**BEFORE THE CITY COUNCIL**

**FOR THE CITY OF PORTLAND, OREGON**

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| **In the Matter of the Appeal of the Hearings Officer's Approval of EVERETT CUSTOM HOMES, INC.'S Application for Subdivision Approval and Environmental Compliance Review (Type III Proceeding)** | ) ) ) ) ) ) | **FILE NO: LU 16-159330 LDS EN** **HAYHURST NEIGHBORHOOD ASSOCIATION'S MEMORANDUM IN OPPOSITION TO 11-LOT SUBDIVISION, AS PROPOSED** |

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# JONATHAN J. RHODES, HYDROLOGIST

# EXPERT REPORT

**SUBMITTED BY:**

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My name is Jonathan J. Rhodes. My education includes completion of the requirements, but for a dissertation, for a Ph.D. in forest hydrology from the University of Washington (1989). I also hold an M.S. in hydrology and hydrogeology from the University of Nevada-Reno and a B.S. in hydrology and water resources from the University of Arizona.

I have more than 30 years of professional experience. I have been an independent consulting hydrologist since 2002, working for an array of clients, including county governments, on a variety of issues, including the effects of urbanization on water quality, stream conditions, and fish habitats. Prior to 2002, I worked at the Columbia River Inter-Tribal Fish Commission for about 12.5 years, where I served as Senior Fishery Scientist-Hydrologist. For more than 30 years, my work has consistently focused on the impacts of various land and water management on water quality, stream flows, channel conditions, and fish habitats.

I have lectured extensively on these topics and have authored numerous peer-reviewed research articles and technical reports related to the impacts of human activities on watersheds, fish, and fish habitats throughout the Western United States. I have served as a peer reviewer for international conference proceedings related to land use and fish habitat impacts, as well as for several scholarly scientific journals.

**Summary**

I provide these comments regarding LU 16-159330 LDS EN and the proposed development's effects on Environmental Conservation areas, wetlands, water quality, and affected significant resources and functions, related to salient Portland City Code, including approval criteria.

**Springs on the site of the proposed development require the protection described in City Code 33.640.**

City staff documented three springs outside of the currently delineated Environmental Conservation area on the site, as described in the memo from J. Antak to J. Tunnard and S. Beckman dated March 7, 2017 (Hereinafter: 2017 Memo). One of the three springs was flowing at the time of the site visit, as described in the 2017 Memo.

These springs require protection under the City's Code 33.640 for springs and seeps as indicated in the following excerpt from that code:

> "33.640.010 Purpose
> The standards in this chapter ensure that important streams, seeps and springs that are not already protected by the Environmental Overlay Zones, are maintained in their natural state.
> 33.640.100 Where These Standards Apply
> The standards of this chapter apply to all land divisions where a stream, spring, or seep on the site is outside of an Environmental Overlay Zone.
> 33.640.200 Stream, Spring, and Seep Standards
> A. Preservation in a tract. Streams, springs, and seeps must be preserved in a tract as follows:
> 1. The edges of the tract must be at least 15 feet from the edges of the stream, spring, or seep."

The springs found on the site described in the 2017 Memo clearly meet the current definition of springs and seeps in City Code 33.910, dated 3/31/17, which states (p. 910-31):

> "Seep or Spring. An area where groundwater is discharged onto the land surface, creating either saturated soil conditions or visible flow at the land surface."

Visible flow of groundwater discharging onto the land surface outside of the Environmental Conservation area on the proposed site was observed, as described in the 2017 Memo. Therefore, the observed springs meet the definition of a seep or spring in the 3/31/17 City Code.

However, even using the seep and spring definition in the cited in the memo from M. Kuziensky to J. Turner, dated 3/8/17 (Hereinafter: AQEA Memo), the springs found outside of

the Environmental Conservation zone on the site (2017 Memo) still require protection as required by City Code 33.640.

The AQEA Memo provides the following definition of seeps or springs:

> "Seep or Spring. The point where an aquifer intersects with the ground surface and discharges into a stream channel that flows into a wetland or other water body."

There are several reasons why the springs described in the 2017 Memo meet this definition.

First, water transmitted to the ground surface in the form of a spring must come from an aquifer. In both common parlance and within the field of hydrology, an aquifer is defined as permeable subsurface material that stores and can transmit water. For instance, Merriam Webster[1] defines an aquifer as: "a water-bearing stratum of permeable rock, sand, or gravel." The Cambridge English Dictionary[2] defines an aquifer as: "a layer of rock, sand, or earth that contains water or allows water to pass through it." On more a more technical front, the Idaho Museum of Natural History[3] states: "An aquifer is a body of saturated rock through which water can easily move," while the Handbook of Hydrology (Maidment, p. 6-15, 1992) defines an aquifer as "a permeable geologic unit that transmit and store significant quantities of water." Thus, the existence of a spring, which inherently involves stored water in permeable geologic materials being transmitted to surface, is diagnostic of the presence of an aquifer that intersects the ground surface.

Further, the City's Fanno Creek and Tributaries Conservation Plan (p. 11) states that the widespread occurrence of low infiltration layer in soils throughout the watershed "causes ***aquifers*** to perch…during the winter." (Emphasis added). The Fanno Creek and Tributaries Conservation Plan (Hereinafter: FCP) also states (p. 37) that in the watershed "…most

[1] https://www.merriam-webster.com/dictionary/aquifer
[2] http://dictionary.cambridge.org/us/dictionary/english/aquifer
[3] http://imnh.isu.edu/digitalatlas/hydr/concepts/gwater/aquifer.htm

groundwater tends to remain in seasonal perched ***aquifers***." (Emphasis added). Thus, the FCP acknowledges that shallow seasonally-saturated aquifers commonly occur in the watershed. This bolsters the case that, due to geology and soils in the watershed, the springs found on the site outside of designated Environmental Conservation zone, described in the 2017 Memo, are likely fed by a shallow perched aquifer. This is highly significant because the FCP is explicitly cited in City Code 33.430 Environmental Zones as providing part of the bases for the application of environmental zones, as well as the identification of important natural resources and their functional values.

