ECOnorthwest

The Nature Conservancy

2024

The Benefits & Costs of Tide Gate Upgrades on the Oregon Coast

Prepared for Business Oregon

Acknowledgments

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That assistance notwithstanding, ECOnorthwest is responsible for the content of this report. The staff at ECOnorthwest prepared this report based on their general knowledge of the economics of recreation, amenities, and regional economies. ECOnorthwest staff contributing to this study included ***Mark Buckley, Alicia Milligan, Parmis Taraghi, and Nathanial Trull***. ECOnorthwest also relied on information derived from government agencies, private statistical services, the reports of others, interviews of individuals, or other sources believed to be reliable. ECOnorthwest has not independently verified the accuracy of all such information and makes no representation regarding its accuracy or completeness. Any statements nonfactual in nature constitute the authors' current opinions, which may change as more information becomes available.

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Front Cover Source: Jason Nuckols, TNC 2024

Table of Contents

1

Introduction

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ECOnorthwest, in partnership with The Nature Conservancy (TNC), has conducted a study to better understand the benefits and costs associated with tide gate improvements on the Oregon Coast for private landowners. This report leverages existing data sources and information from interviews to categorize and, where possible, quantify the benefits of tide gates.

Tide gates are critical for managing water levels and facilitating coastal agriculture, playing a vital role in preventing flooding and enhancing agricultural productivity. In coastal areas, tide gates are often used to prevent flooding of agricultural land, which, if compromised by deterioration, can lead to saltwater intrusion, soil erosion, and other impacts that affect crop yield, livestock well-being, and overall agricultural productivity. Failing tide gates impede agricultural activities, flood roadways, and obstruct fish passage, and negatively impacts the wellbeing of fish and wildlife populations across Oregon's estuaries. Estuarine wetlands near seaports and urban areas have been particularly vulnerable to land use conversion. The loss of approximately 25-90 percent of coastal estuary habitat and nearly 40 percent of freshwater wetlands in Oregon and the Pacific Northwest is largely attributed to the implementation of such infrastructure.[1]

Over the last two centuries, extensive areas along the Northwest coast of the United States have been drained and converted into agricultural fields and pastureland through the construction and operation of infrastructure such as tide gates, levees, and channels. These structures are designed to regulate tidewater, prevent flooding, and facilitate land drainage. However, the deterioration of these tide gates poses significant challenges, particularly for farmers and ranchers who rely on them to create dry land for agriculture and pasture. The majority of the estimated 1,000–1,500 tide gates in Oregon's estuarine areas and those connected to the Columbia River likely face issues due to aging and outdated technology.[2]

While the ecological fish and wildlife impacts of tide gates are often monitored, there has been a longstanding desire to understand and quantitatively measure the benefits and costs of tide gate upgrades to agricultural landowners. To conduct this study, ideally a traditional benefits-cost analysis would be possible. In this case, the costs of tide gate modernization are relatively well defined and have been identified through various data sources, stakeholder interviews, and case studies. Costs include activities associated with design and engineering, permitting and fees, construction and implementation, as well as maintenance and operation. Meanwhile, benefits in this study include extended grazing periods, increases in the quantity of productive acreage, and other economic gains to landowners. However, the unique qualities of each site make it challenging to quantify and apply benefits universally, as they are typically specific to the landscape and characteristics of each property.

1 Institute for Natural Resources, Oregon Watershed Enhancement Board. (2018). "Ecological Effects of Tide Gate Upgrade or Removal: A literature Review and Knowledge Synthesis. Accessed at: https://www.oregon.gov/oweb/Documents/Tide-Gate-Ecological-Effects.pdf

2 The Nature Conservancy. (2019). What is a Tide Gate and Why does it Matter? Accessed at: https://www.nature.org/en-us/about-us/where-we-work/united-states/oregon/stories-in-oregon/what-is-a-tide-gate/

Introduction

Lacking sufficient data for a traditional benefit-cost analysis, this report combines qualitative data from case studies, interviews, and existing literature with quantitative data from agency contacts and publicly available sources. The aim is to provide landowners and the public with a comprehensive understanding of the tide gate restoration process and its anticipated impacts, benefits, and costs.

This analysis includes an overview of agriculture on the Oregon Coast and the history of related water management and fish passage regulations. A detailed literature review in Section 3 covers the **biological, ecological, social**, and **economic** impacts of tide gates, alongside the potential benefits and costs of their modernization. To deepen this understanding and gauge perceptions of tide gates among public officials and private landowners, ECOnorthwest conducted a series of focused stakeholder interviews. These interviews were designed to gather and validate information on the current condition of tide gate infrastructure, the nature and scale of impacts on land use and environmental health, and the anticipated benefits of upgrades.

ECOnorthwest also analyzed two distinct case studies of tide gate improvements. In partnership with TNC, two sites were selected for this examination: the Winter Lake Tide Gate Project and the North Bank Tide Gate Project. The first case study focuses on the wetland restoration project at Winter Lake, which was designed to improve habitat for juvenile salmon, lamprey, and migratory birds while enhancing water control for local ranchers. This project involved installing an upgraded tide gate system, constructing 40,000 feet of channels, removing three miles of levees, improving four miles of levees, and planting of 120,000 trees and shrubs. Early estimates suggest that the project allows ranchers to extend the grazing season by several weeks and could result in an additional 300,000 juvenile salmon returning annually.[3]

Source: Salmon laying eggs, Shutterstock

The second case study focuses on the North Bank Tide Gate Project, a 7-foot diameter side-hinge aluminum tide gate with a muted tidal regulator installed in 2023 at mile 7.5 of the Coquille River near the settlement of Randolph. The project site encompasses approximately 40 acres of field and 120 acres of forest. Initiated to improve pasture productivity while enhancing habitat quality for coho salmon, the project balances agricultural productivity with ecological restoration efforts.

Collectively, information gathered through interviews, case studies, and literature reviews, is harnessed towards the development of a framework for assessing the benefits and costs of tide gate upgrades.

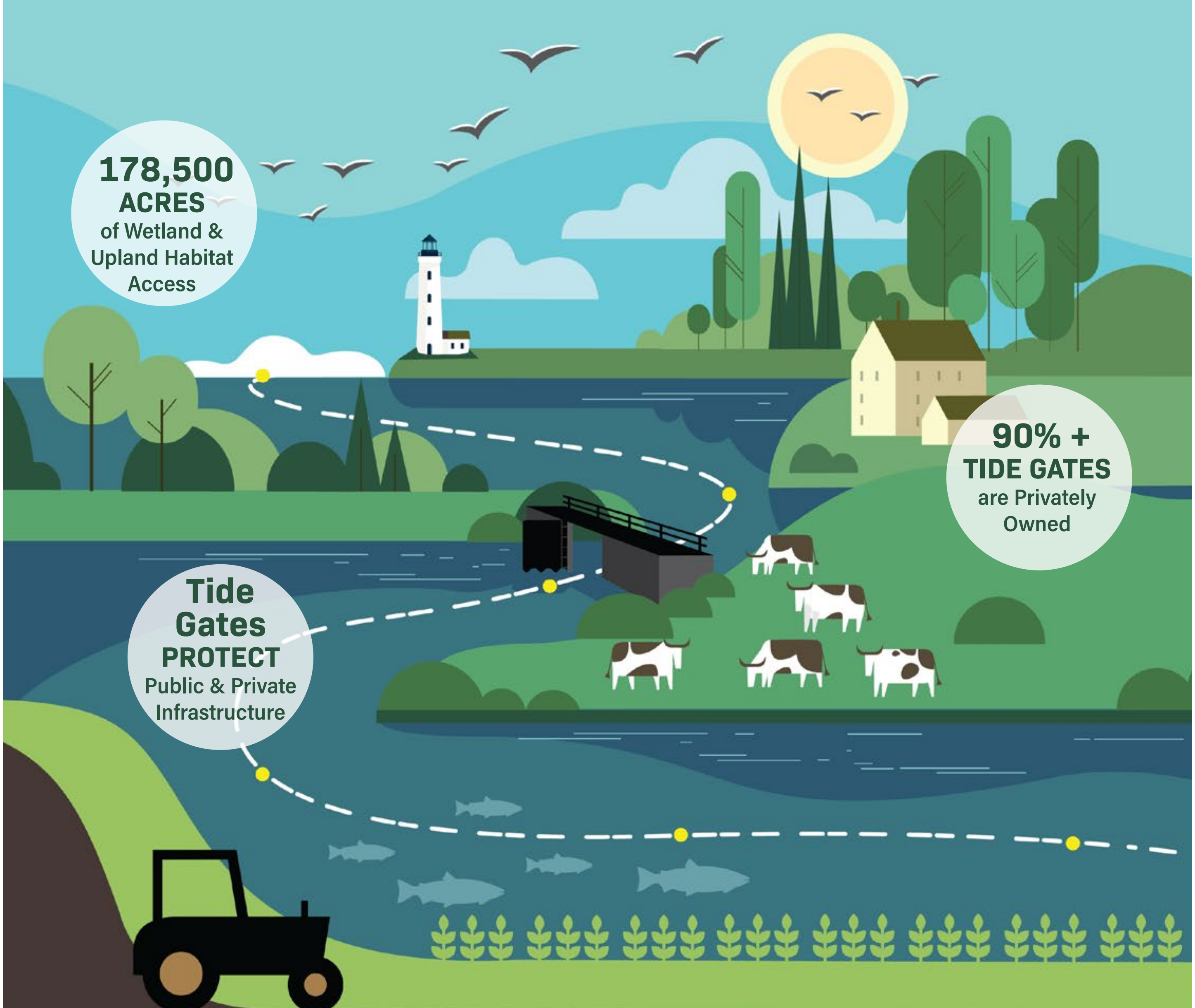
Source: Jason Nuckols, TNC 2024

Source: Jason Nuckols, TNC 2024

3 "Restoring Tidal Wetlands at Winter Lake." The Nature Conservancy. 22nd June 2022. https://www.nature.org/en-us/about-us/where-we-work/united-states/oregon/stories-in-oregon/restoring-tidal-wetlands-at-winter-lake/?vu=tidegates

Coastal Tide Gates:

Utilizing the Tide Gate Optimization Tool and associated GIS data provides the following insights into tide gates along the Oregon Coast*



There are almost 1,800 miles of streams above tide gates, of which:

1,100+ MILES of Streams have Salmonid	**264 MILES** of Streams have Coho Salmon	**42 MILES** of Roads & Railroads	**1,000+ BUILDINGS** Homes & Public Structures	**22,100 ACRES** of Estuary Habitats Affected by Tide Gates	**20,200 ACRES** of Farmlands Affected by Tide Gates

*Does not include the Columbia River estuary

2

Agriculture & Ecosystem Management in Coastal Oregon

Agriculture in Coastal Oregon

Approximately 1,000–1,500 tide gates are in estuaries along the Oregon Coast and in waters connected to the Columbia River.[4] These tide gates are vital for farmers and ranchers, as they ensure dry, arable land for agriculture and pasture, protecting valuable assets from tidal flooding and storm surges. A comprehensive understanding of agriculture in the state — particularly on the Oregon Coast — is essential for assessing the potential impacts, benefits, and costs of tide gate modernization in the area.

69%
OF ALL FARMLANDS
in the estuary are affected by tide gates

The State of Oregon is among the most agriculturally diverse states in the country, with farmers producing over 225 different agricultural commodities across 15 million acres of dedicated farmland. Approximately 60 percent of privately owned land is utilized for agricultural purposes. Oregon generates $5.5 billion in farm production and $288 million in agritourism, direct sales, and added value from farms.[5, 6]

Coastal Oregon contributes significantly to the state's overall agricultural productivity. Coastal farms and ranches, known for their dairy products and specialty crops, play an essential role in the local economy.[7] The coastal agricultural sector has the potential for growth, capable of meeting the needs of both local communities and the tourism industry while continuing to provide important regional commodities.

The United States Department of Agriculture's National Agricultural Statistical Service (USDA-NASS) Cropland Data Layer (CDL) provides agricultural/crop acreage totals for Coastal Oregon on a three-year average basis. This data, combined with Oregon's Coastal Zone boundary (see blue outline in Exhibit 1) and data on proximity to tide gates, can be used to develop a spatial assessment of Oregon's cropland acreage.

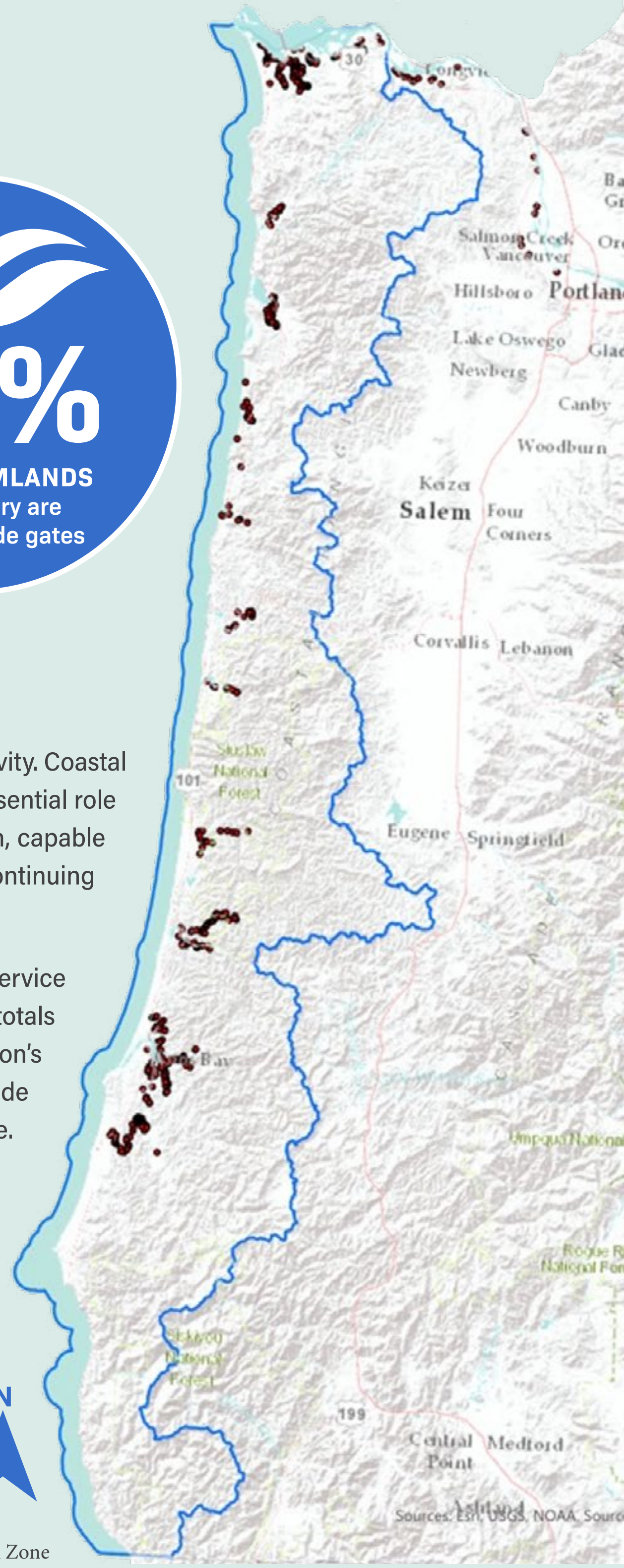


EXHIBIT 1
Coastal Tide Gates & Oregon Coastal Zone

LEGEND
Tide Gate Inventory (2023)
Oregon Coastal Zone
0 5 10 20 Miles
N

Source: ECOnorthwest, Oregon Explorer, Coastal Zone

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4 The Nature Conservancy. (2019). "What is a Tide Gate and Why Does it Matter?". Accessed at: https://www.nature.org/en-us/about-us/where-we-work/united-states/oregon/stories-in-oregon/what-is-a-tide-gate/

5 Sorte, Bruce, Jeffrey Reimer, and Gordon Jones. Oregon Agriculture, Food and Fiber: An Economic Analysis. Oregon State University, College of Agricultural Sciences, 2021.

