55.

Public Comment: Kristen Bryant, Emails dated December 11, 2014 Related to the Public Hearing PLN13-0027 Posted November 25, 2014

Tracey Redd

From: Brenda Martinez
Sent: Thursday, December 11, 2014 3:28 PM
To: MDRT User
Subject: FW: Addtional Comments for Plat 2C
Attachments: Comments Substantive.pdf; Comments Procedural.pdf

Brenda L. Martinez
City of Black Diamond

From: Kristen Bryant [mailto:kristenbry@gmail.com]
Sent: Thursday, December 11, 2014 2:42 PM
To: Brenda Martinez
Subject: Addtional Comments for Plat 2C

Hello Brenda,

Here are additional comments from Save Black Diamond.

thank you,
--

Kristen - 425-247-9619

Tracey Redd

From: Brenda Martinez
Sent: Thursday, December 11, 2014 3:28 PM
To: MDRT User
Subject: FW: Comments for Plat 2C Hearing
Attachments: Bryant Comments on Plat 2C.pdf; PublicHearingTestimonyDec11_2014_SilverTip.pdf

Brenda L. Martinez
City of Black Diamond

From: Kristen Bryant [mailto:kristenbry@gmail.com]
Sent: Thursday, December 11, 2014 2:22 PM
To: Brenda Martinez
Subject: Comments for Plat 2C Hearing

Hello Brenda,
I plan to come to the hearing, but thought I would send these electronic comments for the record.

thank you,

--

Kristen - 425-247-9619

Comments from Review of Plat 2C Documentation

Submitted by: Kristen Bryant and on behalf of William and Karen Bryant
Date: December 11, 2014

SEPA Timing

If any comments may relate to SEPA, it should be noted that as of July 1st, a public disclosure request for Plat information had not been completed and I noted that any additional comments should be considered as part of the plat hearing.

Plat Hearing Timing

While I understand the timing and reasons for it, I would like to point out that it is difficult to complete any thorough review in the time given. While staff worked on this for many months, the public had from the time of the announcement on the 21st, with documents posted to city website on November 25th, followed by Thanksgiving holiday weekend where most already had plans. Additional records became available after that.

In particular it is important to point out that immediately after the holiday, when I was able to give the most thought to how to testify, the need for experts that would provide useful information to the Hearing Examiner became apparent. I contacted a wetlands expert, who was already over-booked and could not work on it. I contacted a second expert, and for almost a week went back and forth on whether this was work that could be fit into the schedule, and ultimately it could not.

If the examiner would hold the record open for an additional two weeks, we could provide expert testimony to give an opinion on specific concerns with regard to complying with applicable code for wetlands issues.

Contents

No Plat Approval before Public Improvements are Complete

There is no reason to approve Plat 2C before things like the access road from Plat 1A is complete and the sewer and water hookups that are needed in Plat 1A are complete. The city staff certified that the sewer, water, and road access for this plat all depend on these being available for Plat 1A. These must be actually available prior to preliminary plat approval.

Otherwise, the city might be expected to continue to lock in long-term approvals for all kinds of development that can't effectively be started for years. This creates confusion for residents, makes it easy for staff turnover or time to cause conditions to be forgotten, and creates a situation where other development and changes that occur in the city or important changes that occur on the site cannot or will not be considered.

Requested Action: It would be appropriate for the Hearing Examiner to remand the plat until such time as that infrastructure is complete.

Alternately: The city should require public improvements be complete before any clearing and grading are allowed, and before a final plat is approved and recorded.

National Marine Fisheries Service lists Rock Creek as critical Steelhead habitat.

Below is an excerpt from the city's own letter earlier this year noting that "Puget sound steelhead are listed as threatened by the National Marine Fisheries Service..." and "in January of 2013, a map of Proposed Critical Habitat for Puget Sound Steelhead was published... identifying the entire Rock Creek system... as within the species critical habitat."

Letter dated May 8, 2014, subject "RE: City of Black Diamond's Comments on the DRAFT Environmental Assessment Completed for the John Henry Mine Permit Renewal":

> listing of fish species that are impacted by water flowing from the mine site (page 39 of the EA)." Puget Sound Steelhead (O. mykiss) are listed as threatened by the National Marine Fisheries Service in the September 2008 version of the Federal Register. In January of 2013, a map of Proposed Critical Habitat for Puget Sound Steelhead was published in the Federal Register, identifying the entire Rock Creek system, within the City of Black Diamond, as within the species critical habitat. The City has some concerns with regard to this listing and the effluent leaving the John Henry Mine when operations begin again as this serves as a significant headwater source for both Rock and Ginder Creeks, identified as key spawning and rearing areas for Puget Sound Steelhead within the Duwamish Sub basin 17110013.

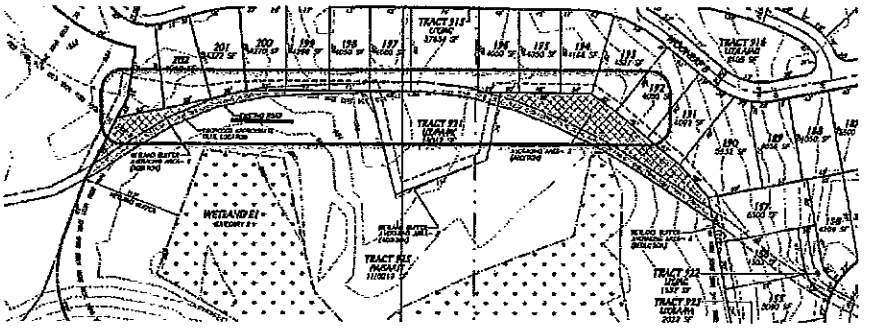
Comment: The plat application does not document any special review or conditions taken to protect this habitat even though Rock Creek crosses through the development parcel.

Action Requested: Require additional review by the city natural resources director to apply additional protective conditions per best practices.

Buffer on the north portion of wetland E1 is incorrect.

This buffer does not follow Black Diamond Municipal Code or follow wetlands standards from the Department of Ecology.

A portion of the map showing the buffer in question. This was taken from plat drawing 06-PP1.pdf.



The thick grey dashed line shows a trail and buffer edge. The averaging plan shows buffer the applicant marks as "added" to the north of this trail. In fact, this is much smaller than the required buffer.

