Water Resources Consulting L.L.C.
Peter Willing, Ph.D.

September 6, 2000

Mr. Tom Luster
Washington State Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7001

RE: Implementation Plan for the Des Moines Creek Flow Augmentation Facility

Dear Mr. Luster,

Please take into account the following comments as you consider whether the Port of Seattle has provided reasonable assurance that its plans for expansion of SeaTac airport will meet the State's water quality standards. My analysis bears specifically on the proposed mitigation plan for Des Moines Creek, and are submitted on behalf of the Airport Communities Coalition. Page and paragraph references below refer to the Revised plan, dated August 18, 2000.

Summary of Comments

- The Port's Implementation Plan is not a specific plan but a bare concept.
- The Implementation Plan contains no supporting hydrologic analysis of extreme climatic conditions that the plan is intended to mitigate.
- The Des Moines Creek Basin Plan describes past damage and recommends remediation, but the Port's Implementation Plan would co-opt the entire mitigation package to offset the effects of the third runway.
- Temperature improvements claimed for the Implementation Plan cannot be realized with one of the Port's sources of water.
- The Implementation Plan relies on technological inputs whose continuity cannot be assured.
- One of the two proposed sources of water would require nearly a mile of construction trenching through the golf course area; there is no information about where or how the construction would be done.
- One of the two sources would have to be purged of drinking water conditioning chemicals, an undertaking that the Implementation Plan treats as no more than a concept.
- The Implementation Plan proposes the use of flow measurement devices that have poor fish passage characteristics.
- The preferred source of water is a well that exploits three different aquifers in a common casing, in contravention of state guidance on protecting upper aquifer zones.

The following pages will elaborate on each of these main points.

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Exhibit 348
Date 2/15/01
Witness Willing
Diane Mills, Court Reporter

- The Port's Implementation Plan is not a specific plan but a bare concept.

The intent of the Implementation Plan presumably is to demonstrate to the Department of Ecology and the public in general that there is an assured plan for mitigating low flow and attendant water quality problems in Des Moines Creek. The Implementation Plan hardly lives up to its name. It does not contain a plan, but instead a vaguely defined concept of adding to the remaining natural flow from some other source. Two sources are suggested, but neither one has been secured nor has either of them any certainty of being secured.

After perusing the Implementation Plan we do not know if dechlorination will be needed, or if it is needed whether it will be passive or active (chemical based), or if it is chemical based, what chemical it will be based on; but "the technology exists and can be readily adapted for the flow augmentation project" (P 3 para 1). None of these critical elements, which would help to establish confidence in the implementation plan, have been finalized.

The revised plan describes the status of the plan as follows: " . . . because construction of the facility is not scheduled to begin until 2002, . . . the final decision on the source of water has not been made, the design has not progressed . . . no detailed design drawings . . ." Ecology has been invited to grant its approval now and allow the Port to leave the most critical elements for later. The Port will "commit to funding the design and construction of the Seattle water supply option, if the water rights issue cannot be resolved, and if final approval from SPU is obtained." Neither the Port nor Ecology have any idea what has been committed to here. The Port plan is a structure consisting of conditional assumptions and contingencies. State law requires a plan that has a reasonable certainty of actually working, with demonstrable performance measures, not vague commitments to spend money in the future while the Port casts about for solutions.

The revised Implementation Plan says that "The Port and the Des Moines Creek Basin Planning Committee are still considering two sources for the water . . ." (P 1 para 2) However, Des Moines Creek Basin Planning Committee members have informed the ACC that the Committee has never considered any alternative source but the former Highline Water District Well #1. Therefore this assertion makes it appear that the Port may be using the Committee's name for credibility. The idea of buying water from Seattle Public Utilities is an afterthought of relatively recent origin, which does not carry any approval or even knowledge of the Des Moines Creek Basin Committee.

- The Implementation Plan contains no supporting hydrologic analysis of extreme climatic conditions that the plan is intended to mitigate.

The Plan says, "The target flow is . . . 1 cfs; the maximum augmentation rate and duration is based on the most extreme climatic conditions." The Port has not submitted the information, so

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there is no way to tell whether there was any analysis of extreme climatic conditions. A reasonably curious reviewer would ask to see a low flow time series for Des Moines Creek, and a low flow duration curve. There is less than a 10-year record of flow data for Des Moines Creek, and some of the existing data are of low reliability because of recorder problems (King County Department of Natural Resources, 2000).