6 Daniel Bigelow, "Oregon Agriculture by the numbers, part 1: total farms, farmland acres and sales." (February 2024). Available at https://extension.oregonstate.edu/business-economics/rural-development/oregon-agriculture-numbers-part-1-total-farms-farmland-acres.

7 https://www.oregon.gov/oda/shared/Documents/Publications/Administration/ORGrowingRegions.pdf

Agriculture & Ecosystem Management in Coastal Oregon

Approximately 20,200 acres (69 percent of all farmlands) located in the estuary are affected by tide gates.[8] On the Oregon Coast, 95 percent of agricultural acreage is devoted to grassland and/or pasture, indicating that grazing is likely the predominant use of coastal agricultural land.

The average area of land used annually for agricultural production in Coastal Oregon is 304,000 acres. Approximately 20,200 acres (69 percent of all farmlands) located in the estuary are affected by tide gates.[8] On the Oregon Coast, 95 percent of agricultural acreage is devoted to grassland and/or pasture, indicating that grazing is likely the predominant use of coastal agricultural land.

The per-acre value (in USD 2024) of pasture in Oregon has increased steadily over the last seven years from $891 per acre in 2017 to $1,050 per acre in 2024 (an 18 percent increase). The USDA defines pasture value as:

> *"The value of land that is normally grazed by livestock. Pasture does not need to have livestock grazing on it at the time of the interview or during the current year in order to be valued as pasture or grazing land."* [9]

Source: Dairy cows, Shutterstock

Using the 2024 value for pasture, this puts the three-year average value of coastal Oregon pastureland at $305 million. Farm real estate values per acre in Oregon have also seen a steady increase over the last seven years, rising from $2,927 per acre in 2017 to $3,720 in 2024 (a 27 percent increase). The value of irrigated cropland has also increased steadily from $6,139 per acre in 2017 to $7,650 per acre in 2024 (a 25 percent increase).[10] Coastal Oregon counties also have some of the highest cash rental rates for pasture. In 2024, cash rents were $27 per acre and $33.50 per acre in Coos and Curry counties respectively. In 2023, cash rents in Tillamook County were the highest in the State at $153 per acre.[11, 12]

Outside of grassland/pastureland, other top production crops on the coast include hay, corn, sod/grass seed, tree crops, fallow/idle land, clover/wildflowers, winter wheat, and dry beans. A breakdown of the three-year average coastal crop acreages excluding Grassland/Pasture is illustrated in Exhibit 3. Further analyses discussed in this report will use a refined crop selection based on the specific characteristics of agricultural areas surrounding the tide gates of interest.

Dairy production is a crucial feature of Coastal Oregon's agricultural industry. Dairy is Oregon's 5th largest agricultural commodity, accounting for $9.73 billion in total annual economic impact ($3.1 billion in direct impacts and $6.6 billion in indirect impacts). Statewide, the dairy industry supports 45,564 jobs (13,273 direct and 32,291 indirect), contributes 4 percent to Oregon's gross domestic product (GDP), and generates $304.3 million in state taxes.[13] There are four coastal counties with

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8 Nuckols, Jason. Oregon Tidegate Optimization Tool and Data. Accessed March 2024.

9 United States Department of Agriculture – National Agricultural Statistical Service. (2024). "Land Values: 2024 Summary." Accessed at: https://www.nass.usda.gov/Publications/Todays_Reports/reports/land0824.pdf

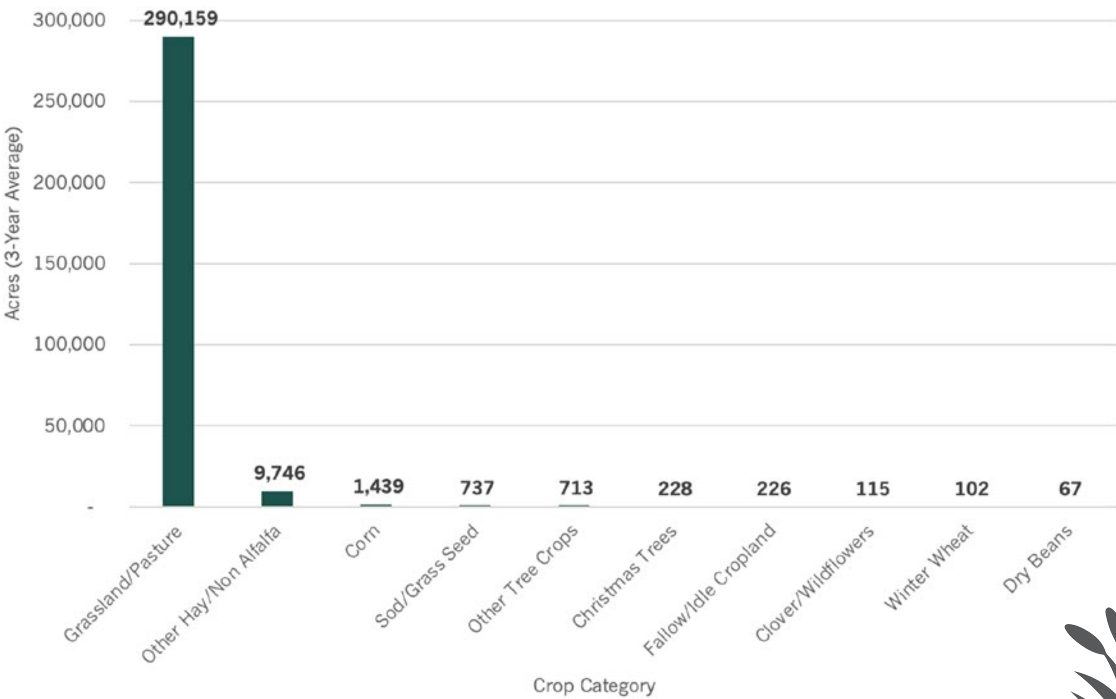
10 Recent, localized agricultural land sales indicate this may be a low estimate.

11 USDA. (2024). "Press Release". Accessed at: https://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Current_News_Release/2024/CSH_CNTY.pdf.

12 Cash rent values were not available in 2024 for Tillamook County.

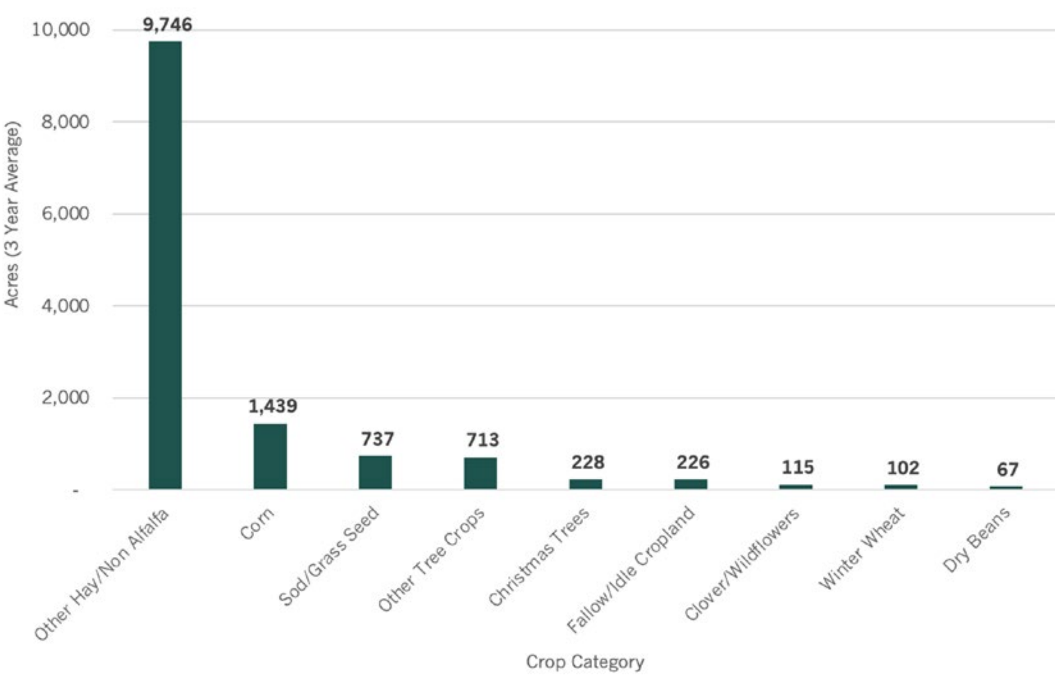
13 Oregon Dairy Farmers Association. (2024). "Oregon Dairy Economic Impact." Accessed at: https://www.oregondairyfarmers.org/resources/oregon-dairy-economic-impact.

EXHIBIT 2:
Three-year Average of Coastal Crop Acreages



Source: ECOnorthwest, USDA National Agricultural Statistical Service (USDA-NASS) Cropland Data Layer

EXHIBIT 3:
Three-Year Average of Coastal Cropland and Acreages, Excluding Grassland/Pasture



Source: ECOnorthwest, USDA National Agricultural Statistical Service (USDA-NASS) Cropland Data Layer

Source: Tillamook factory, Tillamook, Shutterstock

dairy operations: Clatsop, Coos, Lane, and Tillamook, with 3, 11, 4, and 88 dairy operations, respectively.[14] The 2022 Census of Agriculture details there were 200 dairy cattle & milk production operations statewide accounting for 117,000 milk cows.[15] The Tillamook Bay Estuary, which supports 40 square miles of converted agricultural lowland, is home to thousands of dairy cattle.[16] It is evident that agriculture (particularly dairy) on the Oregon Coast is a valuable industry that provides labor income and tax revenue for local communities. Agricultural inputs and production on the Oregon Coast are subject to exogenous risks related to weather and climate. Potential increases in these risks could affect agricultural production on the Oregon Coast in the future.

A key input in the production of dairy cattle is the time cattle spend out at pasture foraging on pasture grass, hay, and other such forage crops. Dairy cattle grazing is seasonal and typically occurs for a minimum of 120 days.[17] Changes in snowpack, precipitation, and temperature resulting from climate change could decrease the amount of forage, as well as the length and timing of the grazing season.[18] Another potential threat to agricultural production (e.g., dairy cattle production) and communities on the Oregon Coast is sea-level rise (SLR) due to climate change. Ancillary effects of SLR include coastal erosion, high tides, loss of wetlands due to flooding, and loss of agricultural lands.[19] The effects of climate change on coastal lands will directly impact tide gates and the benefits they provide through their water management functions.[20] Improvements or upgrades to existing tide gates could provide resilience to SLR that would impact coastal agricultural producers, including dairy farms.

Source: Dairy cows, Shutterstock

Impacts of Flooding on Agriculture

Flooding creates substantial challenges for agricultural lands and the operations they sustain, leading to crop loss, soil erosion, the spread of invasive species, and damage to equipment. While the economic impact of flooding in Oregon has been less

14 Oregon Dairy Farmers Association. (2018). "Map of Oregon Dairy Farmers." Accessed at: https://www.oregon.gov/oda/AboutUs/Documents/Board%20of%20Agriculture/02-19/TammyDennee_ODFA_MapofOregonDairyFarmers.pdf.

15 United States Department of Agriculture – National Agricultural Statistical Service. (2022). Census of Agriculture., Accessed at: https://www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_1_State_Level/Oregon/.

16 Souder, J.A., L.M. Tomaro, G.R. Giannico and J.R. Behan. (2018). "Ecological Effects of Tide Gate Upgrade or Removal: A Literature Review and Knowledge Synthesis. Report to Oregon Watershed Enhancement Board." Institute for Natural Resources, Oregon State University. Corvallis, OR. Accessed at: https://www.oregon.gov/oweb/Documents/Tide-Gate-Ecological-Effects.pdf

17 Oregon Tilth. (2025). "Requirements for Ruminant Grazing." Accessed at: https://tilth.org/help-center/requirements-ruminant-grazing/.

18 United States Department of Agriculture – National Agricultural Statistical Service. (n.d.) "Grazing Lands in Idaho, Oregon, and Washington." Accessed at: https://www.climatehubs.usda.gov/hubs/northwest/topic/grazing-lands-idaho-oregon-and-washington.

19 U.S. Global Change Research Program. (2018). "Fourth National Climate Assessment: Chapter 10 - Agriculture and Rural Communities." Accessed at: https://nca2018.globalchange.gov/chapter/10/.

20 Nuckols, Jason, Shonene Scott, Claire Ruffing, and Jena Carter. (2021). "Oregon's Tide Gate Optimization Tool: Supporting Decisions to Benefit Nature and People. Portland, OR: The Nature Conservancy. Accessed at: https://oregontidegates.org/wp-content/uploads/2021/11/Oregons-Tide-Gate-Optimization-Tool-Supporting-Decisions-to-Benefit-Nature-and-People.pdf

studied, its significant effects in other regions underscore the need for effective flood risk mitigation strategies. According to the American Farm Bureau Association, excessive precipitation, flooding, and hurricanes led to around $4 billion in crop losses in 2023.[21] In Massachusetts, flooding affected at least 75 farms in 2023, causing losses of about 2,000 acres of crops valued at a minimum of $15 million.[22] Earlier flood-inducing events, such as Tropical Storm Irene in 2011, caused significant damages to East Coast agriculture, damaging approximately 15,400 acres of farmland and resulting in an agricultural economic impact of about $20 million USD.[23]

Although there is limited literature on the economic impacts of flooding on agriculture in Oregon, some studies from other U.S. states have explored its operational and financial effects on farmers and their willingness to invest in flood risk mitigation. A 2021 study by Timothy R. Hodge examined the impacts of flooding on agricultural land values in the flood-prone Fargo-Moorhead area of North Dakota and Minnesota. The study found that land values dropped by about 6% in the year after a flood, a trend that earlier research had also observed. Using flood modeling data, the study estimated a 0.077 percent drop in land value for each additional percent of flooded area and a 2.2 percent drop per foot of flood depth. Properties outside flood zones that experienced flooding saw a steeper decline, with a 6.7 percent discount per foot of flood depth, while properties within floodplains faced a 2.1 percent discount per foot of flood depth. Importantly, these price drops were temporary, usually fading within two years of the flood event.[24]

Another study surveyed around 700 Missouri farmers near the Missouri River and found that the most significant consequences of flooding were yield reduction, loss of growing crops, and the inability to plant new ones. Nearly 40 percent of affected farmers reported financial losses exceeding $100,000. Results regarding willingness-to-pay (WTP)[25] to mitigate flood risks showed that less than half of the surveyed farmers were inclined to pay for such measures, with an average WTP estimated at $3 per $10,000 value of agricultural land.[26] Notably, a large share of the respondents (37 percent) indicated a WTP of $0, with many of these zero responses coming from protest voters. These individuals did not oppose flood protection itself but expressed distrust toward government implementation. Many farmers in the study perceived government water management as a contributing factor to the 2019 Missouri River floods, fueling distrust. This suggests that farmers' willingness to pay might increase if flood risk management were handled by a non-governmental entity.[27]

Although similar studies have not been conducted among Oregon farmers, they may exhibit a comparable distrust of government entities and a similarly low WTP for flood risk mitigation. This suggests that farmers' willingness to pay might increase if flood risk management were handled by a non-governmental entity, given the significant distrust toward government-led water management. Moreover, even with significant financial losses from flooding, farmers may be hesitant to invest in or allocate funds towards mitigation measures or allocate funds unless they see clear, immediate benefits or guaranteed effectiveness. Oregon farmers might exhibit similar reservations about investing in tide gate modernization, particularly if they are uncertain about the direct benefits to their land or crop yields.

