0								
											95th		182	12								
											75th		30	10								
											median		24	8								
											25th		17	6								
											min		4	4								
											sd		102	6								
											CV, %		194%	71%								
											# non-detected		0	0								
											% non-detected		0%	0%								
										Airfield	count		121	119	130	84	84	84	120	120	120	
										(SDS3, SDS4, SDN3, SDN4)	max		310	320	646	32	355	364	0.139	0.043	0.194	
											95th		76	45	86	9	22	31	0.081	0.009	0.127	
											75th		18	15	10	3	3	5	0.039	0.003	0.055	
											median		9	7	5	3	3	5	0.026	0.001	0.034	
											25th		3.8	4.8	3.0	1.0	1.0	2.0	0.018	0.001	0.023	
											min		0.6	0.7	0.0	1.0	1.0	2.0	0.003	0.000	0.003	
											sd		40	35	75	5	42	44	0.024	0.005	0.038	
											CV, %		212%	162%	664%	332%	1786%	1172%	63%	406%	126%	
											# non-detected		3	0	27	72	68	67	0	59	0	
											% non-detected		2%	0%	21%	86%	81%	80%	0%	49%	0%	

AR 012809

APPENDIX C TABULAR DEICING EVENT SAMPLE DATA SUMMARIES

All Deicing Event Sample Data

order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
1	SDE4	SDE4 111394	11/11/94	1995	storm	0.28		46	NPDES		no				7	3	3	6	
2	SDE4	SDE4 111894	11/18/94	1995	baseflo	0			NPDES		no				28	3	3	6	
3	SDE4	SDE4 111994	11/19/94	1995	storm	0.42		52	NPDES		no				8	3	3	6	
4	SDE4	SDE4 041095	4/10/95	1995	storm	0.29		56	NPDES		no				8	3	3	6	
5	SDE4	SDE4 042895	4/28/95	1995	baseflo	0			NPDES		no					3	3	6	
6	SDE4	SDE4 050295	5/2/95	1995	nonstor	0.42		36	NPDES		no					10	3	10	
7	SDE4	SDE4 081795	8/16/95	1996	storm	1.34			NPDES		no					3	8	8	
8	SDE4	SDE4 012096 AVG	1/19/96	1996		1.8			SES	series avg	yes				72	13	11	24	20-hr avg of 6 discrete samples. 2 of 6 glycol <MDL
9	SDE4	SDE4 020496 AVG	2/3/96	1996		1.6			Washoff	series avg	yes				95	18	12	30	10-hr avg of 5 discrete samples. All>MDL
10	SDE4	SDE4 020396	2/3/96	1996	storm	1.6			NPDES	flow-wt comp	yes				74	14	12	26	
11	SDE4	SDE4 032296	3/22/96	1996	storm	0.21			StipAg	flow-wt comp	no				12	3	3	5	
12	SDE4	SDE4 041696	4/15/96	1996	storm	0.49			NPDES	flow-wt comp	no	3	5		7	3	3	6	
13	SDE4	SDE4 090396	9/3/96	1997	storm	0.29		76	NPDES	flow-wt comp	no	0	3	3	7	3	3	6	
14	SDE4	SDE4 112196 A99	11/20/96	1997					NPDES	series avg	yes	60	237	0		21	71	92	composite of bottles A1, A2, A3 for quarterly glycols
15	SDE4	SDE4 121596	12/15/96	1997	nonstor	0.11		72	NPDES	flow-wt comp	no	11	41	63	9	3	3	5	nonstorm: backup data in case short on data for 96 Q4
16	SDE4	SDE4 122196	12/19/96	1997	storm	0.36		103	NPDES	flow-wt comp	no	38	44	76	12	3	3	5	
17	SDE4	SDE4 123196 AVG	12/26/96	1997		1.12			SES	series avg	yes	222	256	256	33	3	4	6	30-hr avg of 5 time-compositesamples. most glycol and BOD<MDL
18	SDE4	SDE4 010797 AVG	12/26/96	1997		1.12			SES	series avg	yes	222	256	256	13	8	15	23	6-day avg of 15 time-composite samples. 12of 15 BOD<MDL, 11 of15 glycol <MDL
19	SDE4	SDE4 011697	1/16/97	1997	storm	1.21		154	NPDES	flow-wt comp	no	22	57	136	13	3	3	5	
20	SDE4	SDE4 012797	1/27/97	1997	storm	0.41		109	StipAg	flow-wt comp	no	21	59	145	2	3	49	49	
21	SDE4	SDE4 030697	3/5/97	1997	storm	0.39		42	NPDES	flow-wt comp	no	31	51	51	4	3	[illegible]	5	
22	SDE4	SDE4 060397	6/3/97	1997	storm	0.26		78	NPDES	flow-wt comp	no	1	2	2	6	1	[illegible]	2	
23	SDE4	SDE4 102897	10/28/97	1998	storm	0.47		26	NPDES	flow-wt comp	no	9	12	9	4	1	1	2	
24	SDE4	SDE4 121697	12/15/97	1998	storm	1		87	NPDES	flow-wt comp	no	15	23	30	2	1	1	2	
25	SDE4	SDE4 011398	1/12/98	1998	nonstor	1.13		123	NPDES	series avg	yes	181	266	457	213	6	5	11	24-HOUR TIME COMPOSITE
26	SDE4	SDE4 030198	3/1/98	1998	storm	0.98		6	NPDES	flow-wt comp	no	11	10	11	5	1	1	2	
27	SDE4	SDE4 030998	3/8/98	1998	storm	0.86		132	NPDES	flow-wt comp	no	15	42	154		1	1	2	taken for aircraft deicing only, no grab taken (No Liquid Detected)
28	SDE4	SDE4 042398	4/23/98	1998	storm	0.46		264	NPDES	flow-wt comp	no	6	8	29	21	1	1	2	
29	SDE4	SDE4 051498	5/14/98	1998	storm	0.21		125	NPDES	flow-wt comp	no	4	7	15	11	1	1	2	
30	SDE4	SDE4 091898	9/18/98	1999	nonstor	0.19	0.16	456	NPDES	flow-wt comp	no	3	4	5	14	1	1	2	nonstorm
31	SDE4	SDE4 092598	9/24/98	1999	storm	0.47	0.26	148	NPDES	flow-wt comp	no	0	0	3	2	1	1	2	
32	SDE4	SDE4 100398	10/3/98	1999	storm	0.4	0.22	36	NPDES	flow-wt comp	no	2	3	2	5	1	1	2	
33	SDE4	SDE4 102798	10/27/98	1999	storm	0.64	0.19	72	NPDES	flow-wt comp	no	5	8	12	5	1	1	2	
34	SDE4	SDE4 110498	11/3/98	1999	storm	1.62	0.48	35	NPDES	non-rep comp	no	8	11	8	2	1	1	2	not representative, incomplete sample, flow probe error
35	SDE4	SDE4 111998	11/19/98	1999	storm	2.34	0.18	73	NPDES	flow-wt comp	no	20	34	44	7	1	1	2	concurrent WET sample
36	SDE4	SDE4 121798	12/17/98	1999	nonstor	0.11	0.03	33	NPDES	flow-wt comp	no	20	33	20		1	1	2	non-storm, suitbale for glycols only
37	SDE4	SDE4 122498	12/24/98	1999	storm	1.19	0.16	153	NPDES	flow-wt comp	yes	125	160	373	335	13	31	44	
38	SDE4	SDE4 011099	1/9/99	1999	storm	0.27	0.05	54	NPDES	non-rep comp	no	14	25	25	2	1	3	4	not representative, taken too late
39	SDE4	SDE4 012299	1/20/99	1999	storm	0.42	0.09	22	NPDES	flow-wt comp	no	14	31	14	6	1	1	2	concurrent WET sample
40	SDE4	SDE4 021899	2/18/99	1999	storm	0.6	0.06	20	NPDES	flow-wt comp	no	16	26	16	4	1	1	2	
41	SDE4	SDE4 022399	2/22/99	1999	storm	0.56	0.14	9	NPDES	flow-wt comp	no	15	28	15	2	1	1	2	concurrent WET sample
42	SDE4	SDE4 030899	3/8/99	1999	storm	0.28	0.05	96	NPDES	flow-wt comp	no	13	66	147	10	1	6	6	
43	SDE4	SDE4 031399	3/12/99	1999	storm	0.83	0.07	71	NPDES	flow-wt comp	no	13	43	53	5	1	1	2	
44	SDE4	SDE4 032499	3/24/99	1999	storm	0.28	0.08	40	NPDES	flow-wt comp	no	6	11	11	6	1	1	2	
45	SDE4	SDE4 032699	3/27/99	1999	storm	0.24	0.07	26	NPDES	flow-wt comp	no	7	17	7	2	1	1	2	
46	SDE 4	SDE4 110699	11/5/99	2000	storm	0.68	0.11	44	NPDES	flow-wt comp	no			22	2	1	1	2	
47	SDE 4	SDE4 111799	11/16/99	2000	storm	0.6	0.07	23	NPDES	flow-wt comp	no			10	2	1	1	2	
48	SDE 4	SDE4 120699	12/4/99	2000	storm	0.24	0.1	60	NPDES	flow-wt comp	no			34	8	1	1	2	
49	SDE 4	SDE4 011300	1/12/00	2000	storm	0.37	0.04	10	NPDES	flow-wt comp	yes			261		4	7	12	runway deice
50	SDE 4	SDE4 031300	3/13/00	2000	storm	0.47	0.13	49	NPDES	flow-wt comp	no			44	6	1	1	2	
51	SDE 4	SDE4 041300	4/13/00	2000	storm	0.34	0.08	74	NPDES	flow-wt comp	no				9	1	1	2	
52	SDS1	SDS1 111894	11/18/94	1995	baseflo	0			NPDES		no				54	32	[illegible]	32	
53	SDS1	SDS1 111994	11/19/94	1995	storm	0.42		52	NPDES		no				46	14	[illegible]	14	
54	SDS1	SDS1 020695	2/6/95	1995	baseflo	0			NPDES		no					3	3	6	

AR 012812

All Deicing Event Sample Data

order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
55	SDS1	SDS1 021395	2/13/95	1995	baseflo	0			NPDES		yes				5	3	3	5	
56	SDS1	SDS1 021695	2/15/95	1995	storm	1.1		86	NPDES		yes				92	260	15	275	
57	SDS1	SDS1 042895	4/28/95	1995	baseflo	0			NPDES		no					3	3	5	
58	SDS1	SDS1 050295	5/2/95	1995	nonstor	0.42		36	NPDES		no					3	3	5	
59	SDS1	SDS1 092995	9/29/95	1996	baseflo	0			NPDES		no					3	3	5	
60	SDS1	SDS1 011496	1/13/96	1996	storm	0.37			NPDES	flow-wt comp	no				18	3	3	5	
61	SDS1	SDS1 012096 AVG	1/19/96	1996		1.8			SES	series avg	yes				130	105	193	298	20-hr avg of 6 discrete samples. 5 TKN <MDL
62	SDS1	SDS1 020496 AVG	2/3/96	1996	storm	1.6			Washoff	series avg	yes				131	23	96	118	14-hr avg of 6 discrete samples. 1 glycol <MDL
63	SDS1	SDS1 041696	4/15/96	1996	storm	0.49			NPDES	flow-wt comp	no	3	5		24	3	3	5	
64	SDS1	SDS1 042296	4/22/96	1996	storm	2.83			StipAg	flow-wt comp	no	12	14		9	3	3	5	
65	SDS1	SDS1 070496	7/3/96	1997	storm	0.23			NPDES	flow-wt comp	no	1	1		11	3	3	5	
66	SDS1	SDS1 110496	11/3/96	1997	nonstor	0.14		120	NPDES	flow-wt comp	no	5	10	24	6	3	3	5	taken for aircraft deicing only
67	SDS1	SDS1 112096 A1	11/20/96	1997					SES	time-comp	yes	60	237	0	428	59	2800	2859	
68	SDS1	SDS1 112396	11/23/96	1997	storm	0.63		72	NPDES	non-rep comp	yes	60	82	112	258	8	190	198	not representative (<2 hrs). reference only. grab sample lost: bottle broken in transit
69	SDS1	SDS1 120496	12/4/96	1997	storm	0.82		44	NPDES	flow-wt comp	no	23	92	92	41	3	24	29	
70	SDS1	SDS1 011697	1/16/97	1997	storm	1.21		154	NPDES	flow-wt comp	no	22	57	136	79	3	33	33	
71	SDS1	SDS1 041397	4/13/97	1997	storm	0.31			NPDES	flow-wt comp	no	8	9	8	21	3	3	5	
72	SDS1	SDS1 061797	6/16/97	1997	storm	0.36		135	NPDES	flow-wt comp	no	1	1	3	6	1	1	2	
73	SDS1	SDS1 102897	10/28/97	1998	storm	0.47		26	NPDES	flow-wt comp	no	9	12	9	7	1	1	2	
74	SDS1	SDS1 112097	11/19/97	1998	storm	0.65		24	NPDES	flow-wt comp	no	18	26	18	2	1	1	2	
75	SDS1	SDS1 121697	12/15/97	1998	storm	1		87	NPDES	flow-wt comp	no	15	23	30	6	1	1	2	
76	SDS1	SDS1 011198	1/12/98	1998	nonstor	1.13		123	NPDES	time-comp	yes	181	266	457	6	1	1	2	24-hour time composite
77	SDS1	SDS1 030998	3/8/98	1998	storm	0.86		132	NPDES	flow-wt comp	no	15	42	154		1	6	7	FULFILLS ANNUAL SAMPLE RQMT
78	SDS1	SDS1 102798	10/27/98	1999	storm	0.64	0.19	72	NPDES	flow-wt comp	no	5	8	12	6	1	1	2	
79	SDS1	SDS1 121798	12/17/98	1999	nonstor	0.11	0.03	33	NPDES	grab	no	20	33	20		1	1	2	nonstorm
80	SDS1	SDS1 031299 GRAB	3/12/99	1999	storm	0.83	0.07	71	NPDES	grab	no	13	43	53	123	5	43	49	quarterly deice grab sample in first 60 minutes
81	SDS1	SDS1 062099 GRAB	6/20/99	1999	storm	0.21	0.03	48	NPDES	grab	no					1	1	2	FOAM OBSERVED BELOW OUTFALL
82	SDS1	SDS1 062099 GRAB	6/20/99	1999	storm	0.21	0.03	48	NPDES	grab	no					1	1	2	FOAM OBSERVED BELOW OUTFALL
83	SDS 1	SDS1 070299	7/2/99	2000	storm	0.3	0.11	103	NPDES	flow-wt comp	no				8	1	1	2	
84	SDS 1	SDS1 070299 GRAB 1	7/2/99	2000	storm	0.3	0.11	103	NPDES	first flush grab	no				13	1	1	2	
85	SDS 1	SDS1 070299 GRAB 2	7/2/99	2000	storm	0.3	0.11	103	Source Trace	first flush grab	no				10	1	1	2	
86	SDS 1	SDS1 112799 GRAB	11/27/99	2000	storm	0.32	0.07	22	NPDES	first flush grab	no			31		1	1	2	
87	SDS 1	SDS1 010700 grab	1/7/00	2000	storm	0.36	0.12	23	NPDES	first flush grab	no			60		1	1	2	
88	SDS 1	SDS1 011200 grab	1/12/00	2000	storm	0.37	0.04	10	NPDES	first flush grab	yes			261		2	799	801	runway deice
89	SDS 1	SDS1 042100 grab	4/21/00	2000	Other Storm	0.1	0.04		NPDES	first flush grab	no					3	[illegible]	2	
90	SDS3	SDS3 090894	9/8/94	1995	storm	0.69		93	NPDES		no					3	3	5	
91	SDS3	SDS3 111894	11/18/94	1995	baseflo	0			NPDES		no				2	3	3	5	
92	SDS3	SDS3 111994	11/19/94	1995	storm	0.42		52	NPDES	flow-wt comp	no				18	3	3	5	glycols and BOD on labjob "J 014"
93	SDS3	SDS3 020895	2/8/95	1995	baseflo	0			NPDES		no					3	3	5	
94	SDS3	SDS3 041295	4/10/95	1995	storm	0.29		56	NPDES		no				4	3	3	5	
95	SDS3	SDS3 042895	4/28/95	1995	baseflo	0			NPDES		no					3	3	5	
96	SDS3	SDS3 050295	5/2/95	1995	nonstor	0.42		36	NPDES		no					3	3	5	
97	SDS3	SDS3 093095	9/29/95	1996	baseflo	0			NPDES		no					3	3	5	
98	SDS3	SDS3 093095 GRAB	9/29/95	1996	baseflo	0			NPDES	random grab	no					3	3	5	
99	SDS3	SDS3 011496	1/13/96	1996	storm	0.37			NPDES	flow-wt comp	no				8	3	3	5	
100	SDS3	SDS3 012296 AVG	1/19/96	1996	nonstorm	1.8			SES	series avg	yes				118	25	14	40	3.5-day avg of 8 discrete + 8 time-comp samples. 7 glycol, 4 TKN, 2 NH3 <MDL
101	SDS3	SDS3 020696 AVG	2/3/96	1996	nonstorm	1.6			SES	series avg	yes				162	16	13	29	2-day avg of 8 time-comp samples. 5BOD>result, 2 glycol, 1 NH3 <MDL
102	SDS3	SDS3 032296	3/22/96	1996	storm	0.21			StipAg	flow-wt comp	no				8	3	3	5	
103	SDS3	SDS3 041696	4/15/96	1996	storm	0.49			NPDES	flow-wt comp	no	3	5		6	3	3	5	
104	SDS3	SDS3 102196	10/21/96	1997	storm	0.68		64	NPDES	flow-wt comp	no	7	8	18	2	3	3	5	

AR 012813

All Deicing Event Sample Data

order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
105	SDS3	SDS3 112896 AVG	11/20/96	1997					SES	series avg	yes	60	237		75	14	15	28	9-day avg of 32 time-comp samples. 11 glycol, 28 NH3 <MDL
106	SDS3	SDS3 112396	11/23/96	1997	storm	0.63		72	StipAg	flow-wt comp	yes	60	82	112	34	18	10	28	
107	SDS3	SDS3 010297 AVG	12/26/96	1997		1.12			SES	series avg	yes	222	256	256	252	19	44	62	7-day avg of 29 time-comp samples. 12 glycol, 8 BOD, 14 NH3 <MDL
108	SDS3	SDS3 011697	1/16/97	1997	storm	1.21		154	NPDES	flow-wt comp	no	22	57	136	10	3	3	6	
109	SDS3	SDS3 030597	3/5/97	1997	storm	0.39		42	NPDES	flow-wt comp	no	31	51	51	2	3	3	6	
110	SDS3	SDS3 011298	1/12/98	1998	nonstor	1.13		123	NPDES	time-comp	yes	181	266	457	17	1	5	5	24-hour time composite
111	SDS3	SDS3 013098	1/29/98	1998	storm	0.2		107	NPDES	flow-wt comp	no	5	9	39	14	5	4	10	
112	SDS3	SDS3 030198	3/1/98	1998	storm	0.98		6	NPDES	flow-wt comp	no	11	10	11	8	1	1	2	
113	SDS3	SDS3 030998	3/8/98	1998	storm	0.86		132	NPDES	flow-wt comp	no	15	42	154	38	23	9	32	backup monhtly sample in case 3/1/98 sample didn't qualify under new permit
114	SDS3	SDS3 042398	4/23/98	1998	storm	0.46		264	NPDES	flow-wt comp	no	6	8	29	9	1	1	2	
115	SDS3	SDS3 051498	5/14/98	1998	storm	0.21		125	NPDES	flow-wt comp	no	4	7	15	6	1	1	2	
116	SDS3	SDS3 091998	9/18/98	1999	nonstorm	0.19	0.16	456	NPDES	non-rep comp	no	3	4	5	12	1	1	2	not representative, extended into post-storm baseflow period
117	SDS3	SDS3 092598	9/24/98	1999	storm	0.47	0.26	148	NPDES	flow-wt comp	no	0	0	3	5	1	2	3	GLYCOLS MAY BE HIGH BIASED, DUPE WAS <MDL
118	SDS3	SDS3 100398	10/3/98	1999	storm	0.4	0.22	36	NPDES	flow-wt comp	no	2	3	2	4	1	1	2	
119	SDS3	SDS3 102798	10/27/98	1999	storm	0.64	0.19	72	NPDES	flow-wt comp	no	5	8	12	5	1	4	5	
120	SDS3	SDS3 110498	11/3/98	1999	storm	1.62	0.48	35	NPDES	flow-wt comp	no	8	11	8	7	5	1	6	
121	SDS3	SDS3 111398	11/11/98	1999	storm	0.98	0.15	31	NPDES	flow-wt comp	no	16	26	16	18	11	1	12	concurrent WET sample
122	SDS3	SDS3 121798	12/17/98	1999	nonstor	0.11	0.03	33	NPDES	flow-wt comp	no	20	33	20		1	12	13	non-storm, suitbale for glycols only
123	SDS3	SDS3 122598	12/24/98	1999	storm	1.19	0.16	153	NPDES	flow-wt comp	yes	125	160	373	450	32	82	113	
124	SDS3	SDS3 011099	1/9/99	1999	storm	0.27	0.05	54	NPDES	flow-wt comp	no	14	25	25	22	8	14	22	
125	SDS3	SDS3 011499	1/13/99	1999	storm	1.07	0.16	85	NPDES	flow-wt comp	no	12	24	34	8	1	10	11	concurrent WET and WER
126	SDS3	SDS3 020399	2/3/99	1999	storm	0.28	0.07	27	NPDES	flow-wt comp	no	8	16	8	6	1	2	3	
127	SDS3	SDS3 030999	3/8/99	1999	storm	0.28	0.05	96	NPDES	flow-wt comp	no	13	66	147	220	7	151	158	
128	SDS3	SDS3 031399	3/12/99	1999	storm	0.83	0.07	71	NPDES	flow-wt comp	no	13	43	53	15	1	6	7	
129	SDS3	SDS3 032599	3/24/99	1999	storm	0.28	0.08	40	NPDES	flow-wt comp	no	6	11	11	2	1	1	2	
130	SDS 3	SDS3 110699 COMP 2	11/5/99	2000	storm	0.68	0.11	44	Source Trace	flow-wt comp	no			22	11	[illegible]	[illegible]	2	
131	SDS 3	SDS3 110699	11/5/99	2000	storm	0.68	0.11	44	NPDES	flow-wt comp	no			22	15	[illegible]	[illegible]	2	
132	SDS 3	SDS3 110699 GRAB 2	11/5/99	2000	storm	0.68	0.11	44	Source Trace	random grab	no			22	14	1	1	2	
133	SDS 3	SDS3 111699	11/16/99	2000	storm	0.6	0.07	23	NPDES	flow-wt comp	no			10	12	1	6	7	
134	SDS 3	SDS3 120599	12/4/99	2000	storm	0.24	0.1	60	NPDES	flow-wt comp	no			34	48	3	18	21	
135	SDS 3	SDS3 120999	12/8/99	2000	storm	0.49	0.09	40	NPDES	flow-wt comp	no			43	26	1	23	24	
136	SDS 3	SDS3 011300	1/12/00	2000	storm	0.37	0.04	10	NPDES	flow-wt comp	yes			261	646	9	355	364	runway deice
137	SDS 3	SDS3 031300	3/13/00		storm	0.47	0.13	49	NPDES	flow-wt.comp	no			44	16	1	9	10	
138	SDS 3	SDS3 041400	4/13/00		storm	0.34	0.08	74	NPDES	flow-wt comp	no				18	1	1	2	
139	SDN1	SDN1 111994	11/19/94	1995	storm	0.42		52	NPDES		no				6	3	3	6	
140	SDN1	SDN1 010595	1/5/95	1995	baseflo	0			other		no				11	3	3	6	baseflow
141	SDN1	SDN1 020895	2/8/95	1995	baseflo	0			NPDES		no					3	3	6	
142	SDN1	SDN1 021395	2/13/95	1995	baseflo	0			NPDES		yes				5	3	3	6	
143	SDN1	SDN1 021695	2/15/95	1995	storm	1.1		86	NPDES		yes				31	6	[illegible]	6	
144	SDN1	SDN1 030595	3/4/95	1995	storm	0.18		158	StipAg		no				4	3	3	6	
145	SDN1	SDN1 030995	3/8/95	1995	storm	2.16		88	StipAg		no				6	3	3	6	
146	SDN1	SDN1 031595	3/13/95	1995	nonstor	0.23		24	StipAg	random grab	no				4	3	3	6	nonstorm
147	SDN1	SDN1 040595	4/4/95	1995	storm	0.17		270	StipAg		no				5	3	3	6	
148	SDN1	SDN1 040795	4/6/95	1995	storm	0.61		60	NPDES		no				40	3	3	6	
149	SDN1	SDN1 020496	2/3/96	1996	storm	1.6			NPDES	flow-wt comp	yes				15	3	3	6	
150	SDN1	SDN1 041296	4/11/96	1996	nonstor	0.21		110	StipAg	flow-wt comp	no	10	14	17	15	3	3	6	nonstorm
151	SDN1	SDN1 041696	4/15/96	1996	storm	0.49			StipAg	flow-wt comp	no	3	5		2	3	3	6	
152	SDN1	SDN1 042296	4/22/96	1996	storm	2.83			NPDES	flow-wt comp	no	12	14		9	3	3	6	
153	SDN1	SDN1 042596	4/25/96	1996	nonstor	0.31		18	StipAg	flow-wt comp	no	5	9	5	2	3	3	6	nonstorm
154	SDN1	SDN1 051396	5/13/96	1996	storm	0.99		12	StipAg	flow-wt comp	no	2	6	2	4	3	3	6	
155	SDN1	SDN1 052296	5/21/96	1996	storm	0.31			StipAg	flow-wt comp	no	6	10		10	3	3	6	xtra NPDES/Stip Ag
156	SDN1	SDN1 052296 GRAB	5/21/96	1996	storm	0.31			StipAg	random grab	no	6	10		12	3	3	6	
157	SDN1	SDN1 062396	6/23/96	1996	storm	0.46			StipAg	flow-wt comp	no	2	5		20	3	3	6	xtra NPDES/Stip Ag
158	SDN1	SDN1 070496	7/3/96	1997	storm	0.23			NPDES	flow-wt comp	no	1	1		11	3	3	6	

