JOSEPH BRASCHER

POLLUTION CONTROL HEARINGS BOARD
FOR THE STATE OF WASHINGTON

AIRPORT COMMUNITIES COALITION and CITIZENS AGAINST SEA-TAC EXPANSION, Appellants, v. STATE OF WASHINGTON DEPARTMENT OF ECOLOGY, and THE PORT OF SEATTLE, Respondents.	PCHB No. 01-160 **PREFILED TESTIMONY OF JOSEPH BRASCHER**

Outline of Testimony

Page

AR 015849

ORIGINAL

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

Page

AR 015850

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

1. I have personal knowledge of the facts stated in this testimony and would be competent to testify to those facts.

BACKGROUND

Current Position and Experience

2. I have been employed by AQUA TERRA Consultants for almost nine years, since May 1993. My responsibilities with the firm currently include, project management, hydrologic analysis and computer programming, in addition to management of the Olympia satellite office. Prior to beginning my employment with AQUA TERRA, I was employed by the City of Olympia Surface Water Department as temporary technician from June 1991 until April 1993. My duties included hydrologic model review and model application. From May 1992 until April 1993, I worked for the Thurston County Water and Waste Management division, where my duties included hydrologic model review and model application. A copy of my C.V. describing my professional experience and education is attached as Exhibit A.

Retention and Overall Role

3. My involvement in the Seattle-Tacoma International Airport (STIA) proposed third runway project began in December 1999, when I was retained by Earth Tech to aid in the review of Des Moines Creek, Miller Creek, and Walker Creek Hydrologic Simulation Program — FORTRAN (HSPF) models. In July 2000 the King County Department of Natural Resources retained me to aid in their on-site review of the recalibration of Miller and Walker Creeks. In August 2000 I was retained by Parametrix to aid in continued use of the Miller Creek and Walker Creek HSPF models and to prepare the calibration reports for these streams. My work for Parametrix included making modifications to the models as improved data was made available and components of the hydrologic modeling conducted on the third runway embankment.

AR 015851

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

Prior Experience with HSPF Modeling

4. I have extensive experience working with hydrologic models, including the Hydrologic Simulation Program — FORTRAN, which I will refer to as HSPF. HSPF is generally recognized as the most complete and defensible process-based continuous simulation watershed model for quantifying runoff and addressing water quality impairments. Since its initial development nearly twenty years ago, the HSPF model has been applied in numerous countries throughout North America and the world and in numerous climatic regimes; it enjoys the joint sponsorship of both the U.S. Environmental Protection Agency and the U.S. Geological Survey.

5. Over the past 10 years, I have calibrated HSPF models representing more than 15 watersheds in western Washington using the HSPF software package. These projects include a wide range of watershed conditions from highly developed areas to regions that are mostly forested. I have used HSPF models to determine impacts caused by various types of development, including small residential developments, large commercial developments, and primarily basin wide impacts due to projected future developments. Typically, the impacts analyzed include future peak flows, future flow durations, and impacts to future low flows. My role in the hydrologic modeling of the STIA proposed third runway embankment called for similar analyses.

LOW STREAMFLOW MODELING AT STIA

Modeling Goals and Selected Approach

6. The work performed by Aqua Terra comprised several components of the overall low streamflow analysis conducted for the third runway project at the Seattle-Tacoma International Airport (STIA). Our goals in performing this analysis were to determine the critical low-streamflow periods for Miller Creek, Walker Creek, and Des Moines Creek, the existing streamflow magnitudes (target streamflows) for each stream, and the impacts to each stream resulting from construction projects in the Master Plan Update for STIA. A detailed

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

modeling analysis was used to determine the impacts to streamflows during the summer low-streamflow periods. Aqua Terra's work was one part of this detailed analysis.

Integration of HSPF Model with Hydrus and Slice Models

7. The overall modeling plan implemented for the proposed third runway embankment can be summarized as follows: (1) calculate the runoff and recharge from precipitation; (2) model the variable saturated vertical flow through the embankment fill; (3) model saturated, quasi-horizontal flow at the bottom of the embankment; (4) integrate those results across the fill embankment; and (5) incorporate the results back into the Miller and Walker Creek recharge models.

8. In designing our approach, we decided to employ a combination of what we determined to be the best and most appropriate tools available for modeling the introduction of the third runway fill embankment area. Because of HSPF's superior evapotranspiration (ET) and runoff-modeling capabilities, we selected it to model runoff and recharge (Step 1 as described above), and to model the net effects to flow during the summer low-streamflow periods (Step 5). We determined that additional modeling tools, Hydrus and Slice, would more effectively simulate flow through and below the proposed embankment. We selected Hydrus to simulate vertical flow through the embankment fill and Slice to simulate flow beneath the embankment fill. Aqua Terra was responsible for performing recharge calculations through the use of HSPF (Step 1) and incorporating Hydrus and Slice results obtained by Pacific Groundwater Group (PGG) back into the Miller Creek and Walker Creek HSPF models (Step 5). PGG performed intermediate Steps 2 through 4.

9. I disagree with ACC consultant William Rozeboom's criticism that our integrated approach "involves an apples-to-oranges mixture of methods" that is "unlikely to produce meaningful results." In my opinion, the use of a single model to simulate runoff, infiltration, flows over and through the third runway embankment, and stream recharge, although superficially less complex, would have resulted in a deeply flawed analysis due to the particular limitations inherent in each of the specific models used. For example, although it is

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

possible to use HSPF to model active groundwater, the HSPF models alone are not in my opinion capable of accurately simulating groundwater flows of this type. For this reason, we determined that a combination of HSPF with additional modeling tools was a more appropriate approach to simulate flow through the proposed embankment in the Miller and Walker Creek watersheds. By integrating HSPF with Hydrus and Slice, we were able to capitalize on the advantages and the best features offered by each model, while eliminating or at least minimizing the drawbacks and limitations of each model.

10. In summary, HSPF was used to compute runoff from the pervious and impervious surfaces accounting for the evapotranspiration into the atmosphere. PGG then applied the data derived from HSPF modeling into Hydrus and Slice to determine the amount of surface runoff that would result from filter strips, the timing of the movement of water through the vertical soil column, and the resultant split in flow between the drains that underlie the embankment and the seepage into the till layer. Aqua Terra then entered the resultant time series from the Hydrus/Slice models into the HSPF models for Miller and Walker Creeks to determine the impacts of the embankment on low flows in these streams.

CALIBRATION

11. The calibration of hydrologic models allows the adjustment of model parameters to achieve a close match between recorded streamflows and simulated streamflows for a period when flow data are available. Hydrologic modeling using HSPF requires the consideration and calibration of many model-specific parameters that describe the different hydrologic processes. These processes include:

- Rainfall runoff from pervious and impervious surfaces.
- Infiltration of rainfall to soils.
- Soil moisture accounting.
- Flow of groundwater from soils to streams.
- Loss of groundwater to deep aquifers.

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

12. Our calibration process included the use of all available data related to the stream reach and its tributary watershed. During the calibration process we attempted to match as closely as possible all existing recorded streamflow data and to reflect the general behavioral characteristics of each watershed without sacrificing accuracy and defensibility. We used the HSPF model to simulate continuous watershed hydrology and to design stormwater detention facilities for the Port's Master Plan Update. Because the third runway project encompasses three watersheds, we developed three separate HSPF models, one each for Miller, Walker, and Des Moines Creeks. Calibration of Des Moines Creek was performed by Dr. David Hartley of the King County Department of Natural Resources. The Miller and Walker Creek models were calibrated by the Calibration team, which was comprised of David Harms, Kelly Whiting from King County, and myself. Following calibration, the models could then be run to compare base conditions (1994) with post-project conditions (2006).

13. I understand that King County has raised concerned about the potential impact to the Miller and Walker Creek calibrations based on the minor changes that have been made to 1994 land use conditions. These impacts have been examined and have been determined to be inconsequential. Our evaluation of these impacts was summarized in a calibration verification report recently provided to the County.

Miller Creek Low Streamflow Calibration

14. We used two streamflow gages in the Miller Creek watershed to perform low-streamflow analysis calibration. One gage was located near the mouth of Miller Creek and a second gage was located further upstream at the Miller Creek detention facility. The results of our analysis are summarized in Tables 2-1 and 2-2 of the December 2001 Low Streamflow Report prepared by Parametrix, which has been submitted as an Exhibit. Those tables list average simulated and observed streamflows for each 7-day low-flow period during 1991 through 1996 for the downstream gage (Table 2-1) and the upstream gage (Table 2-2). Gage locations are depicted in Figure 2-1. For the Board's convenience, all tables and figures from the 2001 Low Streamflow Report that I refer to in my testimony are attached collectively as

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

Exhibit B. The data we computed revealed that in general the observed 7-day low flows exceeded the predicted 7-day low flows at both gages, particularly for the gage located at the Miller Creek detention facility. In other words, the models tended to underestimate flows at Miller Creek.

15. In his pre-filed written direct examination, ACC's consultant Keith Malcolm Leytham is critical of the calibration we performed on Miller Creek, asserting that the calibration fails to incorporate groundwater inputs from the noncontiguous Miller Creek groundwater area. However, Dr. Leytham himself points out that "the exact noncontiguous area [is] . . . difficult to define." See Dr. Leytham's pre-filed written direct examination, ¶ 19.

16. Moreover, Dr. Leytham's colleague at Northwest Hydraulic Consultants, William Rozeboom, has stated his approval of the Miller Creek calibration. In his Declaration of October 8, 2001 (¶ 8), Mr. Rozeboom states: "I am in partial agreement with the Port and Ecology as to the adequacy of the HSPF model calibration for this project . . . . It is my opinion that the HSPF model calibration to Miller Creek is adequate for a range of applications." A true and correct copy of Mr. Rozeboom's Declaration is attached as Exhibit C. I agree with Mr. Rozeboom's assessment of the Miller Creek calibration and continue to maintain its validity.

