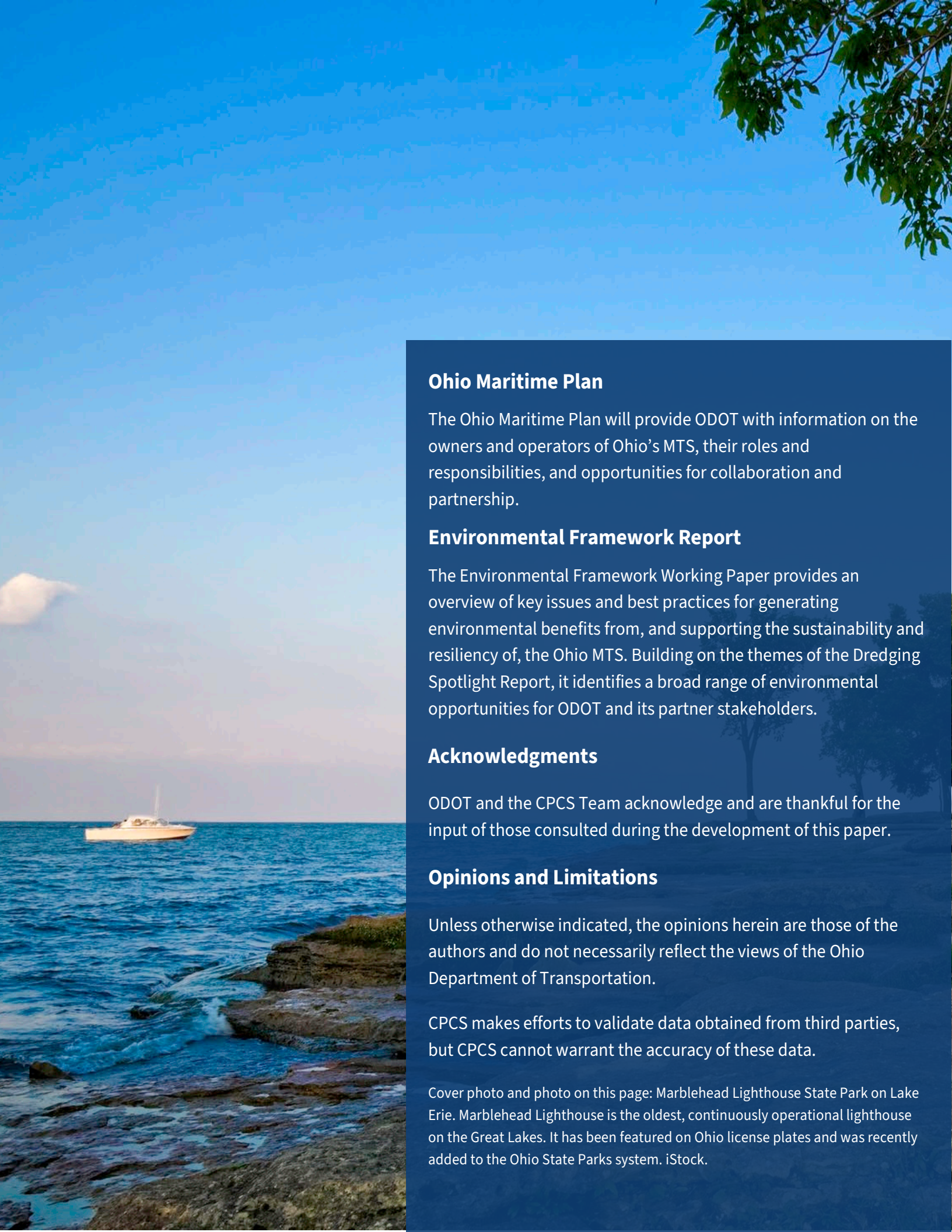
Ohio Maritime Plan

WORKING PAPER 6:
Environmental Framework

WSP cpcs Ohio Department of Transportation



Ohio Maritime Plan

The Ohio Maritime Plan will provide ODOT with information on the owners and operators of Ohio's MTS, their roles and responsibilities, and opportunities for collaboration and partnership.

Environmental Framework Report

The Environmental Framework Working Paper provides an overview of key issues and best practices for generating environmental benefits from, and supporting the sustainability and resiliency of, the Ohio MTS. Building on the themes of the Dredging Spotlight Report, it identifies a broad range of environmental opportunities for ODOT and its partner stakeholders.

Acknowledgments

ODOT and the CPCS Team acknowledge and are thankful for the input of those consulted during the development of this paper.

Opinions and Limitations

Unless otherwise indicated, the opinions herein are those of the authors and do not necessarily reflect the views of the Ohio Department of Transportation.

CPCS makes efforts to validate data obtained from third parties, but CPCS cannot warrant the accuracy of these data.

Cover photo and photo on this page: Marblehead Lighthouse State Park on Lake Erie. Marblehead Lighthouse is the oldest, continuously operational lighthouse on the Great Lakes. It has been featured on Ohio license plates and was recently added to the Ohio State Parks system. iStock.

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Acronyms and Abbreviations

Acronym	Definition
AIS	Aquatic Invasive Species
ATTAIN	Grant Program
BR	Brandon Road
BWM	Ballast Water Management
CAP	Climate Action Plan
CDF	Confined Disposal Facility
CTF	Clean Truck Fund
CTMP	Comprehensive Truck Management Program
CY	Calendar Year
EDRR	Early Detection and Rapid Response
EMA	Emergency Management Agency
EPA	Environmental Protection Agency
EV	Electric Vehicle
FEMA	Federal Emergency Management Agency
GHG	Greenhouse Gas
GLCRS	Great Lakes Coastal Resiliency Study
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program
IDNR	Illinois Department of Natural Resources
IIPD	Illinois International Port District
IMO	International Marine Organization
LED	Light-Emitting Diode
LEPRP	Lake Erie Protection and Restoration Plan
LNG	Liquified Natural Gas
LPO	Loan Programs Office
MARAD	US Department of Transportation Maritime Administration
META	Maritime Environmental and Technical Assistance
MTS	Maritime Transportation System
NGO	Non-Governmental Organization
NJ	New Jersey
NOAA	National Oceanographic and Atmospheric Administration
NPO	Non-Profit Organization
NY	New York
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OH	Ohio
Ohio DOD	Ohio Department of Development
Ohio DOE	Ohio Department of Energy

Acronym	Definition
ORDC	Ohio Rail Development Commission
PIANC	Permanent International Association of Navigation Congresses
PIDP	Port Infrastructure Development Program
PROTECT	Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation
RCE	Railroad Crossing Elimination Grant Program
RIP	Resilience Improvement Plan
RLP	Remediation Loan Program
RSM	Regional Sediment Management
SAGE	Systems Approach to Geomorphic Engineering
SC	South Carolina
TIFIA	Transportation Infrastructure Finance and Innovation Act
TSMO	Transportation Systems Management Office
TX	Texas
US	United States
USACE	United States Army Corps of Engineers
USDOT	United States Department of Transportation
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USGS	United States Geological Service
VA	Virginia
VAST	Vulnerability Assessment and Scoring Tool
VMT	Vehicle Miles Traveled

Executive Summary

Ohio's maritime transportation system (MTS) includes marine cargo operations on the Ohio River and Lake Erie. Its diverse infrastructure includes navigation channels, locks and dams, fleeting and mooring areas, marine cargo terminals both public and private, and port designations aggregating terminals into larger management or organizational frameworks. The MTS is also used for non-cargo activities including boating, canoeing, tourism, recreational fishing, and passenger transportation; it establishes shorelines and accommodates changes in water levels; and supports a rich biodiversity of aquatic life, mammals, and birds alike. With such an extensive, multi-faceted system, Ohio MTS facilities and operations have effects on the environment, and in turn, are affected by environmental factors and pressures. The aim of the Ohio Maritime Plan's Environmental Framework is to examine:

- Best practices to achieve environmental benefits from the Ohio MTS; and
- Best practices to ensure sustainability and resiliency of the Ohio MTS.

With these dual goals of providing benefits and ensuring sustainability and resiliency, the Ohio Maritime Plan considers best practices related to three areas of focus – MTS Operations, Climate, and Communities. With input from the Ohio Department of Transportation (ODOT) and the Ohio Maritime Plan Steering Committee, a reference framework was created to organize the diverse range of environmental issues and best practice opportunities based on whether they relate more to achieving benefits or ensuring resiliency and sustainability, and whether they relate more to operations, climate, or community factors.

Figure ES-1: Ohio MTS Environmental Analysis Issues Framework

Achieving Environmental Benefits from Ohio's MTS through Best Practices	Enhancing Ohio MTS Sustainability and Resiliency through Best Practices
Operations	
• Dredged materials management/use • Aquatic invasive species management • Site improvement and remediation	• Sustainable vessel operations • Sustainable terminal operations • Sustainable landside access
Climate	
• Modal diversion • Terminal electrification and emissions reduction • Vessel emissions reduction • Truck emissions reduction	• Resistance to water level, wind, and temperature extremes • Management of stormwater and runoff • Erosion and shoreline protection • TSMO
Communities	
• Truck routing and management • Rail grade crossing elimination and management • Noise, dust, and lighting management • Complementary water and land uses	• Economic integration • Local workforce development • Community connectivity

Next Steps and Strategies for ODOT and other MTS stakeholders

This Environmental Framework Working Paper offers suggestions and recommendations for ODOT and its partners – port authorities, marine facility owners and operators, communities hosting port activities, and other state agencies – to advance environmental best practices for Ohio's MTS.

Recommended strategy options for **ODOT** include:

Support the Lake Erie Commission and Ohio River Commission – ODOT should coordinate with and support the established Lake Erie Commission and newly-formed Ohio River Commission to advance and implement recommendations consistent with this Environmental Framework.

Promote general and consistent awareness of MTS environmental best practices – Through the Ohio Maritime Plan, Transport Ohio, and other ODOT plans and studies, ODOT should promote best practices to MTS stakeholders, support continued research and education on emerging best practices, and promote coordination among Ohio agencies on MTS environmental issues.

Provide direct funding and federal grant application support for environmental best practice implementation - ODOT can leverage the current Ohio Maritime Assistance Program and other mechanisms (including Carbon Reduction Program and CMAQ funds) to encourage implementation by MTS stakeholders. This could include helping all Ohio port authorities develop, update, and implement sustainability and resiliency goals and plans, assisting public and private facilities with facility and asset improvements, collaborating on Brownfield redevelopment, and working with communities on the inclusion of MTS issues in local and regional environmental plans.

Expand ODOT's Ohio's Resilience Improvement Plan, Carbon Reduction Strategy, and Asset Reliability Study – ODOT can expand its RIP to more specifically address MTS facilities and expand ODOT's attention to performance monitoring and real-time management of MTS environmental conditions and issues through TSMO mechanisms including VAST.

Advance Ohio Maritime Plan recommendations in other ODOT plans and programs – Plan recommendations should be integrated into other state, regional, and local plans and programs to allow for a coordinated effort across agencies and ensure sustainability goals are aligned across the state.

Recommended strategy options for other **Ohio MTS** stakeholders include:

For public agencies – Coordinate with port authorities and responsible federal, state, regional, and local agencies to implement Environmental Framework strategies across their areas of jurisdiction. Some Ohio port authorities are already engaged in such efforts, and the opportunity is for all port authorities to make comparable and mutually supportive commitments, through individual Climate Action Plans and possibly through a shared higher-level Ohio MTS Climate Action Plan.

For private facility owners and operators – Provide technical support and guidance to private parties to include Environmental Framework strategies in their ongoing facility development and improvement, asset management and acquisition, and ongoing operations. While private-sector timelines for near-term, business-critical expenditures and actions sometimes make public-private partnerships impractical, new partnerships could be framed around longer-term investment and environmental upgrade programs with shared private and public benefits.

For communities – Work collaboratively with public and private ports on issues related to truck and rail access, complementary water and land uses, and economic and community relationships, and –- importantly – ensure that Ohio MTS issues and factors are fully considered in regional and local environment and climate plans and analyses.

1 Introduction

Ohio's maritime transportation system (MTS) includes marine cargo operations on the Ohio River and Lake Erie. Its diverse infrastructure includes navigation channels, locks and dams, fleeting and mooring areas, marine cargo terminals both public and private, and port designations aggregating terminals into larger management or organizational frameworks. Each terminal or port typically has waterfront docking and mooring structures, equipment for transferring goods between vessels and land, open and/or covered areas for storage and processing of cargo, landside cargo handling equipment (forklifts, conveyors, etc.), equipment maintenance and administration buildings, truck and auto parking, a secure vehicle gates, and sometimes direct on-terminal rail tracks. The MTS is also used for non-cargo activities including boating, canoeing, tourism, recreational fishing, and passenger transportation; it establishes shorelines and accommodates changes in water levels; and its waterways support a rich biodiversity of aquatic life, mammals, and birds.

With such an extensive, multi-faceted system, Ohio MTS facilities and operations have effects on the environment, and in turn, are affected by environmental factors and pressures. The aim of the Ohio Maritime Plan's Environmental Framework is to examine:

- Best practices to achieve environmental benefits from the Ohio MTS; and
- Best practices to ensure sustainability and resiliency of the Ohio MTS.

Figure 1: Goals of Environmental Best Practice for Ohio's MTS

Environmental Benefits

Provide positive outcomes with actions, policies or practices to directly benefit the natural environment of the MTS and residents who live along it.

Enhancing Sustainability

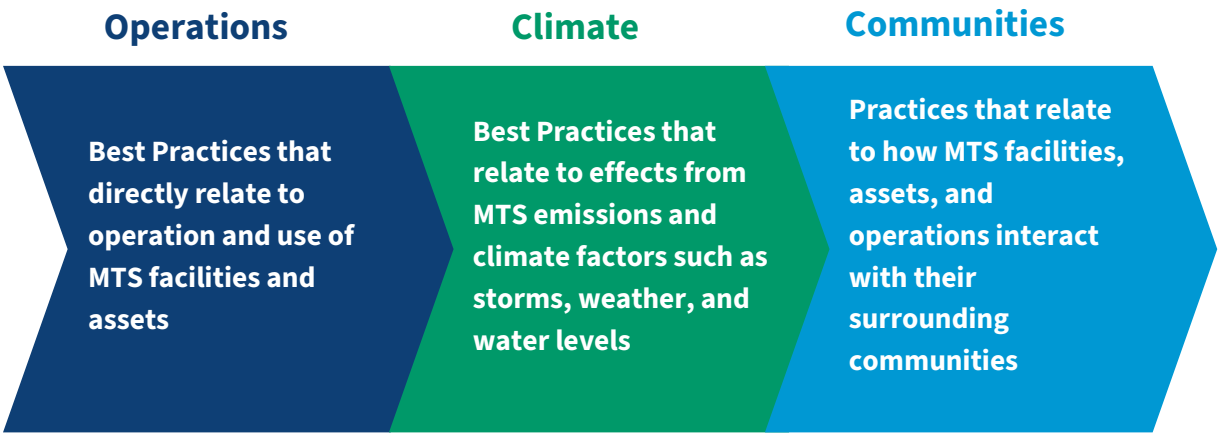
Maintain and support the MTS over time without compromising the ability of future generations to meet their own needs.

Enhancing Resiliency

Ensure the MTS is prepared to withstand, adapt to, and recover from environmental pressures.

With these dual goals of providing benefits and ensuring sustainability and resiliency, the Ohio Maritime Plan considers best practices related to three areas of focus – MTS Operations, Climate, and Communities – as shown in Figure 2.

Figure 2: MTS Environmental Analysis Areas of Focus



The number and diversity of issues and recommendations potentially relevant to Ohio's MTS can be challenging to absorb, manage, and act upon in a coordinated way. Chapter 2 of this Working Paper organizes environmental issues and best practice applications in a simple thematic structure that directly addresses the two key best practice goals (benefits and resiliency/sustainability) and the three key focus areas (operations, climate, and communities).

Chapter 3 offers thoughts on potential best practice concepts and policy actions the Ohio Department of Transportation (ODOT) and its partners may consider promoting and implementing, including establishing performance standards, and the ongoing evaluation of MTS performance.

In developing best practice guidance, the starting point was a review of established policy from State of Ohio agencies, ports, international industry/academic/advocacy research, and Federal agencies. Past policy and plans address different issues – their use for this Working Paper is detailed in **Appendix A** for reference. Additionally, many Federal agencies offer grant and loan programs that may be relevant for improvements and investments to provide Ohio MTS environmental benefits, and these program opportunities are summarized at the end of **Appendix A.**

2 Ohio MTS Environmental Issues and Best Practices

2.1 Organization of Issues

With input from ODOT and the Plan Steering Committee, a reference framework was created to organize the diverse range of environmental issues and best practice opportunities based on whether they relate more to achieving benefits or ensuring resiliency and sustainability, and whether they relate more to operations, climate, or community factors, as shown in Figure 3.

Figure 3: Ohio MTS Environmental Analysis Issues Framework

Achieving Environmental Benefits from Ohio's MTS through Best Practices	Enhancing Ohio MTS Sustainability and Resiliency through Best Practices
Operations (see Section 2.2)	**Operations (see Section 2.5)**
• Dredged materials management/use • Aquatic invasive species management • Site improvement and remediation	• Sustainable vessel operations • Sustainable terminal operations • Sustainable landside access
Climate (see Section 2.3)	**Climate (see Section 2.6)**
• Modal diversion • Terminal electrification and emissions reduction • Vessel emissions reduction • Truck emissions reduction	• Resistance to water level, wind, and temperature extremes • Management of stormwater and runoff • Erosion and shoreline protection • TSMO
Communities (see Section 2.4)	**Communities (see Section 2.7)**
• Truck routing and management • Rail grade crossing elimination and management • Noise, dust, and lighting management • Complementary water and land uses	• Economic integration • Local workforce development • Community connectivity

The identified best practices are centered around achieving environmental benefits for the MTS and enhancing the MTS's sustainability and resiliency through best practices. Some of these actions are already taking place in parts of Ohio while others are not. These actions can differ in how they are implemented depending on where along the MTS they take place. Some issues and opportunities are common to Lake Erie and the Ohio River, while others are unique to one or the other.

