

Title: Natural Variability in Water Quality and Changes after Forest Harvest in the Trask Watershed

Investigators:

PI: Jeff Hatten, OSU FERM; Co-PIs: Alba Argerich, OSU FERM, Sherri Johnson, PNW.
Kevin Bladon, OSU FERM has joined the team as Casey Steadman co-advisor

Project duration:

July 1, 2014 – June 30, 2016

Objectives:

To improve the current understanding of patterns and causes of variability in water quality across forest watershed landscapes we will characterize natural and post-disturbance variability in stream nutrients at the Trask River watershed. Specifically, we will:

- Characterize variability in background nutrient concentrations across time, by analyzing water chemistry samples collected over the pre-harvest period, and across space, by comparing water chemistry data across sub-catchments.
- Analyze responses in nutrient concentrations to forest harvest by comparing pre- and post-harvest nutrient concentrations.
- Compare pre- and post-harvest data to nutrient criteria under consideration for this ecoregion.

Summary of accomplishments toward objectives over past year:

- We have integrated hydrology data with water chemistry data to explore patterns of nutrient transport (Fig. 1).
- Storm water samples collected over the duration of the Trask study (2010-2016) have been started to be analyzed to expand the database of water chemistry.

Problems, barriers, proposed changes to objectives:

The analysis of the complete set of storm water samples has been delayed until next spring due to the moving of the laboratory where we are analyzing all of our samples (the COLLAB) during Peavy remodel.

Comprehensive summary of project results and impacts over life of project:

Preliminary data analysis reveal that nutrients surpass proposed criteria throughout the year with at least 57% of analyzed samples surpassing Total Nitrogen (TN) proposed criteria of 0.12 mg L^{-1} and at least 88% surpassing Total Phosphorus (TP) proposed criteria of 0.010 mg L^{-1} (Fig. 1) Maximum concentrations were generally observed in winter months for TDN while the opposite was true for TDP, indicating distinct drivers of temporal variability for each nutrient. Spatial variability (Fig. 2) is observed among the four catchments as Upper Main Creek had the lowest median concentrations of TDN (0.100 mg L^{-1}) and TDP (0.009 mg L^{-1}) while Pothole Creek had the highest median concentrations of TDN (0.170 mg L^{-1}) and TDP (0.043 mg L^{-1}). Additionally, Pothole Creek surpassed proposed criteria most frequently with at least 76% and 95% of samples exceeding TN and TP proposed criteria, respectively. The highest

concentrations of both TDN and TDP have generally been observed in Pothole Creek, which is underlain by highly erodible volcanoclastic geology and characterized by the presence of swampy areas. In Pothole Creek, higher concentrations and greater variability of nitrate were observed during the rising limb of the annual hydrograph compared to the falling limb while orthophosphate showed little variability or change in magnitude when comparing rising and falling limb concentrations (Fig. 3) indicating different drivers for nitrogen and phosphorus. The trends observed in Pothole Creek were representative throughout all sub-catchments. For a more expanded results see the attached posters.

