

# Riparian Buffers: Function, Management, and Economic Implications for Agriculture

## Summary

During the year, the project has progressed significantly. In January, we used the USDA SARE project to leverage \$50,000 from Washington State University and a mature native forest buffer site was added to the project. Work completed this year included determination of the direction of ground water flow at our three buffer sites, installation of a total of 120 piezometers for ground water sampling, 255 soil water samplers and 93 tensiometers, the experimental buffer plots were established, ground water was sampled for two months, economic modeling for potato, blueberry, and raspberry farms was conducted, and the project website was completed.

## Objectives/Performance Targets

Our goal is to identify what constitutes a functional riparian buffer to protect water quality and improve salmon habitat on agricultural land in western Washington, and to determine the economic impact of such buffers on farm enterprises. Specific objectives include: 1) To determine the effects of buffer width, species composition and management on buffer function including nutrient removal, sediment reduction, shade, and bank stabilization; 2) To conduct economic impact analysis of different riparian buffer designs on individual farm enterprises; and 3) To develop and disseminate buffer recommendations and decision-making tools to farmers, farm agencies, regulators and policy makers dealing with farmland along watercourses in western Washington.

## Accomplishments/Milestones

### Leveraged Funding

In January 2004, a proposal was written and submitted to Washington State University College of Agriculture and Human Economics Safe Food Initiative Supplemental Funding Program. We were awarded \$50,000 for 2004 and 2005 that allowed us to add back one of two buffer sites we had to cut due to reduced SARE funding in 2003. The buffer added is a natural 50-60-year old riparian forest dominated by a mixture of black cottonwood (*Populus trichocarpa*) and red alder (*Alnus rubra*) situated on the DeVries farm between the Skagit River and an adjacent pasture receiving repeated manure application.

### Accomplishments/milestones under Objective 1

#### Experimental buffer establishment:

1) In March, the experimental buffer site was cleared of debris and weeds including Reed canarygrass and Himalayan blackberry were treated with glyphosate. The following month, two buffer plots (each plot measured 100' by 50') consisting of hybrid poplar cuttings and two buffer plots consisting of bare-root red alder seedlings were planted. A total of 300 trees per species were planted at a 7' by 7' in an offset pattern. At that same time, two additional plots were raked and then seeded with perennial rye grass. Throughout the summer, the tree plots were kept free of weed competition by a combination of mowing and herbicide application. The grass plots were periodically mowed when the grass exceeded 12-16" in height. The grass clippings were left on the plots. The trees survived and grew well with the exception of the first row along the creek, which was under water during most of June. These will be replanted in April 2005. As of November, the average height of the alder was 5 feet with individual trees being well over 7 feet tall. Nearly all of the poplar trees had been clipped by beaver (see below).

2) In May, beaver activity was observed on the tree plots. In an attempt to protect the trees from the beaver, a 600' long fence (4' high) was installed along the edge of the stream. While the fence appeared to deter the beavers, during several floods when the creek level topped the fence, beaver came in and clipped most of the poplar trees. A trapper was hired in November to reduce the beaver population along this reach of the Nookachamps Creek. The poplar plots will

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be replanted in April 2005 with 6' whips and individual polyethylene tree protectors. The alder plots for the most part were unaffected by the beaver.

#### Instrumentation

1) Using piezometers installed in the fall of 2003 at Bayview Farm and DeVries Farm, water table depth was measured weekly by students at Skagit Valley College from January through March 2004. These data were then used to determine flow direction of ground water through our proposed buffers (see Appendix A), allowing us to install sampling piezometers in transects parallel to ground water flow.

2) In August after determining direction of ground water flow and when the water table was at its annual minimum, transects were laid out and a total of 120 piezometers were installed at the 3 buffer sites (78 at the DeVries Experimental Buffer site, 15 at the DeVries Mature Buffer site and 27 at the Bayview Farm site), ranging in depth from 5 feet to 25 feet. The piezometers were installed with a 4" diameter soil bucket auger and each hole was dug to the depth of the water table. Two-inch diameter PVC well pipe was then installed with a 5' capped screen at the bottom and then sealed with sand and the top of the well sealed with a layer of bentonite. Each piezometer was sealed with a compression plug and labeled with an aluminum tag.

