CENTER FOR OCEAN SOLUTIONS

Washington State's Legal and Policy Options for Combating Ocean Acidification in State Waters

A REPORT TO THE WASHINGTON STATE BLUE RIBBON PANEL ON OCEAN ACIDIFICATION

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Foreword

In March 2012, the organizers of Washington State's Blue Ribbon Panel on Ocean Acidification asked the Center for Ocean Solutions (COS) to contribute a legal and policy analysis to support the Panel's deliberations. The charge was to provide a toolbox of existing and potential options for combating acidification in Washington's State waters, but to do so without making specific recommendations. The Panel itself would make the final policy recommendations on the basis of an inclusive, public process that would play out between March and November 2012, with final recommendations due to be submitted to Washington's Governor Christine Gregoire in late November 2012. This Panel process would be the first comprehensive State-level effort to address the growing challenge of a pervasive shift in ocean chemistry known as "ocean acidification."

The document you are now reading is that policy toolbox. COS developed this piece between March and August 2012, providing Panel members with access to draft versions that informed their discussions during monthly meetings. Concurrently, the Panel's scientific experts carried out an intensive review of the science of ocean acidification as it applied to Washington State waters. That effort resulted in a science white paper (referenced herein), which developed alongside the policy piece. Although ideally the scientific review would have been completed prior to beginning the analysis of policy options for addressing acidification and its effects, the Panel's compressed timeline made this impossible. We accordingly monitored the developing science review and incorporated its findings into the policy work as the two documents progressed. The Panel's working groups used the science white paper and the policy toolbox—among other documents—as springboards for internal deliberation and to develop draft recommendations that then were circulated to the complete Panel for refinement.

"Washington State's Legal and Policy Options for Combating Ocean Acidification in State Waters" is the second such report COS has produced on the subject. The first, released earlier in 2012, focuses on California and is entitled "Why Ocean Acidification Matters to California, and What California Can Do About It." We have written each of these documents in response to requests from policymakers and elected officials in the two states, and we hope that the reports are relevant for the many other states that are just beginning to grapple with ocean acidification and its potential impacts.

Executive Summary

Ocean acidification is primarily a global, CO_2-driven phenomenon, and because Washington emits only a small fraction of the world's CO_2, identifying the State's policy options for addressing the acidification of State waters is challenging. However, it is likely that some coastal pollutants, such as nutrient runoff, exacerbate the effects of atmospheric-CO_2-driven acidification in nearshore waters, magnifying impacts on shellfish and other marine organisms. Because these pollutants originate within Washington, the State generally has the authority to curtail them, offering a means of partially alleviating the effects of acidification in State waters.

The purpose of this report is to provide an account to Washington's Blue Ribbon Panel on Ocean Acidification[2] of the State's options for combating ocean acidification in State waters. We focus almost exclusively on existing policy tools, but note several instances in which new tools might be developed. Although this policy report developed in parallel with the related science report authored by Panel scientists and their colleagues, our work was heavily influenced by the science piece and references that work accordingly.

Several overarching themes emerge from a review of Washington's relevant existing policy tools. First is the juxtaposition between the State's broad authority to regulate the pollutants that cause or worsen ocean acidification and the limited resources available for implementation of that authority. A consistent comment from state and local officials[3] was the lack of staff to deal with inquiries,

A consistent comment from state and local officials was the lack of staff to deal with inquiries, inspections, and enforcement actions.

[2] *Washington Shellfish Initiative Ocean Acidification Blue Ribbon Panel Charter*, Wash. St. Dep't Ecology, 1 (Feb. 21, 2012), http://www.ecy.wa.gov/water/marine/oa/charter.pdf.

[3] We consulted officials from the Washington State Departments of Agriculture, Ecology, and Health, the State Conservation Commission, individual Conservation Districts, city and county offices, the University of Washington, and Washington State University, as well as the federal Environmental Protection Agency-Region X, U.S. Department of Agriculture, and a homeowner along the Hood Canal whose property was proposed to be part of a septic-to-sewer transition project.

inspections, and enforcement actions. Meanwhile, those same officials often stressed the importance of personal, on-the-ground contact with regulated parties in developing mutual trust and understanding that can result in progress on such complex social and environmental issues as emissions and nonpoint source runoff.[4]

Recognizing that state resources are limited and voluntary options (if effective) are preferred over regulatory ones, myriad existing relevant grant and loan programs may be useful. These programs are scattered among different agencies, focusing on individual pollutants or issues. However many aim at similar large-scale goals of cleaner water, improved habitat, and more resilient ecosystems. If these programs could be harnessed to coordinate their funding streams, they might prove effective both at meeting their own original goals and at addressing acidification in Washington State waters. Further developing outreach efforts and citizen science—for example, where landowners are encouraged to monitor their own water quality—may have an important role to play in developing stakeholder involvement and lowering the cost of compliance monitoring.

Reducing exacerbating coastal pollutants is a concrete step that Washington can take to address the effects of ocean acidification, but ultimately, mitigating ocean acidification requires dramatic reductions in CO_2 emissions globally. Some options simultaneously address CO_2 and other subsidiary pollutants—for example, use of methane biodigesters with appropriate nutrient management, or reducing vehicle miles travelled through telecommuting incentives and transit-friendly growth. Finally, several instances of collaborative planning processes stand out as being helpful to build consensus and to make a noticeable difference in water quality: examples include the success of the Nisqually River Council[5] process, the implementation of Best Management Practices along the Chehalis and Willapa Rivers,[6] county- and watershed-level Shellfish Protection Districts,[7] and local watershed planning efforts statewide.[8,9] In addition, the Voluntary Stewardship Program and the Washington Stormwater Center are promising ongoing initiatives. Such collaborative efforts probably must have a regulatory backstop in order to be effective (i.e., real improvements in water quality are required, but actors are given latitude in determining how to reach this goal), and offer attractive models for process-based policy action to mitigate ocean acidification in Washington.

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[4] Note that decreasing the cost of data collection could alleviate this mismatch between authority and implementation somewhat.

[5] Nisqually River Council, http://nisquallyriver.org/.

[6] "In 2011 the state of Washington reported that 84 impaired water bodies in the Chehalis and Willapa watersheds had been restored or partially restored, thanks in large part to widespread non- point source pollution control efforts…[T]his remarkable achievement brings Washington's total number of restored water bodies up to 91—making up approximately 25 percent of the 366 restored (or partially restored) water bodies reported to date nationwide. Washington's recipe for success appears to be a combination of regulatory requirements, stakeholder collaboration, targeted implementation and voluntary efforts. Importantly, the success is documented by watershed-wide monitoring." EPA, *Dairy Regulations and Coordinated Approach Help Restore Record Number of Washington Water Bodies*, Nonpoint Source News-Notes, May 2012, at 14, *available at* http://water.epa.gov/polwaste/nps/outreach/NewsNotes_index.cfm.

[7] These are county- or watershed-wide venues in which to address the various sources of pollution that impair the health and safety of shellfish beds. See discussion below.

[8] *See* RCW 90.82 (Watershed Planning statute).

[9] California's process to delineate the North Coast Marine Protected Areas under the State's Marine Life Protection Act offers another successful example of collaborative environmental decisionmaking within the bounds of an existing regulatory authority. *See Marine Life Protection Act North Coast Study Region*, Cal. Dep't Fish & Game, http://www.dfg.ca.gov/mlpa/northcoast.asp.

Introduction

The Washington State Blue Ribbon Panel on Ocean Acidification is charged with developing recommendations for addressing the emerging threat of changing ocean chemistry to the shellfish industry and to the State's broader marine environment.[10] Doing so requires a strong understanding of the chemistry, oceanography, and biology of Washington's State waters. However, because much of the relevant science is still evolving, even the best available scientific information does not yet resolve critical research and policy questions. Although we necessarily undertake this policy analysis amidst some degree of uncertainty about the extent, causes, and effects of coastal ocean acidification in Washington, several important points of clarity from the Panel's science white paper guide our work:

- Washington's State waters (and surrounding water bodies) have become significantly more acidic over the past several decades, and are particularly vulnerable to pH decline due to a combination of oceanographic and anthropogenic factors;[11]
- The observed ocean acidification primarily reflects a global trend due to rising atmospheric CO_2, a result of human industrialization and related activities;[12]
- The observed rate of chemical change may cause potentially important social, economic, and ecosystem impacts in Washington State, most immediately in the shellfish industry.[13]

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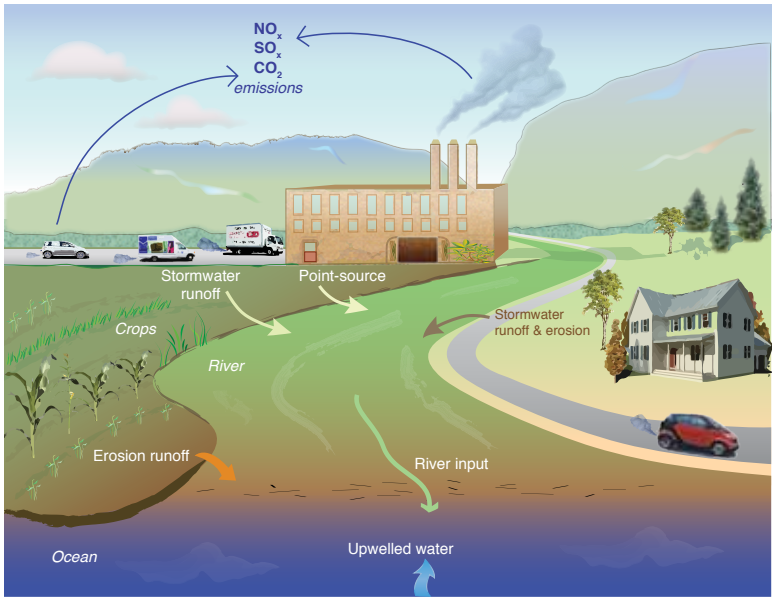
[10] *Washington Shellfish Initiative Ocean Acidification Blue Ribbon Panel Charter*, Wash. St. Dep't Ecology, 1 (Feb. 21, 2012), http://www.ecy.wa.gov/water/marine/oa/charter.pdf ("The Panel will point the way to advancing our scientific understanding of the effects of ocean acidification and will help shape our response to this pressing problem, strengthening the link between science and effective management of our natural resources.") (hereafter, "Charter").

[11] Washington Shellfish Initiative Blue Ribbon Panel on Ocean Acidification Draft Science White Paper 1 (June 25, 2012) (hereafter, "Draft Science Report").

[12] *Id.*

[13] *Id.* at 52 *et seq.* (discussing ocean acidification's potential impacts on species and ecosystems).



A range of sources including upwelling seawater rich in carbon dioxide (CO_2) and excess nutrients and organic carbon from point and nonpoint sources, can contribute to acidification of marine waters. Absorption of carbon dioxide, nitrogen oxides (NO_X), and sulfur oxides (SO_X) from the atmosphere into marine waters may also be important in some local areas (adapted from Kelly et al., 2011). (Scientific Summary of Ocean Acidification in Washington State Marine Waters, Feely et al., 2012).

In addition to global atmospheric CO_2, local- or regional-scale inputs may exacerbate acidification and its impacts locally, by contributing to more acidic conditions and/or by weakening the resilience of coastal ecosystems to the otherwise acidifying ocean. Many of the policy tools we discuss below therefore focus on diminishing these subsidiary pollutants, although these small-scale actions are not a substitute for combating the principal driver of global ocean acidification, CO_2.

In this document, we aim to provide the Panel with a wide variety of tools it might recommend to combat acidification in Washington's State waters. Because acidification is a water- and air-quality problem, many of the policy tools we detail here are longstanding means of controlling water and air pollution. We have also highlighted many non-regulatory, incentive-based programs that would help meet the same goals, recognizing the value of these programs as "carrots" rather than "sticks." The Panel's working groups will focus on issues of cost and feasibility, both of which are critical to the effectiveness of recommendations. Consequently, we do not treat these issues in depth here, despite their importance.

Each of the policy actions we describe below is subject to the threshold requirement that the best available science—although incomplete—suggests that the action 1) is more likely than not to be effective to address the changing ocean chemistry of Washington's State waters, and 2) is likely to cause more good than harm for marine ecosystems when net effects are considered.

Where a policy tool meets these threshold criteria, its relative merit then depends upon its efficacy in combating the acidification of Washington's State waters and upon its impacts on the State's citizens. The efficacy of combating any given acidifying pollutant, in turn, depends upon the relative importance of that pollutant among contributors to acidification in Washington.[14] Determining the relative contribution from each of multiple stressors is complicated by the fact that the importance of different pollutants is likely to vary in space and time, given the spatial and temporal variability of carbonate chemistry in Washington's State waters.

[14] Although this information is not available at present for ocean acidification, several excellent studies point the way toward developing a source budget of contributing pollutants. *See, e.g.*, Teizeen Mohamedali et al., *Puget Sound Dissolved Oxygen Model, Nutrient Load Summary for 1999-2008*, Wash. St. Dep't Ecology, xxii (Nov. 2011), https://fortress.wa.gov/ecy/publications/publications/1103057.pdf; Island County Public Health Department, Environmental Health Division, Draft Island County Surface Water Quality Monitoring Program: Water Years 2007-2011 (provided to the authors by courtesy of the Island County Public Health Department); and Tom Tomich and collaborators' developing nitrogen budget for California, *The California Nitrogen Assessment*, Agric. Sustainability Inst. UC Davis, http://asi.ucdavis.edu/research/nitrogen.

It is therefore important to underscore that any policy analysis explicitly depends upon ongoing scientific analysis, and that even a preliminary finding about the relative importance of chemical inputs can serve to prioritize policy action in a rational way. We emphasize the value of viewing such policy actions as explicit tests of hypotheses about the best means of mitigating, adapting to, or remediating ocean acidification in Washington. Leveraging all available credible information to implement and evaluate the effects of the State's efforts then allows adjustments when necessary, making efficient use of scarce resources.[15]

Decisionmaking, Uncertainty, and Risk

Such actively-developing science—combined with ecosystem complexity—underscores the Panel's role in making decisions despite a degree of contextual uncertainty. However, policy decisions rarely are made with perfect information: instead, decision-makers invariably apply some set of risk-analysis criteria (whether explicitly or implicitly), given the information in hand. In the case of addressing ocean acidification in Washington State, rational decisionmaking requires an assessment of the relative risks and benefits of each policy action, compared with the risks and benefits associated with inaction.

In particular, the Panel's task brings two key functions of government to the fore. The first is managing externalities. The central problem of ocean acidification is the same as that of any widespread pollution: the costs of emitting CO_2 (or any exacerbating factor) are not proportionately borne by the emitters. This is a classic externality, a market failure worsened by a general lack of awareness about the magnitude of the change human activities have created. Overcoming such market failures in order to safeguard human health, security, prosperity, and sustainability is a core function of government.

The second key function is risk management. Where—as here—the costs of policy inaction are uncertain (but not zero) and the costs of policy action are concrete, individual actors often suffer from optimistic bias, Adam Smith's "absurd presumption"[16] that often leads one to irrationally and systematically misjudge probabilities in one's own favor. Hence the risk management function of government, counterbalancing the aggregate effects of individual responses to uncertainty where such effects would undermine the security and well-being of the citizenry as a whole.[17]

The Blue Ribbon Panel's charter requires it to "help shape our response to this pressing problem [of ocean acidification], strengthening the link between science and effective management of our natural resources."[18] Doing so requires not just an acknowledgement of the existence of uncertainty surrounding ocean acidification's effects on the shellfish industry and the broader economy and ecosystems of Washington State. Rather, responding to this fundamental charge requires some transparent calculation of the relative risks of inaction versus action, as well as some recommendation as to how the costs of hedging those risks should be borne.[19]

The central problem of ocean acidification is the same as that of any widespread pollution: the costs of emitting CO_2 (or any exacerbating factor) are not proportionately borne by the emitters.

[15] It is worth emphasizing that policy decisions need not be one-time events, but instead can stretch over a period of learning-while-doing. Such explicit hypothesis-testing focuses learning and is substantially more efficient than other, non-adaptive processes. These kinds of policy processes—often aspired to, but rarely achieved—are especially appropriate in the context of a mandate for action under uncertainty. *See generally*, Kai N. Lee, Compass and Gyroscope: Integrating Science and Politics for the Environment (1994).

[16] Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations (1776).

[17] Examples of this function abound, from social security to bankruptcy law to federal deposit insurance. *See generally* David A. Moss, When All Else Fails: Government as the Ultimate Risk Manager (2004). Note that the governmental functions of managing externalities and managing risk appear to converge according to this description; risk-management may be seen as a special case of externality-management.

[18] Charter, *supra* note 10, at 1.

[19] Policy change may reduce, shift, or spread risk in response to a perceived threat. With respect to ocean acidification, we assume the Panel seeks to reduce risk to Washington's economy and ecosystems, do it at the lowest possible social, political, and economic cost, and to spread that cost in an equitable way.

Policy Overview

The Panel's science report identifies broad categories of input sources that may affect the chemistry of state waters. These include nitrogen, phosphate, and carbon (broadly, nutrients) from a variety of industry-specific terrestrial sources, as well as atmospheric CO_2 and subsidiary air pollutants.[20] Other inputs—such as anthropogenically CO_2-enriched coastally upwelled waters and changed freshwater contributions to the coastal ocean from upland areas—also influence coastal carbonate chemistry. Even in the absence of data speaking to the relative importance of each of these inputs, we nevertheless know that some combination of inputs is increasing the vulnerability of Washington's waters to CO_2-driven acidification.

Washington's policy tools for combating the different potential sources of ocean acidification in State waters fall into four broad categories: laws regulating water quality, laws regulating land use, laws regulating air quality, and voluntary incentive programs that have similar goals. In addition, the State retains the authority to seek abatement or payment for damages from polluters under its civil and criminal nuisance laws.

Here, we explore the set of inputs discussed in the science report by identifying the specific categories of sources generating these inputs. We then lay out the specific legal and policy tools that the State might use to reduce anthropogenic acidification in its waters. Where possible, we also highlight existing barriers to implementation and means of surmounting those barriers. Other documents—in particular, those developed by the working groups on particular sources—will more specifically aid the Panel in assessing the desirability and feasibility of different policy options by estimating the time scales over which policy changes are likely to occur, the time scales over which results might be apparent, and the costs of each.

[20] Draft Science Report, *supra* note 11, ch. 1.

Terrestrial Inputs: Nitrogen, Phosphate, and Carbon

Nutrient inputs effectively fertilize coastal waters,[21] just as these same nutrient compounds are used to fertilize agricultural fields and residential gardens. Their addition can trigger the enhanced growth of algae; this growth requires the algae to assimilate additional CO_2 via photosynthesis, incorporating that carbon into their tissues and thereby converting it from an inorganic state to an organic one. The organisms that ultimately decompose those algae then remineralize the carbon back into CO_2 as a consequence of metabolism. Where that "exhaled" CO_2 builds up—such as can happen in stratified bottom waters—it decreases the pH of the surrounding waters in just the same way as increased atmospheric CO_2 does. In short, the source of the CO_2 does not matter; the acidifying effect is the same whether it derives from respiration or the atmosphere.

