Restoration of a Riparian Buffer: Traditional and Non-Market Benefits and Costs

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Summary

Through the collection of traditional costs and benefits, and by using the direct benefit transfer method we were able to construct a range of monetized costs and benefits that better represent the true value of the Fourmile Creek restoration project when compared to normal accounting methods. By attempting to identify and monetize traditional as well as non-market benefits and costs, we could begin to compare the potential benefits to stakeholders both within the project area and further afield, as a result of the initial investment in the restoration project.

1. About the Fourmile Creek revegetation project

Overview of the Restoration Project

The Fourmile Creek is a tributary of the Nooksack River in northwest Washington State. The creek runs through high-value commercial farmland that has historically been drained to support intensive berry and dairy production. Prior to the start of the restoration project, little or no riparian vegetation remained along Fourmile Creek. The stream channel was infested with reed canary grass and choked with sediments. Regular dredging of both the ditches and the creek were necessary to maintain adequate drainage of agricultural land. Instream fish habitat was in a poor state, due to limited water flow and high water temperatures.

Objectives of the project

- Drainage of agricultural land:
  Remove accumulated sediments and non-native reed canary grass from the Creek itself, in order to maintain adequate drainage of their land for continued agricultural production.
- Improvement of fish habitat and water quality:
  Improve fish habitat and water quality, which had been compromised by lack of shade cover, encroachment of reed canary grass and build-up of sediments in the stream channel, leading to higher temperatures and low dissolved oxygen levels in the water.
- Improvement of water quality for shellfish and public health:
  Improve water quality downstream in the Tenmile Creek, where there is a TMDL in place for fecal coliforms.

The restoration project involved removal of accumulated sediments and non-native reed canary grass from the stream channel to improve drainage, and then planting of native trees and shrubs in riparian buffers between 15 and 30 feet in width. The Fourmile Creek riparian revegetation project was part of a larger restoration effort for the Tenmile Creek watershed. Funding for Tenmile Creek restoration efforts since 2002 has come from two WA Department of Ecology Centennial Clean Water Fund grants and from a US Fish and Wildlife Service grant. Whatcom Conservation District managed the grants and worked with the Nooksack Salmon Enhancement Association and Whatcom County Sheriff's Alternative Corrections Program crews to plant and maintain the vegetated buffers during the project.

Before: Stream channel with little shade, choked with reed canary grass and sediments

Photographs by Steve Seymour

Photograph from Belisle et al. (2006).

Planting: After the creek has been cleared of sediments and canary grass, the shrub buffers are planted. Buffer width varies between 5' and 15', in addition to a 20' grass filter strip.

Outcomes

Since the project was completed in 2005, some maintenance and replanting of vegetation has occurred, but the channel remains generally clear of sediments and free of reed canary grass. No dredging has been necessary since the initial removal of sediments at the beginning of the project. Ongoing monitoring indicates that instream dissolved oxygen and temperature meet Washington State water quality criteria for aquatic life (document WAC 173-201A-200) requirements at the confluence with Tenmile Creek downstream for temperature and dissolved oxygen.

Progress: Shrub buffer two years after planting showing partial shade cover.

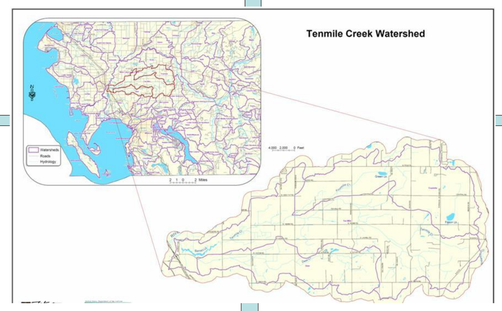
Progress: Shade cover increases as the vegetated buffer reaches maturity preventing growth of new canary grass while providing improved habitat and effective drainage. Photo taken in 2008.

Photographs from Belisle et al. (2008)

Outcomes:. Note grass filter strips installed between the corn field and the vegetated buffer. *Photograph by Heather MacKay (2011)*

Benefits

As a result of the initial investment in restoration, the project has generated tangible benefits for agricultural landowners, fish habitat and water quality downstream. Additional ecosystem services generated by the project potentially include increased pollinator habitat, increased aesthetic value and enhanced biodiversity. In an attempt to quantify these benefits, a pre-analysis of the benefits and costs was undertaken using non-market valuation methods and the benefit transfer method to estimate ranges of values for the ecosystem services provided by the stream restoration.