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order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
	All Deicing Event Sample Data																		
159	SDN1	SDN1 071796	7/17/96	1997	storm	0.27			StipAg	flow-wt comp	no	0	2		25	3	3	5	
160	SDN1	SDN1 080296	8/2/96	1997	storm	1.01		325	StipAg	flow-wt comp	no	0	0	1	14	3	3	5	
161	SDN1	SDN1 090396	9/3/96	1997	storm	0.29		76	StipAg	flow-wt comp	no	0	3	3	10	3	3	5	
162	SDN1	SDN1 091496	9/13/96	1997	storm	0.72		144	StipAg	flow-wt comp	no	0	0	0	10	3	3	5	
163	SDN1	SDN1 091996	9/18/96	1997	storm	0.38		28	StipAg	flow-wt comp	no	0	0	0	2	3	3	5	
164	SDN1	SDN1 100496	10/4/96	1997	nonstor	0.59		18	StipAg		no	2	6	2	6	3	3	5	insuff sample for TSS, paired up/down sample
165	SDN1up	SDN1 121597	12/15/97	1998	storm	1		87	NPDES	flow-wt comp	no	15	23	30	5	1	1	2	
166	SDN1up	SDN1 091898	9/18/98	1999	nonstor	0.19	0.16	456	NPDES	flow-wt comp	no	3	4	5	9	1	1	2	nonstorm
167	SDN1up	SDN1 122598	12/24/98	1999	storm	1.19	0.16	153	NPDES	flow-wt comp	yes	125	160	373	116	14	12	26	
168	SDN 1	SDN1 111699	11/16/99	2000	storm	0.6	0.07	23	NPDES	flow-wt comp	no			10	5	1	1	2	glycols not required at SDN1
169	SDN 1	SDN1 041300	4/13/00	2000	storm	0.34	0.08	74	NPDES	flow-wt comp	no				7	1	1	2	glycols not required at SDN1
170	SDN2	SDN2 111994	11/19/94	1995	storm	0.42		52	NPDES		no				10	8	3	5	
171	SDN2	SDN2 030595	3/4/95	1995	storm	0.18		158	StipAg		no				12	36	3	36	
172	SDN2	SDN2 031595	3/13/95	1995	nonstor	0.23		24	StipAg	random grab	no				5	3	3	5	nonstorm. questionable high ammonia
173	SDN2	SDN2 040795	4/6/95	1995	storm	0.61		60	StipAg		no				15	3	3	5	
174	SDN2	SDN2 041295	4/10/95	1995	storm	0.29		56	NPDES		no				30	3	19	19	
175	SDN2	SDN2 121095	12/9/95	1996	nonstor	0.82			Washoff	flow-wt comp	no					3	3	5	
176	SDN2	SDN2 012296 AVG	1/19/96	1996	nonstorm	1.6			SES	series avg	yes				21	22	24	44	4-day avg of 17 time-composite samples.8 glycol, 5NH3, and 5 BOD<MDL
177	SDN2	SDN2 020496 GRAB	2/3/96	1996	storm	1.6			SES	grab	yes				180	18	26	44	storm after runway deice
178	SDN2	SDN2 020696 AVG	2/3/96	1996	nonstorm	1.6			SES	series avg	yes				108	9	14	23	2.5-day avg of 8 time-composite samples. 3 glycol, 6 NH3 <MDL
179	SDN2	SDN2 021796	2/17/96	1996	storm	1.29			NPDES	flow-wt comp	no				6	6	11	17	
180	SDN2	SDN2 032996 GRAB	3/29/96	1996	nonstor	0.13		120	StipAg	grab	no				10	3	8	5	nonstorm
181	SDN2	SDN2 041696	4/15/96	1996	storm	0.49			StipAg	flow-wt comp	no	3	5		2	3	3	5	
182	SDN2	SDN2 041996	4/19/96	1996	nonstor	0.09		16	StipAg		no	6	16	6	2	3	3	5	nonstorm (0.02" storm)
183	SDN2	SDN2 042296	4/22/96	1996	storm	2.83			NPDES	flow-wt comp	no	12	14		7	3	3	5	
184	SDN2	SDN2 042596	4/25/96	1996	nonstor	0.31		18	StipAg	flow-wt comp	no	5	9	5	2	3	3	5	nonstorm
185	SDN2	SDN2 051396	5/13/96	1996	storm	0.99		12	StipAg	flow-wt comp	no	2	6	2	5	3	3	5	
186	SDN2	SDN2 052296	5/21/96	1996	storm	0.31			StipAg	flow-wt comp	no	6	10		5	3	3	5	xtra NPDES/Stip Ag
187	SDN2	SDN2 052296 GRAB	5/21/96	1996	storm	0.31			StipAg	random grab	no	6	10		6	3	3	5	
188	SDN2	SDN2 062396	6/23/96	1996	storm	0.46			StipAg	flow-wt comp	no	2	5		18	3	3	5	xtra NPDES/Stip Ag
189	SDN2	SDN2 070396	7/3/96	1997	storm	0.23			StipAg	non-rep comp	no	1	1		21	3	3	5	
190	SDN2	SDN2 071796	7/17/96	1997	storm	0.27			StipAg	time-comp	no	0	2		18	3	3	5	flow-wt comp failed, reset to 20 min time comp
191	SDN2	SDN2 102196	10/21/96	1997	storm	0.68		64	NPDES	flow-wt comp	no	7	8	18	5	3	3	5	
192	SDN2	SDN2 112696 AVG	11/20/96	1997	nonstorm				SES	series avg	yes	60	237	0	249	31	134	165	9-day avg of 33 time-composite samples. 2 glycol, all NH3 <MDL
193	SDN2	SDN2 010297 AVG	12/26/96	1997	nonstorm	1.12			SES	series avg	yes	222	256	256	54	11	27	37	2-day avg of 7 time-composite samples. 1 glycol and 3 BOD<MDL
194	SDN2	SDN2 123196 AVG	12/26/96	1997	nonstorm	1.12			SES	series avg	yes	222	256	256	1180	315	370	684	6-day avg of 20 time-composite samples. 1 BOD and 17 NH3 <MDL
195	SDN2	SDN2 011697	1/16/97	1997	storm	1.21		154	NPDES	flow-wt comp	no	22	57	136	120	3	51	51	
196	SDN2	SDN2 041997	4/19/97	1997	storm	1.16		64	NPDES	flow-wt comp	no	6	8	9	2	3	3	5	
197	SDN2	SDN2 110498 GRAB	11/3/98	1999	storm	1.62	0.48	35	NPDES	grab	no	8	11	8	2	1	1	2	N. CARGO PUMP STATION BYPASS
198	SDN2	SDN2 112598 GRAB	11/25/98	1999	nonstor	3.45	0.32	8	NPDES	grab	no	15	28	15	2	1	1	2	from North Cargo Pump Station bypass
199	SDN2	SDN2 012899 GRAB	1/28/99	1999	nonstorm	1.16	0.1	33	NPDES	grab	no					1	1	2	BYPASS SAMPLE, STORM<<DESIGN, MAINT NOTIFIED (O&M IN PROGRESS)
200	SDN2	SDN2 062499 GRAB	6/24/99	1999	storm	1.12	0.35	10	NPDES	grab	no					1	1	2	30 MIN PUMP STATION BYPASS
201	SDN 2	SDN2 121599 grab	12/15/99	2000	Other Storm	1.26	0.32	8	NPDES	first flush grab	no			3		4	1	5	no other bypasses in winter 2000
202	SDN3	SDN3 111994	11/19/94	1995	storm	0.42		52	NPDES		no				4	3	3	5	
203	SDN3	SDN3 020895	2/8/95	1995	baseflo	0			NPDES		no					3	3	5	
204	SDN3	SDN3 021395	2/13/95	1995	baseflo	0			NPDES		yes				3	3	3	5	
205	SDN3	SDN3 021695	2/15/95	1995	storm	1.1		88	NPDES		yes				90	3	3	5	
206	SDN3	SDN3 030595	3/4/95	1995	storm	0.18		158	StipAg		no				3	3	3	5	
207	SDN3	SDN3 030995	3/8/95	1995	storm	2.16		88	StipAg		no				3	3	3	5	
208	SDN3	SDN3 031595	3/13/95	1995	nonstor	0.23		24	StipAg	random grab	no				5	3	3	5	
209	SDN3	SDN3 040595	4/4/95	1995	storm	0.17		270	StipAg		no				3	3	3	5	
210	SDN3	SDN3 011496	1/13/96	1996	storm	0.37			NPDES	flow-wt comp	no				5	3	3	5	

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All Deicing Event Sample Data

order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
211	SDN3	SDN3 012096 AVG	1/19/96	1996	nonstorm	1.8			StipAg	series avg	yes				30	3	3	5	36-hr avg of 4 time-composite samples. all glycol <MDL
212	SDN3	SDN3 020496	2/3/96	1996	storm	1.6			StipAg	flow-wt comp	yes					3	3	5	storm after runway deice
213	SDN3	SDN3 033096 GRAB	3/29/96	1996	nonstorm	0.13		120	StipAg	grab	no				5	3	3	5	nonstorm, insuff flow to enable sampler
214	SDN3	SDN3 040196	3/31/96	1996	storm	0.64			StipAg	flow-wt comp	no				5	3	3	5	xtra NPDES/Stip Ag
215	SDN3	SDN3 041296 GRAB	4/11/96	1996	nonstorm	0.21		110	StipAg	grab	no	10	14	17	4	3	3	5	nonstorm
216	SDN3	SDN3 041696	4/15/96	1996	storm	0.49			NPDES	flow-wt comp	no	3	5		2	3	3	5	
217	SDN3	SDN3 041996	4/19/96	1996	nonstorm	0.09		16	StipAg		no	6	16	6	2	3	3	5	nonstorm
218	SDN3	SDN3 042296	4/22/96	1996	storm	2.83			StipAg	flow-wt comp	no	12	14		7	3	3	5	xtra NPDES/Stip Ag
219	SDN3	SDN3 042596	4/25/96	1996	nonstorm	0.31		18	StipAg	flow-wt comp	no	5	9	5	1	3	3	5	nonstorm
220	SDN3	SDN3 051396	5/13/96	1996	storm	0.99		12	StipAg	flow-wt comp	no	2	6	2	2	3	3	5	
221	SDN3	SDN3 052296	5/21/96	1996	storm	0.31			StipAg	flow-wt comp	no	6	10		2	3	3	5	
222	SDN3	SDN3 120496	12/4/96	1997	storm	0.82		44	NPDES	flow-wt comp	no	23	92	92	2	3	3	5	
223	SDN3	SDN3 122196	12/19/96	1997	storm	0.36		103	NPDES	flow-wt comp	no	38	44	76	4	3	3	5	
224	SDN3	SDN3 030597	3/5/97	1997	storm	0.39		42	NPDES	flow-wt comp	no	31	51	51	2	6	3	6	
225	SDN3	SDN3 121697	12/15/97	1998	storm	1		87	NPDES	flow-wt comp	no	15	23	30	2	1	1	2	HAD QC DUPLICATE: GOOD DUPLICATION
226	SDN3	SDN3 122498	12/24/98	1999	storm	1.19	0.16	153	NPDES	flow-wt comp	yes	125	160	373	222	1	14	15	
227	SDS4	SDS4 111994	11/19/94	1995	storm	0.42		52	NPDES		no				5	3	3	5	
228	SDS4	SDS4 021395	2/13/95	1995	baseflow	0			NPDES		yes				5	3	3	5	
229	SDS4	SDS4 021695	2/15/95	1995	storm	1.1		86	NPDES		yes				93	3	3	5	
230	SDS4	SDS4 011496	1/13/96	1996	storm	0.37			NPDES	flow-wt comp	no				6	3	3	5	
231	SDS4	SDS4 012096 AVG	1/19/96	1996		1.8			SES	series avg	yes				138	3	4	6	20-hr avg of 6 discrete samples. 4 glycol <MDL
232	SDS4	SDS4 020496 AVG	2/3/96	1996	storm	1.6			Washoff	series avg	yes				242	13	18	31	12-hr avg of 5 discrete samples. all BOD>result
233	SDS4	SDS4 020596	2/3/96	1996	nonstorm	1.6			Washoff		yes				13	14	7	21	
234	SDS4	SDS4 041696	4/15/96	1996	storm	0.49			NPDES	flow-wt comp	no	3	5		5	3	3	5	
235	SDS4	SDS4 042296	4/22/96	1996	storm	2.83			StipAg	flow-wt comp	no	12	14		6	3	3	5	
236	SDS4	SDS4 070496	7/3/96	1997	storm	0.23			NPDES	flow-wt comp	no	1	1		6	3	3	5	
237	SDS4	SDS4 120496	12/4/96	1997	storm	0.82		44	NPDES	flow-wt comp	no	23	92	92	2	3	3	5	
238	SDS4	SDS4 041997	4/19/97	1997	storm	1.16		64	NPDES	flow-wt comp	no	6	8	9	4	3	3	5	
239	SDS4	SDS4 011298	1/12/98	1998	nonstorm	1.13		123	NPDES	time-comp	yes	181	266	457	6	1	1	2	24-hour time composite
240	SDS4	SDS4 030998	3/8/98	1998	storm	0.86		132	NPDES	flow-wt comp	no	15	42	154	2	1	1	2	makeup comp for 98Qw non-rep comp, has extra grab
241	SDS4	SDS4 111998	11/19/98	1999	storm	2.34	0.18	73	NPDES	flow-wt comp	no	20	34	44	2	1	1	2	
242	SDW3	SDW3 020496 AVG	2/3/96	1996	storm	1.6			SES	series avg	yes				76	6	6	12	24-hr avg of 3 time-comp samples. 2 glycol<MDL
243	SDN4	SDN4 120496	12/4/96	1997	storm	0.82		44	NPDES	flow-wt comp	no	23	92	92	8	3	3	5	
244	SDN4	SDN4 030597	3/5/97	1997	storm	0.39		42	NPDES	flow-wt comp	no	31	51	51	2	3	3	5	
245	SDN4	SDN4 102897	10/28/97	1998	storm	0.47		26	NPDES	flow-wt comp	no	9	12	9	7	1	1	2	
246	SDN4	SDN4 121697	12/15/97	1998	storm	1		87	NPDES	flow-wt comp	no	15	23	30	5	1	1	2	
247	SDN4	SDN4 011298	1/12/98	1998	nonstorm	1.13		123	NPDES	time-comp	yes	181	266	457	120	1	1	2	24-hour time composite
248	SDN4	SDN4 030198	3/1/98	1998	storm	0.98		6	NPDES	flow-wt comp	no	11	10	11	2	1	1	2	
249	SDN4	SDN4 030998	3/8/98	1998	storm	0.86		132	NPDES	flow-wt comp	no	15	42	154	4	1	1	2	backup monhtly sample in case 3/1/98 sample didn't qualify under new permit
250	SDN4	SDN4 052598	5/24/98	1998	storm	0.58		87	NPDES	flow-wt comp	no	3	5	7	5	1	1	2	
251	SDN4	SDN4 092598	9/24/98	1999	storm	0.47	0.28	148	NPDES	flow-wt comp	no	0	0	3	7	1	2	3	GLYCOLS MAY BE HIGH BIASED, DUPE WAS <MDL
252	SDN4	SDN4 100398	10/3/98	1999	storm	0.4	0.22	36	NPDES	flow-wt comp	no	2	3	2	2	1	1	2	
253	SDN4	SDN4 102798	10/27/98	1999	storm	0.64	0.19	72	NPDES	non-rep comp	no	5	8	12	5	1	1	2	not representative, insufficient duration (~1hr)
254	SDN4	SDN4 110498	11/3/98	1999	storm	1.62	0.48	35	NPDES	flow-wt comp	no	8	11	8	2	1	1	2	
255	SDN4	SDN4 111398	11/11/98	1999	storm	0.98	0.15	31	NPDES	flow-wt comp	no	16	26	16	2	1	1	2	concurrent WET sample
256	SDN4	SDN4 121798	12/17/98	1999	nonstorm	0.11	0.03	33	NPDES	flow-wt comp	no	20	33	20		1	1	2	non-storm, suitbale for glycols only
257	SDN4	SDN4 122598	12/24/98	1999	storm	1.19	0.16	153	NPDES	flow-wt comp	yes	125	160	373	168	7	27	34	
258	SDN4	SDN4 011499	1/13/99	1999	storm	1.07	0.16	85	NPDES	flow-wt comp	no	12	24	34	2	1	1	2	concurrent WET sample
259	SDN4	SDN4 020499	2/3/99	1999	storm	0.28	0.07	27	NPDES	flow-wt comp	no	8	16	8	2	1	1	2	
260	SDN4	SDN4 031399	3/12/99	1999	storm	0.83	0.07	71	NPDES	flow-wt comp	no	13	43	53	2	1	1	2	
261	SDN4	SDN4 032899	3/27/99	1999	storm	0.24	0.07	26	NPDES	flow-wt comp	no	7	17	7	2	1	1	2	

AR 012816

All Deicing Event Sample Data

order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
262	SDN 4	SDN4 110699	11/5/99	2000	storm	0.68	0.11	44	NPDES	flow-wt comp	no	22	7			1	1	2	
263	SDN 4	SDN4 111699	11/16/99	2000	storm	0.6	0.07	23	NPDES	flow-wt comp	no	10	4			1	1	2	
264	SDN 4	SDN4 120999	12/8/99	2000	storm	0.49	0.09	40	NPDES	flow-wt comp	no	43	5			1	2	3	duplicate had EG<MD: PG result for this sample may be <MDL
265	SDN 4	SDN4 121799	12/17/99	2000	storm	0.34	0.06	26	NPDES	flow-wt comp	no	11	2			1	1	2	
266	SDN 4	SDN4 013100	1/31/00	2000	storm	1.76	0.15	9	NPDES	flow-wt comp	no	12	2			1	1	2	
267	SDN 4	SDN4 031400	3/13/00	2000	storm	0.47	0.13	49	NPDES	flow-wt comp	no	44	4			1	1	2	
268	SDN 4	SDN4 041300	4/13/00	2000	storm	0.34	0.08	74	NPDES	flow-wt comp	no		6			1	1	2	
shaded cells indicate result <MDL, value shown is 1/2 MDL										All outfalls	count			146	227	268	268	268	
											max			457	1180	315	2800	2859	
											95th			373	203	18	44	50	
											75th			76	18	3	3	5	
											median			21	7	3	3	5	
											25th			8.0	4.2	1.0	1.0	2.0	
											min			0.0	1.0	1.0	1.0	2.0	
											sd			114	109	26	181	189	
											CV, %			156%	278%	405%	759%	625%	
											# non-detected				41	221	209	203	
											% non-detected				18%	82%	78%	76%	

All Deicing Event Sample Data

order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
										SDE4	count			38	44	51	51	51	
										(002)	max			457	335	21	71	92	
											95th			278	92	14	23	37	
											75th			73	12	3	3	5	
											median			24	7	1	3	4	
											25th			10.3	4.3	1.0	1.0	2.0	
											min			0.0	2.0	1.0	1.0	2.0	
											sd			110	60	5	12	16	
											CV, %			148%	240%	137%	218%	177%	
											# non-detected				9	42	38	38	
											% non-detected				20%	82%	75%	75%	
										SDS1	count			18	26	38	38	38	
										(003)	max			457	428	260	2800	2859	
											95th			290	226	66	284	373	
											75th			107	73	3	5	25	
											median			31	16	3	3	5	
											25th			13.5	6.6	1.0	1.0	2.0	
											min			0.0	2.0	1.0	1.0	2.0	
											sd			116	96	45	468	477	
											CV, %			141%	162%	309%	418%	378%	
											# non-detected				1	30	28	26	
											% non-detected				4%	79%	74%	68%	
										SDS3	count			33	42	49	49	49	
										(005)	max			457	646	32	355	384	
											95th			306	250	21	67	93	
											75th			53	25	5	10	13	
											median			25	13	3	3	5	
											25th			12.0	6.5	1.0	2.1	5.0	
											min			2.0	2.0	1.0	1.0	2.0	
											sd			111	126	7	55	57	
											CV, %			149%	223%	140%	313%	253%	
											# non-detected				4	35	29	28	
											% non-detected				10%	71%	59%	57%	
										SDN1	count			12	30	31	31	31	
										(006)	max			373	116	14	12	26	
										(includes both stations)	95th			184	36	4	3	6	
											75th			12	14	3	3	5	
											median			4	9	3	3	5	
											25th			1.8	5.0	2.5	2.5	5.0	
											min			0.0	2.0	1.0	1.0	2.0	
											sd			106	21	2	2	4	
											CV, %			284%	150%	79%	71%	75%	
											# non-detected				2	29	30	29	
											% non-detected				7%	94%	97%	94%	
										SDN2	count			12	28	32	32	32	
										(007)	max			256	1180	315	370	684	
											95th			256	225	33	88	102	
											75th			48	24	5	12	20	
											median			9	10	3	3	5	
											25th			4.5	4.8	2.5	2.5	5.0	
											min			0.0	2.0	1.0	1.0	2.0	
											sd			99	225	55	68	122	
											CV, %			166%	300%	351%	300%	320%	
											# non-detected				5	23	23	22	
											% non-detected				18%	72%	72%	69%	

