northwest hydraulic consultants inc.

16300 christensen road, suite 350
seattle, washington 98188-3418
(206) 241-6000 - phone
(206) 439-2420 - fax
www.nhcweb.com

sacramento
vancouver
edmonton
seattle



January 30, 2002

Colonel Ralph H. Graves
Ms. Muffy Walker
Ms. Gail Terzi
U.S. Army Corps of Engineers
Seattle District
P. O. Box 3755
Seattle, WA 98124-3755

Dear Colonel Graves, Ms. Walker and Ms. Terzi:

Re: Corps Ref. No. 1996-4-02325; Port of Seattle Low Streamflow Analysis

---

Northwest Hydraulic Consultants, Inc., (**nhc**) has been retained on behalf of the Airport Communities Coalition (ACC) to provide a technical review of stormwater facilities and streamflow impacts from development activities at SeaTac airport. The purpose of this letter is to comment on the December 2001 "Low Streamflow Analysis and Summer Low Flow Impact Offset Facility Proposal" prepared by Parametrix, Inc., for the Port of Seattle.

The December 2001 Low Streamflow Analysis has numerous flaws, including, but not limited to, being largely unresponsive to concerns we have raised previously. For example, while the report now acknowledges poor upper-gage low flow calibration of the hydrologic models used for the analysis, there does not appear to have been any attempt to improve that calibration or to address the resultant uncertainty in the interpretation of model results. Low-flow impacts of Industrial Wastewater System (IWS) improvements and borrow area developments continue to be ignored. The report fails to provide the digital data files (as were provided with previous documents) which would give reviewers the opportunity to independently interpret the Port's simulation results and to assess the significance of apparent modeling errors. Also, there appear to be serious fundamental problems in the methodology and assumptions for the third runway embankment seepage analyses and in the integration of that seepage analysis with the HSPF modeling used to predict impacts.

Each of the three streams considered by the Low Streamflow Analysis—Miller, Walker, and Des Moines Creeks—have different sets of unresolved modeling/analysis issues. For Miller Creek, the main concern is over embankment modeling methods and the way that the embankment model results are integrated with the HSPF hydrologic model. For Walker Creek, the main concern is over how IWS system expansion and leak reduction efforts may be causing potentially-large reduction in headwater

baseflows. The Low Flow Analysis fails to address the fact that post-1991 recorded streamflow data for the upper Walker Creek gage, compared to the simulated flows, suggest a pronounced (more than 30%) reduction in low flows. For Des Moines Creek, the main concern is an apparent inability to accurately model the low flows and a failure to explore the physical reasons we have identified previously (specifically IWS lagoon seepage and a possible stream losing reach) which might improve the model calibration. The upper-gage calibration results for Des Moines Creek show that actual recorded low flows are on average nearly double (representing a 100% discrepancy) the upper-basin low flows which were simulated with the calibrated model.

Our comments below are limited to identifying some of the specific errors and inadequacies in the Miller Creek low flow analysis. These are issues which arose from our review of the December 2001 Low Flow Analysis and which we have not raised previously.

1. Double-counting of groundwater discharges from embankment areas is occurring in the Miller Creek analysis due to an input error in the future-conditions HSPF model for Miller Creek. The apparent intent of the HSPF modelers was to identify areas assessed by PGG with a special "PERLND 80" pervious land segment, and to import the PGG groundwater model results as a lateral groundwater inflow into that land segment. However, the input sequence shows that precipitation is incorrectly being applied (with a 1.00 multiplier) to the PERLND 80 land segment in addition to the groundwater inflows being imported from the PGG analysis. This is resulting in a double-application of rainfall to the areas in question and a subsequent double-counting of groundwater flow from those areas. Similar methods were used in the Port's assessment of Walker Creek, but without this input error. The HSPF input sequence for Walker Creek shows that no precipitation (actually precipitation with a 0.00 multiplier) is correctly applied to the PERLND 80 land segment. This problem of double-counting embankment area groundwater discharge appears to be restricted to the Miller Creek model. The consequence is that project impacts to Miller Creek low streamflows are substantially under-estimated

2. Discussion of the embankment seepage modeling is found on pages 2-6 through 2-8 and in Appendix B of the Low Flow Analysis report. This modeling work was performed by Pacific Groundwater Group (PGG) for the Port of Seattle, using groundwater flow calculations which were in some ways similar to calculations performed by PGG in an earlier study for Ecology (Sea-Tac Runway Fill Hydrologic Studies Report, June 19, 2000). The most recent seepage modeling work for the Port is described as "a more detailed evaluation" (Appendix B page 1) and as "building on" (executive summary) the previous PGG work for Ecology. However a fundamental methodology change occurred between PGG's earlier work for Ecology and the most recent work for the Port. The current PGG study, unlike the original work, examines only a future scenario condition without a comparable examination of current conditions as a necessary baseline for assessing impacts.

