DEPARTMENT OF ECOLOGY
NORTHWEST REGIONAL OFFICE
3190 – 160th Avenue S.E.
Bellevue, WA 98008-5452

Memorandum

March 9, 2001

TO: Kevin Fitzpatrick, Ecology NWRO Water Quality Section Manager
Ann Kenny, Ecology NWRO Shorelines and Environmental Assessment

FROM: Dave Garland, Ecology NWRO Water Quality Nonpoint Unit

SUBJECT: *Review of "Sea-Tac Airport Master Plan Update Low Streamflow Analysis" Earth Tech, December 2000*

BACKGROUND

Comments are provided resulting from my review of the report, *"Sea-Tac Airport Master Plan Update Low Streamflow Analysis" (Earth Tech, December 2000).* This low streamflow analysis is associated with the Port of Seattle's latest 401 Permit application for construction on the Sea-Tac Airport Third Runway in proximity to Des Moines, Walker, and Miller creeks. Earth Tech, Inc., performed the analysis which expanded upon analyses in recent studies conducted by Pacific Groundwater Group(PGG) and Earth Tech (*Sea-Tac Runway Fill Hydrologic Studies Report, June 2000*), Hart Crowser (*Effects on Infiltration and Baseflow, Proposed Third Runway Embankment, October 2000*) and Parametrix (Stormwater Management Plans and HSPF streamflow modeling reports; *November 1999, August 2000, and December 2000*).

The subject report uses the term "low streamflow" to refer to total flow in a given stream during August and September, since those months are considered critical for minimum streamflows. After characterizing existing August and September streamflow conditions in Miller, Walker and Des Moines creeks, the report considers existing watershed modeling of current and proposed (post-project) hydrologic conditions. The analysis performed for this report then incorporates factors not taken into account in the existing watershed modeling.

WATERSHED MODELING

Existing studies had determined that the base year for defining pre-project hydrologic conditions in streams around Sea-Tac Airport would be 1994. Predicted hydrologic conditions associated with the proposed airport improvements are described as year 2006 (post-project) land-use conditions. An updated HSPF streamflow model was used to derive pre-project and post-project low flow statistics. The updated HSPF modeling for the proposed project condition incorporates recently designed extended duration discharge from stormwater detention facilities with infiltration galleries feeding shallow groundwater adjacent to Miller Creek. The HSPF modeling indicates that, for return intervals ranging from 2 to 20 years, post-project 7-day low flows are slightly reduced in all three streams compared to pre-project (1994) flows. Average monthly post-project streamflow in Miller Creek decreased by 0.17 cfs in August and 0.10 cfs in September. In Walker and Des Moines creeks, average monthly streamflows for August decreased by 0.002 cfs and 0.01 cfs, respectively, and for September increased by 0.004 cfs and 0.09 cfs, respectively.

LOW STREAMFLOW ANALYSIS

The HSPF streamflow model is designed for whole watershed modeling and does not effectively characterize hydrologic effects of local, atypical features such as those associated with the proposed runway fill located immediately adjacent to Miller and Walker creeks. To perform a more comprehensive low streamflow analysis, Earth Tech considered the limitations of the HSPF streamflow model in characterizing secondary recharge from runway and taxiway pavement, non-hydrologic flow changes due to local land use conversion from residential, and late summer discharge of infiltrated water stored in the embankment fill. The analyses also recognize the need to include the managed release of stormwater from reserved storage, which was not accounted for in the HSPF modeling.

Both the HSPF model and the PGG Runway Fill Hydrologic Studies assumed that runoff from impervious area is completely conveyed to storm-drain systems and discharged to streams. However, this is not the case for runoff from the proposed third runway and connecting taxiways. Since proposed taxiways and runways will be bordered by permeable grass filter strips ranging from 30 to 75 feet wide, the infiltration into pervious soils surrounding the runways was underestimated by prior hydrologic modeling. The subject low streamflow analysis took secondary impervious recharge into account, which results in increased August and September flows in Miller Creek of 0.04 and 0.025 cfs, respectively; and increased August and September flows in Walker Creek of 0.005 and 0.003 cfs, respectively. These estimates are considered conservative since they do not account for additional infiltration expected from permeable drainage collection swales adjacent to the runway filter strips.

Pacific Groundwater Group and Parametrix quantified the non-hydrologic flows, or changes to groundwater recharge from conversion of residential neighborhoods. While some residents had wells and water rights, much of the water used in residential areas was imported via municipal water systems. The best estimates of residential influences on hydrology involved interviewing past residents and concluded that cessation of recharge from imported residential irrigation and drainfield use will result in estimated reduction in Miller Creek streamflow of 25,000 gpd (0.04 cfs).