Walker Creek Low Streamflow Calibration

17. As we did in the Miller Creek analysis, we used two streamflow gages in the Walker Creek watershed to conduct our low streamflow calibration. One gage was located near the mouth of Walker Creek, and a second gage was located further upstream near the Walker Creek wetland. The results of our analysis are summarized in Tables 2-3 and 2-4 of the December 2001 Low Streamflow Report. Those tables list the average simulated and observed streamflows for each 7-day low-flow period for the gage near the mouth of Walker Creek (Table 2-3) and for the gage near the wetland (Table 2-4). See Exhibit B. In general, with the exception of 1995, the observed 7-day low flows exceeded the predicted 7-day low flows at both gages.

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

18. ACC's consultant William Rozeboom challenges the Walker Creek low flow calibration. In his pre-filed testimony (¶ 12), Mr. Rozeboom states, "For Walker Creek the main concern is over how Industrial Wastewater System (IWS) expansion and leak reduction efforts may be causing potentially-large reduction in headwater baseflows." For the following reasons, I disagree with Mr. Rozeboom and maintain that the approach we adopted and implemented provided the most accurate, valid, and useful data.

19. The issue of base flows for Walker Creek is admittedly a complex one, as the Walker Creek watershed has several unique characteristics. The tributary drainage area upstream of gage 42c (the upper Walker Creek gage) is approximately 233 acres. The average base flow at gage 42c is approximately 0.7 cfs. In contrast, Miller Creek at its mouth has a drainage area of approximately 4700 acres and an average base flow of approximately 1.4 cfs. In other words, an area of approximately 1/20 the size of Miller Creek produces approximately one half the base flow.

20. In my opinion, base flow of this magnitude cannot be generated locally. An outside source of groundwater is therefore likely to be contributing to base flow. After investigating all potential sources of groundwater, I have concluded that the probable source is the non-contiguous groundwater basin. Using the groundwater maps, we determined the size of the contributing groundwater basin. We added this area to the Walker Creek model and connected the groundwater from this area to the Walker Creek wetland. These steps greatly improved the base flow and volume calibrations of the Walker Creek model.

21. In my investigation we could identify no other probable sources of base flow. We considered many other potential sources, including the IWS drainage system, the IWS lagoons, and the possibility that Miller Creek groundwater that had been lost to a deep aquifer, but could not locate any quantitative flow information for any of these sources. We therefore concluded that the inclusion of these potential sources in the calibration would be purely speculative. Although such inclusion could make the calibration *appear* more accurate and valid, it was unlikely to actually improve the accuracy or validity of the calibration.

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

22. Furthermore, there is no conclusive data indicating that any of these inputs changed significantly during the calibration time period. Because the IWS lagoons were lined after the period in which the calibration was conducted, they could not be considered an impact to the calibration process. Potential leaks to the IWS drainage system would be impossible to quantify and would at best introduce error into the calibration. It is possible that a portion of the groundwater lost from the Miller Creek watershed reaches the Walker Creek wetland, but the mapping renders this possibility highly unlikely.

23. ACC's consultants have also pointed to the 30% decline in base flows over the calibration period, asserting that the decline reveals a flaw in the calibration. However, this "pronounced" 30% reduction in low flows can be attributed entirely to reductions in precipitation during the calibration period. A review of measured precipitation from 1991 to 1995 makes this point clear. Total precipitation in 1991 was 45.6 inches. Precipitation in water-year 1992 was 30.62 inches, a 33 percent reduction from the previous year. Similarly, precipitation in water year 1993 was reduced by 30 percent compared to 1991, precipitation in 1994 by 44 percent, and precipitation in 1995 by 14 percent. Notably, in his pre-filed direct examination, Mr. Rozeboom also refers to the dramatic reduction in precipitation during the calibration period, noting that the years between 1991 and 1994 ranked as first, fifth, tenth and 25th driest years. See ¶ 32. I believe that this reduced precipitation, considered alone, more than explains the 30 percent reduction in base flows over the calibration period.

24. In summary, the low streamflow analysis calibration performed in Miller Creek and Walker Creek indicated that calibrated low flows at the mouth of each stream were reasonably accurate, while calibrated low flows at the upstream gages typically showed lower flows than actually observed. These discrepancies do not impair the validity or usefulness of the models. Rather, they are likely the result of unusual or unverifiable groundwater conditions in each of the watersheds, combined with general and typical streamflow gaging inconsistencies. I understand from my review of King County's streamflow gaging records for gage 42c, for example, that unexplained drops were common and that such reductions possibly

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

resulted from water leaving the stream or from a gage malfunction. I agree. It has been my experience that observed streamflow records, while generally good, often have unexplained flaws. It is therefore my general practice not to make unsubstantiated changes to a model just to match potentially erroneous observed streamflow data.

LOW STREAMFLOW ANALYSIS

Determination of Low Streamflow Periods

25. We determined the low-streamflow period for each stream by analyzing modeled streamflow from the calibrated HSPF model for each stream. Our analysis used land use conditions existing in 1994. The 7-day low-flow period for each year in the 47-year period of record (1949 to 1995) for each stream was determined at points of compliance near the airport, specifically, 200th Street in Des Moines Creek, SR 509 in Miller Creek, and at the outlet of the wetland near Des Moines Memorial Drive in Walker Creek. The 7-day flow was selected as an indicator of persistent dry season flow. For example, summer low streamflows tend to decrease gradually; therefore, a shorter low-streamflow period is unlikely to result in significantly lower average flows or target flows.

Determination of Existing Summer Low Streamflows

26. The magnitude of existing summer low streamflow (target streamflow) in each stream was determined through analysis of the 7-day low-flow periods under existing (1994) conditions described above. Based on the analysis described in detail in the December 2001 Low Streamflow Analysis, the existing summer low streamflows (7-day, 2-year-frequency) were determined to be 0.33 cfs for Des Moines Creek, 0.77 cfs for Walker Creek, and 0.73 cfs for Miller Creek.

EMBANKMENT MODELING

27. Our goal in calculating recharge through HSPF models was to produce unit area run-off from pervious and non-pervious surfaces. Precipitation on the modeled fill area (MFA) was used to calculate hourly runoff (designated "SURO") from impervious surfaces

AR 015859

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

(runway and taxiways), and hourly infiltration (designated "AGWI") into pervious areas. Pervious areas were modeled as grass on flat outwash.

28. For pervious areas, application of the generic HSPF model yielded hourly volumes of water that infiltrate beyond the bottom of the root zone (AGWI). This hourly volume was combined with the SURO time series from which groundwater recharge was calculated. Unit area runoff was applied to filter strips and other pervious areas. A separate calculation was used to estimate the extent to which runoff from impervious surfaces would also infiltrate, or conversely, run off, from filter strips. PGG then used the total amount of infiltration into filter strips (a portion of AGWI and SURO) and other pervious areas (AGWI only) as input to the Hydrus models. The process can be more specifically described as follows:

HSPF Input and Runoff Calculations

29. The HSPF model allowed us to account for precipitation, runoff, infiltration, and evapotranspiration on an hourly basis between 1984 and 1994 on outwash soils with land slopes of less than five percent. HSPF model output (AGWI) provided hourly estimates of recharge below the root zone, taking into account the effects of runoff and evapotranspiration.

30. HSPF also allowed us to calculate hourly volumes of runoff (SURO) from a typical acre of impervious surface. Under current plans, runoff from impervious surfaces will be routed into "filter strips" that treat the water prior to storage and discharge. The filter strips are part of the pervious surface of the new fill. Therefore, the SURO and AGWI water volumes were added together and compared to the infiltration capacity of the filter strips. We considered water in excess of the infiltration capacity of the filter strips to constitute runoff. Remaining water was considered to infiltrate and become groundwater recharge. For these calculations, areas of impervious surface and filter strips were based on GIS analysis of design data. We assumed uniform flow over the filter strip and ignored likely storage of water in surface irregularities. The infiltration capacity was calculated as the saturated hydraulic conductivity of the fill under a unit hydraulic gradient, over the area of the filter strip.

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

31. A small amount of runoff was also calculated for "other pervious areas" (pervious areas that are not filter strips and therefore do not receive runoff) because AGWI on occasion exceeded the calculated infiltration capacity of other pervious area. The total volume of runoff from the other pervious areas was 6 percent of the AGWI volumes for both basins.

32. ACC's consultant William Rozeboom takes issue with our decision to use hourly volumes rather than a shorter time step. Our decision to use hourly volumes can be explained quite simply. All of the HSPF modeling work we performed up to this point had used an hourly time step. For the sake of consistency, we believed that runoff from the runway embankment and runoff from the rest of the basin should be computed on the same time step. I agree with Mr. Rozeboom that the use of a shorter time step could potentially increase the amount of surface runoff. In other words, the switch from hourly to 15-minute data may slightly increase the amount of surface runoff from the embankment (just as the use of a 5-minute time step will produce more surface runoff than a 15-minute time step). However, I believe that the key concern as it relates to the time step selected and applied is consistency. I previously noted Mr. Rozeboom's and ACC's general complaint about the Port's decision to integrate hydrologic models. Given that complaint, it is ironic that Mr. Rozeboom now criticizes our decision to use a single, consistent time step for the HSPF phases of the modeling

Effective Recharge

33. Effective recharge is the average downward groundwater flux over the entire pervious area, just below the root zone. It consists of those portions of AGWI and SURO that infiltrate. The filter strips and other pervious areas receive different amounts of water. In order the simplify the analysis, PGG calculated the *average* effective recharge for the entire pervious area as the summed volume of water infiltrated in those two areas, divided by the total pervious area.