Lake Erie is 9,940 square miles with Ohio having 312 miles of coastline along the Lake. The lake is bordered by four states – Michigan, Ohio, Pennsylvania, and New York – and the Canadian province of Ontario. It is an important part of the Great Lake system being connected to the Atlantic Ocean via the St. Lawerence Seaway. Lake Erie is one of the most biologically

productive lakes within the Great Lakes System.[1] The ecosystem is made up of plants, fish, birds, and aquatic and terrestrial animals which rely on the lakes to thrive. Large Lakers transport goods to harbors along the shore which require a 27-foot draft to safely maneuver. Due to the physical characteristics of these vessels specialized equipment is required which often is not used along the Ohio River. Additionally, the types of goods that are moved on Lake Erie can differ, providing unique environmental challenges.

The Ohio River spans 981 miles from western Pennsylvania to its confluence with the Mississippi River at the southern tip of the Illinois River. It flows through or borders six states including Ohio, Pennsylvania, West Virginia, Indiana, Kentucky, and Illinois. The larger Ohio River Basin, which includes seven navigable tributaries, comprises over 2,500 miles of waterways. The basin encompasses 204,000 square miles stretching as far south as Georgia, Mississippi, and Alabama. The ecosystem comprises plants, fish, birds, and aquatic and terrestrial animals that rely on the river to thrive. The Ohio River provides access to the Gulf of Mexico through the Mississippi River. The entire river has 21 locks and dams – of which 9 border Ohio – which control water levels in a series of pools and allow vessels to transit between pools at different levels. Unlike Lake Erie, navigation is typically limited to 9-foot draft barges.

To clarify where and how best practice recommendations may apply, each recommendation discussed in Section 2.2 through Section 2.7 is noted with one of the three icons shown below.

Figure 4: Case Example Symbology

[1] Ohio DNR, Ohio Coastal Atlas – Ecosystem and Habitat, 2018. https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/coastal/ohio-coastal-atlas/CH06_EcosystemHabitat.pdf. Accessed September 2024.

2.2 Best Practices to Achieve Environmental Benefits: Operations

Dredged Materials Management & Use

Ships and barges require a specified channel depth to be able to navigate waterways. In Lake Erie, that necessary depth is 27 ft while barges along the Ohio River typically require a depth of 9 feet. Water currents and ship movements cause lake and riverbeds to build up layers of sediment, requiring frequent dredging to maintain the channel depth. This material can include sand, silt, clay, gravel, and other organic matter. The United States Army Corps of Engineers (USACE) is the federal water resources agency responsible for maintaining the federal navigational channels along the Ohio River and Harbors along Lake Erie. Terminal owners and operators are responsible for maintaining their own approach channels connecting to the federally maintained navigation channel, and for ensuring adequate depths at their berths. Together, the USACE and ports are responsible for millions of cubic yards of material nationwide. How Ohio Ports and USACE handle dredged materials (disposal, storage, use) is dictated by regulations set by the Ohio Environmental Protection Agency (Ohio EPA), USACE, USEPA, and a port's ability to fund a storage or beneficial use site.

Over the years there has been extensive work on how to put dredged materials to beneficial use. The USACE defines beneficial use of dredged materials as "productive and positive uses of dredged material, which cover broad use categories ranging from fish and wildlife habitat development to human recreation, to industrial/commercial uses." The dredged material must then be either reused or stored in a federally-compliant disposal facility. According to the USACE, "10-15 percent of dredged material requires special handling, while 85 percent is available for beneficial use."[2] The dredging process results in millions of cubic yards of material which can be reused to provide benefit to the MTS ecosystem.

The beneficial use of dredged materials can specifically be used for ecological, human, and industrial uses. Examples of these include utilizing the material for rehabilitation/restoration of wetland habitats and aquatic habitats, parks and areas of recreation, upland habitats, beach/shoreline nourishment, agriculture, horticulture, forestry, aquaculture, construction uses, dike replenishment, reclamation of strip mines, and solid waste landfills. Since 2022, the Ohio EPA, USACE, and public ports have partnered to construct eight beneficial use or storage sites for dredged materials including wetland rehabilitation in Sandusky and Ashtabula, multipurpose uses in Cleveland, beach/shoreline nourishment in Fairport Harbor, confined disposal in Lorain Harbor, for commercial uses in Conneaut Harbor, confined disposal near Cincinnati and Vermillion Harbor.[3] Ohio's ports have been leaders in exploring the production of agricultural soils and other

[2] USACE, Beneficial Use Program, N.D. https://www.usace.army.mil/Missions/Civil-Works/Beneficial-Use-Program/, Accessed September 2024.

[3] USACE Engineer Research and Development Center, RSM Sediment Placement Data Viewer, 2023. https://experience.arcgis.com/experience/448e41753a1f408e9dd2c98896e818c0/page/2022-Present/. Accessed September 2024.

uses. A fuller discussion of this subject is offered in the separate **Ohio Maritime Plan Dredging Spotlight Report**.

Aquatic Invasive Species Management

Aquatic invasive species (AIS) can pose a threat to the ecosystem of Lake Erie and the Ohio River, negatively affecting the native population. Aquatic invasive species include plants and animals living in the waterways. Some of the top AIS noted by the Ohio Department of Natural Resources (ODNR) are Bighead Carp, Silver Carp, Black Carp, Diploid, Grass Carp, Curly leaf Pondweed, Red Swamp Crayfish, and Zebra Mussels to list a few.[4] AIS disrupts the balance of the ecosystem by preying on native species or out-competing them for resources which can lead to a decline or extirpation of native populations. An ODNR Report highlighted that the economic impact of AIS on the Great Lakes region accrues more than $100 million in economic damages annually.[5] The economic damages related to AIS are costs to governments, companies and households on managing the AIS or repairing the damages caused by them. These invasive species can arrive at the waterways in multiple different manners including through ballast water, attaching themselves to boat hulls, connecting waterways, aquatic trade, or intentional introductions. While many invasive species are already present in Ohio's MTS the outlined steps can be taken to hinder their proliferation or the introduction of new invasive species.

Ballast Water Management Plans

Lake Erie receives vessels from other states and internationally from Canada and Europe (via the St. Lawerence Seaway). These ships have ballast tanks that are filled with water to provide stability and improve maneuverability during travel. While ballast water is necessary for vessels to safely travel this leads to the unintended consequence of occasionally transporting aquatic species and introducing them into a new environment when ballast water is discharged.

Ballast water management plans are a means for vessels to reduce the likelihood of carrying species from one region to another. The International Marine Organization (IMO) is a specialized agency of the United Nations that sets regulations for maritime transport. They have set an international convention for the control and management of vessel's ballast water and sediment (BWM). BWM plans are comprehensive

[4] Ohio DNR, List of Ohio's Aquatic Invasive Species, N.D. https://ohiodnr.gov/discover-and-learn/safety-conservation/fish-management/aquatic-invasive-species/aquatic-invasive-species. Accessed September 2024.

- [5] Ohio Department of Natural Resources. (2014). *Ohio Aquatic Invasive Species State Management Plan*. Retrieved from https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/wildlife/fish-management/Ohio%20AIS%20State%20Management%20Plan.pdf

strategies set to manage and treat ballast water on a vessel to minimize the transfer of invasive species. They set standards on how ballast water is to be treated. Treatment methods differ but can include one or multiple treatments including filtration systems, chemical disinfection, ultraviolet treatment, deoxygenation, heat treatment, acoustic treatment, electric pulse, and magnetic field treatment.

Monitoring and Surveillance

The monitoring and surveillance of AIS is an important strategy that can help lead to quick responses to addressing AIS infiltration into an ecosystem. Monitoring techniques include conducting regular surveys, DNA-based monitoring, and public involvement. Through the Bipartisan Infrastructure Law, the federal government has supported projects addressing early detection and rapid response (EDRR) for AIS. The US Fish and Wildlife Service created a pilot program for the EDRR program which provides funding in the form of grants to assess and support response actions for quick containment or eradication of newly detected species.[6]

Electric Barriers

The US inland waterway system is a physically interconnected network of commercially navigable waterways, non-commercially navigable waterways, tributaries, and streams. Aquatic species can migrate along the system and take hold in other areas. Electric barriers are one strategy to maintain vessel navigation while discouraging the movement of fish.

While there are questions about the ultimate effectiveness of electric barriers, there is increasing interest. Within Illinois, the USACE has installed an electric fish barrier at the Brandon Road Lock and Dam on the Chicago Area Waterway System near Joliet, Illinois. The barrier was installed to stop Asian Carp from migrating upstream and ultimately into Lake Michigan. The barrier works by generating a low-voltage electric current across the canal. The barrier was installed with other countermeasures to deter migration of the AIS such as air bubble curtains and acoustic fish deterrents as shown in Figure 5.[7] The barriers are erected in a manner that allows for continued navigation for both commercial and recreational vessels.

[6] US Fish and Wildlife Service, A Rapid Response Fund for Aquatic Invasive Species, N.D. https://www.fws.gov/story/rapid-response-fund-aquatic-invasive-species.

[7] USACE Rock Island District, Brandon Road Interbasin Project Review Plan, July 2021. https://www.mvr.usace.army.mil/Portals/48/docs/Environmental/BrandonRoad/Brandon%20Road%20Review%20Plan_Redacted.pdf?ver=IqazX-a-ryxPKU5c_JSlrw%3d%3d

Figure 5: Brandon Road Lock and Dam AIS Counter Measures

Source: USACE, BR Interbasin Project, September 2024. https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/BR-Interbasin-Project/#:~:text=Brandon%20Road%20Lock%20and%20Dam%20near%20Joliet,. Accessed September 2024.

Commercial Uses of Aquatic Invasive Species

Asian Carp are prolific breeders spawning multiple times per year leading to a high reproductive rate which contributes to their rapid growth and large numbers. Many states have found commercial use for Asian Carp to instead benefit from its growing population. Commercial uses include harvesting the carp for human-grade food products, pet food, bait, fertilizer, leather, and fish meal. Illinois, Indiana, and Kentucky allow for commercial harvesting of the carp to control their population. States can work with emerging businesses to encourage the harvest of this AIS. Since 2010, the Illinois Department of Natural Resources (IDNR) utilized federal funding from the Great Lakes Restoration Initiative to help Illinois's commercial fishermen harvest the species. IDNR created an Enhanced Contract Fishing Program which offers Illinois commercial fishermen financial incentives for each pound of the species harvested. IDNR also targets specific areas by increasing these incentives based on the location. Some of the challenges with commercialization include the lack of processing infrastructure, low market price, freshness, low volume of current operations, cost of transport

to processing facilities, and regulations regarding the type of equipment that is allowed to be used to catch the fish (nets).[8]

Site Improvement and Cleanup

Brownfield Redevelopment and Facility Abatement

Brownfields are locations that require cleanup and remediation before they can be safely redeveloped or reused. According to the analysis of the Ohio EPA data, there are a total of 14 brownfield sites located on Lake Erie or the Ohio River.[9] Cleaning up a brownfield site and making it available for redevelopment can be a lengthy process requiring substantial financial commitment. However, the redevelopment of a brownfield site can lead to many positive effects including improving the environmental footprint of the site, improving the health of the community, and can lead to economic growth and rehabilitation of the surrounding communities. Redevelopment of these sites can lead to new residential, commercial, industrial, or green spaces for a community.

The specific steps and methods during this process can vary based on the unique set of circumstances of the site and its desired redevelopment. Generally, the following is required to redevelop a brownfield including assessment, planning, cleanup, monitoring, and redevelopment. The Ohio Department of Development (Ohio DOD) has a robust program to assist communities in the cleanup of brownfield sites. The Brownfield Remediation Program was included in the 2023 state biennium budget bill which provided $350 million in funding to clean sites through grants. The program has a maximum award cap of $10 million with a local match required, and the grant award cannot exceed 75 percent of project costs. Additionally, the program has a $1 million set aside for each county in the state. Funds are available for both assessment and cleanup/remediation.[10]

The Port of Cincinnati Development Authority has been successful in brownfield redevelopment to date having cleaned up over 250 acres and benefiting nearly 50 properties in Hamilton County. In 2024, the port received over $2 million through the Brownfield Remediation Program for the cleanup of four brownfield

[8] U.S. Fish and Wildlife Service, Virtual Invasive Carp Forum, August 2022. https://www.fws.gov/sites/default/files/documents/2022%20Invasive%20Carp%20Forum%20Slide%20Deck.pdf. Accessed September 2024.

[9] Ohio EPA, Ohio Brownfield Inventory Database, https://epawwwextp01.epa.ohio.gov:8443/ords/epaxp/f?p=109:1:0:. Accessed September 2024.

[10] Ohio DOD, Brownfield Remediation Program Guidelines, January 2024. https://development.ohio.gov/wps/wcm/connect/gov/3e191d68-7337-4318-83ef-26cb7675eb8a/20231109-FY24-Brownfield-Program-Guidelines-FINAL.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_79GCH8013HMOA06A2E16IV2082-3e191d68-7337-4318-83ef-26cb7675eb8a-p5cteyp. Accessed September 2024.

sites.[11] Additionally, the port was awarded an $800,000 grant from the US Environmental Protection Agency (US EPA) to capitalize a new site Remediation Loan Program (RLP). The goal of the RLP is to ensure that funding is available to properly clean up contaminated sites, return land to communities, and deliver a safer and healthier environment for Hamilton County residents.

2.3 Best Practices to Achieve Environmental Benefits: Climate

Mode and Port Diversion

Mode Shift Advantages

Ohio benefits from having strong access to all modes of freight transportation – highway, rail, air, pipeline, and both international and domestic marine transportation via the Great Lakes and inland waterway systems. This provides consumers and producers within the state options on how to transport their product providing a competitive advantage in terms of price but also the greenhouse gas (GHG) footprint of the movement. The transportation of goods along the Ohio MTS releases substantially less GHG per ton-mile as compared to truck or rail movements. Water vessels have a much larger cargo capacity than their landside modal counterparts allowing them to move large volumes of goods at a relatively lower price while benefiting the environment. The USACE notes that barges can move one ton of cargo 675 miles per gallon of fuel, whereas rail would move the same 472 miles per gallon, and trucks only 151 miles per gallon.[12] The spill rate for barges is substantially lower at 2.3 gallons per million ton-miles, compared to rail's 6.6 gallons per million ton-miles and trucks' 5.5 gallons per million ton-miles.[13] CO2 emissions for grams per ton-mile inland towing releases 9.3 times less CO2 than trucks and 1.4 times less CO2 than rail.[14]

Encouraging mode shift from rail and truck is also an important strategy to help reduce truck vehicle miles traveled (VMT) over Ohio's roadway system. Although marine terminals generate local impacts from short-haul trucks accessing the facilities, they eliminate longer-haul truck trips over the larger network. For example, one fifteen-barge tow can handle around 22,500 tons of freight, the equivalent of around 1000 trucks; over a 100-mile travel distance, each tow eliminates 10,000 truck VMT.

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[11] The Port, State of Ohio Assists the Landbank in Cleaning up Hamilton County, August 2024. https://www.cincinnatiport.org/state-of-ohio-assists-the-landbank-in-cleaning-up-hamilton-county/. Accessed September 2024.

[12] USACE St. Paul District, Fact Sheet 13: Comparing Navigation, March 2023. https://www.mvp.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/588155/fact-sheet-13-comparing-navigation/. Accessed September 2024.

[13] Waterways Council, Marine Log - Inland Waterways, April 2022. https://waterwayscouncil.org/file/422/MarineLogInlandwaterways_Apr_ML.pdf. Accessed September 2024.

[14] National Waterways Foundation. (2022). *A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001–2019*. Retrieved from https://www.nationalwaterwaysfoundation.org/file/28/tti%202022%20final%20report%202001-2019%201.pdf

Multimodal Considerations

The diversion of goods onto the MTS with proper supply chain planning with other modes makes the MTS a great means to combat the effects of climate change – provided that shippers and receivers have effective access to the MTS. Users who are not located directly on water require effective inland connections via the state's highway, rail, and pipeline systems. Siting ports and port expansion projects where they can be effectively served by networks, ensuring those networks perform effectively, and building sufficient space for modal transfers into marine terminals, can facilitate multi-modal connectivity and encourage mode shifting to the MTS.

Inland Ports and Logistics Hubs

An emerging trend for the MTS nationally is the growing integration of marine terminals with inland logistics hubs, planned and implemented specifically to (a) collect goods from inland shippers (typically by truck) and move them efficiently to selected ports (typically by rail) for shipment, (b) distribute goods to inland receivers (typically by truck), after receiving them from ports (typically by rail). They combine transportation facilities and accessibility with space for warehouse/distribution, manufacturing, and other logistics functions. Examples of this type of inland port have been well-established in Alliance, TX where the port is roughly the size of Manhattan and by far the largest in the US. Similar inland ports have also been developed in Front Royal, VA, Greer, SC, and throughout Georgia. While inland ports were initially conceived to link coastal ports to inland destinations, newer concepts – such as the "I-64 Express" in Virginia – link coastal and inland ports via barge in lieu of rail.

In Ohio, the Columbus Rickenbacker Inland Port links international air cargo service with two Class I railroads and trucking. While it has not been marketed as a means of handling marine cargo, some share of its rail and truck cargo is related to port activity. Given its strategic location within central Ohio, accessibility to Lake Erie and the Ohio River, and ability to serve and distribute to markets between the East Coast and Mississippi River, its potential to more directly support and serve Ohio MTS operations should be explored.

Figure 6: Proximity of Rickenbacker Inland Port to North American Freight Destinations

Source: Rickenbacker Inland Port, Workforce Access Improvements, October 2017. https://www.morpc.org/wordpress/wp-content/uploads/2017/12/101617Narrative_Rickenbacker.pdf#:~:text=Located%20in%20Central%20Ohio,%20the. Accessed September 2024.