The Des Moines Creek Basin Plan (Des Moines Creek Basin Committee, 1997) contains the logic and the data supporting a 1 cfs minimum flow in the creek, for the purpose of mitigating past damage to the creek. The Basin Plan also says that future conversion of the basin to impervious surface will cause a further 20% reduction in base flows compared to forested conditions. The present flow augmentation plan is not being scaled to deal with this future reduction, which could easily nullify all efforts under the present plan. The Port of Seattle has co-opted the Basin Plan's recommendation of 1 cfs augmentation flow and claimed it as mitigation for the third runway.

- Temperature improvements claimed for the Implementation Plan cannot be realized with one of the Port's sources of water.

The first iteration of an Implementation Plan (under cover letter from Keith R. Smith to Tom Luster, July 25, 2000) proposed a temperature target of 16EC for Des Moines Creek flows. The revised plan does not mention it. Even with cool water, attaining a target temperature of 16EC could require more than 1 cfs of augmentation water. But the Port is proposing to use Seattle Public Utilities water, which SPU staff have informed us sometimes reaches 20EC in September. Obviously, this will not work. The Port does not know what it will require, but just promises to figure it out empirically after it has all been built.

- The Implementation Plan relies on technological inputs whose continuity cannot be assured.

The Implementation Plan says that "Both sources will be able to provide water in perpetuity" (p 1 para 3). There is a fundamental weakness in a mitigation plan that depends on technological inputs, such as chemicals, electronic sensors, programmable controllers, and large horsepower pumps. This point has been raised by the Corps, in its comments: "We discourage the use of structures in a mitigation site that might need direct human interaction over long periods of time to operate." (Terzi and Freeman to J. Kelly, Parametrix, August 11, 2000). The Port has assumed that an SPU augmentation water supply would be non-interruptible (p. 2, top paragraph), but has not negotiated a water purchase agreement with the City of Seattle.

- One of the two proposed sources of water would require nearly a mile of construction trenching through the golf course area; there is no information about where or how the construction would be done.

Delivery of water from the Seattle Public Utilities source (p 2 para 3) would entail a 6" or 8" 4,500' pipeline from the present end of the distribution system to Des Moines Creek. This is a major construction project, that will require at least a 10' construction path, probably more; a pipe buried as much as 4 feet, bedded in pea gravel, the trench to be backfilled with pit run
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gravel. "No wetlands will be affected" is the summary of effects. The pipeline would have to be routed around wetland 28, which is 35 acres, is discontinuous, and surrounded by other non-jurisdictional wetlands. A plan sheet would be more convincing than a bland assurance. Likewise, the stilling basin, rock channel, constructed channel – are not accompanied by so much as conceptual drawings.

- One of the two sources would have to be purged of drinking water conditioning chemicals, an undertaking that the Implementation Plan treats as no more than a concept.

Dechlorination: "The chemical used will probably be sodium thiosulfate . . ." (p 2 para 3) This is an unlikely chemical for the purpose, because large volumes are needed and it is expensive. It is typically used in laboratories only. Other chemicals such as sodium bisulfite might work, but the Port and its consultants have hardly given the matter much thought. What they say is, "a mechanism . . . would have to be designed . . . the technology exists and can readily be adapted . . ." The Port of Seattle has clearly not done its homework. Obviously chlorine has a high toxicity to fish and cannot be tolerated in an augmentation flow. WAC 173-201A-040, the Washington State water quality criteria, specifies a maximum of 19 Φg/l maximum 1-hour concentration of chlorine in a 3-year period. For perspective, the City of Bellingham dechlorinates its sewer discharge of approximately 10 mgd using sodium bisulfite, and typically achieves a discharge concentration of 20 - 50 Φg/l – which is well within its NPDES permit limits, but which is not low enough to meet the water quality criterion without the large dilution volume afforded by Bellingham Bay.