The anthropogenic nitrogen loading into Washington State waters is enormous relative to natural levels. For example, 73% of dissolved inorganic nitrogen entering the Puget Sound is human-derived; human sources of this nutrient dwarf natural sources by a nearly 3-to-1 ratio.[22] The sources of nutrient runoff include wastewater treatment, septic systems, residential fertilizer, stormwater, dairy operations, crop agriculture, livestock, and increased terrestrial erosion.

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[21] Note that carbon can have a different effect than nitrogen or phosphorous with respect to ocean acidification. Carbon may feed heterotrophs directly, whereas nitrogen and phosphorous tend to catalyze the growth of autotrophs (i.e., plants) in shallow water. Hence, remineralization to CO_2 may be faster with carbon input than with nitrogen or phosphorous input. This temporal difference may also have a spatial effect, where water masses tend to move or particulate nutrients tend to sink.

[22] Mohamedali et al., *supra* note 14, at xxii.

1. Wastewater Treatment

Publicly-owned treatment works (POTWs) process large volumes of sewage from surrounding municipalities, which face the dual challenges of how to efficiently treat that sewage and where to dispose of it. The relative proportion of nutrients entering Washington State waters from wastewater varies spatially, but overall, wastewater treatment plants account for the majority of nitrogen inputs into Puget Sound and the surrounding Strait of Juan de Fuca.[23] As such, improved wastewater management may have a disproportionately large impact on water quality and chemistry in these heavily affected waters. However, it is important to note that the principal acidifying effect of wastewater inputs occurs through eutrophication and subsequent algal degradation, and therefore nutrient inputs at depth (out of the photic zone) may have proportionately less impact on marine carbonate chemistry than the same inputs would have in surface waters.[24]

Laws Governing Water Pollution

POTWs are point sources under the federal Clean Water Act, and are therefore subject to NPDES[25] permitting requirements. This makes these entities easier to monitor and regulate than many other sources of pollution. However, changes to POTW infrastructure and operation tend to be of large scale and great expense, with public utility ratepayers bearing the costs. This makes the economic risk of a type I error (i.e., acting when one should not) large, although it does not speak to the probability of such an error.

As with other point sources, Washington State Dept. of Ecology can directly influence the discharges of POTWs through the NPDES permitting process. POTWs are subject to heightened reporting requirements in their permit applications[26] and must limit their discharges to a greater degree than the technology-based standards alone dictate.[27] As a result, the State could require POTWs to minimize discharges by altering the prevailing water quality standards, effectively making POTW discharge limits more stringent.

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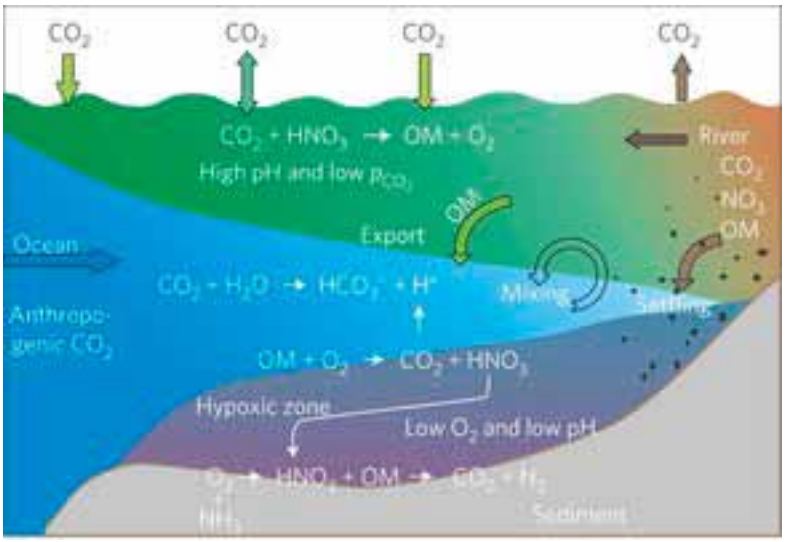
[23] *Id. See also id.* app. F tbl.E-1 (summarizing dissolved inorganic nitrogen loading into the Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca and showing that wastewater treatment plants discharge higher amounts of nitrogen than other industrial sources considered in the study). Other point sources—in particular, pulp mills and oil refineries—also contribute substantial effluent to Washington waters, but we omit their discussion here due to a lack of readily-available data on their impacts. *Id.*

[24] *See* Draft Science Report, *supra* note 11, at 12, 29, and 75 (detailing the role of the photic zone in algal blooms).

[25] National Pollution Discharge Elimination System, 33 U.S.C. § 1342.

[26] *See* 40 C.F.R. § 122.21(j).

[27] Clean Water Act § 301(b)(1)(C), codified at 33 U.S.C. § 1311(b)(1)(C).



A conceptual model for a large river plume eutrophication and subsurface water hypoxia and acidification. Reprinted by permission from Macmillan Publishers Ltd: Nature Geoscience (W-J Cai et al), copyright (2011).

Ecology, as the designated State water pollution control agency for all purposes of the federal Clean Water Act,[28] could also supplement the federal *technology*-based standards for POTWs by requiring cleaner effluent that is less likely to eutrophy coastal receiving waters.[29] Washington State laws compel Ecology to require treatment of wastes with all known, available, and reasonable treatment methods prior to their discharge or entry into waters of the State, regardless of the quality of the water to which wastes are discharged or proposed for discharge, and regardless of the minimum water quality standards established for said waters.[30] In fulfilling this mandate, Ecology could require tertiary treatment[31] including nitrification-denitrification (N-DN)[32] for POTWs to address coastal eutrophication.[33] Nationally, such treatment is now required on a case-by-case basis depending upon the condition of the receiving water body and the beneficial uses for which it has been designated.[34] Where financially feasible,[35] Washington's regional bodies could apply this same

Wastewater treatment plants account for the majority of nitrogen inputs into Puget Sound and the surrounding Strait of Juan de Fuca.[23]

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[28] RCW 90.48.260(1). *See also* RCW 90.48.262.

[29] While the Clean Water Act does not expressly give states the power to change technology-based standards, the power of states to create more stringent standards is consistent with the Act, which contemplates a lead role for states in setting applicable clean water standards, and with case law. *See, e.g., Shell Oil Co. v. Train*, 585 F.2d 408, 410 (9th Cir. 1978)("Congress sought 'to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution' … The role envisioned for the states under the 1972 amendments is a major one, encompassing both the opportunity to assume the primary responsibility for the implementation and enforcement of federal effluent discharge limitations and the right to enact requirements which are more stringent than the federal standards…Congress clearly intended that the states would eventually assume the major role in the operation of the NPDES program.") (emphasis added) (citations to the federal Clean Water Act omitted).

[30] RCW 90.52.040 (Pollution Disclosure Act of 1971) and RCW 90.54.020(3)(b) (Water Resources Act of 1971).

[31] Note that the term "tertiary treatment" is nonspecific and may be used differently by different authors. Here, we use the term to refer to a process that removes biosolids and nutrients (critical for coastal water quality), as well as disinfecting effluent into receiving waters. *See, e.g.*, Christopher Forster, Wastewater Treatment & Technology 183 (2003). *See also* N.F. Gray, Biology of Wastewater Treatment 136 (2004).

[32] N-DN is the coupled chemical process by which bacteria remove biologically-available nitrogen from an environment. Treatment works could use N-DN to lessen the impact of millions of tons of sewage on coastal water quality, directly lowering the eutrophication that can lead to hypoxia and local acidification. N-DN is not a standalone aspect of municipal water treatment, but can be added in order to improve the quality of already-treated effluent.

[33] See *EPA Pathogens Grant: Denitrification*, Wash. St. Dep't Health, http://www.doh.wa.gov/ehp/sf/EPA-nitrogen.htm for a Washington-specific effort to test denitrification technologies.

[34] *See, e.g., Chesapeake Bay TMDL*, U.S. EPA, http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/index.html. New York State requires tertiary treatment of some combined sewer overflows into the Chesapeake River drainage. N.Y. State Dep't of Envtl. Conservation, *Chesapeake Bay Nitrogen, Phosphorus and Sediment Total Maximum Daily Loads, New York Draft Phase I Watershed Implementation Plan*, U.S. EPA, 29 (2010), http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/NYDraftPHIWIP.pdf

[35] Marginal costs of N-DN treatment include infrastructure for aeration and raw materials for carbon-limited reaction steps, and may entail tens to hundreds of millions of dollars in expenditures. Low-cost alternatives may be available: *see, e.g.*, J. Jokela et al., *Biological Nitrogen Removal From Municipal Landfill Leachate: Low-Cost Nitrification in Biofilters and Laboratory Scale In-Situ Denitrification*, 36 Water Research 4079 (2002); C. Fux & H. Siegrist, *Nitrogen Removal From Sludge Digester Liquids by Nitrification/Denitrification or Partial Nitritation/Anammox: Environmental And Economical Considerations*, 50 Water Science & Techn. 15 (2004)(noting environmental costs as well as economic costs of different methods). However, N-DN plants may have lower operating costs than conventional plants. *See* D. Rosso & M.K. Stenstrom, *Energy-Saving Benefits of Denitrification*, Envtl. Engineer, Summer 2007, at 2, *available at* http://www.aaee.net/DownloadCenter/EEJournalV03P2.pdf.

analysis to the State's coastal POTWs with respect to ocean acidification and related ocean issues.[36] For example, where marine receiving waters are especially vulnerable to acidification or related water quality issues due to upwelling or freshwater input, N-DN might be particularly appropriate.[37]

Laws Governing Land Use

Comprehensive plans under the Growth Management Act of 1990 (GMA)[38] contain mandatory land use elements accounting for the location and capacity of all existing and proposed utilities.[39] In designating the proposed general distribution and general location of public utilities and other land uses, counties and cities must:

> provide for protection of the quality and quantity of groundwater used for public water supplies. Where applicable, the land use element shall also review drainage, flooding, and storm water runoff in the area and nearby jurisdictions and provide guidance for corrective actions to mitigate or cleanse those discharges that pollute waters of the state, including Puget Sound or waters entering Puget Sound.[40]

When developing and adopting comprehensive plans, local jurisdictions could assign proposed POTWs to locations where their impact on nutrient loads in coastal waters is likely to be minimal.[41] Since most treated wastewater is however discharged into waterways that eventually run into the ocean, it is questionable whether this would have a noticeable beneficial effect.[42]

Where an environmental impact statement is required under the State Environmental Policy Act (SEPA)[43] before a new POTW goes into operation, the review process must assess whether the proposed project would cause a significant adverse environmental impact.[44] Where the proposed plant would have a significant impact on ocean acidification as a result of such nutrient loading, the lead agency could require mitigation—such as enhanced nitrogen-removal technology—as a condition of a mitigated determination of nonsignificance.

Voluntary and Incentive Measures

Because changes to POTW infrastructure and operation entail great expense, they require robust financing, either from tax dollars or through support from grant and loan programs. The three main programs available in Washington—the Centennial Clean Water Grant Program, the Clean Water State Revolving Fund, and the Clean Water Act § 319 nonpoint source program—are administered jointly by Ecology's Water Quality Program under an integrated annual funding cycle.[45]

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[36] California's regional water boards, for instance, have required N-DN for particular facilities in the past. For example, the Central Valley Regional Water Quality Control Board recently required N-DN for the Sacramento Regional Wastewater Treatment Plant. *Order R5-2010-0114 (NPDES Permit CA0077682)*(Dec 1, 2011), *available at* http://www.swrcb.ca.gov/centralvalley/board_decisions/adopted_orders/sacramento/r5-2010-0114-01.pdf. *The Los Angeles Region had earlier required N-DN at the D.C. Tillman Water Reclamation Plant. See* Order R4-2011-0196 (NPDES No. CA0056227)(Dec 8, 2011), *available at* http://www.waterboards.ca.gov/rwqcb4/board_decisions/adopted_orders (describing facility and its tertiary treatment, including N-DN).

[37] State and regional authorities may also implement local effluent limits for POTWs to ensure they meet the requirements of their NPDES permits. *See* EPA Office of Wastewater Management 4203, *Local Limits Development Guidance*, U.S. EPA, 1-3 (2004), http://www.epa.gov/npdes/pubs/final_local_limits_guidance.pdf.

[38] RCW 36.70A.

[39] RCW 36.70A.070(4).

[40] RCW 36.70A.070(1). *See also* RCW 36.70A.150 (identifying land useful for public utilities such as water treatment facilities).

[41] Comprehensive sewer planning and facilities planning for water pollution control facilities under the Growth Management Act are eligible for funding under the Clean Water State Revolving Fund Loan Program described below. *See* WAC 173-98-100(13)(a).

[42] Moreover, such siting must balance a wide range of environmental impacts, and only applies prospectively. Thus there is probably little obvious room for improvement in POTW siting with respect to ocean acidification.

[43] RCW 43.21C. Review under SEPA is required for government actions that may have significant impacts on the environment. WAC 197-11. Licenses for discharges to air or water are exceptions to otherwise blanket exemptions to this requirement. WAC 197-11-305.

[44] RCW 43.21C.030. Here, the significant impact might take the form of increased nutrient loads (a potential ultimate cause of acidifying bottom waters) or of pH change (*i.e.*, the acidification itself).

[45] Ecology has issued comprehensive funding guidelines for all three programs. Fin. Mgmt. Section, Water Quality Program, Wash. State Dep't of Ecology, *Funding Guidelines, SFY 2012-2013*, Wash. St. Dep't Ecology (2010), http://www.ecy.wa.gov/biblio/1010049.html. (Hereafter, "Funding Guidelines")

The Centennial Clean Water Grant Program provides grants and loans of up to $5 million to public entities for water quality projects.[46] Funded by state dollars, the program's grants for point sources are exclusively designated for wastewater treatment construction projects in financially distressed communities.[47] Other expenses relating to wastewater treatment facilities, including the construction of water pollution control facilities to meet existing residential needs, are eligible for loans at interest rates substantially below the market average.

Provided for by the federal Clean Water Act, the Clean Water State Revolving Fund program is funded via an annual EPA capitalization grant, state matching funds, and principal and interest repayments on past loans, which today make up the majority of the fund. [48] With a portfolio of approximately $1 billion, the Revolving Fund constitutes the "backbone" of the Water Quality Program funding administered by Ecology.[49] Wastewater treatment construction projects are eligible for low interest and forgivable principal loans under the program.[50] A portion of the fund is reserved for "green projects," which include infrastructure that reduces impacts to watersheds, and those projects that prepare a POTW for adaptation to the long-term effects of climate change.[51]

Because changes to POTW infrastructure and operation entail great expense, they require robust financing...

The third available funding source is the Clean Water Act § 319 Program, containing grant funds from the federal EPA that the State must match with forty percent in funding. The § 319 program provides grants to eligible nonpoint source pollution control projects similar to the State Centennial program.[52]

Project proponents can apply for water quality funds from all three funding sources with a single application—a striking example of coordination among different funding streams. The funds are then distributed by Ecology to the highest priority projects in a combination of grants and loans depending on the project type and funding source.[53] In recent years, the funds available through the three programs ranged from $67.5 million to $140.2 million per year.[54] Other relevant sources of funding are listed in Appendix I.

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[46] *See* RCW 70.146 and WAC 173-95A.

[47] "Hardship assistance" according to WAC 173-95A-100(10). WAC 173-95A-400 lists the three primary factors considered in determining hardship funding for the construction portion of a wastewater treatment facility project, namely the service area population, existing residential need at the time of application, and the level of financial burden placed on the ratepayers.

[48] *See Water Quality Grants & Loans*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/wq/funding/funding.html.

[49] *See* Funding Guidelines, supra note 46, at 2.

[50] Financial assistance to the state and to local governments is provided for the planning, design, acquisition, construction, and improvement of water pollution control facilities and related activities in the achievement of state and federal water pollution control requirements for the protection of the state's waters. *See* RCW 90.50A.005.

[51] WAC 173-98-130. To the extent that ocean acidification is related to climate change—in that the two phenomena share a mechanism in common (CO_2)—perhaps POTW projects related to ocean acidification may qualify as "green" for these purposes. Hardship funding for the construction of wastewater treatment facilities projects, consisting of forgivable principal loans of up to five million dollars, is available from the Revolving Fund under the same conditions as under the Centennial Fund. If a forgivable principal loan is provided for a hardship project in conjunction with a centennial program grant award for hardship, the ceiling amount for the combined forgivable principal loan and centennial program grant is five million dollars.

[52] *See Water Quality Grants & Loans, supra* note 49. The program places a high priority on the collection of data associated with estimating pollutant load reductions for nitrogen, phosphorus, and sediment in state waterbodies. All states must annually report on these load reductions to the EPA, as one of the federal legislative yardsticks for the effectiveness of federal Section 319 funding to the states.

[53] See Funding Guidelines, supra note 46, at 3.

[54] For detailed funding statistics see Funding Guidelines, supra note 46, at 4.

2. Septic Systems

A huge number of people living along Washington's shores use septic systems rather than sewers: according to the Puget Sound Partnership, nearly half a million families living near the Sound rely on septic systems (also known as "on-site sewage systems").[55] Moreover, this number is increasing as new residences unconnected to sewers continue to be built.[56] These systems leach into the ground surrounding sewage sources; where they are concentrated, they can overwhelm the capacity of the surrounding area to incorporate the attendant nutrient loadings. Concentrated and failing septic systems therefore create a significant water quality problem, primarily in Puget Sound. This may contribute to ocean acidification in a similar fashion as other nutrient inputs do—fertilizing the surface waters and leading to hypoxia and lower pH in bottom waters through respiration.[57]

[55] *Septic Systems*, Puget Sound Partnership Resource Center, http://www.psparchives.com/our_work/waste/septics.htm. According to Washington's Water Quality Management Plan to Control Nonpoint Sources of Pollution, on-site sewage systems serve a total of approximately 1.4 million people in the 39 Washington counties. William A. Hashim & Helen Bresler, *Washington's Water Quality Management Plan to Control Nonpoint Sources of Pollution*, Wash. St. Dep't Ecology, 20 (2005), http://www.ecy.wa.gov/pubs/0510027.pdf.

[56] *Id.*; *see also* RCW 70.118A.010(2) ("A significant portion of the state's residents live in homes served by on-site sewage disposal systems, and many new residences will be served by these systems.").

[57] The effect of sewage depends in part upon its organic content; while organic carbon inputs tend to feed heterotrophs directly (and therefore quickly generate CO_2 via respiration), nitrogen and phosphorus inputs tend to catalyze plant growth, which is then decomposed and generates CO_2 in the same way. Different inputs may therefore create different spatial and temporal effects, depending upon the pathway from input to respiration. *See* Draft Science Report, *supra* note 11, at 9-14.

