Habitat Farming Enterprise Program Economic Remuneration

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1 1Executive Summary

As part of the Entiat Valley Habitat Farming Enterprise Program ("HFEP"), Six Mile Consulting Group has developed a remuneration model for estimating the opportunity, installation and maintenance costs of converting commercially viable orchard into riparian buffer zone.

This report explains both how to use the model and the economic theory underlying the model's structure. This report also provides a background on the HFEP, a summary of the economic and legal concerns facing its successful implementation, as well as a list of potential funding sources for the HFEP.

Summary of Modeling

We were fortunate to be provided data on a number of tree fruit orchards in the Wenatchee region. For obvious reasons, we were only allowed access to contract, cost, and revenue information with owner’s and renter’s names redacted. We do not know the location of any of the orchard leases, but we do know the crops, the acreage, and some financial information.

Using these data covering the years 2004-2007, we were able to estimate the opportunity cost of rental for tree fruit orchard land. We used gross revenues and total costs to obtain net income from tree fruit farming across several crops: apples, pears, cherries, and apricots. Each of these contracts was a revenue sharing rental. Rental rates varied from a low of 20 percent of net income to a high of 40 percent of net income.

Assuming that these revenues could be obtained for long periods of time, we capitalized the value of the rental flows, assuming that the land had no alternative superior use. We averaged the rental rates across crops and across years. The average rental rate per acre for all the data, all crops, all years was $1,531 per acres per year. This annual rental rate maps into a capitalized land valuation of $15,306 at 10 percent and $19,132 at 8 percent.

These valuations differ across crops. We averaged across years and adjusted for inflation from the 2004-08 period to the current time, 2009. In present value terms the land in our database upon which fruit was grown is worth approximately $15,757 (at 10 percent) and $19,697 (at 8 percent capitalization rate) per acre. However, it is important to note that there is considerable variance depending upon site specific factors. Some land we calculate is worth less than $10,000 per acre and some as much as nearly $50,000 per acre. One of the major reasons for this HFEP process is that various individuals – stakeholders, government agents, advocacy groups, landowners, and others – suspect that there is a superior use over orchards, such as buffer zones, riparian areas and/or some type of housing/industrial development, or other uses. And the developers have typically been more willing to pay or pay at a higher rate for their use. By this line of reasoning, there should be an extra financial incentive to participate in this program above the existing income potential for the orchard.

Additionally, to the direct lost opportunity of the land which might be converted to habitat farming, there are costs borne by habitat farmers which we have attempted to model. These include physical maintenance, tax consequences, impacts on remaining orchard trees, and similar effects. Using data from land conversions in California and Washington, we have attempted to assay these costs which we can then add to the raw land value. We estimate that these costs, in present value terms, sum to between $2,000 and $5,000 per acre depending on circumstances. These two values then, raw land plus maintenance, sum to create the proper economic remuneration for tree fruit farmers who convert to conservation habitat.

Based on our research to date, we estimate that each acre of tree fruit taken out of production, placed into riparian habitat production, and maintained properly, is worth on average about $23,000 per acre, but the range is large and could go as high as approximately $60,000 per acre. Some land, apricot acreage to be precise, might be worth considerably less, but this begs for additional study.

2 Project Background

To understand the transition from growing fruit to growing fish, a general history of the region and its relationship with the endangered salmon species is needed. This section provides a basic history of the area of interest and illuminates important factors that influence this analysis.

2.1 The Upper Columbia

Since the major irrigation projects of the early 20th century, tree fruit has been the mainstay of Columbia River communities like Entiat, Washington. Indeed, nearby Wenatchee is known as the "Apple Capital of the World." With more than 170,000 acres of orchards along the foothills of the Cascade Mountains and over half the domestic apple production coming from Washington State, the reputation is appropriate.

The Upper Columbia River and encompassing sociopolitical atmosphere are changing. The region's beauty attracts retirees and vacationers from nearby Seattle. Second homes now occupy former apple and pear orchards, and second homeowners often complain about spray drift and noise from nearby orchards. Rising labor costs and increased competition from China, Europe, and South America have lowered some profit margins, making the potential profits from selling to a residential developer even more appealing.

Adding to the development and competition pressures, fewer children stay on the land to make careers in tree fruit production than did previously. Although tree fruit acreage increased seven percent between 1987 and 1997, most of that growth occurred in southern Washington, near the Oregon border, and most of that growth has slowed over the last ten years.[1] Simply put, the future of the Upper Columbia tree fruit industry is

[1] Elfving, D.C. 1997. "Trends in the Washington State Tree-Fruit Industry." *Acta Hort*. (ISHS) 451:31-44 http://www.actahort.org/books/451/451_1.htm.

uncertain. The 2006 Washington Fruit Census has more current data and is more indicative of the current situation.[2] The 2006 census shows that the Washington tree fruit acreage declined from approximately 255,000 acres to 241,000 acres between 2001 and 2006.[3] The decline in the Wenatchee district for that same period of time was more significant, about 20 percent.

2.2 The Threatened and Endangered Salmonids

Just as apples have grown to characterize the region, the anadromous fish that swim hundreds of miles to inland spawning grounds have also come to symbolize the Pacific Northwest and its abundant natural resources. Somewhat ironically however, the same factors that contributed to the success of the region's tree fruit industry also contributed to the decline in several fish populations. The most commonly cited factors include: the loss of spawning habitat and the effect of hydropower on migration routes to the spawning habitat. Other factors include: fishing pressure, both tribal and non-tribal, ocean conditions, and predators.

As a result of population decline, the National Marine Fisheries Service listed two Upper Columbia River salmonid species for protection under the Endangered Species Act; the Upper Columbia River spring-run Chinook salmon (*Oncorhynchus tshawytscha*) was listed as endangered on March 24, 1999 and the Upper Columbia River steelhead (*Oncorhynchus mykiss*) was listed as endangered on August 18, 1997. The steelhead was reclassified as threatened on January 5, 2006, but this reclassification was invalidated as the result of the *Trout Unlimited, et al. v. Lohn* decision on June 13, 2007.[4] The U.S. Fish and Wildlife Service listed the Columbia River bull trout (*Salvelinu confluentus*) as threatened on June 10, 1998.

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[2] *Washington Fruit Survey 2006,* Compiled by USDA/NATIONAL AGRICULTURAL STATISTICS SERVICE, Washington Field Office, Olympia, WA. Online at http://www.waclearinghouse.org/nonmembers/Fruittreesurvey2006.pdf.

[3] See table on page 7 of the *Washington Fruit Survey 2006*.

[4] Governor's Salmon Recovery Office, Salmon Recovery Regions, Upper Columbia River Salmon Recovery Region, http://www.governor.wa.gov/gsro/regions/upper.asp.

In response to these classifications, the state of Washington passed the Salmon Recovery Act which established five regional Salmon Recovery Boards.[5] The Upper Columbia River Salmon Recovery Board develops the Salmon Recovery Plan that most directly impacts the bull trout, steelhead, and spring Chinook salmon. The plan identifies habitat loss, hydropower, harvest and hatcheries – collectively known as the four H's – as the most significant causes of salmonid decline.[6]

The plan aims to 1) protect existing areas where high ecological integrity and natural ecosystem processes persist, 2) restore connectivity throughout the historical range, where feasible and practical, and 3) protect and restore riparian habitat along spawning and rearing streams and identify long-term opportunities for riparian habitat.[7] While the plan discusses the effectiveness of local community recovery programs,[8] these programs have yet to address the myriad economic constraints facing tree fruit farmers interested in improving riparian habitat. Even if they want to help the endangered salmonid species, keeping their orchards profitable and maintaining their rural lifestyle are of higher priority.

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5 Chelan County Natural Resources, Salmon Recovery Planning, http://www.co.chelan.wa.us/nr/nr_salmon_recovery_planning.htm.

6 Notices, Federal Register, Vol. 72, No. 194, Tuesday, October 9, 2007, 57305; see also News from NOAA, "NOAA Fisheries Service Releases Its Final Recovery Plan for Chinook and Steelhead on the Upper Columbia River," October 9, 2007, Contact: Brian Gorman.

7 Notices, Federal Register, Vol. 72, No. 194, Tuesday, October 9, 2007, at p. 57305-6.

8 "Private landowners have proactively implemented many habitat restoration, conservation, and enhancement activities voluntarily (outside of planning processes) and many local stakeholders are involved in local planning efforts." Upper Columbia River Salmon Recovery Plan, at p. 197.

2.3 Viewing Wildlife as an Asset

The Endangered Species Act (ESA) imposes tough restrictions on land deemed critical habitat.[9] We believe that when landowners figure a way to profit from the presence of an endangered species, or at least minimize the risks, they will view the species as an asset rather than a liability. Accordingly, those landowners will steward their property for the benefit of the species.[10]

Ray Sandidge is one such landowner. His family owns approximately 20 acres of pear and apple orchard along the Entiat River, a tributary of the Upper Columbia that provides prime spawning habitat for the endangered salmonid species. Rather than a potential liability, Sandidge sees opportunity in the endangered salmon species swimming through his land. He understands that society places a high value on the recovery of these three species – as evidenced by the amount of money invested in failed recovery programs.

Like most orchardists along the Entiat, Sandidge also understands that how he manages his riparian property in terms of salmonid spawning habitat could have significant effects on steelhead, spring Chinook, and bull trout numbers not only in the Upper Columbia Region but throughout much of the range of those species. In particular, by retiring riparian lands from apple and pear production and replacing the fruit trees with cottonwoods and other thick, overhanging trees and shrubs, the Entiat River orchardists think they might dramatically improve survival numbers. As it turns out, there is ample evidence to support this point of view.[11]

The farmers also realize that a riparian buffer zone would create or improve habitat for other wildlife such as mammals, amphibians, reptiles and birds.[12] But the orchardists need to be compensated for growing fish rather than fruit, for digging up their pear and apple

[9] Lueck, Dean, and Jeffrey A. Michael. 2003. "Preemptive Habitat Destruction under the Endangered Species Act." *J. of Law & Economics* 46(1): 27-60.

[10] See for instance T. Kennedy, W. Smathers, and R. Costa, "Market Incentives for Protecting Red-Cockaded Woodpecker Habitat," SRDC, MSU, online at http://srdc.msstate.edu/publications/230_habitat.pdf.

[11] Spence, B.C., G.A. Lomincky, R.M. Hughes, and R.P. Novitzki. 1996. *An ecosystem approach to salmonid conservation*. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, OR .

trees, and for managing the land for wildlife habitat; they hope to contract directly with those individuals and groups supporting salmonid recovery rather than enroll in a government program whose funding is subject to a dynamic political process. Growers also express concerns about long term funding commitments from individuals and groups supporting salmonid recovery. It also should be noted that removing orchard for riparian buffers beyond what growers are already doing stands to jeopardize the sustainability of the orchard and by doing so reduce the environmental benefits currently being provided by the orchard owner free of charge. What is critical is that the landowners have assurances that they will retain the legal right to return their riparian buffer to agricultural production if the funding source is lost in cases where the payment is not 100 percent up front.

[12] "This habitat provides areas for cavity-nesting birds and mammals as well as insectivores, cover and resting habitat for amphibians, reptiles, and small mammals. A robust riparian habitat has well developed vegetation, usually with multiple canopy layers, each providing a unique habitat, niche, or microclimate." Monahan, John T. and Wayne S. Wright. June 26, 2007. *Habitat Farming Enterprise Program Conceptual Riparian and Aquatic Habitat Restoration Plan*, p. 1 (quoting personal communication Messrs. Sandidge, Small and Small., Entiat valley orchardists, 2007); citing Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. "Stream Temperature and Aquatic Habitat: Fisheries and forestry Interactions," pages 191-232, in: E.O. Salo and T.W. Cundy (eds.). *Streamside Management: Forestry and Fishery Interactions*. Institute of Forest Resources Contribution Number 57. University of Washington, Seattle.