3) Piezometer samplers were designed and tested during August and early September followed by the construction of 6 kits for use by WSU personnel and Skagit Valley College students.

4) In late October 3 Skagit Valley College students and their instructor were trained to collect water samples from the piezometers and in early November, a full set of 120 water samples were collected and sent to WSU-Pullman for nutrient analysis. The December samples were also collected, but due to flooding, sampling took place over a period of two weeks.

5) A total of 93 soil tensiometers and 255 soil water samplers were installed at the 3 buffer sites in December. Sampling of soil water will start in January 2005.

#### Impact and contributions/outcomes of these activities:

With the completion of the installation of the experimental buffer along with the sampling devices at all 3 buffer sites, we will start gathering data on nutrient movement from agricultural land through our three buffers. We will collect water samples from both the piezometers and soil water samplers on a monthly basis from March – June and September – December, coinciding with months of maximum rainfall and hence greatest potential for nutrient movement. Currently, there are no data about buffer uptake of nutrients by different buffer types on low gradient streams in the Pacific Northwest.

#### Shade modeling:

1) In June, we met at and toured the buffer sites with Jason Cross, Shade model specialist at the University of Washington's Rural Technology Initiative, to discuss project shade modeling needs.

2) During the fall we developed and refined a proposal written by Jason Cross to calculate amount of shade cast by riparian poplar buffer during the course of the growing season, both on the adjacent crop and on the stream bank. Shade production by the buffer can potentially influence solar radiation (temperature) of the adjacent stream and growth, yield, and health conditions of the adjacent crop.

3) In December, we finalized the proposal and contracted with Jason Cross for shade model development to begin in January 2005. The modeling exercise should be completed in two months after it begins. Model verification using a Solar Pathfinder will take place in the summer 2005.

Impact and contributions/outcomes of these activities: Once the shade model has been developed, it will be applied at each of buffer sites during the 2005-growing season. The information generated by this model will help growers assess the impacts of buffer shade on crop production. Shade production information will also be helpful to regulators in assessing the efficacy of buffer placement and size for optimal stream benefit. Site specific, experimental research-based data are not currently available for shade production from buffers in the Pacific Northwest.

## Accomplishments/milestones under Objective 2

### Buffer economic impact analysis:

- 1) Cost data was collected for installation of the experimental buffer plots at DeVries farm. These costs were applied to the economic modeling efforts described below.
- 2) Three economic models were initiated and completed to draft stage. These models evaluate the economic impact of different riparian buffer designs and widths on farm enterprise net return for potato, blueberry, and raspberry farms in the Skagit. The potato model is scheduled for field verification ("debugging") with two potato growers in early January, to be followed by 4 case study analyses in Jan-February 2005. Raspberry and Blueberry models will be field verified with local growers in January-February, 2005, and case study analyses conducted in March 2005. Final case study analysis report is scheduled for completion in Summer 2005.
- 3) An economic evaluation of the hybrid poplar buffer (Bayview Farm site) was finalized. PIs Henri and Johnson wrote a manuscript based on the results of this evaluation and was submitted for publication to Journal of Soil and Water Conservation in October 2004.

Impact and contributions/outcomes of these activities: The finished models and user instructions will be available for download from the project website in 2005. Individual farmers can use these models to assess their own farm and the viability of adding conservation buffers to their operation. Publication of the article will add to the limited body of literature concerning the economic viability of riparian buffers.