Poor seasonal drainage is a key challenge for rural property owners. Effective water management can help ensure that the right quantity and quality of water is available for agricultural use. Tide gates and other infrastructure facilitate the management of

21 Munch, Daniel. (2024). "Major Disasters and Severe Weather Caused Over $21 Billion in Crop Losses in 2023." Accessed at: https://www.fb.org/market-intel/major-disasters-and-severe-weather-caused-over-21-billion-in-crop-losses-in-2023

22 LeBlanc, Steve. (2023). "Northeast farmers 'heartbroken' as floods devastate months of labor and crops are swept away". Accessed at: https://www.pbs.org/newshour/nation/northeast-farmers-heartbroken-as-floods-devastate-months-of-labor-and-crops-are-swept-away

23 Climate Hubs: US Department of Agriculture. (n.d.). "Farming the Floodplain: Trade-offs and Opportunities". Accessed at: https://www.climatehubs.usda.gov/hubs/northeast/topic/farming-floodplain-trade-offs-and-opportunities

24 Hodge, Timothy R. (2021). "Flooding and the Value of Agricultural Land". Accessed at: https://le.uwpress.org/content/early/2021/08/18/wple.97.1.061019-0075R1

25 WTP represents the highest amount a customer is willing to spend on a product or service.

26 Skevas, Theodoros, Ray Masset, Sherry L. Hunt. (2023). "Farm impacts of the 2019 Missouri River floods and economic valuation of flood risk reduction". Accessed at: https://www.sciencedirect.com/science/article/pii/S0301479723012719

27 Skevas, Theodoros, Ray Masset, Sherry L. Hunt. (2023). "Farm impacts of the 2019 Missouri River floods and economic valuation of flood risk reduction". Accessed at: https://www.sciencedirect.com/science/article/pii/S0301479723012719

water levels, prevent saltwater intrusion, and ensure adequate drainage and irrigation. In turn, agricultural practitioners must comply with water management regulations and fish passage requirements to prevent overuse or contamination of water resources, balancing agricultural interests with the ecological integrity of the land.

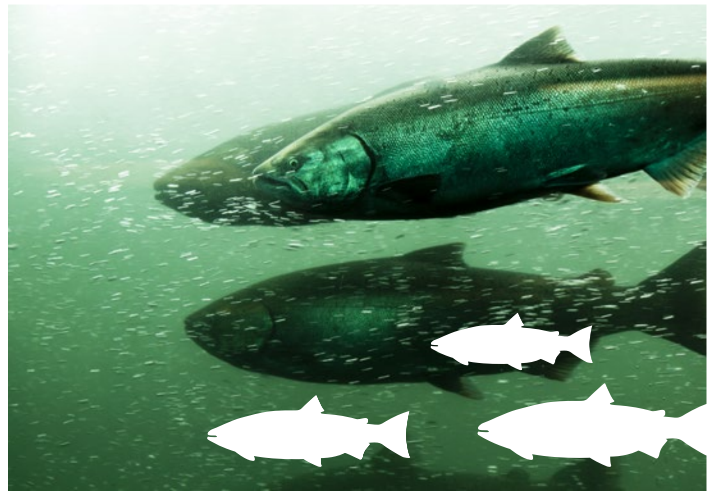
Water Management Requirements

The management of land drainage in Oregon is governed by the ***Oregon Drainage Law***, with drainage districts playing a central role. This law emerged not through legislative action but through court rulings, which led to the adoption of a common law doctrine. Drainage districts are authorized to form under the Oregon Revised Statutes, specifically Chapter 547. The foundation of their authority is outlined in *ORS 547.005*, which states:

> ***The persons shown by the records of the county to be the owners of 50 percent of the acreage in any contiguous body of swamp, wet or overflowed lands or irrigated lands, waters from which contribute to the swamp, wet or overflowed conditions of those or other lands, situated in one or more counties of the state, may form a drainage district for the purpose of having such lands reclaimed and protected by drainage or otherwise from the effects of water, for sanitary or agricultural purposes, or when the same may be conducive to the public health, convenience and welfare or of public utility or benefit.***[28]

The State of Oregon is home to 35 drainage districts, each operating as an independent local government. These districts safeguard properties from flooding by operating and maintaining flood management systems and infrastructure. They are responsible for ensuring that new land developments do not escalate flood risks and that all government regulations are adhered to. Each district is governed by a board of supervisors, elected by local landowners within the district's territory, and is financed through annual property assessments.[29] Drainage districts operate in alignment with the ***Oregon Drainage Law,*** which permits unobstructed "natural drainage flow" across adjoining landowner parcels.[30]

Fish Passage Requirements



Source: Salmon run, Shutterstock

Alongside drainage considerations, landowners and other stakeholders seeking funding and support for tide gate upgrades must also comply with fish passage requirements. Oregon landowners must adhere to a necessary water management regulation, the ORS 509 Fish Passage Statutes. This legislation mandates that native migratory fish be allowed upstream and downstream passage in water bodies where they currently are or historically were present. Additionally, it prohibits landowners from constructing any "artificial" barriers that fail to accommodate migratory fish passage.[31]

Landowners who own and/or operate an artificial barrier have been subject to this regulation since August 2001. According to the Oregon Department of Fish and Wildlife (ODFW), the native migratory fish species covered under this regulation are salmon, trout, lamprey, sturgeon, suckers, and a few other species. ODFW states that there are currently 42,780 inventoried artificial barriers that could impact fish passage to critical habitats. Due to the expense of repairing these barriers, ODFW must prioritize barriers to repair each year based on maximizing fish returning to critical habitats.[32]

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28 Oregon Legislature. (2023). "Chapter 547 - Drainage Districts." Accessed at: https://www.oregonlegislature.gov/bills_laws/ors/ors547.html.

29 Special Districts Association of Oregon. (n.d.). "Drainage Districts." Accessed at: https://sdao.specialdistrict.org/files/56e5c821e/drainage.pdf.

30 Oregon Department of Transportation. (2014). "ODOT Hydraulics Manual: Chapter 2 - Legal Aspects.".

31 Oregon Department of Fish and Wildlife. (2015). "Chapter 509 - General Protective Regulations." Accessed at: https://www.dfw.state.or.us/fish/passage/docs/ORS_509_Fish_Passage_Statutes.pdf.

Agriculture & Ecosystem Management in Coastal Oregon

As an example of one program, under the *Bipartisan Infrastructure Law of 2021* (BIL),[33] NOAA recommended over $240 million in fish passage projects under the *Removing Fish Passage through Barrier Removal* funded by the BIL for 2024 across two rounds of funding. Seven of those projects are in the State of Oregon, totaling $42.6 million.[34] To date, 609 fish passage projects across 9 federal agencies, totaling $937 million in funding have been implemented.[35] Improved fish passage is a key benefit of upgrading tide gates.

Summary

In summary, the agricultural industry on the Oregon Coast, particularly dairy production, plays a crucial role in the state's economy, contributing significantly to local and state revenues. Tide gates, vital for maintaining arable land and supporting agricultural productivity, also present a critical intersection between agriculture and ecosystem management. The challenges of climate change, including sea-level rise and increased flood risks, underscore the importance of effective water management practices, including modernizing tide gates.

As agricultural practitioners strive to balance productive land use with ecological integrity, compliance with water management regulations, including drainage laws and fish passage requirements, becomes increasingly essential. Upgrading derelict tide gates offers significant benefits, not only by enhancing agricultural resilience but also by supporting environmental goals such as improved fish passage.

This section has laid the groundwork for understanding the intricate relationships between agriculture, water management, and ecosystem health on the Oregon Coast. The following comprehensive literature review will build on this foundation, summarizing existing literature and data relevant to the benefits and costs of tide gates, focusing on the biological, ecological, social, and economic impacts associated with tide gate improvements.

32 Oregon Department of Fish and Wildlife. (2024). "Fish Passage." Accessed at: https://www.dfw.state.or.us/fish/passage/.

33 USFWS. (n.d.). "National Fish Passage Program's Bipartisan Infrastructure Law 2024 Funding Opportunity Guidance." Accessed at: https://www.fws.gov/page/national-fish-passage-programs-bipartisan-infrastructure-law-2024-funding-opportunity-guidance.

34 NOAA Fisheries. (2024). "Fish Passage Projects Selected for Funding." U.S. Department of Commerce. Accessed at: https://www.fisheries.noaa.gov/national/habitat-conservation/fish-passage-projects-selected-funding.

35 Federal Interagency Fish Passage Task Force. "Interagency Fish Passage Portal." Last modified 2023. Accessed at: https://interagency-bil-fish-passage-project-1-fws.hub.arcgis.com/.

3

Tide Gate Impacts:
A Comprehensive Literature Review

This section summarizes existing literature and data relevant to the benefits and costs of tide gates, focusing specifically on the biological, ecological, social, and economic impacts associated with tide gate improvements.

To guide this review, several key questions are considered:

- **What are the design and operational differences among various tide gate types, and how do these differences influence their effectiveness and the surrounding ecosystems?**
- **What are tide gate modernization's primary biological and ecological impacts on local fish populations and habitats?**
- **How do tide gates affect the social and economic landscape, particularly for agricultural productivity and landowners' resilience to sea level rise?**

By addressing these questions, this section aims to provide a comprehensive understanding of the potential benefits and costs associated with tide gate improvements, thereby informing future decision-making and policy development.

Source: Kilchis, Jason Nuckols, TNC 2024

Tide Gate Technology: An Introduction

Tide gates regulate water flow between downstream tidewater regions and enclosed, upstream drained lands and water features. These gates consist of a hinged door positioned at the end of a culvert connecting the zones, and a mechanism determining when and how the door opens for bidirectional water movement. By default, tide gates are typically shut, with some exceptions. Historically, the predominant design featured top-hinged structures made of steel or wood, while others adopted a side-hinged configuration. Both types are self-regulating: in top-hinged gates, higher water levels downstream prompt closure, whereas in side-hinged gates, the gate remains open during a portion of the tidal influx when downstream water levels are lower than in the culvert.

Contemporary tide gate designs include self-regulating and muted tide gates. Self-regulating tide gates (SRTs) typically have elevated door buoyancy and counterbalancing arms with floats. This design allows the buoyant door to float and stay open during incoming tides. It remains open until it reaches the floats, at which point it closes. These enhancements ensure that the door remains open for extended periods. A more recent design, known as a muted tidal regulator, keeps the gate open, allowing tidal flows until the water level in the pool behind the gate reaches a predetermined surface elevation. Notably, this gate control relies on upstream water levels, aiming to enhance connectivity for fish species by adjusting the gate's status based on those upland water levels.[36]

Biological and Ecological Impacts

Numerous studies have investigated the impacts of tide gates and their modernization on channel morphology and fish habitat. The consensus across these studies is that no tide gate is entirely fish-friendly, and the limited connectivity created by tide gates is typically suboptimal for fish community composition and water quality.

The environmental impact of tide gates can be seen through their effects on channel characteristics, like flow, temperature, salinity, pH, and heavy metal content. For instance, the change in channel morphology induced by tide gates can cause freshwater stagnation and restrict tidal inflow. This restriction often increases upstream water temperatures, creating potentially unsuitable conditions for juvenile salmon that use the lower river and the upper estuary as nursery grounds. Moreover, the absence of a two-way flushing cycle can cause sediment to accumulate in upland channels instead of reaching the estuary, resulting in increased sedimentation, even in areas considered beyond tidal influence. For instance, closing the tide gate on Joe Leary Slough in Washington led to a 75 percent decrease in suspended sediment in waters above tidal influence.[37] Drained lands that are cut off from tidal exchange are more susceptible to oxidation, a process whereby oxygen is introduced into the soil, promoting aerobic decomposition of organic matter. When soil is drained, the balance between the accumulation and decomposition of organic materials shifts significantly. When a decrease in salinity and water levels allows organic matter to oxidize, the subsequent decline in dissolved oxygen levels can lead to extensive fish fatalities. Oxidation is one of the primary causes of organic soil subsidence, which involves a reduction in the volume and depth of organic soils, resulting in a gradual settling or sudden sinking of land.[38, 39]

Source: Shutterstock

In the Winter Lake land area, subsidence in the floodplain dates to the first instances of water drainage and tide gate installations in 1908-1909, which lowered the average summer water table by about 5 feet. Before this, sediment deposition from the Coquille River created carbon-rich soils in the wetlands, with organic layers from plants and trees that accumulated over thousands of years. Draining the wetlands introduced oxygen into these soils, accelerating bacterial decomposition and leading to a loss of soil volume as bacteria used the carbon as an energy source. This uneven subsidence has resulted in shallow depressions that hinder water drainage, complicating fish passage and pasture management in the affected area. As of 2022, the lands in the Phase III project area at Winter Lake have subsided by more than three feet.[40]

Tide gates can negatively impact fish by impeding migration and degrading habitat quality and connectivity. These effects extend beyond indirect consequences on fish due to changes in estuarine plant and invertebrate communities, as abrupt changes in salinity caused by tide gates can directly affect migrating fish. Juvenile salmon require a gradual change in salinity during their transition from freshwater to saltwater,

36 Souder, Jon and Guillermo Giannico. (2020). "Tide Gates: Operation, Fish Passage, and Recommendations for their Upgrade or Removal." Accessed at: https://ir.library.oregonstate.edu/downloads/rb68xk26g

37 Giannico, Guillermo and Jon A. Souder. (2005). "Tide Gates in the Pacific Northwest: Operation, Types, and Environmental Effects". Accessed at: https://seagrant.oregonstate.edu/sites/seagrant.oregonstate.edu/files/sgpubs/onlinepubs/t05001.pdf

38 NOAA. (n.d.). "Soil Subsidence". Accessed at: https://oceanservice.noaa.gov/facts/subsidence.html#:~:text=Subsidence%20%2D%20sinking%20of%20the%20ground,%2C%20fracking%2C%20or%20mining%20activities.

39 NRCS. (2012). "Soil Subsidence". Accessed at: https://efotg.sc.egov.usda.gov/references/public/AR/Soil_Quality_Degradation_Subsidence.pdf

40 Claire, Chris, Fred Messerle and Caley Sowers. (2022). "Winter Lake Phase III Project Hydrologic Assessment." Accessed at: https://coosswcd.specialdistrict.org/files/8b3776c91/5+404_Attach_C_HydroAssess.pdf

and abrupt changes can lead to osmotic shock and mortality. Additionally, tide gates can alter estuarine habitats critical for juvenile salmon survival, impacting food availability and habitat quality. The duration and width of tide gate openings make them a physical barrier and indirect obstacle to fish passage, affecting water velocities and turbulence. Overall, the impact of tide gates on salmon, trout and lamprey migration and habitat underscores the need for careful consideration of their design and operation to mitigate adverse effects on these fish populations.[41]

Varying gate designs, such as side-hinged or top-hinged, impact fish migration differently. Even modified tide gates designed for fish passage can significantly delay the movement of juvenile and adult fish. For estuarine-dependent species like juvenile Chinook salmon, SRTs support habitat use above gates less than natural channels but slightly better than traditional flap gates. While estuary restoration using SRTs might offer limited benefits for juvenile Chinook salmon, it can enhance connectivity and improve rearing habitat quality compared to traditional flap gate designs. Optimizing SRT designs and operation standards to maximize connectivity and selecting sites that prioritize reconnecting substantial habitat areas may mitigate the reduced habitat use linked with SRT installation. To assess the efficacy of SRT installation, comparing its benefits with other estuary restoration techniques like dike breaching or setback can provide a clearer understanding of its potential advantages and limitations.[42]


Top-hinged gate

Source: YouTube, 2011


Side-hinged gate

Source: Nehalem, 2017, source unknown

Social and Economic Impacts

The impacts of tide gates on agricultural productivity and the benefits to landowners are less well documented. The majority of studies that do exist are specific to coastal properties impacted by SLR. A recent report released by NOAA predicts regional sea level rise (SLR) scenarios for the U.S. coastline through 2150, highlighting that by 2050, higher sea levels will lead to more frequent and intense coastal flooding. Without measures to reduce risk, this rise may significantly impact coastal infrastructure, communities, and ecosystems.[43] The report offers SLR projections based on different carbon emission levels, showing a wide range of possible outcomes for the Oregon coast, which will help guide future planning efforts.