3 Restored Riparian Buffers

This chapter presents estimates and considerations for creating riparian habitat between agricultural land and fishable waterways. Section 3.2 provides a description of methodology used for estimating the riparian buffer zone costs; Section 3.3 presents the potential installation and maintenance costs associated with riparian areas; Section 3.4 details the goals and attributes of analogous river projects; Section 3.5 presents potential alternatives to riparian buffers; and Section 3.6 provides the limitations and uncertainties of this assessment.

3.1 Introduction

Waterways can be adversely impacted by agriculture and a variety of other stressors. Since recreational anglers pay fishing fees with observable prices and quantities, estimating the economic value of conserving these waterways may appear relatively straightforward. However, many complicating conceptual and empirical issues pose significant challenges to estimating the change in economic surplus from changes in the number of recreationally targeted fish. Despite these potential complications, incorporating riparian buffers into the landscape stands to remain a benefit, but this need not be true in every case. A riparian buffer, at times, can actually generate a loss. Not every foot of riparian buffer or orchard is of equal value or benefit. For example, if a buffer requirement on agricultural land becomes too large the entire orchard, despite being zoned as agriculturally significant, can potentially become unsustainable. As a result, the land may be developed for some other use that is potentially less environmentally friendly. Some potential riparian areas are more valuable to the

watershed than others.[13] Potentially those areas most valuable to the watershed are also the ripest for real estate development.

3.2 Methodology

The methodology employed to estimate water conservation benefits associated with the installation and maintenance of riparian zones follows the guidance of 2NCW Resource Conservation and Development Council, Okanogan, WA. Suggested approaches included contacting several Sacramento River Project experts as well as a thorough investigation of similarly successful projects. In addition, Six Mile Consulting Group attempted to contact members of The Nature Conservancy, Washington, to obtain more state-specific information. Specific contact information for these individuals, along with a telephone conversation transcript, is provided in the Appendix.

3.3 Installation and Maintenance

Riparian buffers have two primary fees: installation costs and maintenance costs. These two types of expenditures fundamentally differ in terms of pay schedule and overall price. Most often, installation costs exceed maintenance costs over the duration of the riparian habitat. Despite potentially daunting costs, community involvement and additional businesses can dramatically offset both types of expenses in terms of both time and money.

3.3.1 One-time Costs

The process of creating riparian buffers has comparatively high costs that may need to be paid at the time of service. The overall cost of installation depends upon the type of

[13] Chelen County Conservation District commissioned a prioritization project on the riparian areas of the Entiat (2007) proposing places that could be most valuable. See *Final Draft Report Entiat River Watershed Reparian Areas Prioritization Porject*, Chelan County, WA, File No. 15850-002-00 June 25, 2007; online at http://www.cascadiacd.org/files/documents/Final_PiparianPrior_062507_.pdf.

contractor used. Private sector contactors typically charge higher rates than their non-profit counterparts. Similarly, the rate of payment is based on the individual contractor. While most companies require payment when the service is rendered, special agreements may allow a patron to pay the installation costs over time, thus reducing the need for a potentially large, lump sum. Choosing the appropriate contractor is based on a complex set of individual needs and is not within the scope of this report.

The Nature Conservancy, California, has provided information on riparian forests created along the Sacramento River. The one-time installation cost ranged from $3,000 to $7,000 per acre, a relatively inexpensive price due to the status and overall mission of the organization. Price varied with the hydrogeochemical attributes of the land, as well as the type of construction needed to create an effectual buffer zone.

3.3.2 Ongoing Costs

Maintenance costs are time and attribute dependant, but they have a considerably smaller price tag compared to the aforementioned installation costs. Irrigation costs are common to nearly all riparian buffers. These expenses occur for the first three years, after which this component drops out of the maintenance equation. The costs of maintaining site-specific attributes such as fire breaks and trail access are present throughout the life of the riparian buffer. Including additional attributes such as trails is again at the discretion of the client. It is also important to note that environmental incidents such as earthquakes and hurricanes may cause unforeseeable damage to a riparian buffer zone, thus creating an exceptional onetime maintenance cost comparable to installation costs. Flooding may also be destructive and require maintenance. The Entiat River has had several flooding incidents, most if not all, related to area forest fires.[14]

[14] The flood of 1948 was particularly destructive and a large portion of fish habitat was lost then.

3.3.3 Offsetting Costs

While the cost of installing and maintaining riparian buffers may be daunting, there are several successful ways to offset these costs in terms of both time and money. First, numerous non-profit organizations have funds available for conservation efforts. Resource conservation districts are typically staffed by local employees that are willing to install riparian forest trees for a comparatively low cost.[15] Portions of this report may be used to apply for funds/grants and demonstrate the environmental benefits of this project.

Second, The Nature Conservancy has had success incorporating community members into the installation and maintenance processes. More specifically, schools were encouraged to include a "plant a tree" day in the curriculum. Recruiting students for school-based planting days increases community awareness and environmental stewardship, and it reduces the cost of installation. Companies may similarly be encouraged to participate in conservation efforts through more complex avenues such as trail maintenance. In addition to the quantifiable reduction in both time and money, community involvement has been shown to promote awareness, a less quantifiable benefit. While no definite answer has been issued, there are many non-profit organizations in the area, such as The Nature Conservancy, Washington, who may be willing to collaborate on this project.[16]

Establishing an alternative business will likely increase the benefits of riparian buffers. Sources of additional income for farmers may include anything from dog breeding to fly-fishing vacation packages. The later has been used with great success along the Sacramento River in California. One family ranch of particular interest provides anglers with housing, meals, and river access for $300 to $400 per day. While this additional income helps farmers offset riparian buffer costs, it may also serve to increase awareness about conservation efforts across Washington.

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[15] Groups that might offer assistance here include the Upper Columbia Regional Fisheries Enhancement Group, Earth Corps, and IRIS's pilot working group NCW Stewardship Cooperative.

[16] Note that there may be significant costs associated with getting school groups on the ground and with organizing and managing volunteers, particularly on private lands.

3.4 River Goals and Attributes

Any viable conservation effort must be economically feasible, socially desirable, and ecologically viable. The goals for the area of interest must thus be clearly outlined in order to meet each of these three tenets. Interests of the community, anglers, and neighboring farmers should be taken into consideration. In addition, the hydrogeochemical and physical attributes of the land matter. A complete assessment and characterization of the land may not be necessary. Rather, a basic yet thorough understanding of the needs of the river, land, and wildlife will likely provide a sufficient platform for this project.

3.4.1 The Sacramento River Project: A Brief Case Study

The Sacramento River project is an excellent example of how clearly outlined goals and an intimate understanding of the ecosystem can yield optimal results. In recent years The Nature Conservancy, California, purchased 100 miles of continuous riverfront along a critical portion of the Sacramento River. The organization determined that 30 acres of depth on either side of the river was necessary in order to support the local wildlife species and allow the river to properly meander.[17] Experts from the organization note that this distance and depth will vary with conservation goals.

Floodplains and eroding lands were targeted for acquisition due to their comparatively cheap price and high benefits for wildlife. Two 100 mile by 30 acre plots, one on either side of the river, were obtained by The Nature Conservancy. These areas provided vital habitat for bird and fish species that were of particular value to the community. By conserving this habitat, The Nature Conservancy further appealed to anglers who provide notable income for conservation efforts. Land payments were issued directly to the

[17] This information was obtained from TNC's Sacramento River Project manager Dawit Zeleke.

landowners without the use of an intermediate that may have deducted a percentage of the overall sale price. We believe there are organizations out there, such as The Nature Conservancy, Washington, which may be willing to provide similar information and financial assistance for such an initiative in Washington State.[18]

3.4.2 Habitat Considerations

There is a fundamental difference between riverside land and land further from water. Those areas closest to water are not typically as valuable for cropland directly. Rather, these lands are valuable for water access and are thus indirectly useful for riparian flora and fauna. Riparian zones have undeniable benefits for water quality and aquatic species. Moreover, riparian forests are wonderful habitat for song birds, species that have marked valued for the local community. Native pollinators similarly increase with the installation of riparian forests. Despite these quantitative and more qualitative benefits, it is prudent to recognize the rise of pest populations that may accompany riparian buffer zones which will add pest management costs to the landowner/farmer.

Many pests live in riparian forests. These species do not recognize the political boundaries that distinguish one owner's land from another. For example, gophers are known to live in riparian forests and feed on neighboring crops that are often on another farmer's property. Pests have historically moved into surrounding communities and caused problems in more suburban areas. Both types of movement, onto farmland and into residential areas, are detrimental because they reduce the popularity of conservation efforts and decrease community support for sustaining riparian zones. As previously shown, community involvement can be an important component to offsetting costs of installation and maintenance. While these problems may be quite great, land grant universities such as the WSU Cooperative Extension Service, frequently help to assess and reduce pest problems through both proactive and reactive strategies. Thus, these pests

[18] See Appendix B for some contact information.

may represent an additional incremental cost in relation to the benefits created through restoring songbird and fish habitat.

3.5 Alternatives

Some conservationists rightly oppose the use of riparian buffers as a method of increasing wildlife habitat. These opponents argue that the benefits of such an effort do not outweigh the costs and that another alternative can provide a more cost-effective solution. Despite this potentially valid assertion, many conservation efforts of this nature have clearly shown that a cost-benefit analysis is both site and goal specific. Riparian buffer zones typically increase benefits to the environment and thereby to the community.

In some situations, pesticides such as diazinon are known carcinogens and neurotoxins that also cause a decline in water quality.[19] More environmentally-friendly substitutes may prevent human and environmental harm while still reducing the pests diazinon is designed to kill. Many sustainable agriculture programs, with increased costs, will help subsidize these alternatives. In addition to a potentially higher chemical price, making the transition to a softer chemical or farming practice may also include equipment and training costs. Quantifying such costs is indeed possible but is beyond the scope of this report. The WSU Cooperative Extension Service may be able to provide a list of chemical alternatives that are licensed in the state of Washington and provide similar guidance for their use. The grower-funded Washington Tree Fruit Research Commission has been actively researching new innovative pest control techniques and reviewing national and international research concerning these issues. WSU Cooperative Extension field tests research results and conducts grower outreach to facilitate the use of such techniques. It is our assessment that the tree fruit industry in Washington has been successful in improving and protecting water quality. WSU Cooperative Extension, Tree Fruit Research Commission and the Tree Fruit Research Center, has also developed a

[19] Diazinon is currently not an issue in the Entiat River valley. For information related to WSDA/DOE surface water monitoring for pesticides in the Entiat Valley and other tree fruit production areas, see http://agr.wa.gov/PertFert/NatResources/swm/.

"Pesticide Transition Program" that assists growers in recognizing and adopting new pest control techniques as they become available.

3.6 Limitations and Uncertainties

The information contained herein is based upon conversations with environmental experts as well as a thorough review of analogous conservation initiatives. It is important to note that the Sacramento River project was executed in California and dealt with walnut, plum, and almond growers. Thus, extrapolating this data to Washington state apple and pear farmers may overestimate or underestimate the true riparian buffer costs and benefits. Despite this potential fault, no known conservation efforts of this exact type and style have involved apple and pear farmers in Washington state.[20] This analysis appears to be the first of its kind. Therefore, using estimates from analogous projects is the most reasonable method for this assessment.

[20] Tree fruit growers have been involved in many types of conservation efforts primarily as a result of educational outreach by WSU Cooperative Extension and to some extent the Conservation Service. In general, Conservation Service programs are designed more to address issues related to program crops-dry land farming, not orchard farming.