Here is an excerpt from "The Villages MPD Phase 2 Plat C-Wetland Review" dated March 31, 2014 from Perteet,

Memorandum — Perteet

To:	Stacey Welsh, Community Development Director, City of Black Diamond
From:	Jason Walker, ALSA, PWS, Environmental Manager, Perteet Inc. Doug Gresham, PWS, Lead Ecologist Perteet Inc.
Date:	March 31, 2014
Re:	The Villages MPD Phase 2 Plat C-Wetland Review

Perteet states:

4. The following items pertain to wetland buffers:

   a. It was agreed in our July 25, 2012 memo for The Villages Phase 1A that the buffer for Wetland E1 may stop at the logging road pursuant to BDMC 19.10.230 from information provided by the applicant and due to the disturbance frequency of the road that was verified by City staff. For Wetlands E7, E8, and E10, the logging road is not distinct in the field, does not appear to have the same disturbance frequency, and would not serve as an ecological break; therefore, this code provision would not apply. Revise the Phase 2 Plat C drawing sheets to indicate the full standards buffer widths for Wetlands E7, E8, and E10.

(Note that the city's online posting currently omits the above by leaving out page 3 of the Perteet letter.)

http://ci.blackdiamond.wa.us/Depts/CommDev/planning/The%20Villages%20Preliminary%20Plat%20Phase%202%20Plat%20C_112514/Exhibits%20-%20Scanned%20Version/28c.%20Wetland%20Rpt%20Review.pdf

Comment: The underlined portions above demonstrate that the wetlands reviewer did not visit the logging road in question. They relied on city staff who are not wetlands experts. Had the visit been done, it would be shown that the road is not solid-surface, and relatively little work would be needed to restore the vegetation to make this a functioning buffer.

The reviewer also mis-stated BDMC. BDMC 19.10.230 Wetland buffers , section E states:

E.

Measurement of wetland buffers. All buffers shall be measured from the wetland boundary as surveyed in the field. The width of the wetland buffer shall be determined according to the wetland category. The required buffer should be extended to include any adjacent regulated wildlife habitat area, landslide hazard areas and/or erosion hazard areas and required buffers. Buffers shall not be extended across existing human features that functionally and effectively separate the potential buffer from ecological functions of the resource, and shall include hardened surfaces including improved roads or other lawfully established structures or surfaces, or the developed portions of lots, under separate ownership, lying between the habitat area and the subject property, unless restoration of buffer functions on such property is or may reasonably be expected to be the subject of a permit condition or an adopted public plan. The buffer for a wetland created, restored, or enhanced as compensation for approved wetland alterations shall be the same as the buffer required for the category of the created, restored, or enhanced wetland. Only fully vegetated buffers will be considered....

Comment [K1]: The underlined portions note that you cannot apply this condition to a surface that is not a hardened surface or improved road. These old trails are neither.

Comment [K2]: There is every reasonable expectation that this old road on this property would be restored. The preliminary plat should not be approved unless this portion of BDMC is adhered to by requiring a condition for restoration of the buffer over the logging road on E1, and full buffer width for E1 is put in place.

We asked Dr. Sarah Cooke, a wetlands expert who has testified in Black Diamond before, about the use of such a road being a stopping point for a wetland buffer. Dr. Cooke wrote:

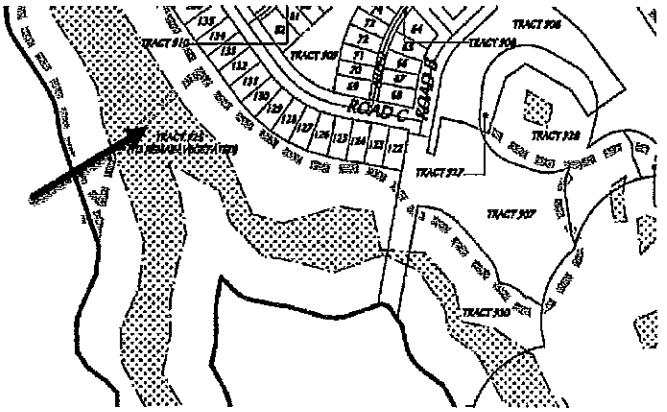
> "A logging road is not a buffer under any scenario. I don't know of any jurisdiction that would allow for a logging road as a buffer edge- it certainly is not Best Available Science. Logging roads have no positive functional attributes. If anything they are detrimental because they are unvegetated and often contribute sediment to runoff when rain hits their bare surface. It is very common to have the drainage ditches along logging roads discharge directly into creeks/streams. "

If the road really were a solid surface separating the road from ecological functions of the buffer, then the applicant would not add buffer averaging north of it (see map). In truth, there is no separation and the ecological function needed is the much wider 110' buffer.

Action Requested: Require the full buffer width on the north portion of wetland E1, and restoration of the vegetation.

Wetland Trail

Wetland trail. In its wetland review, Perteet asked for removal of the trail crossing wetland E1, but it is still shown in the drawing posted in November by the city. See plat drawing 05-CV4-TR-OS.pdf



Here is the City Reviewer, Perteet's Follow-Up Response:

Memorandum

Perteet

c. **We recommend eliminating the soft surface trail that bisects Wetland E1 using an abandoned logging road because this road has become naturalized and would cause disturbance to hydrology and vegetation and would be considered a wetland impact.**

Applicant Response:
Applicant proposes a condition that such trail will either be eliminated during final engineering design or designed and constructed in such a way as to avoid wetland impacts.

Perteet Follow-Up Response:
We request the City condition compliance with our original comment to avoid wetland impacts and to keep the trails in the outer edges of the wetland buffers consistent with BDMC 19.10.220(B)(3c)

Black Diamond Municipal Code 10.10.220(B)(3) (a) and (c):

> Trails may be permitted within a category II, III, or IV wetlands or their buffers and may be permitted only within the buffer of a category I wetland, the buffer of a wetland in the core complex or the buffer of a headwaters wetland if the following criteria are met:
>
> a.
>
> > Trails are limited to buffer areas except for limited area of pile supported trail sections or viewing areas may be placed within category II, III and IV wetlands for interpretive purposes.

c.

The trail or facility is located in the outer fifty percent of the category II, III and IV buffer and the outer twenty-five percent of the buffer of a category I wetland, the buffer of a wetland in the core complex or the buffer of a headwaters wetland, except for limited placement closer to the wetland edge or within a category II, III and IV wetland for interpretive purposes as provided above."

Comment: There is no mention of "interpretive purposes" or conditions on the city's approval that this must be done.

Action Requested: Require that there be no trail allowed through the wetland and that this be removed from the drawing.

Wetland Buffer Impacts Not Adequately Considered.

In the letter dated March 31, 2014 from the city's reviewer, Perteet, they indicate they need more information on additional development tracts to assess impacts.