41 Giannico, Guillermo and Jon A. Souder. (2005). “Tide Gates in the Pacific Northwest: Operation, Types, and Environmental Effects.” Accessed at: https://seagrant.oregonstate.edu/sites/seagrant.oregonstate.edu/files/sgpubs/onlinepubs/t05001.pdf

42 Greene, Correigh and J. Hall. (2012). “Biological and Physical Effects of “Fish-Friendly Tide” Gates: Final Report for the Washington State Recreation and Conservation Office.” Accessed at: http://skagitcoop.org/wp-content/uploads/EB2673_Greene-et-al_2012.pdf

43 NOAA. (2015). “Global and Regional Sea Level Rise Scenarios for the United States.” Accessed at: https://sealevel.globalchange.gov/internal_resources/756/noaa-nos-techrpt01-global-regional-SLR-scenarios-US.pdf

Tide Gate Impacts: A Comprehensive Literature Review

A 2023 study from the Chesapeake Bay finds that the impacts of tide gates are tied to the vulnerability of coastal properties to SLR and the functionality of existing hydrological structures. The susceptibility of farms or woodlots to SLR depends on topographic features and weather events, with nearshore, low-lying areas facing more significant exposure to overland flooding and saltwater intrusion. Artificial hydrological connectivity structures, including tide gates, designed for drainage, can inadvertently become conduits for saltwater, exacerbating the threat of inundation. Tide gates, dikes, and berms, intended to prevent water from reaching the land, can fail, leading to instances where water backs up into fields or structures that need replacement due to wear and tear. The lifespan of tide gates is a notable concern, with producers facing the challenge of replacing them every 20-25 years. Failures can occur due to blockages from debris or during extreme tide events, further compromising the effectiveness of these structures.[44]

The lifespan of tide gates is highlighted as a concern, with producers facing the challenge of replacing them every 20-25 years.

The study emphasizes the complexity of land use decisions for private landowners in response to SLR. While most of the producers surveyed in the study express a willingness to transition their land to uses more compatible with flooding and saltwater intrusion in the long term, not all producers adopt a uniform approach in the short and long term. Some choose the same approach in both time frames, while others exhibit shifts in strategies. Producers may employ a combination of strategies simultaneously, such as putting a portion of their land into a conservation easement, accepting changes in certain areas, and resisting SLR impacts by installing or upgrading tide gates in others. The decision-making process is influenced not only by the immediacy and severity of the threat but also by the long-term goals producers have for their managed properties. This underscores the need for effective, efficient, and low-risk alternatives to agriculture practices and resilient infrastructure, including tide gate upgrades, to encourage adaptive land use decisions in the face of sea level rise.[45]

Projects that show multiple potential benefits—such as water quality improvement, fishery recovery, agricultural conservation, recreational opportunities, tribal harvest, flood mitigation, climate change resilience, or the correction of environmental injustices—typically attract a broader range of stakeholders and can access a wider variety of national and state funding sources compared to projects with a single objective.[46] The Oregon Department of Agriculture recognizes

Before

Source: Jason Nuckols, TNC 2024

After

Source: Jason Nuckols, TNC 2024

44 Sudol, Taryn A., Christine D. Miller Hesed, Jenna M. Clark, Fredrika C. Moser. (2023). "Resisting-accepting-directing sea level rise on the Chesapeake Bay: Agricultural producers' motivations and actions." Accessed at: https://www.sciencedirect.com/science/article/pii/S0301479723001433

45 Sudol, Taryn A., Christine D. Miller Hesed, Jenna M. Clark, Fredrika C. Moser. (2023). "Resisting-accepting-directing sea level rise on the Chesapeake Bay: Agricultural producers' motivations and actions." Accessed at: https://www.sciencedirect.com/science/article/pii/S0301479723001433

46 Souder, J.A., L.M. Tomaro, G.R. Giannico and J.R. Behan. (2018). "Ecological Effects of Tide Gate Upgrade or Removal: A Literature Review and Knowledge Synthesis. Report to Oregon Watershed Enhancement Board." Institute for Natural Resources, Oregon State University. Corvallis, OR. Accessed at: https://www.oregon.gov/oweb/Documents/Tide-Gate-Ecological-Effects.pdf

the following objectives with regard to the management of tide gates and other such structures:

- Recognize landowner goals
- Maintain different species' habitat characteristics
- Avoid wetland conservation if not desired by the landowner
- Maintain or improve bank stability

Such objectives and positive management practices outlined in the report support proper and timely water drainage off the land and the prevention of tidewaters from flooding surrounding pasturelands. With drainage systems in place, riparian and aquatic habitats can be provided and enhanced for various species.[47]

This section focused on the social and economic impacts of tide gates concerning resilience to SLR, but it's also crucial to consider other hazards, like increased storm surges and projected rises in winter precipitation, that threaten the natural and structural stability of farms along the Oregon Coast. Recent data shows a rise in both the frequency and intensity of storms in Oregon, with individual events producing larger waves and stronger storm surges.[48] Additionally, streams originating from the Coastal Range are expected to have higher runoff due to increased winter rainfall, while experiencing drier conditions in the summer as rainfall decreases. The intensification of rainfall may lead to more frequent and severe flooding in these streams.[49]

Overall, existing literature suggests that tide gates have significant biological, ecological, social, and economic impacts. While advancements in gate designs, such as self-regulating and muted tidal regulators, offer improvements for fish migration and habitat quality, challenges remain. Effective tide gate management must balance ecological needs with agricultural productivity and resilience to SLR. Projects with broad objectives tend to attract more support and funding, highlighting the importance of a comprehensive approach to tide gate improvements for sustainable benefits.

Source: Shutterstock

47 Oregon Department of Agriculture. (2020). "Coos and Coquille Agricultural Water Quality Management Area Plan". Accessed at: https://www.oregon.gov/oda/shared/Documents/Publications/NaturalResources/CoosCoquilleAWQMAreaPlan.pdf

48 Oregon Explorer: Natural Resources Digital Library. (n.d.). "Coastal Climate Change Effects". Accessed at: https://oregonexplorer.info/content/coastal-climate-change-effects?topic=44&ptopic=38

49 Oregon Explorer: Natural Resources Digital Library. (n.d.). "Coastal Climate Change Effects". Accessed at: https://oregonexplorer.info/content/coastal-climate-change-effects?topic=44&ptopic=38

4

Modernizing Tide Gates: Benefits, Costs, and Processes

Tide gate modernization offers crucial benefits that span economic, ecological, biological, and social dimensions, particularly for coastal communities facing the challenges of aging infrastructure. Interviewees emphasized the dire consequences of failing tide gates, such as prolonged flooding that can devastate pastures and agricultural operations, potentially driving farmers and ranchers out of business. The risk extends beyond individual landowners, with municipalities and state agencies like the Oregon Department of Transportation (ODOT) also facing significant threats from flooding, which could damage critical infrastructure. Conversely, modernized tide gates prevent these costly outcomes, support agricultural productivity, and protect communities from the escalating impacts of climate change.

One of the primary challenges of upgrading tide gates is navigating the complex regulatory landscape that must be addressed before modernization can begin. To aid in this process, it is essential to clearly outline the steps involved in a tide gate modernization project and provide an overview of the anticipated benefits and costs for landowners, tide gate coordinators, and government agencies. Given the complexity of quantifying specific impacts, this section does not present a traditional benefit-cost analysis, but offers a detailed exploration of the various benefits and costs involved.

Source: Shutterstock

Modernizing Tide Gates: Benefits, Costs, and Processes

Benefits of Modernizing Tide Gates

Economic Benefits

Tide gate modernization offers substantial economic benefits that can positively impact coastal communities, particularly where agriculture, flood protection, and fisheries are key economic drivers. Generally speaking, investments in flood infrastructure projects, such as tide gate modernization, can yield various local economic benefits in the short, medium, and long term. These include increased property values, protection of roads and critical infrastructure, savings on flood insurance, reduced workdays lost, and protection against future property damage and loss of life. Improved habitat and fish and wildlife populations also provide additional recreational and amenity benefits, boosting the local economy through increased visitor spending. While these benefits extend beyond agriculture, they can be particularly advantageous for farms, especially those vulnerable to the escalating consequences of flooding driven by a changing climate.[50]

The benefits of restoring tide gates can also be assessed by considering the potential costs of flooding that these restorations could help prevent. Anecdotal predictions from agency representatives involved in tide gate upgrades on the Oregon Coast suggest that portions of pasture could be five and a half feet under water at high tide levels in the absence of functional tide gates. Moreover, refusals to properly repair a damaged/failing tide gate could impose costs on adjacent landowners monetarily and through spillover flooding effects.[51]

One interviewee described a significant breach in a dike, with a 125-foot section giving way, resulting in a 30-foot wide and 15-foot deep sinkhole. Without upgrades, they believe the entire field would have been lost.

Dysfunctional, aging tide gates contribute to upstream flooding. A farmer interviewed by Capital Press noted: "*I was taking on more water than I could get rid of,*" which reduced forage quality and limited pasture access. "*It was just a maintenance nightmare.*"

One of the most direct economic benefits of modernizing tide gates is increased agricultural productivity. By effectively managing water levels and preventing tidal flooding, modernized tide gates help maintain dry, arable land, which is crucial for sustaining and enhancing agricultural output. In addition, the ability for improved water management allows farmers to maximize land use, extend grazing periods, and increase crop yields, leading to higher profitability. Anecdotal evidence gathered through interviews suggests that some agricultural producers are experiencing increased grazing acreage, contributing to improved pastures and field production, resulting in potentially higher weight gains for livestock and greater crop yields. Quantifying the specific economic benefits of tide gate upgrades was out of scope for this project, as these benefits have yet to be documented in the literature. There is a need for further research and data collection in this area. Potential avenues for further analysis are described in Section 6: Conclusion and Next Steps.

In addition to boosting agricultural productivity, tide gate modernization can enhance land value. By protecting farmland from flooding and other water-related issues, these upgrades help preserve or even increase the market value of the land. Agricultural land value is susceptible to infrastructure improvements that enhance productivity and reduce risk. This rise in land value benefits landowners directly, providing greater economic stability and the potential for reinvestment in agricultural operations. Farm real estate—land and structures, specifically—accounts for a large part of the total asset value of most U.S. farms.[52] Changes in these real

50 Kahn, Matthew E., Mac McComas, Vrshank Ravi. (2021). "The Local Economic Impact of Flood-Resilient Infrastructure Projects." Accessed at: https://21cc.jhu.edu/wp-content/uploads/2020/12/economic-impact-of-flood-infrastructure_full.pdf

51 ECOnorthwest. (April 3, 2024). Personal communication with landowner.

52 USDA Economic Research Service. (n.d.). "Land Use, Land Value, & Tenure." Accessed at: https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/

estate values can have a profound impact on the financial wellbeing of producers; land is the single largest component of most farmer's investment portfolios. They are the main source of collateral for farm loans. Changes in farmland values affect the financial well-being of agricultural producers because farm real estate is the largest single component in a typical farmer's investment portfolio, serving as the principal source of collateral for farm loans.[53]

Moreover, modernized tide gates can reduce the costs associated with flood damage, which include expenses related to repairing flood-affected infrastructure, restoring fields, and replacing lost equipment or livestock. By lowering the risk of flood damage, tide gates contribute to the overall economic resilience of coastal communities. Despite Oregon farmers being some of the least insured for crops in the United States, the state still insures up to $300 million in pastureland production value.[54] This highlights the significant risk tied to pastureland, the primary agricultural commodity on the Oregon Coast. By reducing flood risks through modernized tide gates, producers might be less inclined to purchase insurance, leading to potential savings.

Modern tide gates also support fisheries and aquaculture by improving fish passage and habitat quality. Healthier fish populations can lead to more robust Tribal, commercial and recreational fishing industries, which are important sources of

Source: Nehalem Marine Manufacturing, Wilson River, Tillamook, 2008

Source: Nehalem Marine Manufacturing, Wilson River, Tillamook, 2008

income for coastal communities. The sustainability and growth of these industries are directly linked to the ecological benefits provided by well-functioning tide gates, underscoring their economic importance.

Furthermore, the process of modernizing tide gates itself generates economic benefits by creating jobs and stimulating local economies through construction, engineering, and ongoing maintenance activities. The long-term benefits of improved tide gates, such as increased agricultural productivity and enhanced fisheries, contribute to broader economic development in coastal regions.

As climate change brings about rising sea levels and more extreme weather events, modernized tide gates play a crucial role in protecting coastal infrastructure and agricultural land, thereby increasing the resilience of these areas. This resilience is economically beneficial as it reduces the potential costs associated with climate-related impacts, such as property damage and loss of agricultural productivity.

Finally, improved ecological conditions resulting from tide gate modernization, such as healthier wetlands and estuaries, can enhance the natural beauty of coastal areas, making them more attractive for tourism and recreation. This can increase revenue from activities like bird watching, fishing, and eco-tourism, further benefiting local businesses and economies.

53 USDA Economic Research Service. (n.d.). "Land Use, Land Value, & Tenure." Accessed at: https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/

54 Delbridge, Tim. (2023). "How important is crop insurance in Oregon?". Accessed at: https://extension.oregonstate.edu/business-economics/rural-development/how-important-crop-insurance-oregon

Modernizing Tide Gates: Benefits, Costs, and Processes

Source: Fly Fishing, Willamette River, Shutterstock

In summary, while tide gates are often primarily implemented for agricultural and flood protection purposes, their modernization brings many economic benefits. These include increased agricultural productivity, enhanced land value, reduced flood damage costs, support for fisheries and aquaculture, job creation, and increased resilience to climate change. By balancing agricultural needs, environmental protection, and flood management, tide gate modernization contributes to a more sustainable and economically resilient future for coastal regions.

Biological Benefits

The biological benefits of tide gate upgrades and removals are variable and influenced by factors like gate type, location, and channel characteristics. Gates that remain open for longer periods or have wider opening angles show a more positive effect on fish passage conditions. Additionally, specific modifications like pet door additions or muted tide gates have shown some positive responses in fish and crustacean communities. However, the overall impact on water quality and habitat is inconsistent, with larger restoration projects combining various actions alongside tide gate modifications demonstrating clearer and more consistent, positive effects on species diversity, fish numbers, and habitat improvement.[55]

The Institute for Natural Resources and the Oregon Watershed Enhancement Board report suggests that the relationship between tide gate upgrades and fish communities, water quality, and habitat is complex. While tide gate absence is preferred for salmonid habitat and passage, improved gates with active management can mitigate adverse impacts. However, the replacement of tide gates with newer designs shows inconsistent outcomes, prompting a recommendation to recognize the diversity among estuarine channels and the limitations of one-size-fits-all solutions.[56] Findings indicate that the most successful restoration outcomes are associated with large-scale tide gate upgrade projects incorporating various restoration actions. Projects combining actions such as tide gate upgrades or removal, dike setback or breaching, tidal channel creation, upstream riparian plantings, and in-stream complexity enhancements consistently yield stronger and more positive fish and habitat responses.

In contrast, simple and localized enhancement efforts show less favorable results. The recommendation emphasizes a preference for comprehensive restoration projects prioritizing reestablishing connectivity and ecosystem-level processes over interventions targeting a single factor, such as the number of fish passing or water quality above tide gates.[57] In addition to

Source: Nehalem River, Tillamook, Shutterstock

55 Institute for Natural Resources, Oregon Watershed Enhancement Board. 2018. "Ecological Effects of Tide Gate Upgrade or Removal: A Literature Review and Knowledge Synthesis." Accessed at: https://www.oregon.gov/oweb/Documents/Tide-Gate-Ecological-Effects-ES.pdf

56 Souder, J.A., L.M. Tomaro, G.R. Giannico and J.R. Behan. 2018. "Ecological Effects of Tide Gate Upgrade or Removal: A Literature Review and Knowledge Synthesis." Report to Oregon Watershed Enhancement Board. Institute for Natural Resources, Oregon State University. Accessed at: https://www.oregon.gov/oweb/Documents/Tide-Gate-Ecological-Effects-ES.pdf

57 Souder, J.A., L.M. Tomaro, G.R. Giannico and J.R. Behan. 2018. "Ecological Effects of Tide Gate Upgrade or Removal: A Literature Review and Knowledge Synthesis." Report to Oregon Watershed Enhancement Board. Institute for Natural Resources, Oregon State University. Corvallis, OR. Accessed at: https://www.oregon.gov/oweb/Documents/Tide-Gate-Ecological-Effects-ES.pdf

these actions, smaller and larger tide gate installations can be especially beneficial when completed together in a connected tidal reach.