4 Payments for Ecosystem Services

4.1 General Findings

Payments for ecosystem services or PES projects involve compensating landowners for conservation-minded property management. We surveyed several recent PES projects in order to learn more about their design, contracting structure, payment calculations, and overall effectiveness. Appendix A lists specific details for several of the PES case studies we surveyed, while this section outlines our general findings applicable to the HFEP.

In recent years, several PES programs have created riparian buffer zones on private land. Those programs involving the removal of agricultural crops require compensation be paid to the landowner sufficient to offset not only the foregone agricultural revenue but also the indirect reductions in farm income related to buffer maintenance and lost economies of scale.[21] In general, the size of the buffer zone is positively correlated with the reduction in agricultural income and, accordingly, the necessary rental and cost-sharing payments. Few riparian buffer zone programs have recognized this fact and fully off-set landowner costs. According to one assessment of riparian buffer zone projects in Washington's Stillaguamish River Basin, 100 percent cost-sharing and maximum rental payments offset economic impacts completely only 36 percent of the time.[22] To achieve long-term success, riparian buffer zone programs *must* fully compensate private landowners for both direct and indirect expenses.

The majority of riparian buffer zone projects have been federal and state programs in which the seller of the ecosystem services (in this case, riparian habitat) submitted an application for financial assistance to restore riparian lands. Depending on the land's predominant use, soil type, and fitness for habitat restoration, these programs offer

[21] Evergreen Funding Consultants, "A Primer on Habitat Project Costs" (2003) Prepared for the Puget Sound Shared Strategy and available on-line at http://www.sharedsalmonstrategy.org/files/PrimeronHabitatProjectCosts.pdf.

[22] Carolyn J. Henri, "Economics of Riparian Restoration on Selected Stillaguamish Farms" Report for Washington State Department of Agriculture and US Fish and Wildlife Service, April, 2004.

landowners contracts ranging from 10-15 years and providing restoration cost-sharing of up to 50-75 percent. Few, if any, government-funded programs surveyed allowed for 100 percent cost-sharing.

While government funding appears to preclude 100 percent cost-sharing – at least among the cast studies we found – most of the local incentive or financial assistance programs involved community members such as local governments, local landowners, or local individuals joining together to form organizations. These community organizations played a pivotal role not only in fund raising efforts, but also in terms of volunteer recruitment and overall community support.

As to property identification and enrollment, while some of these programs initiated site research to determine the best place for habitat restoration and approached the landowner directly, other programs, ones similar to the federal programs, require the seller of the ecosystem services (landowner, farmer) to initiate consideration for funding. The most effective approach will depend on the opportunity costs of agricultural, riparian land in the community; farmers who are not using riparian land for agricultural production will likely be more willing to initiate program enrollment, while those with productive riparian land will be less likely to initiate enrollment and also more costly to enroll.[23]

4.2 Riparian Buffers on Agricultural Land

Given the wide variety of riparian buffer zone projects, the relevant financial considerations are location specific. Foregone crop production, fencing, installation, and maintenance are not the only issues; wildlife damage, shading, drainage, erosion, and changes in the market price of crops all demand consideration. While the majority of the cost-sharing programs we surveyed provide maintenance costs for five years, maintenance frequently extended well beyond that amount of time. Furthermore, the type

[23] Forest Trends, The Katoomba Group, and UNEP. Payments for Ecosystem Services. Getting Started: A Primer. Harris Litho. Washington, DC: May 2008.

of buffer affects labor and maintenance costs; a grass buffer will require more maintenance than a forested buffer, but the grass buffer is initially less expensive to install. The amount of cost-share paid to landowners will determine which of these generates the most costs.

The following is a summary of the costs associated with installing and maintaining a riparian buffer zone on agricultural land, accumulated from the various case studies, articles, and papers discussed in Appendix A.

i. Installation
    (1) Removal of previous crop (trees)
    (2) Site preparation
    (3) Cost of riparian plants
        (a) Dependent upon tree species, density (trees per acre), labor (cost of replanting)
        (b) Machine planted trees often have a higher survival rate and can be less expensive
        (c) Land fumigation
        (d) Installation of irrigation
        (e) The trees themselves
        (f) Training trees
        (g) Spraying (may not be needed for all riparian installations)
        (h) Protection of young trees
ii. Foregone crop revenue
    (1) For each species, foregone revenue equals the yield multiplied by the prevailing fruit prices
    (2) As price or yield increases over years, buffer cost increases
iii. Foregone expenses
    (1) Money no longer spent: variable and fixed costs of caring for and harvesting crop
    (2) Number of acres taken over by riparian land
iv. Transaction Costs

(1) Investment of time

(2) Paperwork: applications and contracts for participating in cost-share and/or incentive programs

(3) Often have many organizations providing a small amount of financial assistance; may have to front the money and wait an extended period of time to be paid back from all the various agencies that assist landowners

v. Potential reductions in crop yield - due to

(1) Drainage issues

(2) Shading of current crops

(3) Wind flow pattern changes

(4) Wildlife damage (insects, birds, beavers, etc.)

vi. Wildlife damage mitigation costs

(1) Costs of fencing or hiring a trapper

(2) Insects

vii. Increased cost of caring for and harvesting crops

(1) Odd-shaped field boundaries due to riparian land

(2) Leveling land, irrigation, or operating machines may be more difficult

(3) Increased fungicide treatment

(4) Increased harvest costs due to uneven fruit maturation on shaded plants. [from WSU blueberry enterprise summary]

viii. Riparian Buffer Zone Maintenance

(1) Weed control

(2) Mowing

(3) Replacing dead shrubs and trees

(4) Fence maintenance

ix. Potential reduction in value of land

(1) River bank trees may aggravate bank erosion, as well as loss of property.

(2) Lost scenic view

(3) Irreversibility: Can you ever plant on this land again?

(a) Example: what if an endangered species establishes itself in the buffer? (Maryland Cooperative Extension: When A Landowner

Adopts a Riparian Buffer-Benefits and Costs)

(b) CREP participants have 5 years after the end of their contract to reclaim cropland before wetland legislation can be enacted

x. PES Case Studies – See Appendix A

5 Potential Funding Sources

Some land owners have expressed concern and lack of confidence in governmental entities to enter into long term land use agreements without having these agreements subject to change by pressure groups or circumstance, partisan political forces, changes in funding priorities, or revision of land use regulations. Because of these concerns other funding sources are addressed and sought as first choice options.

5.1 Identifying Customers

First and foremost, the tree fruit growers – like any producer of goods or services – need to know their customers and their customers' preferences. For the Entiat River orchardists interested in producing salmonid habitat there are many potential customers.

5.1.1 Recreational, Tribal, and commercial fishermen

Historically, the Entiat, Wenatchee, and Columbia Rivers have been popular destinations for recreational, Tribal, and commercial fishing. But after listing of the three salmonid species, National Marine Fisheries Service (NMFS) and Washington Department of Fish and Wildlife (WDFW) closed these and other fisheries in the Upper Columbia River region. The primary concern was that some protected fish would inevitably mix with the non-listed hatchery and other non-protected species, be caught by anglers, and die despite the catch-and-release practices.

On July 10, 2008, NMFS issued a 10-year ESA fishing permit for non-listed species in the upper Columbia basin. NMFS can close the fishery however, if run projections are low and mortality rates of the endangered fish rise above a certain level, so recreational

and commercial fishing groups in the area might be willing to pay some amount to increase protected fish numbers and correspondingly reduce the probability of closure.

Tribes have established rights in this region of the country. And by that, they stand to be an important source of demand for habitat because of their legal claims on fish that might spawn and grow out of the habitat.

5.1.2 Hydropower

The Chelan and Douglas County Public Utility Districts signed a Habitat Conservation Plan ensuring that the Rocky Reach and Rock Island Hydro Projects have no net loss on mid-Columbia salmon and steelhead runs. To mitigate the unavoidable mortalities associated with operating these hydroelectric projects (estimated at two percent of all fish passing through the projects), the public utility district will fund habitat protection and restoration work along the Entiat River and other tributaries to the mid-Columbia River.

By the Habitat Conservation Plan, "[h]igh priority shall be given to the acquisition of land or interests in land such as conservation easements…."[24] We interpret this to mean that the public utility districts stand to be important demanders of habitat farming of the kind we are discussing here.

5.1.3 Detailed Potential Funding Sources List and Description

See Appendix B

[24] See http://www.midcolumbiahcp.org/index_habitat.htm, Rocky Beach, section 7.7.1, p. 21.

6 Specific Legal Issue Related to the HFEP

6.1 Tax

6.1.1 Tax Effects of Changing the Land Use

The Washington State Department of Revenue considers the removal of trees or stumps from existing orchards to be a horticultural service when performed for farmers in preparation for replanting orchards or cultivating a different agricultural product. Under the Washington Administrative Code, "agricultural product" means any product of plant cultivation or animal husbandry, including products of "aquaculture" and animals that are "cultured aquatic products." The Revised Code of Washington further defines "aquaculture" as "the process of growing, farming, or cultivating private sector cultured aquatic products in marine or freshwaters and includes management by an aquatic farmer." Further, it defines "private sector cultured aquatic products" as "native, nonnative, or hybrids of marine or freshwater plants and animals that are propagated, farmed, or cultivated on aquatic farms" and expressly lists salmon as one such "product." Therefore, the removal of trees and stumps on an orchard for the purpose of creating a riparian habitat could be considered "cultivating a different agricultural product."

This activity remains a horticultural service regardless of the type of equipment used, or whether all or only some of the trees or stumps are removed. Charges for horticultural services performed for farmers are subject to the service and other activities business and occupation tax classification (B&O tax). Sales tax does not apply.

The state of Washington does not have an income tax. Instead, it has the state B&O tax, which is a gross receipts tax. It is measured on the value of products, gross proceeds of sale, or gross income of the business. This means there are no deductions from the B&O tax for labor, materials, taxes, or other costs of doing business.

The removal of trees or stumps for consumers is treated differently. Charges for removal of trees or stumps from orchards in preparation for nonagricultural purposes are a retail sale when performed for consumers.

Both farmers and contractors should keep sufficient documentation in their records and indicate that the hired services are in preparation for replanting an orchard or cultivating a different agricultural product, if they wish for it to be treated as such.

6.1.2 Tax Effects of the New Land Use

Many orchardists are concerned with potential tax effects that could stem from transforming part of their property from orchard to riparian habitat. One potential solution to their concerns is the Chelan County Public Benefit Rating System.

This system creates an incentive to property owners to preserve open space resources by providing a property tax reduction based upon current use of the property rather than the highest and best use of the property. The system gives examples of public benefit open space resources, including stream, lake, and wetland buffers, and threatened or endangered wildlife habitat.

Lands that are used for agricultural or forest practices and assessed as open space agriculture or open space timber are not considered under the system. Therefore, in order for the benefits to be received, the county cannot treat the "farmed" habitat as agricultural. An open space contract must be signed between the property owner and Chelan County upon approval of an application.

6.1.3 Conclusion

The farmer's current tax status will be affected by changing the land use from orchard to riparian habitat. The best scenario for the orchardists would be to agree to a contract with the county to be a part of the Public Benefit Rating System. This would require that the riparian habitat not be designated as open space agricultural land (for raising salmon), because that designation would cause the removal of the trees and stumps to be considered a consumer transaction subject to any retail sale tax, as the removal would not be for the cultivation of another agricultural product.

Participation in the Public Benefit Rating System would be the best scenario, as the benefits of a property tax reduction for the lifetime of the riparian habitat would far outweigh any one-time additional tax for the removal of the trees.

It should also be noted that the transition of part of the orchard to riparian area can also potentially reduce the land value/production value and consequently impact financing of ongoing orchard operations.

6.2 Zoning

Sanray Orchards is currently zoned as commercial agricultural land, more specifically, "agricultural land of long-term significance." The permitted uses and standards for this classification are outlined in Chapter 11.30 of the Chelan County Code.