Laws Governing Water Pollution

Because runoff from septic systems is nonpoint source pollution under the federal Clean Water Act,[58] most directly enforceable legal provisions for abating this runoff arise from State law rather than from federal law.

Washington's primary regulatory tool for septic systems is a set of regulations that provide baseline standards for such systems, a permitting process, and relevant enforcement measures.[59] These provisions require a person to have a permit to install, repair, or maintain a septic system. However, where the majority of the nonpoint source pollution problem from septic systems stems from decrepit and unpermitted systems, enforcement is likely to be the weak link.[60]

A 2006 statute aimed to increase local-scale programs in marine recovery areas to identify and require repairs to failing septic systems.[61] Local health officers are now required to develop a management plan and designate "marine recovery areas," creating an electronic data system to track all septic systems in such areas. It remains to be seen whether this decentralized reporting system has improved regional water quality appreciably.[62] If it has, perhaps this kind of bottom-up reporting is a model for other nonpoint source pollution that impacts ocean acidification and the related issues of eutrophication and hypoxia.

Laws Governing Land Use

Counties' and municipalities' comprehensive plans can limit the use of septic systems. For example, King County Code states "[a]ll new development within the Urban Growth Area shall be served by an adequate public or private sewage disposal system, including both collection and treatment facilities.... On-site sewage treatment and disposal systems shall be permitted in the Urban Growth Area only for single-family residences or for short subdivisions only [on an interim basis under particular conditions.]"[63] The City of Olympia has also focused on limiting the use of septic systems as a means of protecting public health and water quality within the city.[64] It is thus clearly within the authority of such jurisdictions to limit the use of septic systems as appropriate.

However, many areas of Washington are not served by municipal sewer systems, and so such limitations may be inappropriate because of the very large per-household costs of creating or extending central sewer systems. In these cases, combining maintenance incentives with inspections (financed by modest user fees) may effectively reduce septic systems' contribution to nonpoint source pollution, and may ultimately thereby lessen Washington's vulnerability to ocean acidification.

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[58] But note that under Washington's implementation of the federal Clean Water Act, the State must set out "the standards for repair of existing, failing on-site sewage disposal systems at single-family residences that were legally occupied prior to June 9, 1988, and that are adjacent to marine waters." RCW 90.48.264.

[59] WAC 246-272A

[60] The State has adopted the Uniform Plumbing Code as the relevant section of its building code. RCW 19.27.031. Violations of this code are enforceable by counties. RCW 19.27.050.

[61] RCW 70.118A ("[I]t is the purpose of this chapter to authorize enhanced local programs in marine recovery areas to inventory existing on-site sewage disposal systems, to identify the location of all on-site sewage disposal systems in marine recovery areas, to require inspection of on-site sewage disposal systems and repairs to failing systems, to develop electronic data systems capable of sharing information regarding on-site sewage disposal systems, and to monitor these programs to ensure that they are working to protect public health and Puget Sound water quality."). Large septic systems—at least 3500 gallons/day—are subject to more stringent regulations and permitting requirements. RCW 70.118B.

[62] County health departments are not required to have management plans for Marine Recovery Areas until July 1, 2012. RCW 70.118A.050. Moreover, it is not clear that the State Department of Health aggregates the county-level data in an accessible way, although maps of such data were apparently publicly available prior to a recent update of the State Health Department's website.

[63] KCC 13.24.136 (implementing county comprehensive plan).

[64] *See Septic to Sewer*, City Olympia, http://olympiawa.gov/city-utilities/wastewater/septic-to-sewer (last updated June 13, 2012) (describing the city's wastewater management plan, limits to new developments using septic systems within the city, and incentives for hooking up to the city's existing sewer lines).

Voluntary and Incentive Measures

The Revolving Fund, described above, provides loans to repair or replace ailing septic systems.[65] These low-interest loans are awarded by Ecology and administered by local municipal agencies, lowering financial barriers for individual septic system owners and generating a substantial public health and water quality payoff.[66] Small grants or loans from Shellfish Protection Districts, discussed above, or through salmon recovery funds are especially salient here, because they are likely to be sufficient to fix many common septic system problems.[67] Similarly, the Department of Health's Pollution Identification and Correction (PIC) program awards grants from the federal EPA funds to ameliorate threats from bacterial pathogens in coastal waters,[68] and may be useful to counties wishing to address failing septic systems.[69]

Citizen monitoring and involvement creates a social base for clean water efforts.

More systemically, jurisdictions can use such grants—or, more likely, the larger allotments of funds from the federal § 319 nonpoint source program—to bypass failing septic systems and hook up to existing sewer systems. In some cases and where the residential density is sufficient to support such infrastructure, U.S. Department of Agriculture funds are available to build new sewer systems under Rural Development grants.[70]

It bears noting—for septic system cleanup as with other nonpoint source pollution—that citizen monitoring and involvement creates a social base for clean water efforts. When individuals generate data themselves, they may be more likely to view those data as legitimate.[71] Accordingly, local efforts that can involve landowners and other concerned individuals in data collection may multiply the benefits of their investment. The State also provides a toolkit for local government clean water campaigns,[72] which may be used to raise community awareness of these issues.

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[65] Local Government Loan Program for On-Site Septic Repair and Replacement Using the Washington State Water Pollution Control Revolving Fund, Wash. St. Dep't Ecology (2005), http://www.ecy.wa.gov/biblio/0110024.html.

[66] Local septic system repair projects are also eligible for Centennial Clean Water Fund and § 319 funds. *See* Funding Guidelines, supra note 46, at 19-21.

[67] Some counties, such as Thurston County, may provide low-interest loans or grants to cover septic system repair. *See* Thurston Cnty. Envtl. Health, *Septic System Repair Financial Assistance Program*, Thurston County, Wash, http://www.co.thurston.wa.us/health/ehoss/pdf/LoanFlyer.pdf (highlighting grants for marine shoreline repairs). Some private low-interest loans are also available for similar uses. See *Craft3 Septic Loans*, Craft 3, http://www.craft3.org/Borrow/SepticLoans (formerly Enterprise Cascadia).

[68] *EPA Pathogens Grant: Pollution Identification and Correction*, Wash. St. Dep't Health, http://www.doh.wa.gov/CommunityandEnvironment/Shellfish/EPAGrants/PathogensGrant/PIC.aspx.

[69] Another option for counties would be to loan individual property owners the amount of money required to fix their home septic systems, and recoup this cost by assessing a fee on the individual's property tax, spread out over a multiyear period. The outstanding loan amount appears as a lien on the relevant property until it is completely paid off. *See* Merrian C. Fuller et al., *Energy Efficiency & Renewable Energy Financing Districts for Local Governments*, City Berkeley (Sept. 2009), http://www.ci.berkeley.ca.us/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Guide%20to%20Renewable%20Energy%20Financing%20Districts2009.pdf. But note that senior liens may violate mortgage contracts. Statement, Federal Housing Finance Agency, FHFA Statement on Certain Energy Retrofit Loan Programs (July 6, 2010), http://fhfa.gov/webfiles/15884/PACESTMT7610.pdf.

[70] *Water & Waste Disposal Programs*, USDA, Rural Dev., http://www.rurdev.usda.gov/wa/UTLwwPrograms.htm.

[71] *See, e.g.*, C. Evans et al., The Neighborhood Nestwatch Program: Participant Outcomes of a Citizen-Science Ecological Research Project, 19 Conservation Biology 589, 592 (2005) (documenting results from a citizen-science project focused on birds in urban and suburban areas) ("It was apparent from interviews that by making such detailed observations, participants felt more connected to their backyard birds, and their levels of concern about the welfare of the birds and their nestlings increased.")

[72] *Tools for Local Government*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/washington_waters/toolkit.html.

3. Residential Fertilizer

Residential fertilizer from home gardens and yards can be a persistent source of nutrients into coastal waters. When and where this is the case, residential fertilizer use may contribute to Washington's vulnerability to ocean acidification. Because of the diffuse, small-scale nature of residential fertilizer use, it is especially difficult to address as a policy matter: any given individual homeowner probably is not a significant pollutant source, but thousands of homeowners combine to create a cumulative problem. The State has partially addressed the residential fertilizer problem by banning the application of lawn fertilizers containing phosphorous, a ban that goes into effect Jan. 1, 2013.[73] Washington has acted similarly with regard to phosphorus in other household products such as dishwater and laundry detergents, where a ban has been enforced under the State's public health and safety regulations.[74] To the extent that the amount of phosphorous—and not nitrogen—controls algal blooms in coastal waters, these regulations are important steps in limiting inputs to State waters that can exacerbate ocean acidification. However, where coastal waters are nitrogen-limited (rather than phosphorous-limited), such regulations targeting phosphorus do not address a primary cause of concern surrounding the use of residential fertilizer (i.e., nitrogen).

…where coastal waters are nitrogen-limited… such regulation targeting phosphorus do not address a primary cause of concern surrounding the use of residential fertilizer…

Laws Governing Water Pollution

Washington's State Water Pollution Control Act[75] makes it unlawful for any person to discharge or allow the seepage into State waters of organic or inorganic matter that causes or tends to cause pollution.[76] Ecology may inspect private property for compliance with this rule, take enforcement action, and impose penalties for its violation.[77] The small-scale nature of individual contributions would however make it difficult to identify infringements by single households. Moreover, in the absence of a permitting system limiting the number of households to be monitored,[78] widespread enforcement action would probably be cost-prohibitive.

Laws Governing Land Use

Protection of the environment and enhancement of the State's air and water quality are key planning goals of land-use policy process embodied in the GMA.[79] Local governments could limit fertilizer runoff from residential sources through zoning and careful designation of urban growth areas—where use of residential fertilizer is most intense—by ensuring adequate buffers exist to prevent sources of urban runoff from entering local water bodies. The GMA's Critical Areas provision, too, is useful for preserving fertilizer-free habitat.[80] Note, however, that since the Critical Area designation does not imply a change in a landowner's right to use his or her land under current law,[81] it would be most valuable as a planning tool for future residential development.

With Shoreline Master Programs under the Shoreline Management Act (SMA),[82] coastal communities have another tool at their disposal to influence the distribution and location of residential areas likely to use non-commercial fertilizer. A Shoreline Master Program could, for instance, provide for buffer zones between residential areas and rivers and coastlines, thus limiting the direct impact of residential fertilizer use on aquifers and the marine environment.[83]

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[73] RCW 15.54.500.

[74] RCW 70.95L.

[75] RCW 90.48.

[76] RCW 90.48.080.

[77] RCW 90.48.090; RCW 90.48.037; RCW 90.48.140.

[78] Washington's State Water Pollution Control Act requires waste disposal permits only for commercial or industrial operations. *See* RCW 90.48.160. Similarly, individual homes are not required to apply for NPDES permits under the Federal Clean Water Act.

[79] RCW 36.70A.020(10).

[80] Critical areas include those with a critical recharging effect on aquifers used for potable water. Together with agriculture and on-site sewage systems, residential fertilizer contributes to the contamination of aquifers with nitrates, see Melanie Redding, Nitrate *Trends in the Central Sumas-Blaine Surficial Aquifer*, Wash. St. Dep't Ecology (July 2008), http://www.ecy.wa.gov/pubs/0803018.pdf, and therefore the GMA's Critical Areas provision speaks directly to the problem of residential fertilizer.

[81] WAC 365-190-040(6).

[82] RCW 90.58. The SMA governs land-use and permitting decisions along the shorelines of the State.

[83] Note however that single-family residences and their appurtenant structures enjoy priority where alterations of the natural conditions of the shoreline are allowed. *See* RCW 90.58.020, RCW 90.58.030, RCW 90.58.140, RCW 90.58.100.

Regarding large-scale residential developments that are likely to have a significant environmental impact, project assessment under SEPA could moreover account for the effects of residential fertilizer on the environment if the questions in SEPA's environmental checklist relating to potential discharge into groundwater, water runoff, and proposed landscaping were construed so as to include the nutrient pollution resulting from non-commercial fertilizer. This could prompt the development of alternative landscaping designs less susceptible to future excessive fertilizer use. This cost-neutral policy tool would be easy to implement and could help improve the nutrient levels in state waters over the long term.

Whereas the strategies just discussed would take effect mainly with regard to future land use (i.e., new development), a reduction of fertilizer utilization by existing households could be achieved through regulations, potentially under local building codes, that limit the allowed size of lawns (which are particularly fertilizer-intensive) of individual residences. To find public acceptance, such measures would need to be accompanied by extensive public awareness campaigns—and so influencing demand as well as supply.[84]

Voluntary and Incentive Measures

Even in the absence of mandatory regulations, public awareness campaigns are a valuable tool to induce behavior changes in homeowners using residential fertilizer.[85] Informing homeowners about simple ways to reduce watershed pollution from residential fertilizer can be an effective means to improve the quality of Washington's State waters and may help reduce local causes of ocean acidification. Many counties and communities already have in place such awareness

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[84] *See, e.g.*, C.B. Cooper et al., Citizen Science as a Tool for Conservation in Residential Ecosystems. 12 ECOLOGY AND SOCIETY 11, available at: http://www.ecologyandsociety.org/vol12/iss2/art11/ ("An … alternative to merely presenting information or recommendations to the public, community-based social marketing techniques are effective tools to identify and eliminate barriers to participation and enhance benefits for individuals and communities.")

[85] A 2005 Department of Ecology white paper assessed the potential impacts on water quality of lawn fertilization with phosphorus fertilizer, concluding that the risk of surface or groundwater contamination from phosphorus fertilizer is minimal if lawns are properly managed. Landowners should avoid application of fertilizer to immature lawns prior to forecasted heavy rain, as well as ensure that fertilizer that ends up on hardscapes is swept or blown back into the turf area. Eric Miltner, *Phosphorus Fertilization of Turfgrass and Potential Impacts on Water Quality*, WASH. ST. DEP'T ECOLOGY (2005), http://www.ecy.wa.gov/programs/wq/tmdl/spokaneriver/dissolved_oxygen/docs/p_whitepaper_for_spokane.pdf. Note that these findings do not necessarily apply to nitrogen, but rather focus on phosphorus.

campaigns, usually focused on high-density residential areas, educating residents to reduce fertilizer and pesticide use.[86] Federal grants and incentive programs could help to implement awareness campaigns statewide.

The Northwest Straits Commission is particularly suited to play an active role in this regard. Through federal funding, the Commission sponsors local-scale programs to improve environmental conditions in nearshore areas. County or community-level projects aimed at reducing watershed pollution from residential fertilizer are conservation projects that would likely meet the Commission's performance benchmarks, as they would help to protect marine habitats from human activities that cause degradation, reduce the input of contaminants into Northwest Straits marine waters, inform the public about threats to living resources, present them with practical measures they can take to prevent further harm, and engage them in an active stewardship opportunity to minimize local causes of ocean acidification.[87]

Education and stewardship programs to reduce nutrient pollution from residential fertilizer might moreover be eligible for funding under the three programs administered jointly by Ecology's Water Quality Program described above (Centennial fund, Revolving fund, and Clean Water Act § 319 fund), which dedicate part of their resources to nonpoint source activities intended to improve water quality.[88]

Community gardening activities may provide another avenue for reducing nutrient pollution from residential fertilizer. Local governments could reduce nutrient pollution from those gardens by restricting fertilizer use and requiring that garden operators take steps to reduce fertilizer runoff. These gardens could also be used as a tool to educate gardeners about the issue.[89] This policy would be most effective in jurisdictions with a large number of community gardens, where the gardens are more likely to be non-negligible sources of nutrient pollution.[90] Local governments could also encourage the use of community gardens, which could concentrate fertilizer use to those areas and make control measures more effective.

Finally, the State could combine its efforts with nonprofit organizations dedicated to preserving the marine environment that have made the prevention of residential fertilizer pollution one of their priorities, as for instance the Surfrider Foundation has done with its successful Ocean Friendly Gardens campaign.[91] The State could, for example, partner with Washington Sea Grant at the University of Washington or Washington State University Extension to help educate residents about ways that they can reduce fertilizer use and avoid runoff.

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[86] See, for example, the campaign by Clark County. *Naturally Beautiful Backyards*, Clark County Wash., http://www.clark.wa.gov/recycle/natural/index.html (last updated Nov. 11, 2011); Phase I Municipal Stormwater Permit Monitoring, Wash. St. Dep't Ecology., http://www.ecy.wa.gov/programs/wq/stormwater/municipal/s8eeffectivenessmonitoring.html; Joy P. Michaud, *At Home with Wetlands, Using Chemicals*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/sea/pubs/90031/index.html#Using%20Chemicals.

[87] For the Commission's support criteria see *Performance Benchmarks*, Northwest Straits, http://www.nwstraits.org/Archives/Background-History/Performance-Benchmarks.aspx.

[88] See Ecology's funding guidelines, *supra* note 46, at 16.

[89] See, for example, the City of Issaquah's Pickering Garden, which is maintained by the City but is used as a "living classroom encouraging behaviors that save water, improve water quality, improve natural habitat and reduce waste." *Pickering Garden*, City Issaquah, Wash., http://www.ci.issaquah.wa.us/Page.asp?NavID=2137.

[90] Although community gardens themselves may only represent a small proportion of nutrient inputs into Washington waters, they are worth noting because of their educational and regulatory potential. The City of Seattle's P-Patch Community Gardening Program, for example, has 75 P-Patches distributed over 23 acres in the City of Seattle withe 4,400 gardeners. Seattle Dep't of Neighborhoods, *P-Patch Community Gardens*-Growing Communities, Seattle.gov, http://www.seattle.gov/neighborhoods/ppatch/.

[91] *See Ocean Friendly Gardens*, Surfrider Found., http://www.surfrider.org/programs/entry/ocean-friendly-gardens.

4. Stormwater

Broadly, stormwater is sheet runoff from impermeable surfaces that occurs during rain events or with snowmelt. Stormwater then carries pollutants of all kinds—including nitrogen, phosphate, and organic carbon—into the coastal ocean. As described by Ecology:

> Land clearing for buildings, parking lots, and landscaped areas is now occurring at a rapid rate. Soils that allowed water to infiltrate are being paved over. With increased impervious surfaces, rainfall runs quickly and directly into streams, dramatically increasing volume and peak flows. In addition, development encroachment into riparian corridors and modifications to the surface water drainage network all work together to increase runoff and pollution. Stormwater runoff may contain high concentrations of heavy metals, fecal coliform, silt, petroleum products, nutrients, and pesticides.[92]

In some coastal areas, stormwater may be a primary contributor to nutrient loads into marine waters, and may magnify the effect of ocean acidification in Washington. However, it is difficult to judge the relative importance of stormwater—as opposed to other kinds of runoff—to coastal ocean acidification.[93] Periodic freshwater inundation is of course a normal aspect of many nearshore ecosystems, but where polluted stormwater contributes significantly to local-scale acidification and other water quality issues, this is another avenue for potential mitigation. Stormwater pollution has been an area of particular focus in Washington in recent years.[94]

Laws Governing Water Pollution

Although much stormwater input to the ocean occurs through nonpoint sources, the federal Clean Water Act treats several classes of stormwater sources as point sources subject to NPDES permits.[95] Most saliently, municipal separate stormwater sewer systems (MS4s) require a discharge permit.[96] As a result, Washington's primary regulatory tool for stormwater is its implementation of the federal Clean Water Act.[97]

If Ecology made the prevailing water quality standards more stringent, or otherwise limited discharges within stormwater NPDES permits, MS4s would have to limit their discharges accordingly. Because freshwater input can drastically change the pH of receiving marine waters,[98] a stricter pH water quality standard might require significant limitations for stormwater runoff from municipalities. However, the changes to infrastructure that such limitations would require would likely be very costly, and as with POTW infrastructure, would require large-scale funding commitments.