Further review of existing literature and ecological reports suggests a debate exists regarding the effectiveness of tide gate upgrades in creating suitable ecological conditions for salmonid species abundance and passage. A significant portion of this debate centers on water salinity and temperature. For example, a study of two creeks in Coos Bay highlights differences in water characteristics between top-hinged and side-hinged gates. Top-hinged gates tend to have a poor seal, which allows water salinity and temperatures behind the gate to match that of the bay side water, potentially providing a more gradual transition for migrating fish. Conversely, side-hinged gates, which are better sealed, leave water behind the gate at lower salinity and higher temperature, potentially causing an abrupt transition from freshwater to saltwater during downstream migration, which may negatively impact the survival of coho salmon smolts.[58] This illustrates that while no tide gate design is entirely fish-friendly, Muted Tidal Regulators (MTRs) are often seen as a good "middle-ground" restoration option compared with top-hinged and side-hinged gates.[59]

Muted Tidal Regulators

Source: Nehalem Marine Manufacturing, 2024

Ecological Benefits

Tide gates, when properly maintained or modernized, offer significant ecological benefits that contribute to the health and sustainability of coastal ecosystems. In addition to supporting aquatic species, modern tide gates help restore natural hydrological processes in estuaries by mimicking natural tidal flows. This restoration can lead to re-establishing improved water quality, water filtration, and supporting natural sedimentation patterns, contributing to revitalizing salt marshes and other tidal habitats. Moreover, by enhancing water exchange between estuarine and marine environments, tide gates can help prevent eutrophication—an excessive buildup of nutrients that can lead to harmful algal blooms and oxygen depletion, negatively impacting aquatic life.

Tide gates also play a crucial role in increasing habitat connectivity by allowing more natural tidal exchange and reducing barriers between different aquatic environments. This connectivity is vital for species' movement and genetic exchange, supporting biodiversity and ecosystem resilience.

Lastly, modern tide gates can restore floodplain functionality by allowing controlled flooding of certain areas. This restoration is important for nutrient cycling, groundwater recharge, and providing habitat for floodplain-dependent species. In sum, while tide gates are often implemented for agricultural and flood protection purposes, their ecological benefits are substantial when designed and managed with environmental health in mind. These benefits are crucial for the long-term sustainability of coastal ecosystems, supporting biodiversity and human communities.

Social Benefits

Tide gate upgrades may also generate indirect social benefits by enhancing the potential for collaborative partnerships. A recent study by Danny Nuckols and Jason Nuckols highlights

58 Bass, Arthur. (2010). "Juvenile coho salmon movement and migration through tide gates."Accessed at: https://seagrant.oregonstate.edu/sgpubs/juvenile-coho-salmon-movement-and-migration-through-tide-gates

59 Greene, Correigh, Jason Hall, Eric Beamer, Rich Henderson, Bruce Brown, and W. A. LaConner. (2012). "Biological and physical effects of "fish-friendly" tide gates." National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Watersheds Program, Northwest Fisheries Science Center, and Skagit River System Cooperative, LaConner, Washington. Accessed at: https://www.researchgate.net/publication/281113782_Biological_and_Physical_Effects_of_Fish-Friendly_Tide_Gates

the potential for diverse partnerships to address the deteriorating state of watersheds and estuaries and achieve conservation objectives.[60] Tide gate upgrades, made necessary by aging infrastructure, offer a unique opportunity for private landowners to partner with others to achieve multiple benefits such as controlling water flow, aligning with drainage and irrigation needs while enhancing the ecological conditions for species like juvenile salmon.

The Winter Lake project (described in Section 5) in the Coquille estuary exemplifies one such local partnership and governance system, blending private and public interests. The project has involved the installation a new state-of-the-art tide gate system and the creation of approximately 40,000-feet of channels through a 2,000-acre valley floor. The aim of the Winter Lake Project has been to improve water control, protect land from flooding, and create habitat for fish and wildlife. The study draws inspiration from Elinor Ostrom's framework for successful non-state governance of common-pool resources (CPR) and examines seven alliances working on damaged wetlands and farmlands in the Coquille estuary. Although it does not match with Ostrom's Common-Pool Resource (CPR) framework perfectly, the project showcases a hybrid governance structure that fosters trust, transparency, and reciprocity among collaborators. Its success is attributed to a mix of public entrepreneurs, local government involvement, private philanthropy, and underlines the potential for effective public-private partnerships in addressing environmental challenges. The study also reveals the importance of grassroots initiatives, led by citizen ranchers and conservationists, in navigating commons dilemmas[61] and achieving sustainable coexistence between ecosystems and profitable agricultural lands. Insights from the Winter Lake project underscore the significance of governance schemes tailored to local contexts, emphasizing the role of engaged individuals in shaping solutions beyond the state and private sector. Ultimately, the study contributes valuable perspectives on how collaborative efforts, informed by self-described governance, can drive positive social and environmental outcomes.

Source: Lincoln City, Shutterstock

Such collaborative achievements are also demonstrated in the Seestrom Tidal Floodplains Restoration Project. This working lands project involved creating new tidal channels, filling drainage ditches, installing large wood, re-establishing fish access to the floodplain, and constructing two large concrete box culverts with muted tidal regulator (MTR) controlled tide gates to manage tidal flows. The project successfully balances habitat improvement with agricultural use on a 300-acre sheep and cattle ranch along the Coquille River in coastal Oregon.[62] The initiative provides critical habitat for coho and other anadromous fish while improving pasture infrastructure and enhancing forage for livestock. Despite challenges with expensive new tide gates and complex permitting processes, the project allows juvenile coho salmon to use the tidal wetlands in winter and it enables ranchers to manage water levels for summer grazing. Completed in 2019, the project created about 3 miles of tidal channel, reconnected 135 acres of tidal floodplain, and improved pasture conditions on the working ranch, exemplifying a successful partnership approach to conservation that benefits both farmers and wildlife.[63]

Costs of Modernizing Tide Gates

Replacing tide gates to meet modern standards can be a significant financial commitment, often costing hundreds of thousands to millions of dollars. Navigating the complex

60 Nuckols, D. and Jason Nuckols. "Agents' reflections towards Eleanor Ostrom's governance scheme: How conservationists and ranchers view collaborative management of Oregon's estuaries." [Manuscript submitted for publication].

61 **Commons dilemmas** are social dilemmas in which individuals in a group each make decisions out of self-interest, eventually causing unintended harm to the group as a whole.

62 WaterWays Consulting, Inc. (n.d). "Seestrom Tidal Floodplain Restoration." Accessed at: https://www.watways.com/seestrom-tidal-floodplain-restoration

63 Smith, Amanda. (2021). "Building Back Better Coastal Systems: Three Local Projects, one National Goal." USFWS Columbia Pacific Northwest Region. Accessed at: https://medium.com/usfwspacificnw/building-back-better-coastal-ecosystems-three-local-projects-one-national-goal-d8dcba80936f

EXHIBIT 4 **Estimated Cost of Tide Gate Modernization Phases**

Phase	Cost	Timeline
Design & Engineering	$13,000–$100,000+	2 months-1 year+
Permits	$2,000–$14,000+	Up to 5 years
Archaeological Survey	<$12,000 to varies	Varies
Materials & Construction	$100,000–$2M+	<6 months–during water year
Maintenance	Varies	Ongoing

Source: Jason Nuckols, 2024

regulatory landscape and securing available funding can be challenging, so it's strongly recommended that landowners collaborate with their local drainage district manager or other water management experts. The modernization process is time-intensive and complex, involving coordination with design and engineering firms, obtaining permits from multiple government agencies, and managing surveying and construction teams in a precise, time-sensitive sequence. Given these challenges, landowners must leverage available resources to help streamline and manage this intricate process effectively.

Modernization costs typically span various stages, including design, engineering, permitting, construction, maintenance, and ongoing operations. Beyond these direct costs, indirect economic, biological, ecological, and social costs are also associated with tide gate modernization. This section outlines the specific costs involved in the modernization process and concludes with a discussion of the potential indirect costs that may arise.

Source: Wikimedia, Envchemprof

Tide Gate Modernization Costs

The cost of each tide gate modernization project is highly specific to the site's location, the complexity of the drainage system, and the combination of actions implemented, which may contribute to more comprehensive outcomes in a watershed. To provide a general understanding of total phase costs and timelines, a set of estimates was developed through discussions with a limited number of technical experts and stakeholders involved in tide gate restoration on the Oregon Coast. These estimates are intended to offer a broad perspective but may either overestimate or underestimate the actual costs associated with tide gate upgrades.

Design and Engineering Costs

Design and engineering represent a significant portion of the total costs associated with tide gate modernization. These costs are crucial for ensuring that the project is well-planned, compliant with regulations, and tailored to the sites' specific environmental and structural needs. The design and engineering phase encompasses several critical stages, each contributing to the project's overall success.

- **PRELIMINARY DESIGN:** This initial stage involves developing project collaborators and contracting with an engineering firm. Key activities include conducting a comprehensive site assessment—covering geomorphic, topographic, and hydrologic factors—along with reviewing lidar assessments and hydrologic modeling. Early archaeological and cultural resource studies are also performed to identify any potential impacts on historically significant sites.
- **30% DESIGN:** At this stage, the preliminary design is refined and presented to the landowner for approval.

This phase is crucial for ensuring the landowner's needs and expectations align with the project's objectives. If the landowner agrees with the preliminary design, the project moves forward to more detailed planning.

- **60% DESIGN:** This phase involves submitting the application for the tide gate upgrade, which includes all necessary permitting applications to state, federal, and local entities. Concurrently, an archaeologist conducts a thorough cultural resource study of the site to ensure compliance with preservation laws. Permitting processes are typically initiated during this stage, laying the groundwork for the final phases of design.
- **90% TO FINAL DESIGN:** All permits have been approved in this final design phase, and the construction teams are organized and contracted to begin work. The timing of construction is carefully coordinated to align with the in-water work period, typically from July 1st to September 15th in Western Oregon coastal streams. This careful scheduling ensures minimal disruption to the ecosystem and maximizes project efficiency.

Each of these stages is crucial for the successful completion of a tide gate modernization project. Still, the timeline for each phase can vary significantly depending on the complexity and specific requirements of the project. Design and engineering costs are closely tied to the scale and intricacies of the work involved. Investing in thorough planning and precise engineering is essential to ensure regulatory compliance and to enhance the long-term functionality and sustainability of the tide gate system.

Permitting Fees

Tide gate repair or replacement projects must secure permits prior to beginning construction. The permitting process can be challenging and time-consuming, especially receiving approval for the county-required permits. The following list describes the different local, state, and federal agencies through which applications may be submitted for tide gate modernization projects and the general range of costs incurred through each. Permitting fees vary depending on the issuing agency and the project's unique characteristics. Exhibit 5 details the leading local, state, and federal agencies to which landowners and

EXHIBIT 5 **Permitting Fees by Agency**

Entity	Cost
Department of State Lands (DSL)	Free
Army Corps of Engineers (USACE)	Free
State Historic Preservation Office (SHPO)	<$12,000
Department of Environmental Quality (DEQ)	
Water Quality Certification–Small	$2,000
Water Quality Certification–Large	$3,000
County Planning Department	$14,000–$21,000
FEMA Floodplain/Floodway	Eng. Study: $13,000–$20,000
(requires engineering study to support floodway application)	Permit Fee: $300–$400
404 Fill and Removal and Conditional Use	$300–$400
Department of Land Conservation and Development (DLCD)	NA
National Marine Fisheries Services (NMFS)	NA
Oregon Department of Fish and Wildlife (ODFW)	Free
Tribes and Tribal Historic Preservation Office (THPO) Consultation	NA

Source: ECOnorthwest – Interviews and local experts

EXHIBIT 6 **Cost Estimates for Tide Gate Installations**

Example Culvert Size and Type	2023 Total Approximate Cost Installed
4' circular	$100,000
5' circular	$200,000
6' circular	$260,000
(1) 6x6 box Concrete	$360,000
(2) 6x6 box Concrete	$540,000
(2) 6x8 box concrete or (2) 7x7 box concrete	$810,000
(2) 8x8 box concrete or (2) 8x9 box concrete	$1,080,000
(2) 8x10 box concrete	$1,260,000
(3+) 8x10 box concrete	$1,900,000
(4+) 8x10 box concrete	$2,000,000

Source: ECOnorthwest, ODFW

tide gate coordinators may apply for permits. Where available, costs are also included.

Construction and Material Costs

Exhibit 6 includes cost estimates for tide gate installation developed using the Tide Gate Optimization Tool. These total cost estimates encompass the expenses for gates, culverts, and associated materials, and the labor required to install the tide gate assembly. This includes items such as excavation and compaction, erosion control, removal of existing culverts and tide gates, aggregate bedding fill under culvert inlets and outlets, crushed rock (base rock), and geotextile under foundation rock.[64]

Maintenance and Operation Costs

Uncertainty remains around the costs associated with the operation and maintenance (O&M) of newly updated tide gates and related infrastructure projects, highlighting the need for further exploration and understanding in this area. An interview with the owner of Nehalem Marine revealed that O&M costs for new tide gates, particularly side-hinged gates with a Muted Tidal Regulator, are minimal when it comes to major components like the door. The owner provided anecdotal evidence of gates that have operated for years without intervention, opening and closing twice daily with tidal changes as designed. Additionally, the owner cited examples of gates that, even after 20 years, continue functioning as effectively as when they were first installed. However, should any maintenance be required, the responsibility typically falls on drainage districts and/or landowners, as outlined in the drainage district's water management plan (WMP). Failure to properly repair a damaged or failing tide gate could result in monetary costs and spillover flooding impacts on adjacent

Source: North Umpqua River, Shuttterstock

64 Nuckols, Jason, The Nature Conservancy. (March 8, 2024). Personal Communication.

65 ECOnorthwest. (April 3, 2024). Personal communication with interviewee.

properties.[65] Despite this responsibility, continued collaboration with water management districts on maintenance and operations issues, should they arise, could provide landowners with additional resources to mitigate the financial burden of these potentially costly investments.

Economic Costs

While offering substantial long-term benefits, tide gate modernization has significant economic costs that must be carefully considered and integrated into the modernization plan. One of the most immediate impacts is the potential loss of agricultural production during the construction phase. Fields may need to be removed from production temporarily, leading to lost income for farmers who rely on consistent planting, harvesting, or grazing schedules. In addition, the direct costs associated with designing, engineering, and installing modern tide gates can be significant (see Exhibits 4-6). These costs include materials, labor, and the machinery required for construction, which can be particularly high if specialized technology or custom designs are needed to meet the sites' specific environmental and operational needs.

The process of obtaining the necessary permits and complying with local, state, and federal regulations can also add to the overall cost. Regulatory requirements often involve environmental impact assessments, fish passage evaluations, and consultations with agencies such as the Oregon Department of Fish and Wildlife (ODFW) or the U.S. Army Corps of Engineers (USACE). These processes can be time-consuming and expensive, increasing the tide gate modernization's economic burden.