The City of Seattle follows standard practice in applying fluoride to its water supply system, at concentrations designed to achieve a concentration of 1 mg/l at the point of service (APHA-AWWA-WPCF, 1989). To achieve the target concentration at the customer's tap means that it has to be slightly higher in the distribution system. Fluoride is applied to Seattle's Highline wells at the wellhead. Fluoride at 1 mg/l has been shown to cause mortality and morbidity in salmonids and other aquatic organisms (Strand, 2000). Fluoride will have to be removed from the water used for flow enhancement, and the Port implementation plan is totally silent on the matter.

Passive dechlorination (p 3 para 2): the problem with this approach is that stripping the chlorine and keeping the temperature low are at odds with each other. What they have asked Ecology to imagine is a system that uses slightly lower temperature SPU system water containing chlorine, discharges it into a pond presumably exposed to sunlight, which will raise the temperature and lower the dissolved oxygen saturation; then run it over rocks to raise dissolved oxygen by aeration, which further raises temperature. It does not sound convincing, and they have made no demonstration to show that it would work. This is especially true in light of the fact that Seattle water is likely to be too warm to achieve any reduction in temperature at all, during the most critical part of the late summer. The Port concludes, "this option will be researched and developed further." This assurance is an inadequate basis for approval of the flow augmentation plan.

- The Implementation Plan proposes the use of flow measurement devices that have poor fish passage characteristics.

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The Implementation Plan states that "The existing rectangular weir(s) will be modified by adding a V-notch or Parshall flume to achieve more accurate measurements during low flows" (p 3 para 3). V-notch weirs and Parshall flumes do not have desirable fish passage characteristics. There is a fundamental conflict in design of low flow measurement devices between measurement accuracy and ease of fish passage. The Washington Department of Fish and Wildlife has an upper limit of 3 feet per second on the velocity of flow through a structure such as the Port is proposing, but the Port "implementation" says nothing about how that will be achieved. To achieve a sufficiently low flow velocity, the flow through a weir has to be wide and shallow, and shallow flow in a weir is harder to measure accurately than a deeper one (Replogle, personal communication, 1999).

The brains of the flow mitigation proposal is apparently to be a programmable controller array (p 4 para 1) that will sense system conditions, know what augmentation flow to apply, and call for that flow as conditions demand. The system has not been designed however – "Logic to resolve this issue will be developed . . ." The Port realizes that all of its flow mitigation proposals are beset by questions: "Because of the current uncertainty over the source of the water, the resulting uncertainty over the need to construct a dechlorination facility, . . . the Port has decided to pursue a design utilizing the pond and constructed channel . . ." In other words, the Port doesn't know what it is going to do, so it doesn't know how to design for it.

- The preferred source of water is a well that exploits three different aquifers in a common casing, in contravention of state guidance on protecting upper aquifer zones.

The revised flow augmentation proposal contains several pages from an unidentified document with pages numbered 34 and 37, and some King County drawings. Page 34, 2nd para under "Assessment of Existing Well" has a description of well #1. There are several errors in this paragraph. It equates perforations with screens. They are not the same. "The second [set of perforations], between 190 and 243 feet, has an aquitard that makes it a confined aquifer." While there may be a large degree of confinement in this horizon, it is hardly an absolute – there is undoubtedly some degree of vertical leakage. The discussion neglects to discuss the third set of perforations that are described on the well log, between 511' and 541', and it does not show on Figure 13.

The Port would have us believe that 35' of screen on an 8" casing at a depth of 511' to 541' is out-producing a total of 141' of perforated 12" casing at much shallower depths. This is very difficult to believe: the longer, larger diameter, shallower open interval would produce most of the water. "The well is configured so that the lower aquifer contributes the most flow." Just how it is configured to achieve this feat is left to the reader's imagination.

It is interesting that the Port uses Highline Well #2 as a counter-example of production from the upper aquifer. Well #2 is screened in the upper aquifer, above 130' depth; Ecology is supposed to think this is different from Well #1, which is perforated from 72' to 160'. The same logic should apply to both: "Withdrawal from this aquifer would probably have an impact on Des Moines Creek recharge." The misconception that Highline Well #1 produces only from the deep aquifer found its way into the Des Moines Creek Basin Plan: "The existing well extends to a depth of 600 feet below the surface and is cased to over 200 feet, so water drawn from the well almost

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certainly has no effect on flow levels in the creek." This misinformation was echoed in Port consultants' response to questions raised by National Marine Fisheries Service in its review of the Biological Assessment (Parametrix, 2000).