Notably, some definitions of an aquifer include the ability of geologic material to yield "significant" or "useable" quantities of water. However, these are qualitative concepts that are dependent on context. From an ecosystem perspective and, certainly in the case of the Fanno Creek system, including the site for the proposed development, flow from seeps and springs are always significant and useable for ecosystem functions. The springs found on the site clearly drain into the delineated wetland. There is no question that water supply is critical to wetland functions, including the support of wetland fauna and flora, as well as wetland physical functions, such as the slow release of stored water to downstream segments and the desynchronization of stormwater runoff.

Flow from seeps and springs fed by groundwater are critically important contributors to streamflows, temperature regulation, and fish habitat conditions downstream. The FCP states (p. 37) that in the Fanno Creek watershed "Surface water [e.g., streamflow] is supplied by recharge and the discharge of groundwater…groundwater discharge contributes water to streams during critical periods of low flow. This water is extremely important for fish and wildlife." Flow from springs, such as those found on the site outside of the Environmental Conservation zone are a

form of groundwater discharge, which the FCP correctly notes is extremely important for fish, which renders the quantity of water yielded from aquifers to springs on the site as both useable and significant for resources and important ecosystem function.

Groundwater discharge, including that from springs, is critically important to water quality and fish habitat. Elevated summer water temperatures are currently a major problem for water quality and fish populations in Fanno Creek, as noted in both the FCP and the City's TMDL[4] Implementation Plan For The Willamette River And Tributaries, dated 2/28/14 (Hereinafter: TP). It is well documented that groundwater discharge, such as that from seeps and springs, is extremely important to the moderation and control of water temperature (e.g., Rhodes et al., 1994; Leblanc et al., 1996). The TP states that some of the key general strategies/Best Management Practices (BMPs) to address water temperature problems in the watershed are to "protect riparian buffers and corridors, headwaters, springs and seeps, wetlands, and native vegetation" and "Restore natural stream hydrology and cool water refuges and wetlands; Increase natural stream flow." Discharge from a spring is an important component of temperature moderation, natural stream flow, and the affected wetland on the site. Thus, quantity of water discharged from the spring on the proposed development site is both useable and significant with respect to significant resources and functional values, including those in the Environmental Conservation zone on the site, as well as downstream water quality, fish habitat, and the City's strategy for addressing water quality problems in the watershed.

Even within the relatively narrow context of domestic water supply, it cannot be reasonably assumed that the aquifer that supplies water to the springs on the site, described in the 2017 Memo, would not be capable of providing significant or useable quantities of water. This

[4] TMDL: Total Maximum Daily Load, which relates to the control of pollutant loads to water-quality impaired water bodies under the Clean Water Act.

is because assessing the ability of an aquifer to yield water requires a considerable amount of information, including the aquifer's dimensions, hydrogeologic properties, quantities of recharge and discharge, as well as its hydrologic relationship to other adjacent geologic formations and hydrologic features. This information is lacking. Therefore, it cannot be reasonably assumed that the aquifer discharging to the springs on the site would not yield water that is significant or useable from a domestic use perspective.

The aquifer intersecting the soil surface and discharging water to the springs documented on the site in the 2017 Memo may only be seasonally saturated. However, this does not mean it is not an aquifer. It is well-established in hydrogeology that many shallow aquifers perched over less permeable materials undergo considerable seasonal fluctuations in water table elevation and degree of saturation, depending on seasonal recharge inputs and discharge outputs. For instance, the Idaho Museum of Natural History[5] states "A perched aquifer's water table is usually highly sensitive to the amount of seasonal recharge so a perched ***aquifer*** typically can go dry in summers or during drought years." (Emphasis added). Similarly, the FCP states that in the Fanno Creek watershed "...recharge is a very slow process, and most groundwater tends to remain confined in ***seasonal perched aquifers***." (Emphasis added). Thus, an aquifer that goes dry during droughty periods is still an aquifer.

The university-level textbook, Groundwater (Freeze and Cherry, 1979), notes that "Of all the words in the hydrologic vocabulary, there are probably none with more shades of meaning than the term *aquifer.*" (Emphasis is theirs). Thus, due to broad nature of the term "aquifer," within the field of hydrology, together with the foregoing discussion, the groundwater feeding the springs found on the site comes from what qualifies as an aquifer.

[5] http://imnh.isu.edu/digitalatlas/hydr/concepts/gwater/aquifer.htm

Second, the aquifer feeding the springs found on the site plainly intersects the ground surface. Water flowing in these springs is direct evidence of this intersection. The physics of flow through geologic materials clearly indicates that water would not flow from a spring unless a saturated aquifer intersects the ground surface. A lack of soil indicators is not compelling evidence of a lack of intersection of an aquifer because, as previously discussed, perched aquifers in the Fanno Creek watershed are likely seasonal with respect to saturation, as is common with perched, shallow aquifers.

Third, the flow from the springs documented in the 2017 Memo discharges into a stream channel that flows into a water body. The flow from the springs clearly flows into the wetland. During wet periods the water discharged to the wetland flows into the stream channel on the southwest part of the site. This channel flows through a culvert into a tributary of Pendleton Creek, which flows into Fanno Creek, which is a water body.

Thus, the springs found on the site of the proposed development meet all of the criteria included in the definition of a seep or spring cited in the AQEA Memo. They issue from an aquifer which intersects the ground surface and discharge into a stream channel that flows into a water body. As such they require protection as required by City Code 33.640 for springs and seeps.

Besides the Code, there are other compelling reasons to protect springs found on the site. As previously discussed, to do otherwise would conflict with the strategies adopted in the City's TMDL plan (TP). Protection of seeps and springs are also vital to conserving the resources and functional values on the site, including those in the Environmental Conservation area on the site.

