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February 16, 2009

Mr. Steve Winter
ESA Adolfson
5309 Shilshole Avenue N
Suite 200
Seattle, WA 98107

Re: Peer Review of Water Resources Documents for Fairhaven Highlands

Dear Mr. Winter:

This letter and attachments are in response to your requests for information in the memorandum dated December 31, 2008.

1. Comment on how or if the wetland monitoring data were used to support development of the modeled wetland hydroperiod analysis.

Attached please find the letter from Clear Creek Solutions discussing wetland calibration and methodology for the hydroperiod analysis.

2. Provide water temperature data or confirm the lack of water temperature data, and provide an analysis based on available information.

Wetland water temperature data was not collected. The stormwater mitigation plan for Fairhaven Highlands includes thermal reduction practices through retention of forest cover, biofiltration, and infiltration and dispersion through vegetative buffers. These best management practices slow discharge velocities, allowing stormwater to cool before entering wetland areas.

The majority of all impervious surfaces will abut native forested areas with mature canopies. Studies have shown that trees reduce surface asphalt temperatures by up to 36° F.[i] *Retention of forest cover will provide shade to impervious surfaces and help moderate absorption of solar radiation. Air temperatures can be 4 to 8 degrees F cooler in well shaded parking lots than in un-shaded parking lots. Similarly, air temperatures in neighborhoods with mature canopies were found to be 3 to 6 degrees F lower in daytime than in newer neighborhoods with no trees.*[ii]

Runoff from impervious surfaces will receive enhanced water quality treatment through biofiltration (raingardens). Heated runoff will be cooled as it filters through the soil column. One study found a temperature drop of 53° F between influent and effluent water.[iii]

All runoff will also be filtered and dispersed through forested buffers prior to entering wetlands.. Lynch et al, (1985) found that a 98-ft buffer from logging operations maintained water temperatures within 1 degree of their former average temperatures.[iv]

3. Provide a proposed land cover table for each wetland contributing basin. This would be the same table provided for each alternative, but further broken down by wetland contributing basin. This will allow me to better respond to public comments that focus on differences between the alternatives.

Steve, you and I discussed this last month and decided this analysis would not be necessary as the treated stormwater released to each wetland is based on pre-development hydrology not post development land cover.

I have also attached a memorandum from Clear Creek Solutions, dated January 2, 2009 in response to paragraph 3 on page 3 of your memorandum.

Please do not hesitate to call if you require clarification or further information.

Sincerely,

RONALD T. JEPSON & ASSOCIATES

Frances E

Frances Eustis

[i] Center for Urban Forest Research. 2001. *Fact Sheet #1: Benefits of the Urban Forest.* Center for Urban Forest Research, USDA Forest Service Pacific Southwest Research Station, Davis, CA.
[ii] McPherson, E.G. 1998. Shade trees and parking lots. *Arid Zone Times* February: 1-2.
[iii] United States Environmental Protection Agency Office of Water, 2000: Bioretention Application – Inglewood Demonstration Project, Largo, Maryland, and Florida Aquarium, Tampa, Florida. EPA-841-B-00-005A.
[iv] Lynch, J.A., E.S. Corbett, and K. Mussallem. 1985. Best Management Practices for Controlling Non-point-Source ;Pollution on Forested Watersheds. J. Soil and Water Conservation 40:164-167.

CLEAR CREEK SOLUTIONS, INC.

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30 January 2009

Frances Eustes
Ronald T. Jepson & Associates
222 Grand Ave., Ste C
Bellingham, WA 98225

SUBJECT: Wetland Calibration in the Fairhaven Highlands.

