Ecosystems Services Case Study: Clean Water Services Tualatin River, Washington

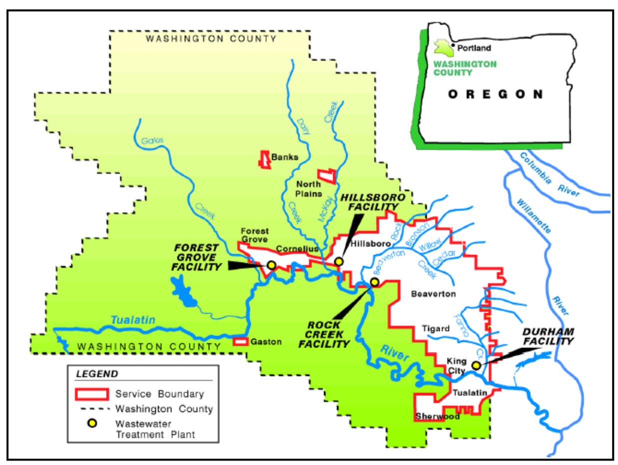
Viewed broadly, the concept of 'ecosystem services' describes the many resources and services provided by nature. Typically, traditional planning and development practices do not adequately represent the full range of benefits received from the natural world.

Case Relevance

The Clean Water Services case discussed here presents an innovative strategy of using a watershed-scale approach to meet regulatory requirements for water quality. The National Pollution Discharge Elimination (NPDES) permit issued to Clean Water Services in 2004 was the first example of a municipal, integrated watershed-based NPDES permit in the nation (Cochran and Logue, 2011). The NPDES permit covers four treatment plants and the Municipal Separate Storm Sewer Systems (MS4), and under this permit the state of Oregon allowed water quality trading—specifically water temperature trading—to be used as a new approach to meet environmental compliance requirements. Utilizing the cooling functions of riparian vegetation[1] in conjunction with supplementing water flows enabled CWS to avoid constructing additional treatment facilities or other mechanized solutions to cooling effluent. This strategy, based on harnessing natural functions and services, offers a multitude of ecological, social, and economic benefits that engineered solutions do not.

Background

Communities in Washington County, situated directly west of the City of Portland, have experienced high population growth rates and rapid suburbanization over the past two decades. Washington County lies almost entirely within the Tualatin River Watershed, a 712 square mile (1,844 km^2) drainage area. Prior to the 1930s, historic land-use practices in this area—such as clearing lands for agriculture and urbanization—removed vegetation from the banks of the Tualatin River (Cochran and Logue, 2011). Loss of riparian vegetation translates into impacts to ecosystem services that can result in lowered capacity for stream temperature regulation, less sediment and nutrient filtration, reduced carbon



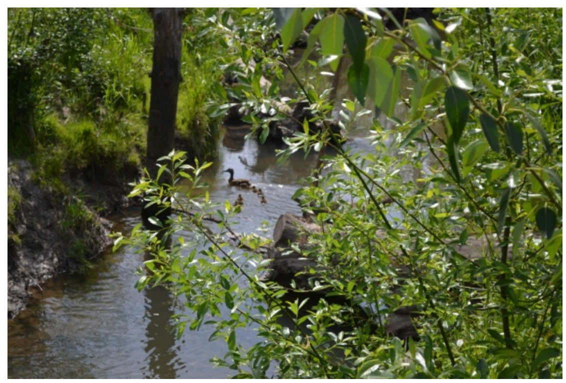
sequestration, and the loss or degradation of wildlife habitat (Cochran and Logue, 2011). Clean Water Services is a utility providing water resources management for more than 500,000 residents of the Washington County area, including wastewater collection and treatment and stormwater management services. In 2001, the Oregon Department of Environmental

[1] The Willamette Partnership has developed tools for calculating the impacts of riparian restoration on water quality: http://willamettepartnership.org/ecosystem-credit-accounting/water-quality/copy_of_water-quality-temperature

Quality (DEQ), in accordance with federal and state water quality and endangered species regulations, issued temperature Total Maximum Daily Load (TMDL) requirements for the Tualatin River and its tributaries. A TMDL sets a limit on how much of a pollutant a river can receive on a daily basis and still meet water quality standards. In the case of temperature, a TMDL dictates an allowable amount that human activities, such as the discharge of treated wastewater to water bodies, can warm a stream above natural conditions. Excessive temperature is one of the most frequent causes of water bodies in the Pacific Northwest becoming listed as "impaired" (i.e. not meeting State water quality standards) on state 303(d) lists[2], triggering TMDL requirements. Cool water is essential to watershed health because it contains more dissolved oxygen than warmer water, and this relationship is critical to the survival of many aquatic species. Anadromous fish, such as salmon, are particularly reliant on cool waters that cause less metabolic stress and reduce physiological triggering of spawning, fry development, and migration.