**The proposed development would have significant and permanent detrimental impacts on a variety of significant resources and functional values on the site, including those in the delineated Environmental Conservation area.**

The FCP notes that upland, riparian, and wetland habitats are significant resources in the Fanno Creek watershed, and within the resource area where the site is located. Significant values within this resource area include pollution control and water supply. Significant functions include water-borne pollutant assimilation, dissipation of erosion from stormwater, groundwater discharge, sediment trapping from stormwater, and the storage, conveyance, and desynchronization of stormwater (FCP). All of these resources, values, and functions exist on the proposed development site, but would be detrimentally affected by the proposed development in a permanent manner.

In the uplands, the creation of impervious surfaces from housing infrastructure, together with rerouting runoff from a large portion of the site to the stormwater system will adversely impact the supply of water to the wetland and stream systems. Infiltration of precipitation in soils will be permanently precluded in areas occupied by impervious surfaces, which will permanently reduce groundwater recharge on much of the site. Reductions in recharge will reduce the significant function of groundwater discharge on the site, including to the wetland on site and streams draining the area. Urbanization typically reduces groundwater discharge due to these effects of impervious surfaces (LeBlanc et al., 1996). Infiltration, recharge, and groundwater discharge impact will also be detrimentally affected on the site in areas outside of the impervious surface footprint. Construction activities using heavy equipment inexorably compacts soils, which persistently reduces infiltration, water storage, and water transmission in affected soils for several decades. The soils on the site are particularly susceptible to compaction, because they have significant fraction of clay in surficial layers and clays are

particularly susceptible to compaction by heavy machinery. Soils with relatively high clay content are also slow to recover from compaction.

Areas of developed lots outside of the impervious surface footprint are also only partially pervious due to urbanization impacts (Booth, 2000). These impacts will also contribute to the persistent loss of the significant function of groundwater discharge due to the loss of infiltration and water recharge in soils.

The proposed road expansion into the delineated wetland in the Environmental Conservation zone on the site will also obliterate wetland functions related to the significant function of groundwater discharge in the area occupied by impervious surfaces. Wetlands provide important sources of flow storage and slow release of stored groundwater discharge to stream systems. In the area of the wetland occupied by impervious surfaces, the damage to this significant function will be permanent and complete.

These same combined impacts from the proposed project will also have significant detrimental impacts on the significant value of water supply. The impervious surfaces, loss of infiltration and water storage capacity in soils, will reduce water supply to the wetland and the stream reach within the Environmental Conservation zone on the site, particularly during drier periods. Impacts on these significant values will be particularly acute in the wetland area affected by the proposed road activities and the creation of impervious surfaces in the wetland.

The project will reduce flow through soils via combined impacts of impervious surfaces and the loss of infiltration capacity and soil water storage, thereby adversely affecting the significant functions of water-borne pollutant assimilation. It is extremely well-documented that water flow through soils is highly effective at removing pollutants in water.

The project's removal of existing vegetation and downed wood outside of the Environmental Conservation area will adversely affect the significant functions of sediment trapping from stormwater and the dissipation of erosion from stormwater, because vegetation and downed wood trap sediment in runoff. The loss of these functions will have particularly significant impacts during the construction phase. This is because construction impacts vastly elevate erosion and downslope sediment delivery and BMPs cannot eliminate these sediment-related impacts to downslope areas.

The creation of impervious surfaces together with reductions in soil water storage will also adversely affect the important significant functions of the storage, conveyance, and desynchronization of stormwater. These impacts will permanently truncate the affected soils' ability to absorb, store, and convey water; these functions are critical to the desynchronization of stormwater (Booth et al., 2004; National Research Council, 2008).

The proposed road expansion into the delineated wetland in the Environmental Conservation zone on the site will permanently destroy the stormwater desynchronization functions in the affected wetland area. This is significant because it is well established that wetlands provide essential stormwater desynchronization functions due to their ability to absorb, store, and slowly release runoff. Sidewalks and asphalt in the delineated wetland will not only completely preempt the desynchronization of storm runoff in the affected area, but also serve to synchronize stormwater runoff. It is not possible to mitigate the wetland hydrologic functions that will be permanently eliminated by constructing impervious surfaces in the wetland.

Much of the water that currently drains on to the site will be permanently prevented from draining to the wetland due to the proposed routing of stormwater from much of the site to

offsite stormwater systems. This will diminish the wetland's stormwater desynchronization functions.

These enduring adverse impacts to significant values and functions are significant for several reasons. First, the cited purpose of the City Code 33.430 for Environmental Zones is to protect identified resources and functional values from detrimental impacts:

> "**33.430.010 Purpose** Environmental zones protect resources and functional values that have been identified by the City as providing benefits to the public."

Second, many of these impacts from the proposed development cannot be completely mitigated or eliminated (Booth et al., 2002; 2004). Third, most of the impacts on these significant resources, values, and functions are permanent. Fourth, these enduring impacts have not been adequately made known or considered. Fifth, the impacts also have adverse impacts on downstream significant resources, values, and functions, including streams, water quality, and fish habitats and populations.

**The proposed development impacts would have significant detrimental impacts on downstream significant resources and functional values, including water supply and fish habitat.**

The FCP identifies water supply and fish habitat as significant values in the resource area where the proposed development site is located. Significant functions identified in this resource area in the FCP include areas for fish rearing, hiding, dispersion, rearing, and migration. These downstream values and functions will be detrimentally affected by the project's impacts in several ways.

As previously mentioned, elevated water temperature in the Fanno Creek system is already a significant water quality problem for endemic fish (FCP). The problem is so severe that a TMDL addressing it is in place (TP). However, the project's impacts will exacerbate these

existing problems, due to the previously discussed impacts on the wetland, site-scale hydrology, water supply, and groundwater discharge. Notably, as discussed, many of these impacts conflict with the aims and strategies in the TP.

The proposed road activities will also contribute to exacerbation of existing water temperature problems. Road runoff that is delivered to streams at stream crossings and other points that are hydrologically connected to streams elevates stream temperatures during summer runoff events (National Research Council, 2008). This is because runoff occurs on impervious surfaces in response to even small precipitation events and this runoff is heated by warm road surfaces during summer. Notably, this thermal pollution from roads occurs when streams are already warm due to seasonal effects, elevating the adverse impacts on salmonids (Rhodes et al., 1994; McCullough, 1999), such as cutthroat trout that inhabit Fanno Creek (FCP). These are significant impacts because they combine with other project impacts on water temperature, including loss of groundwater discharge, exacerbating existing water temperature problems downstream. Thus, the project has significant detrimental impacts on downstream fish habitats, including habitats for rearing, migration, and feeding.