Section 11.30.020 outlines the standards for a property zoned as Commercial Agricultural Lands. This section calls for a minimum lot size of ten acres, a minimum lot width of one hundred fifty feet at the front building line, and that buildings and structures shall not occupy more than thirty-five percent of the lot area. While the use of the land must be predominantly agricultural, the code does allow for some accessory uses "which support,

promote, or sustain agricultural operations and production as a secondary, subordinate, and/or supplemental element of the operation of an ongoing agricultural activity as defined by RCW 84.34.020(2)." The Revised Code of Washington includes "any parcel of land that is twenty or more acres or multiple parcels of land that are contiguous and total twenty or more acres" and that is "enrolled in the federal conservation reserve program…" in its definition of "farm and agricultural land."

The current zoning classification could be affected by changing the land use from orchard to habitat farm because of the added restrictions brought on by wildlife habitat conservation areas. The Chelan County Code has certain standards for development within Class I and Class II wildlife habitat conservation area standards.

Within each class, there is a distinction for major and minor developments. A major development within a Class I wildlife habitat conservation area or within a review area of one thousand feet of a mapped point location of a "den or nest site of a species listed as endangered, threatened, or sensitive by the state of Washington, or registered as endangered or threatened by the federal government" is required to give written notice of the development to the Washington State Department of Fish and Wildlife. If the site does contain regulated wildlife habitat, a habitat management and mitigation plan, pursuant to Section 11.78.100, is required.

Additionally, in the case of bald eagles, an approved bald eagle management plan is required. A written notice must be given for a minor development, as well. If the site does contain regulated wildlife habitat, then certain requirements outlined in the code must be met. First, an administrator will review agency comments according to specific criteria, including published guidelines regarding the protection and management of the affected species; the physical characteristics of the subject parcel and vicinity; potential land uses; historic, current, and proposed uses; and current habitat. Additionally, minor development is subject to the following standards: disturbed areas shall be revegetated with native vegetation within one growing season of project completion; site planning shall minimize disruption of existing topography and vegetation and shall incorporate

opportunities for phased clearing; any limitations to site disturbance shall be marked in the field and approved by the county; site planning shall adhere to fencing requirements and develop erosion and drainage control plans; and, finally, building sites are encouraged to be located away from critical wildlife habitat corridors.

6.3 Water Rights

In the Western United States, any discussion of land use changes is incomplete without also addressing the effect on water rights appurtenant to that land. The Habitat Farming Enterprise Program is no different, as shifting riparian lands from tree fruit production to riparian habitat will undoubtedly change long-term water consumption and, therefore, could affect the water rights of enrolling landowners.

In Washington, the law affecting water rights comes from several sources. The Revised Code of Washington (RCW) is a compilation of all the legislative enactments currently in effect, and Title 90 covers water rights. Additionally, the Washington Supreme Court has issued several opinions on the use of and legal claims to water rights in the state. Finally, the Department of Ecology, charged with administering the state's water rights program, has authority to issue regulations, permits and orders regarding water rights and water right change applications.

To maintain an existing water right, its holder must put the diverted water to a statutorily defined beneficial use. The RCW defines the term "beneficial use" to "include, but not be limited to, use for domestic water, irrigation, fish, shellfish, game and other aquatic life, municipal, recreation, industrial water, generation of electric power, and navigation."[25] The RCW also states that water rights may be relinquished for abandonment or failure to beneficially use without sufficient cause for any period of five successive years.[26]

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[25] Revised Code of Washington §90.14.031.

[26] *See* RCW §§90.14.130-180.

Water rights, however, are not entirely static. Pursuant to RCW §90.3.380 through §90.3.397, a water rights holder may also petition the Department of Ecology to permit a change in the water's purpose of use, point of diversion or place of use, provided that such change can me be made without detriment or injury to existing rights. Additionally, RCW §90.42.10 through §90.42.80 allows water rights holders to negotiate the transfer of water rights to the state for conservation purposes. Such transfers may be permanent or temporary and they may be donative or for valuable consideration.[27]

These statutes could impact the water rights of a landowner enrolled in the HFEP. First, by taking a portion of orchard out of production, an enrolled landowner might use less irrigation water than he or she did prior to enrollment.[28] If so, the landowner might seek to change the place that irrigation water is diverted and used, e.g. by leasing the water to another user or by using it on another portion of the orchard. Alternatively, the landowner might seek to change the purpose of the use, e.g. by leasing the water to the Trust Water Rights Program to benefit fish in the stream.

As discussed in Section 7, HFEP enrollment could have significant financial implications related to water rights. Although Washington's water laws allow for changes in the purpose of use, place of use and point of diversion, such that HFEP enrollment might free up portions of a landowner's water assets, the corresponding administrative process can be both time consuming and costly. Moreover, the value of water rights in terms of lease payments or outright transfers to other agricultural users or for conservation purposes is not uniform.

Landowners in different basins and even those in the same basin might receive vastly different amounts for their excess water – if they have any at all. As such, landowners considering participation in HFEP might also consider obtaining an independent appraisal of the value and transferability of their water rights.

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[27] Often, the Washington Water Trust negotiates the transfers and payments on behalf of the state.

[28] HFEP Advisory Group members have suggested that initial water consumption would not necessarily change given the preliminary irrigation needs of the riparian buffer vegetation. After a period of several years, however, the installed vegetation would require less water, thus "freeing up" irrigation water for other uses and/or transfer.

6.4 Other Considerations

6.4.1 Local Regulations - Chelan County Code

(1) Title 6 - Taxes
   (a) Existing code taxes orchardists by acreage area in orchard production
   (b) Local taxes would need to account for changes in orchard area if converted to other areas

(2) Chelan County Public Benefit Rating System (PBRS)
   (a) Opportunity to credit orchardists for conversion of orchard to public beneficial uses - innovative applications are needed

(3) Title 11.78 - Fish and Wildlife Habitat Conservation Areas Overlay District (FWOD)
   (a) May impose limitations on actions intended to enhance riparian and aquatic habitat under the HFEP

(4) Title 11/12 - Agricultural zoning
   (a) Designates agricultural lands of long-term significance
   (b) May serve to limit ability to implement programs like HFEP
   (c) May need to create a separate land use designation for HFEP lands (potentially through PBRS?)

6.4.2 State Regulations - Revised Code of Washington

Management of water resources in Washington is governed by:

(1) The Surface Water Code (Chapter 90.03 RCW)

(a) Failure to use water for a period greater than five years may result in relinquishment of rights

(b) To avoid relinquishment, water might be applied to riparian vegetation, or used on "reclaimed" lands or placed in the Washington State trust water program

(2) The Claims Registration Act (Chapter 90.14 RCW)

(3) The Minimum Flows and Levels Act (Chapter 90.22 RCW)

(4) The Ground Water Code (Chapter 90.44 RCW)

(5) The Water Resources Act of 1971 (Chapter 90.54 RCW)

(6) The Watershed Planning Act (Chapter 90.82 RCW)

(7) Chapter 173-546 Washington Administrative Code

(8) Water Resources Management Program - Entiat River Basin Water Resource Inventory Area (WRIA) 46 (Ecology 2005)

(a) Created rules for the management of instream and out-of-stream water resources based on assessment findings and plan recommendations

(b) May impose limitations on actions intended to benefit riparian and aquatic habitats and species if such action may require changes in irrigation rights

(9) Water Pollution Control Act (Chapter 90.48 RCW)

(a) Governs management of water quality in Washington

(b) Crop conversion and actions to enhance riparian and aquatic habitat under the HFEP may help meet standards and achieve objectives represented by water quality laws

6.4.3 Takings Law

(1) Washington's constitution requires state and local government to pay private property owners just compensation before taking or damaging private property for public use, and in general it prohibits government from taking private property for private use.

(2) The constitutional requirement to pay just compensation also applies under limited circumstances to laws that restrict the use of private property.

(3) If the restriction completely eliminates the owner's economic use of real property, or if the restriction involves a physical intrusion onto the private property, then just compensation is generally required.

(4) Whether regulations or restrictions on use of real property amount to taking or damaging of private property under the constitution, depends on the particular effects on the individual property.

(5) The law may require just compensation depending on the economic impact of the restriction on the property, how the restriction affects legitimate property uses and the property owner's reasonable investment-backed expectations, and whether the restriction reflects a reasonable means for achieving an important public objective.

(6) Under the state and federal constitutions, a property owner may bring an action for just compensation to obtain the fair market value of property taken or damaged by the government, if the government has not paid compensation.

(7) Under the Washington Constitution, the property owner may also bring an action to invalidate government action that is taking or damaging private property, if there is no public use, only a private use.

6.4.4 Federal Regulations

(1) National Environmental Policy Act of 1969 (NEPA)

(a) NEPA is triggered whenever a project receives federal funding or when an action requires federal permits, licenses, or approval.

(b) NEPA requires a detailed statement of the potential environmental impact of major federal actions that significantly affect the environment be included in every recommendation or report on proposals for legislation.

(2) Endangered Species Act of 1973 (ESA)

(a) The purpose of the ESA is to protect, conserve, and enhance ecosystems upon which threatened and endangered species depend, and to develop and implement plans to recover the habitat and populations to such levels as to prevent extinction.

(b) ESA in the Entiat Valley

(i) Two of five anadromous salmonid stocks utilizing the Entiat River watershed are protected under the ESA (Chinook salmon and steelhead). Bull trout are also protected under the ESA but are not anadromous.

(ii) Three governmental entities co-manage fishery assets in the Entiat based on a complex legal history.[29]

(iii) The only other ESA species known in the orchard's vicinity is the bald eagle.

(iv) In the watershed, compliance is obtained either through permitting of specific actions or through development and approval of a habitat conservation plan (HCP).

(c) ESA Background

(i) The ESA was passed by Congress in 1973.

(ii) The ESA was reauthorized seven times and has been amended on several occasions, most recently in 1988 (as of 2002).

[29] See Section 8.3 for additional discussion.

(d) ESA Oversight

(i) The United States Fish and Wildlife Service (USFWS), under the Department of the Interior, and the National Marine Fisheries Service (NMFS), under the Department of Commerce, share responsibility for administering the ESA.

(ii) NMFS deals with marine species, such as whales and seals, and anadromous fish (those that migrate up rivers from the sea to breed in freshwater).

(iii) USFWS is responsible for terrestrial and freshwater species and migratory birds.

(iv) Listing - The USFWS and the NMFS decide listings.

1) An endangered species is defined as one in danger of extinction throughout all or a significant portion of its range.

2) A threatened species is defined as one that is likely to become endangered within the foreseeable future.

3) Species are listed on the basis of the best scientific and commercial data available.

4) Listings are made solely on the basis of the species' biological status and threats to its existence.

(v) Candidate species

1) Candidate species are plants and animals for which the USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

(3) Clean Water Act

(a) The Act defines the process and standards to regulate discharge of pollutants into U.S. waters.

(b) EPA is responsible for implementing the law.

(c) In Washington, authority is delegated to the Department of Ecology.

7 The Demand for Environmental Services: The Remuneration Model, Basics, Development, and Estimation Procedures

In general, the demand for environmental services is a derived demand. There are, of course, existence demands and related desires, but the major driving force behind ecosystem or environmental services is end-user desires. Take fishing, or hunting, or wildlife viewing. In each of these cases, people want to be able to catch fish, kill deer, or take pictures of local wildlife. Their basic desires are not for the woods, the trees, or the grasses, but rather the outputs of those systems.

To be sure, we do not mean to overstate the case. Part of the pleasure and demand for fishing, hunting, and viewing is being part of the natural environment, and so, yes, there is demand for the raw inputs as well. But the primary point here is that there is big demand for the *outputs* of the environment, over and above the demand for the environment per se.