AR 012819

All Deicing Event Sample Data

order	outfall	POS ID	event	report	type	depth	maxint	dryant	purpose	type	ground deice?	24hr aircraft	48hr aircraft	dryant aircraft	BOD5	E-glycol	P-glycol	total glycols	comments
										SDN3	count			9	23	25	25	25	
										(008)	max			373	222	6	14	15	
											95th			261	84	3	3	6	
											75th			76	5	3	3	5	
											median			30	3	3	3	5	
											25th			6.0	2.0	2.5	2.5	5.0	
											min			2.0	1.0	1.0	1.0	2.0	
											sd			117	48	1	2	2	
											CV, %			162%	273%	34%	82%	40%	
											# non-detected				8	24	24	23	
											% non-detected				35%	96%	96%	92%	
										SDS4	count			5	15	15	15	15	
										(009)	max			457	242	14	18	31	
											95th			396	169	13	10	24	
											75th			154	10	3	3	5	
											median			92	6	3	3	5	
											25th			44.0	4.5	2.5	2.5	5.0	
											min			9.0	2.0	1.0	1.0	2.0	
											sd			179	69	4	4	8	
											CV, %			119%	195%	110%	115%	110%	
											# non-detected				3	13	12	12	
											% non-detected				20%	87%	80%	80%	
										SDN4	count			19	19	27	27	27	
										(011)	max			457	168	7	27	34	
											95th			381	125	5	5	10	
											75th			52	7	1	1	2	
											median			16	4	1	1	2	
											25th			8.0	2.0	1.0	1.0	2.0	
											min			2.0	2.0	1.0	1.0	2.0	
											sd			128	47	1	5	6	
											CV, %			180%	210%	99%	217%	166%	
											# non-detected				9	25	25	25	
											% non-detected				47%	93%	93%	93%	

APPENDIX D WHOLE EFFLUENT TOXICITY SAMPLE DATA SUMMARIES

WET testing/Source tracing sample results

POS ID	stormdate	type	event	Cu	Pb	Zn	d Cu	d Pb	d Zn	hardness	WET survival
SDN1 36INCH 070299 GRAB 2	02-Jul-99	grab	storm	0.0256	<0.002	0.205					not tested
SDN1 36INCH 070299 GRAB 1	02-Jul-99	grab	storm	0.0316	<0.002	0.2					not tested
SDN1 10INCH 070299 GRAB 2	02-Jul-99	grab	storm	0.0422	<0.002	0.422					not tested
SDN1 10INCH 070299 GRAB 1	02-Jul-99	grab	storm	0.0276	<0.002	0.251					not tested
SDN1 36inch 110699	05-Nov-99	comp	storm	0.0078	0.005	0.103	0.0045	<0.002	0.056	11.9	70%
SDN1 10inch 110699	05-Nov-99	comp	storm	0.0064	<0.002	0.104	0.0061	<0.002	0.097	2.15	0%

WET testing done using daphnia Pulex 100% sample concentration
See Whole Effluent Testgin at Seattle-Tacoma International Airport: Final Report, May 2000

APPENDIX E OTHER SAMPLE DATA

stormdate	POS ID	event	Fecals (MPN)	TPH-Dx (mg/l)	TSS (mg/l)	Turb (NTU)	BOD5 (mg/l)	total glycols (mg/l)	TR Cu (mg/l)	TR Pb (mg/l)	TR Zn (mg/l)	comments
Field Equipment Blanks												
05-Nov-99	SDN1 110599 bottle blank	1					<4		<0.002	<0.002	<0.005	bottle blank, prior to sampling
05-Nov-99	SDN1 110699 blank	1					<4		<0.002	<0.002	<0.005	eqpt blank after sampling
08-Dec-99	SDN3 120899 Blank	1	<2	<0.15	<0.05	0.4			<0.002	<0.002	0.004	
18-Apr-00	NPIN 041400 blank	1			<0.05	0.35			<0.002	<0.002	<0.005	
Stormwater Composite Sample Duplicates												
02-Jul-99	SDS3 070299 DUPE	1			11	12	4.6		0.028	0.001	0.030	
	SDS3 070299				11	14	4.7		0.025	0.001	0.028	
	RPD				0%	-15%	-2%		11%	0%	7%	
05-Nov-99	SDN4 110699 DUPE	1			12	19	7.62	2	0.020	0.001	0.024	
	SDN4 110699				12	17	6.94	2	0.017	0.001	0.023	
	RPD				0%	11%	9%	0%	15%	0%	4%	
16-Nov-99	SDE4 111799 DUPE	1			19	27	2	2	0.011	0.005	0.079	
					17	25	2	2	0.011	0.005	0.077	
	RPD				11%	8%	0%	0%	3%	-11%	3%	
04-Dec-99	SDS3 120599 DUPE	1			6.4	6.3	47.0	15.4	0.012	0.001	0.023	
	SDS3 120599				6.4	6.3	48.4	21	0.013	0.001	0.031	
	RPD				0%	0%	-3%		-6%	0%	-30%	
08-Dec-99	SDN4 120999 dupe	1			3.6	5	5.6	2.8	0.017	0.001	0.022	
					2.8	6.2	5.4	3.1	0.018	0.001	0.031	
	RPD				25%	-21%	3%	-10%	-6%	0%	-34%	
31-Jan-00	EY 013100 dupe	1			100	82	33.5	2	0.098	0.075	0.086	sampling problem for metals,
	EY 013100				96	71	24.1	2	0.020	0.026	0.179	but metals analysis not req'd,
	RPD				4%	14%	33%	0%	134%	96%	-70%	
13-Mar-00	SDN4 031400 dupe	1			11	3.1	<4	2	0.012	0.001	0.0025	
	SDN4 031400				14	6	4.04	2	0.030	0.001	0.0025	
	RPD				-24%	-64%	na	0%	-86%	0%	0%	

yellow shading indicates value <MDL replaced with 1/2 MDL

APPENDIX D WHOLE EFFLUENT TOXICITY SAMPLE DATA SUMMARIES

WET testing/Source tracing sample results

POS ID	stormdate	type	event	Cu	Pb	Zn	d-Cu	d-Pb	d-Zn	hardness	WET survival
SDN1 36INCH 070299 GRAB 2	02-Jul-99	grab	storm	0.0256	<0.002	0.205					not tested
SDN1 36INCH 070299 GRAB 1	02-Jul-99	grab	storm	0.0316	<0.002	0.2					not tested
SDN1 10INCH 070299 GRAB 2	02-Jul-99	grab	storm	0.0422	<0.002	0.422					not tested
SDN1 10INCH 070299 GRAB 1	02-Jul-99	grab	storm	0.0276	<0.002	0.251					not tested
SDN1 36inch 110699	05-Nov-99	comp	storm	0.0078	0.005	0.103	0.0045	<0.002	0.056	11.9	70%
SDN1 10inch 110699	05-Nov-99	comp	storm	0.0064	<0.002	0.104	0.0061	<0.002	0.097	2.15	0%

WET testing done using daphnia Pulex 100% sample concentration
See Whole Effluent Testgin at Seattle-Tacoma International Airport: Final Report, May 2000

APPENDIX E OTHER SAMPLE DATA

stormdate	POS ID	event	Fecals (MPN)	TPH-Dx (mg/l)	TSS (mg/l)	Turb (NTU)	BOD5 (mg/l)	total glycols (mg/l)	TR Cu (mg/l)	TR Pb (mg/l)	TR Zn (mg/l)	comments
Field Equipment Blanks												
05-Nov-99	SDN1 110599 bottle blank	1					<4		<0.002	<0.002	<0.005	bottle blank, prior to sampling
05-Nov-99	SDN1 110699 blank	1					<4		<0.002	<0.002	<0.005	eqpt blank after sampling
08-Dec-99	SDN3 120899 Blank	1	<2	<0.15	<0.05	0.4			<0.002	<0.002	0.004	
18-Apr-00	NPIN 041400 blank	1			<0.05	0.35			<0.002	<0.002	<0.005	
Stormwater Composite Sample Duplicates												
02-Jul-99	SDS3 070299 DUPE	1			11	12	4.6		0.028	0.001	0.030	
	SDS3 070299				11	14	4.7		0.025	0.001	0.028	
	RPD				0%	-15%	-2%		11%	0%	7%	
05-Nov-99	SDN4 110699 DUPE	1			12	19	7.62	2	0.020	0.001	0.024	
	SDN4 110699				12	17	6.94	2	0.017	0.001	0.023	
	RPD				0%	11%	9%	0%	15%	0%	4%	
16-Nov-99	SDE4 111799 DUPE	1			19	27	2	2	0.011	0.005	0.079	
					17	25	2	2	0.011	0.005	0.077	
	RPD				11%	8%	0%	0%	3%	-11%	3%	
04-Dec-99	SDS3 120599 DUPE	1			6.4	6.3	47.0	15.4	0.012	0.001	0.023	
	SDS3 120599				6.4	6.3	48.4	21	0.013	0.001	0.031	
	RPD				0%	0%	-3%		-6%	0%	-30%	
08-Dec-99	SDN4 120999 dupe	1			3.6	5	5.6	2.8	0.017	0.001	0.022	
					2.8	6.2	5.4	3.1	0.018	0.001	0.031	
	RPD				25%	-21%	3%	-10%	-6%	0%	-34%	
31-Jan-00	EY 013100 dupe	1			100	82	33.5	2	0.098	0.075	0.086	sampling problem for metals,
	EY 013100				96	71	24.1	2	0.020	0.026	0.179	but metals analysis not req'd,
	RPD				4%	14%	33%	0%	134%	96%	-70%	
13-Mar-00	SDN4 031400 dupe	1			11	3.1	<4	2	0.012	0.001	0.0025	
	SDN4 031400				14	6	4.04	2	0.030	0.001	0.0025	
	RPD				-24%	-64%	na	0%	-86%	0%	0%	

yellow shading indicates value <MDL replaced with 1/2 MDL

APPENDIX F SOURCE TRACING SAMPLE DATA SUMMARIES

SDE4 source tracing analyses in routine NPDES Grab samples

type	stormdate	POS ID	Fecals (MPN)	ph	NH3	K+	NH3/K	FB	Surf	Cond	hard
first flush grab	02-Jul-99	SDE4 070299 grab	900	6.6	0.993	2.96	0.34	0.175	0.527	101	28
first flush grab	16-Nov-99	SDE4 111699 GRAB	>1600	6.3							
first flush grab	24-Nov-99	SDE4 112499 GRAB	21	6.9	0.391	0.74	0.53	0.349	0.352	92.0	34
first flush grab	04-Dec-99	SDE4 120499 grab	50	6.8	0.388	0.987	0.39	0.617	0.100	79.4	32
first flush grab	13-Mar-00	SDE4 031300 grab	170	6.7							
first flush grab	13-Apr-00	SDE4 041300 GRAB	130	6.7							

Table 1. Stormwater data for the Sea-Tac Airport microbial source tracking study.

Site	Date/Time	Sample ID	Event	Fecal coliform (CFU/100 mL)	Q	Enterococcus (CFU/100 mL)	Q	No. of Isolates
SDE4-065	4/12/00 11:10	SDE4-065041200-1	Base 1+2	8	E	NA		
SDE4-065	4/12/00 12:30	SDE4-065041200-2	Base 1+2	2	L	NA		
SDE4-996	4/12/00 10:05	SDE4-996041200-1	Base 1+2	2	L	NA		
SDE4-996	4/12/00 12:10	SDE4-996041200-2	Base 1+2	2	L	NA		
SDS3-OUT	4/12/00 13:05	SDS3-OUT041200-1	Base 1+2	2	L	NA		
SDS3-OUT	4/12/00 14:25	SDS3-OUT041200-2	Base 1+2	2	L	NA		
DMC-200	4/12/00 11:32	DMC-200041200-1	Base 1+2	8	E	NA		
DMC-200	4/12/00 14:00	DMC-200041200-2	Base 1+2	6	E	NA		
SDE4-065	4/25/00 9:15	SDE4-065042500-1	Storm 1+2	2,700		NA		
SDE4-065	4/25/00 11:00	SDE4-065042500-2	Storm 1+2	160	E	NA		
SDE4-017	4/25/00 8:40	SDE4-017042500-1	Storm 1+2	290		NA		
SDE4-017	4/25/00 11:30	SDE4-017042500-2	Storm 1+2	700		NA		
SDE4-996	4/25/00 8:15	SDE4-996042500-1	Storm 1+2	260		NA		
SDE4-996	4/25/00 10:40	SDE4-996042500-2	Storm 1+2	42		NA		
SDS3-OUT	4/25/00 10:15	SDS3-OUT042500-1	Storm 1+2	41		NA		
SDS3-OUT	4/25/00 12:20	SDS3-OUT042500-2	Storm 1+2	19		NA		
DMC-200	4/25/00 10:00	DMC-200042500-1	Storm 1+2	2,000		NA		
DMC-200	4/25/00 11:50	DMC-200042500-2	Storm 1+2	1,900		NA		
SDE4-B	4/25/00 8:10	SDE4-996042500-B	Storm 1+2	1	L	NA		NA
SDE4-065	5/8/00 0:00	SDE4-065050800-1	Storm 3	1,300		NA		
SDE4-017	5/8/00 0:00	SDE4-017050800-1	Storm 3	1,440		NA		
SDE4-996	5/8/00 0:00	SDE4-996050800-1	Storm 3	22	E	NA		
SDS3-OUT	5/8/00 0:00	SDS3-OUT050800-1	Storm 3	64		NA		
DMC-200	5/8/00 0:00	DMC-200050800-1	Storm 3	560		NA		
SDE4-B	5/8/00 0:00	SDE4-996050800-B	Storm 3	2	L	NA		NA
SDE4-065	5/9/00 0:00	SDE4-065050900-1	Storm 4+5	3,200	E	660		
SDE4-065	5/9/00 0:00	SDE4-065050900-2	Storm 4+5	5,200		760		
SDE4-017	5/9/00 0:00	SDE4-017050900-1	Storm 4+5	2,400	E	3,600	E	
SDE4-017	5/9/00 0:00	SDE4-017050900-2	Storm 4+5	540		1,160		
SDE4-996	5/9/00 0:00	SDE4-996050900-1	Storm 4+5	800		220	E	
SDE4-996	5/9/00 0:00	SDE4-996050900-2	Storm 4+5	1,180		1,140		
SDS3-OUT	5/9/00 0:00	SDS3-OUT050900-1	Storm 4+5	102		114		
SDS3-OUT	5/9/00 0:00	SDS3-OUT050900-2	Storm 4+5	38		72		
DMC-200	5/9/00 0:00	DMC-200050900-1	Storm 4+5	700		110		
DMC-200	5/9/00 0:00	DMC-200050900-2	Storm 4+5	700		1,480		
SDE4-B	5/9/00 0:00	SDE4-996050900-B	Storm 4+5	2	E	2	L	NA
SDS3-OUT	5/15/00 0:00	SDS3-OUT051600-1	Base 3+4	2	E	NA		
SDS3-OUT	5/15/00 0:00	SDS3-OUT051600-2	Base 3+4	2	E	NA		
DMC-200	5/15/00 0:00	DMC-200051600-1	Base 3+4	52		NA		
DMC-200	5/15/00 0:00	DMC-200051600-2	Base 3+4	70		NA		
SDE4-B	5/15/00 0:00	SDE4-996051600-B	Base 3+4	1	L	NA		NA
SDE4-065	5/26/00 0:00	SDE4-065052600-1	Storm 6+7	520		NA		

Table 1. Stormwater data for the Sea-Tac Airport microbial source tracking study.

Site	Date/Time	Sample ID	Event	Fecal coliform (CFU/100 mL)	Q	Enterococcus (CFU/100 mL)	Q	No. of Isolates
SDE4-065	5/26/00 0:00	SDE4-065052600-2	Storm 6+7	1,060		NA		
SDE4-017	5/26/00 0:00	SDE4-017052600-1	Storm 6+7	320	E	NA		
SDE4-017	5/26/00 0:00	SDE4-017052600-2	Storm 6+7	660		NA		
SDE4-996	5/26/00 0:00	SDE4-996052600-1	Storm 6+7	440		NA		
SDE4-996	5/26/00 0:00	SDE4-996052600-2	Storm 6+7	100	E	NA		
SDS3-OUT	5/26/00 0:00	SDS3-OUT052600-1	Storm 6+7	90		NA		
SDS3-OUT	5/26/00 0:00	SDS3-OUT052600-2	Storm 6+7	54		NA		
DMC-200	5/26/00 0:00	DMC-200052600-1	Storm 6+7	2,160		NA		
DMC-200	5/26/00 0:00	DMC-200052600-2	Storm 6+7	1,040		NA		
SDE4-B	5/26/00 0:00	SDE4-996052600-B	Storm 6+7	2	L	NA		NA
SDE4-065	6/6/00 0:00	SDE4-065052600-1	Storm 8+9	220	E	NA		
SDE4-065	6/6/00 0:00	SDE4-065052600-2	Storm 8+9	2,200	E	NA		
SDE4-017	6/6/00 0:00	SDE4-017052600-1	Storm 8+9	600		NA		
SDE4-017	6/6/00 0:00	SDE4-017052600-2	Storm 8+9	10,000		NA		
SDE4-996	6/6/00 0:00	SDE4-996052600-1	Storm 8+9	2	E	NA		
SDE4-996	6/6/00 0:00	SDE4-996052600-2	Storm 8+9	40	E	NA		
SDS3-OUT	6/6/00 0:00	SDS3-OUT052600-1	Storm 8+9	4	E	NA		
SDS3-OUT	6/6/00 0:00	SDS3-OUT052600-2	Storm 8+9	60	E	NA		
DMC-200	6/6/00 0:00	DMC-200052600-1	Storm 8+9	66		NA		
DMC-200	6/6/00 0:00	DMC-200052600-2	Storm 8+9	148		NA		
SDE4-B	6/6/00 0:00	SDE4-996052600-B	Storm 8+9	2	L	NA		NA
SDE4-065	6/12/00 0:00	SDE4-065052600-1	Storm 10+11	2,800	E			
SDE4-065	6/12/00 0:00	SDE4-065052600-2	Storm 10+11	1,600	E			
SDE4-017	6/12/00 0:00	SDE4-017052600-1	Storm 10+11	400	E			
SDE4-017	6/12/00 0:00	SDE4-017052600-2	Storm 10+11	3,800	E			
SDE4-996	6/12/00 0:00	SDE4-996052600-1	Storm 10+11	1,400	E			
SDE4-996	6/12/00 0:00	SDE4-996052600-2	Storm 10+11	64				
SDS3-OUT	6/12/00 0:00	SDS3-OUT052600-1	Storm 10+11	60				
SDS3-OUT	6/12/00 0:00	SDS3-OUT052600-2	Storm 10+11	84				
DMC-200	6/12/00 0:00	DMC-200052600-1	Storm 10+11	120	E			
DMC-200	6/12/00 0:00	DMC-200052600-2	Storm 10+11	820				
SDE4-B	6/12/00 0:00	SDE4-996052600-B	Storm 10+11	2	L			NA

NA = not analyzed
Qalifiers (Q):
L = less than indicated detection limit
E = estimated due to less than 20 colonies counted

Table 2. Wastewater and animal feces samples collected for the Sea Tac Airport microbial source tracking study.

Sample	Date/Time	Fecal Coliform (CFU/100 mL)	Q	No. of Isolates	Sample Location	Sample Description
Wastewater						
AWW-1	3/29/00 11:45	1,600	G*		Northwest 35 (Amsterdam) and 95 (Minneapolis)	Blue
AWW-2	5/4/00 13:20	10,000,000			Delta (St. Louis)	Blue
AWW-3	5/25/00 12:30	48,000,000	G		American (several domestic and Tokyo)	Blue
AWW-4	5/25/00 12:45	NA			Northwest (several domestic and Tokyo)	Blue
AWW-5	5/25/00 13:00	NA			American (several domestic)	Blue
AWW-6	6/15/00 11:30	41,000,000	G			
MWW-1	3/29/00 11:15	6,000			MWW (sanitary sewer)	Grey
MWW-2	5/4/00 14:00	39,000			MWW (sanitary sewer)	Grey
MWW-3	5/25/00 11:30	1,100,000			MWW (sanitary sewer)	Grey
MWW-4	5/25/00 12:00	NA			MWW (sanitary sewer)	Grey
MWW-5	6/15/00 11:00	1,900,000				
Animal Feces						
CROW-1	5/1/00	NA			Airport unknown (by USFW)	Black
DOG-1	3/29/00 11:20	NA			Grass 100 feet W of MWW	Light brown; 2.5 cm D
DOG-2	3/29/00 11:30	NA			Grass between Delta and Alaska hangers	Light brown; 1.9 cm D
DOG-3	3/29/00 11:35	NA			Grass between Delta and Alaska hangers	Light brown; 1.9 cm D
GOOSE-1	3/29/00 13:00	NA			40 yards NNE of outlet from west pond in golf course	Dark green with white; 1 cm D
GOOSE-2	5/1/00	NA			Airpot unknown (by USFW)	Dark green with white
GOOSE-3	5/1/00	NA			Airport unknown (by USFW)	Dark green with white
GOOSE-2	5/4/00 11:15	NA			Terminal A roof; UNKNOWN ORIGIN	Not noted
PIGEON-1	3/29/00 14:00	NA			Circle drive at lower floor in parking lot	Dark green with white; 0.3 cm D coil
PIGEON-2	3/29/00 14:10	NA			Circle drive at upper floor in parking lot	Dark green with white; 0.3 cm D coil
PIGEON-3	5/4/00 11:30	NA			Terminal A roof	Not noted
PIGEON-4	5/4/00 11:45	NA			Terminal A roof	Not noted
STARLING-1	5/8/00	NA			Airport trap (by USFW)	Black
STARLING-2	5/8/00	NA			Airport trap (by USFW)	Black
WIGEON-1	3/29/00 12:50	NA			20 feet N of outlet from west pond in golf course	Black; 0.5 cm D
WIGEON-2	3/29/00 12:55	NA			40 feet N of outlet from west pond in golf course	Dark green; 0.5 cm D

NA = not analyzed
Qualifiers (Q): G = greater than number indicated; * = most probable number

APPENDIX G OUTFALL INSPECTION SUMMARY

1999 Dry Weather Inspection for Permitted Outfalls

Conducted on 9/14-9/15/99
by Scott Tobiason, Port of Seattle

Outfall Name	Outfall #	inspection point (1)	date (2)	depth of flow (3), in	Susp Solids (0-5)	Turbidity (0-5)	Color (hue)	Sheen (0-5)	Odor (type)	Foam (0-5)	other	other	Remarks (4)
SDE4	002	manhole SDE4-47	15-Sep	trickle	0	0	0	0	0	0			insignificant flow (<<1 gpm), no baseflow sample possible
SDS1	003	outfall	15-Sep	no flow	no discharge								no flow, pipe was dry
SDS2	004	outfall	14-Sep	no flow	no discharge								pipe and ditch were dry
SDS3	005	outfall	14-Sep	trickle	0	1	0	0	0	0			insignificant discharge (too little to sample), no problems apparent
SDN1	006	manhole SDN1-22	15-Sep	no flow	no discharge								no flow, pipe was barely damp
SDN2	007	manhole	14-Sep	no flow	no discharge								no flow from pump station
SDN3	008	outfall	14-Sep	trickle	0	0	0	0	0	0			insignificant discharge (too little to sample), no problems apparent
SDS4	009	outfall	14-Sep	no flow	no discharge								
SDW3	010	manhole	14-Sep	no flow	no discharge								pipe dry, 188th St North (west bound) road ditch recently cleaned to bare dirt, all vegetation removed (by City)
SDN4	011	outfall	14-Sep	no flow	no discharge								pipe dry
Eng Yard	012	drain inlet	15-Sep	no flow	no discharge								recent concrete cutting water on surface, maintenance notified
Taxi Yard	013	drain inlet	15-Sep	no flow	no discharge								dumpster area dirty, debris on ground, maintenance notified
Subbasin B	014	outfall	14-Sep	no flow	no discharge								pipe dry, 188th St North (west bound) road ditch recently cleaned to bare dirt, all vegetation removed (by City)
Subbasin D	015	outfall	14-Sep	no flow	no discharge								pipe dry, 188th St North (west bound) road ditch recently cleaned to bare dirt, all vegetation removed (by City)

*** note presence and magnitude: 0 = absent, 5 = present to considerable degree

notes:
1. Inspected visually from surface through inlets, or by pumped sample for outfalls with monitoring points requiring confined-space entry (SDE4, SDN1, SDN2, EY, TY)
2. Monthly sampling sites visited on numerous other dates during the period, noted in remarks
3. Depths of flow are approximate, unless registered by local monitoring equipment.