Innovative MTS Uses

Supply chains are ever-changing. Maritime transportation could play a part in providing innovative solutions to address these changes. Expanding the use of the MTS to innovative cargo types is a means to expand its use and provide greater modal diversion benefits. One example is the Port of Cleveland's container service to Europe. Established in 2014 the Port of Cleveland is the only transatlantic container service on the Great Lakes currently operating, allowing for both import and export cargo. Another use of the MTS is for oversized and overweight cargo. Recently, Intel utilized barges to ship large heavy equipment to be installed in their semiconductor manufacturing campus, in New Albany, OH. These pieces of heavy equipment were shipped up the Mississippi River and Ohio Rivers where they were unloaded and moved by truck to their final destination. Similar efforts are taking part across the Midwest – for example in Illinois, stacks of windmill blades are being loaded onto barges and moved to an unloading facility near the installation site.

Terminal Emissions

The MTS includes terminals, which require supporting infrastructure in the form of cranes, conveyors, yard vehicles, warehouses, administrative buildings, and roadway and rail infrastructure. This supporting infrastructure also contributes to the environmental footprint in terms of GHG emissions. Throughout the world, ports and terminal operators have taken steps to reduce the carbon footprint of their terminal operations. These strategies include diversifying their energy sources, upgrading equipment, and retrofitting their structures to be more environmentally friendly.

Terminal Renewable Energy

Utilizing renewable energy can be a means for terminal operators to become energy self-sufficient lowering their energy costs while at the same time reducing their carbon footprint. Terminal operators can do so via a few methods including the installation of windmills and solar panels. The Port of Rotterdam in the Netherlands has taken bold steps to become a CO_2-neutral port by utilizing many strategies one of which is converting their energy supply to renewable and $C0_2$-neutral options. The port has and is constructing offshore wind farms that by 2030 will provide 7.4

Figure 7: Port of Los Angeles Solar Panel Installation

Source: Los Angeles Times, Ocean Tech Hub Makes Waves in San Pedro, May 2024.

Gigawatts of renewable energy.[15] Similarly, the Port of Los Angeles has taken steps to reduce its reliance on fossil fuels. To date, the port has installed nearly 3 Megawatts of photovoltaic solar power systems within the port across many sites including on terminal warehouses (Figure 7), individual dedicated sites, and near parking lots.[16]

The Port of Cleveland is currently reconstructing its Warehouse A with the capability for installation of solar panels. They are also working to support offshore wind installation with the six-turbine Icebreaker Wind project, although the project is currently on hold.[17]

Non-Diesel Terminal Equipment

Terminal equipment is an important part of terminal operations and contributes to greenhouse gas emissions. Historically these pieces of equipment were diesel powered contributing to the operation's carbon footprint. However, other power sources for terminal equipment are available and widely used by terminal operators.

The Port of Savannah has undergone extensive transformation to switch its diesel-powered equipment to more carbon-neutral options. It electrified its massive ship-to-shore cranes, converted refrigerated racks to electricity (cold storage), converted their rubber-tired gantry cranes to electric, and converted eighty-six diesel-powered forklifts to propane.[18] It was able to do this in part to a USDOT Advanced Transportation Technologies and Innovation (ATTAIN) grant award of $7.5 million.[19] The ATTAIN program provides competitive grants to deploy, install, and operate advanced transportation technologies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment.

In 2023, Midwest Terminals, which operates the general cargo docks at the Port of Toledo, began using the first battery electric railroad switching locomotive in the country, converting it from diesel fuel. Midwest Terminals is now converting a second diesel engine to battery electric power. In 2024, the Port of Cleveland

[15] Port of Rotterdam, A New Energy System, N.D. https://www.portofrotterdam.com/en/port-future/energy-transition/a-new-energy-system. Accessed September 2024.

[16] Port of Los Angeles, Solar Power, N.D. https://www.portoflosangeles.org/environment/sustainability/solar-power. Accessed September 2024

[17] Port of Cleveland, Delays Lead to Pause on Lake Erie Wind Turbine Project, December 2023. https://www.portofcleveland.com/challenges-delays-lead-to-pause-on-lake-erie-wind-turbine-project/#:~:text=Cleveland%20%E2%80%93%20December%208,%202023%20%E2%80%94%20Citing%20considerable%20challenges%20and. Accessed September 2024.

[18] USEPA, Georgia Ports Authority Reduces Diesel Emissions, Improves Efficiency, and Saves Costs, May 2024. https://www.epa.gov/ports-initiative/georgia-ports-authority-reduces-diesel-emissions-improves-efficiency-and-saves.

[19] FHWA, Fact Sheet - Advanced Transportation Technologies and Innovation, https://www.fhwa.dot.gov/bipartisan-infrastructure-law/attain.cfm

allocated more than $32 million in funding to modernize its electrical feed system to support charging for electric terminal vehicles, switch locomotives, cranes, and other improvements.

Structure Energy Efficiency

Aside from large capital-intensive projects noted (e.g., wind turbines, solar panels, electric switchers), there are other less capital-intensive steps a terminal operator can take to help reduce their carbon footprint. The Port of Seattle has done so by upgrading all building lighting to highly efficient LED lamps. This was done by conducting a lighting audit to understand the existing lighting within the Port and retrofit them with LED lighting. In addition to helping reduce greenhouse gas emissions, LEDs help reduce energy costs for the port and tenants.[20]

Vessel Emissions

Vessels are critical to facilitate the movement of goods and passengers along the Ohio MTS. While per-ton miles vessels have a lower emissions footprint than other modes of transportation they still contribute significantly to air pollution and GHG emissions. Traditionally both ocean-going and inland barges have been powered by diesel engines. In recent years carriers have taken steps to retrofit these vessels to utilize alternative types of fuels and provide strategies to incentivize these efforts. Likewise, innovative technologies have been used to modify vessels to be more fuel-efficient.

LNG/Dual Fuel Vessels

Converting vessel engines is one means of reducing a carrier's GHG emissions. Companies have begun converting, retrofitting, and procuring vessels powered by liquefied natural gas (LNG) or having them capable of operating on dual fuels. For example, Matson Lines has installed LNG fuel tanks, associated piping, and other conversion equipment on their newest vessels, allowing the use of different fuels depending on where they operate. Matson's conversions are expected to reduce their CO_2 emissions by 24 percent.[21]

[20] Explore Seattle Southside, The Power of LED: Reduced Emissions, Lower Costs, Longer Life, N.D. https://www.seattlesouthside.com/media/press-releases/the-power-of-led-reduced-emissions-lower-costs-longer-life/

[21] Matson, LNG Conversions Next in Long Term Climate Strategy, 2022. https://www.matson.com/corporate/inside-matson/lng-conversions-next-in-long-term-climate-strategy.html. Accessed September 2024.

Electric Vessels

Strides in electric propulsion and battery technology have led some operators to convert their vessels to electric propulsion or purchase new electric-powered vessels. Electric propulsion has the benefit in that it reduces GHG emissions and protects water quality. In 2023, the Mackinac Island Ferry Chippewa in Michigan began the process of converting its two-diesel-powered engines to electric-powered engines. Over the ferry's life, it is expected that emissions will be reduced by 14,120 metric ton CO2 equivalents and 887 metric tons of nitrogen oxides.[22]

Alternative Fuel Towboat Engines

Towboat operators on the inland waterways are also exploring options to utilize lower-emission engines to reduce their environmental footprint. Companies like Caterpillar have taken steps to produce engines that can operate on methanol or a methanol/diesel blend. Methanol is an alternative biofuel that is produced from a variety of feedstocks, gas, coal, biomass, and even carbon dioxide. Converting conventional diesel engines to be able to run with alternative fuel will help reduce a carrier's emissions. The potential for all-electric towboats is uncertain, in part because of the long duty cycles for these vessels (long trips with no time or place to stop and charge) but all-electric boats for shorter-haul use, as well as other alternative fuels, could be promising. For example, the Great Lakes Towing Company has produced diesel-electric hybrid harbor tugs.[23]

Low-Emission and Slow-Steaming Vessel Call Incentives

Vessels operate less efficiently and burn more fuel when they are cruising at higher speeds. These higher speeds lead to more emissions for the vessel. Slow steaming is when a vessel deliberately reduces its cruising speed to save fuel and reduce emissions. The Port of New York & New Jersey has a Clean Vessel Incentive Program which encourages carriers to slow steam and make voluntary engine, fuel, and technology enhancements that reduce emissions beyond regulatory environmental standards.[24] Figure 8 shows a map that calls for vessels to slow steam 20 nautical miles from the port. Based on the program's tier level of compliance, a carrier can receive up to $8,000 per call. Establishing incentive programs is a means by which a port can improve its environmental stewardship and the quality of life of residents near the port.

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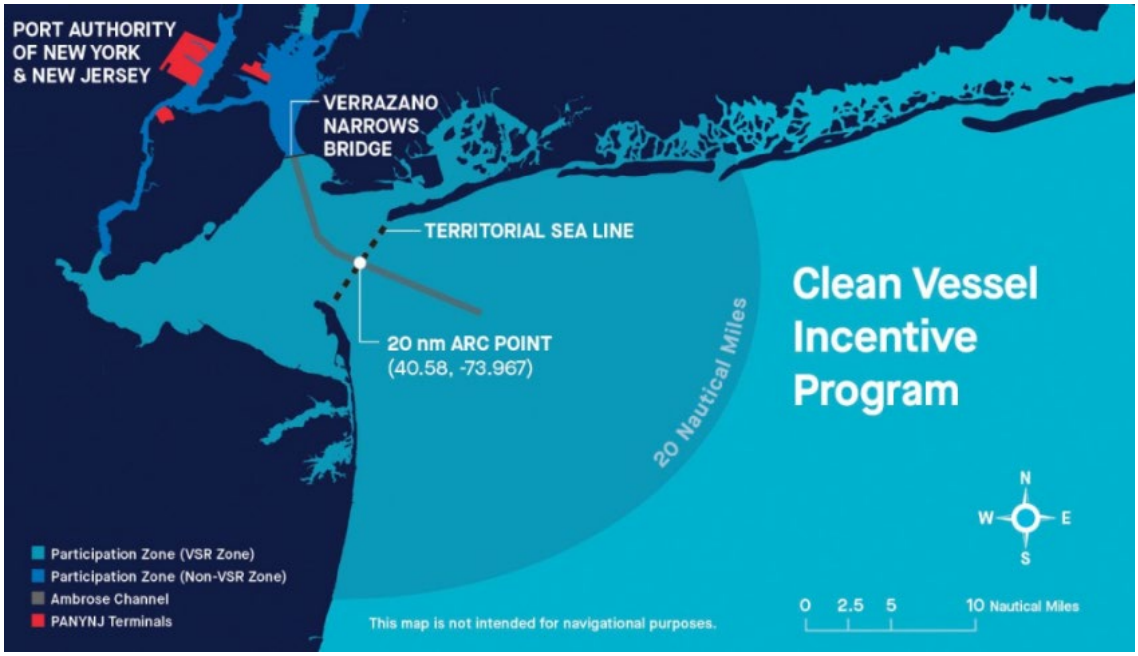
[22] Arnold Transit Company. "Mackinac Island Ferry Chippewa Set for Electric Transformation with EGLE Grant." *Arnold Transit Company*, 2025. https://www.arnoldtransitcompany.com/mackinac-island-ferry-chippewa-set-for-electric-transformation-with-egle-grant/

[23] Green Marine, "A third new hybrid tug for the Great Lakes Towing Company," July 24, 2019, https://green-marine.org/stayinformed/news/a-third-new-hybrid-tug-for-the-great-lakes-towing-company/. Accessed February 2025.

[24] World Ports Sustainability Program, Port Authority of NY & NJ Clean Vessel Incentive Program, 2019. https://sustainableworldports.org/project/port-authority-of-ny-nj-clean-vessel-incentive-cvi-program/. Accessed September 2024.

Figure 8: Port of New York & New Jersey Slow Steaming Map

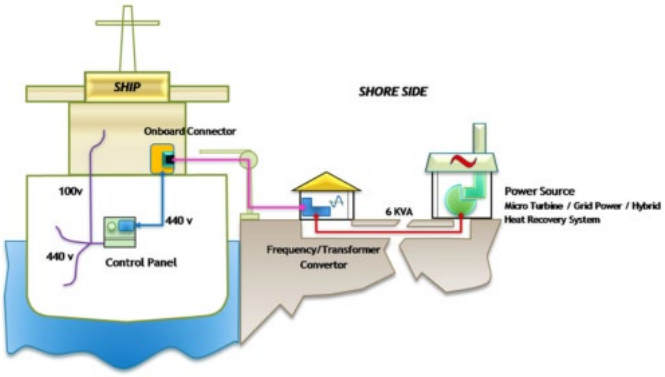


Source: American Journal of Transportation, The Port of NY and NJ Recognizes Companies for Emission Reduction Effort, April 2024. https://www.ajot.com/news/the-port-of-ny-and-nj-recognizes-companies-for-emission-reduction-effort

Vessel Shore Power

When docked, vessels at port typically use their auxiliary engines to generate power activity. With many of these vessels operating on diesel engines this leads to unnecessary emissions. Ports can assist with reducing this process by providing vessel shore power. Vessel shore power is the practice of the port providing an electrical connection to the ship. This allows the vessel to turn its diesel engines off and utilize the port power source which can be from onsite generation or through the electrical grid as shown in Figure 9. Ports are responsible for installing the landside infrastructure, while carriers are responsible for the shipside modifications. The Port of Long Beach

Figure 9: Vessel Shore Power Example



Source: Wikipedia, Cold Ironing, https://en.wikipedia.org/wiki/Cold_ironing

in California utilizes this practice which cuts air pollution from ships at berth by 95 percent.[25] The Port of Cleveland has applied for $95 million in US EPA Clean Ports Program grant funding, which would in part fund shore power for vessels to utilize while at berth.

Low Friction Bottom Coatings

Low friction bottom coating is one means to help improve a vessel's fuel efficiency to lower greenhouse gas emissions. The coating minimizes the friction between the vessel' hull and the water improving its efficiency. Japanese-based Mitsui O.S.K Lines has adopted low-friction ship paint derived from natural material. This coating reduces the vessel's fuel consumption by 4 percent.[26] Additionally, many of these coatings have antifouling properties that prevent marine organisms from attaching to the vessel's hull providing an additional benefit.

Drayage Truck Emissions

Drayage trucks are specialized vehicles used to move containers or bulk freight over short distances, either within a terminal property or between a terminal and a nearby outside location. These trucks are a critical component of the terminal operations and without them, the movement of goods via the MTS would be difficult. Historically, at most ports, these vehicles tended to be the oldest and most polluting trucks in the service fleet. A New York study found that drayage trucks produce between 25-43 percent of port-related nitrogen oxide emissions.[27] However, there have been extensive and successful efforts to retire the older vehicles with more fuel-efficient trucks and even zero-emissions trucks.

Retirement of Older Trucks

Alternative proportion method technology has improved over the years and is now a viable alternative to traditional diesel engines. Electric trucks and hydrogen fuel cells provide an emissions-free fuel type, especially applicable to drayage trucks that do not need to travel long distances and are stored on-site. The State of California through Caltrans has a hybrid and zero-emission truck and bus voucher incentive program (HVIP) that aims to encourage users to either purchase or convert existing trucks to alternative energy types, as shown in Figure 10. Through this program, a total of $71 million has been set aside specifically to support drayage trucks. Additionally, the Ports of Long Beach and Los Angeles have added $60 million to support trucks that operate

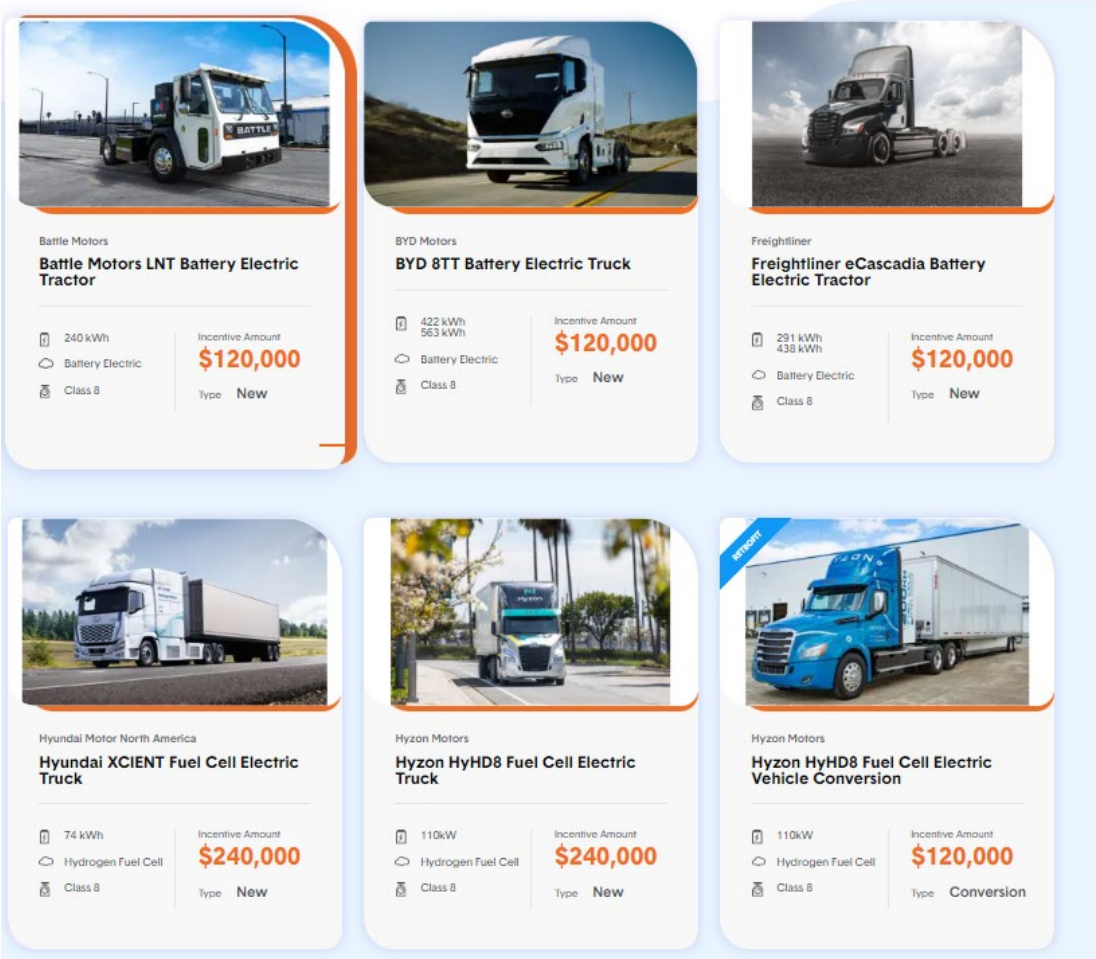
[25] Port of Long Beach, Shore Power, N.D. https://polb.com/environment/shore-power/#shore-power-program-details. Accessed September 2024.