The creation of impervious surfaces, including in the delineated wetland, and other soil and runoff impacts of the development will contribute to reductions in water supply to downstream reaches, particularly during drier, lower streamflow periods, as previously discussed. This loss of streamflow during drier periods will adversely affect downstream fish populations. As previously discussed, the FCP notes that water supply to streams during lower flow periods is critical to fish. Reductions in water supply to streams during lower flow periods detrimentally affects fish habitats by reducing the extent of these habitats. Reductions in low flow water supply also exacerbate water temperature problems, which already afflicts water

quality and fish habitats in Fanno Creek (FCP, TP). Notably, the loss of water supply during lower flow periods conflicts with some of the key strategies for maintaining and improving water temperature in the City's TP, as previously discussed.

Although these impacts will occur near tributaries to Fanno Creek, they will be translated downstream. These combined effects of the proposed development will, thus, have adverse impacts on downstream fish habitats and populations.

**There are other alternatives to the proposed development that would reduce the significant detrimental impacts on identified resources and functional values on the site.**

The City Code 33.420 for Environmental Zones related to environmental review 33.430.220 requires:

> "Evaluation of alternative locations, design modifications, or alternative methods of development to determine which options reduce the significant detrimental impacts on the identified resources and functional values of the site"

The approval criteria in City Code 33.420 for Environmental Zones related to environmental review 33.430.220 include:

> "Proposed development locations, designs, and construction methods have the least significant detrimental impact to identified resources and functional values of other practicable and significantly different alternatives including alternatives outside the resource area of the environmental zone;"

The current proposal does not meet these approval criteria, because the proposal would have enduring detrimental impacts on resources and functional values on the site, including to those on the Environmental Conservation area on the site, and in downstream areas, as previously discussed, that could be reduced by modifying the proposal.

The detrimental impacts from the proposed development would primarily stem from impervious surfaces, soil impacts, and alteration of current drainage. These impacts can be practicably reduced via reductions in the extent of impervious surfaces, soil impacts, and

alteration of current drainage. This can be tractably accomplished by reducing the number of dwellings proposed for construction on the site. Impacts could also be reduced by reducing the proximity of these impacts to delineated Environmental Conservation zone by foregoing the construction of impervious surfaces in areas nearest to the Environmental Conservation zone. Thus, there are alternatives to the current development proposal that would have lower impacts on identified resources and values and comply with the aforementioned approval criteria. For these reasons, the current proposal does not meet the approval criteria.

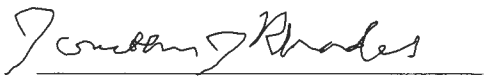
**The City Code 33.430 Environmental Zones requires a consideration of cumulative impacts on affected resources and functional values.**

City Code 33.430.220 states:

> "B. Supplemental narrative. The following is required:
> 1. Impact evaluation. An impact evaluation is required to determine compliance with the approval criteria and to evaluate development alternatives for a particular site. The alternatives must be evaluated on the basis of their impact on the resources and functional values of the site. In the case of a violation, the impact evaluation is used to determine the nature and scope of the significant detrimental impacts. To the extent that the site resources and functional values are part of a larger natural system such as a watershed, the evaluation must also consider the cumulative impacts on that system. The impact evaluation is based on the resources and functional values identified as significant in the reports listed in section 33.430.020"

As previously discussed, the proposed development would have significant detrimental impacts on functional values identified in the FCP and that are part of the natural system that is the Fanno Creek watershed. Thus, the code requires consideration of the cumulative impacts on the system's affected resources and functional values that would be affected by the project, including the significant values within this resource area identified in the FCP: pollution control and water supply. Significant functions identified in the FCP that would be affected by the proposed development include water-borne pollutant assimilation, dissipation of erosion from stormwater, groundwater discharge, sediment trapping from stormwater, and the storage,

conveyance, and desynchronization of stormwater. Thus, the cumulative impacts on these values must also be assessed to comply with the City Code.



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# JONATHAN J. RHODES
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# CURRICULUM VITAE

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## EDUCATION

1989: Doctoral candidacy degree in forest hydrology at the Univ. of Wash. Completed all requirements but dissertation.

1985: M.S. in Hydrology and Hydrogeology at the Univ. of Nev.-Reno. Thesis topic: The influence of seasonal stream runoff patterns on water quality.

1981: B.S. in Hydrology and Water Resources at the Univ. of Ariz.

## PROFESSIONAL HISTORY

Sept. 2001 -- present. Principal Hydrologist, Planeto Azul Hydrology. Main duties: Analysis of water and land use effects on streams and aquatic resources, including native salmonids and their habitats; diagnosis of watershed and stream conditions; stream monitoring; development of programmatic and site-specific watershed and stream protection measures; project management. Some recent projects (and clients): Analysis of potential effects of groundwater pumping on streamflow (Conf. Tribes of the Umatilla Indian Reservation, OR); diagnosis of watershed and stream conditions in an urbanized watershed (West Multnomah Soil and Water Conservation District, OR); analysis of data on sediment effects on ESA-listed salmon in the South Fork Stillaguamish River, WA (Snohomish County, WA). See list of clients at the end of the CV.

Aug. 1990 -- Sept. 2001. Consulting hydrologist for non-profit organizations. Past projects (and clients) include: hydrologic characterization of remnant marsh proposed as urban wildlife refuge/greenspace (Multnomah Co. Parks Dept, OR); review of aquatic effects of: quarry expansion (Friends of Forest Park, OR), urban construction (homeowners consortium, W. Linn, OR); forest manipulations on streamflow (Pacific Rivers Council).