In the original study for Ecology PGG, developed seepage and groundwater flow models for both current and future conditions and then compared the results of the two models to determine impacts. That is a valid methodological approach. However, in the current work for the Port, PGG's scope was "limited to post-construction conditions, and did not attempt to simulate existing conditions" (Appendix B, page 1). Impacts were instead addressed by other Port consultants who in effect compared the results of the PGG groundwater flow models for future conditions against HSPF estimates of groundwater flow under current conditions. This mixing of methods—specifically the use of different models to define current versus future conditions--is inappropriate for evaluating impacts and is unlikely to produce meaningful results.

3. The PGG embankment fill modeling does not appear to have been updated to incorporate the latest information on embankment construction methods. This comment relates to the expectation that while the bulk fill (vertical flow) aspects of the proposed embankment construction will prolong flow times and will likely benefit stream low flows, the engineered subgrade and drain layer (lateral flow) aspects of the proposed embankment may accelerate groundwater flow velocities and impair stream low flows. The current proposal for embankment construction (Hart Crowser, November 2, 2001, "Geotechnical Summary Report, Third Runway Embankment and MSE Retaining Walls, Seattle-Tacoma International Airport" page 13) is to over-excavate problematic soils (including peat or wetland soils) and replace those soils with densely compacted select fill. By removing the wetland soils which tend to attenuate the water flow, the subgrade improvements will accelerate the drainage and flow of water from those areas. However, Figure 5-1 of the PGG study shows wetland soils as persisting beneath the embankment fill, suggesting that effects of wetland soil removal have not been addressed in the PGG analysis.

4. In the Port's analysis of Miller Creek, the volume of airport embankment seepage flow being delivered to Miller Creek at the SR509 point of compliance during the low flow months is approximately two to three times greater than the flow which would actually reach that point based on the findings of PGG's June 2000 report for Ecology. Both of the PGG studies (dated June 2000 for Ecology and November 2001 for the Port) examine vertical seepage through the embankment fill body using a "Hydrus" model. Also, both of the PGG studies used a "Slice" model to determine the fate of that seepage once it reached the bottom of the fill. The output from the Slice model consists basically of two hydrographs: 1) seepage flow from the constructed drain layer at the base of the embankment plus "Qvr" (shallow regional aquifer) discharge; and 2) downward flow through the till. Plots of these hydrographs shown by Figures 5-4 through 5-6 of PGG's November 20001 report show that the volume of "Downward Flow through Till" during the low flow months is on average about double the volume of "Qvr/Drain Outflow." PGG's June 2000 report for Ecology (page 24) states, "[I]n a conceptual sense the till seepage reaches the "Qva" aquifer. This downward seepage is not accounted for further within the cross section." That PGG report (again at page 24) further

states "[T]he analysis suggests that base flow consists mostly of local, shallow groundwater flow and that contributions from the Qva aquifer are small in this reach." That PGG conclusion appears to have been based on Miller Creek Base Flow Gain Field Surveys performed by PGG in October 1999 and January 2000 (results are summarized in PGG June 2000 Figures 3-8 and 2-1) which show virtually no gain in Miller Creek base flows between S 156th Street and the downstream SR509 point of compliance.

In other words, PGG's work for Ecology concluded that the downward flow through the till (i.e. the flows which recharge the deeper Qva aquifer) do not appear to return to Miller Creek in the vicinity of the runway project. However, in assessing project impacts on Miller Creek low flows at the SR509 point of compliance, other Port consultants direct 67% of this till seepage back into the stream above SR509. This assumption that water flowing to deep aquifer recharge will substantially re-emerge to support stream flows in the vicinity of the project is conceptually incompatible with the results of the PGG analysis, and causes low streamflow impacts to be under-estimated

The foregoing is a subset of a more comprehensive set of comments we are preparing for the ACC, and should be read as supplementing the comments we submitted to the Corps in our letters of December 18, 2001, and November 26, 2001. On behalf of the ACC, we again thank you for your consideration of these concerns.

Sincerely,

**northwest hydraulic consultants inc.**

William A. Rozeboom, P.E.
Senior Engineer

K. Malcolm Leytham, Ph.D, P.E.
Principal

cc: Peter Eglick, Helsell Fetterman LLP

WAR/KML/kns
20988 graves 01-30