The Ecosystem Services Concept and Ecosystem Service Markets

Water resources can be exposed to contaminants in a number of ways, primarily identified as either point source or nonpoint source pollution. Point source pollution refers to contaminants that are attributable to an identifiable, specific source, such as that released from pipes, sewage treatment plants, or industrial facilities. Nonpoint source pollution typically enters waterways through runoff, precipitation, drainage, or seepage. Excess temperature, as discussed in this case, can be attributed to point source and nonpoint source pollutions, and is additionally increased by exposure to the sun. Like many watersheds, the Tualatin Basin experiences impacts from a variety of pollution types and sources, requiring comprehensive solutions to improving water quality. In this case, Clean Water Services was essentially able to trade reductions from nonpoint source pollution for the contributions from point source pollution (in the form of temperature) entering from their wastewater treatment facilities.



Shade enhancement project in Greenway Park, Beaverton, Oregon

Effluent from Clean Water Services' Durham and Rock Creek treatment facilities contribute more than 40% of the flow of the Tualatin River during summer months (Cochran and Logue, 2011), making the temperature of this discharge highly influential on the overall water temperature. The TMDL issued for the Tualatin River required that the Durham facility temperature be reduced to 64 F and the Rock Creek facility temperature be reduced to 58 F (Cochran and Logue, 2011). In addition to the effluent released from CWS' facilities, the temperature of the Tualatin River is significantly impacted by solar radiation—a problem that is exacerbated by insufficient shade along the

[2] The 303(d) list details the impaired and threatened waters that require development of TMDLs. yearshttp://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overview.cfm

river. Clean Water Services evaluated a number of technological solutions to meet their NPDES permit requirements, including mechanical cooling with refrigeration technology, exporting effluent out of the river, and evaporative cooling using cooling towers, spray ponds, and cooling ponds (Clean Water Services, 2005). These options were found to be prohibitively expensive, energy intensive, and/or not as effective as needed for the temperature reduction requirements. Mechanical cooling, while effective, has very high construction and maintenance costs (estimated at $150M and $6M per year, respectively). Exporting effluent out of the basin has high associated capital and operational costs (minimum of $78M-$101M and $0.6M-$3.3M per year) and also presents a risk by reducing the flow of the river, which can further threaten water quality and exacerbate temperature increases. Evaporative cooling is estimated to be in the medium cost range ($10k-15k per mgd per degree F plus the purchase of land), but depends on specific humidity conditions and may have limitations due to the climate of the Willamette Valley.

Shade enhancement project in Greenway Park, Beaverton, Oregon

Given these limitations, CWS explored the potential for using a natural infrastructure approach to address the TMDL. In collaboration with the US Environmental Protection Agency (EPA) and Oregon DEQ, Clean Water Services was able to develop a watershed-based permit for the Tualatin River, based on activities outlined in a Temperature Management Plan (2005). The 2004 NPDES permit issued to Clean Water Services by DEQ authorized the use of a thermal load trading program that consists of riparian restoration and flow augmentation to offset the thermal loads from the treatment facilities. This approach includes land rental payments made to landowners for planting trees to provide shade to stretches of stream, and other restoration activities such as removal of invasive species. Oregon's DEQ uses a model (referred to as the Shade-a-Lator model) to calculate the thermal load that is blocked as a result of the riparian planting:

> Heat load reduced = (area of stream shaded)
> x (increase in shade density)
> x (solar insolation rate)
>
> Where Tualatin Basin's solar insolation rate is 479 kcal/ft^2/day.