AR 015861

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

34. For the 11-year embankment modeling period of 1984 through 1994, the following water volumes, total runoff, and total infiltration on Miller and Walker Creeks were determined:

	Miller Creek Modeled Fill Area (ft3)	Miller Creek Modeled Fill Area (percent of total water)	Walker Creek Modeled Fill Area (ft3)	Walker Creek Modeled Fill Area (percent of total water)
Water Available to Filter Strip	69,006,026	70%	12,821,485	88%
Water Available to OPA	29,689,341	30%	1,688,604	12%
Runoff from Filter Strip	19,625,881	20%	2,650,317	18%
Runoff from Other Pervious Area	1,652,948	2%	94,013	1%
Water excluded by Hydrus	220,585	0%	40,091	0%
Water artificially removed from Hydrus to promote stability	0	0%	8,686	0%
Total Runoff	21,499,415	22%	2,793,108	19%
Total Infiltration	77,196,293	78%	11,716,981	81%

INCORPORATION OF HYDRUS/SLICE INTO HSPF MODELS

35. We reported the SURO and AGWI time series to PGG, which input that data into the Hydrus model to determine the variable saturated vertical flow through the embankment fill. PGG then input the resulting data into its Slice models to determine saturated, quasi-horizontal flow at the bottom of the embankment and to integrate the Slice results across the fill embankment. The Hydrus/Slice modeling performed by PGG produced three time series of flow data for both the Miller and Walker Creek watersheds: (1) surface runoff from the embankment area; (2) flow through the drain at bottom of embankment area; and (3) till seepage flow. These three time series of flow data were then provided to us to incorporate into the HSPF model for each watershed and to complete the overall modeling.

Miller Creek

36. The surface runoff from the embankment area was split into three time series based on the ratio of contributing areas. These time series were then linked to the drainage systems that serve the embankment area. The flow through the drain at the bottom of the embankment area modeled by the Slice model was connected directly to Miller Creek stream

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

reach 35. Till seepage flow was routed to PERLND (Pervious Land Segment) 80, which represents the soil beneath the till layer underlying the embankment area and possesses the same parameter values as a Till Grass PERLND. The groundwater outflow from PERLND 80 was then routed the appropriate downstream receiving waters.

37. I am aware that King County has recently raised some concerns relating to precipitation being applied to PERLND 80 and the final destination of PERLND 80 groundwater. The December 2001 Miller Creek HSPF model has been modified to address these concerns by removing the precipitation from PERLND 80 and routing the groundwater to the locations suggested. The County also expressed concerns regarding the routing of the PGG surface flow time series, proposing that the new embankment model surface discharge time series should be routed to the same point as other surface discharges. This change has been incorporated into the Miller Creek model.

38. Finally, I understand that King County has recommended that the point of compliance (POC) defined at SR509 crossing should include MC7B and MC7 in the 1994 HSPF stream model. Specifically, the County proposed that the area associated with the MC7B subbasin (1994 model: 46.5 pervious acres) become the 2006 SDW1B subbasin (groundwater included to POC in 2006 model) and suggested that the POC in the HSPF model should be the outlet of RCHRES16 in both 1994 and 2006 models. An additional benefit identified by the County is that RCHRES16 would also include the MC7 subbasin, which loses 4 pervious groundwater acres and was found to be the furthest downstream subbasin subject to STIA related land cover changes. As suggested by the County, this issue was addressed by including MC7B and MC7 in the 1994 HSPF stream model.

Walker Creek

39. For Walker Creek, the surface runoff from the embankment area was routed directly to the SDW2 pond. The flow through the drain at the bottom of the embankment area was connected directly to the wetland near Des Moines Memorial Drive. Till seepage flow was routed to PERLND 80, which represents the soil beneath the till layer underlying the

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

RESULTS OF ANALYSIS

40. The HSPF model was run for the four-year study period. We determined the net effects to flow during the summer low-streamflow periods by comparing the modeled streamflow before project construction to modeled streamflow after project construction, with non-hydrologic impacts included as appropriate. Based on the previously described analyses, we determined the total net summer low-streamflow impacts to be 0.08 cfs for Des Moines Creek, 0.11cfs for Walker Creek and 0.00 cfs for Miller Creek. These results and supporting data were reported to Parametrix.

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

Executed at Tumwater, Washington, this 6TH day of March 2002.

Joseph Brascher

AR 015864

BROWN REAVIS & MANNING PLLC
1191 SECOND AVE., SUITE 2200
SEATTLE, WA 98101
(206) 292-6300

PRE-FILED TESTIMONY OF JOSEPH BRASCHER

EXHIBITS

A	Resume
B	Figure 2-1 and 2-2 of the December 2001 Low Streamflow Report
C	Declaration of William A. Rozeboom in Support of ACC's Reply on Motion for Stay

A

JOSEPH T. BRASCHER
Hydrologist
AQUA TERRA Consultants
Olympia, WA

EXPERTISE

Hydrology
Surface Water Modeling
Computer Programming
Web Development

EXPERIENCE

Mr. Brascher has a broad range of experience from surface and groundwater modeling to software development and database design using a number of different hydrologic software packages and programming languages. His experience with hydrologic modeling software packages includes HSPF, SWMM, GENSCN, HEC-RAS, HYDRA, WATERWORKS, HYDRAIN, HY8, and MODFLOW. Mr. Brascher also has a thorough understanding of the following software languages: Visual Basic, SQL, C++, Java, HTML, Cold Fusion and Access VBA among others. In 1993 Mr. Brascher joined AQUA TERRA Consultants, where he has been involved in the application of computer models and the development of software applications to provide services to a wide range of clients.

PROFESSIONAL DATA

The Evergreen State College - BS, Physics and Computer Science

REPRESENTATIVE ASSIGNMENTS

Green Cove Creek Low Impact Development Study, City of Olympia, WA – Mr. Brascher Updated a previous calibration of the Green Cove Creek watershed using a new high groundwater module recently added to HSPF. The enhanced calibration allowed for a more detailed study of the impacts of future development on Green Cove Creek. Several experimental low impact development scenarios were studied in an effort to minimize impacts to the Green Cove Creek.

Tambark Creek GENSCN Modeling Study, Snohomish County, WA - Mr. Brascher constructed both an EPA SWMM surface and backwater model and an HSPF version 12 model for the Tambark Creek watershed for the Mill Creek Urban Growth Area Overlay Plan. The models were then connected together using a software package GENSCN, originally developed by AQUA TERRA Consultants for the U.S.G.S. Detailed analysis of surface and groundwater was used to determine impacts of future development and changes in zoning.

Ronald Bog GENSCN Modeling Study, City of Shoreline, WA - Mr. Brascher constructed both an EPA SWMM surface and backwater model and an HSPF version 12 model for the Ronald Bog watershed. The models were then connected together using the software package GENSCN, originally developed by AQUA TERRA Consultants for the U.S.G.S. Detailed analysis of surface and groundwater was used to determine impacts of future development and changes in zoning.

Miller and Walker Creek Calibration , Port of SeaTac, WA – Mr. Brascher, in conjunction with Parametrix, calibrated HSPF models for both Miller and Walker creeks. These calibrated models were then used by Mr. Brascher, Parametrix, and other sub-consultants to evaluate the impacts of the addition of a third runway for SeaTac Airport. This included the sizing of many large detention/retention facilities. Further, the models were used to conduct an extremely detailed analysis of impacts to low flow potentially caused by the construction of the third runway.

Snoqualmie Ridge Master Drainage Plan, WA - The Snoqualmie Ridge Master Drainage Plan was produced for Weyerhauser/Quadrant for a 1500-acre development, located west of the Town of Snoqualmie. The purpose of the Snoqualmie Ridge Master Drainage Plan was to evaluate the effectiveness of the proposed mitigation efforts for the project site. The modeling effort included assembly and calibration of four separate HSPF subbasin models. The calibrated HSPF models were then used to create dozens of future condition scenarios. The future scenarios were evaluated by the Town of Snoqualmie based on King County Master Drainage Plan requirements for impacts to the onsite and off site streams and wetlands. All modeling results were reviewed by the Town of Snoqualmie and their consultants.

Black Hills Village, Tumwater, WA – Black Hills Village is a 300-acre Urban village low impact designed development. Mr. Brascher is constructing HSPF models to determine storm water facility sizes and locations as well as impacts to several large on-site wetlands. The goal of the project is to develop the site using an Urban Village concept that minimizes development impacts.

Western Washington Hydrology Model Development(WWHM), Washington State Department of Ecology(DOE) – Mr. Brascher was the project manager for the development of the WWHM. This model will be distributed by DOE as part of the 2001 DOE development manual. This is a state of the art windows based model that uses HSPF to size detention/retention facilities for developers. The model runs HSPF version 12 and can be used to size any manor of facility.

North Creek Flood Hazard Management Plan, Snohomish County, WA – Mr. Brascher reviewed and updated existing HSPF model of watershed. He evaluated future land use impacts on flood frequency and proposed structural and non-structural solutions to minimize future flood hazards.

HSPF Model of the French Creek Watershed, Snohomish County, WA - Mr. Brascher calibrated an HSPF version 11 model for the French Creek watershed. Identified drainage problem areas and the impacts of future development. This required the implementation of all relevant stormwater regulations and ordinances.

HSPF Model of the Lake Stevens Watershed, Snohomish County, WA - Mr. Brascher calibrated an HSPF version 11 model for the Lake Stevens watershed area. Identified problem areas and the impacts of future development.

HSPF Model of Mallard Pond and the Pacific Avenue Wetland, Thurston County, WA - Mr. Brascher calibrated an HSPF version 12 model for both the Mallard Pond and Pacific Avenue wetlands. Mr. Brascher then used the model to determine the hydroperiod of the Pacific Avenue wetland to aid in the design of a control structure that would lesson impacts of future development on the Little Mcallister Creek. The Mallard Pond model was used to aid in the retrofitting of Mallard pond to decrease downstream erosion.