Source: Shutterstock

Source: Shutterstock

Ongoing maintenance and operation costs related to minor repairs must also be factored into the equation. Even modern tide gates require routine inspections, repairs, and possible upgrades to ensure their continued effectiveness, which can represent a significant long-term expense. Additionally, there may be short-term impacts on land value and usage during the construction phase, as the temporary disruption of land use can reduce overall productivity and profitability. Moreover, the construction and upgrading of tide gates may temporarily displace or disrupt other local economic activities, such as tourism, recreation, or small business operations, leading to a short-term decline in local revenue.

Finally, any tide gate modernization project has a degree of uncertainty and risk. Delays, unexpected complications, inflation, or cost overruns can lead to higher-than-expected expenses, which can strain the resources of the entities responsible for the project, including local governments, landowners, and agricultural operators. Effective planning, budgeting, and stakeholder engagement are crucial to managing these costs and ensuring that the economic benefits of tide gate modernization outweigh the challenges.

Ecological and Biological Costs

Tide gate modernization, while offering significant long-term benefits, comes with certain ecological and biological costs that must be carefully considered. The construction process can disrupt local habitats, particularly wetlands and estuarine channels, through activities like excavation and the use of heavy machinery. These disturbances can lead to temporary habitat loss or degradation, affecting species that rely on these environments. Additionally, the alteration of sediment transport dynamics and changes in water quality, such as increased turbidity or shifts in salinity and temperature, can have immediate negative impacts on aquatic organisms and overall ecosystem health.

Fish passage is another critical concern during the construction process, as it can temporarily block passage, potentially leading to short-term lower survival rates and reduced reproductive success. Changes in water flow and habitat structure can disrupt complex trophic relationships within the ecosystem and may create short-term conditions favorable to invasive species. Moreover, activities associated with construction and restoration can generate greenhouse gas (GHG) emissions through using diesel fuels in construction machinery and the use of input materials such as concrete. For instance, in the case of the Flood Basin Tide Gate Structure Replacement Project in Palo Alto, California, a construction emissions assessment found that tide gate construction or restoration would generate temporary emissions from vehicle exhaust and dust during site preparation, demolition, and construction. These emissions would include particulates (PM10 and PM2.5), carbon monoxide (CO), nitrogen oxides (Nox), and other pollutants, though they would be short-term and localized.[66]

Additionally, areas restored in conjunction with tide gate upgrades may exhibit a temporary increase in emissions as the ecology resets itself before eventually switching back to serving as a net carbon sink. Studies suggest that the restoration of degraded wetlands can sometimes produce an increase in methane (CH4) and nitrous oxide (N2O) emissions. However, these increased emissions should be offset by long-term concomitant increases in net CO2 uptake resulting from restoration.[67]

Source: Salmon spawning, Shutterstock

Despite these costs, the long-term benefits of tide gate modernization often offset these short-term ecological and biological costs. As the estuarine channels and wetlands gradually return to more natural flow patterns, these environments can be restored, leading to healthier ecosystems over time. Proper planning, design, and ongoing monitoring are essential to minimize the immediate impacts and ensure long-term ecological restoration goals are met. In the end, the restoration of natural hydrological processes not only supports the recovery of local habitats and species but also enhances the overall resilience and sustainability of the ecosystem.

Social Costs

Tide gate modernization projects, while beneficial in the long term, may impose several social costs on local communities. The construction phase often leads to disruptions, including noise, dust, and increased traffic, which can temporarily reduce the quality of life for nearby residents. Access to certain areas may also be restricted, affecting local businesses and community activities, particularly in regions dependent on tourism and outdoor recreation. These disruptions can result in short-term economic losses for businesses, especially those reliant on agriculture, fishing, or tourism.

Additionally, cultural and historical impacts are a significant concern, as modernization efforts could disrupt traditional practices deeply tied to cultural identity and heritage. Although archaeological surveys are typically conducted to prevent the inadvertent loss of culturally significant landscapes, the potential alteration of these sites remains a sensitive issue. Equity concerns also arise when the social costs disproportionately affect vulnerable populations, such as low-income communities, or when these groups are excluded from the decision-making process.

66 Palo Alto Flood Basin Tide Gate Structure Replacement Project: Final Mitigated Negative Declaration. (2021). Accessed at: https://www.valleywater.org/sites/default/files/PATG_FinalMND_body_WEB.pdf

67 Schuster, L., Pierre Taillardat, Peter I. Macreadie, Marino E. Malerba. (2024). "Freshwater wetland restoration and conservation are long-term natural climate solutions." Accessed at: https://www.sciencedirect.com/science/article/pii/S0048969724013573

Modernizing Tide Gates: Benefits, Costs, and Processes

Public opposition and conflict may emerge, particularly if residents perceive the project as an overreach by government or outside entities or if the immediate costs are viewed as outweighing the long-term benefits. These social costs highlight the need for inclusive decision-making, effective communication, and targeted mitigation strategies to ensure that the benefits of tide gate modernization are realized without unduly burdening the communities involved.

Processes related to funding, regulatory requirements, and perceptions around cost-effectiveness of projects may lead to social costs of tide gate modernization. Some landowners find that small tide gates that affect limited acreage are not cost-effective for landowners to replace without financial assistance and are often low priorities for habitat restoration funding. According to Coos County grower Sharon Waterman, even when landowners secure funding, they face challenges because grants and permits require them to make operational changes to benefit habitat. Standard requirements like fencing streams, planting trees, and re-digging channels can reduce farmable land and complicate management. A farmer quoted in a Capital Press article argues, ***"You can't do anything without mitigation. Unless you do the mitigation, they want, you're not going to get a permit."*** [68] The social costs of tide gate upgrades are reflected primarily in what landowners perceive as a lack of consideration for their interests. This has led to frustration and skepticism within the community. Such challenges, along with the financial strain and operational difficulties associated with fish passage requirements, underscore the complexities of balancing habitat restoration with the needs of all local community members.

Source: Dairy cows, Shutterstock

Main Takeaways on the Benefits and Costs of Tide Gate Modernization

Modernizing tide gates offers a range of significant benefits and costs that landowners and stakeholders must carefully consider. Economically, tide gate upgrades can lead to increased agricultural productivity, enhanced land values, and reduced costs associated with flood damage. These improvements support local farming operations and strengthen the broader coastal economy through job creation and improved fisheries. Ecologically, modernized tide gates contribute to healthier fish populations, improved water quality, and restored wetlands and estuaries, which are essential for biodiversity and ecosystem resilience. Socially, tide gate projects can foster collaborative partnerships, uniting diverse stakeholders to achieve shared conservation and economic goals.

Modernizing tide gates may also pose challenges, such as construction disruptions and the need for careful coordination with local communities. In addition, tide gate benefits come with considerable costs, including the financial burden of design, construction, ongoing maintenance, and potential ecological disturbances during the construction phase. The complex regulatory environment and the need for extensive planning and permitting further add to the challenges. Despite these hurdles, the long-term advantages of modernized tide gates—such as enhanced flood protection, ecological restoration, and economic resilience—often outweigh the initial investments and short-term disruptions.

With a clear understanding of the benefits and costs associated with tide gate modernization, the next step is to explore how these projects are implemented in real-world situations. The following section presents case studies meant to provide examples of the complexities and considerations involved in upgrading tide gates. By reviewing these examples, stakeholders can better understand the challenges and opportunities accompanying tide gate modernization.

68 Perkowski, Mateusz. (2021). "Tide gate time bomb: Aging structures, regulatory mandates threaten coastal farmland". Accessed at: https://www.capitalpress.com/ag_sectors/water/tide-gate-time-bomb-aging-structures-regulatory-mandates-threaten-coastal-farmland/article_c816a2ee-284c-11ec-b248-6737a084def8.html

5

Case Studies of Oregon Coast Tide Gate Projects

ECOnorthwest conducted two case studies on tide gate improvements in partnership with TNC. The sites selected for this examination are the Winter Lake Tide Gate Project and the North Bank Tide Gate Project. These case studies aim to provide real-world examples of tide gate upgrades, highlighting the complex dynamics and considerations involved in modernization. As tide gate upgrade initiatives along the Oregon Coast are a relatively recent development, these case studies focus on newer projects which have not been in place long enough to observe extensive impacts from long term monitoring.

Winter Lake Complex

Source: Winter Lake, Jason Nuckols, 2024

Case Studies of Oregon Coast Tide Gate Projects

The history of tide gate infrastructure in the Winter Lake estuary along the Coquille River dates to the early 1900s. The formation of the Beaver Slough Drainage District occurred in 1906 and was followed by the construction of a linear canal system (along parcel and property lines) and the installation of tide gates to remove tidal and drainage water from properties. Over the ensuing century, maintenance and reconstruction of the channels and tide gates was a frequent and costly occurrence. After a 1995 storm, the main tide gate at the river was reconstructed with four 8′ metal culverts. By 2008, the culverts had come to the end of their life cycle. As a result of the 2006 Endangered Species Act (ESA) fish passage requirements, the replacement of the tide gates and culverts rendered it necessary to upgrade in such a way that would meet fish passage standards.

Around this time, the Oregon Department of Fish and Wildlife (ODFW) began exploring options for waterfowl habitat. Steve Denney, then with ODFW and later with TNC, led the initiative aimed to identify promising waterfowl properties to acquire in exchange for nearby timber lands.

From 2008–2010, the Beaver Slough Drainage District's efforts focused on identifying funding opportunities for the costly infrastructure needed to design, fabricate and implement a new tide gate system to meet ESA fish passage requirements. Despite challenges, the search for funding persisted, accompanied by hydrological, geotechnical, and preliminary design work. With funding resources limited, meetings were

Source: Sandpiper, Shutterstock

Source: Lamprey laying eggs in the river, Shutterstock

held between Steve Denney, local landowners, and the drainage district's board until a pivotal decision was made to proceed with a land trade. ODFW would trade a piece of timber lands for a privately owned property in the Winter Lake area that is now known as the Coquille Valley Wildlife Area.

Beginning in 2011, the drainage district hosted stakeholder working group meetings and outreach events. Over 400 engagement meetings were conducted, culminating in the eventual launch of a $10+ million tide gate upgrade and habitat restoration project. The ongoing multi-phase initiative seeks to enhance habitat conditions for juvenile salmon, lamprey, migratory birds, and other species, while simultaneously improving the functionality of tide gates and ensuring access for ranchers who depend on drained estuary land for agricultural purposes.

The project area encompasses three hydrologically independent management units. Units 1 and 3 are privately owned and predominantly utilized for agricultural activities. Unit 2, designated as the restoration segment of the Winter Lake project, comprises restored tidal wetland habitat previously used as pastureland. Ownership of Unit 2 is shared between the ODFW and the China Camp Gun Club (CCGC).[69]

Phase I of the Winter Lake project, completed in 2018, replaced outdated tide gates with a new state-of-the-art system.[70] Phase II construction, spanning 2018–2019, focused on habitat restoration across 407 acres of tidal wetlands. Phase III, slated for the future, will encompass the replacement of interior tide

69 Huff, Julie, Gary Vonderohe, Chris Claire.. (2020). "Winter Lake Restoration Effectiveness Monitoring: Year 2." Accessed at: https://www.coquillewatershed.org/wp-content/uploads/2021/08/Winter-Lake-Effectiveness-Monitoring-Year-2-2020-Compressed.pdf

70 Huff, Julie, Gary Vonderohe, Chris Claire.. (2020). "Winter Lake Restoration Effectiveness Monitoring: Year 2." Accessed at: https://www.coquillewatershed.org/wp-content/uploads/2021/08/Winter-Lake-Effectiveness-Monitoring-Year-2-2020-Compressed.pdf

gates in Units 1 and 3, along with new channel construction. These efforts aim to fulfill overarching restoration objectives, reduce clogged and flooded channels, and enhance habitat for fish and wildlife species.[71] Phase III is anticipated to diminish the risk of fish stranding, improve water quality and drainage, and expand summer irrigation opportunities on farmland without salmonid species. The forthcoming activities under Phase III—replacement of interior tide gates and channel construction—will bring the project closer to achieving the final set of restoration and agricultural objectives.[72]

Overall, key project objectives include:

- Restoring over 400 acres of tidally influenced palustrine emergent and scrub-shrub wetlands to improve fish passage, enhance channel complexity and stability, bolster water quality, and rehabilitate riparian and floodplain vegetation.[73]
- Enhancing the productive capacity of more than 1,700 acres of overwintering habitat for coho salmon through strategic water management.[74]
- Enhance agricultural production of pasture grass.[75]
- Remove water from pastures in late spring and early summer to allow access for livestock grazing.[76]

To ensure the project's effectiveness and inform future restoration endeavors along the Oregon coast, the Oregon Watershed Enhancement Board (OWEB) initiated a three-year effectiveness monitoring project. This monitoring effort is intended to assess project outcomes, identify areas for adaptive management, and guide future restoration initiatives.

Monitoring results from the last three consecutive years show a wide range of impacts from the project. Year 3 results suggest that the project surpassed several monitoring parameter standards established by the Monitoring and Adaptive Management Plan (MAMP). Notably, the length of the tidal channel constructed in the restoration unit exceeded the standard by over 10,000 feet, totaling more than 40,000 feet. Additionally, the survival rate of planted trees and shrubs reached 64 percent in the third year, surpassing the required 60 percent. To address identified ponded areas, 3,700 feet of additional channels were constructed, ensuring compliance with MAMP channel connectivity standards.[77] The restoration unit met the stranding and trapping performance standard, and no further issues were identified in subsequent years. While summer temperatures exceeded the performance threshold, the channels still have minimal vegetative shading, and it will likely take another 4–6 years for the planted trees and shrubs to provide sufficient cover to develop and bring temperatures within the desired range. Although no nutrient sampling standards exist for spring and summer, monitoring revealed lower dissolved oxygen (DO) levels during summer, and it is expected to improve with increased shading. Despite these lower DO levels, the habitat remains favorable for juvenile coho, supported by findings from other wetland projects. Units

Source: Winter Lake, Coquille River, Brady Holden, 2019

71 Claire, Christopher W., Fred Messerle, Caley Sowers.. (2022). "Winter Lake Phase III Project Hydrologic Assessment." Accessed at: https://coosswcd.specialdistrict.org/files/8b3776c91/5+404_Attach_C_HydroAssess.pdf

72 Claire, Christopher W., Fred Messerle, Caley Sowers.. (2022). "Winter Lake Phase III Project Hydrologic Assessment." Accessed at: https://coosswcd.specialdistrict.org/files/8b3776c91/5+404_Attach_C_HydroAssess.pdf

73 Huff, Julie, Gary Vonderohe, Chris Claire. (2020). "Winter Lake Restoration Effectiveness Monitoring: Year 2." Accessed at: https://www.coquillewatershed.org/wp-content/uploads/2021/08/Winter-Lake-Effectiveness-Monitoring-Year-2-2020-Compressed.pdf

74 Huff, Julie, Gary Vonderohe, Chris Claire.. (2020). "Winter Lake Restoration Effectiveness Monitoring: Year 2." Accessed at: https://www.coquillewatershed.org/wp-content/uploads/2021/08/Winter-Lake-Effectiveness-Monitoring-Year-2-2020-Compressed.pdf

75 Claire, Christopher W., Fred Messerle, Caley Sowers.. (2022). Winter Lake Phase III Project Hydrologic Assessment. Accessed at: https://coosswcd.specialdistrict.org/files/8b3776c91/5+404_Attach_C_HydroAssess.pdf

76 Claire, Christopher W., Fred Messerle, Caley Sowers.. (2022). "Winter Lake Phase III Project Hydrologic Assessment." Accessed at: https://coosswcd.specialdistrict.org/files/8b3776c91/5+404_Attach_C_HydroAssess.pdf

77 Huff, Julie, Gary Vonderohe, Chris Claire.. (2020). "Winter Lake Restoration Effectiveness Monitoring: Year 2." Accessed at: https://www.coquillewatershed.org/wp-content/uploads/2021/08/Winter-Lake-Effectiveness-Monitoring-Year-2-2020-Compressed.pdf

EXHIBIT 7
Restoration Phase Costs by Component

Restoration Component	Cost
Restoration Design and Engineering	$225,000
Restoration Permitting	$25,000
Restoration Construction	$2,200,000
Restoration Plants and Planting	$350,000
Staff salary, Outreach, Travel, Supplies, etc.	$300,000
Indirect Expenses	$80,000
Total	**$3,180,000**

Source: Jason Nuckols

EXHIBIT 8
Restoration Phase Funding Sources and Amounts

Actions	Gross Funding Amount
NOAA Funding	$1,210,000
ODOT Funding	$300,000
ODFW Funding	$275,000
USFWS Funding	$1,000,000
TNC Funding	$120,000
OWEB Funding	$275,000
Total Gross Funding	**$3,180,000**

Source: Jason Nuckols

1 and 3 met most water depth standards except during the June to September period. The restoration unit (Unit 2) met the water level standards during the over-winter and spring transition periods but did not meet them from June to September. Despite the absence of fish sampling metrics in the MAMP, monitoring indicates positive outcomes for over-wintering juvenile coho, with longer and fatter fish captured in the restoration site compared to outside the restoration site.[78]

The project's impacts on landowners and agricultural operations remain unclear. Interviews with stakeholders in the Winter Lake area suggest that it is too soon after implementation to observe any significant benefits. However, landowners have anecdotally reported seeing improvements, such as more usable acreage and enhanced pastures, which makes them hopeful for continued benefits over time.