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[92] Hashim & Bresler, *supra* note 56, at 21

[93] *See* J. Salisbury et al., *Coastal Acidification by Rivers: A Threat to Shellfish?* 89 Eos 513 (2008)(showing effect of acidic freshwater on coastal mollusc dissolution factor in Casco Bay, Maine).

[94] *See Stormwater*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/wq/stormwater/. Thanks to infrastructure improvements to Combined Sewer Overflows, the State has reduced its output of untreated sewage considerably. These outfalls combine stormwater with wastewater overflows, discharging untreated sewage as a result of increased stormwater during large storm events. King County, for example, reduced CSO outfall by nearly 60% between 1988 and 2006. *See CSO Control Program Review 2006 Executive Summary*, King County, Wash., ES-2, http://your.kingcounty.gov/dnrp/library/wastewater/cso/docs/ProgramReview/2006/ExecSum.pdf.

[95] These include construction sites, industrial sites, sand and gravel operations, and boatyards, all of which may operate under a general stormwater permit. See *Stormwater*, *supra* note 93, for a discussion of these general permits and requirements, as well as resources for implementation.

[96] *See* 33 U.S.C. § 1342(p)(3)(B); EPA requires MS4s to meet both a technology-based standard (reduction to maximum extent practicable) and prevailing water quality standards via best management practices. MS4s serving larger cities and counties normally require specific NPDES permits, while smaller-scale MS4s operate under general permits. Note also that Washington's Department of Transportation operates under a municipal stormwater general permit. *See Washington State Department of Transportation (WSDOT) Municipal Stormwater NPDES General Permit*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot.html.

[97] It bears noting that the Clean Water Act establishes a floor (not a ceiling) of regulation for water quality, and that the State retains the authority to regulate stormwater more stringently than required under the federal Act. Note also that the State could be held liable under CERCLA for unpermitted stormwater discharge through State drainage systems. *See* United States v. Washington State Department of Transportation, 716 F. Supp. 2d 1009 (W.D. Wash. 2010) (holding that the Department of Transportation was liable as an "arranger" under CERCLA for highway runoff through a stormwater drainage system).

[98] *See* Salisbury, supra note 92.

Laws Governing Land Use

Under the GMA, jurisdictions' comprehensive plans must review stormwater runoff and "provide guidance for corrective actions to mitigate or cleanse those discharges that pollute waters of the state."[99] Such corrective actions might include more permeable streetscape designs, greater infill development, and smarter development siting, so as to reduce the causes of stormwater pollution.[100] It would be within the authority of the State to strengthen these requirements, perhaps pairing the "guidance" provision with one that requires consultation with the Washington Stormwater Center and implements best management practices or other proven technologies.

Similarly, lead agencies could exercise substantive SEPA authority to condition project proponents' proposal to mitigate environmental impacts on the implementation of specific stormwater runoff-minimization practices.

The State could also reduce stormwater runoff by strengthening stormwater requirements in Washington's already-existing green building requirement for new state-funded buildings.[101] The Washington Sustainable Schools Protocol (WSSP), Evergreen Sustainable Development Standard (ESDS), and Leadership in Energy and Environmental Design (LEED) have few mandatory stormwater management criteria.[102] The State could strengthen those requirements in order to reduce stormwater runoff by encouraging or requiring that the state-designed programs, WSSP and ESDS, include mandatory stormwater management planning. It could also use a mechanism similar to the one already used for projects using sustainably harvested wood, in which the certifying department awards an additional point under the LEED certification standard for implementing certain practices that are not otherwise required by the green building standards.[103]

Stormwater then carries pollutants of all kinds—including nitrogen, phosphate, and organic carbon—into the coastal ocean.

Voluntary and Incentive Measures

Washington's Stormwater Center, a State water research facility located at the Washington State University campus in Puyallup, was established in late 2010[104] as a public-private testing ground for stormwater management techniques and to help municipalities and private entities with implementation. The Center is an interesting hybrid organization, a "bridge between regulators and people,"[105] whose activities are funded only partly through State revenues.[106] Because the Center is so new, however, the actual effects of its work on water quality remain to be seen.

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[99] RCW 36.70A.070(1). This is part of the required land use element of comprehensive plans.

100 *See, e.g.*, *Green Stormwater Infrastructure*, SEATTLE.GOV, http://www.cityofseattle.net/util/Services/Drainage_&_Sewer/Keep_Water_Safe_&_Clean/CSO/CSOReductionProjects/GreenStormwaterInfrastructure/index.htm (providing information about Seattle's Green Stormwater Infrastructure projects); PLANT*SF, http://www.plantsf.org/ (describing San Francisco's Plant*SF program, which is a nongovernmental program aimed at increasing permeable landscaping in San Francisco).

[101] *See* RCW 39.35D.

[102] The WSSP appears to have the strongest requirements. *See Washington Sustainable Schools Protocol: Criteria for High Performance Schools*, OFF. OF SUPERINTENDENT PUB. INSTRUCTION (2010 ed.), http://www.k12.wa.us/SchFacilities/Programs/HighPerformanceSchools/WSSP2010Criteria.pdf. It requires that schools design site sediment and erosion control plans that follow the Department of Ecology's Stormwater Management Manuals' best management practices or local ordinances, whichever is stricter. *Id.* at 19. It also requires enhanced stormwater treatment for sites with conditions warranted that treatment. *Id.* at 21. The other stormwater requirements in the WSSP are not mandatory, however. *Id.* at 19-21. The ESDS encourages a stormwater management plan but does not require it. Department of Commerce, Housing Trust Fund, *Evergreen Sustainable Development Standard*, WASH. ST. DEP'T COM. (Version 2.0), 24-26, http://www.commerce.wa.gov/DesktopModules/CTEDPublications/CTEDPublicationsView.aspx?tabID=0&ItemID=9669&MId=870&wversion=Staging. It does, however, require all storm drains and storm inlets have a label indicating where the drain leads to serve as a "visual reminder." *Id.* at 27. The LEED requirements for general new construction and for schools do not have mandatory stormwater management provisions, with the exception of requirements for the construction process. *LEED 2009 For New Construction and Major Renovations*, U.S. GREEN BUILDING COUNCIL, 1, 14-16 (updated July 2012), http://www.usgbc.org/ShowFile.aspx?DocumentID=8868; *LEED 2009 for Schools New Construction and Major Renovations*, U.S. GREEN BUILDING COUNCIL, 1, 14-16 (updated July 2012), http://www.usgbc.org/ShowFile.aspx?DocumentID=8872.

[103] *See* RCW 39.35D.030(5) ("[T]he department must credit one additional point for a project that uses wood products with a credible third-party sustainable forest certification or from forests regulated under chapter 76.09 RCW, the Washington forest practices act.").

[104] RCW 90.48.545, passed during the 2009 legislative session. The Center opened its doors on Dec. 9, 2010. *See Our History*, WASH. STORMWATER CENTER, http://www.wastormwatercenter.org/our-history.

[105] Interview with Tanyalee Erwin, a manager at the Washington Stormwater Center (May 31, 2012, by phone). Erwin credited Jay Manning with this description of the Center. The Center appears to function in a somewhat similar way to the agricultural extension services—providing outreach and technical support, and disseminating research findings—but does at least implicitly have an underlying regulatory mission (even if its role is not to enforce water quality laws).

[106] The Center relies heavily on external grants from public and private institutions for its operations.

In principle, the State could expand this institution—or develop another similar one—for all kinds of nonpoint source runoff, rather than focusing on stormwater alone.

In general, where local benefits accrue to cities controlling inputs to their coastal waters,[107] these benefits would partially offset the costs of upgrading MS4 infrastructure. For example, the city of Portland, Oregon, has embarked upon a watershed-wide stormwater management program, which envisions tangibly improving social conditions in addition to reducing the load on municipal infrastructure.[108] In at least some cases auxiliary benefits—along with pressure from environmental groups—have led private entities to capture and treat stormwater, reducing stress on municipal systems.[109] Lastly, the federal EPA has provided suggestions for means of funding MS4 upgrades, with case studies included.[110]

As described above for wastewater treatment, the Centennial Fund, the Clean Water State Revolving Fund, and the Clean Water Act § 319 Program all may function to ameliorate stormwater runoff. Ecology makes "hardship" grants and loans available to some low-income communities for stormwater education, monitoring, and planning.[111] Ecology also provides a wealth of non-monetary stormwater resources and programs, generally focused on technical expertise and outreach.[112]

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[107] See, for example, a recent overhaul of public spaces along city streets in Seattle's Barton Basin, *Barton CSO Control Project*, King County, Wash, http://www.kingcounty.gov/environment/wtd/Construction/Seattle/BartonCSO-GSI.aspx (last updated July 24, 2012), in order to minimize stormwater runoff while beautifying the neighborhood. See also discussion below, regarding reducing water demand and avoiding greenhouse gas emissions associated with water transport.

[108] *See* Vivek Shandas et al., *Tabor to the River Program: An Evaluation of Outreach Efforts and Opportunities for Engaging Residents in Stormwater Management*, PortlandOnline (Oct. 2010), http://www.portlandonline.com/bes/index.cfm?a=335473&c=50500.

[109] For example, the Irvine Company's Pelican Hill golf course in Orange County, California, promoted its water treatment technology, finding public relations value in improved environmental stewardship. *See* http://www.irvinecompany.com (press release from 7/16/2007 describing the then-new golf course's water treatment as follows: "a sophisticated water-quality system has been designed to trap and treat all run- off at the new resort, and promote conservation and recycling. The system – a labyrinth of filters, enormous underground cisterns, catch basins and other measures – essentially mimics and even improves upon nature. Environmental experts say it is the most advanced water-quality management program they have seen on the California coast.")

[110] *Funding Stormwater Programs*, U.S. EPA (Jan. 2008), http://www.epa.gov/npdes/pubs/region3_factsheet_funding.pdf.

[111] These are grants and subsidized loans (through the Revolving Fund) to small, lower-income communities, providing matching funds for activities relating to a required stormwater permit. *See* Financing Guidelines, *supra* note 46, at 10.

[112] *Stomwater*, *supra* note 92.

5. Dairy Operations

Dairy operations and other sites of high manure concentrations are important sources of nutrient inputs into Puget Sound and other Washington State waters. There are approximately 517 dairy farms in the State,[113] producing many thousands of tons of manure annually. This manure is high in nitrogen and phosphate compounds, and can contribute to eutrophication if these nutrients are released into regional watersheds and into the coastal ocean to which those watersheds drain. This eutrophication, in turn, can cause algal blooms and contribute to coastal ocean acidification as described above.[114]

Laws Governing Water Pollution

Washington has a wide variety of policy tools at its disposal—including voluntary and incentives-based programs as well as regulatory and enforcement measures—to help curtail the flow of nutrients from dairies into State waters. Most prominently, these include the Dairy Nutrient Management Act, which requires nutrient management plans[115] for licensed cow dairies,[116] and subjects those dairies to a regular inspection program.[117,118] The Departments of Ecology and Agriculture together implement the Act, operating under a 2011 Memorandum of Understanding that allocates the

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[113] This is the number of dairies registered with the Washington State Department of Agriculture's Livestock Nutrient Management Program as of 2007. *Livestock Nutrient Management Program Report of Activities, January 1-December 31, 2007*, Wash. St. Dep't. Agric. (May 2008), http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/Docs/2007LNMPReportFINAL.pdf. The Washington Dairy Products Commission, listed a total of 460 dairies in Washington as of 2009. *Facts about the Washington Dairy Industry*, Dairy Farmers of Wash., http://www.havemilk.com/article.asp?id=2142.

[114] Many dairies apply the manure they generate to neighboring fields to fertilize feed crops. As such, they are using locally-generated manure rather than commercial fertilizer, likely reducing the overall pollution footprint relative to an operation that requires commercial fertilizer and its transport. Nevertheless, to the extent that dairies contribute nitrogen, phosphate, and carbon to nearby water bodies, they represent inputs to State waters. Note that the use of manure (as "non-commercial" fertilizer) is unregulated in Washington.

115 These incorporate best management practices derived from recommendations from the federal National Resources Conservation Service.

[116] Note that all CAFOs, and not just dairies, must have nutrient management plans. *Concentrated Animal Feeding Operation (CAFO) National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit*, Wash. St. Dep't Ecology. (June 21, 2006), http://www.ecy.wa.gov/programs/wq/permits/cafo/cafofinalpermit06.pdf.

[117] See *Dairy Nutrient Management*, Wash. St. Dep't Agric. (last updated May 23, 2012), http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/ for more information.

[118] "Nutrient Management inspectors conduct a routine inspection of each cow dairy at least once every 22 months. Inspectors look at facilities, land applications, and crop records for risks of nutrients impacting either ground or surface water quality." *Inspections*, Wash. St. Dep't Agric., http://agr.wa.gov/FoodAnimal/Livestock-Nutrient/Inspections.aspx (last updated May 23, 2012). These inspection visits ensure a level of compliance that is unusual in the area of nonpoint source pollution prevention.

respective agencies' responsibilities.[119] Where more stringent requirements for nutrient management plans—paired with increased technical support and information about improved practices—would reduce nutrient pollution into Washington's waters, this is a primary tool for mitigating dairies' contribution to ocean acidification in Washington. The existing inspection routine would ensure compliance with any new rule, at no additional cost to the State.

Dairy operations and other sites of high manure concentrations are important sources of nutrient inputs into Puget Sound and other Washington State waters.

Ecology also has the power to regulate water pollutants—including manure or other dairy runoff—under the State Water Pollution Control Act. Under this Act, discharging "pollution" (defined very broadly)[120] into State waters without a permit is unlawful,[121] whether from a point source or a nonpoint source. This rule allows the State to limit dairies' inputs into State waters directly, although enforcement would remain an ongoing challenge, and would require a significant resource commitment in the absence of internal incentives for dairies to comply.[122]

Federal Clean Water Act provisions layer on top of these State rules, providing two important mechanisms for water quality control: NPDES permitting (for point sources of pollution)[123] and the 303(d)[124] list of impaired waters and TMDLs[125] (for nonpoint sources).[126] Where dairies are classified as Concentrated Animal Feeding Operations (CAFOs) under the Clean Water Act, they are point sources subject to NDPES permitting requirements. Otherwise, runoff from dairies is likely to be nonpoint source pollution.

While Washington could reduce point source discharges by increasing the stringency of NPDES permits, curbing nonpoint sources is more difficult to do directly. The TMDL process is more akin to planning than to permitting or enforcement, and enforcing limits to nonpoint source load allocations developed as part of a TMDL typically requires substantial time and resources from Ecology.[127] Nevertheless, creating enforceable TMDLs—with pollutant allocations assigned to point and nonpoint sources, backed up by appropriate monitoring and enforcement measures—is at least a hypothetical policy option for Washington for water bodies impaired for particular pollutants under §303(d).

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[119] Kirk Robinson and Kelly Susewind, Memorandum of Understanding between the Washington State Department of Agriculture and the Washington State Department of Ecology (Nov. 2011).

[120] RCW 90.48.020 ("Whenever the word "pollution" is used in this chapter, it shall be construed to mean such contamination, or other **alteration of the physical, chemical or biological properties, of any waters of the state,** including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of **any** liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.") (emphases added).

[121] RCW 90.48.080 ("It shall be unlawful for any person to throw, drain, run, or otherwise discharge into any of the waters of this state, or to cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged into such waters any organic or inorganic matter that shall cause or tend to cause pollution of such waters according to the determination of the department, as provided for in this chapter.").

[122] Ecology may issue enforcement orders or fines for violation only after a notification process. *See* RCW 90.48.120 ("Whenever, in the opinion of the department, any person shall violate or creates a substantial potential to violate the [State's water quality provisions], or fails to control the polluting content of waste discharged or to be discharged into any waters of the state, the department shall notify such person of its determination by registered mail…Within thirty days from the receipt of notice of such determination, such person shall file with the department a full report stating what steps have been and are being taken to control such waste or pollution or to otherwise comply with the determination of the department. Whereupon the department shall issue such order or directive as it deems appropriate under the circumstances, and shall notify such person thereof by registered mail.").

[123] 33 U.S.C. § 1362(14) ("The term 'point source' means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.").

[124] As part of the state implementation of the federal Clean Water Act, Washington must develop a list of waters that fail to meet the approved water quality standards. This list is known as the "303(d)" list, after the relevant provision of the Clean Water Act. Washington's current list is available at: *Washington State's Water Quality Assessment and 303(d) List*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/wq/303d/index.html.

[125] Total Maximum Daily Loads; 33 U.S.C. § 1313(d)(1)(C).

[126] Nonpoint sources are those not included under the definition of "point sources," supra.

[127] *See, e.g.*, Oliver A. Houck, The Clean Water Act TMDL Program: Law, Policy, and Implementation 63 (2002)(citing a figure of $1 million per TMDL study and ten times that for implementation of each TMDL.)

Because "[t]he way land is used is the major contributing factor to nonpoint source pollution,"[128] Washington land use statutes are key tools for controlling inputs to Washington state waters. Local counties and municipalities may also exercise some control over the number and location of dairies—and by extension, their effects on the coastal ocean—by amending their comprehensive plans under the GMA.[129] Under the GMA, municipalities and counties have the authority to zone in such a way as to ensure that adjacent land uses are compatible.[130] This may include requiring buffer zones or riparian setbacks between dairies (or other runoff sources) and rivers or coastlines, increasing terrestrial nutrient retention.[131] The State already requires municipalities to address the causes of polluting runoff on State waters through the land use element of their comprehensive plans,[132] but strengthening this provision is another avenue by which the State could improve local oversight of runoff using an existing legal framework.[133]

Similarly, project assessment under SEPA can create incentives to improve nutrient management from dairies: if a newly proposed dairy is subject to environmental review[134] and may have a significant environmental impact, the project proponent is typically required to assess and disclose those environmental impacts through the Environmental Impact Statement process. Moreover, the lead State agency can use its substantive SEPA authority to attach conditions to a party's proposed mitigation efforts.[135] Washington could also make SEPA more responsive to the causes of ocean acidification by requiring lead agencies to ensure that proponents account for the project's lifetime CO_2 emissions and for the cumulative impacts of the project,[136] as well as for the project's nutrient runoff.