HSPF Model of the Thurston County Landfill, Thurston County, WA - Mr. Brascher calibrated an HSPF version 12 model for the Thurston County Landfill. Mr. Brascher then used the model to determine the necessary increase in volume of an existing infiltration facility based on the capping of the landfill.

HSPF Model of the Evergreen Hills Development, Thurston County, WA - Mr. Brascher calibrated an HSPF version 12 model for the Evergreen Hills development. Since the development is located inside the sensitive Green Cove Creek watershed. The HSPF model was used to determine impacts of various development approaches. This helped achieve the goal of creating a low impact development and thus maintain the historic hydrologic conditions in Green Cove Creek.

Issaquah Highlands Wetland Mitigation, Issaquah, WA - Mr. Brascher calibrated an HSPF version 12 model for a 3-acre wetland. This model was used to determine the impacts of development on the wetland as well as the creation of 2 new acres of wetland. A detailed wetland Hydro-period analysis was conduction to determine future operation of the wetland.

GENSCN Development, U.S.G.S., Reston, VA - Mr. Brascher assisted in the development and implementation of the software package GENSCN 1.1. This package is written in Visual Basic and designed to work with several different database formats as well as GIS .SHP files for full data integration. GENSCN also allows data transfer between many different computer models. GENSCN uses a data-grid and a graphing grid developed by AQUA TERRA Consultants as well as several .DLLs developed for data transfer with the WDM database management package.

Snohomish County VIDS - Mr. Brascher customized the VIDS software to meet the needs of the Snohomish County Surface Water Management. This incorporated county-wide mapping and data access to all previously complete computer modeling work.

Hydrologic Model Data Maintenance and Management, King County, WA - Mr. Brascher reviewed, modified, and upgraded King County's HSPF models and hydrometeorologic data for Soos Creek, Bear Creek, East Lake Sammamish tributaries, Issaquah Creek, and Cedar River tributaries. He created a Visual Basic interactive data system (VIDS) to provide King County SWM staff with easy and convenient access to the HSPF models and model results. VIDS allows the user to access maps, HSPF input files and parameter value tables, and model results for each watershed. VIDS is a Windows interactive program that is simple and easy to use; it requires no knowledge of HSPF or programming.

King County Data Management, King County, WA - Mr. Brascher designed and implemented two Visual Basic application and one ACCESS application which when working together allow instant conversion and Web posting of all newly collected hydrometeorlogic data.

HSPF Model of the Des Moines Creek Watershed, King County, WA - Mr. Brascher calibrated an HSPF version 11 model for the French Creek watershed. Evaluated the impacts of runoff from SeaTac Airport on current and future streamflows.

HSPF Model of the Miller Creek Watershed, King County, WA - Mr. Brascher converted an HSPF Version 10 model to HSPF Version 11. The Version 11 model was used to track runoff from the SeaTac Airport as it traveled downstream though the Miller Creek stream system.

May Creek Basin Plan, King County, WA - Mr. Brascher assisted in modeling the May Creek Basin for King County and the City of Renton using HEC-2 and HSPF. Identified drainage problems and solutions in the watershed including the placement of stormwater control facilities.

Chesapeake Bay Watershed Study - Mr. Brascher was a member of the EPA-funded AQUA TERRA simulation team that calibrated streamflows at 38 locations in watersheds draining to the Chesapeake Bay. Using HSPF Version 10 and ANNIE, Mr. Brascher reviewed, updated, and input to WDM files eight years of hydrometeorologic data at 38 locations in four states.

HSPF Calibration of the Chesapeake Bay Watershed Model Phase III - Mr. Brascher assisted in the verification and calibration of the Chesapeake Bay HSPF model, including snow melt parameter adjustments and data preparation.

King County Web Development, King County, WA - Mr. Brascher designed and implemented a data intensive Web application which allows dynamic access to all hydrometeorlogic data available from King County. The application uses SQL, Cold Fusion, IIS, and HTML to deliver super fast data access to the general public for nearly a gigabyte of data.

King County VIDS - Mr. Brascher customized the VIDS software to meet the needs of the King County Surface Water Division. This incorporated county-wide mapping and data access to all previously complete computer modeling work.

Grass Lakes Wetland Study, Olympia, WA - Mr. Brascher used the Green Cove Creek HSPF model to evaluate surface and groundwater impacts on hydroperiod fluctuations of the Grass Lakes Wetland.

Quilceda-Allen Watershed Plan, Snohomish County, WA - Assisted county staff in the use of HSPF for watershed planning in Snohomish County. Investigated the impacts of future conditions alternatives and proposed mitigation on streamflow.

Hylebos Creek Study, City of Federal Way, WA - The Hylebos Creek study involved the joint use of the EPA SWMM and HSPF models to determine the extent of the existing flooding problems and to determine the proper location and size of future stormwater detention facilities. This included culvert removal and replacement at several locations throughout the watershed.

Chambers Creek Study, Thurston County, WA - Modeled Chambers Creek streamflow and surface water/groundwater interactions in Thurston County. Evaluated the effects of Chambers Lake outflow to augment downstream streamflow and seasonal groundwater inflow to lake and stream channel.

HSPF Application to the Woodland and Woodard Creek Basins, Thurston County, WA - Mr. Brascher adapted the calibrated Woodland and Woodard Creek HSPF models to represent future full-development conditions. This included the assimilation of all future zoning regulations and any local requirements pertaining to stormwater retention and detention as well as the implementation of regional projects intended to control stream flows.

College Ditch Stormwater Facility, Lacey, WA - Mr. Brascher adapted the Woodland Creek HSPF model to represent the College Ditch area in more detail. This included analysis of several new stormwater and water quality treatment facilities. Hydroperiod analysis was performed to determine the impacts to a ten-acre wetland.

Surface Water Modeling of the Percival Creek Basin, Olympia, WA - Mr. Brascher prepared and calibrated surface water models which represent all developed portions of the Percival Creek Basin. This included analysis of all conveyance systems and existing detention/retention facilities. Identified drainage problems and solutions in the watershed including the placement of regional stormwater control facilities.

SWMM Modeling of the Indian/Moxlie Creek Basin, Olympia, WA - Mr. Brascher applied the EPA SWMM surface and backwater model to the Indian and Moxlie Creek basins. The model was used to assess the impacts of rerouting a section of Indian/Moxlie Creek to improve fish habitat. Analysis included tidal impacts on current and future flood flows, implementation of local ordinances and regulations and solutions to future drainage problems.

Woodard and Green Cove Creek Development Impacts, Thurston County, WA - Mr. Brascher developed a modeling tool using data generated by the existing HSPF version 12 models for both the Green Cove and Woodard Creek watersheds. This tool can be used to evaluate changes in land use and development strategies.

Log Cabin and Cain Engineering Report, Olympia, WA - Mr. Brascher developed and calibrated a surface water model for the Log Cabin and Cain flood mitigation and engineering report. This included development and analysis of alternative solutions and stormwater facility designs.

HSPF Calibration of the Umatilla River - Mr. Brascher constructed and calibrated an HSFP version 12 model of the Umatilla River. This included use of the irrigation module to determine application rates for croplands. Groundwater interaction with streamflow played a key role in the calibration of the model.

Port of Chelan Regional Water Quality Facility - Mr. Brascher acted as an advisor to Forsgren and Associates in the construction and application of an EPA SWMM model to determine current and future flood flows for the Port of Chelan property. These flows were then used to size a water quality sedimentation facility before discharging into the Wenatchee River.

City of Wenatchee Stormwater Study - Mr. Brascher constructed an EPA SWMM model to determine current and future flood flows for the City of Wenatchee. These flows were then used to size future stormwater improvements.

Burien Depression Analysis, Burien, WA - Modeled flood elevations and groundwater impacts in natural depression draining neighborhood of 200 acres. Evaluated alternative and proposed solutions including pumping and diversion of inflows.

Mystic Lake Court Case, King County, WA - Provided hydrologic analysis of lake elevation changes due to development in a 1200 acre upstream basin. Developed HSPF computer model of lake with and without development and analyzed impacts due to future development.