Dear Frances:

The Fairhaven Highlands development contains several wetlands that currently receive in flow from the surrounding areas. After the development of the project site the hydroperiod of these wetlands will be altered. The changes in runoff have been quantified by the use of WWHM3. In addition, a separate program was used to compute the wetland hydroperiod fluxes for the wetlands in question. The methodology for these computations is explained below:

1) Existing conditions stage for each wetland is modeled producing a time series of hourly stage data comprising over 400,000 values.
2) The mean stage (water depth) value for each month is computed. This is done by taking the mean stage value for each January and then taking the average of all of the January mean values. This process is done for each of the twelve months.
3) The number of excursions of greater than 15 cm from the mean stage for each month is tabulated. An excursion is considered to be a time step in which the stage for the wetland is greater or less than the monthly mean value by more than 15 cm. This is computed by taking the January mean stage (computed in step 2) and tabulating the excursions for all the hours for all of the January values. This is done for each of the twelve months.
4) The above three-step process is then conducted for the future conditions wetland stages.
5) Existing and future wetland fluxes are then compared. The resultant increase in wetland fluctuations can then be evaluated for overall impacts. This is done for time intervals of 72 hours, 168 hours and 336 hours.

Results are shown in tables 1- 4 below:

Table 1 Wetland KK Predeveloped Flux.

Wetland	KK	Predeveloped				
	Month	Mean(cm)	Excursions	72hr	168hr	336hr
	Jan	54.40706	2456	6	4	3
	Feb	54.5329	2257	6	4	1
	Mar	53.8338	1774	7	4	3
	Apr	49.11599	4696	12	10	7
	May	34.6244	18144	42	36	24
	Jun	19.24023	18559	52	35	19
	Jul	6.99181	5190	12	9	6
	Aug	1.45994	1158	5	3	1
	Sep	1.33929	90	0	0	0
	Oct	7.91408	4766	13	10	8
	Nov	32.82679	33711	40	36	32
	Dec	51.03621	5235	11	9	6

Table 2 Wetland KK Mitigated Flux.

Wetland	KK	Mitigated				
	Month	Mean(cm)	Excursions	72hr	168hr	336hr
	Jan	56.59248	1328	5	2	2
	Feb	56.67685	1152	4	2	1
	Mar	56.04594	930	4	2	2
	Apr	53.14103	2183	8	6	2
	May	44.84908	4512	16	10	4
	Jun	36.51573	12977	42	30	15
	Jul	25.52857	14618	42	29	15
	Aug	16.16775	21038	57	44	24
	Sep	25.10588	20583	51	33	20
	Oct	39.96758	20217	53	38	24
	Nov	53.98301	3715	11	9	5
	Dec	57.08145	1533	4	3	2

Table 3 Wetland CC Predeveloped Flux.

Wetland	CC	Predeveloped				
	Month	Mean(cm)	Excursions	72hr	168hr	336hr
	Jan	39.83209	1847	3	3	3
	Feb	40.08085	1638	4	2	2
	Mar	39.63907	775	2	2	2
	Apr	36.60375	1547	7	5	1

	May	28.45837	3444	14	8	2
	Jun	19.14515	7691	26	18	8
	Jul	8.93107	4403	12	8	6
	Aug	2.43119	1213	5	3	1
	Sep	2.74806	628	3	1	0
	Oct	9.39652	4541	13	10	7
	Nov	27.13766	22298	69	47	23
	Dec	38.28283	4557	9	7	6

Table 4 Wetland CC Mitigated Flux.

Wetland	CC	mitigated				
	Month	Mean(cm)	Excursions	72hr	168hr	336hr
	Jan	41.45537	632	2	2	0
	Feb	41.60368	295	3	0	0
	Mar	41.20806	35	0	0	0
	Apr	39.31133	637	3	2	0
	May	35.81519	784	3	3	0
	Jun	32.74398	1523	6	5	1
	Jul	27.69355	4683	18	11	4
	Aug	20.93546	12074	36	30	11
	Sep	27.59624	9969	36	18	8
	Oct	35.76225	4588	13	10	6
	Nov	41.51088	730	3	2	0
	Dec	42.07436	794	2	1	1