Apr. 1989 -- Sept. 2001. Senior Fishery Scientist-Hydrologist, Columbia River Inter-Tribal Fish Commission. Main duties: Administration and implementation of projects monitoring channel change from land use; development of programmatic and site-specific land management plans to ensure protection of watershed integrity, water quality and aquatic resources; development of restoration plans for watersheds degraded by grazing, roads, logging, and mining; design of plans for monitoring watershed and stream erosion, sedimentation, water quality, and habitat conditions; review of land management plans for adequacy of protection of aquatic resources; field evaluation of watershed and channel conditions throughout the Columbia Basin; expert witness testimony; development of technical recommendations for policy staff for protection of natal habitat for anadromous fish; review of state and federal aquatic resource monitoring plans; report and proposal writing; and, participation in various state and federal technical work groups.

Aug. '84 -- Apr. '89. Research assistant, College of Forestry, Univ. of Wash. Main duties: analysis and interpretation of water quality-quantity data; technical report writing; design and maintenance of water chemistry and quantity monitoring network in a coastal forested watershed; training in data acquisition techniques; public presentation of findings.

July -- Oct. 1987 and May -- Oct. 1988. Consulting hydrologist, Tahoe Regional Planning Agency, CA and NV. Main duties: field delineation and mapping of riparian zones, wetlands, and erosion-prone areas.

June -- Sept. 1985 and July 1986. Research assistant, Dept. of Geophysics, Univ of Wash. Main duties: operation of field station for glacier research on Mt. Olympus, Wash.; measurement of snow and glacier melt rates; mapping of supra- and extra- glacial streams contributing to basal sub-glacial flow rates on surging and non-surging glaciers in the Alaska Range, Alaska.

Jan. 1984. Consultant with C.M. Skau, Reno, NV. Main duties: field evaluation of logging roads for erosion potential and sedimentation risk; recommendations for placement of future roads to minimize erosion and sediment delivery to fish-bearing streams in coastal Northern California.

Oct. 1983 -- June 1984. Hydrologic Tech., USGS, Carson City, NV. Main duties: aid in development and calibration of predictive water quality model for the Truckee River; statistical analysis of water quality data; identification and quantification of non-point sources of nutrients to Truckee River, NV.

Aug. 1981 -- Sept. 1983. Research Assistant, Univ. of Nev.-Reno. Main duties: design and installation of instrument network to monitor water chemistry and quantity in a small, forested alpine watershed in the Sierra Nevada; water quality sampling; data interpretation and management; preparation of reports, grant proposals, and publications, computer programming for data reduction and storage; mapping of geology, soils and runoff-producing areas; and, training of field technicians.

Feb. -- May 1981. Water Quality Intern, Pima Assoc. of Gov'ts., Tucson, AZ. Main duties: water quality sampling of agricultural production wells; mapping of groundwater levels; and, coordination of sampling efforts.

## PROFESSIONAL SERVICE

Jan. 2015 – present. Peer Reviewer for the scholarly journal, Environmental Monitoring and Assessment for papers related to sediment-related impacts of logging on water quality and aquatic systems.

May 2009 – present. Peer Reviewer for the scholarly journal, Open Forest Science Journal for papers related to hydrology and forest and watershed responses to disturbance.

Mar. 2013. Invited Panel Speaker, Public Interest Environmental Law Conference: "Public Land Livestock Grazing and Climate Impacts on Aquatic Systems" and "The High Ecological Costs and Low Benefits of Logging Under the Rubric Of Restoration," Univ. of OR, Eugene, OR.

Feb. 2010. Invited Guest Lecturer, Lewis and Clark School of Law course on public lands law: "PACFISH and INFISH and Imperiled Salmonids on Public Lands" Portland, OR.

Feb. 2009. Invited Guest Lecturer, Lewis and Clark School of Law course on public lands law: "PACFISH and INFISH and Imperiled Salmonids on Public Lands" Portland, OR.

Feb. 2008. Invited Guest Lecturer, Lewis and Clark School of Law course on public lands law: "PACFISH and INFISH and Imperiled Salmonids on Public Lands" Portland, OR.

Mar. 2007. Invited Panel Speaker, Public Interest Environmental Law Conference: "Fuel Treatments & Thinning: Its Impacts and Low Priority Relative to Other Needed Restoration Measures" and "The Impacts of Livestock Grazing on Water Quality and Trout Habitats," Univ. of OR, Eugene, OR.

Feb. 2005. Invited Guest Lecturer, Lewis and Clark School of Law course on public lands law: "Postfire Watershed Management on Western Public Lands" Portland, OR.

Mar. 2004. Invited Panel Speaker, Public Interest Environmental Law Conference: "Postfire Watershed Restoration," Univ. of OR, Eugene, OR.

April 2002. Invited Speaker, Restoring Public Lands Conference: Reclaiming the Concept of Forest Restoration, "Watersheds and Fisheries: Restoration Needs for Trout Habitats," Univ. of CO, Boulder, CO

Mar 2002. Invited Panel Speaker, Public Interest Environmental Law Conference: "Soils, Impacts and Effects on Trout Habitat," Univ. of OR, Eugene, OR

Mar. 2001. Invited Panel Speaker, Public Interest Environmental Law Conference: "NFMA and Salmon Habitat Protection," Univ. of OR, Eugene, OR.

May 2000. Invited speaker, 5th National Tribal Conf. on Environmental Management: "Federal Land Management's Effects on Critical Habitat for Endangered Salmon," Lincoln City, OR

July 1998-2000. Peer Reviewer for the scholarly journal, N. Amer. J. Fish, for papers related to the sedimentation of fish habitat in response to erosion from land uses and fire.

Feb. 1998. Invited Speaker, Oregon AFS Annual meeting: "Adaptive management: Is it really adaptive?" Sunriver, OR

May 1996-2000. Guest lecturer, Oregon State Univ. graduate course on riparian and wetland ecology, Corvallis, OR

Apr.-May 1996. Peer-reviewer for Proceedings of Forest-Fish Conference: Land Management Affecting Aquatic Ecosystems, Proc. Forest-Fish Conf., May 1-4, 1996, Calgary, Alberta, Canada. Nat. Resour. Can., Can. For. Serv. Nort. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-356.