4. The following items pertain to wetland buffers:

   a. It was agreed in our July 25, 2012 memo for The Villages Phase 1A that the buffer for Wetland E1 may stop at the logging road pursuant to BDMC 19.10.230 from information provided by the applicant and due to the disturbance frequency of the road that was verified by City staff. For Wetlands E7, E8, and E10 the logging road is not distinct in the field, does not appear to have the same disturbance frequency, and would not serve as an ecological break; therefore, this code provision would not apply. Revise the Phase 2 Plat C drawing sheets to indicate the full standards buffer widths for Wetlands E7, E8, and E10.
   b. Similarly, the Phase 2 Plat C drawings do not indicate what development actions are proposed in tracts that occur in proximity of Wetlands E7, E8, and E10. Information regarding the proposed development actions is needed in proximity of Wetlands E7, E8, and E10 or we request that a condition of plat approval be created by the City to require subsequent review of development activities in this area for direct or indirect wetland and/or buffer impacts.

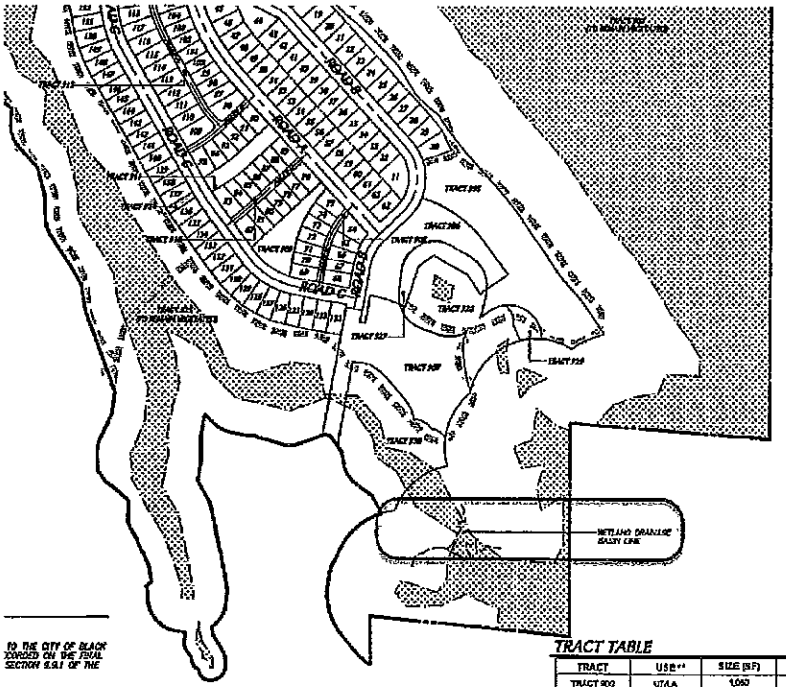
Comments: The developer did respond that there would be residential development, but there is no evidence that impacts were assessed or that conditions were placed on the plat requiring this or something of less impact, nor a condition requiring further wetlands buffer impact review.

Action Requested: Remove these tracts from the Plat. Alternately, use the suggested conditions above.

Wetland Drainage Basin Line Not Validated

The Plat Map excerpt below is from the file "05-CV4-TR-OS.pdf".

An outline is drawn around what is indicated to be a "drainage basin line." However, this drainage basin line has not been validated.



In the July 5 2012 letter from the Department of Ecology to Jason Walker, subject "Wetland Rating Questions", the department of Ecology indicates: "We recommend the wetland be rated as one unit because it is very difficult to identify a legally defensible boundary." And, further, "Drawing a boundary between two units is possible but may take detailed monitoring of water levels for at least a year." [emphasis added]. A copy of this letter is shown below.

The monitoring was not found in any of the city's documentation. The city must require this monitoring be done. This is part of the city's core wetlands complex – a treasure. The city cannot OK a major buffer reduction (from 225' to 110' without doing the correct scientific analysis.

Action Request: Remand for review until detailed monitoring can be done and results reviewed by an independent reviewer.

Subject: FW: Wetland Rating Questions

From: Hruby, Tom (ECY) [mailto:thru461@ECY.WA.GOV]
Sent: Thursday, July 05, 2012 1:23 PM
To: Jason Walker
Subject: RE: Wetland Rating Questions

Jason,

"Abrupt" in the context of the description is relative and depends on local conditions. Generally it means the rate of change of a environmental characteristic is at least 2-3 times higher than the gradient in the surrounding landscape. For example a stream may have an average slope of 2%. An abrupt change in the stream slope would therefore be 4-6%. However, if the average slope is 4-6%, the slope would have to be 8-12% to be considered and abrupt change.

Tom

Tom Hruby, PhD, PWS
Senior Ecologist
Washington State Department of Ecology
PO Box 47600
Olympia WA 98504
(360) 407-7274
tom.hruby@ecy.wa.gov

If I read your description correctly, what you describe is a headwater system with water flowing from the wetland in two directions. Based on our guidance one could separate the wetland into two units for rating because the there is a major change in the water regime (water flows in two directions). The practical issue however is where to draw the boundary; one that is legally and scientifically defensible. If you can identify the boundary where the water direction changes flow to a an accuracy of 5-10 ft then you can separate the wetland into two units. This may require a detailed topographic survey, lidar, or some other measurements such as piezometer readings across the boundary.

This is similar to the problem we face in wetlands with different HGM classes within one delineated boundary. We recommend the wetland be rated as one unit because it is very difficult to identify a legally defensible boundary. When we took wetland experts into the field we were unable to agree on the boundary during just one site visit. The boundaries drawn by different scientists were off by more than 100ft. We ask you to rate the entire wetland as one unit because we could not identify any simple indicators that would allow you to draw an accurate boundary. Drawing a boundary between two units is possible but may take detailed monitoring of water levels for at least a year.

Tom

Tom Hruby, PhD, PWS
Senior Ecologist
Washington State Department of Ecology
PO Box 47600
Olympia WA 98504

NICOLETA C. CRISTEA

Civil and Environmental Engineering
University of Washington
159 Wilcox Hall, Box 352700
Seattle, WA 98195-2700

Phone: (206) 543 0423
Cell: (206) 356 0679
Email: cristn@u.washington.edu

EDUCATION:

PhD, Civil and Environmental Engineering *Water Resources, Hydrology and Environmental Fluid Mechanics*, University of Washington, Seattle WA Dissertation title: *Evaluating reference evapotranspiration and the effects of climate change and soil parameterization within distributed hydrologic models*

M.S.E, Civil and Environmental Engineering, University of Washington, Seattle WA, 2004.

M.S., Hydropower and Environmental Engineering, University POLITEHNICA of Bucharest, Romania, 1997.

B.S., Hydropower and Environmental Engineering, University POLITEHNICA of Bucharest, Romania, 1996.