Let's make the point simply. There are at least two types of fishers. There are those who care about catching fish and then those who enjoy the entire outdoor experience, plus catching the fish. The first care about how many fish there are in the stream and their sizes and varieties. The second care about those as well, but also they care about the places they fish: what these places look like, how they smell, and their beauty, be it natural or otherwise. The first group will pay for more fish in the stream independent of how they got there. The second group will pay also, but in addition they will pay for a native, natural, or pristine or pretty riparian habitat. These demands are not in conflict, and this limited taxonomy is not meant to be exhaustive, but instead illustrative. We will explore this taxonomy in more detail below as we have earlier, but first let us describe the nature of demand for goods such as habitat or environmental assets.

The demands for habitat, or ecosystem services, are not like some regular goods. They are not mutually exclusive in consumption. Economists called these public goods or non-

rivalrous goods, meaning that more than one person can enjoy the asset without reducing another person's pleasure or enjoyment of the good.[30] Technically it means that we sum the demand curves vertically as opposed to horizontally. An example might help to illustrate. Suppose Person A values some riparian habitat at $100 per year on existence grounds. This person lives afar, but simply likes to know that there is habitat on some stream about which they have some limited knowledge or experience. Perhaps they have vacationed close by, or once hiked there, read a story in a magazine, or maybe they used to live in the vicinity. Perhaps they dream of retiring there.

Next there are Persons B & C. B lives near the river and enjoys the view of the landscape, birds, and animals that live and thrive there. This person would pay $10,000 per year for these services.[31] Person C lives miles away but drives by the riparian area several times a week, regularly enjoys the view, and is willing to pay $2,000 per year for these assets. According to the theory of public goods, these people don't demand three different riparian streams (as they would with say televisions), but instead the value of the asset is the sum of the individual valuations. So the asset is worth, annually, $100 + $10,000 + 2,000 = $12,100. If we presume that this flow is continuous, constant, and expected to remain for a very long period of time, then the current value of the riparian asset is the present value of these annual flows. This valuation, of course, depends on the interest rate, but assuming a rate here of 10 percent for illustrative purposes, then the riparian area has a present value of

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[30] There is a massive literature in economics on these types of goods. One of the fundamental and pathbreaking studies is Samuelson, "The Pure Theory of Public Expenditure," *Review of Economics and Statistics* 36 (4): 387–389.

[31] It should be noted that some, potentially a large portion, of these demands, are captured in land values. Land adjacent to high quality environments – lakes, rivers, and oceans – picks up the value of some of these attributes. There is a considerable literature on valuing these hedonic services that are captured by land. For a sampling in the context of environmental assets see F. Limehouse, P. Melvin, and R. McCormick. "On Hedonic Pricing of Environmental Assets." *Journal of Sports Economics*, forthcoming 2009; Li, Mingche and H. James Brown. "Micro-Neighborhood Externalities and hedonic Housing Prices." *Land Economics*. May 1980. 56:2, 125-141; Do, A. Quang, and Grudnitski, Gary. "Golf Courses and Residential House Prices: An Empirical Examination." *J. Real Estate Finance and Economics*. 10 (May 1995): 261-270; Harrison, David, Jr., and Rubinfeld, Daniel L. "Hedonic Housing Prices and the Demand for Clean Air." *J. Environmental Economics and Management*. 5 (March 1978): 81-102; Kiel, K. A. and K.T. McClain. "House Prices During Siting Decision Stages: The Case of an Incinerator from Rumor Through Operation." *J. of Environmental Economics and Management*. 1995. vol 28, pp. 241-255; Palmquist, Raymond B. "Estimating the Demand for the Characteristics of Housing." *Rev. Econ. and Statistics*. 66 (August 1984): 394-404. Rosen, Sherwin. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *J. Political Economy*. 82 (January/February1974): 34-55; or Triplett, Jack E. "The Economic Interpretation of Hedonic Methods." *Survey of Current Business* 66 (January 1986): 36-40.

$PV = (F/r)$

where PV is the current valuation,
F is the annual flow of value, and
r is the interest rate.

Continuing our example, the calculation is

$PV = (\$12{,}100)/(0.10) = \$121{,}000.$

In other words, the people who desire this asset would be willing to pay up to $121,000 for the perpetual flow of services to have it created, nurtured, protected, and kept in service.

In general, there exists a complicated demand for environmental services represented by the line labeled "Demand for Habitat" in Figure 1 below. Take the case in hand, the output of the environmental, riparian segment is fish (and birds, and much more, but for now, let us simplify and only focus on the fish). Anglers demand fish; they are willing to pay for them. Land owners, farmers, are willing to sell riparian services to these people in order to enhance fish populations.[32] For most goods in situations like this a market emerges. There are demanders, suppliers, a market, a price, and goods bought and sold. For many reasons, that market has never appeared in this situation.[33] However, our whole purpose here is to find unusual and creative ways to emulate or create a market, to bring the willing sellers – farmers and land owners – together with willing buyers – anglers and others desiring to preserve, create, and enhance riparian habitat.

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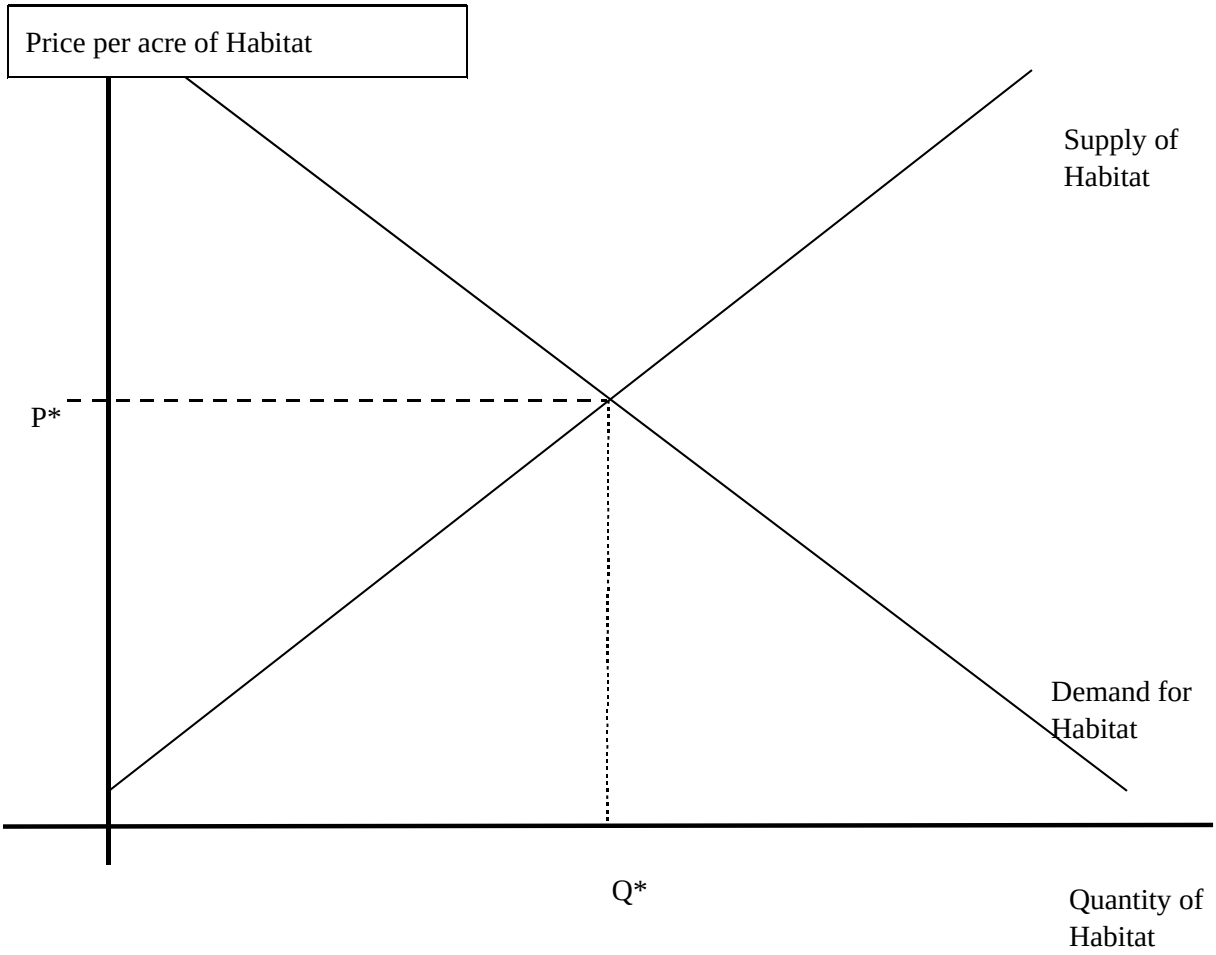
[32] As discussed above, anglers have no demand per se for the riparian habitat in our simple example. They just want fish. If they have demand for the habitat too, then their willingness to pay is even higher than this simple example illustrates.

[33] The people who produce the fish are hard to identify. Whose area produced the fish that Angler Bob caught? Who should the angler pay? This type of property rights disconnect creates the inability of a regular market to function properly or even at all. There is a massive literature on these types of issues. Two classics include, G. Hardin, "The Tragedy of the Commons," *Science*, 13 December 1968, 1243-48 and R. Coase, "The Problem of Social Cost," *J. of Law and Economics*, 3(1), 1-44, 1960.

Figure 1: The Market for Environmental Services



The willing sellers will produce habitat so long as it is viable to them. The line labeled "Supply of Habitat" in Figure 1 represents the seller's willingness to produce riparian habit and presumably fish.[34]

If rights were well defined, organized, and protected, we would expect a price to emerge, *P**, and trades to occur between buyers and sellers in the amount of *Q**. The purpose of

[34] Again, we are simplifying for illustration's sake. The riparian habitat also produces birds, insects, and other creates and views that have value to anglers and others as we have previously noted. The example here is made unidimensional for the sake of simplicity.

our research and this report is to try to estimate the value *P**. What would the market willingly pay and what would farmers require to willingly produce riparian habitat?[35]

If we had access to unlimited and all data, we could estimate both demand and supply curves. We could determine how much people would be willing to pay for various quantities of riparian habitat, the demand schedule, and also how much sellers (farmers and land owners) would require to produce various acreages of riparian habitat.[36]

We have been able to acquire some cost data on production. It turns out that there are several land leases in this area which give us a market estimate of the value of the land which will be lost from tree fruit production in order to create riparian habitat farming. In addition to these rental rates we will have to add various costs (see earlier discussion on costs in section 3(i)):

1. The cost of creating and maintaining the riparian habitat;
2. The cost to adjacent orchards of lost wind flow (Riparian habitat will have more dense and perhaps taller trees which, during severe cold spells, will reduce wind flow and can thereby potentially negatively impact fruit production. The costs of mitigating this reduced wind flow will necessarily be a cost of riparian habitat production.);
3. Any legal costs of verifying the existence and maintenance of habitat;
4. Additional costs of tree fruit production associated with losses of economies of scale;
5. Other legal issues as we have discussed above with respect to irreversibility and other claims that might be made by governmental or other units. (While

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[35] We note that we are not measuring total values of land rent. We are attempting to measure valuation at the margin. The total value of the riparian habitat is much larger than the incremental or marginal value. It is the entire area of the triangle above the supply curve and below the demand curve. For more on this point consult the discussion of the "diamond water paradox" in any principles of economics textbook. For an online discussion see http://en.wikipedia.org/wiki/Diamond_water_paradox.

[36] Obviously all riparian habitat is not the same. There are considerable variations in the kinds of fish, the kinds of streams, the types of buffers that might be produced up and down any given stream such as the Entiat, and even more variety as we consider the entire Columbia River. We are here abstracting from this complication and assuming that an acre of riparian habitat is the same no matter where it is in any particular watershed. Of course, we could, as it would be deemed appropriate to create categories of habitat, put different prices on them, and create submarkets based on quality. The only limitation here would be the availability of the relevant data.

these can be partially or completely mitigated by up-front full value payments, they raise other incentive issues.)