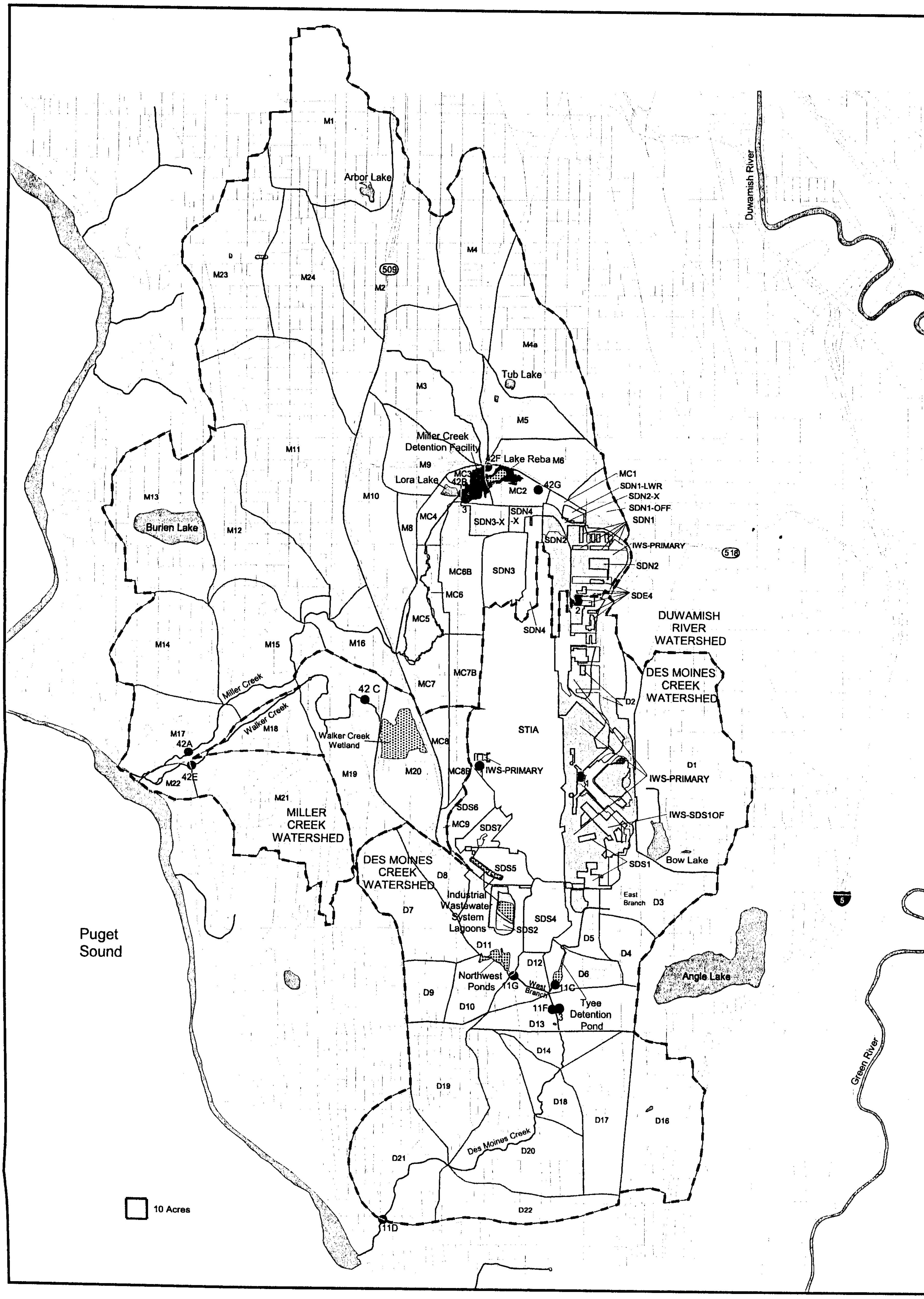
Southeast Olympia Drainage Basin Study, Olympia, WA - Mr. Brascher developed and calibrated a surface water model for the Southeast Olympia area, including detailed analysis of stormwater facilities, stormwater drainage systems and impacts on wetlands.

CH13 Drainage Basin Study, Thurston County, WA - Mr. Brascher calibrated a surface water model for subbasin CH13 located in the Chambers Creek watershed. Identifying alternative solutions to current flooding problems and designing stormwater facilities to mitigate the impacts of future development.

Thurston County VIDS - Mr. Brascher customized the VIDS software to meet the needs of the Thurston County Water and Waste Management Division. This incorporated county wide mapping and data access to all previously complete computer modeling work.

City of Kent VIDS - Mr. Brascher customized the VIDS software to meet the needs of the City of Kent Surface Water Division. This incorporated city-wide mapping and data access to all previously complete computer modeling work.

B



Parametrix, Inc. Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rrseatac-apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries are approximate.
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.
STIA subbasins assume existing (1994) conditions.

N

1000 0 1000 2000 Feet

1:36,000

Roads

Existing (1994) Drainage Subbasins

STIA Area (see note)

Constructed Water Features

IWS Drainage Area

Subwatershed Boundary

Watershed Boundary

Rivers

Water Bodies

Detention Facilities (existing)

Precipitation Gaging Stations:
Type 1 - National Weather Service (Gage relocated 1996)
Type 2 - POS Rainfall Monitoring
Type 3 - King County Rainfall Monitoring

Streamflow
King County Gaging Stations:
42A - Miller Ck @ SW 175th Pl & 12th Ave SW
42B - Miller Ck @ Lake Reba/RDF Outlet
42C - Walker Ck @ 171st Pl
42E - Walker Ck @ 12th Ave SW
42F - Miller Ck @ SR518
42G - Miller Ck @ East Branch
11D - Des Moines Ck near mouth
11F - Des Moines Ck @ Golf Course
11C - Des Moines Ck @ Tyee Pond
11G - Des Moines Ck @ NW Ponds

Figure 2-1
Map of Basins with Gage Locations

AR 015875

2.2.2.1 Miller Creek Low Streamflow

Two streamflow gages located in the Miller Creek watershed were used in the low-streamflow analysis calibration review (Figure 2-1). One of these streamflow gages was located near the mouth of Miller Creek, and the other was located further upstream at the Miller Creek detention facility.

Average simulated and observed streamflows for each 7-day low-flow period during 1991 through 1996 are listed in Table 2-1 for the gage near the mouth and Table 2-2 for the gage at the Miller Creek detention facility. In general, the observed 7-day low flows exceeded the predicted 7-day low flows at both gages, particularly for the gage located at the Miller Creek detention facility.

Table 2-1. Miller Creek at the mouth, 7-day low flows for water-years 1991 through 1996.

Water-Year	Observed Average Flow (cfs)	Calibrated Average Flow (cfs)	Difference (cfs)
1991	1.348	1.749	-0.401
1992	1.457	1.390	0.067
1993	1.639	1.300	0.339
1994	1.361	1.100	0.261
1995	1.500	1.661	-0.161
1996	2.762	2.138	0.624
Average Difference	**2.517**	**2.335**	**0.182**

Table 2-2. Miller Creek at the detention facility, 7-day low flows for water-years 1991 through 1996.

Water-Year	Observed Average Flow (cfs)	Calibrated Average Flow (cfs)	Difference (cfs)
1991	0.400	0.150	0.250
1992	0.127	0.124	0.004
1993	0.190	0.110	0.080
1994	0.000	0.090	-0.090
1995	0.183	0.137	0.045
1996	0.263	0.189	0.074
Average Difference	**0.291**	**0.200**	**0.091**

2.2.2.2 Walker Creek Low Streamflow

Two streamflow gages located in the Walker Creek watershed were used in the low-streamflow calibration review (see Figure 2-1). One of these streamflow gages was located near the mouth of Walker Creek, and the other was located further upstream near a wetland.

Average simulated and observed streamflows for each 7-day low-flow period are listed in Table 2-3 (1993 through 1996) for the gage near the mouth and Table 2-4 (1991 through 1996) for the gage near the wetland. In general, with the exception of 1995, the observed 7-day low flows exceeded the predicted 7-day low flows at both gages.

Table 2-3. Walker Creek at the mouth, 7-day low flows for water-years 1993 through 1996.

Water-Year	Observed Average Flow (cfs)	Calibrated Average Flow (cfs)	Difference (cfs)
1993	1.502	0.923	0.579
1994	0.987	0.833	0.154
1995	0.915	1.077	-0.163
1996	1.719	1.287	0.432
Average Difference	**1.281**	**1.030**	**0.250**

Table 2-4. Walker Creek near wetland, 7-day low flows for water-years 1991 through 1996.

Water-Year	Observed Average Flow (cfs)	Calibrated Average Flow (cfs)	Difference (cfs)
1991	1.208	0.786	0.422
1992	1.098	0.682	0.416
1993	0.800	0.666	0.134
1994	0.670	0.614	0.056
1995	0.256	0.750	-0.494
1996	0.896	0.870	0.026
Average Difference	**0.656**	**0.725**	**-0.069**

2.2.2.3 Des Moines Creek Low Streamflow

Two streamflow gages located in the Des Moines Creek watershed were used in the low-streamflow calibration review (see Figure 2-1). One of these streamflow gages was located near the mouth of Des Moines Creek, and the other gage (11c) was located further upstream.

Average simulated and observed streamflows for each 7-day low-flow period are listed in Table 2-5 (1992 through 1996) for the gage near the mouth and Table 2-6 (1991 through 1996) for gage 11c. In general, the observed 7-day low flows were close to the predicted 7-day low flows at the gage near the mouth, while the observed 7-day low flows at gage 11c exceeded the predicted 7-day low flows.

2.2.2.4 Summary

Low-streamflow analysis calibration review was performed for two gage locations in Miller, Walker, and Des Moines Creeks. Results generally indicated that calibrated low flows at the mouth of each stream were fairly good, while calibrated low flows at the upstream gages typically showed lower flows than observed flows. Groundwater conditions in each of the watersheds are somewhat speculative and may account for these discrepancies at the upstream gage locations.

C

Rozeboom
EXHIBIT NO. 245
2-5-02
M. Green

POLLUTION CONTROL HEARINGS BOARD
FOR THE STATE OF WASHINGTON

AIRPORT COMMUNITIES COALITION, Appellant, v. STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY; and THE PORT OF SEATTLE, Respondents.	)	No. 01-133 No. 01-160 DECLARATION OF WILLIAM A. ROZEBOOM IN SUPPORT OF ACC'S REPLY ON MOTION FOR STAY (Section 401 Certification No. 1996-4-02325 and CZMA concurrency statement, Issued August 10, 2001, Reissued September 21, 2001, under No. 1996-4-02325 (Amended-1))

William A. Rozeboom declares as follows:

1. I am over the age of 18, am competent to testify, and have personal knowledge of the facts stated herein.

2. I have reviewed the declarations of Steven G. Jones, Joseph Brascher, Donald W E. Weitkamp, Paul S. Fendt, and the Port of Seattle's Memorandum Opposing ACC's Motion for Stay, all filed by Foster Pepper & Shefelman, PLLC. I have also reviewed the declarations of Ann Kenny, Eric Stockdale, Kelly Whiting, and the Department of Ecology's Response to Appellant's Motion for Stay, all filed by the Attorney General of Washington. I offer responses to the above documents, most of which include some reference to my declaration filed previously in support of ACC's Motion for Stay.

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

COPY

3. I have also reviewed other recent declarations filed by the Port and Ecology, not identified above, in addition to very large quantities of emails, reports, internal memoranda, and other documents obtained by the ACC from Ecology, the Corps of Engineers, and other agencies through Public Disclosure Requests by the ACC. These documents have been provided to me by the ACC for information and review. I have reasonably comprehensive knowledge of all publicly available documents involving SeaTac hydrology and natural resource issues, and the positions taken on those issues by the Port and Ecology from October 1999 to date.