PROFESSIONAL EXPERIENCE:

2013 – present Post doctoral researcher Department of Civil and Environmental Engineering, University of Washington, Seattle.

2006 - 2012 Doctoral Candidate, Department of Civil and Environmental Engineering, University of Washington, Seattle.

2004 - 2006 Environmental Engineer, Washington State Department of Ecology.

2002 - 2004 Research assistant, Department of Civil and Environmental Engineering, University of Washington, Seattle.

1997 - 2000 Research /teaching assistant, University POLITEHNICA of Bucharest, Romania.

PUBLICATIONS:

Scientific journals:

Lundquist, J.D., Dickerson-Lange S.E., Lutz, J. A., *Cristea, N.C.* (2013). Lower forest density enhances snow retention in regions with warmer winters: A global framework developed from plot-scale observations and modeling *Water Resources Research* DOI: 10.1002/wrcr.20504.

Cristea, N.C., Lundquist, J.D., Loheide II, S.P., Lowry C.S., Moore C. E. (2013). Modeling how vegetation cover affects climate change impacts on streamflow timing and magnitude in the upper Tuolumne Basin, Sierra Nevada, *Hydrological Processes* doi: 10.1002/hyp.9909.

Feld, S., *Cristea N.C.*, Lundquist, J.D. (2013). Representing atmospheric moisture content along mountain slopes: Examination using distributed sensors in the Sierra Nevada, California, *Water Resources Research*, 49, doi: 10.1002/wrcr.20318.

Cristea, N.C., Kampf, S.K., Burges S.J., (2012). Linear models for estimating annual and growing season reference evapotranspiration using averages of weather variables, *International Journal of Climatology*, DOI: 10.1002/joc.3430.

Cristea, N.C., Kampf, S.K., Burges S.J., (2013). Revised coefficients for Priestley-Taylor and Makkink-Hansen equations for estimating daily reference evapotranspiration, *Journal of Hydrologic Engineering (ASCE)*. doi:10.1061/(ASCE)HE.1943-5584.0000679.

Mirus, B.B., Loague, K., *Cristea*, N.C., Burges S.J., and Kampf S.K. (2011). A synthetic hydrologic-response dataset. *Hydrological Processes*, DOI:10.1002/hyp.8185

Cristea, N. C. and S. J. Burges (2010). An assessment of the current and future thermal regimes of three streams located in the Wenatchee River basin, Washington State: some implications for regional river basin systems. *Climatic Change*, 102(3), 493-520, DOI:10.1007/s10584-009-9700-5

Cristea, N. C. and S. J. Burges (2009). Use of thermal infrared imagery to complement monitoring and modeling of spatial stream temperatures. *Journal of Hydrologic Engineering (ASCE)*, 14(10), 1080-1090, DOI: 10.1061/(ASCE)HE.1943-5584.0000072.

Washington State Department of Ecology publications:

Hood S., *Cristea, N.C.,* Stohr A (2011). Whatcom, Squalicum, and Padden Creeks Temperature Total Maximum Daily Load: Water Quality Improvement Report, Washington State Department of Ecology, Olympia, Washington, Publication Number 07-03-028 https://fortress.wa.gov/ecy/publications/publications/1110019.pdf.

Cristea, N.C., and Janisch, J. (2007). Modeling the effects of riparian buffer width on effective shade and stream temperature, Washington State Department of Ecology, Olympia, Washington, Publication Number 07-03-028 https://fortress.wa.gov/ecy/publications/publications/0703028.pdf .

Kardouni, J., and *Cristea, N.C.* (2006). Quality Assurance Project Plan for Snoqualmie River Temperature Total Maximum Daily Load Study. Washington State Department of Ecology, Olympia, Washington, Publication Number 06-03-106 https://fortress.wa.gov/ecy/publications/publications/0603106.pdf .

Cristea, N.C., and Pelletier, G. (2005). Wenatchee River Temperature Total Maximum Daily Load Study. Olympia, Washington, Publication Number 05-03-011 https://fortress.wa.gov/ecy/publications/publications/0503011.pdf .

AWARDS/SCHOLARSHIPS:

Travel support from the University of Washington Department of Civil and Environmental Engineering to present at the American Geophysical Union meeting, San Francisco, December 2010, 2011, 2013

Egtvedt fellowship, University of Washington, Seattle (3 mo, 2009)

European Commission ERASMUS scholarship (Institut National des Sciences Appliquées de Lyon, France, 3 mo, 1999)

European Commission ERASMUS scholarship (Politecnico di Torino, Italy, 6 mo, 1998)

European Commission TEMPUS scholarship (Vrije Universiteit Brussel, Belgium, 4mo, 1997)

Governmental scholarship to support undergraduate studies (1991-1996)

CONFERENCE ABSTRACTS:

Cristea N. C., and Burges, S. J., (2004). Wenatchee River, Washington, Water Temperature Modeling and Assessment Using Remotely Sensed Thermal Infrared and Instream Recorded Data. *Eos. Trans. AGU* 85(47), Fall Meet. Suppl., Abstract H13C-0449.

Cristea, N.C., Kampf S.K., Mirus B.B., Loague K., Burges S.J. (2007). Developing a framework for testing distributed hydrologic models at the hillslope scale. *Eos Trans. AGU,* Fall Meet. Suppl., Abstract H21A-0170.

Cristea, N.C., Kampf S.K., Mirus B.B., Loague K., Burges S.J. (2008). Developing a framework for testing distributed hydrologic models at the hillslope scale – examples of test model runs for event based and long term simulations. *Eos Trans. AGU,* Fall Meet. Suppl., Abstract H11C-0765.

Cristea, N.C., Kampf S.K., Mirus B.B., Loague K., Burges S.J. (2009). Distributed hydrologic model testing at the catchment scale using a hypothetical reality data set. *Eos Trans. AGU,* Fall Meeting Supplement, Abstract H33F-0953.

Cristea, N.C., Kampf S.K., Mirus B.B., Loague K., Burges S.J. (2010). Effects of soil parameterization on distributed hydrologic response: Testing a distributed hydrologic model using a hypothetical reality dataset. *Eos Trans. AGU,* Fall Meeting Supplement, Abstract H41F-1131.

Cristea, N.C., Kampf S.K., Burges S.J. (2011). Revised coefficients for Priestley-Taylor and Makkink-Hansen equations for estimating daily reference evapotranspiration. *Eos Trans. AGU,* Fall Meeting Supplement, Abstract H33A-1280.