[26] Mitsui OSK Lines, MOL Adopts Low-friction Ship Bottom Paint on a New PCTC for the First Time, November 2010. https://www.mol.co.jp/en/pr/2010/1052.html. Accessed September 2024.

[27] National Renewable Energy Laboratory, Port of New York and New Jersey Drayage Electrification Analysis, December 2022. https://www.nrel.gov/docs/fy23osti/83400.pdf. Accessed September 2024.

at their facility. The ports help fund the $60 million via the Clean Truck Fund (CTF) which is done by collecting a $10 per twenty-foot equivalent unit from cargo owners on loaded containers entering and exiting the ports.[28] The CTF also encourages the use of alternative trucks by exempting trucks hauled by zero-emission trucks. These programs provide up to $240,000 in the form of a voucher for the purchase or conversion of a truck.

Figure 10: HVIP Tractor Vehicle Inventory



Source: Energy Central, Electric Trucks and Buses in California, March 2022. https://energycentral.com/system/files/ece/nodes/534983/electric_trucks_and_buses_in_ca.pdf

[28] Port of Long Beach, Ports of Long Beach, Los Angeles to Make $60 Million Available for Zero-Emissions Trucks, November 2023. https://polb.com/port-info/news-and-press/ports-of-long-beach-los-angeles-to-make-60-million-available-for-zero-emissions-trucks-11-09-2023/. Accessed September 2024.

On-Terminal Electric Truck Charging

The Port of New York & New Jersey in partnership with the National Renewable Energy Laboratory and several port tenants conducted a study examining drayage truck electrification at the port. The study found that most of the drayage trucks could realistically switch over to electric vehicles with the average truck driving 140 miles per day with a maximum daily distance of 573 miles. The study found that 9 percent of energy used by the trucks was idling which would not be the case for an electric vehicle.[29] Any effort to substantially increase the use of electric drayage trucks would require investment in the port's charging infrastructure. In 2024, the Port of Long Beach began construction of a charging depot capable of powering 44 heavy-duty electric trucks simultaneously in about 90 minutes.[30] These types of investments will encourage tenants to switch their fleets over to electric vehicles reducing their carbon footprints and providing energy cost savings.

2.4 Best Practices to Achieve Environmental Benefits: Communities

Truck Routing & Management

The movement of trucks into and out of a port or terminal plays an important role in the vehicle emissions of the operations. Congestion into and out of a terminal can lead to higher idling time and increased and unneeded emissions. Truck routings that pass through sensitive neighborhoods can place burdens on these communities. Having proper truck routing and management is a means of controlling truck traffic which can help reduce emissions, improve efficiency, and protect communities.

Truck Management and Routing Plans

Truck management plans are a means for ports and terminal operators to examine their current conditions, look at anticipated growth, and create a strategy for how to address existing and anticipated areas of concern. These plans can focus on multiple issues including air quality, safety and security, community, and operations. An example of one of these plans is the Port of Oakland's Maritime Comprehensive Truck Management Program (CTMP). A core component of the CTMP was addressing the issue of traffic and congestion. Basic roadway improvements were identified to improve circulation and proper signage to inform drivers and where to go and fines associated with idling. Additionally, truck management plans also include time-of-day plans which examine when trucks are most prevalent and work with tenants to identify how loads can be picked up or dropped off in non-peak

[29] National Renewable Energy Laboratory, Port of New York and New Jersey Drayage Electrification Analysis, December 2022. https://www.nrel.gov/docs/fy23osti/83400.pdf. Accessed September 2024.

[30] Port of Long Beach, Construction Begins on Truck Charging Depot at Port, May 2024. https://polb.com/port-info/news-and-press/construction-begins-on-truck-charging-depot-at-port-05-15-2024/. Accessed September 2024.

hours. These strategies can help reduce emissions and improve the quality of life of residents in the surrounding communities.

Planning for access improvements can also consider community-sensitive truck routing. For example, planning for the replacement of the Willow Avenue Lift Bridge, an important truck connector for the Port of Cleveland, includes options that would re-route traffic away from the adjacent Lakeview Terrace community.

Rail Grade Crossings

Rail grade crossings are conflict points between the roadway and rail line which can lead to negative effects on communities. Two key issues related to these crossings are safety and congestion. When these modes intersect safety is a prime concern in the US each year there are more than 2,000 incidents and 200 fatalities at grade crossings.[31] Additionally, trains often block grade crossings leading to congestion and delay resulting in increased emissions and reduced accessibility for community residents and emergency services.

Grade Crossing Elimination Programs

The elimination of grade crossings can be a costly and complex undertaking requiring coordination from multiple partners including the terminal operator, the roadway owner, and the railroad itself. That said, there are many State and Federal programs in place to assist with the associated costs of eliminating grade crossings. The Ohio Rail Development Commission (ORDC) is administrating the Ohio Grade Crossing Elimination Program which provides $100 million to assist Ohio in competing for grade crossing elimination grant funding from the Federal Railroad Administration's Railroad Crossing Elimination Program (RCE). The RCE is a federal grant program that provides funding for highway-rail or pathway-rail grade crossing improvement projects that focus on improving the safety and mobility of people and goods. Eligible projects under the RCE program include grade separation or closure, track relocation, improvements or instillation of improved safety related to a separation, closure or track relocation projects, planning, environmental review, and design of an eligible project type.[32]

[31] Federal Railroad Administration, Highway-Rail Grade Crossing Safety, N.D. https://railroads.fra.dot.gov/railroad-safety/divisions/highway-rail-crossing-and-trespasser-programs/railroad-crossing-safety

[32] Federal Railroad Administration, Railroad Crossing Elimination Grant Program, N.D. https://railroads.dot.gov/grants-loans/railroad-crossing-elimination-grant-program#:~:text=Overview%3A%20This%20program%20provides%20funding,mobility%20of%20people%20and%20goods. Accessed September 2024.

Noise/Dust/Lighting

The communities surrounding a terminal or port facility can pose challenges for residents and businesses located near them these challenges include noise, dust, and lighting. These can lead to health and quality of life effects and affect property values. Various measures can be implemented to address the concerns of the surrounding community.

- Noise can harm the surrounding population disturbing the quality of life of the community. Facility operators can help manage the effects of noise by monitoring sound and soundproofing structures and equipment, and by upgrading to newer and quieter equipment where possible.
- When receiving or shipping commodities many times they produce dust which can negatively affect the surrounding communities' air quality. Facility operators should consider installing dust suppression systems or enclosed conveyors/storage. In Coruña Spain the port enclosed its coal storage (see Figure 11) and reduced airborne particulates by 90 percent. Additional strategies to reduce the effects of dust include vegetation buffers and regular cleaning of the facility.
- To minimize the effects of light pollution on the surrounding communities there are several strategies facility operators can implement. Directional lighting can be installed to position lighting away from the outside communities, directional light shields can be installed, or selective lighting systems could be investigated. The Port of HaminaKotka in Finland installed a selective light control system in port areas which helps reduce lighting effects. Each lighting mast has 9-24 lights which are connected in three groups so each mast can be controlled in three parts. The system takes into consideration the time of day and turns on groups accordingly and when needed for operation.

Figure 11: Medusa Coal Terminal

Source: Google Images

Water and Land Use

Ohio's navigable waterways are important not only for freight movement but also for recreation, tourism, ecology, marinas and boat services, and passenger transportation. Many strategies can support the successful co-development of diverse cargo and non-cargo water uses. Throughout the world, ports utilize their land for other uses aside from their purposes of freight commerce. Spaces can be developed as public open spaces, parks, community centers, tourist attractions, bicycle trails, fishing, housing, and retail/commercial. These non-cargo water and land uses provide the surrounding community with quality-

of-life benefits and in many cases generate positive revenue streams for ports while contributing to positive overall environmental benefits for their communities.

Designated Recreational Boating and Swimming Areas

Designated recreational boating and swimming areas are a strategy used by the Port of San Diego to allow non-freight users to safely utilize the water while at the same time supporting freight commerce. The port supports recreational use of San Diego Bay by maintaining launch ramps, guest docks and anchorage, fuel docks, parks, and swimming and boating areas within the bay. San Diego Harbor Police patrol the bay, ensuring safe use and compliance with all laws including use of appropriate areas.

Wetland and Habitat Restoration

Figure 12: Port of Oakland Middle Harbor Enhancement Area

Source: Port of Oakland, Middle Harbor Shoreline Park, N.D. https://www.portofoakland.com/community/waterfront-recreation/middle-harbor-shoreline-park/

While the port's main purpose is to support freight commerce, they also have been participants and strong advocates for wetland and habitat restoration projects. Efforts by ports have included donating land, providing financial resources, incorporating habitat restoration in their projects, and advocacy. Through this process ports often receive environmental mitigation credits to allow for future development in other areas. The Port of Long Beach has actively been involved in restoring the Colorado Lagoon providing $28.6 million to improve the water and habitat quality in Long Beach.[33] As part of its 2000, $1.2 billion, capital expansion plan the Port of Oakland included 181-acre creating a shallow water fish and wildlife habitat area reusing 4 – 6 million cubic yards of sediment from the Oakland Harbor channel deepening as shown in Figure 12.[34]

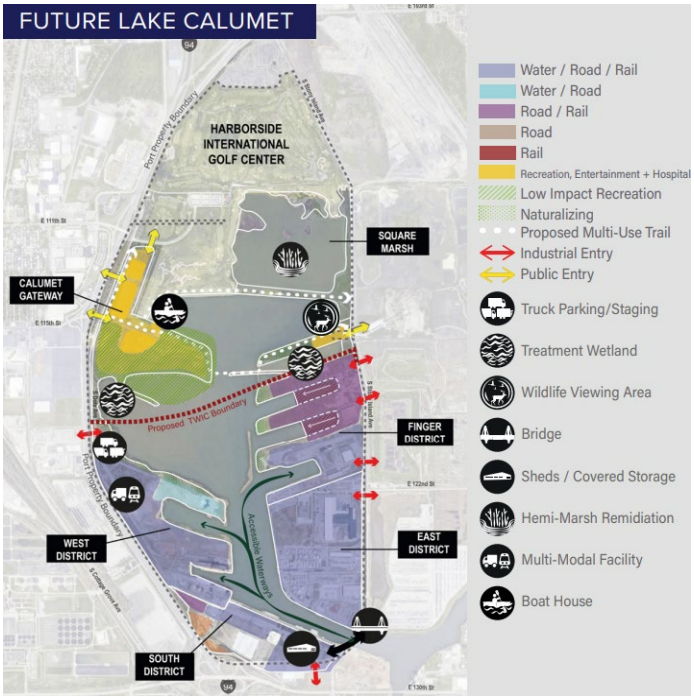
[33] Port of Long Beach, Port Agrees to Fund Colorado Lagoon Upgrades, July 2019. https://polb.com/port-info/news-and-press/port-agrees-to-fund-colorado-lagoon-upgrades-07-11-2019/.

[34] PIANC World Congress Panama City, Port of Oakland's Vision 2000 Middle Harbor Basin Projects, 2018. https://coms.events/pianc-panama/data/full_papers/full_paper_295.pdf

Integration of Natural Preserve Areas

When developing a new port/terminal, or expanding an existing location, natural areas can be integrated into their design. One example of this is at the Port of Cleveland. Between 1979 and 1999 the USACE placed dredged sediment in a confined disposal facility (CDF) called Dike 14. After the USACE stopped using the site as a CDF natural foliage and wildlife took hold and today it is known as the Cleaveland Lakefront Nature Preserve.[35]

Figure 13: IIPD Future Uses



Source: Illinois International Port District Master Plan, November 2021

The Illinois International Port District (IIPD) designated a 138.6-acre open-water marsh conservation area within Lake Calumet to be preserved as a wildlife habitat. IIPD has included the preservation within their master plan with the vision to continue remediation of Square Marsh to encourage the development of a hemi-marsh as shown in Figure 13. Integrating nature preserves is a significant means for MTS facility owners and operators to provide environmental benefits to their communities.

Alternative Land Uses

Land use strategies for port and terminal operators can vary for owners based on a variety of circumstances including the amount of land they use, the characteristics of the surrounding community, and financial means. A key characteristic that all the locations share is their location on the MTS which is highly attractive for the development of other uses. Below are some of the strategies that have been used by operators around the country.

- **Open Public Space** – The Port of Cleveland is working with key stakeholders and agencies to assemble $45 million to restore the Irishtown Bend shoreline and adjacent hillside. The plan includes creating the Irishtown Bend Park a 25-acre green space that will connect downtown and Cleaveland's

[35] Port of Cleveland, Field Guide, https://www.portofcleveland.com/cleveland-lakefront-nature-preserve/field-guide/. Accessed September 2024.

neighborhoods to the Cuyahoga River.[36] The project will also develop a trail connecting Lake Erie to the Cuyahoga Valley National Park and areas south on the 101-mile Towpath trail.

- **Fishing** – The Port of Seattle and the Department of Fish and Wildlife help maintain piers popular among anglers for fishing. Recently they have been collaborating on restoring Pier 86 which was closed in 2017 due to safety concerns. Providing safe locations for fishing adds value to the quality of life of residents and can revitalize the area.
- **Bike and Pedestrian Paths** – Integrating bicycle and pedestrian paths along port property can help connect the community providing a safe location to bike and improving residents' health. These paths can be developed in conjunction with open public spaces such as parks and green spaces. To encourage effective planning port owners should engage community stakeholders.
- **Commercial/Residential Development** – Ports with additional land unsuitable for freight commerce can be used for commercial and residential development. This allows the owner to diversify their assets, add economic benefits, and provide an alternative revenue stream. America's Central Port near St. Louis owns and maintains roughly 150 townhomes and apartments. The Port also owns land along a major roadway exploring options for retail development.[37]

2.5 Best Practices to Achieve Sustainability and Resilience: Operations

Vessel Loading, Fleeting, and Navigation

Vessel loading, fleeting, and navigation infrastructure are critical components of maritime operations, allowing for the efficient and safe movement of goods. This infrastructure requires continued maintenance and if it goes into disrepair can hinder port/terminal operations and business supply chains. Climate change has added stress to this infrastructure with dramatic changes in water levels due to intense floods and drought which affect water levels. Proper maintenance, and strategies supporting that maintenance are necessary to provide minimally interrupted operations.

Monitor and Model Hydrological Data

The monitoring and modeling of hydrological data is important for port/terminal operators to ensure smooth operations. Monitoring hydrological levels includes the collection of data on water levels, flow rates, and other parameters using sensors and gauging stations. This data helps detect changes in water levels allowing for the management of water resources and provides information for vessel operators. Hydrological modeling uses the data collected to

[36] Port of Cleveland, Irishtown Bend, https://www.portofcleveland.com/irishtown-bend/. Accessed September 2024.

[37] Rivers Edge Apartments, Housing Options at America's Central Port, https://www.riversedgeapts.com/. Accessed September 2024.

simulate water levels and movements predicting future conditions. These two approaches allow proper planning for infrastructure maintenance and improvements.

Vessel Sensors

Sensors on vessels can help provide real-time data regarding water conditions which can be shared with other vessels and officials to inform them of navigation conditions. This technology is used by workboats within the Port of New Orleans providing vital insight into water depth, currents, and visibility.[38] Additionally, the sensors can provide information on sediment buildup which can impede navigation. The data combined with forecasting tools helps the port become more efficient and resilient to changing water conditions.

Dredging Schedules

Dredging navigation channels is an important task in ensuring the MTS system can operate smoothly. Along the river and certain approach channels the USACE is responsible for dredging and maintaining an appropriate channel depth. However, within ports and terminal approaches, the port/terminal operator is responsible for the maintenance of those sections. Maintaining a proper dredging schedule based on current, historical, and forecast data is important to provide safe conditions for vessels. This schedule coupled with forecast water levels can help ports/terminals accelerate dredging in advance of lower water events. Careful scheduling (taking into consideration the breeding seasons of aquatic species) of dredging activities combined with other best practices can reduce aquatic organism impacts from dredging.

Dredging Depths

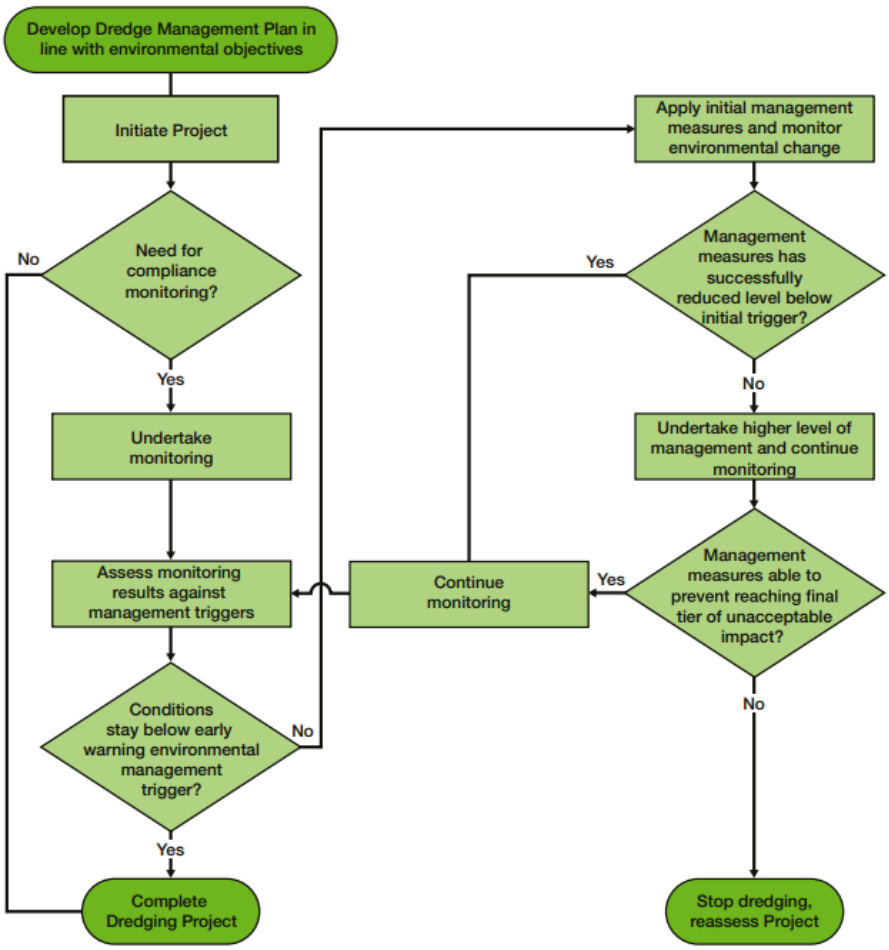
As climate change affects water levels, a strategy to combat lowering water depths is to add buffer depths to the dredged channels. When conducting regular dredging deeper channels should be dredged to anticipate lower water levels. By adding a dredged buffer, port/terminal operators can reduce the costs of emergency dredging in the event of unforeseen low water levels. Likewise, the added buffer will reduce the likelihood of closure of the channel due to low water events and supply chain effects.