4. The declaration of Steven Jones, ¶3, discusses Port responses to public comments and attaches as exhibits copies of the Port's responses to comment letters received from Amanda Azous, Dr. Peter Willing, Dr. John Strand, and Tom Luster, together with the original comment letters, all of which were filed by the ACC. The materials provided by Mr. Jones however fail to include my comment letter, also filed by the ACC, or the Port's response to that letter. In order that the record be more complete, my comment letter of February 15, 2001 is attached as Exhibit A, the Port's response to that comment letter is attached as Exhibit B, and my follow-up comment letter of June 25, 2001 is attached as Exhibit C. These documents show that there are many significant issues which have been raised previously and which the Port and Ecology in my opinion have failed to satisfactorily address.

5. Most of the points I will make in this Declaration fall into one of three broad categories of disagreement with the Port and Ecology. First, I strongly disagree with the Port and Ecology's assertions as to the adequacy of the calibration of the HSPF modeling used to assess

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

stream low flow impacts to Walker and Des Moines Creeks. Second, I strongly disagree with the Port and Ecology's assertions that effects of Industrial Wastewater System improvements on stream low flow impacts can or should be ignored. Finally, I very strongly disagree with the Port and Ecology's assertions that the significant problems and deficiencies in the low flow mitigation plan can be adequately resolved with the conditions proposed in Ecology's 401 Certification. There also are miscellaneous errors and points of disagreement which do not fall into the above categories.

6. The Declaration of Ann Kenny, ¶19, states that the Port "*agreed to comply with the King County Surface Water Design Manual*". This statement is misleading and inaccurate. The Port agreed to comply with only the technical provisions of the Manual, and negotiated an exemption from what the Port considered to be "procedural" requirements. In particular, the Port claimed exemptions from King County requirements for Drainage Reviews and Financial Guarantees. If the Port had fully complied with the King County Surface Water Design Manual (KCSWDM), the airport improvements would have been subject to a Large Site Drainage Review (KCSWDM Section 1.1.2) and through that process might have incurred additional flow and water quality requirements beyond the KCSWDM minimum requirements. In the initial King County review findings (Paragraph 3, Enclosure 1, Letter dated September 15, 2000 from King County/Bissonnette to Ecology/Luster), King County states, "*If processed under King County regulations, this project would have exceeded the threshold for Large Site Drainage Review and would have been subject to the procedural requirements whereby performance*

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

standards are tailored specific to the proposed development." From the King County reviewer's recent declaration (Whiting, Page 5, top bullet) it is stated that "*Enhanced water quality treatment, beyond the Manual's basic menu may be warranted based on the monitoring data presented in the SMP*". The record should show that the project is not in compliance with the King County regulations and, had such compliance been required, that enhanced water quality treatment would have likely been required.

7. The Port of Seattle's Memorandum opposing ACC's Motion for Stay, at Page 11, Line 8, states "*It bears emphasis that Mr. Rozeboom concedes that there is sufficient water to meet the low flow needs. See Rozeboom, ¶4.*" This is incorrect. No such statement or concession was made by me regarding sufficient water to meet low flow needs.

8. I am in partial agreement with the Port and Ecology as to the adequacy of the HSPF model calibration for this project. I agree that some of the calibration is adequate, but strongly disagree that all of the calibration is adequate in light of the range of purposes to which the models are being employed. I disagree in particular with the statement by Fendt, ¶24, that "*The calibration approved by King County in the SMP is also applicable to the Low Flow Analysis.*" It is my opinion that the HSPF model calibration to Miller Creek is adequate for a range of applications, but that calibration to Walker and Des Moines Creek is not. The hydrologic processes affecting surface-runoff peak flows are different from the hydrologic processes affecting groundwater-seepage low flows, and successful calibration to peak flows

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

does not assure successful calibration to low flows. My overall opinion of the current (September 2001) calibration of the models being used for this project is as summarized below.

HSPF Model -- Flow Regime	Calibration Adequate?
Miller Creek – Peak Flow	YES
Miller Creek – Low Flow	YES
Walker Creek – Peak Flow	YES
Walker Creek – Low Flow	NO
Des Moines Creek – Peak Flow	YES
Des Moines Creek – Low Flow	NO

My statements in the remainder of this declaration focus on the Walker Creek and Des Moines Creek low flow models which are in my opinion deficient.

9. I believe that my assessment of the HSPF model calibration is more or less consistent with the opinions of the King County reviewer retained by Ecology, and possibly the Port's own consultants with credible expertise in HSPF modeling. The King County reviewer's declaration (Whiting, Page 7, Line 7) states that *"These calibrations have been accepted for purposes of SMP flow control mitigations."* However, the King County reviewer does not provide any endorsement or acceptance of the model calibration relative to low flow analysis or mitigation. Instead, he recommends further documentation and discussion of the accuracy of the calibrations in predicting upper-stream low flows (Whiting, Page 7, Line 18). Aqua Terra, the Port's consultant responsible for modeling flows and impacts in Miller and Walker Creeks, states (Brascher, ¶11) that *"The HSPF Modeling that will be included in the final version of the Low Flow Analysis will be peer reviewed and endorsed by Norman Crawford, the hydraulic engineer who actually developed the model itself."* By inference, there is an expectation by the Port's own consultant that

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

the current HSPF model(s) will be revised, presumably to correct some deficiency, prior to inclusion in a final low flow analysis. Also, Brascher's statement indicates that the current models have either not been subjected to a competent peer review or that there has been no public disclosure of the results of a competent peer review which may have already occurred.

10. The Port's submittals fail to provide credible information regarding the adequacy of the HSPF model for Des Moines Creek. From the declaration of Aqua Terra / Brascher, ¶4, Aqua Terra performed the modeling of surface water flows for Miller and Walker Creeks, but that *"Parametrix performed the modeling for Des Moines Creek in consultation with other subconsultants."* In the declaration of Parametrix project manager Fendt at ¶2, it is notable that HSPF experience is absent from Mr. Fendt's summary of qualifications. The declaration of Brasher at ¶13 states his opinion that the results of the HSPF model constitute an *"accurate assessment of the impacts on the flows of . . . Des Moines Creek"*, but it is not apparent how he could have reached this opinion when the modeling for Des Moines Creek was performed by others apparently not associated with Aqua Terra. In all of the declarations filed by the Port and Ecology, I have been unable to locate a declaration for any person directly responsible for the HSPF low flow modeling of Des Moines Creek.

11. Statements have been made to the effect that my analyses and conclusions are based on a single year of data (Weitkamp, Page 10, Line 19; Fendt, ¶24). This is incorrect. My previous declaration at ¶9 presented a plot of a single year of data (upper Walker Creek, 1991) as an illustration of problems which occur over the period of record for model calibration. One of the

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

problems is that the calibration for Walker Creek exaggerates the low flows in late summer and discounts the low flows in June and July. The model simulation has flows which recede more rapidly, and later into the fall, than is indicated by the actual gage data. The table below examines this issue further, considering the full period of record for which calibration data are presented in the SMP for Walker Creek.

WALKER CREEK STREAMFLOW DATA AT UPPER GAGE, CFS
RECORDED = ACTUAL STREAMFLOW DATA RECORDED BY KING COUNTY
SIMULATED = HSPF MODEL RESULTS FOR SAME PERIOD

	MINIMUM FLOW - RECORDED					MINIMUM FLOW - SIMULATED		
	Jun-Jul	Aug-Sep	Difference			Jun-Jul	Aug-Sep	Difference
1991	1.2	1.3	-0.1		1991	0.94	0.83	0.11
1992	1.2	1	0.2		1992	0.85	0.71	0.14
1993	0.9	0.8	0.1		1993	1	0.71	0.29
1994	0.89	0.73	0.16		1994	0.73	0.64	0.09
1995	0.13	0.12	0.01		1995	0.87	0.74	0.13
1996	0.85	0.41	0.44		1996	0.87	0.74	0.13

	AVERAGE FLOW - RECORDED					AVERAGE FLOW - SIMULATED		
	Jun-Jul	Aug-Sep	Difference			Jun-Jul	Aug-Sep	Difference
1991	1.55	1.62	-0.07		1991	1.17	0.98	0.18
1992	1.37	1.31	0.06		1992	1.01	0.82	0.19
1993	1.46	0.87	0.60		1993	1.35	0.82	0.53
1994	1.17	0.93	0.24		1994	0.92	0.72	0.20
1995	0.77	0.70	0.08		1995	1.05	0.90	0.15
1996	1.25	1.78	-0.53		1996	1.20	1.02	0.18
AVG	1.26	1.20	0.06		AVG	1.12	0.88	0.24

Two key conclusions can be drawn from this summary examination of the calibration data for the Walker Creek upper gage. First, the actual minimum flow recorded for the months of June and July is about as low (see 1995) or is lower (see 1991) than in the months of August and September,

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

representing 2 out of 6 years or 30 percent of all years of calibration record. Second, the actual data show that average flows during June and July are on average quite close (within about 5% or 0.06 cfs) to average flows in August and September. The simulated flows, on the other hand, suggest incorrectly that average flows in August and September are significantly lower (by about 21% or 0.24 cfs) than those in June and July. We repeat our previous point that the analysis should pay appropriate attention to the actual data, and that the actual data in this instance do not support the Port's apparent conclusions that Walker Creek low flows occur only in the period of August 1 through October 31, and that mitigation should be provided for that period only.