Apr. 1995. Invited speaker, Pacific Rivers Council Workshop on Watershed Analysis and Salvage Logging, Wenatchee, Wash.

Apr. 1995. Invited speaker, Oregon State Univ. Dept of Fisheries and Wildlife Seminar, Corvallis, OR

Apr. 1995. Invited speaker, American Fisheries Society North Pacific International Chapter, Annual Meeting, Vancouver B.C., Can.

Mar. 1995. Invited speaker, American Fisheries Society Idaho Chapter Annual Meeting, Boise, ID.

Nov. 1994. Invited speaker, President's Council on Sustainable Development Workshop, Yakima, WA.

Sept. 1994. Invited speaker, Oregon Water Resources Research Institute Streambank Restoration Conference: "Biological Methods to Stabilize Streambanks--From Theory to Practice," Portland, OR.

Mar.-April, 1994. Peer-reviewer for Henjum et al., 1994. Interim Protection for Late Successional Forests, Fisheries, and Watersheds: National Forests East of The Cascade Crest, Oregon and Washington. The Wildlife Soc., Bethesda, MD.

Jan. 1993-Sept. 1995. Member, Oregon Department of Environmental Quality's (ODEQ) Technical Advisory Committee for Triennial Review of the State Water Temperature Standard.

Mar. 1993. Invited speaker, Northwest Scientific Association Symposium: "Cumulative Effects of Land Management Practices on Anadromous Salmonids," La Grande, OR.

Aug. 1992 - Sept. 1992. Member, Ad Hoc Consultant Selection Committee for Portland Water Bureau Study of Future Water Supply Needs.

May 1992. Invited Speaker, US Forest Service, Pacific Northwest Region, Regional Workshop on Monitoring Soil and Water Resources, Bend, OR.

May 1992. Invited Speaker, Northern Arizona University, School of Forestry, Graduate Seminar Series, Flagstaff, AZ.

Jan. 1991 - Mar. 1995. Member, Technical Work Group: Upper Grande Ronde River Anadromous Fish Habitat Protection, Restoration and Monitoring Plan.

Aug. 1989 - Feb. 1990. Member, Technical Advisory Committee to ODEQ for development of definitions for level of beneficial use impairment by nonpoint sources.

May 1989 - Jan. 1991.Member, Nonpoint Source Technical Advisory Committee to Idaho Department of Environmental Quality: Coordinated Nonpoint Source Monitoring Program For Idaho.

## PUBLICATIONS

Peer-Reviewed:

Rhodes, J.J., C.M. Skau, and W.M. Melgin, 1984. Nitrate-nitrogen flux in a forested watershed -- Lake Tahoe, USA. In: Recent Investigations in the Zone of Aeration, Proc. of Inter. Symp., Munich, West Germany, 1984, P. Udluft, B. Merkel, and K. Prosl (Eds), pp. 671-680.

Rhodes, J.J., 1985. A Reconnaissance of Hydrologic Transport of Nitrate in An Undisturbed Forested Watershed Near Lake Tahoe. M.S. thesis, Univ. of Nev. Reno, 254 pp.

Rhodes, J.J., C.M. Skau, and J.C. Brown, 1985. An areally intensive approach to hydrologic nutrient transport in forested watersheds. In: The Forest-Atmosphere Interaction, B.A. Hutchison and B.B. Hicks (Eds), pp. 255-270.

Rhodes, J.J., C.M. Skau, D. Greenlee, and D.L. Brown, 1985. Quantification of nitrate uptake by riparian forests and wetlands in an undisturbed headwaters watershed. US Forest Service Gen. Tech. Rept. RM-120.

Rhodes, J.J., C.M. Skau, and D. Greenlee, 1986. The role of snowcover on diurnal nitrate concentration patterns in streamflow from a forested watershed in the Sierra Nevada, Nevada, USA. In: Proc. of AWRA Symposium: Cold Regions Hydrology, Fairbanks Alaska, 1986, D.L. Kane (Editor), pp. 157-166.

Rhodes, J.J., R.L. Armstrong, and S.G. Warren, 1987. Mode of formation of "ablation hollows" controlled by dirt content of snow. J. Glaciology, **33**: 135-139.

Edmonds, R.L., T.B. Thomas, and J.J. Rhodes, 1991. Canopy and soil modification of precipitation chemistry in a temperate rain forest. Soil Soc. of Amer. J., **55**: 1685-1693.

Rhodes, J.J., McCullough, D.A., and Espinosa Jr., F.A., 1994. A Coarse Screening Process for Evaluation of the Effects of Land Management Activities on Salmon Spawning and Rearing Habitat in ESA Consultations. CRITFC Tech. Rept. 94-4, Portland, OR

Rhodes, J.J. 1995. A Comparison and Evaluation of Existing Land Management Plans Affecting Spawning and Rearing Habitat of Snake River Basin Salmon Species Listed Under the Endangered Species Act. CRITFC Tech. Rept. 95-4, Portland, OR

Rhodes, J.J. 1996. Description and Evaluation of Some Available Models for Estimating the Effects of Land Management Plans on Sediment Delivery, Channel Substrate, and Water Temperature, CRITFC, Portland, OR

Espinosa, F.A., Rhodes, J.J., and McCullough, D. A. 1997. The failure of existing plans to protect salmon habitat on the Clearwater National Forest in Idaho. J. Env. Manage: 49: 205-230.

Rhodes, J.J., and Purser, M.D., 1998. Overwinter sedimentation of clean gravels in simulated redds in the upper Grande Ronde River and nearby streams in northeastern Oregon, USA: Implications for the survival of threatened spring chinook salmon, Forest-Fish Conference: Land Management Affecting Aquatic Ecosystems, Proc. Forest-Fish Conf., May 1-4, 1996, Calgary, Alberta, Canada. Nat. Resour. Can., Can. For. Serv. Nort. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-356, pp: 403-412.