Lowry, C.S., Loheide II, S.P., Lundquist, J.D., *Cristea, N.C.*, Moore, C.E. (2012). High Elevation Groundwater Dependent Ecosystems: Modeling ecohydrology to quantifying historical and restoration scenarios. International Association of Hydrologists Congress, Niagra Falls, Ontario, Canada, Abstract 573.

Lundquist, J.D., Dickerson S., *Cristea, N.C.*, Lutz J. (2012). Thinned forests enhance snow retention in warmer climates. *Eos Trans. AGU,* Fall Meeting Supplement, Abstract GC51F-04.

Lundquist, J.D., *Cristea N.C.*, Wayand, N. Feld, S. Henn, B., Lapo, K., Hinkelman, L. (2013). Data driving us to distraction – where to focus attention for snow and stream simulations in complex terrain. Davos Atmosphere and Cryosphere Assembly DACA – 13 Air, Ice & Process Interactions. Abstract 712.

Cristea N. C., and Burges, S. J., (2013). Hydrologic effects of evapotranspiration representation in a Richards equation based distributed hydrologic model at the catchment scale, American Geophysical Union, Fall Meeting 2013, Abstract H23E-1327.

Curriculum Vitae

DR. CHRISTINA J. BANDARAGODA

10623 56th Ave W, Mukilteo, WA, 98275 USA
Phone: 425-493-6502 Email: christina@silvertipsol.com

Citizenship: USA Birthday: 11/9/1973

EDUCATION:

Ph.D., Civil & Environmental Engineering, Utah State University, Logan, Utah, 2007.
Concentrations: Hydrology, rainfall-runoff modeling, environmental model calibration, water resource management
Dissertation Title: Distributed Hydrologic Modeling for Streamflow Prediction at Ungauged Basins. Advisor: David G. Tarboton

M.B.A., Business Administration, Utah State University, Logan, Utah, 2006.
Concentrations: Economics, Environmental Economics

M.S., Biological & Agricultural Engineering, Utah State University, 2001.
Concentrations: Remote sensing, geographic information systems, irrigation engineering, spatial data management for irrigation resources in development.
Thesis Title: "Mapping riparian resources in semi-arid watersheds using airborne multispectral imagery in the Escalante River corridor." Advisor: Christopher M. U. Neale

B.S. Wheaton College, Wheaton, Illinois, 1995.
Major: Biology, International Development Studies

AREAS OF EXPERTISE:

- Hydrologic modeling for water resource management, glacier dynamics, flood modeling, instream flows for fish, temperature; spatial parameterization, calibration, evaluation of watershed models.
- Linking policy and science in decision-making with integrated watershed modeling via decision-support systems and spatial data analysis. Provide technical advice in support of policy development for water resource management.
- Developing and applying remote sensing and GIS technology to communicate policy implications in dynamic environments, and system feedback of best management practices, for water resource development and protection.
- The intersection between economic development and water resources management, including development of new water and environmental based indices.
- Partnering with inter-disciplinary specialists, cross-cultural groups and multi-sector agencies. Organizational development, facilitation of efficient processes through communication and project strategy.

PROFESSIONAL EXPERIENCE:

Research Faculty. 2014-current. University of Washington Civil & Environmental Engineering, Ecohydrology Research Group. Watershed and glacier hydrologic modeling projects with Seattle City Light and Nooksack Indian Tribe.

Independent consultant; founder Silver Tip Solutions, LLC., 2006-Current.

2012: Project lead for Water Resource Inventory Area 1 Water Budget. Updated climate, spatial data, streamflow databases and calibration for watershed model; translated technical information into accessible and usable for public decision making.

2010: Advised local policy and decision makers on water resource availability. Expert hydrology legal witness for multiple legal cases involving environmental, water quality and agricultural land protection. Used spatially distributed watershed information to support the development of an operational water budget and classification, and water quantity inputs for a reservoir water quality analysis.

2009: Developed water quantity model and analysis used for economic modeling of water quality trading. Expert hydrology legal witness for water use estimation, hydrologic modeling and stormwater drainage.

2008: Coordinated hydrologic model update and collaboration between multi-sector agencies. Developed strategy for future model development required to support water resource management and analysis of best management practices. Managed decision-support system and hydrologic model update for drinking water resource management in the Weber Basin, Utah.

Clients range between community groups, private individuals, engineering firms, local, state and tribal government, and universities, with collaboration between groups on proposals for federal funding.

Research Engineer. 2007. Utah Water Research Laboratory. Responsible for water quantity modeling component of EPA (U.S. Environmental Protection Agency) funded Targeted Watersheds Project for development of pollution trading.

Research intern, 2004 to 2005, USGS EROS Data Center, International Program, Sioux Falls, SD, Integrated Calibration and Sensitivity Analysis programs for Famine Early Warning System (FEWS) geospatial flood forecasting model (GeoSFM) supported by USAID funding for development of flood forecasting .

Graduate Research Assistant, 2001 to 2004. Utah State University, Utah Water Research Laboratory, Logan, UT, Distributed Model Intercomparison Project, National Weather Service.

Graduate Research Assistant, 1998 to 2001. Utah State University, Remote Sensing Services Laboratory, Biological and Irrigation Engineering Department, from Worked in the Dominican Republic creating survey questionnaire and

developing hydro-agricultural database for irrigation resource development project. Managed large datasets used in image processing, data calibration, and classification, natural resource evaluation and ecosystem analysis.

Biological Technician 1996-1998., National Park Service, assisted in resource management projects including vegetation mapping and hydrology for the Division of Water Rights (NPS).

TEACHING EXPERIENCE:

UW Math Science Upward Bound (MSUB) Engineering Design course. Summer 2014

Curriculum Development for K-12 STEM active learning. 'Water Around Us' piloted in the Mukilteo School District sponsored by the City of Mukilteo and Washington State Department of Ecology.

Graduate Assistantship in Areas of National Need (GAANN) fellow, 2005-2007, Department of Civil & Environmental Engineering, Utah State University, Logan, UT. The GAANN fellowship was funding by the U.S. Department of Education and included teacher training and development for professional scientists.

Water Resources Engineering (CEE 5460/6460), Department of Civil and Environmental Engineering, Utah State University. 2006. Implemented new Problem Based Learning (PBL) approach to course.