12. The statement was made that calibration to low flows was accurate because mass balance was achieved (Brascher, ¶14). While I agree with the importance of attaining mass balance, I disagree with this statement, in its present context, for two reasons. First, attainment of mass balance for a long-term (annual or multi-year) period does not provide any assurance that suitable mass balance is attained for the low-flow summer months which in this case is the period of specific interest. Second, the examination presented above of the calibration data for the Walker Creek upper gage show that mass balance was not achieved at that gage for summer low flow months. The data show that for the 6-year period of calibration data, the simulation results on average underestimate the actual flows by about 11% (1.12 vs 1.26 cfs) for June and July, and underestimate the actual flows by about 27% (0.88 vs 1.20 cfs) for August and September. Not only are the low flows consistently under-simulated, but for this gage the data suggest that the simulation data are biased towards too-low flows in late summer and early fall. One practical

HELSELL FETTERMAN LLP
1600 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

implication of under-simulation is that reliance on the Port's model might cause false conclusions to be drawn regarding whether future low streamflows show evidence of project low flow reductions. For instance, using the actual data, low flow impacts would be indicated (for climate conditions such as during the calibration period) if average August-September fell below 1.2 cfs, but using the Port's model, no mitigation would be offered until the average flows fell below 0.88 cfs. I do not dispute that calibration data may have been accurate for other gages. My point remains that the calibration to low flows is poor or unknown for the upper gages on Walker and Des Moines Creeks.

13. The statement has been made (Brascher, ¶16) that one of the ACC reviewers (presumably meaning me) suggested that calibration should have been done using only the gage located in the upper basin of these watersheds. That is not correct. The actual statement, which may be found on page 8 of my February 2001 letter (Exhibit A) is given below.

> We recognize that model calibration is a challenging process and that data reliability is often an issue. However, because the purpose of this work is to address and mitigate conditions in the upper basin (airport) areas of the watershed, calibration efforts should place more emphasis on matching upper basin flows unless those data are confirmed to be unreliable. The current calibration effort is deficient because it has placed too much emphasis on matching conditions at the lower gage, and has prematurely discounted the more-important upper basin data.

14. The statement is made by Brascher, also at ¶16, that King County has stated that the upper gage is less reliable than the lower gage for Walker Creek. However, no evidence or supporting documentation is provided to show that King County ever made such a statement, and there is no discussion of the specific data quality/reliability issues. The gage data for upper Walker

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

Creek cannot be so readily or easily dismissed on hearsay information, particularly since gages typically tend to be more reliable at low flows (which are of interest here) than at high flows for which field streamflow measurements are more difficult to obtain.

15. The statement has been made (Brascher, again at ¶16) that if calibration was based on gage data for the upper basin, then the model would have been out of calibration. This seems to be a concession that the model is not well calibrated to the upper basin gage. It is my opinion that the calibration effort should seek to understand the physical processes affecting each individual stream and to model these accordingly, rather than ignore available data which may be difficult to model or reproduce. For example, in the case of Des Moines Creek (for which low flow modeling was performed by persons unknown), we have previously identified several calibration issues including groundwater processes which would likely result in difficulty in reproducing low flows and attaining mass balance at both the upper and lower gages. The relevant text from Page 7 of my February 2001 comment letter is repeated below.

> Another groundwater-related problem with calibration is that it has overlooked possible stream losses to groundwater in the lower part of the basin. Figure B1-3 groundwater mapping shows that the Des Moines Creek below about elevation 200 feet does not intersect the regional groundwater table. This transition area corresponds roughly to the location of a knickpoint described in SMP page P-2 where the Des Moines Creek channel gradient increases and where bed sediments change from fine grained materials to relatively coarse materials with boulders, cobbles, gravel, and fine sand. Considering the evidence of the streamflow data, it seems likely that the lower part of Des Moines Creek includes a "losing reach" which has cut through the perching layer which supports the regional shallow groundwater table. The physical condition of a losing reach would be consistent with streamflow data at the mouth which show unexpectedly low flow peaks and volumes relative to streamflow data for the headwater areas. It is possible that the "poor calibration" problems described by SMP page B1-13, and the difficulty in

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

reconciling measured flows at the upper and lower gages, could be rectified if the presence of a losing reach were confirmed.

16. Statements are made to the effect that the Port's analysis is accurate because it is based on 47 or nearly 50 years of flow record for each stream (Fendt, ¶¶13, 15, Weitkamp, ¶16). Such statements are misleading in that they fail to acknowledge that the analysis is based fundamentally on about six years of streamflow record and 47 years of rainfall record. If the calibration is poor, as appears to be the case for the upper gages for Walker and Des Moines Creeks, then the HSPF modeling effort has produced a 47-year series of synthetic streamflow data which are similarly poor. Given a choice between 1) a 47-year sequence of unreliable synthetic flows based on a very poor calibration and 2) a six-year sequence of actual recorded flows, it is my opinion that the actual recorded flows should provide useful data and most certainly should not be ignored in favor of a longer synthetic sequence of dubious accuracy.

17. It is stated (Kenny, ¶21) that "*by the time Ecology issued the 401 Certification in August every single issue pertaining to the adequacy of the stormwater plan had been successfully resolved and the SMP amended to reflect those changes.*" This is misleading on at least two counts. First there are numerous stormwater and related issues described in my recent review and follow-up letters (See Exhibits A and C) which in my opinion have not been successfully resolved. Second, at the time of those review comments, the SMP included the low flow analysis and low flow mitigation plan as one element of the SMP document, and the low flow analysis had clearly become the greatest remaining hurdle to approval of the SMP. I consider it misleading for Ecology to assert that every single issue had been successfully resolved when the primary remedy was to

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

remove the low-flow analysis from the SMP discussion and to process it as an independent document. This resolution is inconsistent with King County review requirements (KCSWDM Section 2.3) that drainage review documents include specific Technical Information Report materials including "Special Reports and Studies." Under King County regulations, special reports and studies serve to "further address the site characteristics, the potential for impacts associated with the development, and the measures which would be implemented to mitigate impacts". The project low flow analysis would most likely be a required special study under the King County drainage review process. The "successful resolution" described by Kenny required ignoring substantive technical issues which in my opinion remain unresolved, as well as apparent non-compliance with the procedural requirements of the King County Surface Water Design Manual.

18. Port and Ecology responses to my comments on the low flow impacts of the Industrial Wastewater System (IWS) seem to have focused on the footprint of impervious surface at the IWS lagoons and IWS Lagoon 3 in particular (Kenny, ¶35; Ecology's Response, Page 12, Line 7; Port's Response, Page 10, Line 13; Fendt, ¶34) My comments have apparently been mis-interpreted, and will be clarified here. My concern is not with the relatively-small footprint of the lagoons, but rather with the fact that these lagoons have to some extent functioned historically as infiltration ponds and have allowed some fraction of the water from the entire IWS collection area, approximately 300 acres, to be infiltrated to groundwater at IWS Lagoons 1 and 2 which are located at the groundwater basin divide between Walker and Des Moines Creeks. A description of the

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

condition of the IWS lagoons at issue was provided on Page 9 of my February 2001 comment letter and is repeated below.

> The IWS has a direct significant impact on seepage and base flows in the Walker and Des Moines Creek systems by its removal of large areas of basin which would naturally form the headwater recharge areas for those streams. Until recently, the effects of these diversions have been partially offset by infiltration recharge to groundwater from the three IWS storage lagoons which are located near the groundwater divide between Walker and Des Moines Creeks.
>
> Our source of information on the history and status of the IWS system is a recent hydrogeologic study by Associated Earth Sciences, Inc., "Hydrogeologic Study, Industrial Waste System (IWS) Plant and Lagoons, Seattle Tacoma International Airport," prepared for Port of Seattle, June 21, 2000. Lagoon 1 has been used to store wastewater since 1965. Lagoon 2 was built in 1972 and "is utilized during times of heavy rainfall events." Lagoon 3 was constructed in 1979 and "is used to provide excess storage capacity for industrial wastewater in the event that Lagoons 1 and 2 reach capacity." The bottoms of the lagoons most regularly in service - Lagoons 1 and 2 - were reportedly "composed of compacted gravelly sand" which should have a relatively high infiltration capacity. A program to install leak prevention liner systems in the lagoons has been underway since 1996: Lagoon 1 was lined in 1996, Lagoon 2 was lined in 1997, and construction documents have been prepared for Lagoon 3 to be lined in the near future.

My point is that the unlined IWS lagoons have historically allowed potentially significant volumes of groundwater recharge from water collected from hundreds of acres of the IWS collection system, and that IWS system leak reduction efforts, such as lining of Lagoons 1 and 2 in particular, seem likely to have some impact on stream low flows. While the lagoons were not constructed or operated with the objective of achieving infiltration to groundwater (Fendt, ¶31) the unlined lagoons have nonetheless served to perform an infiltration function. It is my opinion that these effects should be addressed in the assessment of airport impacts to stream low flows.

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

19. It is apparently argued by the Port and Ecology that the IWS lagoon leak reduction efforts (such as lagoon linings) should not be considered in the low flow analysis since these linings already exist and because Section 401 Certification is not being sought for those activities. I respond that year 1994 is clearly identified in the SMP (Page 2-2) as the base year to define existing airport land use conditions, and that the lagoon linings are not grandfathered as they were constructed subsequent to that regulatory base year. Second, while Section 401 Certification is not being sought directly for the IWS improvements, the proposed stormwater system clearly does rely on IWS expansion to accommodate a significant amount of the increased runoff resulting from the airport Master Plan Update (MPU) improvements. MPU improvements are expected to add approximately 305 acres of new impervious surface to the airport, of which approximately 67 acres or 22% will be diverted away from the storm drain system (which discharges to the area streams) and into the IWS system (which discharges directly to Puget Sound).