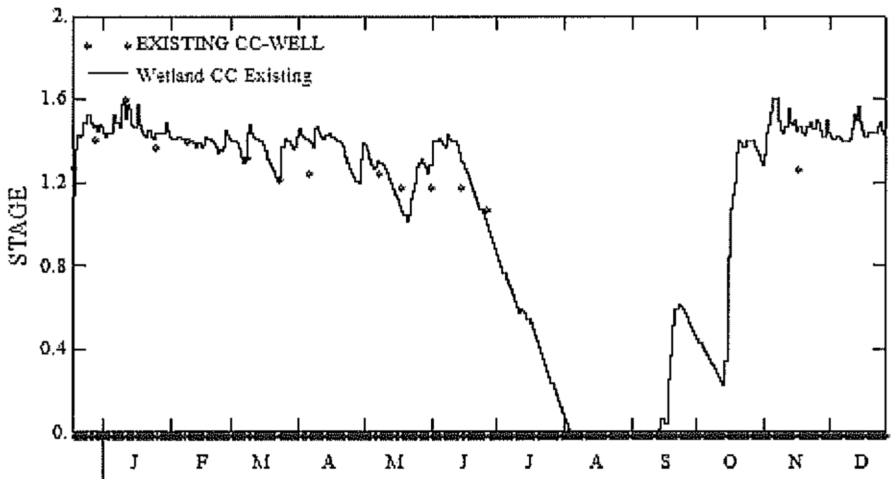
Calibration of wetlands CC and KK.

Wetlands CC and KK were calibrated using existing stage storage information, infiltration data, and observed stage monitoring data. The observed monitoring data used in the model are listed below:

Fairhaven Highlands Hydrology Monitoring, December 2005 to December 2006				
			Wetland KK	
Date	Well #2		Well #6	
	Surface Water Depth (inches)	Surface Water Depth (ft)	Surface Water Depth (inches)	Surface Water Depth (ft)
12/19/2005	8.13	0.68	15.25	1.27
12/29/2005	9.88	0.82	17.63	1.47
01/12/2006	12.13	1.01	25.00	2.08

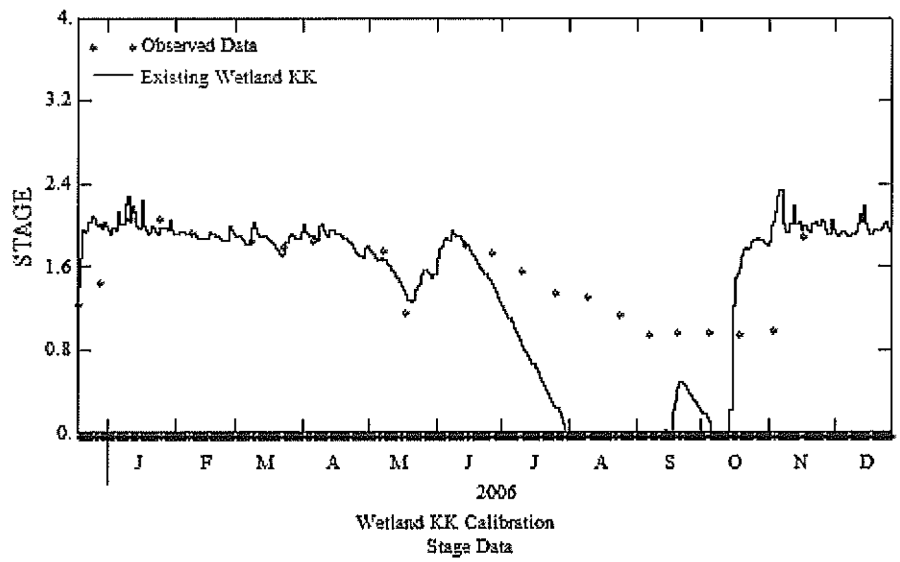
01/26/2006	9.38	0.78	24.38	2.03
02/09/2006	9.75	0.81	24.25	2.02
02/23/2006	9.25	0.77	25.00	2.08
03/09/2006	8.75	0.73	23.50	1.96
03/23/2006	7.50	0.63	23.00	1.92
04/06/2006	7.88	0.66	22.50	1.88
04/20/2006	8.00	0.67	21.75	1.81
05/08/2006	7.88	0.66	22.50	1.88
05/18/2006	7.13	0.59	21.38	1.78
06/01/2006	7.13	0.59	21.50	1.79
		0.00		0.00
06/15/2006	7.13	0.59	22.00	1.83
06/27/2006	5.75	0.48	21.25	1.77
07/10/2006	0.00	0.00	19.00	1.58
07/26/2006	n/a	n/a	16.50	1.38
08/10/2006	n/a	n/a	16.00	1.33
08/24/2006	n/a	n/a	14.00	1.17
09/07/2006	0.00	0.00	11.75	0.98
09/20/2006	0.00	0.00	12.00	1.00
10/04/2006	0.00	0.00	12.00	1.00
10/18/2006	0.00	0.00	11.75	0.98
11/03/2006	0.00	0.00	12.25	1.02
11/16/2007	8.00	0.67	23.00	1.92