7.1 Estimates of Fees from Rental Contracts

As mentioned earlier, we have been fortunate to have access to market-based contracts for tree fruit trees and land. Our analysis of these contracts provides a starting point for estimating the proper fees to be paid to farmers and land owners who agree to produce habitat for fish (and other environmental amenities). These leases cover recent periods (2004-2008) and hence are approximately accurate with respect to current prices and inflation. To be prudent we would, as this model turns into practice, include an inflation adjustment so that the real or true cost of production is maintained over time as prices rise (or fall).[37]

The overall inflation from the 2004-08 period to 2009 is 2.95 percent annually. Accordingly, when we derive our compensation targets using data from the 2004-08 period we will increase the payments by a factor of 5 × 2.95 percent to capture the declining value of the dollar over the past five years. As the model is used in future years, additional inflation factors will have to be applies to bring the compensation forward in real dollar terms.

Additionally, our compensation estimates do not account for potential changes in water consumption brought on by HFEP enrollment. The lease rates discussed below include water consumption during the entire lease period. Although the HFEP might involve "conservation leases" of similar duration, water consumption would likely fall after some initial riparian vegetation growth period. This means that (1) the compensation estimates might be overstated for the years after water consumption for the riparian buffer zone

[37] This inflation adjustment can be accomplished with relative ease once an appropriate index is chosen. The federal government has a wide variety of inflation adjustment indices. The most common and widely used if the GDP implicit price deflator. But others might be used that are more farm specific. In the appendix we list the GDP deflators for the fourth quarter of each year from 2003-2008 upon which we base our inflation adjustment factor of 2.95 percent.

falls and (2) landowners enrolled in the HFEP might be able to apply the conserved water to other portions of their orchard or transfer the conserved water to other agricultural users or the state for valuable consideration.

Here is a summary of the facts we found in these leases:

1. The term length is typically a growing season.
2. The landowner receives 20 or 40 percent of annual net income. The contracts have very precise details about the definition of net income, but basically the farmer pays all costs, and then splits the remainder 70-30, with the land owner getting the 30 percent share.[38]
3. The farmer has to care for the orchard and pay all expenses.
4. The farmer's books are open to audit by the landowner.
5. The landowner reserves all other uses of the land save tree fruit farming.
6. The fruits vary from apples, pears, apricots, and cherries. Some are organic, which cost more to produce and earn a higher market price, but this should not impact the land rental rate unless the land has specialized and unique characteristics.

We report as examples, two calculations from our rental farm database, and after that, we summarize the findings.

[38] The sharing ratio varies from a low of 90 percent farmer and 10 percent landowner to 60 percent farmer and 40 percent landowner. For our calculations below we use the most common or average of these, 70-30.

Table 1: Contract data from 2006 in 2006 USD

Total Cost of production	$144,587
Production Cost per acre	$4,819
Implied acreage	30
Total Gross Revenue	$219,470
Total Net Income	$74,883
Landowners share at 30 %	$22,465
Landowners share per implied acre	$749
Present value of land based on this rental rate at 10 % interest	$7,487

Again, we would adjust this present value per acre upward to reflect inflation over the past two years.

Data from a second orchard provides a much higher rental valuation to the land. The first inclination is to presume that this is due in part to the fact that the fruit is organic apples, but unless the land is specialized to that particular fruit or production method, the rental rate should not be impacted by the higher cost of production and higher prices of fruit. Put differently, land rents in this region, in the long run, should be the same whether the fruit is organic or not. Competition from farmers for land, and competition between land owners should create a market price for land irrespective of what grows on the land, again, unless there are site specific features of certain parcels of land that make it easier or more difficult to grow organic fruit.[39]

[39] Said differently, in downtown Wenatchee, two commercial buildings which are otherwise the same in terms of location, size, features, and quality should rent for the same price irrespective of whether the operator of the business is wildly successful or just barely making ends meet. The buildings are interchangeable and hence the rents will gravitate to the same price. The same is true for tree fruit land.

Table 2: Contract data from 2007 in 2007 USD. Includes data for red, golden, and Granny apples production

	reds org early pool	reds org sl pool	goldens org early pool	goldens org sl pool	goldens org o/r pool	granny org sl pool	TOTALS
Total Cost of production		$176,215			$83,803	$9,921	$269,939
Actual acreage		46.5			17	3.5	67
Total Gross Revenue	$28,398	$464,885	$60,906	$172,246	$2,783	$5,634	734852
Total Net Income							$464,913
Landowners share at 40 %							$185,965
Landowners share per acre							$2,776
Present value of land based on this rental rate at 10 % interest							$27,756
Present value of land based on this rental rate at 8 % interest							$34,695

Note: examination of a second lease reveals considerably higher rental rates.

In total we have examined four different leases over four different periods over several types of fruit: apples, pears, apricots, and cherries. We find different rental rates for these fruits and our remuneration model takes these differences into account.

Table 3: Summary of data analysis findings

Analysis Across Crops				
Type of Crop		*Valuation per Acre at 10%*		*Valuation per Acre at 8%*
Pears	**$**	**10,673.00**	**$**	**13,341.00**
Cherries B	$	59,123.73	$	73,904.66
Cherries C (2006)	$	20,844.10	$	26,055.13
Cherries C (2007)	$	25,033.01	$	31,291.26
Cherry Average	**$**	**35,000.28**	**$**	**43,750.35**
Apricots	$	-	$	-
Apples C (2006)	$	2,999.60	$	3,749.50
Apples C (2007)	$	15,894.11	$	19,867.64
Apples D (2007)	$	27,756.00	$	34,695.00
Apples Average	**$**	**15,549.91**	**$**	**19,437.38**
Overall Average	**$**	**15,305.80**	**$**	**19,132.18**
Adjustment for inflation to 2009	**$**	**15,757.32**	**$**	**19,696.58**

Note: Computation of adjustment for inflation is reported in Appendix D.

This summary reveals that the average acre of land in tree fruit production, across all types of fruit and across the several years, is worth approximately $19,700 per acre using an 8 percent discount factor which we deem conservative. This represents the value lost to the raw land of giving up fruit production, but it does not capture the entire cost of habitat farming as we discussed earlier and estimated using Washington state and California data. It similarly does not capture the potential reduction in water consumption and the corresponding possibility that landowners enrolled in the HFEP might (1) receive less in rental payments after the riparian buffer is fully grown, or (2) transfer that water either temporarily or permanently to other agricultural users or to the state for conservation values.

7.2 Summary

We need to stress that this estimate is NOT what we think the land is worth as habitat for fish and wildlife. This is our estimate of the opportunity cost of taking the land out of tree fruit production. As the economics displayed in Figure 1 illustrate, the value of the riparian buffer in fish/wildlife/ecosystem production has NOT been estimated. The value strongly depends on other unmeasured factors: willingness to pay by anglers, bird watchers, environmentalists in general, existence demanders, and the like. We have not tasked ourselves to this chore.

Moreover, the value of the raw land taken out of production has additional costs when placed in riparian production that must also be compensated. These include the increased risk of frost due to reduced airflow over the orchard and the increased risk of infiltration by beaver and insects. The lease-based estimates similarly do not account for changing water consumption on enrolled orchards or the orchardist's ability (or inability) to apply that water elsewhere or transfer it for value. From a balance sheet perspective, the enrolled landowner should be indifferent as to whether he or she receives a lease payment that includes an amount for water consumption or the excess (transferable) water itself.[40] However, given the uncertainties over administrative approval and the value of the water, each landowner should consider the impact HFEP enrollment will have on the orchard's water consumption.

[40] Consider the difference between a ten year agricultural lease and a ten year conservation leases proposed under the HFEP. The agricultural lessee receives the landowner's trees, land and water for the entire duration of the lease. The conservation lessee on the other hand effectively receives use of the landowner's land and trees for the lease duration, but would only retain use of the landowner's water during the portion of the lease in which the riparian vegetation requires irrigation. Thereafter, the landowner (lessor) would be able to apply the remaining water elsewhere on the orchard or, potentially, transfer that water to another user and place of use/diversion. The conservation lessee would not automatically retain the excess water because changes in the purpose of use and place of use (e.g. for instream flows) requires administrative approval.

7.3 The Remuneration Model

Here we annotate the full remuneration model based on contract data and adding other costs of production.

Table 4: Remuneration model for Apples[41]

[41] We cannot estimate a model directly for apricots as all of the data on apricot production lead to negative income. We do not think that apricot farming is perpetually a negative present value proposition, and hence additional work is required to estimate the value of apricot land converted to riparian habitat.

	Per acre one time cost	***Per acre annual cost***	***Present value per acre (8% discount rate)***
Opportunity Cost of Land in terms of lost tree fruit production		$1,555	$19,438
Legal costs (5% of land value)			$972
Additional costs of fruit production, loss of economies of scale etc. (depends on farm size, assume 7% of land value)			$1,361
Loss of view shed (10% of value)			$1,944
Total one time costs	$3,000 to $5,000		$4,000

Net Present Valuation per acre	**$23,714**

(Note: we have produced an electronic version of this calculation which allows users to perform sensitivity analysis, add new data, add new crops, and project into the future. This pro forma also allows the cost percentages to be altered for alternative computations)

Table 5: Remuneration Model for Cherries

	Per acre one time cost	Per acre annual cost	Present value per acre (8% discount rate)
Opportunity Cost of Land in terms of lost tree fruit production		$3,500	$43,750
Legal costs (5 percent of land value)			$ 2,187.52
Additional costs of fruit production, loss of economies of scale etc. (depends on farm size, assume 7% of land value)			$3,063
Loss of view shed (10 % of value)			$4,375
Total one time costs	$3,000 to $5,000		$4,000
Net Present Valuation per acre			$53,375

Cherry land converted to riparian habitat is worth approximately $53,375 per acre, much higher than apples.

Table 6: Remuneration model for Pears

Pears			
	Per acre one time cost	Per acre annual cost	Present value per acre (8% discount rate)
Opportunity Cost of Land in terms of lost tree fruit production		$3,500	$1,067
Legal costs (5 percent of land value)			$ 667.00
Additional costs of fruit production, loss of economies of scale etc. (depends on farm size, assume 7% of land value)			$934
Loss of view shed (10 % of value)			$1,334
Total one time costs	$3,000 to $5,000		$4,000
Net Present Valuation per acre			$16,276

Pear land removed from production and placed into riparian habitat falls between apples and cherries. It is worth approximately, $16,276 per acre.

In each case – apples, cherries, and pears – we have not made the appropriate inflation adjustment. As this model turns into reality, it is imperative that prices be adjusted for overall inflation so that payments be made in real, not nominal, dollar terms. Given that these data were computed using 2004-08 data, each should be adjusted upwards by 2.95 percent to convert them to 2009 purchasing power dollar terms.

Accordingly, our remuneration model projects these valuations for land converted from tree fruit production to riparian habitat:

Table 7: Inflation adjustment of remuneration models

Inflation Adjustment			
Fruit	*Inflation Factor*	*Mid-2000 valuation*	*Valuation 2009*
Apples	2.95%	$23,714	$24,413.56
Cherries		$53,375	$54,950.00
Pears		$16,276	$16,756.14

Based on other research, there is an alternative method of computing the full costs of riparian creation and maintenance. This method is based on a case study in the Stillaguamish Farms.[42] According to the study, the full cost of riparian implementation is 7.5 times the lost crop revenues. The problem with this approach is that it depends heavily on the type of crop being replaced. In the case study, the crops were silage, beef cattle, and dairy cattle. Table 8 reports the estimates of annual costs determined in those case studies.[43]

[42] Resource Consulting. 2004. Economics of Riparian Restoration on Selected Stillaguamish Farms, Final Project Report, Arlington, WA, April 20, 2004. Online at http://www.snohomishcd.org/Final%20Buffers/Stillaguamish_Buffers.pdf.