Development of online physical hydrology training material. Assisted in development of content and responsible for audio recording. . Tarboton, D.G., Bandaragoda, C.B., Kaheil, Y., Zachry, M., Hult, C., (2003) Rainfall Runoff Processes. An online module developed for the National Weather Service COMET outreach program. http://media.engineering.usu.edu/RRP/

RELATED SKILLS

Basic Software and Programming

- Microsoft Office: Word, Excel, Powerpoint, Access
- ESRI ArcGIS, MapWindow
- Matlab
- S, SAS, and R statistical packages
- Visual Studio: C++ and Fortran

Models/Modeling Packages

- ArcGIS – Geographic Information System
- TopNet/TopModel – Rainfall Runoff Model
- Western Washington Hydrologic Model (WWHM- HSPF model)
- HEC-RAS - Surface Water Model
- TZTS – Temperature and Solute Model
- GeoSFM – Rainfall Runoff Model

- WWHM3 – Rainfall Runoff Model
- DAMBRK – Dam Model
- Qual2E - Water Quality Model
- MODFLOW – Groundwater Model
- VenSim

Field Work Experience

- Socio-economic questionnaire development and field survey
- Cross section/discharge measurements
- Temperature probe deployment and use
- Tracer study tests, Pebble counts

PROFESSIONAL DEVELOPMENT:

Research Intern, National Institute of Water and Atmospheric Research (NIWA), Christchurch, New Zealand, Spring 2006. Worked on a priori parameter estimation studies for distributed models.

Modular Modeling System (MMS) Workshop - Utah State University - 2003

Development Intern; EFICOR, New Delhi India. 1994; 1998, Ten months with non-profit organization in India, research analysis of rural health center, water resource management and economic development projects.

SERVICE:

- Initiated Columbia Community Rain Garden Project and 5th grade curriculum development in coordination with Snohomish County Conservation District
- Coordinate Destination Imagination Program at Columbia Elementary
- Journal Review: Computer & Geosciences – 2010, Advances in Water Resources – 2006
- Board Member: Save Our Communities, Mukilteo, WA. 2010. www.socnw.org

RECOGNITIONS:

Outstanding Student Paper with Bethany Neilson, *Data Collection Methodology for Dynamic Temperature Modeling, Testing, and Corroboration*, AGU Fall Conference 2005.

PROFESSIONAL SOCIETIES:

Washington Hydrologic Society: 2007- current
American Geophysical Union: 2001-current
American Society of Civil Engineers: 2001-current

LANGUAGES:

First and working language: English. Conversational: Spanish.

PUBLICATIONS:

Dissertation:

Bandaragoda, Christina, 2007. Distributed Hydrologic Modeling for Streamflow Prediction at Ungauged Basins. Doctoral Dissertation, Civil and Environmental Engineering, Utah State University, Logan, UT.

Master's Thesis:

May, Christina. 2000. Mapping Riparian Resources in Semi-Arid Watersheds Using Airborne Multispectral Imagery. Masters Thesis. Biological and Irrigation Engineering. Utah State University. Logan, UT.

Refereed Papers:

Bandaragoda, C. D. Tarboton, R. Woods, J. Boettinger (2012), Predicting Streamflow Recession from Soil and Watershed Properties, Water Resources Research, Accepted, In Review.

Bandaragoda, C., and B.T. Neilson, (2011), Increasing parameter certainty and data utility through multi-objective calibration of a spatially distributed temperature and solute model, Hydrol. Earth Syst. Sci., doi:10.5194/hess-15-1-2011.

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Artan, G., H. Gadain, J. L. Smith, K. Asante, C. Bandaragoda and J. Verdin, (2007), "Adequacy of Satellite Derived Rainfall Data for Stream Flow Modeling," Natural Hazards, May, 10.1007/s11069-007-9121-6

Bandaragoda, C., D. Tarboton, D. Maidment (2006), Hydrology's Efforts Toward the Cyberfrontier, Eos Trans. AGU, 87(1), 2, 10.1029/2006EO010005.

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May, Christina and Neale, Christopher M.U., (2000), "Mapping Riparian Resources in Semi-Arid Watersheds Using Airborne Multispectral Imagery", Proceedings of Remote Sensing and Hydrology 2000 Symposium, IAHS publication #267, Santa Fe, NM, April 2-7, pp.539-541.

Conference Proceedings & Posters:

Bandaragoda, C. D. Tarboton, R. Woods, J. Boettinger (2007), Relating Streamflow Recession from Soil and Watershed Properties, *Eos Trans.AGU,* 88(52), Fall Meet. Suppl., Abstract H21A-0186.

Neilson, B. T., Stevens, D. K., Chapra, S. C., Bandaragoda, C.J., Hardy, T.B., (2006), Model Development for Mass and Energy Transfer Between Main Channel Flows, Dead Zones, and the Hyporheic Zones in High Gradient Systems, *Eos Trans. AGU, 87*(36), Jt. Assem. Suppl. H22C-07.

Bandaragoda, C., Tarboton, D., (2006), Examination of the Relationship Between Plot Scale Soil Properties and Catchment Scale Streamflow Recession Properties, *Eos Trans. AGU, 87*(36), Jt. Assem. Suppl. H41A-02.

Artan, G., Gadain, H., Bandaragoda, C., Asante, K., Verdin, J., (2006), Utility of Satellite Derived Rainfall Data for Flood Risk Monitoring, *Eos Trans. AGU, 87*(36), Jt. Assem. Suppl.: H32A-02.

Neilson, B.T., C. Bandaragoda, D.K. Stevens, S.C. Chapra, T. B. Hardy, M. McKee. November 2006. Multiobjective Dynamic Stream Temperature Model Calibration: Understanding the Causes and Effects of Temperature Impairments and Uncertainty in Predictions. 2006 Annual Water Resources Conference. American Water Resources Association. Baltimore, MD.

Neilson, B.T., C. M. Bandaragoda, and D.K. Stevens. March 2006. Virgin River Temperature and Endangered Species. Water Environment Association of Utah 2006 Annual Conference. St. George, UT.

Neilson, B. T., Bandaragoda, C.J., (2005), Data Collection Methodology for Dynamic Temperature Modeling, Testing, and Corroboration, *Eos Trans. AGU, 87*(52), Fall Meet. Suppl. H13B-1332.

Tarboton, D. G., C. Bandaragoda and D. R. Maidment, (2005), "User Needs for a Community Hydrologic Information System," Eos Trans. AGU, 86(52): Fall Meet. Suppl., Abstract H23F-1498.

Bandaragoda, C., Artan, G., (2005), A Framework for the Calibration of a Spatially Distributed Hydrologic Model Using Multiple Streamgage Locations, *Eos Trans. AGU, 87*(52), Fall Meet. Suppl., Abstract H43A-0487.

Tarboton, D. G., C. Bandaragoda, Y. Kaheil, M. Zachry and W. Reed, (2003), "An Online Module on Rainfall Runoff Processes," Eos Trans. AGU, 84(47): Fall Meet. Suppl., Abstract ED32C-1213.