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[128] Hashim & Bresler, *supra* note 56, at 9.

[129] RCW 36.70A.

[130] This kind of coordination of compatible land uses is precisely the purpose of the Growth Management Act. RCW 36.70A.10 ("The legislature finds that uncoordinated and unplanned growth, together with a lack of common goals expressing the public's interest in the conservation and the wise use of our lands, pose a threat to the environment, sustainable economic development, and the health, safety, and high quality of life enjoyed by residents of this state. It is in the public interest that citizens, communities, local governments, and the private sector cooperate and coordinate with one another in comprehensive land use planning.").

[131] Local jurisdictions' police power authority is not without limits. In the absence of a compensatory scheme, the takings clause of the 5th Amendment of the U.S. Constitution and a similar clause in the Growth Management Act ("Private property shall not be taken for public use without just compensation having been made." RCW 36.70A.020) prevent local jurisdictions from adopting zoning laws or implementing their land use laws in a manner that would deprive a property owner of all economically viable use of their property. Riparian buffer zones or setbacks are common features of zoning laws and normally do not involve situations that rise to the level of a taking.

[132] RCW 36.70A.070(1) ("The land use element shall provide for protection of the quality and quantity of groundwater used for public water supplies….Where applicable, the land use element shall review drainage, flooding, and storm water run-off in the area and nearby jurisdictions and provide guidance for corrective actions to mitigate or cleanse those discharges that pollute waters of the state, including Puget Sound or waters entering Puget Sound.").

[133] For instance, by requiring land-use-category-specific Best Management Practices for runoff. Note, however, that the State has only a weak role in overseeing the adequacy of comprehensive plans under the GMA; any individual can challenge a plan's adequacy, which is then determined on a case-by-case basis by the Growth Management Act Hearings Boards. *See* Growth Mgmt. Hearings Board, http://www.gmhb.wa.gov; *see also* Substitute S.B. 6214, 61st. Leg., 2010 Reg. Sess. (Wash. 2010) (consolidating regional boards into a single statewide entity with regional offices). Shoreline Master Programs may provide another avenue for the State to address runoff from dairies and would allow the State greater opportunities to oversee the adequacy of the programs through the State approval process. *See* RCW 90.58.090.

[134] Licensing a dairy under the Dairy Nutrient Management Act, for example, or under the Clean Water Act (if a CAFO), may trigger SEPA review.

[135] RCW 43.21C.060.

[136] Ecology has issued guidance for incorporating CO_2 (and other greenhouse gas emissions) impacts into the SEPA review process. This guidance applies only when Ecology acts as the lead agency in a review, but other agencies are free to adopt similar policies. *Guidance for Ecology: Including Greenhouse Gas Emissions in SEPA Reviews*, Wash. St. Dep't Ecology, (Jun. 3, 2011), http://www.ecy.wa.gov/climatechange/docs/sepa/20110603_SEPA_GHGinternalguidance.pdf. Note that any lead agency *could* ensure that a project proponent include these emissions impacts under the existing SEPA regulations, but that it would take a rulemaking to *require* lead agencies do so.

Voluntary and Incentive Measures

Many grants and incentive programs are also available to help Washington's jurisdictions and dairy farmers limit their nutrient runoff. These fall into two broad categories: planning incentives and cash grants for structural improvements to farms or nearby habitats. One further source of funds is enforcement actions: civil penalties levied under the Dairy Nutrient Management Act are used by the Washington State Department of Agriculture to fund relevant research and education activities.[137]

Many counties have engaged in voluntary, collaborative watershed-wide planning, for example, under the Watershed Planning Act.[138] Although these plans are not required to address water quality —they instead focus on water quantity—most of the existing plans do. Many of these plans are awaiting implementation funding following budget reductions in the past few years, and finding a means to implement these would leverage already-existing human capital and sunk costs to realize water quality improvements.[139]

For infrastructure improvements, federal and state dollars and technical expertise are available to jurisdictions or individuals interested in improving nutrient management. County conservation districts,[140] for example, have important existing relationships with dairy operators and farmers, and can ease infrastructure improvements with both expertise and limited funding opportunities.[141] Federal Environmental Quality Incentives Program (EQIP)[142] funds and other grants through the National Resources Conservation Service[143] play a similar role.[144] The Salmon Recovery Act[145] is one of several sources of funds for local jurisdictions proposing to improve salmon habitat; many of the relevant habitat improvement measures combat nonpoint source pollution simultaneously, generating dual environmental benefits for the same expenditure. Finally, the Clean Water Act and Coastal Zone Management Act each provide funding for nonpoint source pollution such as that deriving from dairies.[146] A more complete list of grants and funding programs appears below in Appendix I.

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[137] *Livestock Nutrient Management Program Report*, *supra* note 112, at 10.

[138] RCW 90.82.

[139] Watershed planning authorities can assess their own fees in order to finance Plan implementation, although only one (Island County) has yet done so.

[140] RCW 89.08. See, for example, the Conservation Reserve Enhancement Program (CREP), which includes specific grant programs for dairies and for projects targeting Puget Sound. Wash. St. Conservation Commission, http://scc.wa.gov.

[141] Although in principle dairies could request such grants and technical assistance of their own volition, much of the time such requests come as a result of inspections and the threat of enforcement for discharges into state waters. Anonymous interview with Washington State Department of Agriculture employee, May 18, 2012 (notes on file with the authors).

[142] EQIP is a federally-funded program that provides grants and technical assistance for conservation initiatives on agricultural land.

[143] Another example is the Coastal and Estuarine Land Conservation Program (CELCP); although Washington has a CELCP plan in place, the federal government has yet to allocate any funds to the program. *See Coastal & Estuarine Land Conservation Program*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/sea/wetlands/stewardship/celcp.html.

[144] *See 2011 Environmental Quality Incentives Program (EQIP) in Washington*, USDA Nat. Resources Conservation Service, http://www.wa.nrcs.usda.gov/programs/eqip/FY11/index.html (last updated Jan. 24, 2012).

[145] RCW 77.85.

[146] However, these dollars are subject to variable appropriations, and in any given year, may not provide funds.

6. Crop Agriculture

Crop agriculture is a significant source of nutrient pollution into Washington State waters, as is the case nationally.[147] The federal Clean Water Act largely exempts agricultural activities from its purview,[148] and so most of the relevant regulatory authority derives from Washington State law. However, a significant number of State-level voluntary programs exist to help farmers reduce runoff and recoup savings in reduced fertilizer expenditures.

Laws Governing Water Pollution

Washington's State Water Pollution Control Act gives Ecology the power to regulate nonpoint source runoff directly through the mechanism described above: because discharging pollution into state waters is unlawful, Ecology already has the authority to require farmers to employ management practices effective for avoiding such pollution. Ecology also regulates the labeling, distribution, and contents of commercial fertilizer,[149] although these regulations do not limit the actual amounts of fertilizer farmers may apply to their fields. Manure, however, is not included under the statutory definition of "commercial fertilizer," and the application of manure in crop agriculture is unregulated. Washington could choose to safeguard public health and water quality by establishing a certification program for those who apply manure or commercial fertilizer to more than a critical number of acres—as other states do[150]—providing a framework for assessing the total amount of nutrients added to agricultural lands and for requiring best management practices.

Where waters are listed as impaired under the federal Clean Water Act, TMDLs offer a means of accounting for the proportion of impairment due to nonpoint sources such as agricultural operations. However, unless the State provides reasonable assurances of enforcement for load allocation limits, TMDLs remain more of a planning tool than an enforceable limit on nonpoint source loadings into coastal waters. As a result, nonpoint source pollution—not least from nutrient enrichment—remains a primary cause of water quality problems in Washington.

A significant number of State-level voluntary programs exist to help farmers reduce runoff and recoup savings in reduced fertilizer expenditures.

Laws Governing Land Use

Comprehensive plans under the GMA are generalized, coordinated land use policy statements.[151] As such, the Act provides opportunities to develop smart zoning measures to avoid agricultural runoff, as is the case for dairy runoff discussed above. Where incompatible land uses threaten to converge geographically, jurisdictions' comprehensive plans can create buffer zones or setbacks, as discussed above. This has the corollary benefit of avoiding nuisance-based lawsuits and other similar disputes that inevitably arise as a result of incompatibilities in land use.

The GMA's Critical Areas provision also has potential for combating runoff through comprehensive plans. Using the best available science, jurisdictions must designate a suite of spatially-explicit Critical Areas for five specified purposes: wetlands; areas of critical recharging effect on aquifers used for potable water; fish and wildlife habitat conservation areas; flood zones; and geologically hazardous areas.[152] These areas—particularly the aquifer and wildlife conservation areas—may be useful for ensuring the preservation of high-quality habitat, buffer zones, anti-runoff measures, permeable surfaces near shores and littoral zones, and similar water-quality measures.[153]

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[147] Hashim & Bresler, *supra* note 56, at 17-18.

[148] 33 U.S.C. § 1342 provides a waiver from the NPDES permitting program for return flows from irrigated agriculture; § 1344(f)(1)(a) does the same for dredge and fill material relating to agricultural production. Thus, most agricultural pollution falls into the nonpoint source category.

[149] RCW 15.54.800. The statute defines "commercial fertilizer" as "a substance containing one or more recognized plant nutrients and that is used for its plant nutrient content or that is designated for use or claimed to have value in promoting plant growth, and shall include limes, gypsum, and manipulated animal and vegetable manures. It does not include unmanipulated animal and vegetable manures, organic waste-derived material, and other products exempted by the department by rule." RCW 15.54.270(4).

[150] Delaware, for example, has such a program. Del. Code Ann. tit. 3 § 2201 *et seq*. Maryland has a similar one. Md. Code Regs 15.20.04.01 *et seq*.

[151] RCW 36.70A.030.

[152] WAC 365-196-485(2).

[153] Note that the SMA prohibits Shoreline Master Programs from requiring modification or limitation of agricultural activities on agricultural lands. RCW 90.58.065(1). This provision was inserted in 2002, although it did not go into effect until 2004. *See* Dunlap v. City of Nooksack, Shorelines Hearings Board, SHB No. 02-026 (2003). Thus the SMA is of limited utility in abating existing runoff from row agriculture, although it may still be useful in prospective applications.

However, the Critical Areas program has rested uneasily with the preservation of agricultural lands, another of Washington's land-use priorities; counties and municipalities have found it difficult to preserve land in agricultural use and to protect critical areas simultaneously.[154] The new Voluntary Stewardship Program (VSP), described below, gives counties an option to address this conflict within the context of an alternative collaborative process.

Only proposed (i.e., prospective) actions that are both likely to cause substantial environmental impact and that require a state permit must undergo SEPA's full environmental impact analysis. However, in determining whether or not a proposed project must complete an Environmental Impact Statement, project proponents must include discharge of agricultural runoff into surface and ground waters as a project impact.[155] The State's lead agency can then require particular best management practices or cleanup efforts as a condition of allowing the proponent to mitigate his/her impacts (i.e., substantive SEPA authority.)[156]

It seems unlikely that many new development projects would propose to create entirely new agricultural operations within Washington,[157] but to the extent that these do exist and threaten to discharge nutrients into surface waters, SEPA at least requires proponents to disclose those environmental impacts.

Voluntary and Incentive Measures

The voluntary programs and incentive measures appropriate for row crops overlap substantially with those for dairies (above) and for livestock operations (below).[158] An extensive list is provided in Appendix I. However, a subset of such measures are particularly appropriate in this context. For example, State conservation districts implement the federal Conservation Reserve Enhancement Program (CREP),[159] which provides funding to help farmers address high-value environmental issues such as salmon habitat protection and restoration and irrigation efficiencies. Similarly, the Conservation Districts convene multi-county and Tribal work groups to establish ranking criteria for awarding cost-sharing grants from the federal Environmental Quality Incentives Program (EQIP).[160]

The Voluntary Stewardship Program (VSP) arose as a means of balancing the different aims of the Growth Management Act, but may be broadly useful as a framework for collaborative planning and environmental stewardship.

Mentioned above, the Voluntary Stewardship Program (VSP) arose as a means of balancing the different aims of the Growth Management Act, but may be broadly useful as a framework for collaborative planning and environmental stewardship. The VSP allows counties to bypass some GMA Critical Areas requirements by opting into an alternative means of preserving agriculture while protecting Critical Areas. Jurisdictions that have opted into the VSP will receive funding to develop watershed-specific plans to harmonize these land uses. Counties had until early 2012

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[154] This conflict reached a peak in 2007, when the state Supreme Court decided *Swinomish Indian Tribal Community vs. Western Washington Growth Management Board*, 161 Wash. 2d 415 (2007). There, a tribe and an environmental nonprofit organization challenged the Board's decision largely upholding Skagit County's balancing of critical areas and agricultural lands under the GMA. The Court held that the Act's requirement to "protect" critical areas did not necessarily require the County to remediate the condition of those areas, and further, that "the GMA does not require the county to follow [the Best Available Science (BAS)]; rather, it is required to 'include' BAS in its record." *Id.* at 427-30. After the case was argued before the state Supreme Court, but before it was decided, the legislature imposed a moratorium on critical area designation and requested that the nonpartisan Ruckelshaus Center analyze the conflict between the two land uses under the GMA and develop a recommended solution. Substitute S.B. 5248, 60th Leg., 2007 Reg. Sess. (Wash. 2007); 2007 Wash. Sess. Laws ch. 353. This resulted in the Voluntary Stewardship Program. RCW 36.70A.700.

[155] *See SEPA Guide for Project Applicants*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/sea/sepa/apguide/apguide1.htm.

[156] RCW 43.21C.060.

[157] Note, for example, that in 2012 the State legislature passed a bill requiring project proponents to assess their impacts to agricultural lands, suggesting these lands are under persistent threat in Washington. *See* S.B. 6082, 62nd Leg., 2012 Reg. Sess. (Wash. 2012); 2012 Wash. Sess. Laws ch. 247.

[158] These include the Salmon Restoration Act, Shellfish Protection Districts, and Watershed Planning Districts.

[159] *See CREP*, Wash. St. Conservation Commission, http://www.scc.wa.gov/index.php/Conservation-Reserve-Enhancement-Program/; *Conservation Programs*, USDA Farm Service Agency, http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep.

[160] *See Washington's Environmental Quality Incentives Program*, USDA Nat. Resources Conservation Service, http://www.wa.nrcs.usda.gov/programs/eqip/FY06/index.html. Other federal Farm Bill programs that provide incentives for resource stewardship include Conservation Innovation Grants (http://www.wa.nrcs.usda.gov/programs/cig/FY11/index.html), the Conservation Stewardship Program (http://www.wa.nrcs.usda.gov/programs/csp/CSP12/index.html), the Conservation of Private Grazing Land Initiative (http://www.nrcs.usda.gov/programs/cpgl/), the Farm and Ranchland Protection Program (http://www.wa.nrcs.usda.gov/programs/frpp.html), the Grassland Reserve Program (http://www.nrcs.usda.gov/programs/grp), the Wetlands Reserve Program (http://www.wa.nrcs.usda.gov/programs/wrp/wrp.html), and the Wildlife Habitat Incentives Program (http://www.wa.nrcs.usda.gov/programs/whip/WHIP11/index.html).

to decide whether to opt into the program; 28 of 39 counties joined, representing the bulk of the State's agriculture-heavy areas.[161] The success of the VSP remains to be seen, but as the Panel considers options for combating chemical change in the coastal ocean, the process that resulted in the Program could be a useful model for collaborative decisionmaking. One aspect of VSP implementation might include supporting landowners' efforts to monitor their own water quality, increasing the perceived validity of those data and making any water quality problems apparent.[162]

One program not in existence in Washington is a form of revenue or yield insurance for farmers, tied to the use of manure and fertilizers on their fields. Where the marginal cost of additional nutrient application is less than the perceived risk of crop yield loss due to under-fertilization, farmers have an incentive to over-fertilize fields. Specialized insurance could ease this incentive, guaranteeing a certain degree of revenue or yield in exchange for particular agronomic practices (including applying nutrients at agronomic rates.)[163]

[161] A minority of the more urban Puget Sound counties opted into the VSP. See map at *Information on the Ruckelshaus Process*, Wash. St. Conservation Commission, http://www.scc.wa.gov/index.php/Voluntary-Stewardship-Program/Information-on-the-Ruckelshaus-Process/Voluntary-Stewardship-Program.html (last updated Feb. 16, 2012).

[162] This idea was suggested by a Skagit Conservation District official, and was independently underscored by a Mason County shoreline homeowner who pointed to his community's own water quality sampling as evidence of its water quality. Phone interview notes on file with the authors.

[163] Of course, the details of such a program would matter enormously; the moral hazards of revenue insurance abound. *See, e.g.*, Joseph W. Glauber, *Crop Insurance Reconsidered*, 86 Am. J. Agric. Econ. 1179 (2004).

7. Non-Dairy Livestock

Unlike dairies, many of Washington's agricultural operations that revolve around livestock (such as ranching and small-acreage farms) have no associated regulatory scheme for waste nutrient management.[164] A small percentage of animal operations are large enough to be classified as CAFOs subject to regulation under the State's implementation of the Clean Water Act and its NPDES program. But the remainder of such operations has the potential to generate nonpoint source nutrient pollution where animal wastes enter State waters. To the extent that these nutrients reach the coastal ocean, they may increase Washington's vulnerability to ocean acidification.

Laws Governing Water Pollution

As with other nonpoint sources, the primary authority for managing nutrient loads from most livestock operations rests with the State Water Pollution Control Act. Ecology has ample enforcement authority to curtail discharges into State waters, as noted above, although nonpoint source enforcement actions against individual landowners have been relatively rare as a result of Ecology's limited resources and substantial political resistance to nonpoint source enforcement. Nevertheless, this authority is useful as the regulatory backstop to voluntary programs such as the Voluntary Stewardship Program and grants to improve water quality.[165]

TMDLs and their attendant waste load allocations, discussed above for crop agriculture, offer a secondary path to reducing nonpoint source nutrient pollution. Finally, requiring nutrient management plans for commercial livestock operations may also make sense if these are significant sources of nutrient pollution that contribute to ocean acidification in Washington.

One means of addressing water pollution more holistically bears noting.[166] Counties may create special utility districts—such as Island County has done[167]—to focus on the problem of water quality. Island County's Clean Water Utility is a clearinghouse for health, environmental, and utility issues, financed through user fees. Partly as a result of this entity's effort, Island County is nearing completion of an intensive evaluation of the causes and effects of surface water pollution in the County's watersheds.[168] The utility is eligible for grants from state and federal agencies, and could be a forum for concerted action on ocean acidification and associated issues. Other counties may find that they have similar incentives to align their clean water expenditures in this way.