[43] See "Economics of Riparian Restoration on Selected Stillaguamish Farms," 2004 at vii.

Table 8: Estimated case study costs of riparian buffers in three crop situations

Crop	*annual costs*
Silage	$403
Dairies	$570
Beef	$1,212

This method produces lower installation and maintenance costs than the California study. We believe that the California case more closely approximates the situation in the Wenatchee River environs, and hence our earlier calculations are deemed appropriate for the purposes of this project.

8 Other Issues, Incentives, and Contracting Costs

8.1 Contracting Issues

There is a veritable host of contracting issues which we can only list and briefly elaborate. Performance requires monitoring. Accordingly, on the one hand, habitat farmers have the best incentive to produce and maintain quality riparian habitat if they are paid piece rate, that is annually, based on fish production. This is highly problematic. Measuring production is costly at best and impossible at worst. Some sort of long term, regulated or standards approach is the likely compromise. Although it might seem far fetched, fish measuring methods currently in place in the Entiat might make yield measurement feasible.

The annualized payment coin has two sides. If tree fruit farmers convert their land to riparian habitat, an ex post contractual opportunistic behavior problem arises because it is expensive to restore the tree fruit.[44] The farmer could be left holding the bush if the paying agency decides to renege on payments. Courts are not free to access, and thus, a contracting cost is present. The solution to this problem is a lump sum upfront payment.

How to balance these incentive effects? There is no easy, one-size-fits-all answer. Government escrowed accounts are one potential solution from which farmers could be paid annually, but the accounts would have to be fully funded. An alternative is to create a local agency or use fish and wildlife services to monitor habitat maintenance after a lump sum payment. Fines could be levied for farmers failing to live up to obligations.

[44] See Klein, Crawford, and Alchian, "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process," *J. of Law and Economics*, October 1978, 21, pages 297-326.

8.2 Access Issues

Protecting private property rights is critical to protecting environmental resources because incentives matter. Riparian habitat has to remain the private property of the land owner in order to avoid a host of common access issues. Only then will the land owner view environmental resources as assets rather than liabilities and, as such, properly maintain them.[45] Landowners are less likely to invest in stream restoration if they have no meaningful or lawful way of limiting public access. These costs lead private riparian landowners to view non-navigable streams as liabilities rather than assets and, therefore, discourage private investment in stream maintenance and improvement.

Many communities are struggling with the problem of access, and the debate can become heated. Table 9 details the current variability and flux in western states access law.[46] The primary point here is that previous history and precedent do not tell us exactly how local and state governments in Washington State will deal with riparian habitat purchased with public monies.

8.3 Tribal Issues

Tribal rights are important in this region of the country. For instance, the Columbia River Inter-Tribal Fish Commission says, "The treaty promises of the United States to protect the aboriginal right of our tribes to take fish at all of our usual and accustomed fishing places precedes all other laws affecting the Columbia Basin and were not diminished by those laws. The laws regarding operations that may affect treaty fisheries are subject to the treaties and need to be read consistent with them."[47] Treaties between tribes and the U.S. Federal government give sovereignty which complicates our analysis but also

[45] Lueck, Dean, and Jeffrey A. Michael. 2003. Preemptive Habitat Destruction under the Endangered Species Act. *J. of Law & Economics* 46(1): 27-60.

[46] Reed Watson, Stream Access Across the West, PERC Reports Spring 2009, p. 13. www.percreports.org.

[47] http://www.critfc.org/oldsite/text/trp_leg.htm.

provides a source of demand for supporting habitat farming.[48] By treaty and court rulings, tribes have the right to fishing, but that right does not by itself provide them fish to catch.[49] Thus, tribes stand to be an important source of demand for habitat as they have claims on fish that might spawn and grow out of the habitat.

[48] There is a tribal salmon recovery fund. See http://www.critfc.org/sots/sots2.html for some details.

[49] See United States v. Winans, 198 U.S. 371 (1905).

3**Table 9:** Western law variability by state

State	Public recreation rights on non-navigable waterways	Public easement on privately owned streambeds	Public's portage rights over private property	Easement across private property to reach waterway
AK	Flotation only	Emergency use only	Yes	No
AZ	No, unless streambed is federally owned	No	No	No
CA	No, but counties have eminent domain power	Under navigable-in-fact waterways	Yes	Yes, at public road crossings
CO	Flotation only	No	No	No
ID	No, but navigability is broadly defined	No	Yes	No
MT	Virtually unlimited	Yes	Yes	Yes, at county road crossings
NV	No	Untested	Untested	No
NM	Yes	Yes	Yes	No
OR	Flotation only, unless "public passageway"	No	Untested	No
UT	Virtually unlimited	Yes	Yes	Likely
WA	No	No	No	No
WY	Flotation only	No	Yes	Likely

Appendix A – PES Case Studies

1. Enhancing surface water quality - a user fee and private payment scheme in Heredia, Costa Rica (copied from Smith, de Groot, and Bergkamp 47)
    a. Empresa Servicios Publicos de Heredia (ESPH) is a water utility company in the Heredia region of Costa Rica. ESPH is a pubic company in which the citizens of the area are also shareholders. ESPH recognized the urgent need to protect the water supply and catchment area from risks posed by land use in the upper watershed, and they determined that paying landowners to manage the watershed sustainably would be more cost effective than building a filtration plant. All parties therefore agreed that management costs for conservation of five micro-watersheds should be levied as payment for the water quality benefits received.
    b. Ecosystem services are provided: forest cover is maintained in strategic areas of the watershed to help ensure water quality downstream, reducing public health risks and costs of chlorination.
    c. Stakeholders involved:
        (1) Buyers: Household users and the private sector. Water users in the city of Heredia pay a Tarifa Hidrica to ESPH in their monthly water bills. In addition, Florida Ice & Farm, a large soft drink, bottled water, and brewing company, finances 55 percent of each contract in the Río Segundo watershed, for conservation of the upper watershed areas that supply water to their production facilities.
        (2) Sellers: Public (the Braulio Carillo National Park) and private landholders. Participating landowners receive a payment close to U.S. $110/hectare/year for protecting forests around ESPH's water sources. This amount represents the opportunity cost of land use in the upper watershed. In the case of the national park, the Ministry of Environment (MINAE) is paid for conservation and reforestation activities at the rate of U.S. $ 30/hectare/year.
        (3) Intermediaries: ESPH and FONAFIFO (The National Forestry Financing Fund) act as intermediaries in this scheme.
    d. Payment scheme type: Private transfer payments and user fees. ESPH

collects fees from consumers in their monthly utility bills. The money collected is equivalent to U.S. $0.1/m3, half of which is invested in forest conservation and reforestation in three watersheds in the Central Valley of Costa Rica (Rio Segundo, Rio Tibas and Rio Ciruelas); the other half of the funds raised are invested in water infrastructure and research. The major private sector buyer, Florida Ice & Farm, pays its share of contracts directly.

2. Market for flood regulating ecosystem service (Duraiappah 11) Water necessary to operate the Panama Canal has been drying up. John Forgach, chairman of ForestRe in London, believes that companies that depend on the canal can and should pay for reforestation of the watershed, which would regulate the water supply. "Planting forests around the Panama Canal would… have the same effect as building vast reservoir and filtration beds." Mr. Forgach is working with insurance and re-insurance companies to "put together a deal in which these companies would underwrite a 25-year bond that would pay for the forest to be replanted. The companies would then request their big clients who use the Canal to buy the bond." (Wal-Mart, Asian carmakers, etc.)

3. Securing aquifers - a private sector payment scheme by Nestlé Waters in France (Smith, de Groot, and Bergkamp 48)
    a. Vittel (a subsidiary of Nestlé Waters) is the world's largest bottler of natural mineral water. Its most important water sources in France are in heavily-farmed watersheds. Runoff of nutrients and pesticides risked contaminating the aquifers on which the company's business depends. The company determined that purchasing farmland, reforesting sensitive infiltration zones, and financing farmers to build modern facilities and switch to organic farming was in fact more cost effective than building filtration plants. The cost advantages were so significant that participating farmers could be offered extremely profitable terms.

b. Ecosystem services provided: Reduced chemical usage and sustainable land-use management to sustain extremely high spring water quality standards.
c. Stakeholders involved:
   (1) Buyers: Vittel, a bottler of natural mineral water. For the first seven years the company spent an average of U.S. $24.5 million annually.
   (2) Sellers: Farmers and landowners. In compensation for reduced use of fertilizer - and hence reduced profitability and higher perceived risk - farmers were given contracts by Vittel for up to 30 years.
   (3) Intermediaries: The government facilitated the deal by providing a small amount of financial aid and a strong legal framework to ensure the enforceability of contracts.
d. Payment scheme type: Private sector payment scheme. Vittel purchased 1500 ha of farmland for U.S. $9 million, paying more than the market price. Usufruct rights were then granted back to the farmers, giving them the legal right to use and derive profit from land owned by Vittel. Farmers receive U.S. $230 per hectare annually to manage the land using sustainable practices that insure high water quality standards.

4. Protecting watersheds
   a. Water protection fund in Quito, Ecuador (Smith, de Groot, and Bergkamp 57)
   b. Catskill water market in New York (Duraiappah 5-6)
   c. Private rights were created for the water purification ecosystem service provided by the Catskill mountain ecosystem. "Water purification was provided by negotiating with land owners to modify their land-use patterns in a manner that guaranteed the continued supply of that particular ecosystem service. The collective right was bought by individuals who valued the public good ecosystem service sufficiently to pay for the supply of this service."
   d. The cost of a substitute water purification service (i.e. building and maintaining a water filtration plant) was calculated and used to determine

the value of the ecosystem service.

5. Establishment of Riparian Buffers on Agricultural Lands in the Oregon Coast Range: Beaver Creek Case Study (2001)
    a. This case study looks at dairy farms in Oregon, but has some relevant findings: The goal of this project was "to develop information on how to establish riparian filter belts that lead to improved stream protection and fish habitat in the agricultural portions of coastal watersheds while removing as little pasture as possible from production."
    b. There were a number of problems with beaver (Page 7).
    c. This buffer was put into place in 1995; beaver were restricted with three foot high (minimum) plastic tree shelters.
    d. By August, 1996, beaver had removed or damaged 81 percent (65 of 80) of the alder trees planted with protection by Vexar tubes.
    e. Trees protected by another type of tube (Protex) had a better survival rate; 2 percent (10 out of 450) were damaged by beaver.
    f. The Protex tubes require maintenance every year to ensure they are secure (before beaver begin feeding in spring).
    g. Herbicide treatments were continuously applied (Page 12) to control weeds.
6. Federal Duck Stamp Program
    a. History of the Federal Duck Stamp – The Federal Duck Stamp Program was established in 1934 by President Franklin D. Roosevelt's signing of the Migratory Bird Hunting and Conservation Act. This Act required all waterfowl hunters age 16 and over to purchase the stamp (not valid for postage) from the U.S. Postal Service as a hunting license. Proceeds (98 cents on every dollar) go to the U.S. Fish & Wildlife Service for habitat conservation. The funds are managed by The Migratory Bird Conservation Commission (MBCC) for the lease and purchase of wetlands.
    b. Junior Duck Stamp Program – The Federal Junior Duck Stamp (JDS) Conservation and Design Program began in 1989. This program combines art with wetland and waterfowl conservation into a curriculum for students

in grades K-12. Any student of this age may enter the design contest, and an average of 27,000 students submit entries annually. Proceeds from Junior Duck Stamp sales go towards awards and scholarships for environmental education programs across the country.

