PORT OF SEATTLE MASTER PLAN UPDATE FOR STIA

WATER QUALITY ASSESSMENT

This document provides a summary of the water quality assessment (WQA) currently underway in support of the Port of Seattle's (the Port) Master Plan Update for the Seattle-Tacoma International Airport (STIA). This document complements the Sampling and Analysis Plan (Parametrix 1998) submitted to the Port in November of this year. Following the introduction, the remainder of this document describes the overall goal of the WQA the approach we propose to achieve that goal.

INTRODUCTION

[Text to be provided later]

Goal of the Water Quality Assessment: To reach agreement with the Department of Ecology on the Port's ability to comply with the water quality requirements of the current NPDES permit No. WA-002465-1 and the 401 certification following construction of the third runway.

This goal, in part, will be achieved through a number of Best Management Practices (BMPs) that are currently being explored by the Port and which are described elsewhere. This document focuses on characterizing the stormwater and receiving streams, both now and in the future, to help determine whether aquatic life in the receiving streams will be sufficiently protected. Characterization includes examining stormwater and receiving water chemistry and toxicity, fluctuations in the stormwater discharge and an understanding of stormwater and receiving water mixing. To ensure acceptability of our approach, tasks conducted under the WQA will use standard water quality protocols and techniques where possible.

PROPOSED APPROACH

We are currently taking a three pronged approach to the WQA that:

- or a translator

a) uses a "water effect ratio" (WER) to modify state water quality standards,

b) explores the use of a mixing zone to ascertain the point of compliance (i.e., where in the receiving streams should the water quality standards be met), and

c) examines the variability in stormwater quality

These three approaches are described below.

Water-Effect Ratio Study (or the Indicator Species Procedure)

Guidelines set forth by US EPA (1984) allow for the modification of water quality criteria using several approaches. One of these approaches is known as the "Indicator Species Procedure" otherwise know as the "Water-Effect Ratio". The procedure accounts for differences in the biological availability and toxicity of a constituent due to physical and/or chemical differences between site water and water used in the laboratory to derive the water quality criteria/standards. In contrast to laboratory water, site water often contains suspended particulate matter, organic carbon and humic substances as well as sulfides that can bind up the dissolved forms of metals rendering them unavailable for uptake by the aquatic organisms. Under such circumstances, the toxicity of equivalent concentrations of a constituent will be lower in site-water than in laboratory water and the generic water quality standard would be overprotective for site-specific conditions. Under such circumstances, the water quality standard can be modified by a "water-effect ratio" which is ratio of site water toxicity to laboratory water toxicity.

The water-effect ratio (WER) requires that toxicity tests be conducted with at least two indicator species, a fish and an invertebrate. These species should either be resident at the site or surrogates that are indicative of the sensitivities of the species living at the site. The chemical of concern (in this case, copper) is spiked into laboratory dilution water and site dilution water at known concentrations. The toxicity tests will be conducted according to standard EPA guidelines (US EPA 1993) and Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*, at Parametrix' toxicity testing laboratory in Kirkland, WA. The tests (with lab and site water) will be run at the same time under the similar conditions (e.g., temperature, light etc.). A median lethal concentration (LC50) will be derived for each water and the two compared to generate a WER. The WER will then be applied to the generic water quality standard (WQS) to derive a site-specific standard:

WER * generic WQS = site-specific WQS

Since the condition of interest is the toxicity of stormwater once it is mixed with the receiving water, we propose to collect stormwater (effluent) and site water under typical storm conditions. This is because we expect that the receiving waters during or shortly after a storm will exhibit water quality characteristics that are different from baseflow conditions. For example, it is highly likely that stormwater will contain higher concentrations of particulate matter and organic substances that can bind the chemicals rendering them less bioavailable to aquatic life. The stormwater and receiving water will then be mixed in a ratio that typifies their mixing in the receiving streams. This mixed water then constitutes the site water for the WER study. Because we are interested in *future* conditions following construction of the third runway, we will model the expected stormwater and receiving water hydrographs (assuming that a number of best management practices (BMPs) are in place) to make an initial estimate of future mixing. Once the mixing zone has been completed (see below), we will have a more accurate estimate of the mixing ratios at the future points of compliance (i.e., edge of the acute mixing zone for each outfall). Note that the WER study also assumes the chemical and physical quality of stormwater and receiving water in the future will be similar to current conditions.

We propose to conduct the water effect ratio (WER) study in the following phases.

Phase 1 Screening Study

We will test the acute toxicity of the site water (i.e., a mixture of the stormwater discharge and the receiving streams) as well as receiving water upstream of the anticipated points of discharge. Testing upstream water will provide information on any upstream sources of toxicity that are not attributable to STIA. Site water is initially tested to determine whether it exhibits any toxicity. If the site water is acutely toxic, then the WER study cannot proceed.

Phase 2 Range-finding Study

If the site water is not toxic, then we propose to conduct a 'range-finding' WER using nominal copper concentrations for each receiving stream (Miller Creek, Walker Creek and Des Moines Creek). The range-finding WER is a cost-effective approach since it does not involve any analytical chemistry to confirm test concentrations, but provides a robust estimate of the WER. If the results of the range-finding WER show the study to be a viable approach for the Port, we would recommend writing a Work Plan for review by Ecology prior to embarking with Phase 3. The Work Plan would provide details on sampling techniques, test protocols, analytical methods, quality assurance and data analysis. [Note, it is possible that by the time the Work Plan is written, we have conducted the mixing zone study and will know exactly what the ratio of stormwater to receiving water should be].