Beschta, R.L., Rhodes, J.J., Kauffman, J.B., Gresswell, R.E, Minshall, G.W., Karr, J.R, Perry, D.A., Hauer, F.R., and Frissell, C.A., 2004. Postfire Management on Forested Public Lands of the Western USA. Cons. Bio., 18: 957-967. http://pacificrivers.org/files/post-fire-management-and-sound-science/Beschta-etal2004.pdf

Karr, J.R., Rhodes, J.J., Minshall, G.W., Hauer, F.R., Beschta, R.L., Frissell,C.A. Perry, D.A, 2004. Postfire Salvage Logging's Effects on Aquatic Ecosystems in the American West. BioScience, 54: 1029-1033. http://www.earthjustice.org/library/reports/the-effects-of-positive-salvage-logging.pdf

Rhodes, J.J. and Odion, D.C., 2004. Comment Letter: Evaluation of the Efficacy of Forest Manipulations Still Needed. BioScience, 54: 980.

Rhodes, J.J., 2005. Comment on "Modeling of the interactions between forest vegetation, disturbances, and sediment yields" by Erkan Istanbulluoglu et al. J. Geophys. Res. Earth Surf., Vol. 110, No. F1, F01012 10.1029/2004JF000240

Rhodes, J.J., 2007. The Watershed Impacts of Forest Treatments to Reduce Fuels and Modify Fire Behavior. Pacific Rivers Council, Eugene, OR

Rhodes, J.J. and Baker, W.L., 2008. Fire probability, fuel treatment effectiveness and ecological tradeoffs in western U.S. public forests. Open Forest Science Journal, 1: 1-7.

Beschta, R.L., Donahue, D.L., DellaSala, D.A., Rhodes, J.J., Karr, J.R., O'Brien, M.H., Fleischner, T.L., and Deacon-Williams, C., 2013. Adapting to Climate Change on Western Public Lands: Addressing the Ecological Effects of Domestic, Wild, and Feral Ungulates. Env. Manage. 57: 474-491 doi 10.1007/s00267-012-9964-9.

Beschta, R.L., Donahue, D.L., DellaSala, D.A., Rhodes, J.J., Karr, J.R., O'Brien, M.H., Fleischner, T.L., and Deacon-Williams, C., 2014. Reducing Livestock Effects on Public Lands in the Western United States as the Climate Changes: A Reply to Svejcar et al. Env. Manage. 53:1039-1042. doi:10.1007/s00267-014-0263-5.

Rhodes, J.J., and Frissell, C.A., 2015. The High Costs and Low Benefits of Attempting to Increase Water Yield by Forest Removal in the Sierra Nevada. Environ. Now, Los Angeles, CA

Technical Reports:

1986. Annual Report on Watershed Studies at Olympic National Park. College of Forestry, Univ. of Wash., Seattle, Wash. (Co-authors: R.L. Edmonds, T.B. Thomas, T.W. Cundy)

1987. Annual Report on Watershed Studies at Olympic National Park. College of Forestry, Univ. of Wash., Seattle, Wash. (Co-authors: R.L. Edmonds, T.B. Thomas, T.W. Cundy)

1988. Annual Report on Watershed Studies at Olympic National Park. College of Forestry, Univ. of Wash., Seattle, Wash. (Co-authors: R.L. Edmonds, T.B. Thomas, T.W. Cundy)

1989. Annual Report on Watershed Studies at Olympic National Park. College of Forestry, Univ. of Wash., Seattle, Wash. (Co-authors: R.L. Edmonds, T.B. Thomas, T.W. Cundy)

1990. Coordinated Nonpoint Source Monitoring Program For Idaho. Idaho Dept. of Environmental Quality, Boise, Idaho. (Co-authors: B. Clark, D. McGreer, W. Reid, T. Burton, W. Low, I. Urnovitz, D. McCullough, T. Litke)

1992. The Upper Grande Ronde River Anadromous Fish Habitat Protection, Restoration and Monitoring Plan. Wallowa-Whitman National Forest, Baker, OR (Co-authors: M. Purser, P. Boehne, R.E. Gill, R.L. Beschta, J.R. Sedell, B. McIntosh, J. Zakel, J.W. Anderson, D. Bryson, S. Howes, R. George).

1992. Salmon Recovery Program for the Columbia River Basin: An Advisory Report for the US Congress, Col. Riv. Inter-Tribal Fish Comm., Portland, OR (Co-authors: P.R. Mundy, D.A. McCullough, M.L. Cuenco, T.W. Backman, D.Dompier, P. O'Toole, S. Whitman, E. Larson, B. Watson, G. James).

1993. A comprehensive approach to restoring habitat conditions needed to protect threatened salmon species in a severely degraded river--The Upper Grande Ronde River Anadromous Fish Habitat Protection, Restoration and Monitoring Plan. USFS Gen. Tech. Rept RM-226, pp. 175-179. (Co-authors: J.W. Anderson, R.L. Beschta, P. Boehne, D. Bryson, R.E. Gill, S. Howes, B. McIntosh, M.D. Purser and J. Zakel).

1993. Dante's Video Guide to Habitat Conditions for Wild Spring Chinook Salmon, Steelhead and Bull Trout in the John Day Basin, Oregon. (Video) Presented at AFS National Meeting, Portland, Or, Aug. 29-31. (Co-authors: R. Taylor and M. Purser).

1995. Wildfire and Salvage Logging: Recommendations for Ecologically Sound Post-Fire Salvage Logging and Other Post-Fire Treatments on Federal Lands in the West. Pacific Rivers Council, Portland, OR (Co-authors: R. Beschta, C. Frissell, R. Gresswell, R. Hauer, J. Karr, G. Minshall, D. Perry).