Other observations at non-permit locations:

Outfall Name	Outfall #	inspection point	date	depth of flow, in	Susp Solids (0-5)	Turbidity (0-5)	Color (hue)	Sheen (0-5)	Odor (type)	Foam (0-5)	other	other	Remarks
S 28th St outfall	n/a	outfall											optional location not inspected
DM Creek *above* SDS1	n/a	creek	15-Sep	~ 4"	0	0	0	0	0	0			
DM Creek *Weir at Golf Course*	n/a	creek											optional location not inspected
DM Creek at SDS4	n/a	creek	15-Sep	~ 4"	0	0	0	0	0	0			
L. Reba outlet	n/a	outlet											optional location not inspected

AR 012848

1999-2000
Wet Season Outfall Inspection Summary

outfall	total number of visits	01-Jul-99	02-Jul-99	05-Jul-99	06-Jul-99	14-Jul-99	16-Jul-99	17-Jul-99	19-Jul-99	20-Jul-99	23-Jul-99	02-Aug-99	20-Aug-99	03-Sep-99
SDE4	30													
SDS1	21	M (N)	S (N)*1	M (N)								M (N)	M (N)	
SDS2	6													
SDS3	23	M (N)	S (N)	M (N)										
SDS4	5													
SDS7	5													
SDS5	5													
SDS6	5													
SDN3	5													
SDN4	29					M (N)	M (N)	S (N)	M (N)		M (N)		M (N)	M (N)
SDN2	23													
SDN1	33	M (N)	S (N)		M (N)									
EY	8													
TY	11	M (N)	S (N)		M (N)									
N.Cargo	4									D.L.				

S= Sample
N.A. = sampled but not analyzed
D = duplicate taken
B = blank taken
M = visited for set up or for maintenance
(N) = Information from site visit log book
D.L. = Data download from meter
* = info from chain of custody

Observations:
1. 7/2/99 storm runoff at SDS1 had foam below outfall, sampled and analyzed for surfactants in multiple samples.

AR 012849

Port of Seattle

1999-2000
Wet Season Outfall Inspection Summary

outfall	22-Sep-99	23-Sep-99	30-Sep-99	01-Oct-99	02-Nov-99	03-Nov-99	04-Nov-99	05-Nov-99	06-Nov-99	08-Nov-00	10-Nov-99	11-Nov-99	14-Nov-99	16-Nov-99
SDE4				M (N)	M (N)		M (N)	S (N)	M (N)				M (N)	S (N)
SDS1	M (N)	S (N)*2	M (N)											
SDS2														
SDS3														M (N)
SDS4														
SDS7														
SDS5														
SDS6														
SDN3														
SDN4								M (N)	M (N)				M (N)	M (N)
SDN2			M (N)					M (N)	M (N)		M (N)			M (N)
SDN1					M (N)	M (N) B	M (N)	M (N)	M (N)	M (N)		M (N)	M (N)	M (N)
EY														
TY														
N.Cargo														

S= Sample **D** = duplicate taken **M** = visited for set up or for maintenance ***(N)*** = Information from site visit log book

N.A. = sampled but not analyzed **B** = blank taken ***D.L.*** = Data download from meter

* = info from chain of custody

Observations:

2. 9/23/99 storm runoff at SDS1 - 2 grab samples taken; considerable foam below outfall (~1 cubic foot), runoff was orange/ brown. Second sample taken about 1 hour later; there was much less foam, and runoff was clear

AR 012850

Port of Seattle

1999-2000
Wet Season Outfall Inspection Summary

outfall	09-Dec-99	11-Dec-99	12-Dec-99	15-Dec-99	16-Dec-99	18-Dec-99	21-Dec-99	26-Dec-99	01-Jan-00	03-Jan-00	05-Jan-00	07-Jan-00	08-Jan-00
SDE4	M (N)	M (N)	M (N)		M (N)								
SDS1									M (N)			s (N)	
SDS2													
SDS3	N.A. (N)	M (N)		M (N)						M (N)	M (N)		
SDS4													
SDS7													
SDS5													
SDS6													
SDN3													
SDN4	s (N)							M (N)					M (N)
SDN2	M (N)		M (N)	s (N)*3			M (N)		M (N)	M (N)			
SDN1				s (N)	M (N)	N.A. (N)		M (N)					
EY													
TY													
N.Cargo													

S= Sample
D = duplicate taken
M = visited for set up or for maintenance
(N) = Information from site visit log book
N.A. = sampled but not analyzed
B = blank taken
D.L. = Data download from meter
* = info from chain of custody

Notes:
3. 12/15/99: Pump station bypass due to rainfall intensity exceeding design. Manual grab sample taken by Scott Tobiason and Curtis Nickerson

(N) = Information from site visit log book
D.L. = Data download from meter
* = info from chain of custody

AR 012851

1999-2000
Wet Season Outfall Inspection Summary

outfall	10-Jan-00	12-Jan-00	15-Jan-00	21-Jan-00	27-Jan-00	28-Jan-00	01-Feb-00	02-Feb-00	03-Feb-00	04-Feb-00	07-Feb-00	08-Feb-00	10-Feb-00	20-Feb-00
SDE4		s (N)*4												
SDS1	M (N)	s (N)*4												
SDS2														
SDS3		s (N)	M (N)								M (N)			
SDS4														
SDS7														
SDS5														
SDS6														
SDN3														
SDN4		s (N)					s (N)		M (N)					
SDN2									M (N)					
SDN1														
EY		M (N)			M (N)	M (N)	s (N)	M (N)						
TY										M (N)	M (N)	M (N)	s (N)	s (N)
N.Cargo				D.L.										

S= Sample
D = duplicate taken
M = visited for set up or for maintenance
(N) = Information from site visit log book

N.A. = sampled but not analyzed
B = blank taken
D.L. = Data download from meter
* = info from chain of custody

Notes:
4. 1/12/00: Ground surface deicing event, sand and cehmicals applied. SDS1 and SDE4 samples had noticeable TSS and turbidity.

Port of Seattle

1999-2000
Wet Season Outfall Inspection Summary

outfall	25-Feb-00	07-Mar-00	10-Mar-00	13-Mar-00	14-Mar-00	21-Mar-00	22-Mar-00	28-Mar-00	01-Apr-00	03-Apr-00	14-Apr-00	15-Apr-00	21-Apr-00	04-May-00
SDE4		M (N)			s (N)					M (N)	s (N)	M (N)		
SDS1							s (N)						s (N)	
SDS2														
SDS3					s (N)					M (N)				
SDS4								M (N)	M (N)					
SDS7														M (N)
SDS5														M (N)
SDS6														M (N)
SDN3														
SDN4		M (N)		M (N)						N.A. (N)	s (N)	M (N)		
SDN2						M (N)								M (N)
SDN1						s (N)	s (N)			M (N)	s (N)	M (N)		
EY			M (N)											
TY	s (N)													
N.Cargo														

S= Sample
N.A. = sampled but not analyzed
D = duplicate taken
B = blank taken
M = visited for set up or for maintenance
(N) = Information from site visit log book
D.L. = Data download from meter
* = info from chain of custody

AR 012853

Port of Seattle

1999-2000
Wet Season Outfall Inspection Summary

outfall	10-May-00	11-May-00	18-May-00	19-May-00	08-Jun-00	09-Jun-00	11-Jun-00	13-Jun-00	20-Jun-00	26-Jun-00	29-Jun-00	30-Jun-00	01-Jul-00	03-Jul-00
SDE4						M (N)	M (N)							S (N)
SDS1														
SDS2	M (N)		M (N)	M (N)							M (N)			S (N)
SDS3						M (N)	M (N)		M (N)					
SDS4														
SDS7						M (N)	M (N)	M (N)						
SDS5						M (N)	M (N)	M (N)						
SDS6						M (N)	M (N)	M (N)						
SDN3													M (N)	
SDN4										M (N)				
SDN2	M (N)	M (N)	M (N)				M (N)			M (N)		M (N)		
SDN1					M (N)		M (N)						M (N)	S (N)D
EY														
TY														
N.Cargo		D.L.												

S= Sample
N.A. = sampled but not analyzed
D = duplicate taken
B = blank taken
M = visited for set up or for maintenance
(N) = Information from site visit log book
D.L. = Data download from meter
* = info from chain of custody

AR 012854

Port of Seattle

1999-2000
Wet Season Outfall Inspection Summary

outfall	04-Jul-00	05-Jul-00	11-Jul-00	20-Jul-00	21-Jul-00	24-Jul-00	25-Jul-00	04-Aug-00	08-Aug-00
SDE4							M (N)		M (N)
SDS1						M (N)			
SDS2						M (N)			
SDS3									M (N)
SDS4				M (N)		M (N)			M (N)
SDS7					M (N)				
SDS5					M (N)				
SDS6					M (N)				
SDN3	S (N)	M (N)			M (N)				M (N)
SDN4			N.A. (N)			M (N)			
SDN2							M (N)		
SDN1									
EY					M (N)				M (N)
TY					M (N)				M (N)
N.Cargo								D.L.	

S= Sample
N.A. = sampled but not analyzed
D = duplicate taken
B = blank taken
M = visited for set up or for maintenance

(N) = Information from site visit log book
D.L. = Data download from meter
* = info from chain of custody

AR 012855

C

WATER EFFECT RATIO SCREENING STUDY

AT SEATTLE-TACOMA INTERNATIONAL AIRPORT:

TOXICITY EVALUATION OF SITE WATER

Prepared for

PORT OF SEATTLE
Seattle-Tacoma International Airport
P.O. Box 68727
Seattle, Washington 98168-0727

Prepared by

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FEBRUARY 1999

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1. INTRODUCTION

This report summarizes the procedures and results of biological testing conducted on site water from Seattle-Tacoma International Airport (STIA) for the Port of Seattle (POS). The purpose of these tests is to provide screening-level toxicity information in anticipation of formal tests that will be used to set site-specific water quality standards via a water effect ratio. Site water consisted of receiving water, outfall discharge, and a mixture of the two.

All biological testing was conducted by Parametrix's Environmental Toxicology Laboratory in Kirkland, Washington. Analytical chemistry was provided by Aquatic Research Incorporated in Seattle, Washington.

2. SAMPLE SOURCE AND HANDLING

Samples were collected according to the Storm Water Quality Sampling and Analysis Plan (SAP) dated December 11, 1998. Highlights of these procedures, as well as minor deviations from this plan, are described below. Pertinent client and sampling/test information is summarized in Table 1.

Table 1. Screening-level study: summary information.

Client name	Port of Seattle
Parametrix job number	55-2912-01 (61)
Date of sampling	January 14, 1999
Toxicity testing requirements	Acute screening-level *Ceriodaphnia dubia* bioassays
Sample location	Seattle-Tacoma International Airport
Name of receiving water	**Miller Creek Upstream** of Lake Reba **Miller Creek Downstream** (@ 8th Ave. S.) **Lake Reba Outfall** to Miller Creek **Walker Creek** @ SR 509 **East Branch Des Moines Creek** @ fork **West Branch Des Moines Creek** near fork **STIA Outfall SDS-3** (005) **City of Sea-Tac Storm Outfall** to NW Ponds
Samples collected by	Ron Simmons, Justin Kophs

Samples were collected at eight locations (Table 1) during a storm event (as defined in the *POS Procedure Manual for Stormwater Monitoring*) on the morning of 14 January 1999. The antecedent dry period preceding this storm was 86 hours. Precipitation started at 1600 on 13 January and ended at 1600 on 14 January 1999; samples were taken from approximately 0700 to 1000 on 14 January. Approximately 1.18 inches of rain fell at STIA during this 24-hour storm. Rainfall intensity increased from the beginning of the event through the three-hour period in which the grab samples were collected.

Parametrix staff collected two-liter grab samples at 15-minute intervals over a three-hour period from seven of the eight sampling sites. Field staff approached sampling locations carefully from downstream to avoid stirring up sediment and compromising sample integrity. Water level (stage) was measured in the culvert immediately following each grab sample. Temperature and pH measurements were recorded at least once during the three-hour event at each location. Field data (i.e., date and time) were recorded in field data logbooks currently located in project files at Parametrix.

POS staff collected samples at the eighth location (SDS-3), with an ISCO sampler programmed to take flow-weighted composite samples.

Samples were placed on ice immediately after collection, and delivered to the Parametrix laboratory shortly after collection of the last grab sample at each location. Within 4 hours of receipt by the laboratory, all grab samples were flow-weight-composited into a 10-liter cubitainer based on flow estimates. Flow at each location was estimated by entering stage measurements into the Manning or empirical stage-discharge equations.

Sample water from SDS-3 was mixed with sample water from Miller Creek Downstream and Walker Creek sites to represent the proposed ratio of Third Runway stormwater to receiving water. SDS-3 stormwater, which almost exclusively drains runways, taxiways, and infields, is assumed to be representative of future stormwater from the Third Runway. The proportions of these mixes were estimated to be 1 part SDS-3 to 5 parts Miller Creek Downstream, and 4 parts SDS-3 to 1 part Walker Creek based on hydrographs generated using HSPF.

Subsamples for analytical chemistry were decanted from the ten composited samples into clean bottles provided by Aquatic Research (samples volumes for dissolved analyses were filtered through a 0.45 μm filter), immediately after compositing and mixing. The subsamples were delivered to Aquatic Research with completed chain-of-custody forms on 15 January at 1300, approximately 30 hours after collection.

Two liters of each sample were used by Parametrix for the 48-hour acute screening-level bioassays.

Quality assurance and quality control elements addressed during sample collection included:

- bottles labeled with the location and interval designation,
- bottles rinsed three times with ambient water,
- samples collected in new (or cleaned by the analytical lab) HDPE bottles,
- bottles inverted before being placed in water for rinses and grabs (to minimize collection of surface water),
- interval samples placed in a cooler with ice to maintain the samples at 4°C.

3. SCREENING-LEVEL BIOASSAYS

Two liters of each sample were used by Parametrix for the 48-hour acute screening-level bioassay. Test conditions are summarized in Table 2.

Table 2. Summary of test conditions for the acute screening-level *Ceriodaphnia dubia* bioassay.

Test Dates	15-17 January 1999
Test Protocol	Washington State Department of Ecology, WAC Chapter 173-205, 1993; WDOE Publication No. WQ-R-95-80; and *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (USEPA 1993).
Test Material	Composite samples of site water from at Seattle-Tacoma International Airport
Test Organisms/Age	*Ceriodaphnia dubia* (water flea); ≤ 24 hours at initiation
Source of Organisms	In-house cultures
Acclimation Period	None
Number/Test Chamber	5
Volume/Test Chamber	25 mL
Test Concentrations	0 and 100% site water
Replicates	Four
Reference Toxicant	Copper as copper sulfate
Test Duration	48 hours
Control/Dilution Media	Natural spring water; Gold Creek Trout Farm, Woodinville, Washington (80-100 mg/L hardness as $CaCO_3$)
Preparation Date of Control/ Dilution Water	12 January 1999
Pretreatment of Dilution Water	None
Test Chambers	30 mL polypropylene cups
Lighting	Fluorescent bulbs (50-100 foot candles)
Photoperiod	16 hours light; 8 hours dark
Aeration	None
Feeding	None
Renewal	None
Temperature	20 ± 1°C
Chemical Data	Dissolved oxygen, temperature, and pH at test initiation and every 24 hours; conductivity at test initiation and termination; hardness, alkalinity, salinity, ammonia, and residual chlorine at test initiation for 100% site water
Effect Measured	Mortality
Test Acceptability	Control mortality ≤10%
Endpoints reported	Percent survival in 100% site water Lowest observed effect concentration (LOEC) No observed effect concentration (NOEC)

4. RESULTS

Records of biological and chemical data collected during testing and the statistical analyses used for reporting are included in Appendix A of this report. Water quality parameters are reported in Appendix B. Hydrographs for Miller and Walker Creeks were generated using HSPF and are included in Appendix C of this report.

Bioassay results are summarized in Table 3 below. Overall, there was 100% survival in 100% site water for all ten tests, NOECs of 100% site water and LOECs of >100% site water. Control responses and reference toxicant results were within acceptable ranges for all ten tests.

Table 3. Summary of bioassay results.

Sample	Percent Survival 100% Site Water	NOEC	LOEC
Miller Creek Downstream	100	100	<100
Miller Creek Upstream	100	100	<100
STIA Outfall SDS-3	100	100	<100
City of Sea-Tac Storm Outfalls	100	100	<100
Walker Creek	100	100	<100
Des Moines Creek -West	100	100	<100
Des Moines Creek -East	100	100	<100
Lake Reba	100	100	<100
Mixture: SDS-3 + Miller Downstream	100	100	<100
Mixture: SDS-3 + Walker Creek	100	100	<100

5. REFERENCES

U.S. EPA. 1993. Methods for measuring the acute toxicity of effluents and receiving waters to freshwater and marine organisms. EPA/600/4-90/027F, August 1993. U.S. Environmental Protection Agency, Cincinnati, Ohio.

WDOE. 1997. Laboratory guidance and whole effluent toxicity test review criteria. Washington State Department of Ecology, Publication No. WQ-R-95-80. Revised March 1997.

APPENDIX A

ACUTE SCREENING-LEVEL *Ceriodaphnia dubia* BIOASSAY DATA

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: MC
Test Dates: 1/15-1/17/99

Sample Collection Date: 1/14/99
Test Initiation Time: 1400
Source/Age of Organisms: In house, <24 hours

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.3	8.4	8.4	8.9	8.7	327	261
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.6	8.3	8.4	8.5	8.8	8.7	131	136
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JP	BQB	BQB	HM	BQB	BQB	HM	BQB	BQB	HM	BQB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

DEW

Comments

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS

Sample: ~~MCB~~ MC U JP 1/15

Test Dates: 1/15-1/17/99

Sample Collection Date: 1/14/99

Test Initiation Time: 1400

Source/Age of Organisms: In house, <24 hours

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
		0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.3	8.4	8.4	8.9	8.7	327	261
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.8	8.4	8.4	8.7	8.8	8.7	82	163
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JP	BJB	BJB	JP	BJB	BJB	[illegible]	BJB	BJB	JP	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments

2144 [illegible]

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: SDS3
Test Dates: 1-15-99 – 1/17/99

Sample Collection Date: 1/14/99
Test Inititation Time: 1400
Source/Age of Organisms: In house, <24 hours

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.2	8.2	8.3	8.4	9.0	8.8	327	365
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.5	8.4	8.4	8.9	9.0	8.8	53	108
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JC	BJB	BJB	HM	BJB	BJB	HM	BJB	BJB	HM	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments

DEO

AR 012866

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS

Sample: ~~MCB~~ MC U JP 1/15

Test Dates: 1/15 - 1/17/99

Sample Collection Date: 1/14/99

Test Initiation Time: 1400

Source/Age of Organisms: In house, <24 hours

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.2	8.3	8.4	8.4	8.9	8.7	327	261
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.8	8.4	8.4	8.7	8.8	8.7	82	163
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JP	BJB	BJB	JP	BJB	BJB	HM	BJB	BJB	JP	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments

2144 DW

AR 012867

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: SDS3
Test Dates: 1-15-99 - 1/17/99

Sample Collection Date: 1/14/99
Test Initiation Time: 1400
Source/Age of Organisms: In house, <24 hours

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.2	8.2	8.3	8.4	9.0	8.8	327	365
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.5	8.4	8.4	8.9	9.0	8.8	53	108
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JC	BJB	BJB	HM	BJB	BJB	HM	BJB	BJB	HM	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments ______ DEO

AR 012868

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: STO
Test Dates: 1/15/99 – 1/17/99

Sample Collection Date: 1/14/99
Test Initiation Time: 1400
Source/Age of Organisms: In house, <24 hrs

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	Number of Organisms 24	Number of Organisms 48	pH 0	pH 24	pH 48	Dissolved Oxygen (mg/L) 0	Dissolved Oxygen (mg/L) 24	Dissolved Oxygen (mg/L) 48	Specific Conductivity (µS) 0	Specific Conductivity (µS) 48
Control	A	5	5	5	8.7	8.2	8.3	8.4	9.0	8.8	327	305
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100 %	A	5	5	5	7.5	8.3	8.4	8.3	8.9	8.8	166	77
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JP	BJB	BJB	HM	BJB	BJB	HM	BJB	BJB	HM	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.
NT = Not Taken

Comments ______________________________ DEW

AR 012869

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: WC
Test Dates: 1/15 - 1/17/99

Sample Collection Date: 1/14/99
Test Inititation Time: 1400
Source/Age of Organisms: In house, <24 hrs

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.2	8.2	8.2	8.4	9.0	9.0	327	399
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.7	8.2	8.2	8.8	9.0	9.0	131	183
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	[illegible]	BJB	BJB	HM	BJB	BJB	HM	BJB	BJB	HM	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments

AR 012870

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: DMC-west
Test Dates: 1/15-1/17/99

Sample Collection Date: 1/14/99
Test Initiation Time: 1400
Source/Age of Organisms: In house, <24 hrs

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.2	8.2	8.2	8.4	9.0	9.0	327	399
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.4	8.3	8.3	8.6	9.0	9.0	159	89
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JC	BGB	BGB	AM	BGB	BGB	AM	BGB	BGB	AM	BGB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: DMC-east
Test Dates: 1/15-1/17/99

Sample Collection Date: 1/14/99
Test Inititation Time: 1400
Source/Age of Organisms: In house, <24 hours

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

		Number of Organisms			pH			Dissolved Oxygen (mg/L)			Specific Conductivity (µS)	
Conc.	Rep.	0	24	48	0	24	48	0	24	48	0	48
Control	A	5	5	5	8.2	8.3	8.2	8.4	9.0	9.1	327	414
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.6	8.4	8.3	8.8	9.0	9.1	52	80
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JC	BJB	BJB	HM	BJB	BJB	HM	BJB	BJB	HM	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.
NT = Not Taken

DEO

Comments

AR 012872

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: POS
Sample: LR
Test Dates: 1/15 - 1/17/99

Sample Collection Date: 1/14/99
Test Initiation Time: 1400
Source/Age of Organisms: In house, <24 hrs

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.7	8.3	8.2	8.4	9.0	9.1	327	414
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.6	8.5	8.4	8.7	9.0	9.1	251	314
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	JP	BQB	BQB	HM	BQB	BQB	HM	BQB	BQB	HM	BQB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.
NT = Not Taken

Comments

2150 DEO

STATIC ACUTE *Cerlodaphnia dubia* TOXICITY TEST

Client: POS
Sample: SDS3 - MC
Test Dates: 1/15/99 - 1/17/99

Sample Collection Date: 1/14/99
Test Initiation Time: 1400
Source/Age of Organisms: In house, <24h

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.2	8.1	8.5	8.4	9.0	9.2	327	319
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100%	A	5	5	5	7.1	8.2	8.5	8.9	8.9	9.2	118	199
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	[illegible]	BJB	BJB	AM	BJB	BJB	AM	BJB	BJB	AM	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.