[38] The Water Institute, Sensor Data Helps Ports Ensure Efficient Navigation, June 2021. https://thewaterinstitute.org/media/in-the-news/sensor-data-helps-ports-ensure-efficient-navigation.

Adaptive Dredging Process

Adaptive Dredging is the process that conducts dredging in a manner that takes into consideration environmental factors, socioecological restrictions, and stakeholder feedback to perform dredging. The process develops a framework that is organized to be transparent to assist in the dredging process. Conducting adaptive dredging is done by following guidelines to ensure all environmental considerations are taken into account. The guidelines are listed in Figure 14, which shows the steps for an adaptive dredging management plan.[39]

Figure 14: Adaptive Management in a Dredging Project



Source: Central Dredging Association, Integrating Adaptive Environmental Management into Dredging Projects, March 2015. https://dredging.org/media/ceda/org/documents/presentations/webinars/cedawebinar-adaptivemanagement-vanraalte-2016-01-19.pdf

[39] EcoShape, Adaptive Monitoring and Execution of Dredging Operations, 2024. https://www.ecoshape.org/en/knowledge-articles/adaptive-monitoring-and-execution-of-dredging-operations/

Maintaining Terminal Operations

The maintenance of landside port/terminal infrastructure is crucial for ensuring the safety, efficiency, and longevity of the infrastructure and equipment. Regular maintenance helps prevent accidents and equipment failure which can lead to costly delays and negatively affect the natural environment. This upkeep helps increase the operational life of the infrastructure and equipment reducing long-term costs of replacement. Additionally, this ensures the operation is in line with regulatory standards promoting a safer MTS.

Asset Management Plan

Having a proper well-documented asset management plan is an important strategy to ensure that all assets are maintained efficiently and effectively throughout their lifecycle. By having a plan in place port/terminal operators can help reduce long-term costs and unexpected breakdowns. The following steps should be taken in a proper asset management plan:

- **Asset Inventory**: Create a comprehensive list of all equipment and assets that require maintenance.
- **Condition Assessment**: Regularly evaluate and document the state of each asset.
- **Maintenance Strategy**: Based on the condition assessment implement preventive, predictive, and corrective maintenance strategies for each asset. Strategies will vary depending on the specific asset.
- **Resource Allocation**: Assign personnel and document who is responsible for each asset and what kind of tools and materials are required for maintenance.
- **Scheduling**: Develop a maintenance schedule that will minimize the disruption of port/terminal operations. Conduct this maintenance in off-peak hours or less busy times of the year.
- **Performance Monitoring:** Monitor the asset and document its performance to identify potential issues to optimize maintenance.
- **Document and Reporting**: Keep detailed records of all maintenance activities to inform financial and personnel needs of the assets. Conduct annual or bi-annual reviews of these records to plan activities accordingly.

Infrastructure Resiliency Five-Step Planning

Climate change affects ports and terminals due to their position along the MTS. However, steps can be taken to plan for a more resilient system. General strategies are listed below, although their specific application will differ depending on local factors.

- **Risk Identification**: Identify climate-related risks which are rising lake and river levels, increased storm frequency, and extreme weather events. This will require examining historical climate data and projecting future changes to understand the potential threat to infrastructure and operations. Existing research on the risks of climate change to Lake Erie and the Ohio

River already exists, including the Great Lakes Integrated Sciences and Assessments summary of climate effects on Lake Erie and USACE's study on risk impacts on the Ohio River basin.[40]

- **Vulnerability and Impact Assessment**: Utilizing the information gathered in the risk identification assess the vulnerabilities of port/terminal assets which builds upon the documentation from an existing asset management plan.
- **Response and Mitigation Options**: Based on the risk identification and vulnerability impact assessment proactively develop options on how to mitigate or respond to the impact. These countermeasures could include elevating critical infrastructure, strengthening infrastructure, or adding redundancies to reduce the impact.
- **Prioritization**: Prioritize risks and mitigation measures based on their likelihood to impact operations. This will allow the port/terminal operator to allocate resources efficiently to address the most critical vulnerability first.
- **Implementation and Action**: Execute the mitigation countermeasures and monitor their effectiveness over time. Additionally, communication and training with staff should be undertaken to help them better understand and identify potential risk impacts.

Energy and Utility Redundancies

Energy and utility redundancies are critical to ensure that a port/terminal can continuously operate in the event of power outages or utility failure. By implementing one or multiple of these strategies ports/terminals can reduce the severity of outages. Strategies for these include:

- **Backup Generators**: Backup generators can supply power for an extended period during a power outage. These generators are typically diesel or natural gas-powered.
- **Renewable Energy Sources**: Ports/terminals can install solar and wind to have onsite energy generation in the event of a power outage.
- **Energy Storage System**: Battery storage systems can store excess energy which can be used during an outage, they can be paired with onsite renewable energy to ensure batteries can be recharged even with the grid is still down.

[40] Great Lakes Integrated Sciences and Assessments, Lake Erie Prospective, September 2022, https://glisa.umich.edu/wp-content/uploads/2022/09/Erie_Prospective_Report_2022.pdf; USACE and Ohio River basin Alliance, Ohio River Basin, May 2017. https://spcwater.org/wp-content/uploads/2020/01/USACE_ClmtChng_2017-1.pdf.

Landside Access

Maintaining road and rail access is vital to ports/terminals to ensure the efficient movement of goods and minimize supply chain disruptions. These assets require periodic maintenance to reduce any issues accessing the facility, as well as advance planning to make them more sustainable and resilient in the face of risks.

Capacity and Service Improvements

A terminal or port should, through its asset management plan, maintain regularly scheduled maintenance of its road and rail infrastructure. In addition, a facility should expand road and rail infrastructure to accommodate future growth if warranted. However, when expanding infrastructure, outreach should be done with the surrounding communities to ensure their concerns are considered.

Multiple Modes and Route Options

Facility operators should explore integrating other modes of transportation into their location. For example, if there is a nearby rail service the facility should examine if adding a rail spur would be warranted. Diversification of transportation options can help the facility in multiple ways. First, it can help retain existing customers by providing a cheaper alternative mode of transportation and even expanding their customer base who would otherwise not use the facility. Second, adding rail or pipeline service reduces GHG emissions compared to trucks. Third -- and most important for sustainability and resiliency – it provides other access options in the event service by one mode is interrupted. Similarly, for highway access, it is highly desirable to have at least two viable truck access points and inland connecting corridors for each facility, for redundancy.

2.6 Best Practices to Achieve Sustainability and Resilience: Climate

Water Level, Wind, and Temperature Extremes

The changing climate can have extreme effects on water levels, wind, and temperatures which can affect marine transportation and the infrastructure that supports it. Rising water levels increase the risk of flooding within the MTS affecting facility operations. Extreme storms can cause severe damage to port and terminal facilities' infrastructure such as docks, wharves, cranes, and other equipment. Additionally, temperature extremes can affect the integrity of material used in marine infrastructure, leading to faster deterioration and greater maintenance costs. These factors pose challenges to the reliability and safety of the MTS. Several resiliency strategies port/terminal operators can implement to reduce the effects of a changing climate are listed below.

Resistance to Higher Water Levels

When constructing new terminal infrastructure facility operators should do so at a sufficient elevation above the flood stage, when possible, the types of infrastructure should include both water and landside. Additionally, when not possible to raise existing infrastructure facility operators can construct gray infrastructure and nature-based solutions to manage these effects, while also addressing erosion and shoreline protection issues.

- **Gray Infrastructure** includes solutions that include constructing seawalls, levees, bulkheads, flood barriers, and jetties to protect against flooding and erosion. While these solutions can help control the effects of higher water levels they must periodically be upgraded or replaced to deal with rising water levels. Additionally, the gray infrastructure.
- **Nature-based solutions** include restoring wetlands and creating living shorelines, and marshes are a means to use nature to help reduce the effects of rising water levels. These nature-based solutions have the benefit of being able to grow in elevation as water levels rise.

Resistance to Stronger Storms

The effects of climate change have led to more intense storms with higher winds. While infrastructure is often constructed to resist strong winds, over time intense storms can lead to failure. New infrastructure should be reinforced to take into consideration extreme weather events utilizing materials and designs to resist wind damage. Another strategy to reduce the effects of extreme winds is to construct wind barriers, these can be both natural as with tree lines, or artificially specially designed walls.

Resistance to Extreme Temperatures

Being located in the Midwest, Ohio sees both high and low-temperature extremes, additionally, temperature swings can happen overnight leading to stress on infrastructure particularly with pavement. When constructing or reconstructing pavement facility operators should consider temperature-resistant pavement materials and strategies. Asphalt modified with styrene-butadiene-styrene or rubber can enhance the durability of the pavement. Thermal reflecting coatings can be applied to reduce the surface temperature and extend its lifespan. Phase-changing materials can be incorporated into the pavement helping regulate temperature by absorbing and releasing heat as they change phases, this helps reduce thermal stress and prevents cracking. Concrete should be considered as it is more resistant to temperature fluctuations as compared to asphalt.

Resistance to Increases in Stormwater and Runoff

During intense rain events water flows over impervious surfaces like roads, rooftops, and parking lots. Many times, during these high rain events the local public sewer system cannot accommodate the large amount of water leading to flooding. Facility operators can make investments of their own to help increase the resiliency of their operation resulting in fewer distributions of service.

Stormwater management practices can help reduce the effects of flooding during high rainfall events. Two green infrastructure strategies that can help with this are bioswales and retention ponds. Bioswales are shallow, vegetated channels designed to capture, convey, and filter stormwater. They utilize native plants and porous soil to slow down water flow allowing it to infiltrate the ground and reduce runoff. Retention ponds are designed to capture and store stormwater runoff, allowing it to slowly infiltrate into the ground or be released at a controlled rate. These strategies help control the effects of flooding events, especially in urbanized areas which are often impervious environments. Additionally, green infrastructure can be installed to help water infiltrate the ground reducing runoff and filtering pollutants. This infrastructure includes green roofs, rain gardens, and permeable pavements.

Erosion and Shoreline Protection

Erosion is a major issue that ports and river terminals face due to the constant exposure of water movements and weather events. Strong storms can lead to the erosion of shorelines and major flooding can change the river flow speed affecting the integrity of riverbanks. Erosion can undermine the stability of the infrastructure at a port/terminal resulting in costly repairs and operational disruptions. However, some strategies can be implemented to reduce the effect of erosion through shoreline protection.

Shoreline Replenishment

Since 1999, the USACE has developed Regional Sediment Management (RSM) programs to address sediment-related challenges at a regional scale. The RSM program works with stakeholders and local partners to integrate the RSM principles and practices into new and existing projects. The goal of RSM programs is to create short-term and lifecycle economic savings while increasing environmental and social benefits through adaptive management of sediments from a regional perspective. Utilizing sediment for shoreline replenishment provides cost savings, improves environmental conditions, and improves interagency and stakeholder relationships.[41]

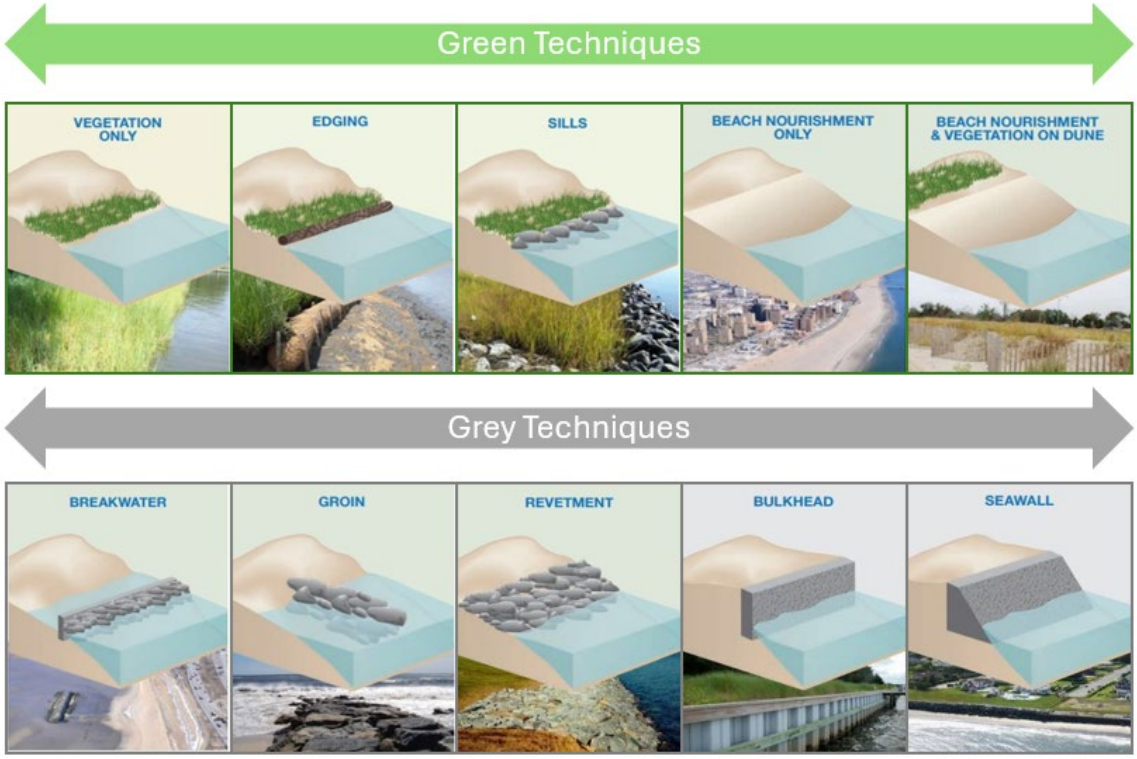
Systems Approach to Geomorphic Engineering

The USACE has led an effort for a systems approach to geomorphic engineering (SAGE). The SAGE program is geared toward the integration of green and gray solutions for shoreline protection. By combining these practices port and terminal operators can improve the resilience of their facilities for both people and nature. The green solutions include living shorelines of vegetation only, edging, sills, beach nourishment, and vegetation on dunes. The gray solutions include breakwaters, groins, revetment, bulkheads, and seawalls. Figure 15 illustrates each type of shoreline solution. Each solution poses unique benefits and disadvantages in their implementation and the surrounding community's characteristics should be considered. The SAGE program

[41] USACE, National Regional Sediment Management Program, March 2020. https://rsm.usace.army.mil/initiatives/facts/FY20-RSM_FactSheet.pdf.

is a great forum to explore solutions to the issue of shoreline erosion due to the existing technical research, recommended policy, and expansive opportunities for knowledge exchange.[42]

Figure 15: Shoreline Protection Options



Source: Virginia Department of Conservation and Recreation, Shoreline Erosion Advisory Service, 2018. https://www.vims.edu/ccrm/outreach/workshops/2018/presentations/p6_credits_wendt.pdf

Open Spaces Protection

Open spaces can be used to create a buffer between the facility and the shoreline. This buffer space protects the facility from high water events being located away from the immediate shore resulting in a lower likelihood of flooding. These green spaces are typically parks and can provide value by providing a community space. An example of a green space is the Irishtown Bend Park in Cleveland. Likewise, the City of Euclid is undergoing a waterfront improvement project which is a public/private partnership in which the city worked with 100 lakefront stakeholders which ultimately will provide public access to the historically private shoreline.

[42] USACE, Systems Approach to Geomorphic Engineering, N.D. https://www.iwr.usace.army.mil/SAGE/. Accessed September 2024.

2.7 Best Practices to Achieve Sustainability and Resilience: Communities

Economic Integration

Ports and terminals are large economic generators for the communities they're located in. They are a large employer providing career opportunities for many who otherwise would not be afforded the opportunity. Additionally, these jobs are often well-paying providing great benefits for workers. Likewise, these facilities provide indirect economic benefits to the community through supporting services that are needed to support the operations.

Port and terminal operators can help benefit the local economy by utilizing local suppliers and contractors for port equipment and improvements instead of ones located outside the community. By doing so the port can ensure that money spent stays within the community bolstering the local economy. Local contractors should be utilized, if not possible it should be a point that local labor is used by an outside contractor. If possible, equipment and supplies should be procured from a local vendor. A facility operator can work with the local chamber of commerce to examine which businesses can provide materials, equipment, or services that are needed for their operations. The Port of Oakland has a robust plan to provide bid preferences for local, small, and disadvantaged businesses.

Local Workforce Development

A skilled workforce is just as if not more important than the infrastructure at a facility. Having a skilled workforce is important to ensure a facility can operate efficiently. Operations at facilities can require a unique skillset which is not often available from the local workforce. A limited skilled workforce can inhibit the growth of services at a facility. A workforce development program is one means a facility operator can help ensure its workforce demands are met.