c. Sale of Stamps – While waterfowl hunters are required to purchase the stamps as a hunting license, sale is not limited to hunters. Any citizen may purchase the stamp for use as a season pass to national wildlife refuges (these refuges usually charge an entry fee); stamp collectors purchase Duck Stamps as collectibles; conservationists buy them because 98 cents on every dollar goes towards the purchase of wetland habitat for the U.S. Fish and Wildlife Service's National Wildlife Refuge System. The First Day of Sale Ceremony at the Smithsonian National Postal Museum in Washington, D.C., releases the latest stamp design to the public on July 1st of each year. Stamps are available for purchase at U.S. post offices, online, and at many sporting goods stores. The 08-09 Federal Duck Stamp sells for $15, and the 08-09 Federal Junior Duck Stamp sells for $5. Products bearing the stamp design may be sold by licensed vendors, but the USFWS does not produce these products.
d. Stamp Design Contest – The first Federal Duck Stamp was designed at the request of Franklin D. Roosevelt by Jay "Ding" Darling. In the following years, wildlife artists were invited to submit designs, and in 1949 the design of the stamp was opened as an annual competition to all U.S. citizens over the age of 18. Judges are renowned waterfowl authorities, artists, and stamp-collectors appointed by the Secretary of the Interior. The winner of the contest is not compensated but may sell prints of his design.
e. Success of the Program – The Federal Duck Stamp Program has raised over $700 million since its inception in 1934. These funds have been used to obtain over 5.2 million acres of habitat for the National Wildlife Refuge System.
f. Similar Programs – Since the success of the Federal Duck Stamp Program, many states have created their own duck stamp programs. The purposes

for these state programs range from the production of a collector's item to hunting and conservation functions similar to those of the federal program.

g. Sources

(1) Duraiappah, Anantha Kumar. iisd. Markets for Ecosystem Services. A Potential Tool for Multilateral Environmental Agreements. Manitoba, 2007: 21pp.

(2) Smith, M., de Groot, D., and Bergkamp, G. Pay. Establishing payments for watershed services. IUCN. Gland, Switzerland, 2006: 109pp. U.S. Fish & Wildlife Service: Federal Duck Stamp Program http://www.fws.gov/duckstamps/Info/Stamps/stampinfo.htm

(3) The National Postal Museum http://www.postalmuseum.si.edu/exhibits/2e_artistic.html

(4) U.S. Fish & Wildlife Service: The Federal Junior Duck Stamp Program http://www.fws.gov/duckstamps/junior/History.htm

(5) Duck Stamps: Save the Wetlands http://www.duckstamp.com/

Appendix B– Contact Information for Sacramento River Project Experts

Name: Dawit Zeleke

Title: Sacramento River project Manager

Company: The Nature Conservancy

E-mail: dzeleke@tnc.org

Phone: (530) 897-6370 (no longer valid)

Alt. Phone: (530) 518-7244 (updated number, cell)

Name: Fred Thomas

Title: Agricultural consultant

Company: None provided

E-mail: None provided

Phone: (530) 891-6958

Alt. Phone: 530-521-7142 (cell)

Name: John Carlon

Title: Economist

Company: Sacramento River Partners

E-mail: www.riverpartners.org (website)

Phone: (530) 894-5401 x224

Alt. Phone: None Provided

Name: General Information

Title: None provided

Company: University of California, Davis

E-mail: www.ucdavis.edu (website)

Phone: (530) 752-1011

Alt. Phone: None provided

Appendix C– Telephone Transcript Example

Hello. My name is Kathryn Sayles from Six Mile Consulting Group. We are working on a project in Entiat, Washington, that looks at various aspects of protecting fish habitat in agricultural areas. Nancy Warner provided us with your contact information and thought you would be able to answer a few of our questions. Is now a good time to talk?

> If yes: Great.
> If no: What would be a better time for you? Is this the best number to reach you? Wonderful. I will give you a call later. I look forward to speaking with you again soon.

First, let me provide you with a little more background information. Last year we began working with a group of apple and pear farmers in Entiat, Washington. Together we are using economic analysis to examine the relative costs and benefits of protecting fish habitat. More specifically, we want to know how much money a farmer would need in order to set aside land for riparian buffer construction and maintenance. We understand that you have had similar experience and success with the Sacramento River.

1. What are the variables that you accounted for in your project?
2. Are there any issues that you wish you could have included, but couldn't for whatever reason?
3. Were there any particular sources for data collection that you found more beneficial than others?
4. Did you find or calculate any estimates for one time costs of installing riparian buffers?
5. What were the specifications of these buffers in terms of type, depth, length along the river etc?

6. Do you think it's reasonable to extrapolate your data to the Washington area? If not, what would you recommend that we include to make these estimates as accurate as possible?
7. What would you estimate is the cost for maintaining these riparian buffers?

8. Are these costs constant over time, or do they increase/decrease as the buffer ages?
9. Is there anything else that you think is valuable to understand about the cost of maintaining buffers between restored riparian habitat and agriculture?

Thank you so much for your time. We really appreciate your input. Please do not hesitate to contact us anytime if you think of anything else that might be helpful. My phone number is (406) 551-4875. Enjoy the rest of your day.

Appendix D – Inflation Adjustment Computation

GDPDeflator		
Quarter	Rate	Rate of Change
2003-IV	107.19	
2004-IV	110.67	3.25%
2005-IV	114.525	3.48%
2006-IV	117.732	2.80%
2007-IV	120.743	2.56%
2008-IV	122.976	1.85%
Annual Average, 2004-2008		2.95%
Source: BEA		
Series Title: Gross domestic product: Implicit Price Deflators for Gross Domestic Product: 2000=100; SA (quarterly)		

Appendix E – Literature Review

Summary of Payments for Ecosystem Services – Forest Trends, The Katoomba Group, and UNEP. Payments for Ecosystem Services. Getting Started: A Primer. Harris Litho. Washington, DC: May 2008.

Developing a Market for Ecosystem Services: Stimulating users to pay online at http://www.fs.fed.us/ecosystemservices/About_ES/faq.shtml

Establishment of Riparian Buffers on Agricultural Lands in the Oregon Coast Range: Beaver Creek Case Study (2001)

- Looks at dairy farms in Oregon, but has some relevant findings: The goal of this project was "to develop information on how to establish riparian filter belts that lead to improved stream protection and fish habitat in the agricultural portions of coastal watersheds while removing as little pasture as possible from production."
- There were a number of problems with beaver (Page 7)
    - This buffer was put into place in 1995; beaver were restricted with 3 foot high (minimum) plastic tree shelters
    - By August, 1996, beaver had removed or damaged 81 percent (65 of 80) of the alder trees planted with protection by Vexar tubes
    - Trees protected by another type of tube (Protex) had a better survival rate; 2% (10 out of 450) were damaged by beaver
    - The Protex tubes require maintenance every year to ensure they are secure (before beaver begin feeding in spring)
    - Added cost? Do we need these tubes?
- Herbicide treatments were continuously applied (Page 12) to control weeds

Payments for Environmental Services in Watersheds: Insights from a comparative study of three cases in Central America

- Not directly relevant; used questionnaires which is definitely not dependable, but provided insights about estimating costs.
- *Page 3:* Describes how opportunity costs were estimated and how the degree of compensation was calculated
    - Opportunity costs:
        - Net profits from on-farm activities that would be foregone
            - Total production multiplied by the average price of products, minus the cost of inputs and labor
        - Provider's willingness to accept as a "fair price" for PES (Payment for Environmental Services)
        - Expected rent that would be obtained if the land were rented out
    - Degree of compensation
        - Calculated by deducting the opportunity costs from the potential or actual amount paid by the PES scheme → a negative value for DoC means PES scheme would not fully compensate for opp. Cost

- *Page 8*: If you calculate net on-farm profits, obtain an estimate of a fair PES and determine farmer's willingness to rent (at what price), they SHOULD be the same. However, this is not the case.
    - Shows that estimation of opportunity costs "may differ considerably depending on the method used and the assumptions adopted."

Rural Technology Initiative

a. Fact Sheet

- NIPF = Non-industrial private forest
- July 2001: All of Washington updated its rules to the "Forest and Fish Rules" (FFR) which are supposed to protect and restore salmon habitats (specifically in forested areas)
- Western Washington: a three zone riparian buffer was now required by law on both sides of fish-bearing streams, and no harvest was allowed in the zones. For those who harvest timber for a living, this meant a reduction in their harvest.

b. Economic Impact of the Forests and Fish Rules on Small, NIPF Landowners

- This report looks at ten case studies involving NIPF landowners affected by this law, and reports the overall effects of the buffers on land value and income
- *Page 4:* Mitigation of economic impacts (compensation plans)
    - Forest excise tax, FREP (Forestry Riparian Easement Program), timber sales,
- *Page 10-15:* Economic Analysis & Impacts
    - discusses the effects of riparian buffer zones on land value and forest value, and the impacts of mitigation
    - Land value specifically seemed to decrease due to these riparian buffer zones; sometimes land could not be used again for timber after a riparian zone was there – does this mean an orchard could not be replanted?
- *Page 17-18*: Economic impacts, management options, effectiveness of mitigation
    - FREP was effective when harvesting was done in riparian zones
- Also discusses the value of harvesting in the riparian lands

What Landowners Should Know When Considering Conservation Easements – Insights from Colorado Landowners

- Based on 20 case studies in the Colorado area; Colorado State University questioned landowners
- Easement: agreement between landowner and land trust and/or government agency that limits property uses to protect the benefits of natural resources (an easement for conservation purposes means you voluntarily give up your land rights)
- *Page 7*: types of compensation – landowners may save through lower estate taxes, income taxes, savings for donation of land, conservation easement payments
- *Page 8*: Property rights affected may include water, mineral, oil and gas, as well as possible public access
- *Page 11:* for surveyed landowners, their CE (conservation easement) averaged 51 percent of the costs.

Lynch, Lori, and Cheryl Brown. "Landowner Decision Making About Riparian Buffers." Journal of Agricultural and Applied Economics 32 (2000): 585-596.

- Discusses Maryland's BIP (Buffer Incentive Program) and CREP (Conservation Reserve Enhanced Program) and attempts to use a model to simulate a landowner's decision making process when considering signing up for one of these cost-share and easement programs
- Journal of Agricultural and

Heimlich, Ralph E. "Costs of an Agricultural Wetland Reserve." Land Economics 70 (1994): 234-246. JSTOR. 16 June 2008.

- *Page 235:* Economic model – "assuming landowner is indifferent between holding cropland and a permanent easement on this cropland if a one-time payment just equal to the discounted present value of returns to agricultural use were available."
- Uses this assumption to determine minimum easement value
- *Page 241:* "Average restoration costs increase little; almost all of the change in total cost from regional enrollment [in these types of incentive and cost-share programs] is due to changes in easement costs."

Paterson, Robert W., and Kevin J. Boyle. "Costs and Benefits of Riparian Forest Management: a Literature Review." Industrial Economics, Incorporated, 2005.

- **Final Report, 2005, Prepared for:** the Minnesota Forest Resources Council
- First section: discusses literature on riparian management benefits (water quality, recreation, etc.)
- *Page 12:* Second section: a literature review of approaches to estimating costs associated with riparian management
    - This is in terms of forests – discussion includes foregone timber revenue, rather than fruit or crop revenue
- *Page 13:* Literature review of Cost-effective riparian management strategies

Maille, Peter. "Farmer Participation in Riparian Buffer Zone Programs." Science and Society Series Paper No. 1 (2001).

- *Page 5:* Addresses concerns of farmers in the Potomac waters region of WV
    - Suspicions about ultimately losing the right to manage the farm as is necessary
    - Time and labor requirements
    - Maintaining fences
    - Desire the presence of a successful model
    - Public access to their riparian buffer zone
    - Uneducated about riparian buffer projects
    - Desire a longer list of allowed conservation activities.