Phase 3 Definitive WER

In accordance with US EPA (1994) guidance, we propose to conduct three WERs possibly for each receiving stream [this could be reduced if the Phase 2 WERs for each receiving stream are comparable]. Each of the WERs will be conducted using the waterflea, *Ceriodaphnia dubia*, with one conducted using the fathead minnow, *Pimephales promelas* as a confirmatory species. The 1994 EPA guidelines require that a WER be conducted at least three times to account for seasonal variability and effects on chemical bioavailability. Given that we interested in the toxicity of stormwater, it is anticipated that chemical bioavailability will be governed more by variations in storms and associated factors such as antecedent conditions rather than by season. Therefore, we propose to capture at least three storm events (with different antecedent conditions and/or different precipitation criteria?) rather than conduct the WERs under three different seasonal conditions. Furthermore, since we are interested in toxicity of stormwater, the EPA 1994 criteria for the number of Type 1 and Type 2 WERs is not applicable [Type 1 WERs are typically conducted under low river flow which is not applicable to the exposure scenarios under examination].

Test water will be analyzed for total and dissolved copper since it is recognized that the dissolved fraction is a much better indicator of the bioavailable fraction. Test water will also be analyzed for total suspended solids (TSS), total organic carbon (TOC), dissolved organic carbon (DOC), hardness, and alkalinity since these factors influence the bioavailability of metals and will help with interpretation of the toxicity data. The final WER can be based on either total or dissolved copper concentrations.

Mixing Zone Study

Because it is recognized that a direct comparison of 'end-of-pipe' stormwater quality to receiving water quality standards is a conservative approach, we propose to conduct a stormwater mixing zone study that accounts for the mixing of stormwater with receiving water (see WAC 173-201(A)-100). This mixing will be used in conjunction with stormwater and receiving water quality to re-calculate a water quality based stormwater effluent limit. Since stormwater discharges are relatively short-lived (on the order of hours), aquatic life are only subjected to acute (as opposed to chronic) exposure regimes. Because of this, the study will only consider an acute mixing zone. While acute water quality standards must be met outside of the acute mixing zone, they can be exceeded within the authorized mixing zone.

Although WAC 173-201(A)-100 sets forth certain numeric size criteria and overlap criteria (i.e., criteria for the overlap of discharge from one outfall with another) for establishing a mixing zone, stormwater discharges from any "point source" not containing "process wastewater" may be granted an exemption to these criteria provided the discharger can demonstrate that:

a) all appropriate best management practices established for stormwater pollutant control have been applied to the discharge.
b) the proposed mixing zone shall not have a reasonable potential to result in a loss of sensitive or important habitat, substantially interfere with the existing or characteristic uses of the water body, result in damage to the ecosystem, or adversely affect public health, and
c) the proposed mixing zone shall not create a barrier to the migration or translocation of indigenous organisms to the degree that has the potential to cause damage to the ecosystem.

In addition, before an exemption may be granted, it must also be demonstrated that:

a) demonstrated that AKART appropriate to the discharge is being fully applied, and
b) all siting, technological, and managerial options which would result in full or significantly closer compliance tha(n) are economically achievable are being utilized. [check with Paul]

Since mixing zones for stormwater discharges must be based on a volume of runoff corresponding to a design storm approved by the department of Ecology, we propose to use the conditions set forth in the current NPDES permit No. WA-002465-1 [Question: do the conditions in the permit allow us to characterize our "design storm"; is there any reason for NOT using conditions already agreed upon in the permit?]

2yr 6hr
2y 72hr

Once the design storm is agreed upon, we will use computer modeling to describe the hydrologic (stormwater) runoff and the hydrodynamic mixing with receiving water. Hydrologic modeling will use WATERWORKS or equivalent to model runoff occurring during the design storm. The model will be calibrated against actual measured stormwater flows. Hydrodynamic mixing of stormwater with receiving water will use RIVPLUM5, CORMIX3 or an equivalent model as appropriate.

Because configuration of future outfalls may differ from one another, we propose to conduct at least two mixing zone studies for the following scenarios:

1) Future stormwater discharge from SDS3 into Des Moines Creek (i.e., accounting for future best management practices (BMPs) to control stormwater).
2) Future stormwater discharge from a new outfall into Walker Creek.

These scenarios were chosen partly because they reflect anticipated differences in mixing characteristics and partly because they complement the sites selected for the water effect ratio studies.

Translator Study

Variability in Stormwater Quality

Because the toxicity of any constituent not only depends upon the magnitude of a threshold exceedance, but also the frequency and duration of the exceedance, it is important to understand fluctuations in the exposure concentrations; in this case, the concentrations of copper, zinc and lead in stormwater discharges. Studies have shown (REF Herricks et al.) that aquatic life can tolerate exceedances to a threshold value if the exceedance doesn't occur often enough or for a sufficient period of time to be deleterious to aquatic life. [Expand on text]. Therefore, we propose to examine the stormwater data collected to date for STIA to discern any trends or characteristics in the frequency, magnitude and duration of the metal concentrations.

[Paul, have we decided how we would do this? We did a similar exercise for our work with Sydney Water and used a "View program" to visually represent the fluctuations in discharge. I wonder if Kerry or Rick Rosario could develop a similar program for the Port's data if there is enough of it and we think a worthwhile exercise].

REFERENCES

Parametrix 1998. Stormwater Water Quality Sampling and Analysis Plan. Prepared for the Port of Seattle, November 1998 [check title].

U.S. EPA 1984. Guidelines for Deriving Numerical Aquatic Site-Specific Water Quality Criteria by Modifying National Criteria. EPA-600/3-84-099

U.S. EPA 1993. Methods for measuring acute toxicity of effluents and receiving water 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 metal. EPA/823/b94/001.