A workforce development program is a means by which a port/terminal operator can increase the local labor force for its operations while providing job opportunities to members of the community who otherwise would not have the skill set to gain employment at the facility. These programs are a net positive for both the community and the facility itself. The Port of Seattle has administered such a program since 2012, the program provides job training for workers who participate in the program. Additionally, the program helps with job placement once the individual is complete with their training.[43] The Port of Oakland also has a

[43] Port of Seattle, Workforce Development, 2021. https://www.nwccc.org/wp-content/uploads/2/021/10/Port-of-Seattle-Workforce-Development-Presentation.pdf/

workforce development program that targets economically distressed areas and populations surrounding the port.[44]

Engagement with Schools

Engagement with schools at all grade levels is a means for ports/terminals to provide education to students on the operation and its importance to the community. These efforts allow students to hear first-hand accounts from MTS-related employees and provide career awareness for students, especially high school students, who soon will enter the workforce. By doing so a port/terminal operator can help build a pipeline of potential future skilled employees.

The Port of Cleveland engages with students through a program with Argonaut to captain the vessels and work with Davis Aerospace and Maritime High School students. Argonaut's mission is to build adventurers through immersive learning experiences that challenge assumptions and shift norms for growing empowered talent in aerospace and maritime fields. Argonaut co-leads the Davis Aerospace and Maritime High School in the Cleveland Metropolitan School District.[45] Construction will be complete in 2026 for Ohio's first Maritime Academy in Sardis which is being developed in conjunction with Mountwest College of Huntington, West Virginia. This Academy will provide students with the education and skills necessary to enter the maritime industry.

Community Connections

Community relations are important for facility operators to help foster transparency and build trust within the community. By engaging the community, residents can gain a better understanding of the importance of the operation and the benefits they gain from the facility. Additionally, the strategy of engaging the community allows the operator to be a good local steward giving back to the community it resides in. A good example is the replacement of the Willow Avenue Lift Bridge at the Port of Cleveland, where planning looked to re-route traffic away from the adjacent Lakeview Terrace community. Another example is the implementation of Ohio rail grade crossing elimination projects to help protect communities.

[44] Port of Oakland, Workforce Development, N.D. https://www.portofoakland.com/community/workforce-development/#:~:text=Workforce%20Development%20Plan%20%E2%80%93%20This%20plan,and%20uses%20Fair%20Chance%20Hiring. Accessed September 2024.

[45] Port of Cleveland, CMSD students & Argonaut cleaning Cuyahoga River, May 2023. https://www.portofcleveland.com/cmsd-students-program-also-helping-prepare-students-for-maritime-careers/.

Community and Public Engagement Plans

A community and public engagement plan is a strategic document designed to guide an organization in building and maintaining a positive relationship with the community it is located in. Plans often set goals and objectives, identify the target audience, provide key messages, outline strategies, and provide tactics on how to engage the community. The Port of Cincinnati developed "A Plan for Renewal" which is a strategic planning document outlining the port's vision and a framework to guide the organization into the future.[46] The plan included extensive stakeholder and public outreach to ensure that the vision and goals of the plan take into consideration the needs of the community.

Celebratory Events

Hosting events is a means of engaging the community and allows community members to learn about and see firsthand a facility's operations. The Port of Rotterdam does such this every year during "World Port Days" in which thousands of visitors come to the port to explore the port and its operations. The several-day event highlights different ships and provides excursions and tours of the facility.[47] This allows the port to highlight itself in a positive manner which otherwise would not be available to the public.

[46] The Port of Cincinnati, A Plan for Renewal, 2021. https://www.cincinnatiport.org/wp-content/uploads/StrategicPlan_FINAL-March-2021.pdf.

[47] Port of Rotterdam, World Port Days 2024, September 2024. https://www.portofrotterdam.com/en/events/world-port-days-2024.

3 Advancing Ohio MTS Environmental Best Practices

This Environmental Framework Working Paper offers suggestions and recommendations for ODOT and its partners – port authorities, marine facility owners and operators, communities hosting port activities, and other state agencies – to advance environmental best practices for Ohio's MTS.

Recommended strategy options for **ODOT** include:

Support the Lake Erie Commission and Ohio River Commission – ODOT should coordinate with and support the established Lake Erie Commission and newly-formed Ohio River Commission to advance and implement recommendations consistent with this Environmental Framework.

Promote general and consistent awareness of MTS environmental best practices – Through the Ohio Maritime Plan, Transport Ohio, and other ODOT plans and studies, ODOT should promote best practices to MTS stakeholders, support continued research and education on emerging best practices, and promote coordination among Ohio agencies on MTS environmental issues.

Provide direct funding and federal grant application support for environmental best practice implementation - ODOT can leverage the current Ohio Maritime Assistance Program and other mechanisms (including the Carbon Reduction Program and CMAQ funds) to encourage implementation by MTS stakeholders. This could include helping all Ohio port authorities develop, update, and implement Climate Action Plans, assisting public and private facilities with facility and asset improvements, collaborating on Brownfield redevelopment, and working with communities on the inclusion of MTS issues in local and regional environmental plans.

Expand ODOT's Ohio's Resilience Improvement Plan, Carbon Reduction Strategy, and Asset Reliability Study – ODOT can expand its RIP to more specifically address MTS facilities and expand ODOT's attention to performance monitoring and real-time management of MTS environmental conditions and issues through TSMO mechanisms including VAST.

Advance Ohio Maritime Plan recommendations in other ODOT plans and programs – Plan recommendations should be integrated into other state, regional, and local plans and programs to allow for a coordinated effort across agencies and ensure sustainability goals are aligned across the state.

Recommended strategy options for other **Ohio MTS** stakeholders include:

For public agencies – Coordinate with port authorities and responsible federal, state, regional, and local agencies to implement Environmental Framework strategies across their areas of jurisdiction. Some Ohio port authorities are already engaged in such efforts, and the opportunity is for all port authorities to make comparable and mutually supportive commitments, through individual Climate Action Plans and possibly through a shared higher-level Ohio MTS Climate Action Plan.

For private facility owners and operators – Provide technical support and guidance to private parties to include Environmental Framework strategies in their ongoing facility development and improvement, asset management and acquisition, and ongoing operations. While private-sector timelines for near-term, business-critical expenditures and actions sometimes make public-private partnerships impractical, new partnerships could be framed around longer-term investment and environmental upgrade programs with shared private and public benefits.

For communities – Work collaboratively with public and private ports on issues related to truck and rail access, complementary water and land uses, and economic and community relationships, and –- importantly – ensure that Ohio MTS issues and factors are fully considered in regional and local environment and climate plans and analyses.

Appendix A. MTS Environment Policy and Practice Review

State of Ohio Plans

While Ohio does not have state or regional environmental policies specific to the MTS, several state and regional plans include strategies and recommendations that are relevant and applicable to the MTS, consistent with larger state and regional approaches. Selected resource documents are highlighted below.

Ohio Carbon Reduction Strategy (2023)

The ODOT Ohio Carbon Reduction Strategy (2023) lays out a broad range of key initiatives related to emissions from the use of the transportation system, capital projects, and operations and maintenance. From the set of initiatives defined as passing an initial screening, the strategies that appear most applicable to Ohio's MTS are summarized in Figure 16.

Figure 16: Initially Screened Recommendations Relevant to Ohio's MTS from the Ohio Carbon Reduction Strategy 2023

Carbon Reduction Strategy	Initiative	Application to MTS
Use of System	Charging infrastructure for electric vehicles	Capabilities within terminals
Use of System	Low-carbon fuel infrastructure for heavy vehicles (e.g., buses, commercial vans, and trucks)	Vehicles accessing terminals
Use of System.	Low-carbon fuel infrastructure for off-road vehicles (e.g., rail, maritime, aviation)	Vessels and railcars accessing terminals
Use of System	Grant programs for zero-emission vehicles and/or more fuel-efficient vehicles	Vehicles accessing or operating inside terminals
Use of System	Strategic warehouse industrial/ warehousing/commercial siting	Location of terminals and supporting uses
Capital Projects	Sustainable design	Design of terminals and related structures
Capital Projects	Targets, specifications, and performance metrics related to the use of sustainable construction materials and fuels	Design of terminals and related structures
Operations and Maintenance	Energy-efficient improvement projects	Design of terminals and related structures
Operations and Maintenance	Operator education on fuel-saving driving techniques	User community

Source: Adapted from Ohio Carbon Reduction Strategy 2023, Ohio Department of Transportation

ODOT Resilience Improvement Plan (2024)

The ODOT Resilience Improvement Plan (2024) addresses transportation system vulnerability and resilience related to climate hazards and scenarios and discusses a systematic approach to resilience. While its scope is focused on roads and bridges within FEMA 100-year floodplains, it is relevant to the MTS because (a) roads and bridges are essential to providing access for MTS facilities, and (b) many findings are also applicable to MTS facilities both public and private (the report notes that "further iterations of the RIP could extend the risk assessment to other hazards and asset types, such as culverts, conduits, and/or ports[48]"). The primary hazards identified are risk from higher frequency and intensity of precipitation events, leading to increased risks from flooding, scouring around bridge and pier supports, pavement integrity and subgrade stability, slope erosion and landslides, and rockfalls. The core tenets of the plan – all of which apply to MTS facilities, operations, and/or landside access – encompass:

- Emergency Preparedness
    - ODOT's Transportation Systems Management Office (TSMO) program
    - ODOT's Emergency Relief Flow Process
- Asset Management
    - Focus on small-scale maintenance to preserve more system assets in good condition, instead of "worst first" investments
- Design and Engineering
    - Consider recent historical weather events and changing climate conditions (flooding, temperature extremes, etc.) in design standards
    - Research different materials and processes to extend the useful life of assets
    - Utilize nature-based solutions for flood and stormwater management and habitat/water quality preservation
- Operations and Maintenance
    - Preventative maintenance supporting asset management
    - Integrate resilience into performance measures for operations, asset management, and preservation
    - Data collection and performance monitoring within TSMO

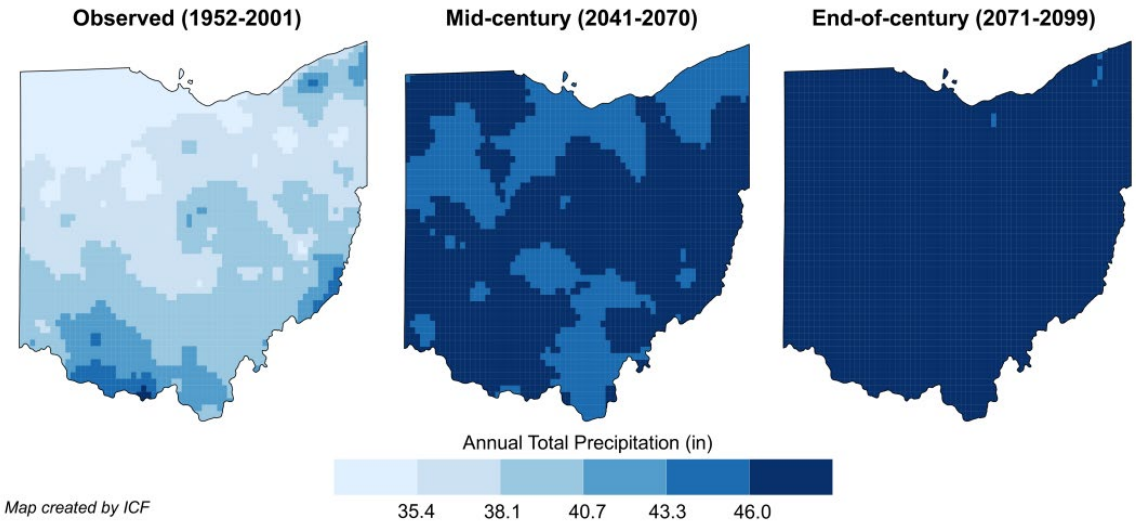
Forward-looking recommendations of the draft Resilience Improvement Plan address: flood incident tracking; nature-based solutions; local case studies of resilience projects; training programs for geohazard prevention; data and materials to demonstrate the costs and benefits of resilience features; and culvert improvements.

[48] ODOT Resilience Improvement Plan Draft, page 8

ODOT Asset Reliability Study (2020)

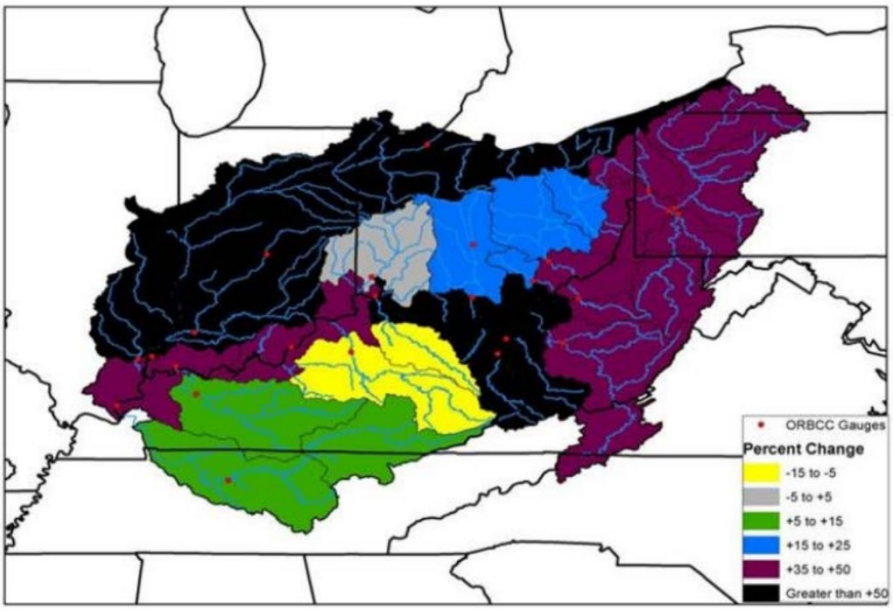
The ODOT Asset Reliability Final Report completes work begun in 2014 to assess the vulnerability of at-risk highway and bridge assets. By the end of the century, Ohio temperatures are projected to increase by 5.5 to 9.5 degrees Fahrenheit, and annual precipitation in all parts of the state is projected to increase by roughly 33 percent. Maximum October stream flows along Lake Erie and the western reaches of the Ohio River are projected to increase by more than 50 percent and by 35 to 50 percent on the eastern reaches of the Ohio River.

Figure 17: Ohio Precipitation Events



Source: ODOT Asset Reliability Study, page 4

Figure 18: Projected Change in October Maximum Streamflow, 2017-2099, When Compared to Base Period, 1952-2001



Source: ODOT Asset Reliability Study, page A-20

Risks to highways and bridges affect the sustainability and resiliency of MTS operations and typically pose comparable risks for MTS terminals, navigation channels, and other assets. The report notes:

> "A major climate implication for Toledo involves its port, which receives two major ships per day. Sedimentation of the Lake Erie shipping channel is an ongoing concern that is likely to worsen in the future with more frequent heavy rainfalls. Higher temperatures will also lead to higher evaporation rates causing the Lake Erie water level to decrease, a further impediment to shipping. Water level fluctuations will also lead to structure failures on the lake."

Ohio Hazard Mitigation Plan (2024)

The Ohio Hazard Mitigation Plan, developed by the Ohio Emergency Management Agency, is a comprehensive document addressing risks to State-owned and State-leased assets from a wide range of hazards.

Figure 19: Hazard Types Identified in the Ohio Hazard Mitigation Plan

Element	Hazard Type
Water	Flooding (riverine and flash flooding), Seiche/Coastal Flooding, Dam/Levee Failure, Drought, Harmful Algal Blooms
Earth	Mud/Landslide, Earthquake, Coastal Erosion, Land Subsidence, Hydraulic Fracturing
Air	Tornado, Winter Storms (inc. snow, ice, extreme cold), Summer Storms (inc. high winds and hail), Extreme Heat
Fire	Wildfire
Cross-Cutting	Invasive Species, Future Growth, Climate Change

Source: Ohio Hazard Mitigation Plan, with WSP classification by element

The plan identifies seventeen different Ohio agencies, including ODOT, which are responsible for hazard reduction resources and programs, along with 95 mitigation measures to be implemented by different agencies from the 2019 plan and their status. While not directly addressing the MTS or other transportation assets, the measures to be led by ODOT and others with apparent relevance for MTS facilities and operations include:

- Action 1 (Ohio Emergency Management Agency (EMA)): Conduct HAZUS Level 2 flood analyses for all counties in the state using the best available data. Ongoing.
- Action 7 (Ohio DOT): Install sensors in shoulders or video detection to monitor flooding. Ongoing.
- Action 8 (Ohio DOT): Continue development of the VAST system. VAST evaluates risks to roads and bridges (from) hazards such as flooding, landslides, and rockfall. VAST is intended to be an improvement over TOAST. (Supersedes Action 56, "Incorporate a weather resilience data category into the Traffic Operation Assessment Systems Tool.") Ongoing.

- Action 9 (Ohio EMA): Work with USGS, NOAA, and other partners to promote flood warning systems and the importance of stream and rain gauges. Ongoing.
- Action 24 (Ohio Environmental Protection Agency (EPA)): Requirements for building facilities above the 100-year flood plain. Ongoing.
- Action 30 (various): Formalize a state-level hazard mitigation grant program for Ohio communities. Ongoing.
- Action 44 (Public Utilities Commission Ohio): Limit construction or assist with relocation of electrical substations, distribution, and transmission lines in flood-prone areas that serve critical infrastructure customers. Ongoing.
- Action 45 (Ohio Department of Development): Continue to administer the Brownfield Grant Program to clean up hazardous materials at brownfields throughout the state. Ongoing.

Ohio Regional Plans and Port Programs

Cleveland

Cleveland's Climate Action Plan (2018) Update includes the goal "Continue to green Cleveland's ports … Build off leadership in solar, electric vehicles, green roofs, stream rehab, and energy efficiency … (move) towards green leases." The Port of Cleveland has adopted the Climate Action Plan as part of its Strategic Plan 2024-2028 and is the first Great Lakes port with a comprehensive climate plan.[49]

Toledo

The City of Toledo is currently developing a Climate Action Plan (CAP) and expects to complete and approve the plan by July 2025. The Port of Toledo undertakes a variety of initiatives related to dredged materials management and other environmental stewardship initiatives.[50]

Cincinnati

The Green Cincinnati Plan (2023) establishes a set of central pillars (sustainability, resilience, and equity) and applies them to different focus areas: buildings and energy, city, operations, community activation, food, mobility, natural environment, resilience, and climate adaptation, and zero waste. It does not directly address the MTS or multimodal freight movement but offers some policy recommendations that are relevant and potentially applicable to Ohio's MTS. These include supporting the transition to zero-emission mobility

[49] Port of Cleveland, Strategic Plan, N.D. https://www.portofcleveland.com/strategic-plan/. Accessed September 2024.