Figure 1 – Observed vs. Simulated stage data at Wetland CC



Wetland CC Calibration
Stage Data

Figure 2 – Observed vs. Simulated stage data at Wetland KK



For the most part the simulated stage data closely matches the observed stage data. This indicates that the modeled representation of the wetlands closely simulates the existing hydroperiod for each wetland. This validates the use of the model to estimate impacts to the wetland hydroperiods based on the proposed development. It should be acknowledged that the period of record is only about one year and the data is only collected on bi-weekly basis. Additional data may enhance the quality of the calibration but is unlikely to alter the wetland behavior significantly.

If I can provide you with any additional information please let me know.

Sincerely,

Joseph T. Brascher
President, C.E.O.
Clear Creek Solutions Inc.

CLEAR CREEK SOLUTIONS

CLEAR CREEK SOLUTIONS, INC.

15800 Village Green Drive #3
Mill Creek, WA 98012
425-892-6454
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DATE: 2 January 2009

TO: Frances Jones, Ronald T. Jepson & Associates

CC: Joe Brascher, CCS

FROM: Douglas Beyerlein, PE

SUBJECT: Response to Adolfson's Peer Review of Water Resources Documents for Fairhaven Highlands

Steve Winter of ESA Adolfson in his memo of 31 December 2008, titled "Peer Review of Water Resources Documents for Fairhaven Highlands", states on page 3 that

"... WWHM is limited in how it simulates rainfall-runoff patterns, and focuses primarily on surface flows. There is no spatially-distributed simulation of surface-groundwater interaction or interflow processes in WWHM."

This statement is an apparent misunderstanding of how WWHM/HSPF works.

WWHM, which is HSPF in a Windows-based interface, simulates all of the complexity of the hydrologic cycle included in HSPF. For the rainfall-runoff interaction this includes interception storage, infiltration, surface runoff, interflow, upper and lower zone soil moisture storage, active and deep groundwater, base flow, and evapotranspiration. WWHM includes the ability to accurately model surface runoff, interflow, and groundwater/base flow. Surface runoff and interflow are the primary components of stormwater runoff and are often the primary focus of stormwater pond sizing, but that is solely a decision made by the user.

WWHM does include spatially-distributed simulation of surface-groundwater interaction and interflow processes. The user defines the spatial distribution of the soils, vegetation, and land slopes that constitute the pervious land segments that contribute surface runoff, interflow, and groundwater/base flow to any specified downstream location of interest.

For the modeling of the wetlands of the Fairhaven Highlands we (Clear Creek Solutions) modeled the individual tributary areas draining to each wetland and in doing so incorporated the spatial distribution of the soils, vegetation, and land slopes of the drainage area. All of this information was important in accurately computing the rainfall-runoff interaction for the hydroperiod analysis.

Please let us know if you need further documentation of any of the above information.