NT = Not Taken

Comments

AR 012874

STATIC ACUTE *Ceriodaphnia dubia* TOXICITY TEST

Client: IOS
Sample: SDS3- WC
Test Dates: 1-15-99 -1/17/99

Sample Collection Date: 1/14/99
Test Initiation Time: 1400
Source/Age of Organisms: In house ≤ 24 hrs

Temp (°C) Day 0: 20 Day 1: 20 Day 2: 20

Conc.	Rep.	Number of Organisms 0	24	48	pH 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	Specific Conductivity (µS) 0	48
Control	A	5	5	5	8.2	8.1	8.5	8.4	9.0	9.2	327	319
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
100 %	A	5	5	5	6.9	8.3	8.5	8.9	8.8	9.1	70	107
	B	5	5	5								
	C	5	5	5								
	D	5	5	5								
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	A											
	B											
	C											
	D											
	Initials	Au	BJB	BJB	HM	BJB	BJB	HM	BJB	BJB	HM	BJB
	Date	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/16	1/17	1/15	1/17

Shading represents areas for which data collection is not required.
NT = Not Taken

Comments

APPENDIX B

FIELD-MEASURED WATER QUALITY PARAMETERS

Initial chemical and physical determinations in 100% site water.

Parameter Measured	SDS-3	STO	WC	MC	DMC-W
Temperature (°C)	8	4	4	4	4
Salinity (ppt)	0	0	0	0	0
Dissolved oxygen (mg/L)	11.0	11.0	11.6	11.8	8.5
pH	6.8	8.1	7.8	7.7	7.5
Conductivity (μS)	52	58	130	128	155
Total hardness (mg/L as $CaCO_3$)	20	28	50	56	60
Total alkalinity (mg/L as $CaCO_3$)	22	32	48	48	86
Total residual chlorine (mg/L)	0.04	0.02	0.02	0.05	0.06
Ammonia (mg/L)[1]	<1	<1	<1	<1	<1

[1] La Motte colorimetric test kit, Detection Limit 1 mg/L

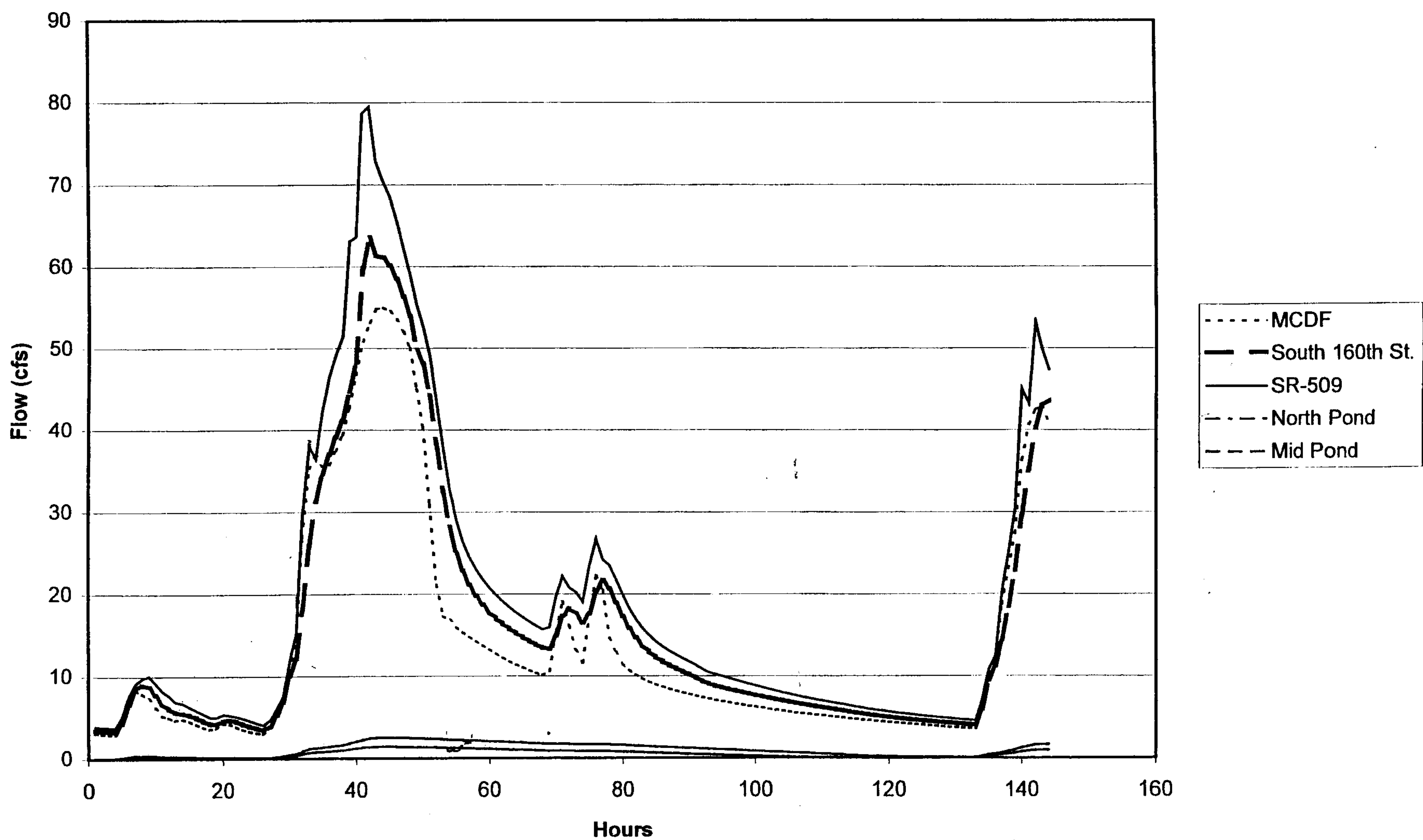
Parameter Measured	DMC-E	LR	MCB	SDS-3 + MC	SDS-3 + WC
Temperature (°C)	4	4	4	4	4
Salinity (ppt)	0	0	0	0	0
Dissolved oxygen (mg/L)	11.7	10.0	11.1	9.2	9.1
pH	7.7	7.4	7.6	6.9	6.9
Conductivity (μS)	49	245	80	123	71
Total hardness (mg/L as $CaCO_3$)	38	112	32	44	26
Total alkalinity (mg/L as $CaCO_3$)	22	112	38	68	30
Total residual chlorine (mg/L)	0.02	0.03	0.03	0.07	0.05
Ammonia (mg/L)[1]	<1	<1	<1	<1	<1

[1] La Motte colorimetric test kit, Detection Limit 1 mg/L

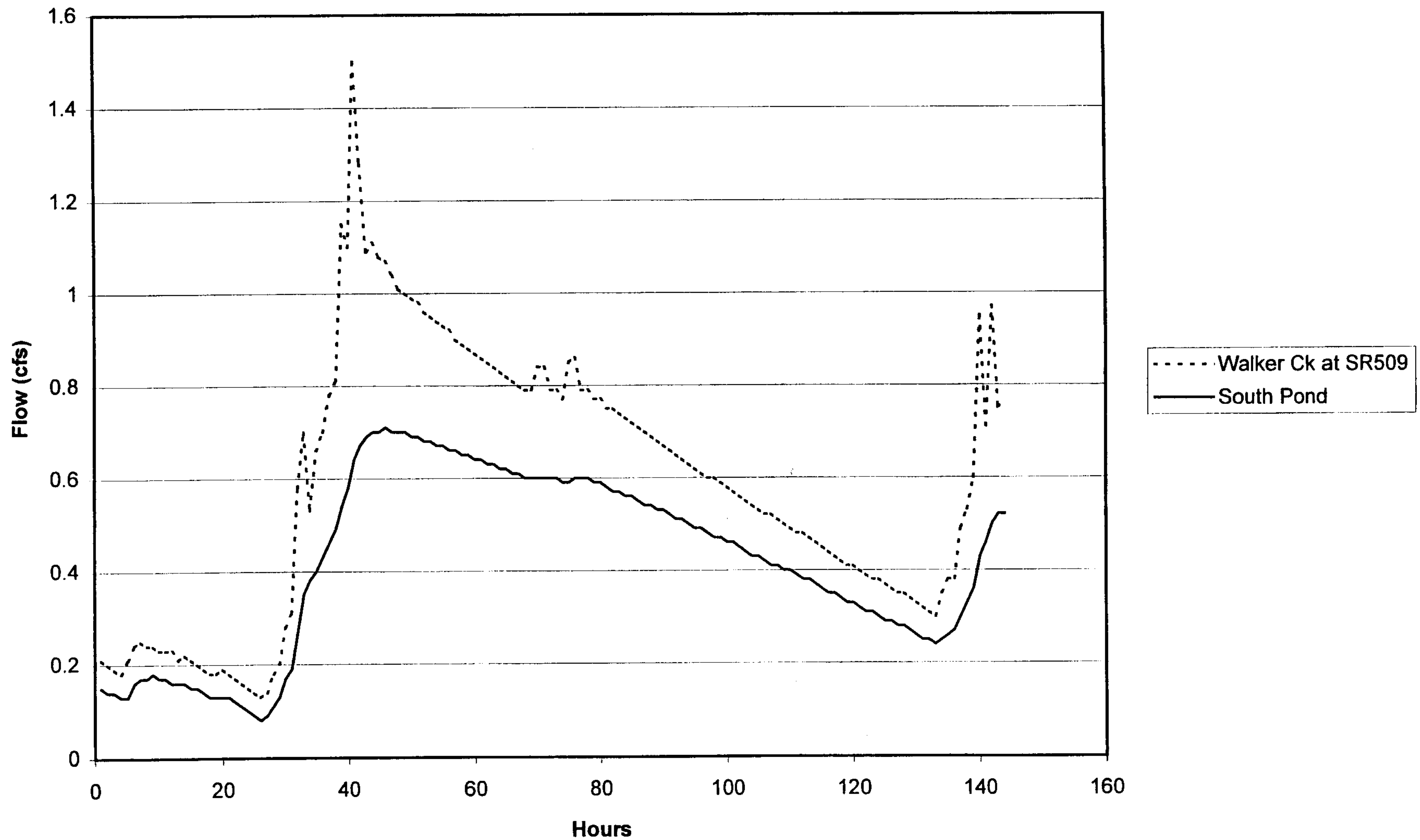
APPENDIX C

MILLER CREEK AND PROPOSED THIRD RUNWAY OUTFALL HYDROGRAPHS, 2-YEAR STORM

Miller Creek 2-Year Flood Event



Walker Creek 2-Year Flood Event



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Port of Seattle

Stormwater Whole Effluent Toxicity (WET) Testing at Seattle-Tacoma International Airport

Final Report

May 2000

Port of Seattle

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The Port thanks the staff of Taylor Associates for their diligence, skill and ingenuity in stormwater sample collection, Aquatic Research, Incorporated for their flexibility and availability in handling the analytical work, and Parametrix, Incorporated for their high quality support in WET testing and for assisting with the novel approach for source-tracing.

1 EXECUTIVE SUMMARY

During a twelve month period in 1998-99, the Port of Seattle characterized the whole effluent toxicity (WET) of at least two stormwater samples from four outfalls at Sea-Tac International Airport (STIA.) This WET testing satisfies the requirements of Special Condition S10 of the Port's NPDES permit (WA-002465-1.) The WET tests used two aquatic organisms, a water flea (Daphnia *pulex*.) and the fathead minnow (Pimephales *promelas*) to characterize the acute toxicity of flow-weighted composite stormwater samples taken during two different storm events. Two of these outfalls were sampled on additional occasions to corroborate results from the first two tests. The Port has previously submitted the WET testing data to Ecology. This final report summarizes all results and subsequent information gathered pursuant to the permit requirement.

Subbasins SDE4 (002), SDS3 (005), SDN1 (006) and SDN4 (011) were sampled for WET testing. All test results for outfalls SDS3 and SDN4 met the Washington Department of Ecology performance standards for survival for each organism. These two outfalls drain 79% (492 ac) of the airfield runways and taxiways, or 51% of the total storm drainage area of the airport. Nine of ten test results for outfall SDE4, which drains 149 acres mostly consisting of access roadways and the terminal and cargo building rooftops, also met the performance standards. One of the fathead minnow results for an SDE4 sample fell just below the performance standard. In contrast, seven of nine WET results for outfall SDN1 fell below the performance standards and led to a subsequent source-tracing investigation.

Supplemental sampling and analysis indicated that metals were the primary source of toxicity in the SDN1 samples. After removal of metals by chelation with EDTA, survival improved dramatically. Comparing these results to the available literature indicated that zinc was the likely source of toxicity. Further investigations revealed that about 2 acres of zinc-galvanized metal rooftop on the two AFCO Air Cargo buildings was the principal source of the zinc. Synthetic runoff samples obtained by spraying domestic water on the rooftops also exhibited toxicity and considerable zinc.. The Port is investigating alternatives to remedy the apparent source of toxicity originating from a tenant-owned facility. Follow up sampling will demonstrate the effectiveness of the remedy selected.

2 INTRODUCTION

The Port of Seattle owns and operates Seattle-Tacoma International Airport (STIA) which lies about midway between the cities of Seattle and Tacoma, Washington. The airport was built in the 1940s and expanded throughout the years to become the 18th busiest airport in the U.S. (POS, 1999a.) As the airport grew, the areas surrounding the airport urbanized and incorporated as the cities of Seatac, Des Moines, and Burien.

STIA storm drainage discharges from 14 principal subbasins through a variety of outfalls; four that drain to Miller Creek[1], eight that drain to Des Moines Creek, and two that drain to a City of Seatac stormwater system. The storm drain system (SDS) connected to these outfalls drains a 963 acre area, which contains about 44% impervious surfaces. Another 370 acres of impervious surfaces where aircraft are serviced (terminal gates and ramps) drain to the Industrial Wastewater System (IWS) and the Industrial Wastewater Treatment Plant (IWTP.) The IWTP discharges directly to Puget Sound through a marine outfall that combines discharges from the nearby Midway Sewage Treatment plant. The IWTP was not monitored as part of the WET testing, therefore this report pertains only to SDS discharges.

In 1994, the Port secured a National Pollutant Discharge Elimination System (NPDES) permit for the stormwater and IWTP discharges. The required intensive stormwater monitoring program has been in place since 1994, and has generated a considerable volume of sample data. As another part of this permit, the Port implements a Stormwater Pollution Prevention Plan (SWPPP, POS 1998) and stormwater best management practices (BMPs.) The permit was renewed in 1997 and a revised permit took effect in March 1998. Special

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[1] Miller and Des Moines Creeks flow directly to Puget Sound.

Condition S10 of the Port's NPDES permit requires the Port to conduct WET testing on stormwater samples from subbasins SDE4, SDS3, SDN4 and SDN1 for two storm events. These four subbasins encompass 68% of the total SDS service area and contain most of the landside and airfield activity.

2.1 WET Testing Background

In Washington state, only eleven NPDES permittees have performed WET testing on stormwater or a mix of stormwater and industrial wastewater (WDOE, 1998a.) WET testing is a common compliance requirement for point source wastewater discharges such as pulp mills and wastewater treatment plants. WET testing improves upon chemical-specific testing because it measures aggregate toxicity, or lack thereof, addresses unknown toxicants, and takes bioavailability into account.

In accordance with EPA protocols (EPA, 1991), WET testing at STIA was performed on 100% stormwater samples plus a series of samples tested at specific dilutions. Results are expressed as percent survival for the100% sample plus the LC50, NOEC and LOEC estimates generated by the dilution series[2]. Source-tracing in subbasin SDN1 used 100% (undiluted) samples only

All WET testing was performed by Parametrix, Incorporated, (1999a-e) and followed the state and federal guidelines (WDOE 1998b, EPA 1991.) WET testing and other analyses were initiated within acceptable holding times.

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[2] The LC50 is the concentration of sample where 50% survival of the test organism occurred. The no observed effect concentration (NOEC) is the maximum concentration of the test sample that produces no statistically significant harmful effect on the test organisms compared to controls in a specific test. The lowest observed effect concentration (LOEC) is the lowest concentration that has a statistically significant deleterious effect on test organisms compared to controls in a specific test (Rand, 1995.)

Chemical specific analyses were conducted by Aquatic Research, Incorporated, which is an Ecology-accredited laboratory. All WET testing data reports have been previously submitted to Ecology for review.

2.2 *Sampling Methods*

All samples tested were collected as flow-weighted stormwater composites using ISCO model 3700 automatic samplers and model 4150 or 4230 flowmeters[3]. Samples generally represented the majority of runoff and are thus considered as event-mean concentrations (EMCs), a common term used in the literature to judge intra-event representativeness and inter-event comparability of a stormwater sample. Composite samples taken for the SDN1 source tracing study were collected concurrently using three automatic samplers programmed to sample a similar duration of the hydrograph from each upstream source area. The SDN1 source tracing also used grab samples taken automatically and manually at several of the upstream locations. Quality assurance procedures and quality control samples were adequate to ensure valid results. The results of the Port's routine quality control field blanks and duplicates indicate ongoing effective sampling techniques (POS, 1999c.)

Samples were collected using the "clean techniques" approach for trace metal sampling (EPA method 1669) adapted for stormwater sampling (EPA 1995, POS 1999d.) Results from field equipment blanks indicated that these techniques were generally adequate. Ecology reviewed an outline of the Port's sampling protocol in June 1999 and agreed the sampling procedures satisfied the requirements of clean techniques (POS 1999e.)

---

[3] Sampling procedures for WET testing work were consistent with the Port's routine NPDES stormwater monitoring program, described in the Ecology-approved "Procedure Manual for Stormwater Monitoring at Sea-Tac International Airport, revision 6, April 22, 1999" (POS 1999b)

2.3 STIA Storm Drainage Subbasins

The Port codes STIA storm drainage subbasin names according to location, for example, "SDN1" means "storm drain north number 1." The NPDES permit refers to outfalls by number; however, this report refers to subbasins and their outfalls by location names (both identifiers are used in subsequent tables). The Port also identifies manhole or other specific locations within a particular subbasin according to an alphanumeric scheme. Figure 1 shows the stormwater drainage subbasins.

Two of the subbasins with discharges tested for WET, SDS3 and SDN4 comprise 51% of the total STIA storm drainage area. These two subbasins drain the majority of the airfield runways, taxiways and aircraft "hardstand" areas that make up the airfield operations area (AOA). In contrast, the other two subbasins with discharges WET-tested, SDE4 and SDN1 drain the "landside" areas and comprise 17% of the SDS. These landside areas are mostly associated with passenger vehicles, including public roads such as the airport access freeway, Air Cargo Road and portions of International Boulevard.

Recent Annual Stormwater Monitoring reports showed that the concentrations of metals and other constituents were lower in airfield outfall samples when compared to results from the landside subbasin outfalls (POS, 1996, 1997.) In the past few years, the Port has constructed a number of source-control best management practices (BMPs) that reroute storm drainage to the IWS for a number of airfield and landside areas, including an entire SDS subbasin (SDN2).

3 RESULTS AND DISCUSSION

3.1 General results

Results of the WET tests performed on stormwater samples from outfalls SDE4, SDS3, and SDN4 met Ecology's WET testing performance standards[4]. However, results from outfall SDN1 exhibited aquatic toxicity that was subsequently traced to metals leaching from uncoated galvanized sheet metal rooftops. According to the manufacturer's literature, the coating on this common sheet-steel roofing product contains 43% zinc by weight (Bethlehem Steel, 1995.) Because the WET test results from outfalls SDS3 and SDN4 demonstrated no toxicity, sampling requirements for these two outfalls were completed early in the program during the fall and winter months of 1998-1999. All test results for these 2 outfalls met Ecology's performance standards for individual results so that additional testing was not necessary. Outfalls SDE4 and SDN1 were sampled during additional storms to corroborate results from the first two tests. For SDE4, the additional sampling and WET testing met the required standards. As a result, further testing was not necessary. Of the five samples evaluated for WET for outfall SDE4, the average survival of 96% for the daphnid and 85.8% for the fathead minnow met the Ecology performance standards. However, samples collected from SDN1 continued to exhibit toxicity. As a result, the Port engaged in the SDN1 source-tracing study described below.

Table 1 summarizes WET testing results and lists the relative percent rank for each supplemental analytical result (metals, TSS, etc.). Though not required to do so, the Port analyzed these additional chemical-specific parameters to characterize the WET test samples and compare results with the 5-year data history for each outfall. Because the results were within the ranges of the historical data for each outfall, the WET test samples are considered to be comparable to other historical samples. Appendix A lists the individual sample results and ranks. Table 2 lists the other WET metrics reported: NOEC, LOEC and LC50.

---

[4] According to WAC 173-205, for acute WET tests the average survival in 100% effluent must be at least 80%, and no single sample must have less than 65% survival. For outfall SDE4, one of ten test results exhibited 63% survival, just below the minimum performance standard of 65% survival for a single test.

Table 1 WET Testing Summary

Outfall (#)	Sample date	WET, % survival: daphnid	WET, % survival: fathead	note
SDE4	11/19/98	90	100	
(002)	1/21/99	100	98	2
	2/23/99	95	63	3
	3/24/99	95	98	3
	7/2/99	100	70	3,4
	Average	*96*	*85.8*	
SDS3	11/13/98	90	98	
(005)	1/14/99	80	95	
	Average	*85*	*96.5*	
SDN1	11/13/98	80	40	
(006)	1/14/99	30	78	
	3/24/99	10	63	3
	5/11/99	5	not tested	3,6
	7/2/99	not tested	33	3,4,5
	11/6/99	[illegible]	not tested	3,6
	Average	*37*	*53.5*	
SDN4	11/13/98	75	100	
(007)	1/14/99	100	100	
	Average	*87.5*	*100*	

Shaded values indicate the individual result was below the performance standard of 65% survival.