[50] Port of Toledo, Transportation, N.D. https://www.toledoport.org/port-of-toledo#:~:text=The%20Port%20of%20Toledo%20is%20home%20to%2013. Accessed September 2024.

options through access to clean fuels and EV charging infrastructure; supporting and funding the development of natural corridors and tree barriers along streams and rivers, interstates and highways; removing invasive species and restoring, maintaining, and reserving forests, wetlands, riparian areas, and natural corridors; increase use of green infrastructure to manage the effects of stormwater, sewer overflows, overland flooding, and contaminated stormwater in waterways; and conduct inventories, assessments, and clean-ups of contaminated industrial sites in alignment with community revitalization priorities and city-planned reuse.

Ohio Lake Erie Commission

As noted on its website, "The role of the Ohio Lake Erie Commission is to preserve Lake Erie's natural resources, to protect the quality of its waters and ecosystem, and to promote economic development of the region by ensuring the coordination of policies and programs of state government about water quality, toxic substances, and coastal resource management. The Commission also oversees the management of the Lake Erie Protection Fund. The Commission is comprised of the directors of six state agencies including the Ohio Environmental Protection Agency, and the Departments of Natural Resources, Health, Agriculture, Transportation, and Development. There are five additional Commission members appointed by the governor and two board members of the Great Lakes Protection Fund who serve as ex-officio members of the Commission."[51]

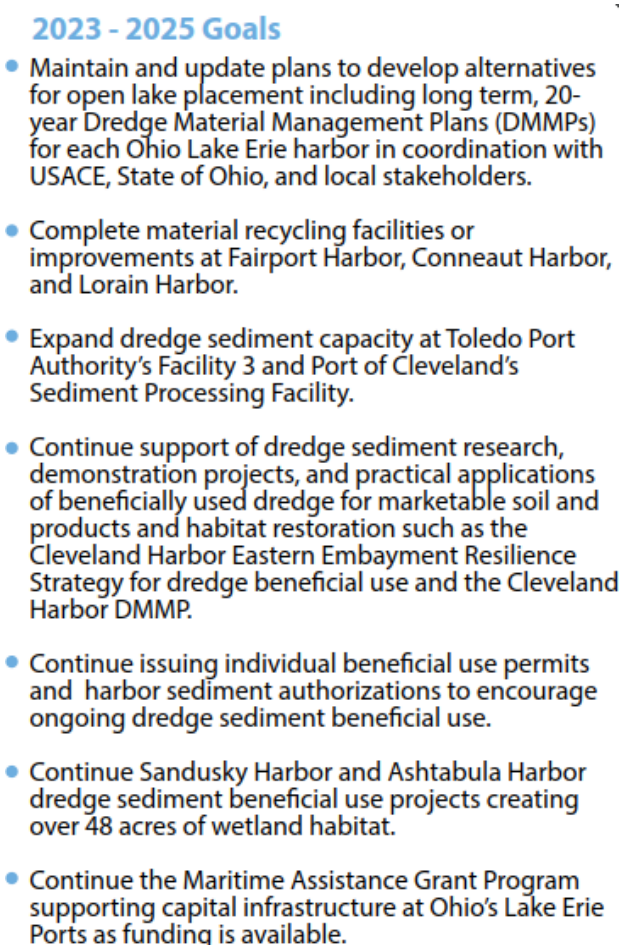
In 2023, the Commission approved its Lake Erie Restoration and Protection Plan.[52] The Plan describes how expenditures from the Lake Erie protection fund (approximately $85 million since 2020) have been made to advance Ohio policies. For the coming years, it sets priorities related to:

- Nutrient pollution reduction
- Habitat and species
- Invasive species
- Dredge material management and marine infrastructure
- Areas of concern
- Toxic pollutants
- Beach and recreational use
- Tourism, jobs, and economy
- Water withdrawals

[51] Ohio Lake Erie Commission, About, N.D. https://lakeerie.ohio.gov/about. Accessed September 2024.

[52] Ohio Lake Erie Commission, Lake Erie Protection and Restoration Plan, 2023. https://lakeerie.ohio.gov/wps/wcm/connect/gov/fa97a536-ad44-41ae-a117-5f48b7c7ce9d/Lake+Erie+Protection+and+Restoration+Plan+Final+2023.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_79GCH8013HMOA06A2E16IV2082-fa97a536-ad44-41ae-a117-5f48b7c7ce9d-oWBuvO3.

Figure 20: LEPRP Dredge Material Management & Marine Infrastructure Priorities



Source: Ohio Lake Erie Commission, Lake Erie Protection and Restoration Plan, 2023. https://lakeerie.ohio.gov/wps/wcm/connect/gov/fa97a536-ad44-41ae-a117-5f48b7c7ce9d/Lake+Erie+Protection+and+Restoration+Plan+Final+2023.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_79GCH8013HMOA06A2E16IV2082-fa97a536-ad44-41ae-a117-5f48b7c7ce9d-oWBuvO3.

"Green Marine" Environmental Program

The Port of Cleveland, along with the Great Lakes St. Lawrence Seaway Corporation and over 100 other ports, terminals, ship owners, and shipyards, are participants in the Green Marine program. The program offers certifications based on self-assessments of environmental performance, consistent with program guidelines and external verifications. It establishes performance standards for air emissions, aquatic ecosystems, community impacts, community relations, dry bulk handling and storage, environmental leadership, spill

prevention and stormwater management, underwater noise, and wastewater management. [53] In each area, members can earn a rating from 1 to 5, with 5 representing the highest level of achievement.

1 = Monitoring of Regulations

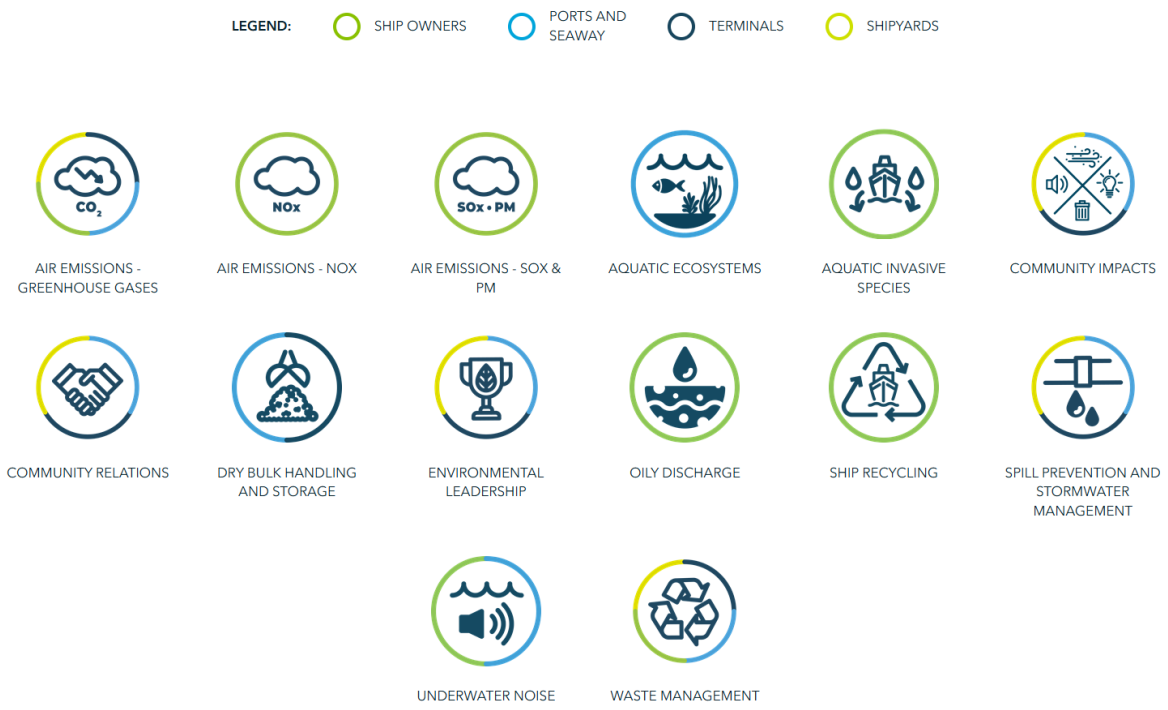
2 = Best Practices

3 = Integrated Management and Quantified Impacts

4 = New Technologies and Reduction Targets

5 = Excellence and Leadership

Figure 21: Green Marine Environmental Performance Indicators



Source: Green Marine Management Corporation, Environmental Program, 2024. https://green-marine.org/media/5zmb10dh/gm_2024_summaryindicators_ports_seaway.pdf.

[53] Green Marine Management Corporation, Environmental Program, 2024. https://green-marine.org/media/5zmb10dh/gm_2024_summaryindicators_ports_seaway.pdf.

Industry, Academic, and Advocacy Research

Great Lakes Coastal Resiliency Study

Ohio is a participant in the USACE Great Lakes Coastal Resiliency Study (GLCRS). This study, initiated in 2023 and planned to take 6 years for $14.4 million, is being cost-shared study among the Great Lakes States of Illinois, Indiana, New York, Michigan, Minnesota, Ohio, Pennsylvania, and Wisconsin. The GLCRS is "a comprehensive watershed assessment of the Great Lakes coastal areas and identifies coastal areas that could be vulnerable to future storms, flooding, extreme low or high water levels, erosion, and accretion; the identification of a range of actions to improve coastal resiliency; and the development of a collaborative-risk informed-decision framework to support the identification and prioritize of coastal investments by federal, state, and local governments, Tribal Nations, and nongovernmental organizations." The study can be expected to produce information critical to sustainability and resiliency planning for Ohio's MTS and collaborative efforts with other states.[54]

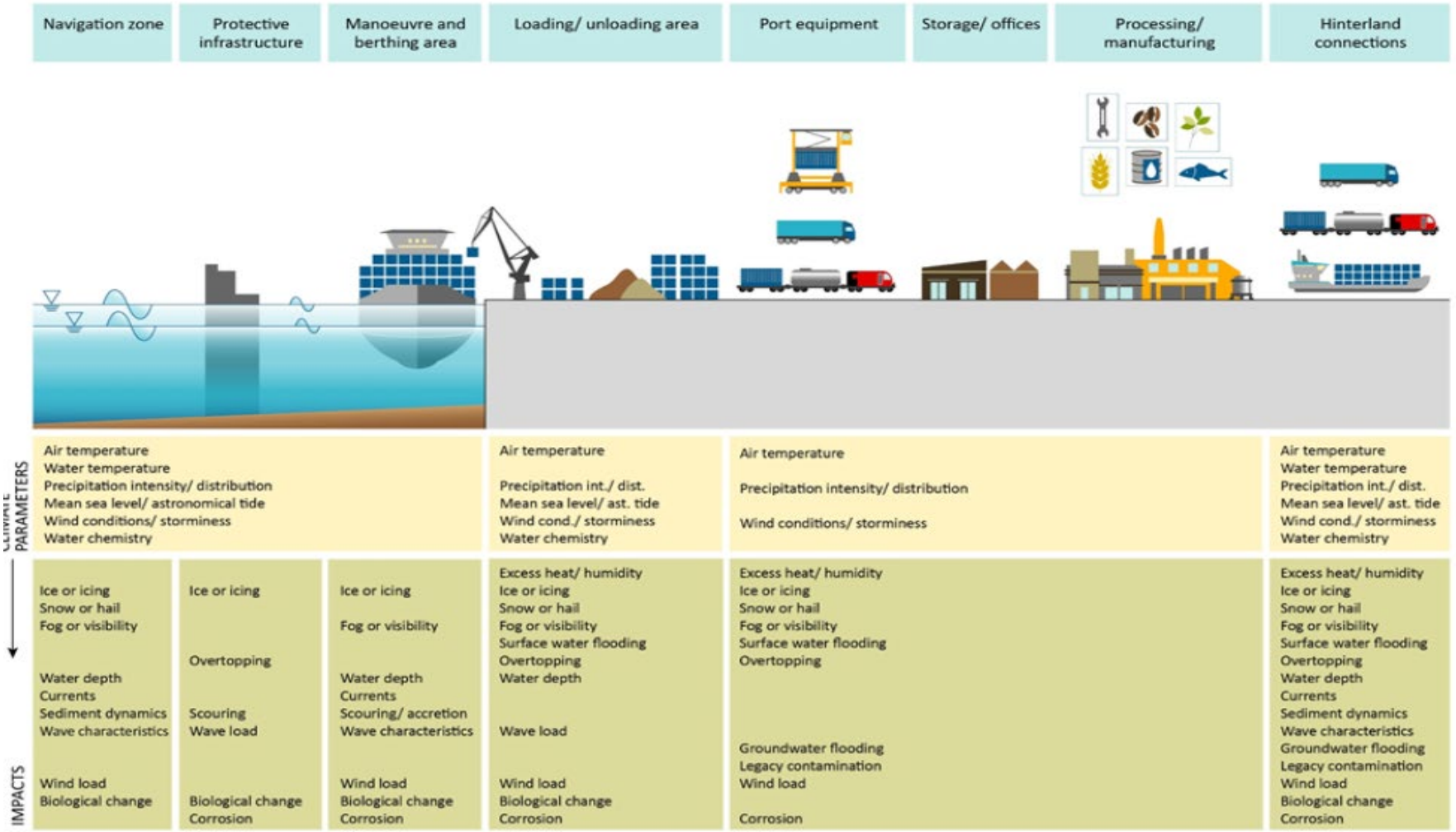
Permanent International Association of Navigation Congresses (PIANC)

The Permanent International Association of Navigation Congresses , now the World Association for Waterborne Transport Infrastructure but still known by PIANC, develops and publishes best practices for global coastal, lake, and water ports. PIANC Report 178, Climate Change Adaptation Planning for Ports and Inland Waterways, was issued in 2020. The report offers a comprehensive view of how changes in climate factors can affect different elements and stages of marine cargo operations (see Figure 22).

It describes a model planning process for adaptation planning, includes 16 global case studies, and provides a "generic" list of potential adaptation strategies that may be applicable depending on conditions (see Figure 23).

[54] USACE, Great Lakes Coastal Resilience Study, July 2024. https://www.lrd.usace.army.mil/Mission/Programs/Article/3646559/. Accessed September 2024.

Figure 22: Climate Effects on Different Stages of Marine Cargo Operations



Source: PIANC Report 178

Figure 23: "Generic" Climate Adaptation Strategies for Ports

Physical measures Structures, systems, technologies, services	Social measures People, behaviour, operations, information	Institutional measures Governance, economics, regulation, policy
Prioritise **maintenance** to maximise operational resilience and improve adaptive capacity	Undertake climate change **risk assessment**, prepare **risk maps**	Prepare strategic level climate change **adaptation strategies**
Install **real-time monitoring** infrastructure	**Prepare** and **raise awareness** of contingency, emergency or disaster response **plans**	Strengthen international cooperation and planning at **river basin level**
Use **Cloud** (back-up) for data storage to reduce physical risks to systems	Introduce and regularly review **warning systems**	Review and revise relevant **codes of practice, standards, specifications or guidelines** to accommodate changing conditions
Relocate vulnerable assets and equipment out of high-risk areas	Prioritise **asset inspection**	Review **health and safety** requirements and revise if needed
Revert to **phased array** for radar	**Educate** workforce, stakeholders, local communities	Introduce **penalties** for non-compliance with standards
Invest in **redundancy**, temporary infrastructure or other physical back-up provision for critical assets (including power and water supply)	Liaise and **coordinate with utilities** and other service providers; develop **information-sharing** protocols	Require **zoning** of assets, operations or activities based on risk
Reinforce, raise, strengthen or otherwise protect or modify critical assets	Improve (or instigate) **monitoring, record keeping** and **data management**, consider cybersecurity issues	Use local regulations (e.g. **byelaws**) to reduce risks, especially in multi-use locations
Install or develop new, **responsive** or **demountable infrastructure** or equipment	Undertake trend analysis or **forecasting**	Policies to encourage **relocation** out of high-risk areas
Install **warning equipment**	Develop **revised operational protocols**; modify **working practices** as conditions change	Collaborate with **land-use planning** systems e.g. to introduce **set back** or **buffer areas**
Nominate or provide physical **sanctuaries**	Introduce and implement **adaptive management** procedures, base operations or working arrangements on monitoring outputs	**Limit new infrastructure development** in high-risk areas
Increase **storage capacity**	Allow for **flexibility** and responsiveness in programming (increase operational **hours**, modify staffing **rotas**, vessel **scheduling**, lock operation, etc.)	Identify, secure and coordinate **alternative transport routes or modes**
Install **multi-modal equipment**	Revert to **traditional, low tech,** ways of operating; ensure binoculars, telephone, paper charts, two-way radios are available	Promote **reduced insurance premiums** if improved resilience is demonstrated
Apply **nature-based solutions,** Working with Nature, soft engineering	Ensure availability of **transport** and **accommodation** for personnel during an incident	Set up **contingency** or disaster response **fund**
Install **treatment** or **reception facilities**	**Temporarily** or **permanently restrict** activities in high-risk areas	Introduce and enforce **build-back-better** or build-out-of-harm's-way policy
Incorporate **flexibility** in new or replacement infrastructure design to allow for modification as conditions change	Nominate **safe routes** and **areas**, identify **diversions**	Facilitate **diversification** in facilities and employment as conditions change
Modify **material or equipment selection** to accommodate changing conditions	Identify and exploit **interconnectivity** and **intermodal options** to maintain business continuity during events	Improve **legal protection** for vulnerable habitats with risk reduction role (e.g. absorbing wave energy, providing erosion protection)
Invest in **SMART** technology	Provide **training** on new tools, codes of practice, procedures or **protocols**, ensure importance of **redundancy** is understood	Provide **grants or incentives** e.g. for development or maintenance of resilient infrastructure
	Facilitate **technology transfer**	**Research** and develop novel tools and methods

Source: PIANC Report 178

Federal Responsibilities

The jurisdiction of the waterways within the US predominantly falls under the oversight of the Federal Government. The Ohio MTS system is part of the inland river and Great Lakes system in which the Federal Government creates rules and regulations to provide a cohesive system that protects all stakeholders and users of the MTS. These rules and regulations ensure there are environmental safeguards in place, allow for the safe commercial navigation of the MTS, and environmental protections in place for wildlife and natural habitats. The primary federal agencies that oversee the system, having different roles and responsibilities based on the purview of their agency, are listed below. Other agencies, such as the Federal Emergency Management Agency (FEMA), National Oceanographic and Atmospheric Administration (NOAA), and the Department of the Interior's US Geological Service (USGS).