20. The statement is made by Fendt, ¶30, that I contended that the IWS Lagoon 3 is in the Walker Creek groundwater contribution area. The intent of my previous declaration at ¶11 has been misconstrued and will be clarified here. First, I did not state or intend to suggest that Lagoon 3 is in the Walker Creek groundwater contribution area. It is not. My point was and is that the IWS service area—that is the area from which water is captured and removed from the stream systems and diverted into the IWS system—occupies a significant portion of the area mapped by SMP Figure B2-2 as comprising the Walker Creek groundwater contribution area. To my knowledge, the IWS system has been progressively enlarged through the period for which calibration

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

streamflow data are provided in the SMP; the future year 2006 footprint of the IWS service area is shown by SMP Figure B2-23. If one overlays this footprint of the IWS service area (Figure B2-23) over the Walker Creek groundwater contribution area (Figure B2-2), it can be seen that the IWS service area captures (and diverts into the IWS system) nearly one half of the non-contiguous groundwater recharge area for Walker Creek. It follows that the IWS system could potentially cause up to about a 50% reduction in Walker Creek groundwater recharge and stream base flows relative to a pre-airport basin condition. Examination of the groundwater basin mapping further shows that IWS lagoons 1 and 2 (both constructed in gravelly sand and expected to be leaky prior to being lined in 1996-97) straddle the groundwater divide between Walker and Des Moines Creeks. Lagoon 1 mostly overlies the Des Moines Creek groundwater basin while Lagoon 2 mostly overlies the Walker Creek groundwater basin. Prior to these lagoons being lined, one or both likely provided some groundwater recharge which in turn supported Walker Creek low flows. It is my opinion that Walker Creek low flows may be particularly sensitive to IWS expansion and IWS system leak reduction efforts, including but not limited to lining of Lagoons 1 and 2. My previous declaration at ¶¶12 and 13 provided an analysis of the available data relevant to this issue and found that either the data indicate a significant (about 0.5 cfs) decline in Walker Creek low flows over the 1991-1996 period of calibration data, or that the model calibration and streamflow data are too poor to draw any conclusions about anything.

21. The statement is made (Fendt, ¶38) that excavation in the borrow pit area would cause an increase in recharge to the shallow regional aquifer. This misses my concern which

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

involves gravel mining effects on flow timing, not recharge quantity. In light of the detailed assessments which have been made to identify low flow timing benefits of embankment construction in the Miller Creek basin, it seems unbalanced that there has been no comparable assessment of potentially-adverse low flow timing impacts resulting from mining in the upper Des Moines Creek basin to obtain the materials for embankment construction.

22. The statement is made (Fendt, ¶29) that I (Rozeboom) am confused over *"the fact that the SMP is not intended to show precise size of low flow mitigation vaults – only their probable locations."* Mr. Fendt's response does not allay my concern, as identified in my previous declaration at ¶17, that the SMP causes confusion for me and probably others because it identifies locations for low flow mitigation vaults which are different from the locations identified in the Low Flow Mitigation Plan. More complete details of this conflict between the SMP and Low Flow documents as to the probable locations of facilities were previously provided to Ecology in a letter by me dated August 6, 2001, as follows.

> The (Low Flow) document is inconsistent with the Stormwater Management Plan (SMP) as to what reserve storage facilities are proposed. One of our comments on the SMP was that, while reserve storage was included in some preliminary facility drawings, there was no comprehensive summary of what facilities were proposed to provide reserve storage. From the present (July 23, 2001) low flow analysis document, it appears that the facilities being proposed are those identified for each stream after the divider sheets titled "Summary of Low Stream Flow Mitigation Vault Storage and Filling." These parts of the low flow analysis document identify the following facilities: for Miller Creek - Vaults NEPL, Cargo, SDN2X/4X, and SDN3X; for Des Moines Creek - Vaults SDS3 and SDS4; and for Walker Creek – Vault F. However, these are different from the facilities for which preliminary reserve storage designs have been provided in the December 2000 SMP and recent SMP addenda. Very recently, on July 2, 2001, the Port (by Parametrix) provided Ecology with "Deliverable 7A (Miller Creek)" SMP revisions which included Exhibits C150 and C151 showing reserve stormwater storage and reserve stormwater release from Vaults C1, C2,

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

and G1. These are different from the reserve storage vaults which are identified in the low flow analysis. With the conflicting documentation in hand, it is uncertain what is actually being proposed.

The SMP final versions of Figures C150 and C151, transmitted as part of a large set of SMP replacement pages by Parametrix to Ecology on July 27, 2001, continues to show reserve storm water releases from Vaults C1 and G1. Again, these vaults are different from the facilities identified in the Low Flow plan as providing reserve storage for purposes of low flow mitigation. If the intent of the SMP, as stated by Mr. Fendt, is to show the locations of the low flow vaults in relationship to the proposed stormwater detention vaults, then the SMP has failed to achieve that intent.

23. The statement is made (Fendt, ¶85) that "*the mere fact that there is not a technical manual for the low flow proposal does not mean it is not feasible or based on sound engineering*" and "*the constructability and engineering issues are far from unique and do not raise feasibility concerns.*" I agree fully that it is feasible to engineer and construct vaults and pipes. At issue is whether those vaults and pipes will function as intended and will provide sufficient flow rates and quantities to mitigate for the low flow impacts of airport activities. From my review work of stormwater facilities at Snoqualmie Ridge, I have experience reviewing many "unique" stormwater facilities including flow splitters and enclosed storage vaults which have been designed and engineered without specific guidance from technical manuals. From that experience, it is my opinion that lack of an applicable technical manual creates a significant opportunity for design oversights and/or errors which can adversely affect facility performance. It is further my opinion

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

that there is currently a high risk that the Port's low flow plan, if approved in its present draft form and without the scrutiny of ongoing public review, will fail to achieve its intended mitigation objectives. I base this opinion in part on the track record of design and analysis errors and oversights by the Port's consultants. For example, the Port's November 1999 and August 2000 versions of the project Stormwater Management Plan contained very serious analysis flaws which were identified only by the diligence of the ACC's review of the project documents and subsequently by King County's review efforts. As an example of a recent construction plan design oversight, the Port issued runway embankment construction plans in January 2001 which could have substantially de-watered one of the wetlands which the project is claiming to protect. That design oversight was identified by me on behalf of the ACC and brought to Ecology's attention as Comment 20f of my February 2001 letter (Exhibit A). The situation was subsequently addressed by the Port and I responded as shown below with Comment 43 from my letter of June 2001 (Exhibit C) .

> We appreciate that the Port recognizes the need for additional analyses and management solutions to the challenge of pumping erosion control water from a pond which will be excavated, within a wetland, to a depth which is about 9 feet below the seasonal groundwater level. However, this is a situation which should have been identified and corrected prior to Port approval of the construction plans[1] and specifications which describe this work. The oversight illustrates that the Port's "systematic, critical construction plan review process" (Port response 41) is fallible and would benefit from additional independent review.

1Port of Seattle major contract construction plans titled "Third Runway - Embankment Construction - Phase 4", Work Order #101346, Project STIA-0104-T-01, approved 1/25/01. The accompanying two-volume Project Manual, including Specifications, is dated January 29, 2001.

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

Again, for the reasons and history given above, it is my opinion that there is a high risk that the Port's low flow plan, if approved in its present incomplete draft form and without the scrutiny of ongoing public review, will fail to achieve its intended mitigation objectives.

24. It has been stated (Kenny, ¶33) that *"Ecology was reasonably assured that the (low flow) impacts had been appropriately identified and that the proposed mitigation was technically feasible."* I fail to understand how there can be assurance of impacts being appropriately identified when the accuracy and adequacy of low-flow model calibration is clearly at issue, as evidenced by Ecology's Certification Condition I.1.a.iii which requires a discussion of the accuracy of the calibration and a statement of the adequacy of the calibrations for the purpose of low flow simulation. As to the technical feasibility of the proposal, it is my opinion that feasibility has been demonstrated at only a highly conceptual level and that there is presently no assurance that this conceptual plan can or will be successfully implemented. It is noteworthy that the King County's review of the low flow impact analysis (See low flow impact analysis letter dated August 3, 2001 from King County/Bissonnette to Ecology/Kenny, Page 1) identified several inconsistencies and/or gaps in the low flow analysis with *"the potential to affect facility design and plan effectiveness beyond a trivial amount."* The declaration of the King County reviewer confirms (Whiting, Page 6, Line 13) that the low flow plan has *"some unresolved design challenges."* My point, which the King County comments seems to support, is that conceptual-level technical feasibility provides no assurance that unresolved, non-trivial, design challenges can or will be adequately resolved.

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201

25. Ecology's water quality certification for this project includes four pages (22 through 25) containing 137 lines of conditions affecting mitigation of low flow impacts. Attorneys for Ecology (Ecology Response, Page 9, Line 17) argue that these conditions are sufficient to ensure that low flow impacts will be offset. In my opinion the conditions as proposed are for many reasons insufficient to provide any such assurance. The single greatest problem with the conditions is the requirement that the revised low flow plan be submitted within 45 days, and then that there is no opportunity or requirement for subsequent review or approval of the revised plan. This time frame is in my opinion far too short to suitably address the outstanding issues, and I would anticipate that at least two or three additional cycles of review would be necessary to produce an adequate plan. Other of the conditions provide insufficient direction to know what would constitute an acceptable plan. For example, what exactly happens if the revised report (per Ecology Condition I.1.a.iii) concurs with our suggestion that the upper-basin calibration is very poor and not adequate for the purposes of low flow simulation? The conditions only require that an analysis and statement be made—the consequences of the findings are not addressed. Furthermore, because the Port's consultants have already declared that the models are in their opinion accurate (Fendt, ¶23; Braschet, ¶13), Ecology's condition that the Port provide a statement of model adequacy seems to be a rather futile exercise.

DATED this 8 day of October, 2001, at Tukwila, Washington.

William A. Rozeboom
William A. Rozeboom, P.E.

HELSELL FETTERMAN LLP
1500 Puget Sound Plaza
1325 Fourth Avenue
Seattle, WA 98101-2509

Rachael Paschal Osborn
Attorney at Law
2421 West Mission Avenue
Spokane, WA 99201