Bandaragoda, C., D. G. Tarboton and R. Woods, (2003), "Application of TOPNET to DMIP," AGU Hydrology Days, March 31-April 2. Fort Collins, CO.

Bandaragoda, C., D. G. Tarboton and R. Woods, (2002), "Application of TOPNET to DMIP," Presentation at National Weather Service Distributed Modeling Intercomparison Project Workshop, Silver Spring, Maryland, August 21

Bandaragoda, C, D.G. Tarboton, and R.Woods., (2002) "Towards model applications without calibration – the use of spatial and temporal data to estimate parameter values of physically based distributed models." AGU spring meeting poster, Washington D.C., May 28-31.

May, Christina and Neale, Christopher M.U., (1999), "Mapping Resources in the Escalante River Corridor using Airborne Multispectral Imagery"; Proceedings of the 17th Workshop on Color Photography and Videography in Resource Management, Reno NV, May 5-7, pp. 208-216.

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Bandaragoda, C. and Joanne Greenberg (2013). Data integration of WRIA 1 Hydraulic, Fish Habitat, and Hydrology Models. 134 pp. Nooksack Indian Tribe, Whatcom County, WA.WRIA 1 Joint Board.

Bandaragoda, C., J. Greenberg, C. Lindsay and M. Dumas, editors. (2013). WRIA 1 Groundwater Data Assessment, 193 pp. Whatcom County PUD #1, Whatcom County, WA. WRIA 1 Joint Board.

Bandaragoda, C., J. Greenberg, M. Dumas, and P. Gill, editors.(2012). Lower Nooksack Water Budget, 440 pp. Whatcom County, WA: WRIA 1 Joint Board.

Bandaragoda, C. and L. Doremus. 2010. Water budget analysis for Black Point Peninsula and the proposed Pleasant Harbor Marina and Golf Course. www.silvertipsol.com Available on request; case pending.

Bandaragoda, C., and J. Greenberg. 2009. Fishtrap Creek Hydrologic Model Update and Assessment. www.silvertipsol.com

Bandaragoda, C. 2008. Bertrand Creek Hydrologic Model Update and Assessment. www.silvertipsol.com

Asante, K.O., Artan, G.A., Pervez, S., Bandaragoda, C., and Verdin, J.P., 2008, Technical Manual for the Geospatial Stream Flow Model (GeoSFM): U.S. Geological Survey Open-File Report 2007–1441, 65 p. http://pubs.usgs.gov/of/2007/1441/

SILVER TIP SOLUTIONS
10623 56th Ave W, Mukilteo, WA 98275 U.S.A

December 11, 2014

Attn: Kristen Bryant, 425-247-9619
Save Black Diamond
SaveBlackDiamond@gmail.com

Re: Stormwater issues of concern for Public Hearing on Yarrow Bay's Plat 2C

Dear Ms. Bryant,

It is our professional assessment that stormwater design for the proposed development project does not meet the minimum computation analysis required by the 2005 Stormwater Manual for Western Washington.

The primary hydrologic reason the stormwater analysis is inadequate is because **the annual average values used for the proposed design are not at spatial and temporal scales appropriate for the site and project**.

Overview Explanation of Why This is Important and What Should Be Done Instead
Wetlands and their surroundings are sensitive to a range of hydrologic, soil, climatic and vegetation processes, and their function and value need to be protected and preserved. The hydrologic response of such system may vary as a function of the size of the storm, antecedent soil conditions (dry or saturated) and the types of anticipated changes. Detailed hydrologic modeling at daily and monthly time scales is needed to capture all these details and to determine changes in water pathways; this can be done by analysis using a continuous hydrologic model. The modeling assessment we recommend and required by the 2005 Stormwater Manual will provide insights on other stormwater design such as sizing of infiltration galleries and other potential changes in the water balance due to construction of the proposed development such as the loss of evapotranspiration through forest removal. Hydrologic processes do not conform to "annual averages' values. There are seasonal peaks, saturation and infiltration levels that vary throughout the year. Plans based on annual estimates are likely a gross underestimation of the full range of stormwater impacts and associated drainage capacity requirements.

Requirements from 2005 Stormwater Manual for Western Washington
Below are detailed requirements summarized from the 2005 Stormwater Manual that pertain specifically to this proposed development:

> "For the purpose of designing most types of runoff treatment BMPs, a calibrated continuous simulation hydrologic model based on the EPA's HSPF (Hydrologic Simulation Program-Fortran) program, or an approved equivalent model, must be used to calculate runoff and determine the water quality design flow rates and volumes If a basin plan is being prepared,

then a hydrologic analysis should be performed using a continuous simulation model such as the EPA's HSPF model, the EPA's Stormwater Management Model (SWMM), or an equivalent model as approved by the local government. Where large master-planned developments are proposed, local governments should consider requiring a basin-specific calibration of HSPF rather than use of the default parameters in the above-referenced models. The Department of Ecology suggests such basin-specific calibrations should be considered for projects that will occupy more than 320 acres. " **2005 Stormwater Manual; Minimum Computation Analysis from Chapter 2 2-2 Volume III – Hydrologic Analysis and Flow Control BMPs February 2005**

Because the proposed project of 1196 acres exceeds the 320 acre size noted above, significant work will be necessary to improve the reliability of the current 'preliminary drainage analysis' submitted for approval of this project.

This project in Black Diamond, a large undeveloped forest and wetland area, is exactly the kind of development the >320 acre recommendation was intended for.

RECOMMENDATIONS:

1. The 2005 Stormwater Manual for Western Washington should be complied with by using a continuous simulation model such as the Western Washington Hydrology Model.

   The City should be aware that the goals of reducing impact on the natural environment and reducing risks of stormwater problems, the WWHM2012 would improve outcomes. WWHM2012, this is the current version of the WWHM that includes several new elements related to Low Impact Development (LID). This should be used to 1) size infiltration galleries and LID components, 2) assess the cumulative impacts of all phases of the project on downstream impacts, including private property, and 3) follow Criterion 1 and 2 (See Guidesheet 3B) for assessing impacts to wetlands. This model is freely available and support by the Washington State Department of Ecology.
   http://www.ecy.wa.gov/Programs/wq/stormwater/wwhmtraining/index.html

2. The stormwater facility management should establish a more detailed plan to demonstrate and achieve compliance with the 2005 Stormwater Management Manual. With private ownership and operation, it is difficult to verify compliance.