This information is then used with a trading ratio to determine the thermal credits that are issued for a riparian enhancement project. Riparian planting projects by Clean Water Services use a 2:1 trading ratio for thermal load reduction requirements (per the temperature TMDL). In effect, this ratio compensates for the lag time between when trees are planted and when they are tall enough to provide full shade benefits to the stream and fish. Each shade credit lasts for 20 years and this life span is based on an equivalent viable lifespan for a hard-engineered technological solution such as a cooling tower. Additionally, in the critical summer and fall months when increased water temperatures can put salmon at particular risk, Clean Water Services releases cooler, stored water from two reservoirs. This additional release of water to the river, referred to as a flow augmentation, counters warmer river temperatures. Thermal credits for flow augmentation are calculated based on the needed release rates in July and August.

Partnerships and Programs

Development of the watershed-based permit for the Tualatin River required cooperation and resources from the US EPA and Oregon DEQ. In 2002 the US Environmental Protection Agency (EPA) issued a policy memo explaining the agency's commitment to furthering the use of holistic strategies for addressing water quality issues, specifically through development of watershed-based NPDES permits[3]. The EPA additionally identified water quality trading as a potential alternative to traditional water quality management options, and instituted funding mechanisms to support state agencies that can facilitate these programs (Clean Water Services, 2005). The Oregon DEQ was a recipient of such a grant in 2002, and (building on prior funding from the EPA) was able to focus a portion of these funds on developing a watershed permit with Clean Water Services (Oregon Department of Environmental Quality, 2007). Additionally, Clean Water Services received a grant directly from the EPA to advance the utility's efforts to create a watershed-wide approach to meeting TMDL requirements (Cochran and Logue, 2011).

The NPDES permit requirements also fostered partnerships with a number of agencies, organizations, and other entities. The temperature management plan that was developed to implement the thermal load trading program established annual benchmarks for shade and estimated that 35 stream miles would be planted during the permit term. The vegetation plantings and restoration efforts span urban and rural areas across the Tualatin watershed, engaging a number of stakeholders in the process. Clean Water Services has partnered with Soil and Water Conservation Districts, tree suppliers, and restoration contractors to ensure that riparian plantings and other improvement projects are consistently implemented, maintained, and monitored for restoration effectiveness. Clean Water Services' tree planting and vegetation restoration efforts have included a capital improvement program and an Enhanced Conservation Reserve Enhancement Program for rural areas (farmers).

The Enhanced Conservation Reserve Enhancement Program for the Tualatin River Watershed was developed and supported by partnerships with the US Department of Agriculture, Oregon Department of Agriculture, Oregon Water Trust, and the Tualatin Soil and Water Conservation District, and 250 acres of farmland is enrolled in the program.

Shade enhancement project in Englewood Park, Tigard, Oregon

Benefits of Water-Temperature Trading

The 2004 NPDES permit effectively allowed Clean Water Services to use thermal load trading to address the requirements of the

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3 http://cfpub.epa.gov/npdes/wqbasedpermitting/wspermitting.cfm

TMDL issued for the Tualatin River. Using a combination of flow augmentation and riparian planting projects, Clean Water Services has offset the thermal loads from the Rock Creek and Durham AWTFs during the permit term. This approach saved Clean Water Services and its ratepayers between $60 to $150 million in construction and maintenance costs for refrigeration units at the wastewater treatment facilities, as well as $2 million a year in annual electricity (Cochran and Logue, 2011). By 2007, costs for the riparian portion of the watershed trading in both urban and rural areas totaled $4.3 million and represented a 95% cost savings as compared to traditional technology approaches (Cochran and Logue, 2011).

In addition to the cooling functions provided by the riparian restoration, these activities produce significant ecosystem service benefits throughout the watershed. Riparian vegetation provides habitat for fish and wildlife, reduces soil erosion along riverbanks, and increases carbon sequestration, among other benefits. Widespread community benefits are also experienced through this project, in the form of payments to participating landowners, as well as the aesthetic and recreational value of restored riparian areas. This project illustrates the advantages that can be experienced through comprehensive approaches to water quality improvement, and the opportunities that exist in developing new strategies to meet regulatory requirements.

References/Additional Resources

Cochran, B. and Logue, C. 2011. A watershed approach to improve water quality: case study of Clean Water Services' Tualatin River Program. *Journal of the American Water Resources Association.* Vol. 47, No. 1.

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