2. Methodology for assessing benefits vs. costs

Objectives of the assessment of costs and benefits:

- Identify the ecosystem services that were potentially restored or enhanced by the restoration project.
- Identify the benefits at various scales of these restored or enhanced ecosystem services.
- Estimate a range of monetary values for the benefits provided.
- Use the results to educate stakeholders and the public about the non-market values associated with stream restoration.

Dorie Belisle on a farm bordering Fourmile Creek. Photo by Heather MacKay.

Costs

Costs associated with the revegetation project were separated into:

1. Direct costs of buffer installation and maintenance during the five years of buffer establishment; including the expenses associated with site preparation, materials, planting, and annual maintenance.
2. Direct costs of buffer maintenance after the first five years of the project, once the buffers were fully established;
3. The cost to landowners of retiring agricultural land , i.e. the opportunity cost of taking land out of production to create the buffers. The opportunity cost, or the next most profitable option to the farmer, was assumed to be equal to the rental value of their land.

Long term monitoring: Citizen volunteers have been monitoring the dissolved oxygen and temperature of Fourmile Creek since 2003.

Benefits

In order to quantify the values of the benefits associated with the restoration project we identified two forms of values, traditional and non-market values.

Traditional Values

1. Reduced future cost of maintaining the ditch for the landowners, i.e. the reduction in or avoidance of dredging costs. The calculation consists of the average cost of dredging pre-restoration using data from 1980 to 2002.
2. Potential value created by maintaining or enhancing the efficiency of Fourmile Creek as part of the land drainage network, and therefore increasing agricultural output within the county. This entailed estimating the increased area of land that was made available by draining agricultural land adjacent to Fourmile Creek and multiplying that by a weighted average rental value of an acre of farmland in the county.

Non-Market Values

Non-market valuation incorporates the idea of ecosystem services.

The benefit transfer method is used to estimate the economic value of the benefits created by ecosystem services through transferring the results of existing valuation studies (hedonic price models, contingent valuation models, travel cost method, etc.) and applying these results to an alternative location (King and Mazzotta, 2003). There are multiple types of the benefit transfer method. The direct benefit transfer method was used in this study.

To use the direct benefit transfer method, we identified existing studies that were similar to the Fourmile Creek restoration project and applied their results to our study. For example, Streiner and Loomis (1995) investigated the aesthetic benefits that were created by stream restoration projects. They quantified the aesthetic benefits, using the hedonic price method, by evaluating how property values change once a restoration has taken place in a given area. Another example of our use of the direct benefit transfer method is Olschewski et al. (2006). Their study estimated the value of pollination services to coffee producers in Ecuador and Indonesia. This study is not highly correlated to the study area at Fourmile Creek, but is one of the few studies that quantify pollination services.

Some studies will provide more accurate approximations of the values than others. However, the direct benefit transfer method is helpful when attempting to estimate multiple non-market values in a short period of time and with a limited budget, as was the case for our project. It also helps to educate stakeholders and the public about the total value and broader benefits of restoration projects.

3. Benefits and costs: results

Costs

Costs of Buffers	Total cost for First Five Years	Estimated Annual Cost Thereafter	Costs to Whom
• Clear and Plant 15' (8.1 acres) • Maintain for first five years (weed, irrigate)	$115,000 ($14,200/acre) Source: NSEA	$2,500/acre/year for maintenance	First 5 years paid through grants and match (see Funding). Ongoing maintenance cost to landowners through DID.
Cost of retiring agricultural land from production	$9,500 ($1,200/acre)	$1,900 per annum ($233/acre/year)	Cost to landowners

A section of the Fourmile revegetation project, 2008. Picture by Dorie Belisle.

Benefits

Service	Benefits	Value	Benefit to Whom	References
Ag production maintained due to effective drainage	Reduced cost of drainage maintenance Contribution to ag economy of Whatcom County	$3,300 per year ($400/acre/year) $350,000 per year (net operational profit for ag)	Fourmile landowners Fourmile landowners, County community	• *DID #3 – costs prior to restoration 1980-2001* • *Whatcom County Farm Friends and Whatcom County Public Works (2009)*
Increased native pollinator habitat	Pollination of crops	$650 – $8,100 per year ($80-$1000 per acre of habitat per year)	Fourmile landowners	• *Olschewski et al. (2006) & Ricketts et al. (2004)*
Aesthetic Value	Increased property value	3-13% increase	Fourmile and surrounding landowners	• *Streiner and Loomis (1995)*
Water quality	Improved fish habitat Improved shellfish beds downstream Public health benefit	Nooksack salmon runs Cost of downstream Drayton Harbor shellfish closures = $337,000 per year Reduced water treatment cost and protection of drinking water quality	Nooksack watershed and Puget Sound residents Shellfish operators County community	• *Drayton Harbor Shellfish Protection District (2010)* • *MacKay (2010)*
Biodiversity	Maintenance of habitat for endangered species	Protection of ESA listed species in Nooksack watershed	County community and Puget Sound Region	• *MacKay (2010)*

Spatial Component (Who benefits?)