Cost estimates for various components of the project's restoration phase are displayed in Exhibit 7. The total cost of restoration was approximately $3.1 million. Funding sources for the restoration phase are presented in Exhibit 8.

An important feature of the Winter Lake Tide Gate Project is the implementation of Water Management Plans (WMP), including the Beaver Slough Drainage District WMP, the Coaledo Tide Gate Replacement and Fish Passage Project WMP, and the Seestrom Tidelands Restoration Project WMP. These WMPs provide detailed roadmaps for how water can be moved across properties within the management unit and include plans for fish passage, with particular attention to coho salmon. Key themes across these WMPs include:

- Balancing fish passage requirements with water management for landowners
- Restoring access and improving ecological conditions for native fish
- Defining water management seasons and transition
- Outlining responsibilities for infrastructure within the district
- Appointing a water manager

The Appendix in Section 7 includes detailed descriptions of each plan.

78 Huff, Julie, Gary Vonderohe, Chris Claire.. (2020). "Winter Lake Restoration Effectiveness Monitoring: Year 2." Accessed at: https://www.coquillewatershed.org/wp-content/uploads/2021/08/Winter-Lake-Effectiveness-Monitoring-Year-2-2020-Compressed.pdf

North Bank Tide Gate Project

The North Bank Tide Gate Project is located at mile 7.5 of the Coquille River near the settlement of Randolph. The project site consists of approximately 33 acres of field and 120 acres of forest. Originally a dairy operation, the fields are now primarily used hay production (with a total value of around $3,000–$4,000 per year). Prior to the arrival of the current residents approximately 10 years ago, the farm was operated by a multi-generational family for nearly a century. This case study is based on discussions with a landowner in the North Bank Tide Gate Project area and a tide gate coordinator responsible for overseeing upgrade.

The North Bank Project aims to balance agricultural productivity with the preservation of natural features. In 2015, the site's landowner initiated a process of ecological restoration of the land in partnership with the Coquille Watershed Association (CWA). As mentioned in interviews, leadership changes led to a discontinuation of their collaboration and the development of a new partnership with the Coos Soil and Water Conservation District in 2017. The Conservation district aims to support agricultural uses while protecting ecological concerns.

In 2018, the landowner received a technical assistance grant from OWEB. After several delays and COVID-19-induced cost increases, the project was eventually completed in the summer of 2023. The tide gate project has

Source: North Bank, Jason Nuckols, TNC 2024 required a complex process of both construction and implementation. In 2020, a significant breach of over 125 feet in the dike prompted emergency repairs. As a result of permitting processes between 2020 and 2021, the landowner secured approximately 13 permits from various entities including, county, state, and NOAA. The lengthy and complex permitting process was highlighted as a major barrier, with county requirements particularly challenging. Moreover, there have been mixed reactions to the project among neighbors, with some feeling skeptical about the merits of government involvement.[79]

Overall, construction costs amounted to just under $1 million with additional expenses for archaeology and permits. The archaeological survey proved time-consuming and involved the use of a little less than $10,000 in personal landowner funds. A detailed cost breakdown is presented in Exhibit 9.

The new tide gate, drainage system, and dike were completed in 2023. The North Bank Tide Gate is a 7-foot diameter side-hinged aluminum gate with a Muted Tidal Regulator, manufactured and installed by Nehalem Marine. Since its completion, land use has improved, with previously flooded areas now draining as designed and becoming usable. The main channel's riparian area is fenced, and side channels have been rerouted and are now draining properly.

The landowner interviewed for this report highlighted several unique community and cultural considerations that influenced the project's development and implementation. These included the differing perspectives among family members with partial land ownership regarding the project's direction. The landowner also emphasized their relationship with the Coquille Indian Tribe and the importance of acknowledging the historical and cultural significance of the project land to the Tribe.[80]

Although it is too early to fully assess the impacts of the North Bank Tide Gate Project, the new tide gate is anticipated to allow for controlled flooding and drainage, prompting grass growth and enhanced field usability. The landowner emphasized how the project exemplifies the potential for farmers to contribute positively to natural resource management while maintaining agricultural productivity. However, they stress that for farmers and landowners to achieve this balance, they must have access to support and guidance in navigating the complex process of environmental upgrades.

Several observable ecological enhancements have also occurred in the area. Those involved in project monitoring have observed juvenile coho feeding in the ponds and channel and waterfowl beginning to occupy the site. They have set pressure transducers and water temperature loggers to document changes in stream temperatures through the summer. As the riparian vegetation planted in the area grows up along the main channel, they anticipate reductions in summer stream temperatures.[81]

EXHIBIT 9 **North Bank Project Costs**

Actions	Approx. Cost
Tide gate and culvert installation	~$96,250
Tide gate and culvert purchase and delivery	~$150,000
Channel excavation/crossings/ fencing/ planting/dike rebuild	~$741,500
Archaeology costs	~$110,000
Engineering/permitting	~$120,000

Source: Coos SWCD, District Manager and Landowner

Summary

With a clear understanding of the benefits, costs and modernization processes through the overview of case studies, the next step is to explore how to plan and implement a tide gate upgrade project successfully. The following section provides a comprehensive guide to getting started, including assessing site conditions, navigating the permitting process, assembling a project team, and securing the necessary resources to ensure a successful outcome. By following these steps, landowners can effectively manage the complexities of tide gate modernization and maximize the benefits for both their land and the broader community.

79 ECOnorthwest. (April 11, 2024). Personal communication with landowner.

80 ECOnorthwest. (April 11, 2024). Personal communication with landowner.

81 ECOnorthwest. (April 11, 2024). Personal communication with landowner.

Conclusion and Next Steps

In conclusion, modernizing tide gates on the Oregon Coast is a complex but essential process for ensuring coastal communities' long-term sustainability and resilience. The challenges posed by aging tide gates, including their negative impacts on landowners and ecosystems, highlight the critical need for timely upgrades.

The analysis provided in this report has outlined the economic, ecological, biological, and social benefits of tide gate modernization. Economically, these upgrades have the potential to enhance agricultural productivity, increase land value, and reduce the costs associated with flood damage, thereby strengthening the overall resilience of coastal economies. From an ecological and biological perspective, modernized tide gates support healthier fish populations, restore natural hydrological processes, and improve habitat connectivity, all crucial for preserving coastal ecosystems. Socially, the modernization process encourages collaboration among various stakeholders, aligning conservation efforts with the needs of local communities.

However, the modernization process does involve significant costs. Financial investments, regulatory challenges, and potential ecological disruptions during construction must be managed effectively to achieve successful outcomes. Despite these challenges, the long-term benefits of tide gate modernization—ranging from enhanced flood protection to improved ecosystem health—often justify the initial investments and temporary disruptions.

Source: Yachats Shutterstock

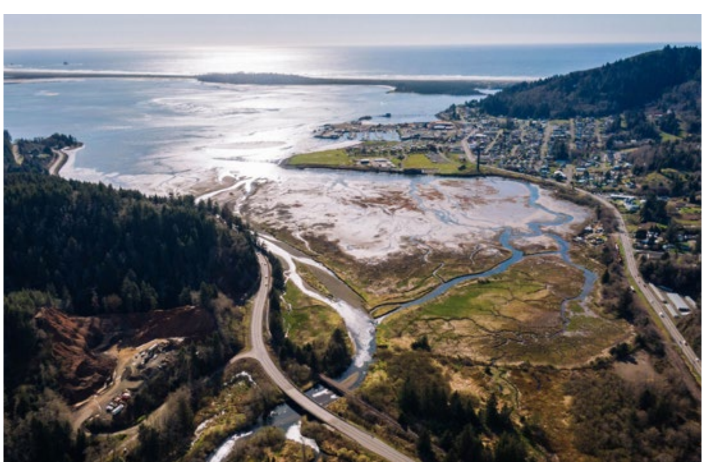
Conclusion and Next Steps

As the Oregon Coast faces the increasing impacts of climate change, including rising sea levels and more frequent flooding, the importance of modernizing tide gates becomes even more apparent. Leveraging available resources, fostering collaborative partnerships, and engaging in meticulous planning are essential steps in ensuring that these projects address current needs while also contributing to a sustainable and resilient future for coastal regions.

The case studies presented in this report offer valuable insights into the practical aspects of tide gate modernization, highlighting the opportunities and challenges associated with these projects. By applying lessons learned from these examples and continuing to advance research, advocacy for state support, and monitoring efforts, coastal communities can more effectively navigate the complexities of tide gate modernization and fully realize the benefits that these upgrades provide.

Next Steps For Enhancing Tide Gate Research

Accurate, site-specific data collection is essential to conduct a benefit-cost analysis of tide gate modernization. Measuring landowner benefits or changes in benefits requires data from pre- and post-modernization periods. Ideally, agricultural producers and landowners would maintain detailed production records from these periods to quantify or monetize the expected positive changes in benefits easily. However, this may not always be feasible due to potential changes in land ownership, loss of records, and other factors. Therefore, once a tide gate modernization process begins, landowners should be encouraged and supported to accurately account for changes in their agricultural productivity before and after modernization. These detailed records would enable site-specific quantification of benefits, which can then be aggregated at various spatial scales (e.g., lands influenced by the tide gate, watersheds, and drainage districts). Key data needs include, but are not limited to:



Source: Kilchis Estuary, Zach Putnam, TNC

- **Farm Size/Parcel Size (in acres)**
- **Land Use:**
  - Crop Mix (in acres)
  - Pastureland (in acres)
  - Other land use types (in acres)
- **Information about any structures on the property**
- **Operation Financials:**
  - Net Revenue or Profit
  - Input Costs
  - Other Overhead Costs
  - Property Taxes
  - Crop Insurance

Another approach to quantifying the economic benefits to landowners is to conduct a follow-up survey of those affected by a modernized tide gate. Questions for landowners could include, but are not limited to:

- Is any of your agricultural production affected by the modernized tide gate? Have you seen an increase or decrease in productive acreage?
- How long did you graze your livestock before the tide gate was modernized? Did this change after tide gate modernization? If so, how much longer was your grazing period?
- Have you seen improvements in forage quality on the land your livestock grazes on?
- Have you seen changes in on-farm revenues post-tide gate modernization? If so, have they increased or decreased? By how much?
- Have you seen changes in on-farm costs post-tide gate modernization? If so, have they increased or decreased? By how much?

The information gathered from such a survey could be used to quantify economic benefits to landowners and aggregated

Conclusion and Next Steps

to varying spatial scales for comparative analysis. Quantifying other benefit categories could be achieved using the benefit-transfer method, which involves applying benefit value estimates from one location to another with similar characteristics. The benefit-transfer method is particularly cost-effective compared to site-specific, primary data collection, which can be time-intensive and costly. Utilizing benefit and cost estimates from other studies, sources, or publications would help fill in the final gaps for a comprehensive benefit-cost analysis. Once all relevant benefits and costs are quantified across the categories presented in this report, the net benefit or net cost of tide gate modernization can be calculated. Key data needed for ecological benefits include, but are not limited to:

- **Salmon population estimates through time**
  Ideally, pre- and post-modernization
- **Willingness-to-pay (WTP) estimates for salmon to use the benefit-transfer method**
  Gathered through academic/government publication review (e.g., Lewis et al., 2022)
- **Other wildlife population estimates through time**
  Ideally, pre- and post-modernization
- **WTP estimates for wildlife species of interest to use the benefit-transfer method**
  Gathered through academic/government publication review
- **Information on changes to water quality through time**
  Ideally, pre- and post-modernization

Fostering collaborative partnerships and enhancing state leadership is essential to continuing to strengthen the tide gate modernization process. Currently, many landowners and stakeholders feel they are largely navigating the complexities of tide gate modernization on their own, leading to inconsistencies and inefficiencies. To address this, several next steps have been identified.

One key step is the development of educational workshops aimed at training individuals from watershed councils, soil and water conservation districts, or drainage districts to continue educating staff. These workshops would help ensure a streamlined and somewhat standardized process, providing a model for all coastal communities and benefiting tide gate coordinators and landowners.

Additionally, it is crucial to continue building cross-functional funding strategies to ensure that communities can work together to achieve multiple restoration and conservation goals while enhancing the region's economic viability. The Oregon Tide Gate Partnership made significant progress in coordinating efforts between various stakeholders, including public safety, fish and watershed groups, and agricultural interests. However, there is an ongoing need for facilitation to bring these groups together and flag any emerging issues.

Addressing the manufacturing challenges identified by the OTGP is also a priority. These challenges include ensuring that the manufacturing processes for tide gates, such as MTRs, are reliable and meet the specific design requirements needed for successful long-term operation. Manufacturing delays and inconsistencies can lead to project setbacks, emphasizing the need for improved collaboration between manufacturers, state agencies, and local stakeholders. By integrating discussions on manufacturing challenges into educational workshops and collaborative planning efforts, stakeholders can work towards overcoming these barriers, ensuring that tide gate modernization projects are efficient and meet the highest standards of quality and durability.

Creating a comprehensive tide gate project list and a clearinghouse of grant and funding options would further support this process. This would allow stakeholders to plan for tide gate projects over multiple years and access diverse funding streams, particularly for smaller projects that may not fare as well in the traditional grantmaking process. By addressing these various aspects, the tide gate modernization process can be made more efficient, equitable, and effective, ultimately leading to better outcomes for both the environment and the communities that depend on these critical structures.

7

Appendix

Tide Gate Modernization: Getting Started

The Oregon Tide Gate Partnership (OTGP) offers guidance to landowners, tide gate coordinators, and agencies on navigating the regulatory processes involved in upgrading and improving tide gates. The Partnership's regulatory process outlines the roles and responsibilities of each party and includes expected outcomes for every step of the process. Those interested in this step-by-step guidance are encouraged to review the information at https://oregontidegates.org/regulatory-process.

Funding for Tide Gate Upgrade Projects

Several grant and assistance programs are designed to support landowners in upgrading or replacing outdated and failing tide gates. The OTGP highlights six such funding opportunities available to private landowners:[82]

- Tide Gate Project Planning and Construction Grant and Loan Program
- OWEB Technical Assistance Grants
- OWEB Restoration Grants
- ODFW Fish Screening and Passage Grant Program
- National Coastal Resilience Fund
- USFWS Coastal Wetland Grants

Exhibit 10 presents a compilation of Oregon tide gate projects from 2021–2022, alongside the grant amounts allocated to each. Grant amounts range from $35,000–500,000, with an average grant amount of $114,100.