Thank you for the opportunity to work with you on this project,

Christina Bandaragoda, Ph.D.
Owner, Silver Tip Solutions consulting
Research Associate, Civil & Env.Eng
University of Washington

Nicoleta Cristea, Ph.D.
Research Associate, Civil & Env.Eng
University of Washington

Attachments
Excerpts from:

- 2005 DOE Stormwater Manual for Western Washington
- Preliminary Drainage Report,
- November 25, 2014 City Staff Report,
- 2012 Stormwater Manual for Western Washington

Excerpted from:

2005 Stormwater Manual
Minimum Computation Analysis from Chapter 2 2-2 Volume III – Hydrologic Analysis and Flow Control BMPs February 2005

> *"For the purpose of designing most types of runoff treatment BMPs, a calibrated continuous simulation hydrologic model based on the EPA's HSPF (Hydrologic Simulation Program-Fortran) program, or an approved equivalent model, must be used to calculate runoff and determine the water quality design flow rates and volumes If a basin plan is being prepared, then a hydrologic analysis should be performed using a continuous simulation model such as the EPA's HSPF model, the EPA's Stormwater Management Model (SWMM), or an equivalent model as approved by the local government. Where large master-planned developments are proposed, local governments should consider requiring a basin-specific calibration of HSPF rather than use of the default parameters in the above-referenced models. The Department of Ecology suggests such basin-specific calibrations should be considered for projects that will occupy more than 320 acres. "*

As noted in the table below (2005 Stormwater Manual Chapter 2 2-2 Volume III pg 2-2), the unit hydrograph method is not applicable for design of flow control.

Summary of the application design methodologies		
	BMP designs in western Washington	
Method	**Treatment**	**Flow Control**
SCSUH/SBUH (Soil Conservation Service Unit Hydrograph/Santa Barbara Unit Hydrograph)	Method applies for BMPs that are sized based on the volume of runoff from a 6-month, 24-hour storm. Currently, that includes only wetpool-facilities. **Note:** These BMPs don't require generating a hydrograph.	Not Applicable
Continuous Runoff Models: (WWHM or approved alternatives. See below)	Method applies to all BMPs.	Method applies throughout Western Washington

Excerpted from: **20. Preliminary Drainage Report.**

> *The estimates of annual runoff, evapotranspiration and recharge for various land coverage types were taken from a 2008 EIS report (Appendix D of the Environmental Impact Statement Technical Report on Geology, Soils, and Ground Water for The Villages; Associated Earth Sciences, Inc.). In their drainage analysis, Triad used an estimate of annual volume of runoff from developed areas totalling approximately 40 acre-feet of annual water recharging wetlands (Table 4).*

Silver Tip Comment on 20. Preliminary Drainage Report
StormSHED, an SBUH hydrologic modeling program was used. They assumes that 1 acre of impervious surface will produce 1.0 cfs of flow during a 100 yr rainfall event. Infiltration trenches disperse 0.5 cfs each. They estimate that 2 trenches will be required for every acre of impervious surface. 24 trenches are planned to drain runoff to wetlands.

In the 5.2 northwest acres with highly infiltrative outwash soils, bioretention cells are expected to retain and treat 91% of the total volume (according to DOE 2005 manual) with the remainder routed to an underground infiltration gallery.

Without a daily model, such as the Western Washington Stormwater Model (version of HSPF), it is impossible to know the increase in water due to loss of ET from mature forest. Generally we expect an increase of 50% in existing runoff. It is likely the major infiltration facilities and more LID measures will be required. Further, depending on the topography, it is unknown how the pathways of increased stormwater will impact downstream neighbors. Only with a stormwater model linked to a groundwater model will it be known what the potential impacts to downstream neighbors and wetlands, given the pathways and quantities of stormwater on a daily/monthly scale of analysis. An annual scale of analysis is insufficient.

Excerpted from: **Staff Report Nov. 25.2014.pdf**

> "General plan: bioretention cells, small scale infiltration facilities (flow dispersal trenches) and two rain gardens. Alternative stormwater zone delineation deviation for Phase 1A regional stormwater pond. "

Silver Tip Comment on Staff Report Nov. 25 2014.pdf
The DA, page 63 lists nine potential LID techniques to be used where feasible in The Villages. The application proposes to use four of the nine recommended measures: media filter strips, rain gardens, reduced roadway widths and small-scale infiltration facilities. The remaining five measures may not be feasible or necessary in Plat 2C, based on the current plans to recharge the large areas of wetlands surrounding the site and the ability to discharge other runoff to the treatment facility in Phase 1A. Pet waste stations should be installed at points along the trail.

Which franchise will do this? The remaining stormwater facilities (flow dispersal trenches, two rain gardens, and roof drains) will be privately owned and operated. The DA requires that any privately-owned pipelines be covered by a franchise in order to cross public rights of way.

Excerpted from: **2012 Stormwater Manual**

"Page D-5; Guide Sheet 3B: Protecting wetlands from impacts of changes in water flows. Hydrologic modeling is useful to measure or estimate the aspects of the hydroperiod under existing pre-project and anticipated post-project conditions. Post-project estimates of the water regime in a watershed and wetland hydroperiod must include the cumulative effect of all anticipated watershed and wetland modifications. Perform this assessment with the aid of a qualified hydrologist. Provisions in these guidelines pertain to the full anticipated build-out of the wetland's watershed as well as changes resulting from an individual development."

"Unfortunately, attempts to modify and use the standard hydrologic models for describing the flow and fluctuations of water in a stormwater pond have failed to adequately model the hydrodynamics in wetlands. It is difficult, to estimate if stormwater discharges to a wetland will meet the criteria for protection developed by the Puget Sound Wetland and Stormwater Research Program.Ecology does not have any hydrologic models available to characterize the hydrodynamics in these types of wetlands. As a result, it is difficult to predict the direct impacts of changes in water flows resulting from a development. In the absence of hydrologic models that characterize all types of wetlands, criteria have to be set using information that is readily available. These criteria are based on risk to the resource rather than an actual understanding of impacts. The following criteria will provide some protection for the valuable wetland types listed in Guide Sheet 1, but we cannot determine if they result in the complete protection of a wetland's functions and values. The risk to wetland functions will increase as the water volumes into the wetland diverge from the pre-project conditions. The risk will be decreased if the divergence is smaller."

"Use the Western Washington Hydrology Model (WWHM), or other models approved by Ecology, for estimating the increases or decreases in total flows (volume) into a wetland that can result from the development project. These total flows can be modeled for individual days or on a monthly basis. Compare the results from this modeling to the criterion below. WWHM 2012 will have the capability to compare these results with the criterion.
Criterion 1: total volume of water into a wetland during a single precipitation event should not be more than 20% higher or lower than the pre-project volumes.
Criterion 2: Total volume of water into a wetland on a monthly basis should not be more than 15% higher or lower than the pre-project volumes."