United States Environmental Protection Agency (USEPA)

The USEPA was established in 1970 with a mission to protect human health and the environment. The agency works to ensure that Americans have clean air, land, and water. They administer and enforce federal laws that protect human health and the environment. The EPA does this by utilizing the best available scientific information and working with state, and local governments, communities, and private businesses to ensure environmental stewardship of the MTS. The EPA's Strategic Plan outlines several goals which are all related to an aspect of the Ohio MTS, listed below.[55]

- Tackle the Climate Crisis
- Take Decisive Action to Advance Environmental Justice and Civil Rights
- Enforce Environmental Laws and Ensure Compliance
- Ensure Clean and Healthy Air for All Communities
- Ensure Clean and Safe Water for All Communities
- Safeguard and Revitalize Communities
- Ensure Safety of Chemicals for People and the Environment

United States Army Corps of Engineers (USACE)

The USACE is a federal agency that is part of the United States Army and oversees many civil and public works projects throughout the MTS. The USACE ensures the inland river system and great lakes are available for commercial navigation. Along the Ohio River, the USACE owns and operates locks and dams to help regulate

[55] USEPA, FY 2022 – 2023 EPA Strategic Plan, 2022, https://www.epa.gov/system/files/documents/2022-03/fy-2022-2026-epa-strategic-plan-overview.pdf.

water levels allowing for safe commercial navigation. Likewise, the USACE is responsible for dredging the main navigation channel of the Ohio River. Along Lake Erie, the USACE assists with ensuring approach channels are dredged. USACE has seven environmental operating principles that help ensure that their missions include the total integration of sustainable environmental practices, listed below.[56]

1. Proactively consider the environmental consequences of all USACE activities and act accordingly.
2. Foster sustainability as a way of life throughout the organization.
3. Create mutually supporting economic and environmentally sustainable solutions.
4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments.
5. Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
6. Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.
7. Employ an open, transparent process that respects the views of individuals and groups interested in USACE activities.

United States Coast Guard (USCG)

The USCG is part of the United States Department of Homeland Security and has six major operational mission programs including maritime law enforcement, maritime response, maritime prevention, maritime transportation system management maritime security operations, and defense operations. The USCG's responsibilities within the Ohio MTS include navigation aids, navigation rules, maritime law enforcement, and environmental protections including vessel and facility inspections. Their enforcement mechanisms are an important part of ensuring that the users both water and landside are conducting their business in an environmentally responsible manner.

United States Department of Transportation (USDOT)

The USDOT Maritime Administration (MARAD) was established in 1950 with a stated mission to "foster, promote and develop the maritime industry of the United States to meet the nation's economic and security needs."[57] MARAD supports technical aspects of the MTS infrastructure. Being part of USDOT, MARAD

[56] USACE, Environmental Operating Principles, N.D. https://www.usace.army.mil/Missions/Environmental/Environmental-Operating-Principles/. Accessed September 2024.

[57] MARAD, About Us, N.D. https://www.maritime.dot.gov/about-us. Accessed September 2024.

promotes the use of waterborne transportation and ensures that the infrastructure is integrated seamlessly with other modes of transportation. MARAD activities are guided by four principles as listed below.[58]

- Support and grow America's merchant fleet and the mariners that crew it.
- Recapitalize sealift in our Nation's National Defense Reserve Fleet.
- Work towards realizing a net zero decarbonization of the maritime industry.
- Support the US Merchant Marine Academy as a world-class educational institution.

Beyond MARAD, the Department offers links to dozens of studies, resources, and tools for climate assessment and adaptation, including materials from other Federal agencies.[59]

To highlight one important resource, the Federal Vulnerability Assessment and Scoring Tool (VAST) was developed by USDOT, NOAA, and other agencies to help transportation agencies develop standardized quantitative risk scoring.[60] It addresses a series of hazards including extreme cold and heat, flooding and drought, high winds, wildfires, and severe winter weather, and addresses a full range of transportation assets and water resources.

United States Department of the Interior Fish and Wildlife Service

The mission of the US Fish and Wildlife Service is to work with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Their purpose is to protect the natural world so current and future generations can live with, live from, and find awe in lands, waters, and wildlife.[61] The service works with others and is responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. Some of the activities the service conducts which relate to the MTS are listed below.

- Acquires, protects and manages unique ecosystems necessary to sustain fish and wildlife such as migratory birds, resident species, and endangered species.
- Provides protection of fish and wildlife from dislocation or destruction of their habitats, overuse, and industrial, agricultural, and domestic pollutants.

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[58] MARAD, Strategic Plan 2022 – 2026, 2022. https://www.maritime.dot.gov/sites/marad.dot.gov/files/2024-04/MARAD%20Strategic%20Plan%20FY22-26%20%283-14%29_0.pdf.

[59] USDOT, Climate Adaption Resources and Tools, N.D. https://www.transportation.gov/priorities/climate-and-sustainability/climate-adaptation-resources-and-tools#:~:text=Vulnerability%20Assessment%20and%20Adaptation. Accessed September 2024.

[60] US Climate Resilience Toolkit, Vulnerability Assessment Scoring Tool (VAST), N.D. https://toolkit.climate.gov/tool/vulnerability-assessment-scoring-tool-vast#:~:text=VAST%20enables%20users%20to%20document%20the. Accessed September 2024.

[61] US Fish and Wildlife Service, Mission and Vision, N.D. https://www.fws.gov/about/mission-and-vision. Accessed September 2024.

- Renders financial and professional technical assistance to States through Federal Aid programs for the enhancement and restoration of fish and wildlife resources.
- Conducts programs of enforcement, management, and professional technical assistance to other agencies for the protection of endangered species.

Federal Funding Program Opportunities

Finally, there are many Federal agencies that offer grant and loan programs that may be relevant for improvements and investments to provide Ohio MTS environmental benefits. Some of the most relevant program opportunities are summarized in the following figure.

Figure 24: Federal Funding Programs

Federal Agency (Sub Agency / Office)	Program	Description	Eligible Uses
Department of Transportation (Office of the Secretary)	Local and Regional Project Assistance Grants (RAISE)	The RAISE program provides funding for grants to the State and local entities on a competitive basis for projects that will have a significant local/regional impact.	• A highway or bridge project eligible for assistance under title 23, United States Code; • A public transportation project eligible for assistance under chapter 53 of title 49, United States Code; • A passenger rail or freight rail transportation project eligible for assistance under title 49, United States Code; • A port infrastructure investment, including inland port infrastructure and a land port-of-entry; • The surface transportation components of certain eligible airport projects; • A project for investment in a surface transportation facility located on Tribal land, the title or maintenance responsibility of which is vested in the Federal Government; • A project to replace or rehabilitate a culvert or prevent stormwater runoff to improve habitat for aquatic species; and • Any other surface transportation infrastructure project that the Secretary considers to be necessary to advance the goal of the program.
Department of Transportation (Federal Highway Administration)	Nationally Significant Freight & Highway Projects (INFRA)	The INFRA program awards competitive grants for multimodal freight and highway projects of national or regional significance to improve the safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas	Projects that improve safety, generate economic benefits, reduce congestion, enhance resiliency, and hold the greatest promise to eliminate freight bottlenecks and improve critical freight movements.

Federal Agency (Sub Agency / Office)	Program	Description	Eligible Uses
Department of Transportation (Office of the Secretary)	MEGA National Infrastructure Project Assistance (Megaprojects)	The National Infrastructure Project Assistance Program supports large, complex projects that are difficult to fund by other means and likely to generate national or regional economic, mobility, or safety benefits	• A highway or bridge project carried out on— • The National Multimodal Freight Network of title 49, United States Code; • The National Highway Freight Network, United States Code; or • The National Highway System, United States Code; • A freight intermodal (including public ports) or freight rail project that provides a public benefit; • A railway-highway grade separation or elimination project; • An intercity passenger rail project; and • Certain public transportation projects that are eligible for Federal Transit Administration funding of title 49, United States Code
Department of Transportation (Office of the Secretary)	Transportation Infrastructure Finance and Innovation Act (TIFIA)	Provides Federal credit assistance to eligible surface transportation projects • Minimum Anticipated Project Costs – • $10 million for Transit-Oriented Development, Local, and Rural Projects • $15 million for Intelligent Transportation System Projects • $50 million for all other eligible Surface Transportation Projects	Surface transportation projects, including highway, transit, intercity passenger rail, some types of freight rail, intermodal freight transfer facilities, and some modifications inside a port terminal, and electrification of buses, ferries, trains, and associated infrastructure. The Bipartisan Infrastructure Law specifically provides new eligibility under the Transportation Infrastructure Finance and Innovation Act Program for airport projects and expanded authority for transit-oriented development.
Department of Transportation (Maritime Administration)	Port Infrastructure Development Program (PIDP)	PIDP supports the efficient movement of commerce through discretionary grant funding that helps strengthen, modernize, and improve ports around the United States. Eligible entities compete for the funding through a competitive process.	• Eligible entities are public entities, including the ports themselves or state/local government jurisdictions. • However, if the lead entity is eligible for funding, then that lead entity can partner with a private company or group of private companies (including the owners or operators of a facility at the port) to apply for funding.

Federal Agency (Sub Agency / Office)	Program	Description	Eligible Uses
Department of Transportation (Maritime Administration)	America's Marine Highway Program	Grants to develop and expand marine highway service options and facilitate their further integration into the current U.S. surface transportation system, especially where water-based transport is the most efficient, effective, and sustainable option.	• Eligible uses: Marine Highway Grant funds can be used for material handling/container handling equipment (e.g., reach stackers, cranes, forklifts) as well as minor port improvements such as lighting or laydown areas. Funds have been used for dredging in non-Federal navigation channels and pier-side. • For vessels, the funds can be used to purchase, lease, or improve/modify vessels documented per the legislation. The Program seeks to procure zero or near-zero-emission equipment when available and practical.
Department of Transportation (Maritime Administration)	Maritime Environmental and Technical Assistance (META) Program	META funds efforts in various maritime areas, including ballast water, vessel, and port air emissions, fuel cells, maritime decarbonization, batter efficiency technologies, autonomous systems, etc.	Project-dependent, but eligible applicants typically include: Industry, Academia, and nonprofit organizations/Non-Governmental Organizations (NPO/NGOs)
Department of Transportation (Federal Highway Administration)	Charging & Fueling Infrastructure Grants (Corridor Charging)	Deploy electric vehicle charging and hydrogen/propane/natural gas fueling infrastructure along designated alternative fuel corridors and in communities	Acquisition and installation of publicly accessible electric vehicle charging or alternative fueling infrastructure, operating assistance (for the first 5 years after installation), acquisition and installation of traffic control devices
Department of Transportation (Federal Highway Administration)	Reduction of Truck Emissions at Port Facilities	Reduction of Truck Emissions at Port Facilities program awards competitive grants to reduce truck idling and emissions at ports, including through the advancement of port electrification	Competitive grants are intended to test, evaluate, and deploy projects that reduce port-related emissions.
Department of Transportation (Federal Highway Administration)	Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT)	PROTECT Grants will support planning, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure. Highway, transit, and certain port projects are eligible.	Recipients: State (or political subdivision of a State), metropolitan planning organization, local government, special purpose district or public authority with a transportation function, Tribe, Federal land management agency (applying jointly with State(s)); Different eligibilities apply for at-risk coastal infrastructure grants.

Federal Agency (Sub Agency / Office)	Program	Description	Eligible Uses
Environmental Protection Agency	Grants to Reduce Air Pollution at Ports	Authorizes the purchase and installation of zero-emission port equipment and technology, conducts associated planning or permitting activities for this equipment and technology, and develops climate action plans to further address air pollution at ports.	Eligible Recipients: (1) A port authority; (2) A state, regional, local, or Tribal agency that has jurisdiction over a port authority or a port; (3) An air pollution control agency; or (4) A private entity (including a nonprofit organization) that applies for a grant in partnership with an entity described in (1)-(3) and owns, operates, or uses the facilities, cargo-handling equipment, transportation equipment, or related technology of a port.
Environmental Protection Agency	Diesel Emissions Reduction Act Program	Provides grants and rebates to eligible entities to fund diesel emission reductions from both road and nonroad engines.	• "Eligible entities" are a regional, state, local, or tribal agency, a port authority with jurisdiction over transportation or air quality, or a nonprofit organization that focuses on pollution reduction for organizations that own or operate diesel fleets, or any private individual or entity that (i) is the owner of record of a diesel vehicle or fleet operated under a contract, license, or lease with a Federal department or agency or an entity. • Includes diesel-powered engines, equipment, and vehicles used in construction, handling of cargo (including at ports and airports), agriculture, mining, or energy production (including stationary generators and pumps)
Department of Energy (Fossil Energy and Carbon Management)	Carbon Dioxide Transportation Infrastructure Finance and Innovation Program	To establish and carry out carbon dioxide transportation infrastructure projects.	Projects that-- • (A) Are large-capacity, common carrier infrastructure; • (B) Have demonstrated demand for use of the infrastructure by associated projects that capture carbon dioxide from anthropogenic sources or ambient air; • (C) Enable geographical diversity in associated projects that capture carbon dioxide from anthropogenic sources or ambient air, to enable projects in all major carbon dioxide-emitting regions of the United States; and • (D) Are sited within, or adjacent to, existing pipeline or other linear infrastructure corridors, in a manner that minimizes environmental disturbance and other siting concerns.
Department of Energy (Loan Programs Office)	DOE Loan Program	A variety of different options focused on decarbonization technologies	LPO has more than $40 billion in loans and loan guarantees available to help deploy innovative clean energy, advanced transportation, and tribal energy projects in the United States.

Federal Agency (Sub Agency / Office)	Program	Description	Eligible Uses
Department of Treasury	Energy efficient commercial buildings deduction.	Buildings that increase their energy efficiency by at least 25 percent will be able to claim this tax deduction, with bonuses for higher efficiency improvements. The claimant can earn additional bonus deductions by meeting prevailing wage and registered apprenticeship requirements.	Eligible Recipients: Owners and long-term lessees of commercial buildings. Designers of energy-efficient building property (architects, engineers). Tax-exempt owners of commercial properties, pending Treasury guidance on deduction allocation.
Department of Treasury	Advanced Manufacturing Production Credit (45X)	Provides a production tax credit for domestic manufacturing of components for solar and wind energy, inverters, battery components, and critical minerals.	• Domestic manufacturers are eligible to receive the credit (for vessels, appears to be the shipyard but can be transferred). • More specific to the maritime side for offshore wind. The credit specifically applies to offshore wind vessels and wind energy components. There are two main components: a 10% credit for the production of offshore wind vessels, based on sale price, and (2) a variable production credit for wind energy components.
Department of Treasury	Credit for Qualified Commercial Clean Vehicles	Provides a tax credit for purchasers or lessors of qualified commercial clean vehicles	• Eligible Recipients: Businesses that acquire motor vehicles or mobile machinery for use or lease; tax-exempt entities that acquire them for use. • Base Credit Amount: The amount of the credit is the lesser of (a) 15% of the vehicle's basis (i.e. its cost to the purchaser) or 30% for vehicles without internal combustion engines, or (b) the amount the purchase price exceeds the price of a comparable internal combustion vehicle. The credit is capped at $7,500 for vehicles < 14,000 lbs and $40,000 for all other clean vehicles.

Federal Agency (Sub Agency / Office)	Program	Description	Eligible Uses
Department of Treasury	Alternative Fuel Vehicle Refueling Property Credit	Provides a tax credit for alternative fuel vehicle refueling and charging property in low-income and rural areas. Alternative fuels include electricity, ethanol, natural gas, hydrogen, biodiesel, and others.	• Tax credit for consumers and businesses. • Existing provision, but extended and modified to include prevailing wage and registered apprenticeship requirements for businesses claiming the credit. Adds bidirectional charging equipment, charging equipment for 2- and 3-wheel electric vehicles. Limited to low-income and non-urban areas. • Eligible Recipients: The qualified alternative fuel vehicle refueling property must be for clean-burning fuels, as defined in the statute, and must be located in low-income or rural areas.
Department of Homeland Security (Federal Emergency Management Agency)	Flood Mitigation Assistance Grants (National Flood Insurance Act Sec 1366)	The Flood Mitigation Assistance program makes federal funds available to states, U.S. territories, federally recognized Tribal governments, and local communities to reduce or eliminate the risk of repetitive flood damage to buildings and structures	• Project scoping (previously advanced assistance) to develop community flood mitigation projects and/or individual flood mitigation projects that will subsequently reduce flood claims against the National Flood Insurance Program. • Projects that address community flood risk to reduce National Flood Insurance Program flood claim payments. • Technical assistance to maintain a viable Flood Mitigation Assistance program over time. • Planning sub-applications for the flood hazard component of State, Local, Territory, and Tribal Hazard Mitigation Plans and plan updates.
Department of Defense (Army Corp of Engineers)	Inland Flood Risk Management Projects	This program funds the construction of projects that help to reduce the risk of damage in a flood, including multi-purpose projects or programs that include flood risk management benefits as a purpose.	Eligible federal projects to reduce the risk of damage from riverine flooding
Department of Defense (Army Corp of Engineers)	Water-Related Environmental Infrastructure Assistance	The program funds the engineering and construction of authorized environmental infrastructure projects that provide safe water supply, waste disposal, and pollution control to cities and towns to protect human health and safeguard the environment	Authorized environmental infrastructure projects

Source: Compiled by WSP from numerous public and private sources.