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164 Note that Washington's dairies must be certified by the State Department of Agriculture. It is then relatively easy to condition this certification on the completion of a dairy nutrient management plan. Non-dairy livestock and crop agriculture, by contrast, have no such certification requirement, and therefore it is more difficult to link nutrient management to an existing regulatory scheme.

165 Note that this is an effective regulatory motivation for landowner action only insofar as Ecology has the resources to undertake enforcement actions.

166 Special utility districts are also applicable to every other input source discussed in this report.

167 *See Island County's Clean Water Utility*, IslandCounty.net, http://www.islandcounty.net/publicworks/clean_water_utility/index.asp.

168 Island County Public Health Department, *supra* note 14.

Laws Governing Land Use

As with other agricultural land uses, the GMA and SMA offer limited policy opportunities for reducing nutrient runoff into State waters from livestock operations. The GMA's Critical Areas provision —and the Voluntary Stewardship Program (VSP) into which most agriculture-heavy counties have opted —are the main means of addressing this nonpoint source pollution within existing land use laws. Where jurisdictions' comprehensive plans have designated Critical Areas either for surface waters' recharging effect on aquifers[169] or for fish and wildlife habitat conservation,[170] protection of these areas may improve surface water quality by reducing anthropogenic nutrient inputs. Where counties have opted into the VSP, water quality must improve measurably in order for the county to maintain its program,[171] although the specific mechanism driving this improvement will vary by county.

Voluntary and Incentive Measures

Livestock operations are eligible for a range of grants and loans to aid nutrient management. For example, the State Conservation Commission implements various programs, including the Conservation Reserve Enhancement Program (CREP) to create riparian buffers and restore habitat, and also assists such operations to develop nutrient management plans.[172] The State Conservation Districts also have some cost-sharing grants available for similar purposes,[173] and it is likely that for small livestock operations, even small grants can make a significant difference in nutrient runoff.[174] Washington also provides some modest tax incentives for livestock nutrient management.[175]

…it is likely that for small livestock operations, even small grants can make a significant difference in nutrient runoff.

The federal Natural Resources Conservation Service (NRCS) implements the EQIP, providing technical and financial assistance to undertake conservation practices.[176] These cost-sharing programs—along with the applicable grant programs for habitat restoration listed in Appendix I—lower the barriers to implementing livestock nutrient management, improving water quality, and ultimately reducing the exacerbating effects of this pollution on ocean acidification in Washington.

State law provides a further measure that localities may take to address nonpoint source runoff. Shellfish Protection Districts[177]—which counties may designate on a voluntary basis or which may be imposed as a result of declining water quality in shellfish growing areas—offer a framework for mitigating the many different inputs to coastal waters. The Districts have the authority to levy fees from watershed residents in order to implement existing water quality authority (although they need not necessarily levy such fees), and they function as a forum for solving water quality problems in a collaborative way. These may be broadly useful tools in coastal jurisdictions, for other sources of pollution as well as for livestock runoff.

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[169] RCW 36.70A.030(5)(b).

[170] RCW 36.70A.030(5)(c).

[171] Counties must fund an approved program and meet measurable benchmarks for environmental protection or else lose their ability to design a customized program to balance critical areas and agricultural land uses. RCW 36.70A.735.

[172] *Overview of Programs*, Wash. St. Conservation Commission (Nov. 13, 2007), http://www.scc.wa.gov/index.php/Programs- and-Services/.

[173] These grants are for up to $25,000 per project for the Conservation District's contribution to a cost-sharing arrangement with grant recipients.

[174] Interview on May 24, 2012, with anonymous Conservation District official, who noted that when dealing with small-scale beef operations or small-acreage farms with 2 or 3 horses, small grants of $200-$5000 make a significant difference in nutrient management. Notes on file with the authors.

[175] RCW 82.08.890. This is an exemption from retail sales tax for sales of equipment and labor relating to livestock nutrient management systems.

[176] *See 2012 Environmental Quality Incentives Program (EQIP) in Washington*, USDA Nat. Resources Conservation Service, http://www.wa.nrcs.usda.gov/programs/eqip/FY12/index.html (last updated May 25, 2012).

[177] RCW 90.72.030.

Nonpoint Source Runoff is Not Low-Hanging Fruit But is Fruit Nonetheless

In highlighting nonpoint source pollution control as an opportunity to limit acidifying inputs into Washington State waters, it is important to acknowledge the longstanding difficulties in limiting nonpoint source pollution for its own sake. Since the Clean Water Act of 1990, federal and state jurisdictions have consistently highlighted the substantial challenge that such pollution poses. More than 20 years later, it remains the largest water quality problem in the United States. This is true despite states' authoring tens of thousands of Total Maximum Daily Loads (TMDLs) for impaired water bodies over the past decade.[178] In Washington State, Ecology and Agriculture continue to dedicate significant effort to mitigating nonpoint source runoff, and despite some significant progress,[179] much remains to be done.

Reducing nonpoint source pollution is thus likely to be difficult and does not address the root cause of ocean acidification: CO_2. However, addressing this longstanding water quality problem is a concrete step that Washington can take to mitigate the chemical change of its waters. Doing so would both abate what is likely a substantial and direct part of the problem in Puget Sound and would increase the resilience of the State's ecosystems in the face of inevitably acidifying waters. Critical concentrations of nonpoint source pollution are both generated more locally and impact water quality more locally than atmospheric CO_2. Hence, State actions to reduce nonpoint source pollution are not subject to the externalities of global CO_2, and so may have a greater local impact over short time scales than efforts to reduce CO_2 emissions alone. Meanwhile, continuing to limit Washington's CO_2 emissions remains the State's primary means of contributing to the global effort to mitigate ocean acidification.

[178] It should be noted, however, that states' TMDLs are generally not enforceable limits on nonpoint source pollution, but rather more akin to road maps describing means of pollution reduction.

[179] Ecology's web site lists a wide variety of success stories, defined variously. *State-wide Stories*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/wq/wqstories/storiesStatewide.html (last updated June 2012).

8. Increased Erosion

Land uses that cause erosion of upland areas increase sediment loadings into rivers, and can ultimately deliver substantial nutrient loads into estuaries and coastal marine waters. Where such loadings bury or shade productive subtidal habitat, or eutrophy coastal waters, they may increase the vulnerability of Washington's state waters to ocean acidification.

Laws Governing Water Pollution

As with other nonpoint sources of pollution, discussed above, Washington has the authority to control erosion and its attendant sediment runoff into state waters. However, in practice such enforcement is rare, and efforts to control erosion have focused on Critical Area designation and forestry practices, both discussed below. Washington may also develop a TMDL for sediment loadings under the Clean Water Act, where particular water bodies are impaired for sediment.

Land uses that cause erosion of upland areas increase sediment loadings into rivers, and can ultimately deliver substantial nutrient loads into estuaries and coastal marine waters.

Laws Governing Land Use

Local jurisdictions can use their broad authority under land use planning laws such as the GMA and the SMA to encourage land-use practices that entail minimal sediment loadings into the State's waters. Apart from general zoning measures in comprehensive plans that reduce loadings into rivers and streams (e.g., riparian buffer zones or setbacks, grading permit programs), the GMA's Critical Areas provision could again play a useful role with respect to upland erosion. Geologically hazardous areas—one of the five categories of Critical Areas under the GMA[180]—include areas prone to significant erosion, such as steep slopes or areas with loose soil. Erosion hazard areas can also include coastal erosion areas, identified by Ecology in the Washington state coastal atlas.[181] The designation of geologically hazardous critical areas, which entails building prohibitions where risks to commercial, residential, or industrial developments cannot be mitigated through technology,[182] could help ensure the preservation of habitat and buffer zones in erosion-prone sites likely to contribute to ocean acidification. Since the purpose of this designation is to prevent the hazards that erosion zones present to public health and safety,[183] employing the provision to combat ocean acidification (again, where erosion is a factor contributing to Washington's vulnerability to the acidifying ocean) may require such a finding.

Forestry is by far the largest land use category in Washington,[184] and is governed by the State's Forest Practices Act.[185] The Act is intended, in part, to support Washington's timber industry while maintaining environmental standards related to water quality and comprehensive watershed management.[186]

> [T]he Washington State Forest Practices Act and rules were designed and adopted, in part, to meet the requirements of the Clean Water Act and the state water quality standards. The Forest Practices Board is the agency responsible for adopting the forest practices rules. However, for those sections of the rules pertaining to water quality protection, the board must reach agreement with the director of Ecology, or the director's designee on the board (RCW 76.09.040(1)(e)).[187]

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[180] RCW 36.70A.030 (5).

[181] *See* WAC 365-190-030(5) and WAC 365-190-120.

[182] WAC 365-190-120(2) ("Some geological hazards can be reduced or mitigated by engineering, design, or modified construction or mining practices so that risks to public health and safety are minimized. When technology cannot reduce risks to acceptable levels, building in geologically hazardous areas must be avoided.").

[183] WAC 365-190-120(1).

[184] Hashim & Bresler, *supra* note 56, at 9; forests make up nearly half of geographic area in the State.,

[185] RCW 76.09.

[186] *See* RCW 76.09.010 and WAC 222-22. The Washington Forest Practices Board, established to implement the act, has also developed a Forest Practices Habitat Conservation Plan. *See Forest Practices Habitat Conservation Plan*, Wash. St. Dep't Nat. Resources, http://www.dnr.wa.gov/businesspermits/topics/forestpracticeshcp/pages/fp_hcp.aspx.

[187] Hashim & Bresler, *supra* note 56, at 12.

The Act's substantive standards[188] are bolstered by strong enforcement provisions: if an entity engaging in forest operations fails to comply with the relevant water quality regulations, it can be forced to discontinue its operations or correct the failure and compensate for the material damage to public resources it has caused, while the Department of Natural Resources retains the right to undertake the remedial action itself and impose the cost on the operator.[189]

The Act also encourages landowners and resource managers to voluntarily develop long-term multispecies landscape management plans for the protection of public resources.[190] This kind of citizen science—along with comprehensive enforcement of forestry practices that avoid erosion and runoff—are important existing tools to combat any nonpoint source contribution to ocean acidification.[191]

Agriculture is also a significant source of erosion and consequent nonpoint source pollution in Washington.[192] The relevant water quality and land-use laws for agriculture are discussed above.

Voluntary and Incentive Measures

For small-scale erosion, education and outreach to homeowners is a critical step towards minimizing erosion as a nonpoint source of pollution. To this end, Ecology provides helpful recommendations on measures that can be taken to control erosion,[193] and local conservation districts also lend technical support. Under certain circumstances, landowners employing best management practices in areas where sedimentation and erosion affect water quality in streams and rivers are eligible for funding under Ecology's Water Quality Program, which includes the three main funds described above.[194] Other, smaller funding sources may also be available: for small-scale projects likely to improve the health of Washington's State waters, the Northwest Straits Commission could decide to fund small-scale erosion control projects implemented by local authorities, for example. Similarly, funds raised by Shellfish Protection Districts could go towards soil stabilization efforts intended to mitigate the detrimental impacts of sediment loadings into coastal marine waters hosting shellfish beds.

For large-scale land uses susceptible to erosion—including, but not limited to, forestry—funding for erosion control may be available through the Salmon Recovery Fund Board,[195] or similar sources of support listed in Appendix I. Land swaps, in which landowners exchange the title or use rights to particular parcels, may be of great use in avoiding erosion—for example, to avoid timber extraction on steep slopes. Similarly, transferable development rights, conservation easements, or analogous ways of creating value for landowners may provide substantial incentives to reduce erosion in marginal areas.[196]

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188 WAC 222-22 (watershed analysis); WAC 222-23 (rivers and habitat); WAC 222-30 (timber harvest practices); among other substantive rules.

189 *See* RCW 76.09.100 (failure to comply with water quality protection regulations.)

190 *See* RCW 76.09.350.

191 The Forest practices board has for instance been authorized to adopt measures for the protection of aquatic resources after a report had revealed that forest practices had a significant detrimental impact on the State's fish stocks. *See* RCW 76.09.055 and RCW 76.09.370. A special fund has been established to implement this program. Similar actions with regard to the mitigation of local sources of ocean acidification could perhaps be undertaken under the Forest Practices Act if ocean acidification was recognized to represent an equally serious policy problem.

192 Hashim & Bresler, *supra* note 56, at 18.

193 *See Erosion Control*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/wq/wqguide/erode.html; *Technical Manual on Stormwater Management for the Puget Sound Basin, Volume II, Erosion and Sediment Control*, City Mercer Island Wash., http://www.mercergov.org/files/91-75V2StormWaterMan-Ero&SedControl.pdf.

194 *See* Funding Guidelines, *supra* note 46, at 56, 60, and 103.

195 *See Salmon Recovery Funding Board*, Wash. St. Recreation & Conservation Office, http://www.rco.wa.gov/boards/srfb.shtml.

196 *See, e.g.*, Margaret Walls and Virginia McConnell, Incentive-Based Land Use Policies and Water Quality in the Chesapeake Bay, Resources for the Future Discussion Paper 04–20 (Mar. 2004) (discussing transferrable development rights, purchases of development rights, and development impact fees with respect to nonpoint source pollution control).

Atmospheric Inputs: CO_2 and NO_x

Carbon dioxide (CO_2) is the global driver of ocean acidification: as humanity has moved hundreds of billions of tons of carbon from the terrestrial realm into the atmosphere, the ocean has absorbed a significant fraction—approximately one third—of anthropogenic CO_2. This absorption, in turn, has lowered the global mean pH substantially since the pre-industrial era. Other atmospheric pollutants such as nitrogen oxides (NO_x) and sulfur oxides (SO_x) form strong acids when dissolved in water, and have the potential to acidify coastal waters in some cases.[197] However, it is not clear that these contribute significantly to acidification in state waters: Washington's energy portfolio contains little coal—a primary source of SO_x—and atmospheric deposition of NO_x appears to account for a very small proportion of the nitrogen in state waters.[198]

Any discussion of limiting CO_2 emissions in Washington as a means of addressing ocean acidification in State waters must take into account the facts that CO_2 is a well-mixed atmospheric gas and that Washington itself generates only a small fraction of the world's CO_2 emissions. Thus, any reduction in CO_2 emissions within Washington could be dwarfed by emissions *increases* anywhere else in the world.[199] These externalities make CO_2 a problem as difficult to tackle in the context of ocean acidification as it is to tackle in the related context of climate change.

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[197] The significant public health benefits of reducing SO_x and NO_x—even if these prove to be minor contributors to ocean acidification in Washington—make these reductions attractive because of their high benefit:cost ratio. For example, the federal EPA recently estimated this ratio at over 30:1 for a rulemaking establishing emissions standards for large marine diesel engines.

[198] For example, atmospheric N deposition was 1% of inorganic N loading to Puget Sound as estimated by Mindy Roberts, Julia Bos, & Skip Albertson, *South Puget Sound Dissolved Oxygen Study: Interim Data Report*, Wash. St. Dep't Ecology (Dec. 2008), www.ecy.wa.gov/biblio/0803037.html. Mohamedali et al., *supra* note 14, at xix , estimates that atmospheric N accounts for a total of 4% of dissolved inorganic N loading into the combined waters of Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca.

[199] Washington produces about 1% of the gross greenhouse gas emissions of the United States. Washington Department of Ecology, Washington State Greenhouse Gas Inventory and Reference Case Projections, 1990-2020 (Dec. 2007), at ES-1.

Energy efficiency and greener purchasing decisions save the State money, internalizing a substantial incentive for emissions.

Nevertheless, Washington has already begun to do its part to address this global problem. Reducing greenhouse gases is already state policy in Washington, embodied in a variety of existing executive orders[200] and statutes.[201] As a result, many emissions-reducing measures are consistent with (or perhaps required by) these instruments. The organization of this report reflects these existing measures; we do not intend to suggest that atmospheric drivers are or should be lower mitigation priorities than non-atmospheric inputs to Washington waters, but rather wish to focus on issues that are not already receiving significant attention through the State's greenhouse gas initiatives.

Moreover, other important reasons exist for Washington to minimize its portion of the global CO_2 problem. Energy efficiency and greener purchasing decisions save the State money, internalizing a substantial incentive for emissions reductions. Some emissions-reducing activities even generate positive revenue—such as the sale of methane from cow manure, or the sale of carbon credits for emissions reductions in the course of changed business practices in the forestry, agricultural, and industrial sectors. Monroe, Washington's methane biodigester is a collaboration among the Tulalip Tribes, farmers, and conservationists, and it illustrates some of the ancillary benefits of this emissions reduction strategy by using cow manure from agricultural operations, avoiding some amount of nonpoint source runoff from manure, generating revenue for salmon habitat restoration, avoiding methane emissions, and generating electricity.[202]

[200] Gov. C. Gregoire, Executive Order 09-05 (May 21, 2009); Executive order 07-02 (Feb. 7, 2007)

[201] RCW 43.21M; RCW 70.235.

[202] See Qualco Energy, http://qualco-energy.org/, for more information. However, because nitrogen is not disposed of in the process, biodigesters can concentrate nutrients from organic waste, which must then be dispersed in such a way as to avoid runoff. Washington has several biodigesters now in operation. See *Operating Anaerobic Digester Projects*, U.S. EPA, http://www.epa.gov/agstar/projects/index.html, for a map of anaerobic digester projects nationwide.

1. CO_2: Industrial, Transportation, and Residential Sources

Because of Washington's already-extensive efforts to develop a comprehensive policy surrounding CO_2 and other greenhouse gas emissions,[203] we only briefly touch on these here. We again underscore that, despite its externalities, CO_2 emissions reduction appears the only plausible long-term means of mitigating ocean acidification, and so we want to emphasize the long-term importance of the work Washington continues to do in this area.

Laws Governing Water Pollution

Although untested by case law, Washington could develop a TMDL for CO_2 loading in State waters, where those waters are impaired for pH. Other atmospheric pollutants—such as NO_x and mercury—have TMDLs in some states,[204] and the direct connection between CO_2 and pH makes a novel TMDL for CO_2 a possibility for addressing ocean acidification. However, if because CO_2 is so well mixed in the atmosphere, global emissions mean Washington's waters would continue to violate its water quality standard for pH independent of any action within the State, this policy tool would be of little practical utility and substantial expense. Consequently, the desirability of a CO_2 TMDL turns largely on the relative importance of Washington-derived CO_2 in driving acidification in Washington's waters.

Laws Governing Air Pollution

The primary legal tool governing air pollution is the federal Clean Air Act, implemented in Washington by the Department of Ecology. We will not recount the history of the federal EPA's struggles with CO_2 regulation here, except to say that at present, there exists no National Ambient Air Quality Standard for CO_2. As a result, it would be difficult for Washington to promulgate its own such standard.

Nonetheless, Washington has other means of reducing in-state CO_2, ranging from automobile emissions standards to building codes, to administrative changes creating incentives for state agencies to reduce electricity usage (and hence reduce emissions).