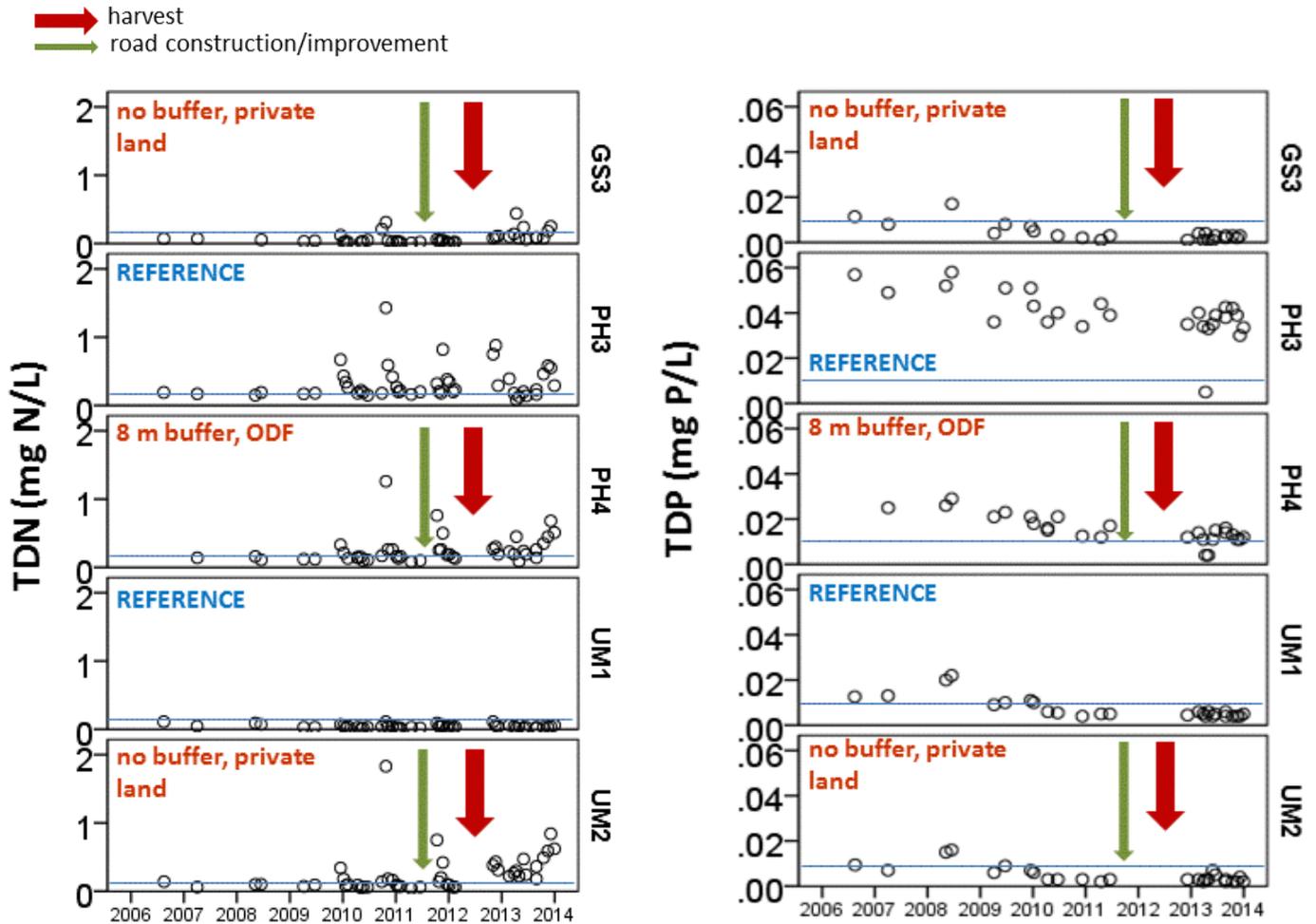


Figure 1. Variability in total dissolved nitrogen (TDN) and total dissolved phosphorus (TDP) in five Trask watersheds. Green arrows indicate road construction/improvement, red arrows indicate forest harvest period, and blue horizontal lines indicate proposed nutrient reference criteria for the ecoregion.

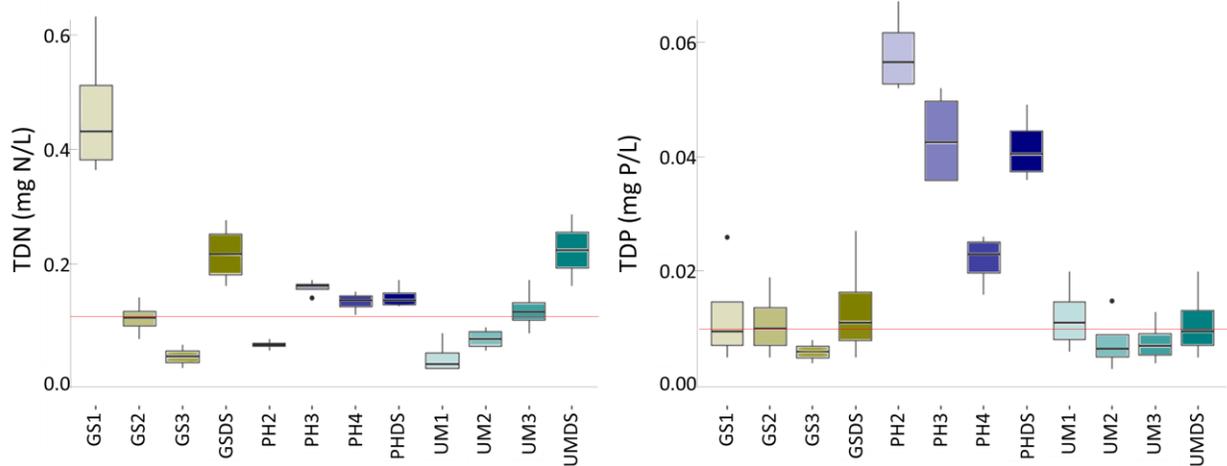


Figure 2. Total dissolved nitrogen (TDN, mg N/L) and Total dissolved phosphorus (TDP, mg P/L) concentrations for each catchment during spring (April-May) before harvest and road improvement (2007-2010). EPA proposed criteria are indicated by solid red line.