Who benefits from the ecosystem service is a major concern when quantifying the value of a benefit for two main reasons. First, the use of the benefit largely dictates the value of that benefit. For example, will the next acre-foot of purified water be used for irrigation or municipal uses? If the next acre-foot of water is used for irrigation the value could be quite different than if it was going to be used by a municipality. Secondly, some benefits are dispersed to beneficiaries over a large area beyond the site where the ecosystem services are generated.

Benefits become more dispersed the farther from the source and are therefore more difficult to quantify at larger scales. The spatial scales that we identified were (by increasing scale) the landowner's property, surrounding landowners' properties, the Whatcom county community, Nooksack Watershed and the Puget Sound Region. For example, improved water quality as a result of the revegetation project could be directly responsible for a potential increase in the quantity/diversity of fish within Fourmile Creek. However, the benefits it may provide as a tributary to Tenmile Creek are highly dispersed benefits to many benefactors. Which of these contributions is more valuable depends on how benefits are aggregated, an aspect which is not addressed often in the literature.

4. Potential application in a natural resources marketplace

Application of findings

This study was undertaken in order to inform development of a future natural resources marketplace (NRM) in Whatcom County, WA. The NRM is intended to provide a platform for facilitating transactions in ecosystem services credits between "sellers" (such as landowners who restore habitat on their land) and "buyers", such as downstream water utilities or salmon recovery programs. The idea that farmers could be both buyers and sellers in the marketplace (see table below) opens up the possibility for transactions based on in-kind, out-of-kind and monetary currencies. Payments to farmers could provide incentives for them to restore and enhance habitat on their land voluntarily, while the structure provided by the marketplace allows resources such as restoration dollars, CREP funding and other incentives to be directed more strategically to high-value projects in areas of high ecological importance.

Summer 2008

Standing in the same spot, summer 2011

Potential credits as incentives or exchanges for restoration and enhancement of stream habitat in the Fourmile watershed

Type of currency	What is this ?	Supplied by	Sought by	Potential reach of transactions.
Drainage credits	Reduced cleaning and maintenance costs, due to shading out of reed canary grass.	Landowners	Drainage District	Within Fourmile Drainage District boundaries
Temperature credits	Reduced summer water temperatures due to shading of the water surface.	Landowners	Salmon recovery programs in Tenmile Creek and Nooksack basin.	Tenmile to Nooksack watersheds. Possibly to Puget Sound.
Water quality credits	Improved water quality downstream due to filtration of nutrients and suspended solids by buffers.	Landowners	Downstream water users,; aquatic habitat managers, water associations, water utilities.	Tenmile to Nooksack watersheds.
Habitat credits	Improved fish habitat and fish passage due to removal of reed canary grass.	Landowners	Aquatic habitat managers.	Within Tenmile watershed.
Drainage permits	Assurances that drainage infrastructure can be maintained to support farm production.	WA Dept of Fisheries & Wildlife (Hydraulic Permit Authority).	Farmers.	Within drainage district boundaries
Water contracts	Assurances that water to support farm operations is accessible.	WA Dept of Ecology; Proposed future water bank or water exchange.,	Farmers.	Within Tenmile watershed.

What is a "marketplace approach"?

The principle behind a range of emerging market-based tools for natural resource management is that people or groups who go beyond the standards required by regulation to manage and protect land, water and natural resources should be able to trade the benefits generated from their actions in exchange for regulatory relief, permits, or payments in kind, with those who seek to purchase credits to mitigate the unavoidable impacts of their actions or projects.

How would a marketplace approach work ?

Conservation markets have increasingly emerged in the US and internationally to provide structured settings ("marketplaces") within which ecosystem services and credits can be valued, priced and traded amongst interested buyers and sellers – in cash as well as in kind. They are designed to operate within and alongside the regulatory framework, and include water banks, wetland banks, mitigation banks, markets in "carbon credits" and water quality trading programs, amongst others. A marketplace facility should allow buyers and sellers to find each other, prices to be negotiated, credits to be verified, and should ensure that all transactions will be compliant with applicable environmental and planning regulations, licenses and permits. For more information, see www.wcfarmfriends.com

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