The transportation sector accounts for nearly half of Washington's CO_2 emissions, and any emissions-reduction strategy will accordingly address transportation in some way. Washington's Department of Transportation allocates federal funds for the Transportation Enhancement Program,[205] which may be used for emissions-saving measures such as increasing the presence of bike lanes and modernizing transit facilities.[206] To the extent that Washington can improve its mass-transit infrastructure and reduce vehicle miles traveled, it will continue taking important steps towards reducing its overall CO_2 emissions.

In Washington, SEPA does not require that project proponents evaluate their greenhouse gas emissions (including CO_2) either alone or as part of a cumulative impacts analysis.

Laws Governing Land Use

Longer-term steps for reducing Washington's emissions surround land-use decisions: the degree to which carbon sinks—such as forests—are converted into carbon sources, the distance between population centers and employment centers (and hence vehicle miles traveled), the transit options available between major population centers, and so on.

SEPA is Washington's overarching environmental protection statute, and like the federal National Environmental Policy Act (NEPA)[207] and its other state equivalents, SEPA is a procedural law not requiring any particular environmental outcome from the proponent of a development project or action. Rather, its purpose is to make clear the environmental impacts the proposed action would have, and to evaluate the impacts of a range of alternatives (including the lack of an action—the

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[203] *See, e.g.*, Janice Adair & Justin Brant, *Path to a Low-Carbon Economy: An Interim Plan to Address Washington's Greenhouse Gas Emissions*, Wash. St. Dep't Ecology (Dec. 2010), http://www.ecy.wa.gov/biblio/1001011.html. *See also Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy, Executive Summary*, Wash. St. Dep't Ecology (Apr. 2012), www.ecy.wa.gov/pubs/1201004b.pdf (focusing on adaptation measures).

[204] *See, e.g.*, *Total Maximum Daily Loads (TMDLs) and Mercury*, U.S. EPA, http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/mercury/index.cfm (last updated May 31, 2012) (describing mecury TMDLs and providing links to example mercury TMDLs).

[205] *Transportation Enhancement Program*, Wash. St. Dep't Transp., http://www.wsdot.wa.gov/LocalPrograms/ProgramMgmt/TransEnhancement.htm.

[206] Note, however, that DOT need not necessarily allocate these grants in this way: scenic beautification and archeological planning and research (among other things) are acceptable uses of these funds.

[207] 43 U.S.C. § 4321 *et seq.*

"no-action alternative.") In Washington, SEPA does not require that project proponents evaluate their greenhouse gas emissions (including CO_2) either alone or as part of a cumulative impacts analysis. Lead agencies have the discretion to require such analysis—and Ecology does—but they need not do so. One important change that the State could make would be to require CO_2—and other greenhouse gas—accounting as part of SEPA analysis, ensuring that the actual environmental impact of a project be made clear consistently across projects subject to SEPA.[208]

Local jurisdictions also could employ the State's two land-use planning statutes—the GMA and the SMA—to favor low-carbon, transit-friendly land uses. Low-impact development could reduce Washington's CO_2 emissions through reductions in vehicle miles traveled, energy efficiency, and related means, and local land use law could encourage these changes. We discuss similar measures in the context of NO_x reduction below.

Voluntary and Incentive Measures

Some market-based incentives already exist that would reduce CO_2 emissions in the private sector, particularly with respect to transit.[209] For example, businesses may be able to generate carbon emissions credits for adopting policies that encourage their workers to telecommute, banking the emissions avoided by driving to and from work.[210] The insurance companies that underwrite individual drivers, too, have a strong incentive to see their customers curtail the number of miles they drive (and hence reduce the risk of accident or injury), and so may be willing partners in helping Washington businesses set up such programs. The federal government may also provide incentives for telecommuting in areas that fall short of air quality standards through the Congestion Mitigation And Air Quality Improvement Program.[211]

Green building strategies are a further opportunity to reduce CO_2 emissions while simultaneously minimizing the overall environmental impact of buildings. In addition to the green building requirement for state-funded buildings,[212] local governments can create incentives for green building practices in the private sector. The Seattle Department of Planning and Development, for example, has a variety of mechanisms in place that prioritize green buildings and speed green building applications through the permitting process,[213] so-called "performance zoning." Any CO_2 reductions Washington can achieve will be a small, but important, step towards controlling the root cause of ocean acidification.

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[208] California and Massachusetts, for example, already require greenhouse gas accounting in their state-NEPA-equivalents. *See, e.g.*, Cal. Code Regs. tit. 14 § 15064.4(b) ("A lead agency should consider the following factors, among others, when assessing the significance of impacts from greenhouse gas emissions on the environment: (3) The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions... If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with the adopted regulations or requirements, an EIR must be prepared for the project."). For the Massachusetts policy, see Executive Office of Energy and Environmental Affairs, *Revised MEPA Greenhouse Gas Emissions Policy and Protocol*, Energy & Envtl. Aff. http://www.env.state.ma.us/mepa/downloads/GHG%20Policy%20FINAL.pdf.

[209] There are already programs in place in Washington that help reduce the number of vehicle miles traveled, and accordingly, CO_2 emissions. These programs are discussed in the next section in the context of reducing mobile sources of NO_x.

[210] Note that such offsets are related to the business claiming the offsets, but not generated by that business. This might impact which markets they can be sold on. Note also that California's impending cap-and-trade system for CO_2 will create a market for such U.S.-based credits.

[211] This is administered by entities within the U.S. Department of Transportation, authorized under the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETY-LU) Act of 2005. *See Congestion Mitigation and Air Quality Improvement (CMAQ) Program*, Fed. Highway Admin., http://www.fhwa.dot.gov/environment/air_quality/cmaq/. For more detail, see *Telecommuting*, Fed. Highway Admin., http://www.fhwa.dot.gov/environment/air_quality/cmaq/reference/telework/.

[212] *See* RCW 39.35D.

[213] *See Priority Green*, seattle.gov, http://www.seattle.gov/DPD/Permits/GreenPermitting/Overview/default.asp.

2. NO_x: Mobile Sources

Atmospheric nitrogen deposition can have at least two effects on water chemistry relevant to ocean acidification. First, NO_2 reacts with water in the atmosphere, forming nitric acid (HNO_3). Nitric acid's dissociation in seawater then has both a direct acidifying effect (giving off a proton, and thus lowering pH) and an indirect effect by which nitrate (NO_3^-) can act as fertilizer and contribute to eutrophication and subsequent acidification via respiration. Because only a small fraction of nitrogen in the State's waters (approximately 1% in Puget Sound) is a result of atmospheric deposition, it seems likely that if NO_x emissions have an appreciable effect on ocean acidification in Washington, they would do so primarily by directly lowering pH (i.e., by donating a proton) rather than via eutrophication and respiration.

By far the largest fraction of NO_x emissions in Washington comes from mobile sources: cars and off-road vehicles emit far more of this acid gas than all other sources in the State combined (see Figure, Appendix II).[214] If atmospheric deposition of NO_x contributes to acidification in Washington's waters, mobile sources represent the area of greatest opportunity for reduction.

[214] Together, highway vehicles and off-highway vehicles account for nearly 83% of all NOx emissions in Washington State. Data are from 2008. *See National Emissions Inventory*, U.S. EPA, http://www.epa.gov/ttn/chief/net/2008inventory.html.

Laws Governing Water Pollution

If atmospheric NO_x deposition appears to be a significant water pollution problem in state waters with respect to ocean acidification, Washington may follow the Chesapeake Bay's lead in developing a TMDL for the pollutant. While it may seem counterintuitive to use a Clean Water Act provision to combat what is normally thought of as an air pollutant, air pollutants can clearly become water pollutants upon deposition in a water body. Moreover, States have increasingly used TMDLs as flexible tools for addressing a wide range of water pollution problems.[215] NO_x is only one example of an air pollutant regulated by an existing TMDL—mercury vapor is another[216]—and by acting to reduce NO_x emissions, the State would simultaneously be addressing water- and air-quality goals.[217]

Laws Governing Air Pollution

Nitrogen dioxide (NO_2) is a criteria pollutant under the Clean Air Act, subject to both federal and state air quality standards that protect public health and welfare. Washington has adopted the federal standards—known as the National Ambient Air Quality Standards—with respect to NO_2, such that the state and federal limits applying to the pollutant are the same. At present, each of Washington's airsheds has attained the relevant standard (maximum average 0.05 parts-per-million over the course of a year).[218]

States may promulgate more stringent air quality standards than those required federally,[219] and so Washington has the authority to tighten its ambient air quality criteria or particular emissions standards for mobile or stationary sources. More stringent standards would have the beneficial side effects of furthering the Clean Air Act's core goals while ameliorating a possible contributor to coastal ocean acidification where atmospheric deposition of NO_x is substantial.

The State may also reduce atmospheric NO_x deposition by encouraging practices that reduce the number of vehicle miles traveled (VMT). Washington's Commute Trip Reduction (CTR) program is one avenue for reducing atmospheric NO_x deposition by vehicle use.[220] The State's CTR program is intended to reduce the number of single occupant commute trips during peak commuting hours and accordingly, reduce air pollution and traffic congestion.[221] The state program requires that designated counties and cities[222] develop CTR plans and "major employers"[223] located within those jurisdictions develop CTR programs to help their employees avoid drive-alone commute trips.[224] The CTR Act also provides for the creation of "growth and transportation efficiency centers"

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[215] For example, the relevant authority governing water quality in the City of Los Angeles, California, has adopted a TMDL for garbage in the Los Angeles Rivershed. See discussion at *Los Angeles River Trash TMDL*, City L.A. Stormwater Program, http://www.ci.la.ca.us/san/wpd/siteorg/program/TMDLs/tmdl_lariver_trash.htm. Other riversheds in southern California have similar TMDLs. For list, *see Total Maximum Daily Load Program (TMDL) Program*, Cal. Envtl. Protection Agency, http://www.waterboards.ca.gov/water_issues/programs/tmdl/.

[216] *See Examples of Approved Mercury TMDLs,* U.S. EPA, http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/mercury.cfm.

[217] For waters impaired for nutrient loads (including nitrates), Washington may be able to develop a TMDL that includes a waste load allocation for atmospheric nitrogen deposition. To develop a TMDL specific to gaseous NOx—to the exclusion of terrestrially-derived nitrogen—the State may need a water quality criterion for NOx as a water pollutant (i.e., p(NOx) or else pH as impacted by NOx). Otherwise, the State's antidegradation policy, WAC 173-201A-310, may deem affected waters to be impaired as a result of NOx, and thereafter the State would develop a TMDL for the pollutant.

[218] WAC 173-475-030.

[219] 42 U.S.C. § 7416 ("nothing in this chapter shall preclude or deny the right of any State or political subdivision thereof to adopt or enforce (1) any standard or limitation respecting emissions of air pollutants or (2) any requirement respecting control or abatement of air pollution; except that if an emission standard or limitation is in effect under an applicable implementation plan or under section 7411 or section 7412 of this title, such State or political subdivision may not adopt or enforce any emission standard or limitation which is less stringent than the standard or limitation under such plan or section."); State of Connecticut v. EPA, 656 F.2d 902, 909 (2d Cir. 1981)("[the Clean Air Act] provides that the states shall be free to adopt air quality standards more stringent than required by the NAAQS or other federal law provisions"); Her Majesty The Queen In Right of the Province of Ontario v. City of Detroit, 874 F.2d 332, 342 (6th Cir. 1989)("[the Clean Air Act] displaces state law only to the extent that state law is not as strict as emission limitations established in the federal statute.").

[220] The CTR program was initially created with the 1991 Commute Trip Reduction Law and was amended in 2006 through the Commute Trip Reduction Efficiency Act. They were codified in the State Clean Air Act at RCW 70.94.521-70.94.555.

[221] RCW 70.94.521.

[222] These requirements are based on location of urban growth areas and proximity to state highways exceeding one hundred person hours of delay. *See* RCW 70.94.527. Under current regulations, nine counties and eighty cities are required to develop CTR plans. WAC 468-63-020(2)(b).

[223] A "major employer" is "a private or public employer, including state agencies, that employs one hundred or more full-time employees at a single worksite who begin their regular workday between 6:00 a.m. and 9:00 a.m. on weekdays for at least twelve continuous months during the year." RCW 70.94.524(1).

[224] *See* RCW 70.94.527, 70.94.531.

(GTECs).[225] These are voluntary designations that allow local governments to enact transportation-demand management measures.[226] GTECs allow governments to address transportation use by employers not affected by CTR programs and vehicle trips not related to work.[227] In its 2011 report to the legislature, the CTR Board reported that in 2010 approximately 574,000 employees had access to employer CTR programs and an additional 535,000 people had access to GTEC programs.[228] As it currently exists, however, the program only reaches citizens in nine out of the State's 39 counties and only six percent of statewide VMT.[229] Although expansion of CTR requirements to all counties may not be feasible or desirable,[230] the collaborative model of CTR and GTEC programs could serve as a starting point for adapting those programs for smaller communities.[231]

The State could also expand its vehicle emissions-testing requirement to reduce atmospheric NO_x deposition. Currently, vehicle emissions testing is only required for cars registered in "emission contributing area[s]"[232] and only sets requirements for carbon monoxide and hydrocarbon emissions.[233] The State could set vehicle emissions testing requirements for NO_x[234] and expand the emissions requirement to encompass a greater number of vehicles.

Washington's Commute Trip Reduction (CTR) program is one avenue for reducing atmospheric NO_x deposition by vehicle use.

Laws Governing Land Use

Washington and its constituent jurisdictions substantially influence land use decisions through their comprehensive plans (GMA), shoreline master programs (SMA), and environmental review process (SEPA). As a result, these jurisdictions could implement new programs that create local conditions to reduce VMT—and thus NO_x emissions—by zoning for mixed-use, high-density, transit-friendly development. SEPA incentives for infill and transit-oriented development would aid in shifting development towards more sustainable land use by helping people work nearer their homes.

Voluntary and Incentive Measures

Improving transit links and increasing urban density reduces sprawl in ways that can increase municipal tax revenues[235] and pay cultural dividends, all while reducing emissions from vehicle miles travelled.[236] King County has already adopted a set of strong policies for reducing VMT and ensuring the vitality of its urban areas, linking transit to development.[237] Other jurisdictions that follow suit will reduce their NO_x emissions for decades to come as a result of smarter, more sustainable growth. State and federal grants for transit and related areas are listed below in Appendix I.

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[225] RCW 70.94.528; WAC 468-63-060.

[226] RCW 70.94.528.

[227] *Growth and Transportation Efficiency Center Program: 2009 Report to the Legislature*, Wash. St. Dep't Transp., 12 (2009), http://www.wsdot.wa.gov/NR/rdonlyres/CEDBB8A1-686F-410A-BED2-282B61E43584/0/GTECProgramReport2009.pdf (comparing CTR and GTEC programs).

[228] Wash. State Commute Trip Reduction Bd., *CTR Report to the Washington State Legislature: 2011*, Wash. St. Dep't Transp., 6 (2011), http://www.wsdot.wa.gov/NR/rdonlyres/05054197-8764-4026-A011-C480E686BBF5/81137/CTRBoard_Report_2011Web.pdf.

[229] *See CTR Report, supra* note 229, at 19.

[230] For example, development of CTR program in smaller counties may not be an efficient use of resources. Additionally, expanding CTR programs to smaller employers is not considered feasible. *Growth and Transportation Efficiency Center Program, supra* note 228, at 7.

[231] The State has also outlined VMT reduction targets which require an eighteen percent reduction by 2020, a thirty percent reduction by 2035, and a fifty percent reduction by 2050. RCW 47.01.440. The steps that the State takes to reach these goals will also help reduce atmospheric NO_x deposition.

[232] RCW 70.120.170.

[233] WAC 173-422A-100.

[234] California's vehicle emissions testing standards, for example, directly address NO_x. *See* Cal. Health & Safety Code §§ 43602, 44012(c), 44001.5(b).

[235] *See, e.g.*, Steve Winkelman et al., *Planning for Economic and Environmental Resilience*, 44 Transp. Res. Part A 575, 581 (2010).

[236] *Id.*

[237] *Climate Motion 2012-0064*, King County, Wash (Mar. 5, 2012), 6-7, http://your.kingcounty.gov/dnrp/climate/documents/2012_Climate_Motion.pdf.

Marine and Aquatic Inputs

Anthropogenically CO_2-enhanced upwelling, described by Feely and colleagues[238] and elsewhere, brings more acidic water to the shallow near-shore environment from deeper in the ocean. This upwelled water carries with it the signature of anthropogenic emissions from decades past, and because humanity's CO_2 emissions have increased steadily over time, the corrosiveness of coastally upwelled water is likely to do the same. To the extent that upwelling intensity increases as a result of climate change,[239] this increase would exacerbate upwelling's acidifying effect.

In addition, Washington is projected to receive greater precipitation in the future as a result of climate change. More precipitation will likely result in greater freshwater outflows to the coastal ocean from rivers and streams, and may lower nearshore marine pH accordingly.[240]

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[238] Richard A. Feely et al., *Evidence for Upwelling of Corrosive "Acidified" Water onto the Continental Shelf*, 320 Science 1490 (2008).

[239] *See, e.g.*, Andrew Bakun et al., *Greenhouse Gas, Upwelling-favorable Winds, and the Future of Coastal Ocean Upwelling Ecosystems*, 16 Global Change Biology 1213 (2010), and related references.

[240] *See* Salisbury et al., *supra* note 922008)(showing effect of acidic freshwater on coastal mollusc dissolution factor); *Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy*, Wash. St. Dep't Ecology, 37-38 (Apr. 2012), https://fortress.wa.gov/ecy/publications/publications/1201004.pdf (showing predicted increases in precipitation and greater seasonality of flows, and hence freshwater input, in Washington as a result of climate change).

These two water-borne inputs—upwelled corrosive water and increased freshwater delivery—would each lower pH in coastal marine waters, but neither is especially susceptible to mitigation. Instead, we include them here as background challenges against which policy decisions must be made. These highlight the need for long-term adaptation—and perhaps remediation—rather than mitigation, and alter the risk-management calculus of ocean acidification policy insofar as the risks of inaction appear to be significant.

Another type of water-borne input, discharge of sewage from floating vessels, is directly anthropogenic and therefore is subject to mitigation. The State could reduce these marine nutrient inputs by designating No Discharge Zones (NDZs). The Clean Water Act authorizes the EPA to designate NDZs in three situations: 1) when a State determines that "some or all waters within such State require greater environmental protection" and the EPA determines that adequate pumpout facilities are available for water that would otherwise be discharged,[241] (2) when the EPA determines after petition by a state that "the protection and enhancement of the quality of specified waters requires" designation of an NDZ,[242] and (3) to create a NDZ in drinking water intake zones.[243] Discharge of sewage, treated or not is prohibited in NDZs.[244] The Puget Sound Action Agenda calls for designation of an NDZ in the Puget Sound[245] and the Department of Ecology is pursuing that goal.[246]

[241] 33 U.S.C. § 1322(f)(3). This type of NDZ is also referred to as a 312(f)(3) NDZ. *No Discharge Zones (NDZs)*, U.S. EPA, http://water.epa.gov/polwaste/vwd/ndz.cfm.