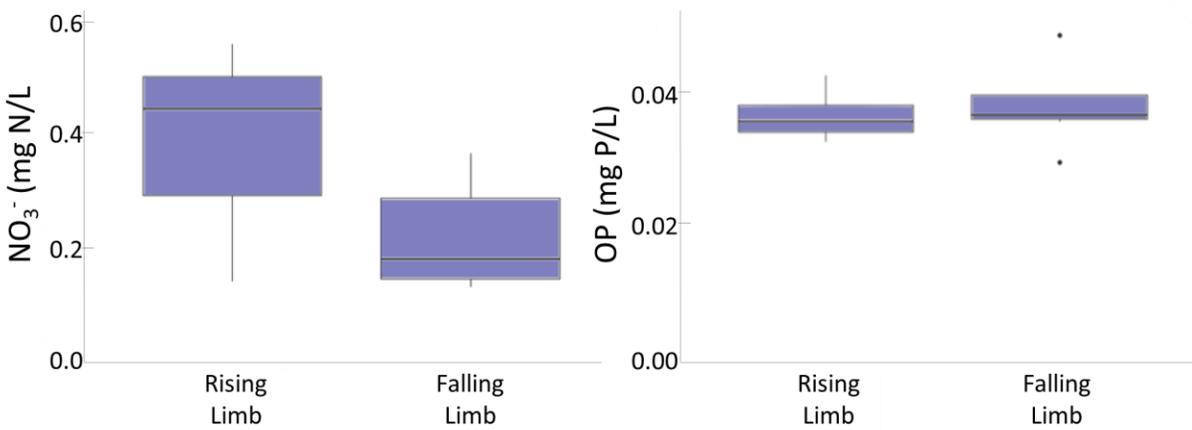


Figure 3. Orthophosphorus (OP, mg P/L) and nitrate (NO_3^- , mg N/L) concentrations during the rising limb (RL) and falling limb (FL) of the annual hydrograph during 2010 in Pothole watershed (RL n=4, FL n=7).

List of names and brief overview of graduate and/or undergraduate engagement in project:

- Casey Steadman, a PhD candidate, has joined the team on summer 2015. She has been processing and analyzing samples collected during water year 2015 and will continue analyzing the samples collected for water year 2016. During her PhD she will study the fundamental processes and principles of water and nutrient movement through forested watersheds and how these may be impacted by land management activities using data from the Trask Watershed.
- Noah Kanzig, an undergraduate student in the Mentored Employee Program, assisted with acid washing and inventory and organization of stored samples.
- Margaret McCormick, undergraduate student worker, assisted with acid washing and digestion procedures of samples for water chemistry analysis.

List of presentations, posters, etc.:

Steadman, C. L., K. D. Bladon, A. Argerich, and S. L. Johnson. Spatial and temporal variability of nitrogen and phosphorus in headwater catchments of the Northern Coast Range of Oregon. The Pacific Northwest Water Research Symposium, Corvallis, OR. April 2016

Steadman, C. L., A. Argerich, K. D. Bladon, and S. L. Johnson. Spatial and seasonal patterns in nutrient concentrations in mountainous headwater streams in Oregon. The Western Forestry Graduate Research Symposium, Corvallis, OR. April 2016

Steadman, C. L., K. D. Bladon, A. Argerich, and S. L. Johnson. Early trajectory of chemical water quality response to disturbance by forest harvesting in the Northern Coast Range of Oregon. The Society for Freshwater Science Conference, Sacramento, CA. May 2016

Steadman, C. L., K. D. Bladon, A. Argerich, and S. L. Johnson. Spatial and temporal heterogeneity of nitrogen in forested headwater catchments of the northern Coast Range of Oregon. The American Geophysical Union Fall Meeting, San Francisco, CA, December 2016

List of publications, thesis citations:

Steadman, C. L. Spatiotemporal Variability of Nitrogen and Phosphorus in Forested Watersheds: a Concurrent Modeling Approach, PhD dissertation, Dept. of Forest Engineering, Resources and Management, College of Forestry, Oregon State University, Corvallis, Oregon

Steadman, C. L., Argerich, A., Bladon, K., and Johnson, S. Natural variability of nutrients and response to contemporary forest practices in Oregon Coast Range watersheds. Journal TBD.