Notes for Table:

1. all samples were flow-weighted composite stormwater samples
2. SDE4 Jan 20, 1999 sample: fathead test duration was 48-hr instead of 96-hr
3. Retested to corroborate previous results.
4. July 2, 1999 samples: fathead control survival of 72.5% was below the performance standard of >90%.
5. July 2, 1999 SDN1 sample: insufficient # of organisms to start daphnid test.
6. Sample taken for source-tracing

Table 2 Additional WET Test Metrics

Outfall	Sample Date	Test Date	Species	Duration	NOEC	LOEC	LC50	% Survival in 100% Sample
SDN1	11/13/98	11/13/98	*D. pulex*	48 hours	100%	>100%	>100%	80%
(006)	1/14/99	1/15/99	*D. pulex*	48 hours	100%	>100%	85.20%	30%
	3/24/99	3/25/99	*D. pulex*	48 hours	50%	100%	74.00%	10%
	7/2/99	7/3/99	*D. pulex*	*not tested*				
	11/13/98	11/13/98	*P. promelas*	96 hours	50%	100%	89%	40%
	1/14/99	1/15/99	*P. promelas*	96 hours	100%	>100%	>100%	78%
	3/24/99	3/25/99	*P. promelas*	96 hours	50%	100%	>100%	63%
	7/2/99	7/3/99	*P. promelas*	96 hours	50%	100%	88%	33%
SDN4	11/13/98	11/13/98	*D. pulex*	48 hours	100%	>100%	>100%	75%
(011)	1/14/99	1/15/99	*D. pulex*	48 hours	100%	>100%	>100%	100%
	11/13/98	11/13/98	*P. promelas*	96 hours	100%	>100%	>100%	100%
	1/14/99	1/15/99	*P. promelas*	96 hours	100%	>100%	>100%	100%
SDS3	11/13/98	11/13/98	*D. pulex*	48 hours	100%	>100%	>100%	90%
(005)	1/14/99	1/15/99	*D. pulex*	48 hours	100%	>100%	>100%	80%
	11/13/98	11/13/98	*P. promelas*	96 hours	100%	>100%	>100%	98%
	1/14/99	1/15/99	*P. promelas*	96 hours	100%	>100%	>100%	95%
SDE4	11/19/98	11/20/98	*D. pulex*	48 hours	100%	>100%	>100%	90%
(002)	1/21/99	1/22/99	*D. pulex*	48 hours	100%	>100%	>100%	100%
	2/23/99	2/23/99	*D. pulex*	48 hours	100%	>100%	>100%	95%
	3/24/99	3/25/99	*D. pulex*	48 hours	100%	>100%	>100%	95%
	7/2/99	7/3/00	*D. pulex*	48 hours	100%	>100%	>100%	100%
	11/19/98	11/20/98	*P. promelas*	96 hours	100%	>100%	>100%	100%
	1/21/99	1/22/99	*P. promelas*	*48 hours*	100%	>100%	>100%	98%
	2/23/99	2/23/99	*P. promelas*	96 hours	25%	50%	>100%	63%
	3/24/99	3/25/99	*P. promelas*	96 hours	100%	>100%	>100%	98%
	7/2/99	7/3/99	*P. promelas*	96 hours	100%	>100%	>100%	70%*

* in this test, survival in the control of 72.5% did not meet minimum acceptability criterion of 90%

3.2 SDN1 source-tracing

Additional stormwater samples collected from outfall SDN1 continued to exhibit toxicity.. To address this, the Port developed a multiphase source-tracing study using additional stormwater sampling and testing. The approach used concurrent WET testing and chemical-specific analysis of stormwater samples to reveal clues about specific sources of toxicity. Because the first three samples showed that the daphnia were more sensitive, source-tracing samples were tested using only Daphnia *pulex* in 100% sample concentration.

Because stormwater from SDN1 has historically exhibited higher zinc concentrations than other outfalls (see Figure 2), this metal was suspected as a potential source of toxicity. Note the considerable number of historical samples (twenty for SDN1) denoted by "N=" below each boxplot in the figure. Based on this information, this additional effort focused on metals and used a chelation technique to determine if particular metals were responsible for any toxicity observed in these subsequent WET tests[5]. During these additional sampling events in SDN1, upstream source area runoff samples were also tested to determine where and under what conditions the problems occurred. These potential source areas upstream of the SDN1 sampling location isolate runoff from the Transiplex rooftops (a total of 4 buildings), AFCO cargo building rooftops (2 buildings), and Air Cargo Road (which also contains runoff from the recently constructed east expansion of the FedEx building rooftop.)

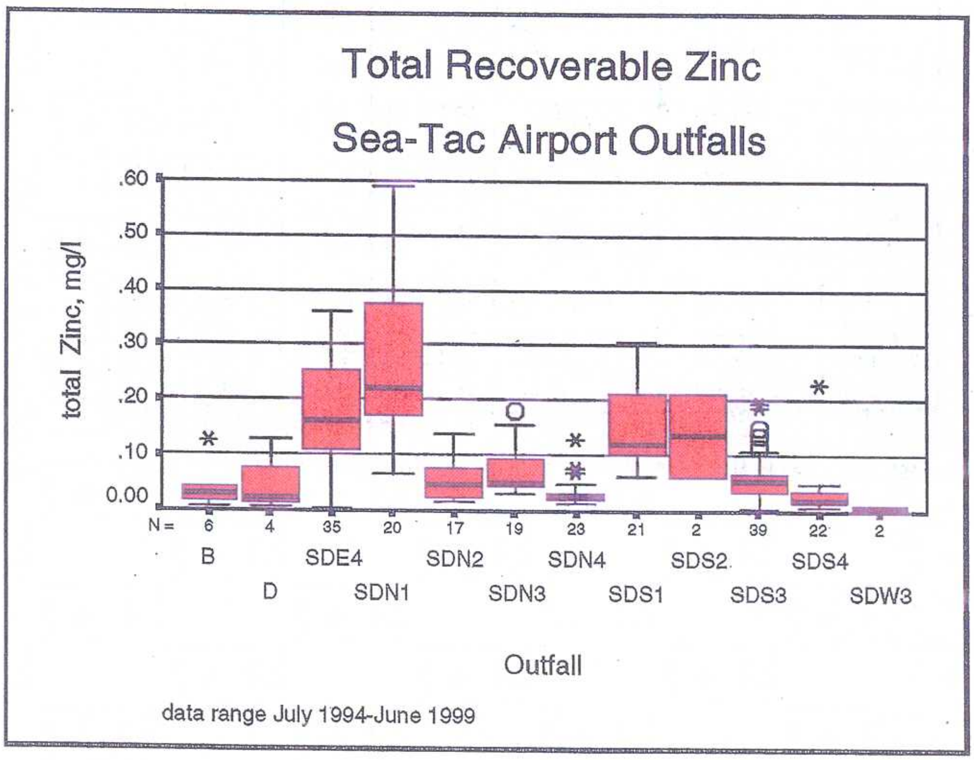

Figure 2 Boxplot of Zinc in STIA Stormwater Samples

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[5] Chelation is the chemical process whereby ions, free metals in this case, are rendered non-bioavailable by binding to a host molecule that forms a stable complex. Free metal ions that are "bioavailable" are the form generally considered to be responsible for toxicity to aquatic organisms.

3.2.1 Summary of source-tracing results

Initial source-tracing and metals chelation confirmed that zinc was the principal, if not sole toxicant present. Total recoverable (TR) zinc concentrations ranged from 120 to 487 µg/l which were within the 11^{th} to 78^{th} percentiles of historical data for SDN1. In four composite samples tested, dissolved zinc ranged from 33 to 117 µg/l, and comprised 18 to 58% of the total zinc. These SDN1 samples generally had higher dissolved zinc than samples from the other outfalls subject to WET testing where dissolved zinc ranged from 12 to 49 µg/l (see Appendix A.) The discussions below focus on metals, because in general other constituents were not associated with survival. Appendix C summarizes the source tracing sample results.

Treating the SDN1 samples with chelating agents that bind dissolved metals confirmed that metals were the principal source of toxicity, with specific indications for zinc. Samples taken from SDN1 drainage isolated from specific rooftops and other contributory areas indicated that the zinc was primarily associated with uncoated galvanized rooftops of the AFCO cargo buildings, but not the nearby non-metal rooftops of the five nearby Transiplex buildings. Synthetic storm runoff samples obtained after spraying domestic water on the AFCO rooftops showed zinc concentrations and toxicity similar to the actual storm samples. The domestic water was not toxic and had about 15 times less zinc than the synthetic runoff sample. These results indicated that the AFCO rooftops were the principal source of zinc. However, other, less significant sources may exist in the SDN1 subbasin. Once the primary source of toxicity (AFCO rooftops) is eliminated, additional sampling should be preformed to determine the effectiveness of the solution. If SDN1 discharges continue to fall below the WET performance standards, additional sampling and source tracing should be undertaken.

The following sections provide details on the sampling, analysis and results of the source tracing as well as a discussion of the potential sources of toxicity.

3.2.2 Field Investigations

Plans and field investigations verified that only reinforced concrete pipe (RCP) and plastic (PVC) piping is used in the SDN1 drainage area studied. None of this drainage passed through corrugated metal pipe (CMP), a potential source of zinc due to galvanized coatings. Also, unlike the other subbasins evaluated for WET, drainage maps and field conditions show that SDN1 runoff receives little to no contact with vegetation and soils; runoff flows directly from the impervious surfaces into the constructed drainage system. Appendix B contains photographs showing the general layout of the SDN1 area under study.

AFCO Cargo Buildings and Their Drainage

Building plans indicated that the two AFCO buildings were constructed about 1989. The plans[6] called for roofing material using uncoated galvanized sheet-steel roofing (POS 1990, Bethlehem Steel, 1995.) Field reconnaissance verified that indeed the roofing material on AFCO building #2 was galvanized and uncoated. According to STIA drainage maps the total roof area is about 2.2 acres, which is similar to the building plans. Because both buildings were designed and built as part of the same project, the as-built conditions of the roofing material on AFCO building #2 are assumed to be the same as that on building #1.

These rooftops represent 25% of the total SDN1 area draining to manhole SDN1-41, the current subbasin SDN1 sampling station for NPDES permit compliance (see Figure 3 and Figure 4.) Other field inspections verified that drainage from these rooftops was the principal discharge present in the 10 inch RCP inlet to manhole SDN1-41 from SDN1-34. The rooftop is in good condition, and has about eight small ventilation stacks, a single air conditioning unit, and no other equipment installed. See the photographs in Appendix B.

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[6] STIA drawing 9029 indicates that the building fabricator was Ruffin Pre-Fab, Inc., of Oak Grove, LA. During a telephone call to this company, a Ruffin employee indicated his familiarity with the AFCO building (previously known as "Avia") project and supplied the material specification cited above.

Other minor amounts of runoff from an area of about 500 square feet of pavement along the East side of this building at loading dock numbers E9 to E13 (see Appendix B) also combines with the AFCO Air Cargo building rooftop drainage. To prevent this drainage from influencing the subsequent samples taken in this study, the outlet of the trench drain that receives this runoff was blocked beginning in June 1999. Ponding due to this blockage did not occur because the affected runoff flows immediately to the adjacent trench drain along loading docks E7 to E9. This second trench drain connects to the IWS, unlike the former which should be considered for a drainage reroute from SDN1 to the IWS. These drainage connections were verified during dry-weather flow and/or dye testing in March 1999.

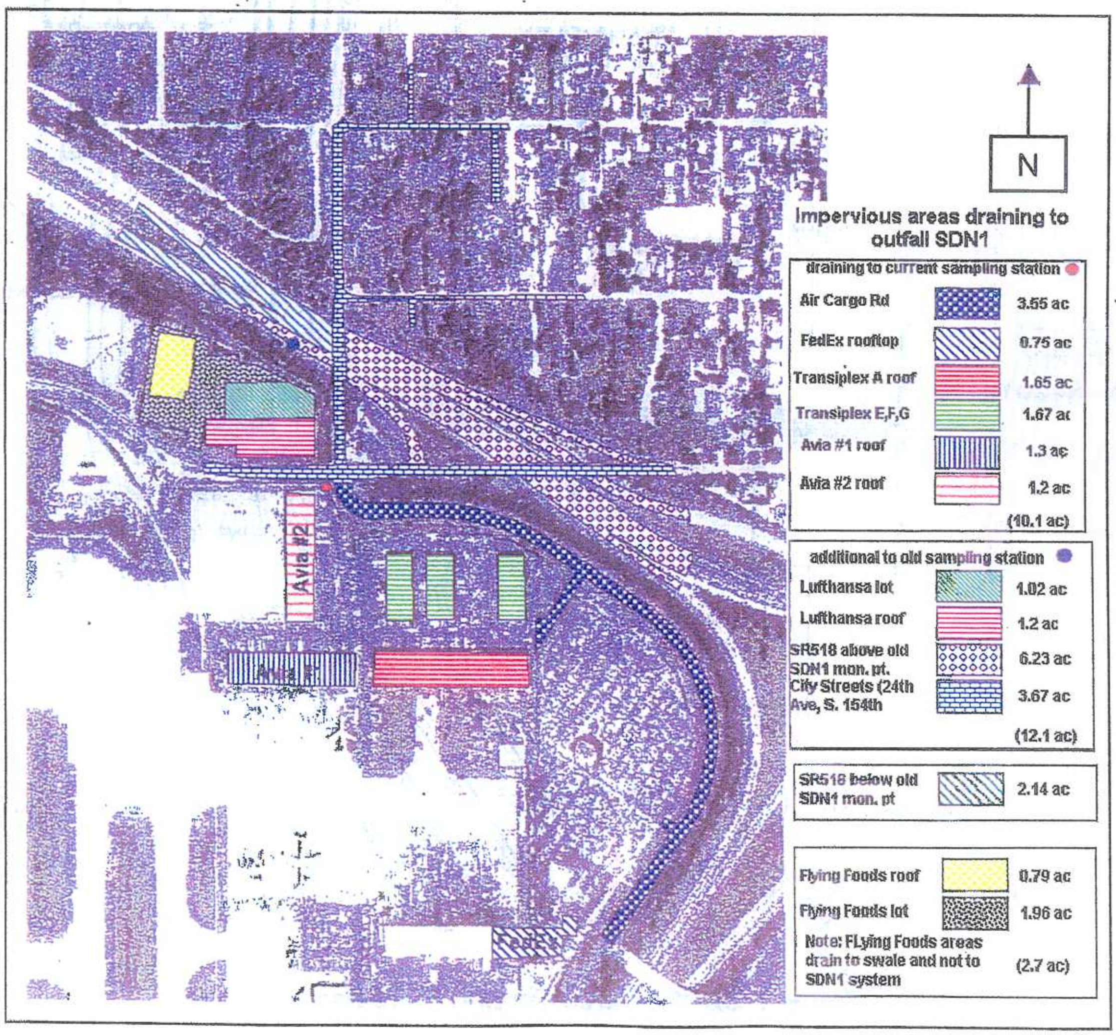

Figure 3 SDN1 Subbasin Map

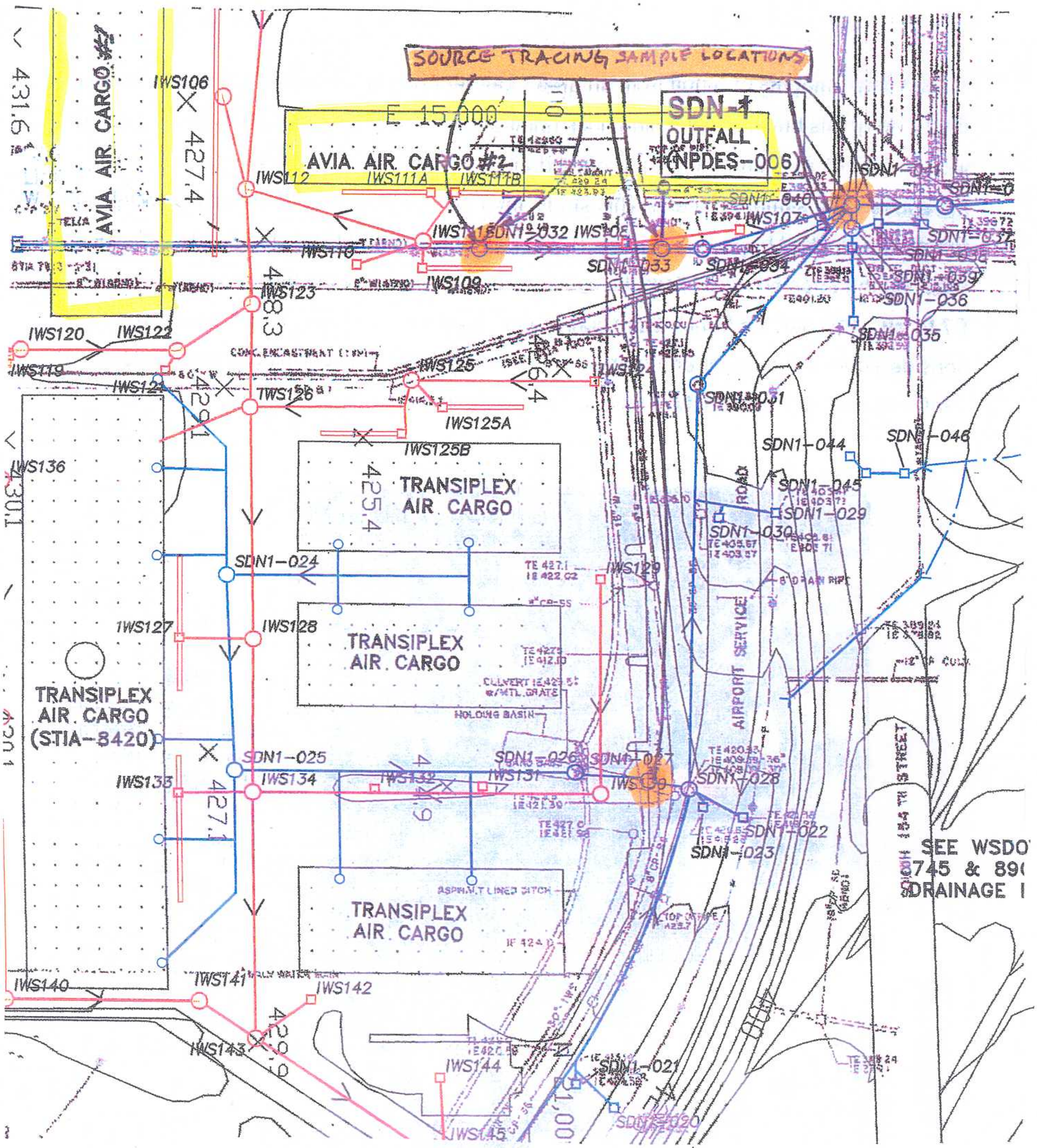

Figure 4 SDN1 Source Tracing Sampling Locations
(SDN1 piping shown in blue)

3.2.3 Sampling Locations

Samples were collected primarily in the three pipes in manhole SDN1-41 that aggregate drainage from various source areas. Grab samples were also taken at other manholes further upstream in the system to isolate drainage from specific source areas and determine their relative metals concentrations. These locations are summarized below and shown in Figure 3 and Figure 4.

1. SDN1-41 manhole: 36" RCP outlet to SDN1-042:
   - This is the routine NPDES compliance sampling location for SDN1 that aggregates all upstream POS drainage. Initial indications of toxicity were found here.
2. SDN1-41 manhole: 36" RCP inlet from SDN1-31
   - This pipe aggregates drainage from Air Cargo Road, and the Transiplex and FedEx rooftops, called "road aggregate" below (labeled "41-31" in Appendix C)
3. SDN1-41 manhole: 10" RCP inlet from SDN1-34
   - This pipe aggregates drainage from locations 5, 6, and 7 below (the two AFCO cargo buildings and the loading dock mentioned below (labeled "41-34" in Appendix C))
4. SDN1-27 manhole: 24" RCP inlet from SDN1-26
   - This location isolates drainage from the four Transiplex buildings A, E,F and G rooftops (about 3.3 acres of rooftops)
5. SDN1-32 manhole: 6" PVC inlet about 3 feet below the manhole rim (not shown on Figure 4)
   - This location isolates drainage from the loading dock trench drain along the east side of AFCO building #2 (about 500 square feet of pavement)
6. SDN1-32 manhole: 10" RCP inlet from the south, bottom of structure
   - This location isolates drainage from AFCO building #1 rooftop only
7. SDN1-33 manhole: 6" PVC inlet about 3 feet below the manhole rim
   - This location isolates drainage from AFCO building #2 rooftop only

3.2.4 Initial Screening Samples

To determine the relative concentrations of metals originating from the various source areas, grab samples were collected during an initial screening of runoff the seven locations listed above. Note that locations 2 and 3 aggregate runoff from the multiple source areas upstream of the sampling location where toxicity was indicated during the initial WET testing. Three storm events were sampled in early 1999: January 13 (1.07"), March 8 (0.28") and March 24 (0.28".) During the first and last of these three storms, grab samples were taken during the rising and falling limbs of the runoff event to determine the relative degree of temporal variation. Appendix C contains the sample results that are plotted in Figure 5 and Figure 6 below. For relative comparisons, these figures show historical interquartile ranges (dashed lines for the 25th and 75th percentile) for SDE4, a comparable landside subbasin with considerable roadway and rooftop drainage, but one that did not exhibit WET toxicity. Working left to right in the figures, the results indicate the following[7].

1. Concentrations of copper and zinc in Transiplex rooftop runoff samples showed:
   - consistently lower concentrations than other locations sampled,
   - dissolved zinc generally an order of magnitude below results from the other rooftops,
   - little difference between samples taken at different times during the discharge (denoted by a sequence number after the sample date),
   - little difference among all samples from the three storm events, and
   - results less than the interquartile range from landside outfall SDE4.

2. Runoff from the loading dock trench drain generally had higher copper and zinc than the other source areas tested, and was higher than the median for SDE4.

3. Comparing samples of runoff isolated from each of the two AFCO building rooftops indicates:
   - copper and zinc were similar between the two buildings among the different events,

[7] Because dissolved lead was generally less than detection limits, it is not shown in the figures.

- the second sample of the March 24, 1999 event had more than double the zinc of the earlier sample, and
- despite the presence of the minor runoff from the loading dock trench drain, metals in the aggregate runoff of both AFCO rooftops ("AFCO roofs") were similar to and approximated an average of the samples of runoff isolated from each rooftop ("AFCO #1, AFCO #2".)

4. Comparing the Road and AFCO roofs aggregate samples, results indicate:
   - TR copper was similar and within or below the interquartile range for SDE4,
   - in the Road aggregate samples, TR zinc was within the interquartile range for SDE4, and varied less than the rooftop samples
   - in the AFCO rooftop runoff, TR zinc varied to a greater degree than the road aggregate samples. Two rooftop samples had considerably higher TR zinc than the road samples and exceeded the SDE4 interquartile range.

5. In general, metals were mostly present in the dissolved form in all samples. Dissolved to total recoverable metals ratios for copper and zinc ranged from 0.21 to 0.91, with an average of about 61% dissolved. Total recoverable zinc results from the AFCO building rooftops during the March 24, 1999 event ranged from 66 to 92% dissolved.