The former Highline well #1 appears, from the Port's description, and from its own well log, to be a non-conforming well with respect to WAC 173-154; in other words it was completed in a way that might have been legal at the time, but would not be allowed now. The construction of this well appears to allow connections between three different aquifers.

> WAC 173-154-050 Protection of upper aquifer zones: In any multiple aquifer system, where the department determines that the uppermost aquifers or upper aquifer zone will not sustain large volume ground water withdrawals without exceeding the safe sustaining yield or causing . . . (5) depletions of spring or stream flows, the department shall require new or additional large volume withdrawals to be restricted to a lower aquifer zone.
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> WAC 173-154-060 Inspections and tests: The department may require inspections and/or tests of withdrawal facilities prior to their use . . . If it is the determination of the department that the facilities are not properly constructed or that the facilities may adversely affect the upper aquifers or upper aquifer zone, the department may (1) require further construction and/or testing of the facilities, or (2) require abandonment of the facilities in accordance with chapter 173-160 WAC, or (3) revoke the permit.
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> WAC 173-154-070 Rehabilitation of withdrawal facilities: The department may require the rehabilitation of existing withdrawal facilities if it finds that the facilities were not constructed or are presently not in accordance with the permit provisions, if any, or the applicable laws and regulations of the department which were in effect at the time of construction of the facilities, and that the withdrawal of waters from such facilities will adversely affect the upper aquifers or upper aquifer zone. . .

The foregoing language requires a detailed hydrogeologic analysis, inspection, testing, and in the end possibly even abandonment of the well. The Port of Seattle did not contemplate these requirements when it submitted its Revised Implementation Plan. Until these requirements are satisfied, they would prevent acceptance of the Implementation Plan as any fulfillment of "reasonable assurance."

The Port's Figure 13 has further discrepancies that do not agree with the well log. It shows a "lower aquitard" consisting of "clay" of indeterminate thickness below 245' depth. The well log shows "Sand, clay, gravel;" "Fine sand and clay;" for this part of the well. To interpret these descriptors, one must acknowledge the well driller's convention of listing the most abundant materials first in the lithologic characterization. The materials described to not constitute an "aquitard." The effect of this discrepancy is to understate the degree of hydraulic continuity between Des Moines Creek and the producing horizon proposed for an augmentation water

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source. In all likelihood, the aquifer is already connected to the creek, so why should the Port go to the trouble of pumping it into the creek and claiming credit for it?

The flow augmentation plan for Des Moines Creek is a trial-and-error approach to project mitigation. It can be approved only if the Port of Seattle can get Ecology to go along with a period of errors to figure out something that works. P 37 para 3: "the pump would be started and run till the conditions change . . ." They do not have any idea how much water will be required to meet the various parameters, what the probability of conditions is that would require pumping, etc. There is nothing in the submittal on flow augmentation that offers a reasonable assurance that water quality standards will be met.

Thank you for your attention to these observations, furnished on behalf of the Airport Communities Coalition.

Sincerely,

Peter Willing, Ph. D.
Enclosure: CurriculumVitae

REFERENCES

APHA-AWWA-WPCF, 1989. Standard Methods for the Examination of Water and Wastewater. 17th ed.

Des Moines Creek Basin Committee, 1997. Des Moines Creek Basin Plan.

King County Department of Natural Resources, 2000. Surface Water Management Hydrologic Monitoring Report.

McKee, J.E. and Wolf, H.W. Water Quality Criteria. California Water Resources Control Board Publication 3-A.

Parametrix, Inc. 2000. Preliminary Response to National Marine Fisheries Service BA [Biological Assessment] Review, Master Plan Update Improvements, January 21, 2000.

Replogle, J.A., Research Engineer, U.S. Water Conservation Laboratory, Phoenix, AZ

Strand, J. A., 2000. Letter to Tom Luster, August 21, 2000 on Port of Seattle's Potential Use of Drinking Water to Augment Summer Low flows in Miller and Des Moines Creeks. Columbia Biological Assessments, Richland, Washington.

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