Source: Kilchis, Jason Nuckols, TNC 2024

The success of tide gate upgrade projects often relies on a partnership approach, where the financial burden to support the expensive infrastructure that is required for modern, environmentally compliant tide gates is shared among various stakeholders, including private landowners, NGOs, and government agencies. This collaborative funding model enables the implementation of new tide gate technologies that can balance multiple objectives such as the agricultural needs with ecological conservation goals that have been explored in this paper.

82 Oregon Tide Gate Partnerships. (2021). "Funding." Accessed at: https://oregontidegates.org/funding/

Appendix

EXHIBIT 10 **Oregon Tide Gate Projects and Grant Amounts (2021-2022)**

Grant #	Client Name	Project Description	Approved Amt.	Award Date	City
TG2204	Port of Astoria	Astoria Airport Tide Gate Study (Design & Engineering)	$99,600	12/20/21	Warrenton
TG2205	City of Warrenton	Tide Gate # 9 (Design & Engineering)	$100,000	3/28/22	Warrenton
TG2115	City of Tillamook	Hadley Road Drainage Project (Construction Project)	$54,700	6/30/21	Tillamook
TG2105	Trout Unlimited	Esther Creek Tide Gate Project (Design & Engineering Project)	$100,000	6/14/21	Tillamook
TG3202	Tillamook County Creamery Association	Carnahan Park Area Tide Gate (Design & Engineering Project)	$57,863	8/8/22	Tillamook
TG2110	Ducks Unlimited Inc	Nestucca NWR Bay Design and Restoration Project (D&E)	$68,842	6/15/21	Oretown
TG2101	Tillamook County	Hawk St - Butte Creek Project (Construction Project)	$95,700	5/6/21	Oretown
TG2108	Partnership for the Umpqua Rivers	Kennedy Slough Tide Gate Replacement (D&E)	$79,900	6/14/21	Reedsport
TG2111	Coos Soil & Water Conservation District	Noble Creek Tidegate Replacement (D&E)	$100,000	6/14/21	Lakeside
TG3201	Coos Watershed Association	Palouse Tide Gate Upgrade Project (D&E)	$100,000	3/28/22	North Bend
TG2112	Coos Watershed Association	Palouse Tide Gate Upgrade Project (D&E)	$100,000	6/14/21	North Bend
TG2109	Coos Watershed Association	Larson Slough Tide Gate Improvement Project (D&E)	$100,000	6/14/21	North Bend
TG2114	City of Coos Bay	Downtown Tide Gates Upgrades and Improvements (D&E)	$200,000	6/24/21	Coos Bay
TG2103	Coos Watershed Association	Catching Slough Tide Gate Replacement (D&E)	$100,000	6/14/21	Coos Bay
TG2102	Coos Soil & Water Conservation District	Albertson Tidegate Replacement (D&E)	$76,300	6/14/21	Coquille
TG2113	Coos Soil & Water Conservation District	Winter Lake Phase III (D&E)	$100,000	6/14/21	Coquille
TG2106	Coos Soil & Water Conservation District	Gatov Field Drain & Tide Gate Replacement (D&E)	$35,000	6/14/21	Coquille
TG2203	Coos Soil & Water Conservation District	North Bank Working Landscape Project (Construction Project)	$500,000	9/21/21	Coquille
TG2104	Coquille Watershed Association	Coaledo Drainage District (D&E)	$100,000	6/14/21	Coquille

Source: "Tide Gates Project Map: 2021-22." Business Oregon. N.d. https://www.oregon.gov/biz/programs/tide_gates_program/Pages/project_map.aspx

Relevant Water Management Plans

Beaver Slough Drainage District Water Management Plan

The main purpose of the BSDD District Water Management Plan (DWMP) is to establish a common framework that enables landowners within the district to manage their water practices independently, without negatively impacting other district members or the district as a whole. BSDD is organized into four subunits, each with its independent WMP that must conform with the guidelines of the DWMP. The DWMP details the plan for the side-hinge tide gate with an MTR at the entrance to the Coquille River. The plan also outlines BSDD's role in managing the district's infrastructure as well as giving the Board of Supervisors the ability to appoint a water manager to operate the infrastructure and implement the DWMP. Landowner responsibilities are also detailed within the DWMP. Landowners are responsible for the upkeep and operations of the interior district infrastructure on their properties. Fish passage requirements are detailed for the new interior infrastructure, and landowners within the same unit are expected to work together to manage water levels related to irrigation, stock water, drainage, and salmon over winter habitat.

The DWMP also defines water management seasons for the gradual transition of water levels within the district. Those three seasons are winter (October–March), spring drain out (April–May), and summer dry season (June–September). The DWMP also sets out contingencies in the event of natural disasters that will impact district infrastructure. A working water level range is set for the district of less than 5.5 feet. There are two distinct modes within the working water level range: drainage mode and inundation mode. The goal of drainage mode is to drain water as quickly as possible to raise soil temperatures to promote forage growth and allow for groundwater storage and drainage of rainwater. Inundation mode has three goals: providing over winter habitat for juvenile coho salmon and other salmonids, base flushing (i.e., maintaining channels), and raising the water table for irrigation. The DWMP sets unit-specific protocols across water management seasons. Reporting procedures are also outlined for the district to collect water elevation levels and water temperature data for the Coquille River at fifteen-minute intervals. The district will also provide a log of requests, maintenance, and contingency events. The annual landowners' meeting will provide an annual summary of this information from the previous year. The Board of Supervisors allows landowners to conduct an annual review/ amendment process.

Source: Coquille River, Jason Nuckols, TNC 2024

Coaledo Tide Gate Replacement Water Management Plan

The WMP for the Coaledo Tide Gate Replacement and Fish Passage project details the joint venture between the ODFW and Coaledo Drainage District (CDD). The project aims to restore fish passage to historical conditions in the Beaver Slough Sub-basin. The tide gate infrastructure for this project is located on Beaver Creek and is owned by CDD. Historically, the infrastructure in this area was for drainage to promote grazing on the lowlands around the tide gate. The tide gate replacement project and WMP were implemented because the existing Coaledo tide gate allowed for limited tidal exchange, which kept fish from accessing high quality wetland habitats and decreased water quality. The WMP discusses that it aims to complement ODFW and National Marine Fisheries Service (NMFS) fish passage requirements and guidelines. It also seeks to meet the water management needs of CDD landowners. The WMP sets up a restoration methodology for the project which involves replacing the old failing tide gate with three side-hinged tide gates with MTRs, and including a smaller, independent slide gate for added management adaptability. The design of the tide gate project is meant to balance ecological and landowner goals as well as meet tidal inflow/outflow goals developed by ODFW, CDD landowners, and other regulatory agencies. The WMP also details the ecological rationale for how the project was developed.

Much like the BSDD DWMP, the Coaledo WMP details different water management goals across the four seasons. Each of the seasons sets a target water elevation based on the North American Vertical Datum of 1988 (NAVD88). For the winter season (December–March), the target is 6 feet NAVD88, which allows for inflows into upstream channels and wetlands to provide overwintering habitats for fish. The spring transition period (April–May 15) sets a target elevation of 5 feet NAVD88, allowing for inflow transitions to grazing conditions. The target elevation for the summer grazing period (May 16–September) is 4 feet NAVD88. This target is meant to keep water within the channels upstream and limit inundation. Finally, the target elevation for the fall season (October–November) is 4.5 feet NAVD88 allowing for sediment flushing from channels. There is an optional season in June per the landowner's request to keep doors open longer to allow inundation for irrigation on agricultural lands.

Like the BSDD DWMP, the Coaledo WMP details CDD's responsibilities for operating and maintaining the district's infrastructure and appointing a water manager. The CDD is also responsible for providing adaptive infrastructure management in the event of bank erosion due to greater tidal inflows and outflows. The WMP also details that landowners are responsible for maintaining their properties' culverts and water diversion mechanisms. Landowners can formally request changes to the WMP which will be approved by the CDD Board, ODFW, and NMFS. The Coaledo WMP details pre- and post-tide gate update monitoring of Oregon Coast ESA coho and Coquille fall Chinook salmon populations. The monitoring program is an existing part of the Coquille Watershed Association's Lower Coquille Tide Gate and Fish Passage Monitoring (LCM) program. The pre-tide gate upgrade monitoring program includes 3–4-year measurements of water temperature, water level, dissolved oxygen, nutrient sampling, and fish monitoring. The fish monitoring is conducted biweekly from December to April at the ODFW Coquille Valley Wildlife Area upstream of the tide gate. Similar monitoring efforts will continue for two years after tide gate installation. Fish monitoring reports are conducted annually, and fish monitoring results are looked at quarterly by the LCM Committee. Water quality monitoring data are reported to the Oregon Department of Environmental Quality (DEQ) on an annual basis. The Coaledo WMP also creates a committee to deal with local beaver populations if they affect water management operations. The Coaledo WMP includes three appendices: tidal inundation maps, mosquito management, and an aperture gate technical performance memo. The mosquito management plan discusses measures for improving conditions that decrease the likelihood of mosquito production.

Seestrom Tidelands Restoration Water Management Plan

The Seestrom Tidelands Restoration WMP discusses a two-phased process for restoring tidal flows to approximately 286 acres in the Coquille River Valley at river mile 13.0. The project area has three tide gates in a state of disrepair that are affecting the lands of a private ranching operation. The goal of the project is to restore access for native salmonids (e.g., Oregon Coast coho salmon) to wintering habitats. The restoration methodology for this project includes replacing undersized culverts with larger, newer culverts as well as replacing tide gates at the outflows of Seestrom and Alder Creeks. The failing tide gates will be replaced with side-hinged aluminum tide gates equipped with MTRs that will be set to close when elevation gets too high.

This WMP aims to maximize ecological function while satisfying landowners' needs to maintain livestock grazing operations. To achieve this, restoration efforts are concentrated on peak coho use from November to March, allowing agricultural activities to continue for the remainder of the year. Like the other two WMPs, the Seestrom WMP defines five seasons for water management operations. Autumn has a minimum inflow target of 5.5 feet NAVDD88. The winter season has a minimum inflow target of 8.0 feet NAVDD88. The spring transition period has a target of 6.5 feet NAVDD88. The spring grazing period has a target of 5.5 feet NAVDD88. Finally, the summer grazing period has a target of 4.5–5.0 feet NAVDD88. The WMP notes that it was developed with extensive input from landowners. The mosquito management plan adopted in this WMP is similar in language and scope to that of the Coaledo WMP.

Source: Shutterstock

Interview Questions

This memo provides an overview of objectives and potential questions for targeted interviews of stakeholders, private landowners, and resource managers. Furthermore, we have formulated targeted questions for leading experts associated with the two case studies: Winter Lake and North Bank Tide Gate Project. The interview process aims to inform and ground-truth research and analysis regarding the benefits and value of tide gate upgrades, focusing on the social, ecological, biological, and economic benefits to landowners and the broader community. Interviews may be conducted individually or through focus group discussions with several stakeholders.

Interview Framing

Before beginning the specific questions, the interviewer will provide an overview of the interview process, including introductions between the interviewer and interviewee, the roles of the client and ECOnorthwest, the goals of the study, and potential ways the information may be used.

General Questions

Optional questions depending on the interview targets

- How familiar are you with tide gates and their functionality?
- In your opinion, what are the key advantages to the restoration or replacement of tide gates?
- In your opinion, what are the key disadvantages to restoration or replacement of tide gates?
- What are the perceived barriers to landowners engaging in tide gate restoration and/or replacement?

Specific Questions for Public Officials

Interview targets:

- Watershed council members
- Drainage district managers
- ODFW biologists
- City, county, or community officials

Social:

General sentiment of tide gate upgrades in their watersheds

- What is the range of opinions among landowners about tide gate upgrades in your watershed?
- Are there others who have an interest in and/or opinion about this topic?
- What are the reasons why some landowners decide to upgrade voluntarily?
- Are there any social barriers or reasons for a landowner's resistance to upgrade?
- Do people share knowledge about upgrades and talk about lessons learned? How do they do this—what forums, how is information shared?

Ecological | Biological:

Ecological Benefits and Costs Associated with Estuaries and Their Biophysical Processes

- What are the realized ecological benefits associated with upgraded tide gates? Have there been observed increases in fish populations or the reintroduction of estuarine species?
- Do you have any new monitoring data to share that could offer insights into the effectiveness of tide gate upgrades?

Economic:

Funding Sources and Strategies to Support Private Landowners

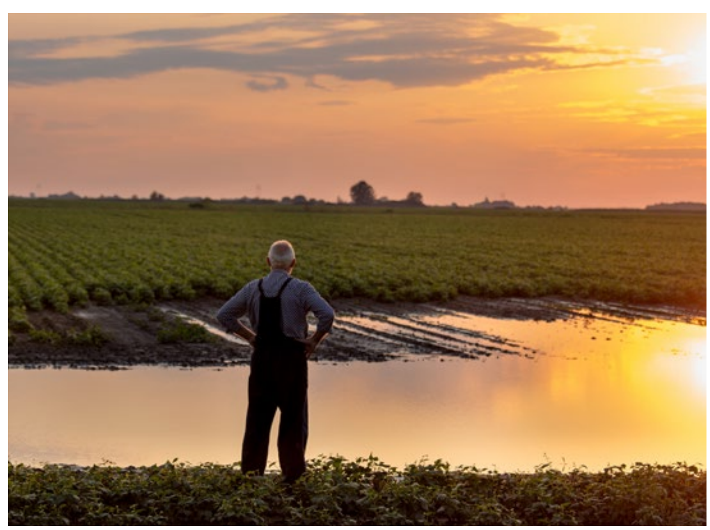
- Beyond grants, what other funding opportunities are available to landowners from county, state, or federal agencies?
- Can you provide examples of the costs associated with planning, designing, and constructing various types of gates, including their operations and maintenance expenses?
  - If not, is there available data that provides a detailed cost breakdown example?
- Are landowners responsible for any operations and maintenance costs, either directly or indirectly, such as through drainage district fees, additional labor, etc.?

Specific Questions for Landowners

Interview Target: ***For landowners who have successfully implemented a tide gate upgrade or replacement***

Social:

- What led you to decide to upgrade your tide gate?
- What are some potential barriers to upgrading tide gates that you've heard from other landowners?



Source: Shutterstock

Appendix

Ecological | Biological:

Understanding Land Changes and Processes Through Experience

- Could you describe any changes in land conditions or physical processes you've noticed since the tide gate was upgraded?

Economic:

Assessing Costs of Upgrades

- What improvements have you observed in your agricultural production following the tide gate upgrade, if any?
  - Alternatively, what benefits do you anticipate gaining in the near term?
- Aside from the construction expenses for the tide gate upgrade, what other indirect costs have you encountered, either during the upgrade or post-completion?
- Has the upgrade led to any changes in the labor required to maintain and operate the tide gate? Could you specify any additional costs or savings incurred as a result?
- Are there ways that the tide gate influences your property value, or do you think about the current or future property ownership costs and benefits?

***Interview Target:* For landowners who have agreed to or are considering upgrading their tide gates**

Social:

- What factors influenced your decision to upgrade the tide gate on your property?
- What are some potential barriers to upgrading tide gates that you've heard from other landowners?

Ecological | Biological:

- Could you describe any changes in land conditions or physical processes you anticipate following the tide gate upgrade?

Economic:

- Do you anticipate any economic benefits to agricultural productivity or costs of production as a result of upgrading your tide gate?
  - If so, please explain.
- Do you have any economic concerns about upgrading your tide gate?
  - If so, please explain
- Are there ways that the tide gate influences your property value, or do you think about the current or future property ownership costs and benefits.

Case Study Assessments

Winter Lake and North Bank – Coquille Watershed

Specific to upgraded tide gates major benefits:

- Under what conditions are tide gate upgrades most likely to have major benefits?
- Conversely, under what conditions are tide gate upgrades least likely to have benefits?
- For large tide gate improvements like [case study site], what is the typical timeline for completion of planning, design, and construction?
- Is there an estimated timeframe for observing improvements within the watershed after the project's completion?
- Do you have any new monitoring data to share that could offer insights into the effectiveness of tide gate upgrades?

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