6. Overall, hardness was low in all samples, which is not surprising given that the runoff has little to no contact with soil surfaces. In general, lower hardness causes metals to be more toxic at lower concentrations.

Based on these initial findings of the source tracing study, the ensuing work incorporated the following considerations:

- it was unlikely that the Transiplex rooftops contributed toxic concentrations of metals,
- the loading dock trench drain was blocked to exclude this drainage from mixing with the AFCO rooftop drainage during the next source-tracing steps. A permanent BMP should be instituted to remove this drainage from SDN1 as part of the SWPPP (POS 1998), and

- subsequent WET testing and chelation evaluations in this project focused on samples from three locations in manhole SDN1-41: 1) the 10" RCP inlet that aggregates the AFCO rooftop runoff, 2) the 36" RCP inlet that aggregates runoff from Air Cargo Road, and the Transiplex and the FedEx rooftops, and 3) the 36" RCP outlet because it is the NPDES compliance sampling location. Samples taken at this outlet measure the net effect of the combined runoff from the two inlets.

3.2.5 Subsequent WET Testing and Chelation Results

Later in 1999, flow-weighted composite samples were collected from the three pipes (two inlets, one outlet) in manhole SDN1-41 during three storm events and analyzed for WET and specific chemical constituents. Two of these sets of samples were processed using chelation to determine if and to what extent metals were associated with toxicity. Samples of runoff produced by spraying the rooftops with domestic water were also tested for WET and the chelation associations.

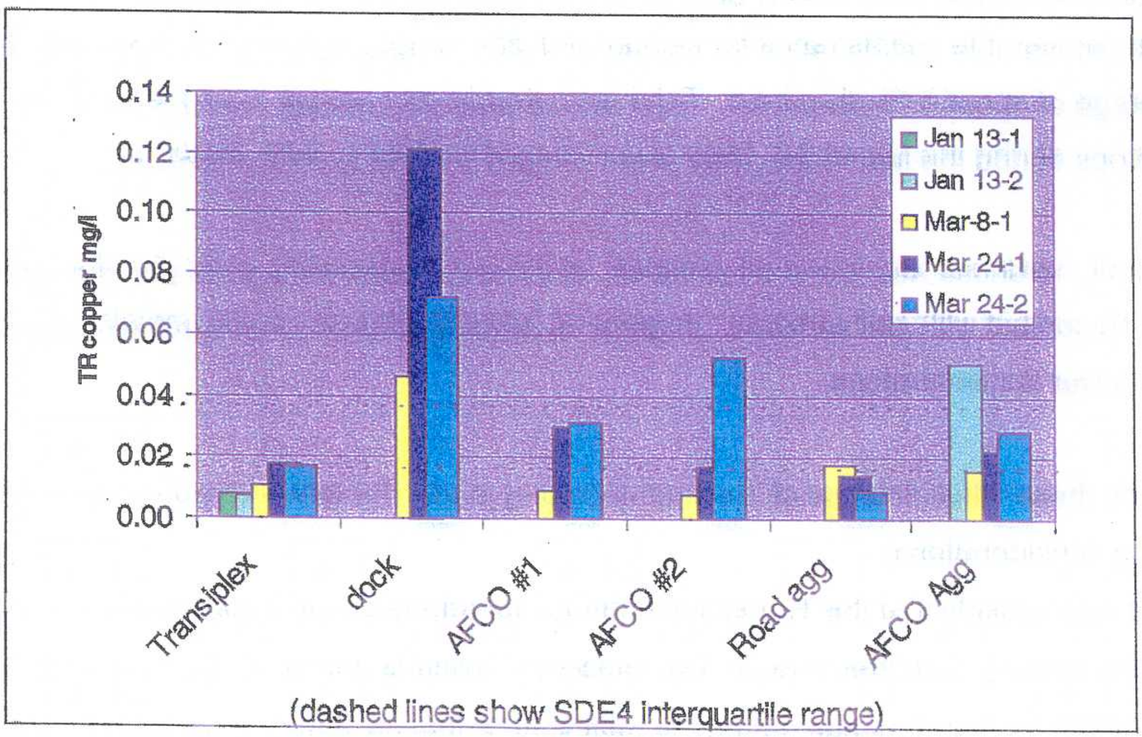

Figure 5 Copper in Initial Screening Grab Samples

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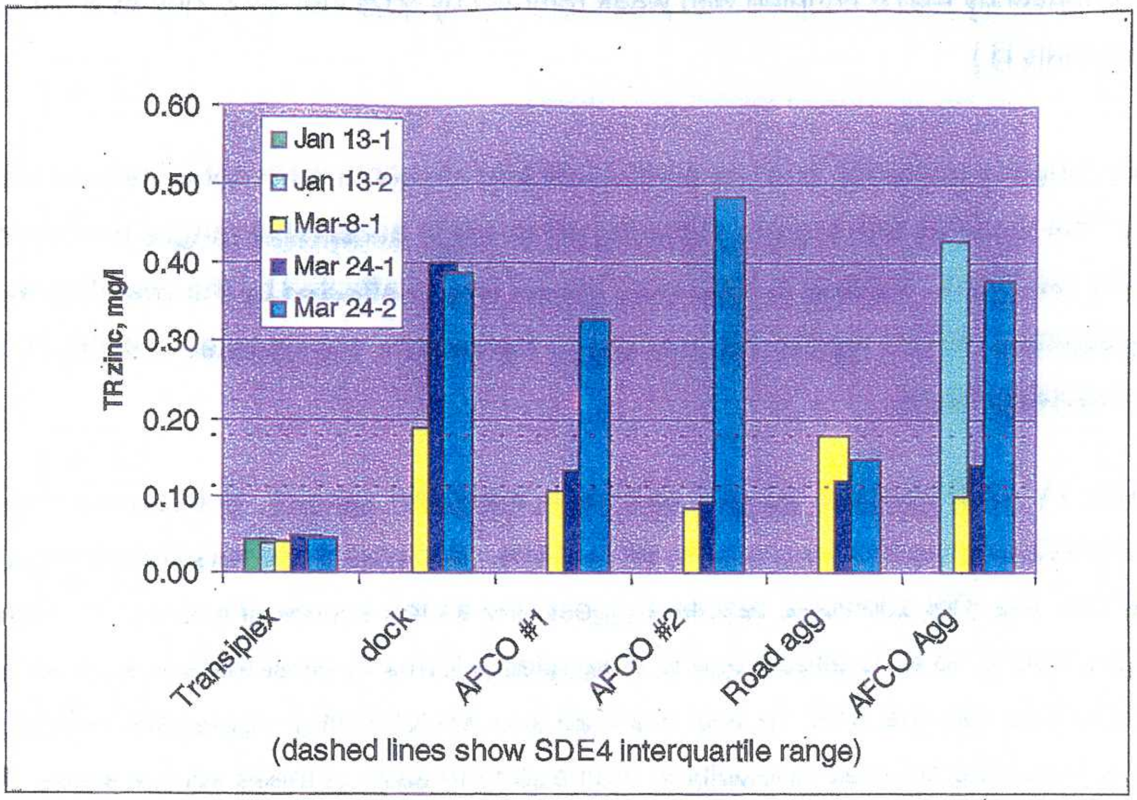

Figure 6 Zinc in Initial Screening Grab Samples

Chelation testing results

Chelation testing on the stormwater yielded interesting and meaningful results. After reducing the bioavailability of metals using two different chelating agents, test organisms had higher survival rates. Therefore, metals were confirmed as the source of toxicity. Furthermore, based on the methods of Hockett and Mount (1996), the pattern of toxicity reduction following chelation confirmed that zinc[8] was indeed the most likely source of toxicity. These tests use EDTA (ethylenediaminetetraacetic acid) and sodium thiosulphate (STS) as chelating agents. Comparing bioassay results before and after adding these agents indicates if and to what degree metals influence toxicity. According to the matrix developed for this method, strong

[8] Hockett and Mount's approach also suggests lead or nickel as potential toxicants, however, historic concentrations of lead and nickel in SDN1 samples were below levels that might have caused toxicity. Lead concentrations analyzed in samples taken during this study were similarly low, and generally not detected. Therefore, this approach indicated zinc as the principal metal attributable for toxicity.

toxicity removal by EDTA coupled with weak removal by STS indicates zinc as a likely source (see Appendix D.)

Other parameters analyzed, such as surfactants and ammonia were not correlated with survival. For samples with low pH, adjusting pH to within acceptable ranges produced little to no toxicity reduction. Survival in laboratory blanks was unaffected by the chelation testing. Table 3 summarizes test results documented by Parametrix, Incorporated (1999f,g,h) with details described below.

In the May 11, 1999 samples, survival was 5% in the SDN1 sample. Subsequent chelation with EDTA dramatically improved survival to 85 to 100%. Because there was limited improvement in survival after the STS additions, results suggest zinc as the source of toxicity. In other words, there were little to no toxic effects due to bioavailable forms of other metals, such as copper, that tend to bind with the STS. In both the road and AFCO rooftop aggregate samples survival was zero, indicating sources of toxicity in drainage from each of these source areas. Because chelation testing was not performed on samples from these source areas, the origins of metals and associated toxicity in the SDN1 sample during this event are not clear. It is important to note that this storm was relatively small (0.14") and that composite samples taken during this event would not meet the minimum rainfall depth criteria (0.20") for NPDES reporting (POS, 1999b.)

Because of problems associated with the WET testing for the July 2, 1999 event, chelation was not pursued[9]. However, the metals results were still valid. There were few other suitable storms for sampling until early fall 1999.

The November 6, 1999 samples tested were from a more typical storm of 0.68 inches. The SDN1 sample and AFCO roof sample each showed a strong improvement in survival after treatment with EDTA. In contrast, the STS additions yielded little to no improvements in

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[9] In the July 2, 1999 WET samples, there was an insufficient number of organisms to start the daphnid test. Also, the fathead minnow survival of 72.5% in the control was below the acceptability criterion of ≥90% for control survival.

survival for these two samples. The sample of aggregate runoff from Air Cargo road, and the Transiplex and FedEx rooftops behaved similarly, though initial survival was higher (70%) and chelation results less dramatic. Note that this particular sample would have passed the Ecology performance standards for WET testing. Nonetheless, the chelation results indicate a mild degree of toxicity associated with metals in this aggregate sample of road and other rooftop runoff, predominantly zinc, and possibly copper. Total recoverable zinc was similar between the roads and AFCO runoff samples, yet, the dissolved fraction in the roof sample (0.097 mg/l) was nearly twice as high the road sample (0.056 mg/l.) Copper concentrations were near or below levels suspected to cause toxicity (less than 0.010 mg/l.)

Synthetic runoff

Samples of synthetic runoff produced by spraying the rooftop of the AFCO #2 building also exhibited toxicity, while the source water did not. See Table 4. Two sets of screening tests were conducted on 100% roof runoff sample, the domestic source water, and a control. The domestic source water used for this test was sampled at the outlet of the hose on the tank truck used in the test. The rooftop area tested was well away from the single air-conditioning unit, a potential source of metals associated with exposed cooling coils. Because sample values fell within acceptable test ranges, no pH adjustments were necessary prior to WET testing these samples.

Copper and zinc were generally 2 orders of magnitude higher in the synthetic runoff than the domestic water. Dissolved copper and zinc fractions were 58% and 52% of the total metals measured in the roof runoff. Lead was not detected in either the roof runoff or source water samples. The source water showed non-detectable copper, lead and dissolved zinc. Total recoverable zinc was about 16 times greater in the roof runoff than in the source water. Therefore, these samples show that the roofing material readily leaches metals, particularly zinc. And because about half the total zinc was dissolved in this test, the results indicate that the AFCO roofing generated some degree of metals in particulate form. It is unlikely that this particulate fraction was due to atmospheric deposition considering that runoff samples from nearby rooftops of different construction (the four Transiplex building rooftops' material is a non-metal, single-ply membrane) had much lower metals, especially zinc (see Figures 5 and 6).

Metals Sources Indicated

The WET testing and chelation point to the AFCO Air Cargo building rooftops as at least one distinct source of toxicity with zinc as the likely toxicant. The chemical-specific results indicate that zinc is associated with the building materials, namely the uncoated galvanized metal steel roofing. Other tests have shown that dissolved zinc is higher in this roof runoff than for other locations. Because of the limited number of samples, inconsistent toxicity responses and indications after chelation, it is not clear whether the aggregate runoff from Air Cargo Road, and the Transiplex and FedEx rooftops is problematic, yet a limited degree of toxicity associated with metals is suggested. Recent reconnaissance found the FedEx cargo building rooftop materials to also be uncoated, galvanized metal similar to the AFCO rooftops. This eastern portion of the FedEx facility was added in 1997 and drains to SDN1, unlike the existing western portion that drains to the IWS. However, corrective actions for the AFCO metal roof runoff situation should be pursued as a first step as it appears to be the more significant source of toxicity due to zinc. The Port has already initiated discussions with AFCO and the roofing material manufacturer to determine alternatives for correcting the situation. If subsequent verification WET testing of SDN1 runoff yields acceptable test results no other actions would be indicated.

Table 3 Chelation Testing Results

Date	Station	pH	pH unadjusted	pH adjusted	Percent survival EDTA addition 0.5 mg/l	3 mg/l	8 mg/l	STS addition 1 mg/l	5 mg/l	10 mg/l
5/11/99	SDN1	7.1	5%	NA	85%	100%	100%	0%	40%	15%
5/11/99	Road agg	6.1	0%	0%	NA	NA	NA	NA	NA	NA
5/11/99	AFCO Roofs	5.4	0%	25%	NA	NA	NA	NA	NA	NA
5/11/99	Blanks	8.3	100%	NA	100%	100%	100%	100%	100%	95%
11/6/99	SDN1	6.7	60%	NA	95%	90%	90%	65%	60%	75%
11/6/99	Road agg	6.8	70%	NA	100%	100%	85%	90%	70%	60%
11/6/99	AFCO Roofs	4.9	0%	0%	5%	0%	55%	0%	0%	0%
11/6/99	Control	7.5	100%	NA	NA	NA	NA	NA	NA	NA

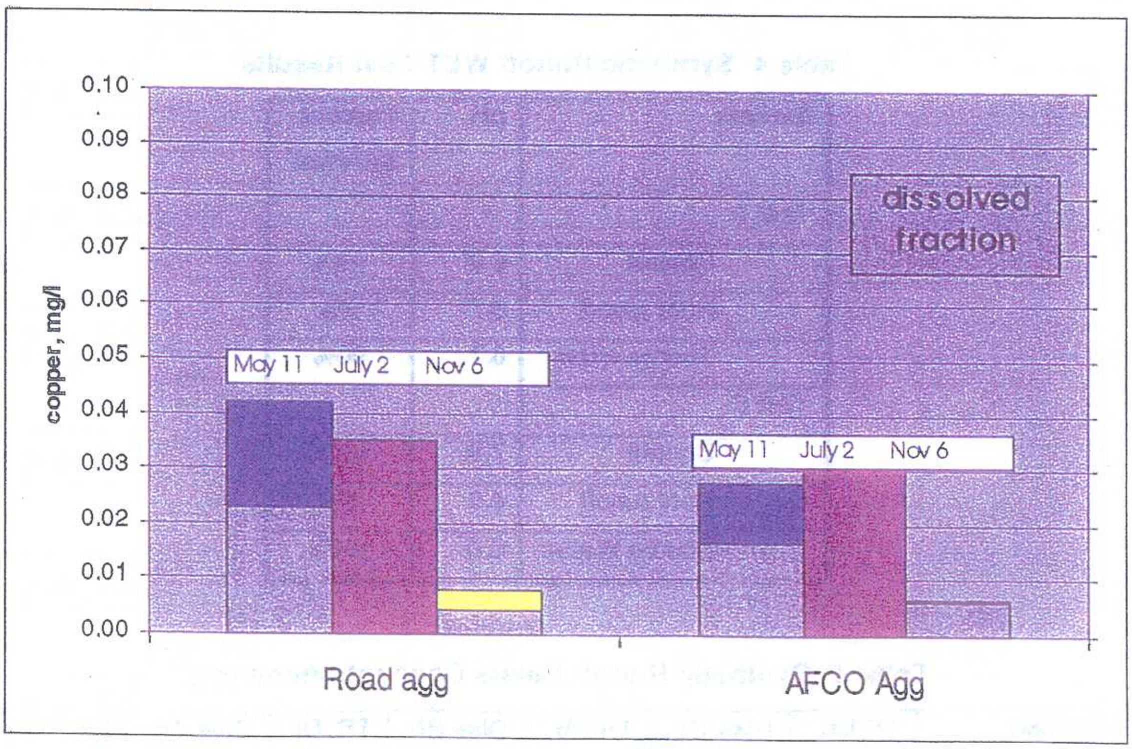

Figure 7 Copper in composite Samples

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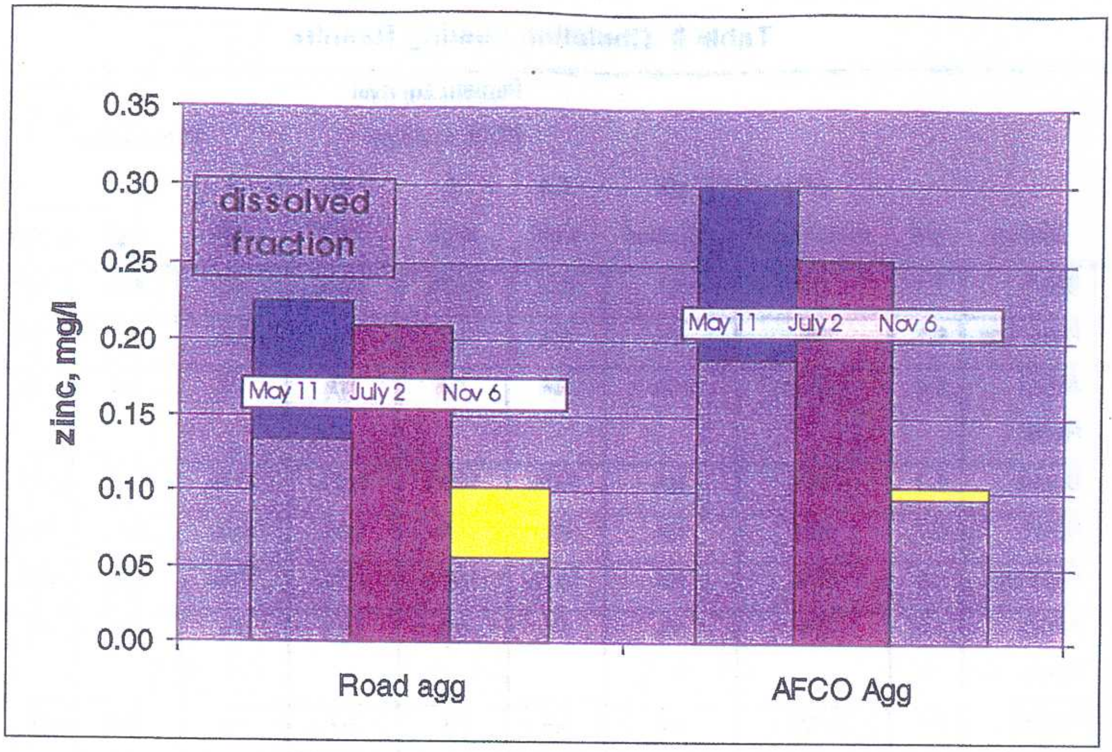

Figure 8 Zinc in composite samples

Table 4 Synthetic Runoff WET Test Results

Sample	**pH**	**Percent Survival**
Test 1		
Control	8.0	95%
Roof runoff	6.7	0%
Source water	6.7	90%
Test 2		
Control	7.8	100%
Roof runoff	6.8	0%
Source Water	6.8	100%

Table 5 Synthetic Runoff Metals Concentrations (mg/l)

Sample	TR Cu	Diss Cu	TR Pb	Diss Pb	TR Zn	Diss Zn	hardness
Roof runoff	0.034	0.023	<0.002	<0.002	0.286	0.148	27.4
Source water	<0.002	<0.002	<0.002	<0.002	0.018	<0.005	23.8

4 CONCLUSIONS

The samples collected and tested to satisfy the NPDES permit condition for WET testing support the following conclusions.

1. No further WET testing is necessary for outfalls SDS3 (005) and SDN4 (011) because samples of these stormwater discharges met Ecology's WET testing performance standards.
2. No further WET testing is necessary for outfall SDE4 (002) because the repeat testing (2 samples) met performance standards and did not indicate a continuation of the slightly below-standard survival for only the fathead minnow observed in the February 1999 sample.
3. The source tracing of problematic WET test results for SDN1 yielded meaningful results indicating the need for BMP actions. Specifically, this source-tracing showed that:
   - toxicity was caused by metals, principally zinc, that originated from uncoated galvanized metal roofing on two cargo buildings (AFCO Air Cargo),
   - runoff samples from the other major cargo building rooftops in the area that had non-metal roofing material (Transiplex) had much lower metals that are not suspected to cause toxicity, and
   - there may be other, less significant sources of runoff toxicity in the SDN1 subbasin that may warrant further investigation if corrective actions for the AFCO Air Cargo rooftop do not result in SDN1 discharges that meet performance standards.

Based on the findings of the source-tracing study for SDN1, the following recommendations should be considered.

1. Mitigate the runoff from the 2 AFCO Air Cargo building rooftops. Alternatives include coating, sealing, or removing and replacing the galvanized roofing material. Treating the runoff to remove metals may not be cost effective over the long term. Rerouting the rooftop drainage to the IWS is not consistent with IWS management strategies. Note that the AFCO buildings are tenant-owned facilities not operated by the Port of Seattle.
2. Follow up after mitigating the AFCO rooftop runoff by evaluating SDN1 stormwater for WET. Investigate the other potential sources if these follow-up results are unfavorable.

3. Prevent future use of uncoated galvanized roofing without coating, or require material leaching tests.
4. Correct the inappropriate connection of the trench drain near AFCO building #2 loading docks E9-E11.
5. Update drainage maps to include the roof and trench drain connections found in the study.