## Accomplishments/milestones under Objective 3

### Develop and disseminate buffer recommendations and decision-making tools:

- 1) In April, Dr. Johnson hosted a field tour of the Bayview Farm site for a group of 35 University of Washington students (and their instructors) enrolled in a Junior-level course dealing with issues facing natural resource professionals. The role of riparian buffers in the landscape was discussed as was issues of the impact of buffers on farming.
- 2) Drs. Johnson and Henri gave presentations at the AWRA national riparian buffer conference in Lake Tahoe, CA in June 2004 regarding general project design, and economic analyses, respectively. Contacts were made with other PIs conducting similar research in other parts of the US.
- 3) Project website was designed, populated with content and placed on line in summer 2004. It will be the repository for all data, photos, and information generated by the project, as well as a dynamic, online resource for the farming, schools and general public communities to learn more about riparian buffers on farmland. New website content and expansion of web pages is scheduled for early 2005. The website address is:  
<http://www.puyallup.wsu.edu/agbuffers/>.
- 4) A partnership was formed with WSU Mount Vernon Extension Staff to help develop and implement project outreach and extension activities. Key WSU extension staff was given introductory tours of the research sites.
- 5) An initial extension, outreach and education programming schedule has been developed for 2005-2006, and includes:
  - A. Education programs at the buffer sites, targeted to specific farming sub-groups
  - B. Integration of buffer studies and research data into the Mt. Vernon High School and Elementary School science curriculum, coupled with hands-on field trips to the buffer sites.
  - C. PI presentations of project progress and results as they become available, to producer groups. Scheduled for the winter months in 2005 and 2006.
- 6) Additional outreach activities in addition to those above are being explored for 2005 and 2006.

Impact and contributions/outcomes of these activities: Field visits and workshops at the buffer sites will help replace preconceived ideas about riparian buffers with real data. This will enable farmers as well as policy makers and regulators to make more informed choices about conservation buffers. Integration of the buffer research sites into the elementary education

curriculum will give students a basic knowledge of riparian buffer principles based on actual field data and visits to the research sites. Presentations by PIs to the farming community will create better awareness of the information being generated by the project

## **Impacts and Contributions/Outcomes**

How the project will increase producer knowledge base: On-farm demonstration sites showing function and management techniques for different buffer designs and economic impacts will enable farmers to gain first-hand knowledge of different riparian buffer alternatives. This will allow them to make informed decisions regarding sustainable agricultural practices on their own farms.

What information will be disseminated and to whom: We will develop written, visual and web-based media for students, teachers, landowners, land management/regulatory staff and conservation groups. Specific information will include effectiveness of buffer size, species composition and management in removing sediment and nutrient flowing into adjacent watercourses, as well as how effectively the different designs meet buffer function for salmon habitat. Educational material regarding technical findings of the study, economic impact findings, and economic evaluation software will be distributed to 600 farmland owners. Two seminars covering economic results of the study and use of the buffer evaluation software will be held for 50 farmland owners.

Outreach activities will be coordinated with WSU Cooperative Extension Skagit County and Skagit Valley College, both of which currently have outreach programs for farm owners in Skagit County. Specifically, these institutions will assist in recruiting attendees, providing facilities for conferences and workshops, and coordinating/facilitating local events. Broader outreach to the wider community and interested parties will include peer-reviewed publications and articles in local extension publications, as well as the Capital Press and the Skagit Valley Herald. A series of field days that will reach approximately 100 farm owners, and an end-of-project water quality conference for approximately 200 landowners and other interested parties will be held.

The measurable number of acres or animals that will be impacted: This research will be relevant to 19 western Washington counties that practice agriculture in riverine flood plain areas. This includes 213,000 acres of cropland (1999) and 406,000 head of livestock (1999). This research will also be relevant for commercial plant nurseries and western Oregon agriculture.

The measurable economic impact (in estimated \$) to farm and ranch families and communities: One of the objectives of the study is to estimate the economic impact of installing riparian buffers on agricultural land, which is presently unknown. All of Washington State is subject to new agricultural regulations designed to recover endangered salmonid populations, and potential economic impact is large: Washington's 1999 agricultural production totaled \$5.3 billion.