1998. Adaptive management: Is it really adaptive? Abstracts: Oregon AFS Annual Meeting, Feb. 11-13, 1998, p. 31.

1998. Thinning For Increased Water Yield in the Sierra Nevada: Free Lunch or Pie in the Sky? Pacific Rivers Council, Eugene, OR. (Co-author: M. Purser)

1999. Annual Project Report: Watershed Evaluation and Aquatic Habitat Response to Recent Storms. Bonneville Power Administration (BPA), Portland, OR. (Co-author: C. Huntington)

1999. Annual Project Report: Monitoring Fine Sediment in Salmon Habitat in John Day and Grande Ronde Rivers. BPA, Portland, OR (Co-author: M. Purser)

2000. Annual Project Report: Watershed Evaluation and Aquatic Habitat Response to Recent Storms. BPA, Portland, OR. (Co-author: C. Huntington)

2000. Annual Project Report: Monitoring Fine Sediment in Salmon Habitat in John Day and Grande Ronde Rivers. (Co-author: M. J. Greene)

2001. Annual Project Report: Monitoring Fine Sediment in Salmon Habitat in John Day and Grande Ronde Rivers. BPA, Portland, OR. (Co-author: M. J. Greene)

2001. Imperiled Western Trout and the Importance of Roadless Areas. Western Native Trout Campaign, Center for Biological Diversity, Tucson, Az. (Co-authors: J. Kessler, C. Bradley, and J. Wood)

2002. Tryon Creek Watershed: Overview of Existing Conditions, Data Gaps, and Recommendations for the Protection and Restoration of Aquatic Resources. West Multnomah Soil and Water Conservation District, Portland, OR

2002. An Analysis of Trout and Salmon Status and Conservation Values of Potential Wilderness Candidates in Idaho and Eastern Washington. Western Native Trout Campaign, Center for Biological Diversity, Tucson, AZ. (Co-authors: C. Bradley, J. Kessler, C. Frissell)

2003. Stream and Fish Habitat Conditions in Tryon Creek: Their Likely Causes and Ramifications for Salmonids. Proceedings of Urban Ecology and Conservation Symposium, January 24, 2003, Portland, OR. Portland State University, Environmental Sciences and Resources, Portland, OR

2008. Primary Sources of Fine Sediment in the South Fork Stillaguamish River. Interim progress report for Washington State Salmon Recovery Funding Board, Olympia, WA. Snohomish County Public Works Surface Water Management, Everett, WA. (Co-authors: M. Purser, B. Gaddis, S. Britton, T. Coburn, and M. Rustay)

2009. Primary Sources of Fine Sediment in the South Fork Stillaguamish River. Project completion report for Washington State Salmon Recovery Funding Board, Olympia, WA. Snohomish County Public Works Surface Water Management, Everett, WA. (Co-authors: M. Purser, B. Gaddis)

2014. Conservation of aquatic and fishery resources in the Pacific Northwest: Implications of new science for the Aquatic Conservation Strategy of the Northwest Forest Plan. http://www. coastrange. org. (Co-authors: Frissell, C.A., Baker, R.J., DellaSala, D.A., Hughes, R.M., Karr, J.R., McCullough, D.A., and others)

Semi-Technical Publications:

1993. Dam the analysis--heal streams instead. The Assoc. of Forest Service Employees for Env. Ethics Inner Voice, **5**(6): 1, 4-5.

1994. Invited Preface to Northwest Science Special Issue--Environmental History of River Basins in Eastern Oregon and Washington. Northwest Sci., **68**.

## PROJECT MANAGEMENT

1993-1996. Technical Assistance Contract with NMFS to produce technical guidance for ESA consultations for effects of land management on critical habitat for listed Columbia basin salmon. Main duties: Co-Primary Investigator; primary author of peer-reviewed reports including proposed ESA consultation guidelines for effects on salmon habitat (Rhodes et al., 1994), evaluation and comparison of compatibility of land management plans with protection of critical salmon habitat (Rhodes, 1995), and evaluation of models for estimating land management effects on salmon habitat (Rhodes, 1996); review and synthesis of available scientific literature; budget preparation and tracking; coordination with subcontractors and grantor representatives. Total budget: $230,000.

1998-2000. Watershed Evaluation and Aquatic Habitat Response to Recent Storms. Main duties: Primary Investigator; design and implementation of monitoring methods, coordination of technical staff in 10 watersheds with differing levels of grazing and logging in 3 subbasins in Idaho, Washington, and Oregon; technical training; data analysis; contract administration; proposal development; report preparation; budget development and tracking; coordination with grantor representatives. Total budget: $164,000.

1998-2000. Evaluation of Effects of Grazing on Rate of Salmon Habitat Recovery. Main duties: Primary Investigator; design and implementation of monitoring methods, training of field technician; data analysis and synthesis; proposal development; preparation of progress reports; budget development and tracking; coordination with grantor representatives. Total budget: $73,000.

1998-2001. Monitoring Fine Sediment Levels in Salmon Habitat in Grande Ronde and John Day Rivers. Main duties: Primary Investigator; design and implementation of methods for monitoring fine sediment levels in four rivers; field technician training; data analysis and synthesis; subcontract administration; proposal development; progress and technical report preparation; budget development and tracking; coordination with grantor representatives. Total budget: $128,000.

2001-2002. Western Native Trout Campaign, Aquatic Scientist and Coordinator. Main duties: Oversight and scientific integrity assurance for all work products; coordinate conservation efforts among campaign member organizations and other groups working to protect and restore trout habitats and populations; reporting; and, budget tracking. Total budget: ca. $1,000,000.

## HONORS AND AWARDS

1996. Leadership and Excellence. Col. River Inter-Tribal Fish Comm., Portland, OR

1991. Employee of the Year. Col. River Inter-Tribal Fish Comm., Portland, OR

1984. Academic Recruitment Scholarship for Outstanding Graduate Prospect. Univ. of Wash, Seattle, Wash.

1982. Maxey Award -- Outstanding Graduate Student Paper in Hydrology. Univ. of Nev.-Reno.

1980. Winslow and Myron Reuben Scholarship for Outstanding Undergraduate in the Earth Sciences. Univ. of Ariz., Tucson, Az.

## ADDITIONAL TRAINING

1993. USFWS Water Temperature Modeling via SNTEMP

1991. USFWS Introduction to IFIM Investigations