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6 APPENDICES

6.1 Appendix A WET Testing Data Summary

1998-99 WET Testing Sample Data

SDE4	sample type	depth rep	rain	dur	maxint	48hr ai	dryant	pH	TSS	Turb	BOD	NH3	Surf	glycols	TRCu	TRPb	TRZn	Dcu	DPb	DZn	Hard	cond	avg rank	WET, % survival daphnid	fathead	Comment
11/19/98	SMC	0.40	2.34	66	0.18	0	73	8.1	66	52	6.8	0.5	n/a	2	0.032	0.0314	0.163		not analyzed		16	37		90	100	
% rank									82%	88%	54%				64%	81%	58%						71%			
1/20/99	EMC	0.35	0.42	28	0.09	0.95	22	8.2	92	52	5.8	0.10	0.06	2	0.022	0.013	0.168	0.006	0.001	0.012	14.5	34		100	98*	1
% rank									96%	88%	41%				35%	28%	61%	0.25	0.08	0.07			58%			
2/22/99	EMC	0.55	0.56	34	0.14	0.04	9	7.2	53	44	2	0.5	n/a	2	0.015	0.022	0.108	0.004	0.001	0.042	10	36		95	63	
% rank									60%	81%	0%				19%	52%	22%	0.29	0.05	0.39			39%			
3/24/99	EMC	0.26	0.28	19	0.08	0.15	40	6.3	41	32	5.9	0.57	0.26	2	0.020	0.017	0.134		not analyzed		10	31		95	98	
% rank									32%	74%	45%				29%	39%	41%						43%			
7/2/99	EMC	0.27	0.30	6	0.11	0	103	6.2	45	39	6.8	1	n/a	n/a	0.026	0.013	0.141		not analyzed		14	41		100	70*	2
% rank									46%	76%	55%				47%	29%	46%						50%			
average							average result	7.1	54	40	5.3	0.5	0.1	2	0.037	0.017	0.139	0.005	0.001	0.041	13	36		96	87	
							average % rank		63%	81%	39%				39%	46%	46%						52%			

SDE4 Historical data (7/94-6/99)	TSS	Turb	BOD	glycols	TRCu	TRPb	TRZn
count	29	28	32	31	32	33	32
max	131	57	29	49	0.078	0.076	0.337
min	8.8	1.5	2.0	2.0	0.003	0.001	0.003
median	49	27	6.4	2.0	0.028	0.021	0.150

SDS3	sample type	depth rep	rain	dur	maxint	48hr ai	dryant	pH	TSS	Turb	BOD	NH3	Surf	glycols	TRCu	TRPb	TRZn	Dcu	DPb	DZn	Hard	cond	avg rank	WET, % survival daphnid	fathead	Comment
11/13/98	SMC	0.52	0.98	62	0.15	0.05	31	7.5	24	29	17.6	0.5	n/a	11.5	0.022	0.004	0.189	0.014	0.001	0.038	24	69		90	98	
% rank									96%	96%	85%			87%	22%	68%	100%	0.61	0.25	0.20			79%			
1/13/99	EMC	0.85	1.07	22	0.16	0	85	6.8	22	16	7.8	0.5	n/a	11	0.023	0.004	0.030	0.013	0.001	0.012	20	52		80	95	
% rank									93%	87%	39%			83%	25%	65%	13%	0.55	0.26	0.40			58%			
average							average	7.1	23	23	13	0.5		11	0.023	0.004	0.110	0.013	0.001	0.025	22	61		85	97	

SDS3 Historical data (7/94-6/99)	TSS	Turb	BOD	glycols	TRCu	TRPb	TRZn
count	33	33	36	25	37	39	37
max	33	42	38	32	0.087	0.016	0.134
min	1	1	2	2	0.004	0.001	0.003
median	7	6	8	5	0.032	0.002	0.045

SDN1	sample type	depth rep	rain	dur	maxint	48hr ai	dryant	pH	TSS	Turb	BOD	NH3	Surf	glycols	TRCu	TRPb	TRZn	Dcu	DPb	DZn	Hard	cond	avg rank	WET, % survival daphnid	fathead	Comment
11/13/98	EMC	0.81	0.98	62	0.15	0.05	31	8.0	53	46	2	0.5	n/a	n/a	0.024	0.0253	0.487	0.006	0.001	0.110	16	20		80	40	
% rank									63%	100%	0%				67%	79%	94%	0.23	0.04	0.23			67%			
1/13/99	EMC	0.85	1.07	22	0.16	0	85	7.0	78	31	2	0.5	n/a	n/a	0.024	0.048	0.182	0.005	0.001	0.033	8	22		30	78	
% rank									94%	75%	0%				61%	100%	33%	0.19	0.02	0.18			61%			
3/24/99	EMC	0.28	0.28	19	0.08	0.15	40	6.6	61	40	4.86	1	n/a	n/a	0.015	0.010	0.175		not analyzed		16	22		10	63	
% rank									69%	88%	53%				30%	44%	28%						52%			
5/11/99	EMC	0.13	0.14	10	0.08	0	50	7.1		26		0.238	0.246	n/a	0.046	0.004	0.276	0.043	0.001	0.117	14.2			5		4
% rank										53%					86%	10%	74%	0.94	0.29	0.42			56%			
7/2/99	EMC	0.30	0.30	6	0.11	0	103	6.1	69	25	4.28	0.3	n/a	n/a	0.038	0.009	0.238		not analyzed		10	21		not tested	33*	2, 3
% rank									83%	52%	36%				83%	32%	69%						59%			
11/6/99	SMC		0.68	12	0.11	0.05	44		26	20	4.1	0.08	0.06	n/a	0.108	0.009	0.120	0.005	0.001	0.069	11.3			60	not tested	
average							average	6.9	57	32	3.5	0.48	0.06	n/a	0.042	0.020	0.240	0.005	0.001	0.071	12	21		40	60	
							average rank		77%	79%	22%				60%	64%	56%						60%			

SDN1 Historical data (1/97-6/99)	TSS	Turb	BOD	TRCu	TRPb	TRZn
count	17	17	18	19	20	19
max	85	46	29	0.062	0.048	0.540
min	9.7	6.4	2	0.003	0.001	0.066
median	43	24	5	0.019	0.011	0.218

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1998-99 WET Testing Sample Data

SDN4	sample type	storm characteristics: depth rep	rain	dur	maxint	48hr ai	dryant	pH	concentration, mg/l: TSS	Turb	BOD	NH3	Surf	glycols	TRCu	TRPb	TRZn	Dcu	DPb	DZn	Hard	cond	avg rank	WET, % survival: daphnid	fathead	Comment
11/13/98	EMC	0.80	0.98	62	0.15	0.05	31	7.5	22	15	2	1	n/a	2	0.025	0.0012	0.127	0.021	0.001	0.049	24	75		75	100	
% rank									94%	89%	0%				23%	81%	100%	0.8379	0.83	0.39			65%			
1/13/99	EMC	0.85	1.07	22	0.16	0	85	6.8	7	9.2	2	0.5	n/a	2	0.020	0.001	0.034	0.014	0.001	0.027	28	56		100	100	
% rank									57%	78%	0%				9%	27%	77%	0.7065	n/a	0.79			41%			
	average						average	7.1	15	12	2	0.8		2	0.023	0.001	0.081	0.018	0.001	0.038	26	66		88	100	
		SDN4	Historical data (7/94-6/99)				count		20	20	22			16	22	23	23									
							max		27	23	36			34	0.091	0.003	0.127									
							min		2	2	2			2	0.015	0.001	0.014									
							median		4	5	4			2	0.035	0.001	0.025									

comments
1. SDE4 Jan 20, 1999 sample: fathead test duration was 48-hr instead of 96-hr
2. July 2, 1999 samples: control failed at 72.5% survival (criterion is >90%)
3. July 2, 1999 SDN1 sample: insufficient # of organisms to start daphnid test.
4. May 11, 1999 SDN1 sample taken for source tracing (was a non-storm) only, not to explicitly satisfy permit condition S10

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

notes
1. pH, ammonia, hardness, and conductivity measured at Parametrix toxicology lab
2. Dissolved metals not routinely analyzed, therefore, no summary statistics provided
3. Summary statistics for each outfall are relative trimmed data set July 1994 through June 30, 1999
4. All data for SDN1 are from "up" station located in manhole SDN1-22
5. Ammonia values <1 analyzed at Aquatic Research unless shown as shaded in table

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Blanks	sample type	storm characteristics: depth rep	rain	dur	maxint	48hr ai	dryant	pH	concentration, mg/l: TSS	Turb	BOD	NH3	Surf	glycols	TRCu	TRPb	TRZn	Dcu	DPb	DZn	Hard	cond	avg rank	WET, % survival: daphnid	fathead	Comment
11/6/99	bottle blank										<4	<0.01	<0.025	n/a	<0.002	<0.002	<0.005	<0.002	<0.002	<0.005	1.17					
11/6/99	eqpt blank										<4	<0.01	<0.025	n/a	<0.002	<0.002	<0.005	<0.002	<0.002	<0.005	1.17					

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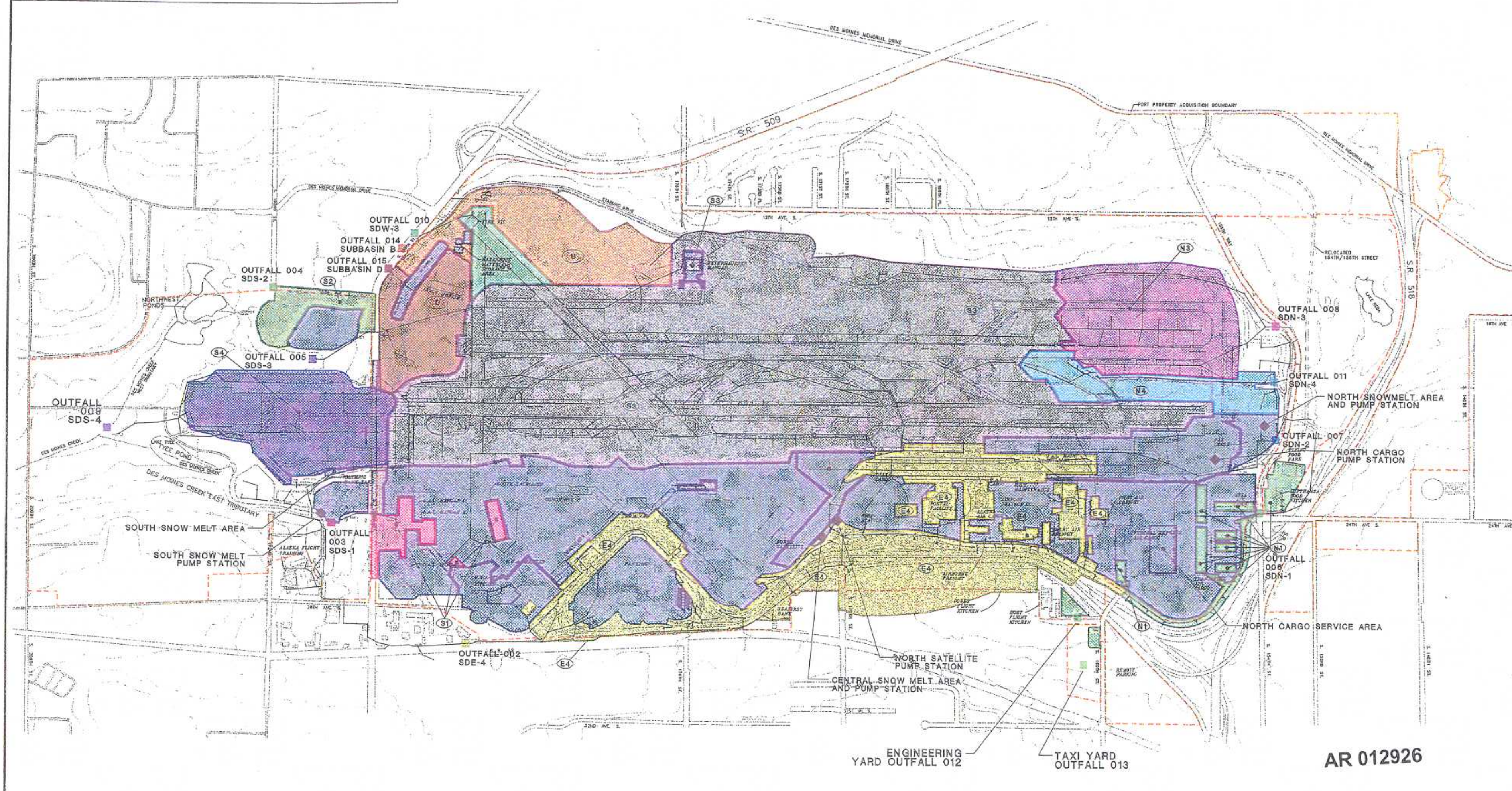
6.2 Appendix B Photographs

LEGEND

○	MANHOLE	PP	PERFORATED PIPE
▫	CATCH BASIN	SDE-20	STORM WATER SYSTEM STRUCTURE IDENTIFICATION
C.O.	CLEANOUT		PROPERTY BOUNDARY
	CLEANOUT		PORT PROPERTY ACQUISITION BOUNDARY
	STORM WATER CONVEYANCE		
	DIRECTION OF FLOW		

SCALE IN FEET: 0 300 600 1200 1800 2400



AR 012926

SECTION G | SECTION T | SECTION B | SECTION N | DISCIPLINES | DWG

STORMWATER DRAINAGE BASIN COLOR CODES:

(N1)	SDN1	(S1)	SDS1	(W3)	SDW3
(N3)	SDN3	(S3)	SDS3	(S3)	B
(N4)	SDN4	(S4)	SDS4	(S3)	D
		(E4)	SDE4	(S2)	SDS2
	IWS				

OUTFALL LOCATION ◆ PUMPSTATION LOCATION

PROJECT ENGR./ARCH.: DESIGNER: DRAWN BY: SCALE: DATE: FILE NAME: P8SK002

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D
△	11/98	K/J	UPDATE FIGURE	
△	10/98	K/J	UPDATE FIGURE	
△	2/98	K/J	UPDATE FIGURE	
△	12/97	K/J	UPDATE FIGURE	
△	7/97	K/J	RELOCATED AND ADDED OUTFALL LOCATIONS	

PORT OF SEATTLE

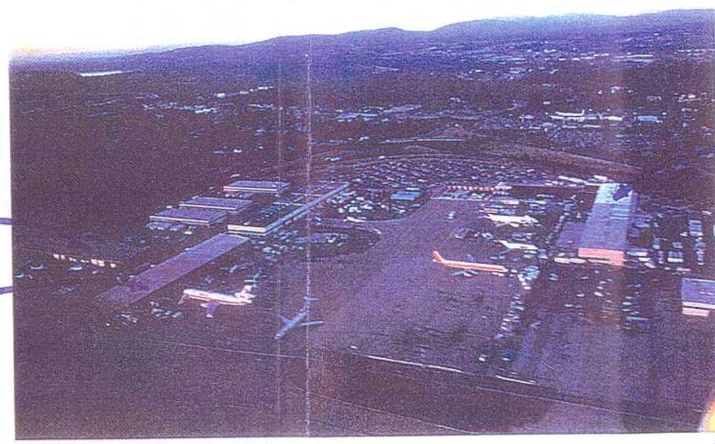
SEA-TAC INTERNATIONAL AIRPORT

COMPREHENSIVE STORM DRAINAGE SYSTEM PLAN AND DESIGN

DRAINAGE BASINS

WORK ORDER NO.:
CONSULTANT'S NO. 976079.23
FIGURE NO. FIGURE 1

PHOTOS TAKEN 8/16/99



LOOKING NORTHEAST   PHOTO TAKEN SEPT 1997

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6.3 *Appendix C Source Tracing Results*

1999 SDN1 Source Tracing in Multiple Upstream Manholes

event	rain in.	max int in/hr	dry ant hr	LF	SDN1 manhole	name	seq	type	pH	TR Cu	TR Pb	TR Zn	Diss Cu	Diss Pb	Diss Zn	Diss/TR ratios Cu	Diss/TR ratios Pb	Diss/TR ratios Zn	Hard	surf	NH3	turb	comment
13-Jan-99	1.07	0.16	85	13.6	26	Transiplex 1/13	1	GRAB	6.83	0.008	0.001	0.044	0.005	0.001	0.021	0.68		0.48					Transiplex rooftops
13-Jan-99	1.07	0.16	85	13.6	26	Transiplex 1/13	2	GRAB	7.49	0.007	0.001	0.038	0.005	0.001	0.022	0.69		0.58					Transiplex rooftops
8-Mar-99	0.28	0.05	96	4.8	26	Transiplex 3/8		GRAB		0.011	0.001	0.040	0.005	0.001	0.012	0.44		0.30	4.29				Transiplex rooftops
24-Mar-99	0.28	0.08	40	3.2	26	Transiplex 3/24	1	GRAB		0.017	0.001	0.048	0.012	0.001	0.046	0.68		0.96	2.98				Transiplex rooftops
24-Mar-99	0.28	0.08	40	3.2	26	Transiplex 3/24	2	GRAB		0.017	0.001	0.046	0.014	0.001	0.036	0.81		0.78	6.53				Transiplex rooftops
8-Mar-99	0.28	0.05	96	4.8	32 dock	dock 3/8		GRAB		0.046	0.012	0.188	0.034	0.008	0.134	0.75	0.66	0.71	3.92				loading dock drain (Avia #2, doors E9-E13)
24-Mar-99	0.28	0.08	40	3.2	32 dock	dock 3/24	1	GRAB		0.121	0.023	0.400	0.111	0.019	0.320	0.92	0.84	0.80	5.6				loading dock drain (Avia #2, doors E9-E13)
24-Mar-99	0.28	0.08	40	3.2	32 dock	dock 3/24	2	GRAB		0.072	0.014	0.389	0.066	0.011	0.263	0.91	0.78	0.68	10.4				loading dock drain (Avia #2, doors E9-E13)
8-Mar-99	0.28	0.05	96	4.8	32	AFCO#1 3/8		GRAB		0.009	0.001	0.108	0.007	0.001	0.034	0.78		0.31	1.49				AFCO Bldg #1 rooftop
24-Mar-99	0.28	0.08	40	3.2	32	AFCO#1 3/24	1	GRAB		0.030	0.003	0.133	0.013	0.001	0.122	0.42	0.29	0.92	2.24				AFCO Bldg #1 rooftop
24-Mar-99	0.28	0.08	40	3.2	32	AFCO#1 3/24	2	GRAB		0.032	0.001	0.330	0.020	0.001	0.217	0.63		0.66	2.8				AFCO Bldg #1 rooftop
8-Mar-99	0.28	0.05	96	4.8	33	AFCO#2 3/8		GRAB		0.008	0.001	0.083	0.005	0.001	0.033	0.65		0.40	1.31				AFCO Bldg #2 rooftop
24-Mar-99	0.28	0.08	40	3.2	33	AFCO#2 3/24	1	GRAB		0.017	0.001	0.091	0.013	0.001	0.074	0.78		0.81	3.92				AFCO Bldg #2 rooftop
24-Mar-99	0.28	0.08	40	3.2	33	AFCO#2 3/24	2	GRAB		0.053	0.003	0.484	0.033	0.001	0.333	0.62	0.38	0.69	4.1				AFCO Bldg #2 rooftop
8-Mar-99	0.28	0.05	96	4.8	41-31	Road agg 3/8		GRAB		0.017	0.021	0.180	0.001	0.001	0.037	0.06	0.05	0.21	6.34				Air Cargo Rd+Transiplex+new FedEx
24-Mar-99	0.28	0.08	40	3.2	41-31	Road agg 3/24	1	GRAB		0.014	0.016	0.121	0.006	0.001	0.046	0.41	0.06	0.38					Air Cargo Rd+Transiplex+new FedEx
24-Mar-99	0.28	0.08	40	3.2	41-31	Road agg 3/24	2	GRAB		0.009	0.003	0.149	0.007	0.001	0.092	0.76	0.33	0.62	8.39				Air Cargo Rd+Transiplex+new FedEx
11-May-99	0.14	0.08	50	4	41-31	Road agg 5/11		ffgrab		0.062	0.017	0.347	0.040	0.001	0.278	0.64	0.06	0.80				2.1	Air Cargo Rd+Transiplex+new FedEx
11-May-99	0.14	0.08	50	4	41-31	Road agg 5/11 comp		comp		0.042	0.002	0.225	0.023	0.001	0.134	0.55	0.42	0.60	12.9	0.329	0.252	31	Air Cargo Rd+Transiplex+new FedEx
20-Jun-99	0.21	0.03	48	1.44	41-31	Road agg 6/20		ffgrab		0.082	0.005	0.525	0.060	0.001	0.394	0.73	0.20	0.75					Air Cargo Rd+Transiplex+new FedEx
2-Jul-99	0.3	0.11	103	11.3	41-31	Road agg 7/2	1	GRAB	6.44	0.032	0.001	0.200											Air Cargo Rd+Transiplex+new FedEx
2-Jul-99	0.3	0.11	103	11.3	41-31	Road agg 7/2	2	GRAB	6.25	0.026	0.001	0.205											Air Cargo Rd+Transiplex+new FedEx
2-Jul-99	0.3	0.11	103	11.3	41-31	Road agg 7/2 comp		COMP		0.035	0.009	0.209							16				Air Cargo Rd+Transiplex+new FedEx
6-Nov-99	0.68	0.11	44	4.84		Road agg11/6 comp		comp		0.008	0.005	0.103	0.005	<0.002	0.056	0.58	na	0.54	11.9	0.067	0.08	18	Air Cargo Rd+Transiplex+new FedEx
13-Jan-99	1.07	0.16	85	13.6	41-34	AFCO agg 1/13		GRAB	7.2	0.051	0.001	0.428	0.013	0.001	0.227	0.26		0.53					total AFCO rooftops
8-Mar-99	0.28	0.05	96	4.8	41-34	AFCO agg 3/8		GRAB		0.016	0.001	0.099	0.008	0.001	0.052	0.54		0.53	6.53				total AFCO rooftops
24-Mar-99	0.28	0.08	40	3.2	41-34	AFCO agg 3/24	1	GRAB		0.022	0.001	0.141	0.016	0.001	0.128	0.74		0.91	4.48				total AFCO rooftops
24-Mar-99	0.28	0.08	40	3.2	41-34	AFCO agg 3/24	2	GRAB		0.029	0.001	0.379	0.019	0.001	0.207	0.64		0.55	3.17				total AFCO rooftops
11-May-99	0.14	0.08	50	4	41-34	AFCO agg 5/11		ffgrab		0.022	0.001	0.649	0.016	0.001	0.210	0.70		0.32				39	total AFCO rooftops
11-May-99	0.14	0.08	50	4	41-34	AFCO agg 5/11 comp		comp		0.028	0.001	0.300	0.017	0.001	0.188	0.61		0.63	4.85	<0.025	0.07	2	total AFCO rooftops
20-Jun-99	0.21	0.03	48	1.44	41-34	AFCO agg 6/20		ffgrab		0.062	0.001	0.449	0.051	0.001	0.388	0.82		0.86					total AFCO rooftops
2-Jul-99	0.3	0.11	103	11.3	41-34	AFCO agg 7/2	1	GRAB	6.06	0.028	0.001	0.251											total AFCO rooftops
2-Jul-99	0.3	0.11	103	11.3	41-34	AFCO agg 7/2	2	GRAB	7.06	0.042	0.001	0.422											total AFCO rooftops
2-Jul-99	0.3	0.11	103	11.3	41-34	AFCO agg 7/2 comp		COMP		0.030	0.001	0.254							3.91				total AFCO rooftops
6-Nov-99	0.68	0.11	44	4.84	41-34	AFCO agg 11/6 comp		comp		0.006	<0.002	0.104	0.006	<0.002	0.097	0.95	na	0.93	2.15	<0.025	0.023	0.63	total AFCO rooftops

Indicates result <MDL, value shown is 1/2 MDL

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6.4 Appendix D Matrix for Interpreting Chelation Test Results

Toxicty Removal by EDTA

Toxicity Removal by Thiosulfate	Strong	Weak	None
Strong	Copper chloride Cadmium chloride Mercury [II] chloride (24h)	Silver Chloride	
Weak	Zinc chloride Lead nitrate Nickel chloride	Manganese chloride Mercury [II] chloride (48h)	Sodium selenate
None			Iron [II] chloride Chromium [III] chloride Potassium dichromate Sodium arsenate Sodium arsenite Sodium selenite Aluminum chloride

Modified from Hockett and Mount, 1996