[242] 33 U.S.C. § 1322(f)(4)(A).

[243] 33 U.S.C. § 1322(f)(4)(B).

[244] *See* 33 U.S.C. § 1322(f)(3)-(4). *See also No Discharge Zones*, *supra* note 241.

[245] *Puget Sound Action Agenda*, Puget Sound Partnership, 48, 49 (2009), http://www.psp.wa.gov/aa_action_agenda.php.

[246] *See* Amy Jankowiak, *Puget Sound No Discharge Zone for Vessel Sewage*, Wash. St. Dep't Ecology, http://www.ecy.wa.gov/programs/wq/wastewater/cruise_mou/MOU.html (select "No-Discharge Zone Project" hyperlink under "2011 Cruise Season").

International Aspects of Ocean Acidification in Washington

Because a substantial portion of nutrient loading to Washington's State waters ultimately derives from Canada,[247] a full discussion of policy actions to address these inputs merits a brief discussion of the relevant law on these transboundary effects. Bilateral treaties between the U.S. and Canada govern water pollution issues in two large watersheds of the Pacific Northwest, the Fraser River and the Columbia River.

With a length of over 850 miles, the Fraser River is the longest river within British Columbia, Canada. It flows into the Strait of Georgia at the city of Vancouver. While most of the river's drainage basin lies in Canada, a small portion of it extends into Washington. Designated a Canadian Heritage River, Fraser River is also heavily exploited for industrial and agricultural uses, especially in its lower reaches.

The Columbia River is the largest river in the Pacific Northwest, flowing for over 1200 miles from its origin in British Columbia, Canada, through Washington, where it forms the state border with Oregon, before emptying into the Pacific Ocean. The Columbia River has been heavily modified for human uses through dams and reservoirs, locks, and dredging, and suffers from industrial pollution.[248]

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[247] Mohamedali et al., *supra* note 14, at xii ("The Fraser River contributes, by far, the largest river load [of Dissolved Inorganic Nitrogen, DIN] in the whole [Salish Sea] study area since it drains a significant portion of western Canada and has considerably higher streamflows than other rivers in the study area."). *See also id.* at 34 ("The Fraser River watershed is by far the largest watershed in the whole study area, draining a large portion of western Canada, and has a mean annual DIN load of 33,140 kg/d. This is followed, in order of highest to lowest DIN loads, by the Snohomish River (5,950 kg/d), Sunshine Coast (4,480 kg/d), Nooksack River (4,180 kg/d), and Skagit River (4,220 kg/d)."); app. F tbl.E-1 (indicating that mean summer and annual dissolved inorganic nitrogen (DIN) loads into the Strait of Georgia and the Strait of Juan de Fuca are 28,023 kilograms per day (kg/d) and that DIN loads into the straits and Puget Sound from U.S. wastewater treatment plants are 31,242 kg/d (summer DIN load) and 34,276 kg/d (annual DIN load)).

[248] For a concise history of the transformation of the Columbia River, *see generally* Richard White, The Organic Machine: The Remaking of the Columbia River (2011).

In 1909, the U.S. and Canada signed the International Boundary Waters Treaty, an agreement protecting cross-border waters, such as rivers and lakes, against pollution. The Boundary Waters Treaty established the International Joint Commission (IJC) to arbitrate water pollution disputes and assist the two countries in finding solutions to problems in these waters. Apart from investigating and monitoring pollution problems, the IJC can also recommend remedial action when asked to do so by the governments of the U.S. and Canada.[249] The IJC has launched the International Watersheds Initiative, a project that promotes holistic, ecosystem-level transboundary waters management and strengthens local participation and capacity. The initiative facilitates the development of watershed-specific responses to emerging challenges such as intensified population growth and urbanization, global climate change, changing uses of water, pollution from air and land, and introductions of exotic species.[250] Such watershed planning—not unlike the watershed planning Washington has already undertaken, is currently implemented in five pilot projects and could be extended to encompass the Fraser and Columbia Rivers. The expertise and experience of the Commission could then be harnessed to develop action plans that minimize pollution discharge from these rivers into the Pacific Ocean.

In 1985, the U.S. and Canada adopted the Pacific Salmon Treaty.[251] The treaty created the international Pacific Salmon Commission, mandated to ensure the conservation of salmon and to allocate fishing quotas between the two countries.[252] To better mitigate and adapt to the challenges of ocean acidification, the Commission's analyses of dangers and enhancement activities could integrate acidification's projected impacts—such as a modeled decrease in target species' body masses or population sizes due to a decrease in prey species such as pteropod molluscs[253]—into the Commission's fishery plans, which are transmitted to the Governments of Canada and the U.S. for final approval and regulatory implementation. This would both highlight acidification as an issue of international concern and would encourage concrete steps to mitigate its impact on fisheries.

The Columbia River Treaty, ratified in 1964, governs bilateral watershed management of the Columbia River regarding power generation and flood control through dams. The four dams constructed under this treaty have provided economic benefits but also created environmental problems relating to fish migration, impeded water flow, habitat destruction, and water quality. A treaty review currently being conducted by the governments of both countries[254] could incorporate environmental provisions addressing these problems in the revised agreement, both to mitigate the exacerbating causes of ocean acidification and to increase resilience of Columbia River plume communities to further chemical change.

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[249] See the IJC's website at http://www.ijc.org/en/background/ijc_cmi_nature.htm#What. The IJC has set up more than 20 boards, comprised of experts from both countries, to help it carry out its tasks. One of them is the International Columbia River Board of Control, mandated to keep the Commission apprised of streamflow and water-level data on both sides of the international boundary affected by the operation of the Grand Coulee Dam and reservoir. *See Mandate*, Int'l Columbia River Board of Control, http://www.ijc.org/conseil_board/columbia/en/columbia_mandate_mandat.htm.

[250] *See Mandate*, Int'l Columbia River Board of Control, http://www.ijc.org/conseil_board/watershed/en/watershed_mandate_mandat.htm.

[251] The treaty has since been significantly revised in 1999 and 2009.

[252] *See* Pac. Salmon Commission, http://www.psc.org/Index.htm.

[253] *See generally* Steeve Comeau *et al.*, Impact of Aragonite Saturation State on Migratory Pteropods, 279 Proceedings of the Royal Society B 732 (2012) (discussing the effects of ocean acidification on mollusc species that are a source of prey for salmon and herring).

[254] *See* U.S. Army Corps of Engineers/Bonneville Power Administration, *Columbia River Treaty – History and 2014/2024 Review*, Bonneville Power Admin. http://www.bpa.gov/Corporate/pubs/Columbia_River_Treaty_Review_-_April_2008.pdf.

Appendix

Appendix I: Relevant Grants and Funding Sources

Centennial Clean Water Fund[255]
"The Centennial program provides grants for water quality infrastructure and nonpoint source pollution projects to improve and protect water quality."

Clean Water Act § 319 Nonpoint Source Program[256]
Grants for water quality infrastructure and nonpoint source pollution, as with Centennial Clean Water Fund. Note the Centennial Fund, the Revolving Fund, and the § 319 Nonpoint Source Fund share coordinated funding guidelines in Washington.[257]

Clean Water State Revolving Fund[258]
Low-interest loans and grants for wastewater treatment and nonpoint source programs.

Coastal and Estuarine Land Conservation Program[259]
Federal grants for protecting important coastal and estuarine areas. Washington has a Coastal and Estuarine Land Conservation Plan in place, making it eligible for federal funds when they are appropriated.

Coastal Zone Act Reauthorization Amendments § 6217 Grants[260]
Nonpoint source pollution program (currently unfunded.)

Columbia Basin Fish Accords, State of Washington[261]
Bonneville Power Administration funds for salmon protection and restoration.

Conservation Assistance Revolving Account[262]
Interest-free State loans administered through the conservation districts, "to aid in the financing of conservation reserve enhancement program projects and continuous conservation reserve program projects."

Conservation Reserve Enhancement Program (CREP)[263]
Grants for agricultural buffers to improve water quality.

EPA Pollution, Identification, and Correction (PIC) Program[264]
Small grants focused on bacterial pathogens in Puget Sound.

Federal Environmental Protection Agency Air Quality Partnerships[265]
Grants and technical assistance programs for reducing air pollution.

Federal Transit Funding and Finance Information[266]
The federal government's available information on financing transit infrastructure.

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255 http://www.ecy.wa.gov/programs/wq/funding/FundingPrograms/Centennial/Cent.html.

256 http://www.ecy.wa.gov/programs/wq/funding/FundingPrograms/Section319/Sec319Prgm.html.

257 http://www.ecy.wa.gov/biblio/1010049.html.

258 http://www.ecy.wa.gov/programs/wq/funding/FundingPrograms/CWSRF/cwsrf.html.

259 http://www.ecy.wa.gov/programs/sea/wetlands/stewardship/celcp.html.

260 http://water.epa.gov/polwaste/nps/czmact.cfm; http://coastalmanagement.noaa.gov/nonpoint/welcome.html.

261 http://www.salmonrecovery.gov/Partners/FishAccords/Washington.aspx.

262 RCW 89.08.550.

263 *See* http://www.scc.wa.gov/index.php/Conservation-Reserve-Enhancement-Program/; http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep.

264 http://www.doh.wa.gov/CommunityandEnvironment/Shellfish/EPAGrants/PathogensGrant/PIC.aspx.

265 http://www.epa.gov/partners/programs/index.htm#air.

266 http://www.fta.dot.gov/grants/12309.html.

Forest Legacy Program[267]
Federal grants for conservation easements, protecting upland habitat, and ultimately water quality.

National Estuary Program[268]
Puget Sound is part of the National Estuary Program, funded through the federal Environmental Protection Agency. Grant funds from the EPA flow to Puget Sound mainly to implement the Puget Sound Partnership's Action Agenda;[269] as such, including ocean acidification mitigation measures in the Agenda may be a means of securing some federal grant money for this purpose. The Lower Columbia River Estuary—shared between Oregon and Washington—is also a part of the National Estuary Program, and funds may accordingly be available for ocean acidification mitigation in that Estuary if compatible with the existing management plan.[270]

National Fish and Wildlife Foundation[271]
Nonprofit organization matching public and private funds for conservation.

Natural Resources Conservation Service[272]
Federal grants through the USDA for agriculture related conservation. Includes Environmental Quality Incentives program (EQIP)[273] and many others.

NW Straits Commission[274]
Distributes federal funds for small-scale projects to improve environmental conditions in nearshore areas.

Pacific Coastal Salmon Recovery Fund[275]
This federal funding, annually appropriated by Congress, is awarded through a competitive process to multiple States and Tribes. The Washington Salmon Recovery Funding Board[276] then distributes Washington's funds to grant recipients.

Recreation and Conservation Office[277]
Washington State agency administering grants for, inter alia, habitat restoration and protection. Implements Estuary and Salmon Restoration Program,[278] Washington Wildlife and Recreation Grant Program,[279] Aquatic Lands Enhancement Account,[280] and others.

Rivers and Habitat Open Space Program (formerly Riparian Open Space Program)[281]
Washington State conservation easements for forest land and riparian habitat (currently unfunded).

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[267] http://www.dnr.wa.gov/BusinessPermits/Topics/ConservationTransactions/Pages/forest_legacy.aspx.

[268] http://www.epa.gov/pugetsound/funding/index.html.

[269] http://www.psp.wa.gov/aa_what.php.

[270] http://www.lcrep.org/management-plan-1.

[271] http://www.nfwf.org

[272] http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial.

[273] *See* http://www.wa.nrcs.usda.gov/programs/eqip/FY06/index.html. Other federal Farm Bill programs that provide incentives for resource stewardship include Conservation Innovation Grants (http://www.wa.nrcs.usda.gov/programs/cig/FY11/index.html), the Conservation Stewardship Program (http://www.wa.nrcs.usda.gov/programs/csp/CSP12/index.html), the Conservation of Private Grazing Land Initiative (http://www.nrcs.usda.gov/programs/cpgl/), the Farm and Ranchland Protection Program (http://www.wa.nrcs.usda.gov/programs/frpp.html), the Grassland Reserve Program (http://www.nrcs.usda.gov/programs/grp), the Wetlands Reserve Program (http://www.wa.nrcs.usda.gov/programs/wrp/wrp.html), and the Wildlife Habitat Incentives Program (http://www.wa.nrcs.usda.gov/programs/whip/WHIP11/index.html).

[274] http://www.nwstraits.org/.

[275] http://www.nwr.noaa.gov/salmon-recovery-planning/pcsrf/.

[276] http://www.rco.wa.gov/grants/salmon.shtml (funds from NOAA PCSRF and from bond sales).

[277] http://www.rco.wa.gov/grants/index.shtml.

[278] http://www.rco.wa.gov/grants/esrp.shtml.

[279] http://wildliferecreation.org/our-campaigns/wwrp-projects.

[280] http://www.rco.wa.gov/grants/alea.shtml.

[281] WAC 222-23; http://www.dnr.wa.gov/BusinessPermits/Topics/OtherIndustryLandownerResources/Pages/riparian_open_space_program.aspx.

Salmon Recovery Act,[282] (associated grants)
This Act created the Salmon Recovery Funding Board, administratively within the Recreation and Conservation Office, and an associated funding account to provide salmon recovery grants.

Transportation, Community and System Preservation Program[283]
Federal grants and research surrounding transit-oriented development.

U.S. Department of Agriculture Rural Development Grants[284]
Includes assistance for public utilities such as sewers.

Urban Waters Initiative[285]
Washington effort to address multiple sources of pollution in three urban watersheds.

Washington Coastal Protection Fund[286]
The Terry Husseman Account is funded by fines for Clean Water Act violations, and grants from this account "support locally sponsored projects to restore or enhance the natural environment."

Washington Stormwater Grant Program[287]
State funding from Capital Budget for NPDES-permitted stormwater projects.

The federal EPA also maintains a list of water quality funding opportunities,[288] as does the State of Washington.[289]

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[282] RCW 77.85.005 ("The legislature finds that it is in the interest of the citizens of the state of Washington for the state to retain primary responsibility for managing the natural resources of the state, rather than abdicate those responsibilities to the federal government, and that the state may best accomplish this objective by integrating local and regional recovery activities into a statewide strategy that can make the most effective use of provisions of federal laws allowing for a state lead in salmon recovery, delivered through implementation activities consistent with regional and watershed recovery plans. The legislature also finds that a statewide salmon recovery strategy must be developed and implemented through an active public involvement process in order to ensure public participation in, and support for, salmon recovery. The legislature also finds that there is a **substantial link between the provisions of the federal endangered species act and the federal clean water act** (33 U.S.C. Sec. 1251 et seq.). The legislature further finds that habitat restoration is a vital component of salmon recovery efforts. Therefore, **it is the intent of the legislature to specifically address salmon habitat restoration in a coordinated manner and to develop a structure that allows for the coordinated delivery of federal, state, and local assistance to communities for habitat projects that will assist in the recovery and enhancement of salmon stocks**. A strong watershed-based locally implemented plan is essential for local, regional, and statewide salmon recovery."). *See also*, http://www.rco.wa.gov/grants/sal_rec_grants.shtml; Note—duplicates some information found elsewhere in this Appendix.

[283] http://www.fhwa.dot.gov/tcsp/.

[284] http://www.rurdev.usda.gov/RD_Grants.html.

[285] http://www.ecy.wa.gov/urbanwaters/index.html.

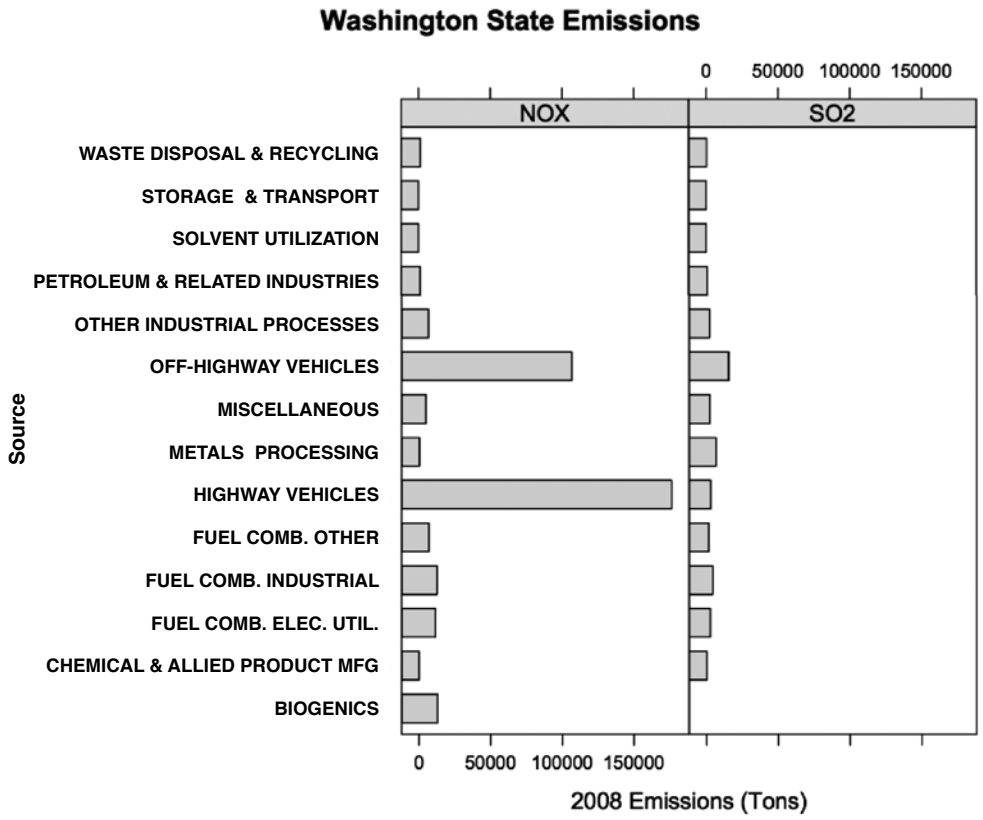
[286] http://www.ecy.wa.gov/programs/sea/grants/cpf/index.html.

[287] http://www.ecy.wa.gov/programs/wq//funding/FundingPrograms/OtherFundingPrograms/StWa12a/FY12aStWa.html.

[288] http://water.epa.gov/grants_funding/.

[289] http://www.ecy.wa.gov/programs/wq/funding/funding.html.

Appendix II: SO_x and NO_x Emissions by Source in Washington, 2008[290]



[290] Data from *National Emissions Inventory*, U.S. EPA, http://www.epa.gov/ttn/chief/net/2008inventory.html. See National Emissions Inventory for relevant abbreviations and discussion.