Since HSPF does not effectively model deep percolation such as through the proposed runway fill and subsequent discharge through the basal embankment drainage layer, adjustments were made to HSPF results to account for the fill. Studies by both Hart Crowser and Pacific Groundwater Group concluded there would be delayed discharge of infiltrated water which would then provide increased discharge from the fill embankment to area streams during low flow periods in August and September. Pacific Groundwater Group developed a "slice model" to quantify the hydrologic behavior of the fill over a characteristic cross-section (PGG, June 2000). The slice model predicts that infiltration of precipitation into pervious areas of the runway fill during winter months will result in summer drainage from the embankment. The subject study integrates the results of the PGG slice model over the 5,400-foot embankment distance along Miller Creek. This analysis concludes that total baseflow from the fill along Miller Creek will increase by 0.108 cubic feet per second in August and 0.065 cubic feet per second in September. Compared to average August and September streamflows in Miller Creek at SR 509 of 1.10 cfs and 1.40 cfs, respectively, the increases in average streamflow from the fill drainage for August and September are 9.8% and 4.6% of the flow, respectively. The cross-section of the June 2000 'slice model' was located at an uncharacteristically thick section of the fill at the proposed Miller Creek retention wall. Consequently, the attenuation and delay of groundwater flow characterized by integrating the 'slice' along the length of the embankment adjacent to Miller Creek may be unrepresentative. For this reason, the delayed fill drainage estimates for August and September may be overstated depending on how the slice model results from PGG (June 2000) were integrated along the embankment adjacent to Miller Creek.

RESULTS

When these additional hydrologic and non-hydrologic factors are taken into account with the existing HSPF watershed modeling results, it is estimated that low streamflows (as measured by 7-day/2-year frequency low flows) will be maintained in Walker Creek at or slightly above pre-project levels. In Miller and Des Moines creeks, predicted year 2006 low streamflows fall short of maintaining 1994 conditions without the release of reserved stormwater. An estimated 0.10 cfs is needed in Miller Creek to maintain or exceed 1994 conditions, while 0.08 cfs is needed to supplement Des Moines Creek low streamflows to maintain or exceed 1994 flows.

CONCLUSIONS

The low streamflow analysis presented in the report, "*Sea-Tac Airport Master Plan Update; Low Streamflow Analysis*" (Earth Tech, Dec. 2000), improves upon existing modeling in that it considers factors pertinent to local hydrology of the proposed Sea-Tac Runway project that are not considered in watershed-wide HSPF streamflow modeling. Factors affecting low streamflows which were taken into account in this analysis, in addition to the HSPF modeling, are reasonable considering the limitations of HSPF for modeling project specific impacts and considering the magnitude of fill, changes in land use, and proposed stormwater management facilities associated with the third runway. The analysis is also consistent with detailed cross-sectional hydrologic modeling of the proposed Runway Fill Embankment (PGG, June 2000). However, the integration of the slice model over the 5,400 foot portion of the embankment along Miller Creek may have overstated the delayed drainage contribution to that stream.

The long-term success of low streamflow maintenance at 1994 levels depends on successful construction, maintenance and operation of additional stormwater storage and release facilities on Miller and Des Moines creeks. These storage facilities would collect and store winter runoff until needed to support low flows during the dry season. In summary, the low streamflow analyses of watershed modeling incorporating the adjustments presented in this report indicate that average August and September flows are predicted to increase slightly in all three streams. The 7-day low flows in Miller and Des Moines creeks are expected to match pre-project conditions with releases of supplemental reserved stormwater.

RECOMMENDATIONS

1. According to this low streamflow analysis, the Port's ability to maintain pre-project streamflows in Miller and Des Moines creeks depends on the construction of stormwater storage facilities designed to collect, store and release winter runoff. These stormwater retention facilities must be of adequate volume and include features that will allow controlled release of supplemental flows as needed to support low flows during the dry season.

2. Supplemental flow releases from stormwater storage facilities on Miller and Des Moines creeks should be actively managed to respond to real-time streamflows rather than initiating the release on fixed dates each year. Figures 7 and 8 in the Earth Tech report include analyses of the most probable time periods for supplemental releases to Miller and Des Moines creeks. Proper timing of these releases will require maintenance and operation of dependable stream gages and intensive summer streamflow-monitoring programs on Miller and Des Moines creeks.

3. A more detailed integration of the PGG 'slice model' (PGG, June 2000) over the 5,400 foot portion of the embankment along Miller Creek would yield improved low flow estimates for delayed embankment drainage to Miller Creek during the months of August and September.

- end -